8th Annual Student Symposium

August 5th-6th 2008

"Championing Scientific Careers"

Highlighting Student Research

University of New Mexico-Los Alamos

LA-UR-08-05017

Los Alamos
NATIONAL LABORATORY
EST. 1943

Office of the Director

August 5, 2008

Welcome to the Laboratory's annual ***"Symposium 2008: Championing Scientific Careers."***

The intent of the Symposium is to broaden students' expertise and prepare them for graduate study and research careers in engineering and science as well as non-technical fields. This is an excellent forum in which to witness science in the making. Oral presentations and posters will give you a unique opportunity to network, whether your goal is beginning or continuing further graduate study, or pursuing a professional career.

You will be in the company of technical staff and distinguished scientists from the Laboratory who volunteer to serve as mentors to undergraduate and graduate student interns. Fields of expertise represented include bioscience, chemistry, computing, earth and space sciences, engineering, materials, physics, and non-technical areas.

Science serving society is best found in the student talent you will meet throughout ***"Symposium 2008: Championing Scientific Careers."***

Michael R. Anastasio
Director

Cy: IRM-RMMSO, MS A150
DIR-08-143

PO Box 1663, MS A100, Los Alamos, NM 87545
505-667-5101 / FAX 505-665-2679

State of New Mexico
Office of the Governor

Bill Richardson
Governor

A Welcome Message from Governor Bill Richardson

As Governor of New Mexico, I am pleased to welcome you to the 2008 Los Alamos National Laboratory Student Symposium, "Championing Scientific Careers." This symposium showcases the innovative thinking and diligent research of the next generation of scientific leaders. Their work as student researchers is invaluable to the mission of the lab.

Stemming from J. Robert Oppenheimer's choice of Los Alamos as the setting for the Manhattan Project, New Mexico has had a long history of scientific and technological excellence. Since its inception, Los Alamos National Laboratory has played a central role in that history, attracting and cultivating some of the brightest minds in the world.

The work we are recognizing here contributes to that important heritage while helping move New Mexico forward as a national leader of scientific progress. This is an exciting time to be a scientist, and Los Alamos is a rewarding place for you to further your education and launch your careers.

I commend you all for your hard work and accomplishments. Best wishes to the presenters and their mentors in this year's symposium.

With warmest regards,

Bill Richardson

Bill Richardson
Governor of New Mexico

State Capitol • Room 400 • Santa Fe, New Mexico 87501 • 505-476-2200 • www.governor.state.nm.us

JEFF BINGAMAN
NEW MEXICO

703 HART SENATE OFFICE BUILDING
WASHINGTON, DC 20510
(202) 224-5521
IN NEW MEXICO—1-800-443-8658
TDD (202) 224-1792
senator_bingaman@bingaman.senate.gov

United States Senate

August 5, 2008

Dear Friends:

I am delighted to have this opportunity to welcome you to the 2008 Los Alamos National Laboratory Student Symposium, "Championing Scientific Careers."

Your participation in the Los Alamos student internship program and the student symposium are excellent examples of the sort of structured university/laboratory partnership that my colleagues and I support and endorsed in last year's America COMPETES legislation passed by Congress and signed into law by President Bush.

Symposium 2008 recognizes our nation's brightest and most talented future scientists and the work they have done under the mentorship of the brightest, most talented, and seasoned scientists in our country. This commitment, dedication, and hard work are to be commended. I thank you all for joining me in acknowledging their contributions to our nation.

Sincerely,

Jeff Bingaman
United States Senator

JB/gz

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http://bingaman.senate.gov/contact/enewsletters/intro1.cfm

PLEASE REPLY TO:

☐ 625 SILVER AVENUE, SW, SUITE 130
ALBUQUERQUE, NM 87102
(505) 346-6601

☐ 148 LORETTO TOWNE CENTRE
505 SOUTH MAIN, SUITE 148
LAS CRUCES, NM 88001
(505) 523-6561

☐ P.O. BOX 1977
118 BRIDGE STREET, SUITE 3
LAS VEGAS, NM 87701
(505) 454-8824

☐ 200 EAST 4TH STREET, SUITE 300
ROSWELL, NM 88201
(505) 622-7113

☐ 119 EAST MARCY, SUITE 101
SANTA FE, NM 87501
(505) 988-6647

PETE V. DOMENICI
NEW MEXICO

COMMITTEES:
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WASHINGTON, DC 20510–3101

August 5, 2008

Dear LANL students and mentors,

I'm very pleased to have this opportunity to welcome you to the Los Alamos National Laboratory 2008 Student Symposium, "Championing Scientific Careers." Los Alamos National Laboratory has a distinguished record spanning over sixty years of providing the finest scientific research in support of maintaining our nation's security. I appreciate and applaud your personal involvement in the Laboratory's student internship program which gives you an opportunity to complement your academic studies with hands-on experience.

Participation in the Symposium allows you to highlight and share the results of your internship experience via posters and presentations with your fellow students, mentors, Lab employees, and the community. The Los Alamos Student Internship Program is the largest student program offered by any of our national laboratories, and I hope you find your experience personally and professionally rewarding. It also gives you an excellent opportunity to meet and network with other highly talented students from across the country and to explore potential opportunities for permanent employment after you complete your academic studies.

Your internship at Los Alamos National Laboratory is an outstanding example of the structured university/laboratory STEM (science, technology, engineering, mathematics) partnerships that my colleagues and I strongly encouraged in our sponsorship and support of the America COMPETES legislation that was passed by Congress and signed into law by the President in 2007.

Best of luck to you in your careers!

Sincerely,

Pete V. Domenici

Pete V. Domenici
United States Senator

ALBUQUERQUE OFFICE:
ALBUQUERQUE PLAZA
201 3RD STREET, NW
SUITE 710
ALBUQUERQUE, NM 87102
(505) 346–6791
FAX: (505) 346–6720

LAS CRUCES OFFICE:
LORETTO TOWN CENTER
505 SOUTH MAIN
SUITE 118
LAS CRUCES, NM 88001
(505) 526–5475
FAX: (505) 523–6589

ROSWELL OFFICE:
FEDERAL BUILDING
SUITE 227
ROSWELL, NM 88201
(505) 623–6170
FAX: (505) 625–2547

SANTA FE OFFICE:
120 SOUTH FEDERAL PLACE
ROOM 302
SANTA FE, NM 87501
(505) 988–6511
FAX: (505) 988–6514

WASHINGTON, DC OFFICE:
SENATE HART OFFICE BUILDING
ROOM 328
WASHINGTON, DC 20510–3101
(202) 224–6621
FAX: (202) 228–3261

http://domenici.senate.gov

Speaker Biographies

Reception Speaker:

Duncan McBranch, PhD

Deputy Principal Associate Director

for Science, Technology and Engineering

Duncan McBranch comes to the Office of the Principal Associate Director for Science Technology and Engineering with a strong track record as a leader in a variety of organizations. He has been an R&D leader in materials chemistry and nanotechnology, an entrepreneur in biotechnology, and a business development leader in growing new programs at Los Alamos with industry.

Duncan was Division Leader for Technology Transfer at Los Alamos (2005-2007), where he was responsible for collaborations with industry, for the commercialization of inventions, and for the spin-out of regional technology businesses. Our industry partnerships form an important component of our mission by keeping our capabilities strong and adapting leading edge technologies to commercial markets. Under his leadership the Division strengthened the Laboratory's approach to intellectual property management to provide stronger leverage for new program growth. TT also expanded its impact and effectiveness in brokering new collaborative research and development projects with industry partners, growing the CRADA portfolio from less than $2M to over $12M in three years. TT also grew the impact of its efforts in generating new entrepreneurial ventures by working more closely with the investment community and in starting new economic development initiatives as part of the LANS community commitment plan.

Previously, Duncan led teams solving complex research, technology, and business problems for over 15 years. This includes founding a biotechnology company (QTL Biosystems), to develop rapid assays for the life sciences markets and handheld detection solutions for environmental pathogen detection. Duncan began his technical career at Los Alamos as a Director's Postdoctoral Fellow, and then led a research team investigating polymeric materials for nanotechnology with applications in optics and electronics.

Duncan has published more than 70 articles in technical journals in materials, chemistry, and biotechnology, and is an inventor with patents across a broad range of applications. Duncan earned undergraduate degrees in physics and mathematics (Whitman College) and a Ph.D. in materials physics (University of California, Santa Barbara).

Symposium 2008

"Championing Scientific Careers"
August 5 and 6, 2008
University of New Mexico-Los Alamos

Tuesday August 5, 2008 (Day 1)

8:00 - 10:00	Registration and Poster Setup	UNM-LA Student Center
10:00 - 12:00	Poster Review by Classification Safeguards, SAFE-1	UNM-LA Building 6 and Student Lecture Hall
12:00 – 1:00	Lunch—on your own	UNM-LA Student Center Café will be open
1:00 – 4:00	Poster Judging Open to judges and presenters only	UNM-LA Building 6 and Student Lecture Hall

Wednesday August 6, 2008 (Day 2)

8:00 – 9:00	Registration	UNM-LA Student Center
8:00 - 11:30	Poster Viewing Session Students must be present at their posters from 8:00 to 11:30 am	UNM-LA Building 6 and Student Lecture Hall
11:30 – 12:45	Lunch—on your own	UNM-LA Student Center Café will be open
1:00 – 5:00	Technical Talk Presentations	UNM-LA Bldgs. 2, & 6
1:00 – 3:00	Poster Breakdown	
5:30 – 7:30	Awards Reception	UNM-LA Student Center

Awards Reception (Continued)

Introduction	Dave Foster, Education and Postdoc Office Program Manager
Introduction of Speakers	Scott Robbins, Team Leader, Education and Postdoc Office
Keynote Address	Duncan McBranch
Student and Mentor Distinguished Performance Award Presentations	SPAC
Symposium Award Presentation	Duncan McBranch
Sustainability Awards Presentation	Environmental Programs Division
Closing Remarks	Dave Foster

Table of Contents

Student Abstracts

Rastogi	Pawan	Sensitizing and Protecting Lanthanide Ion Emission Using Optically Active Nanocrystals	Chemistry	36
Resnick	Jesse	Regeneration and Expedited Preparation of Polyethylene Glycol Terminated Thin Films	Chemistry	37
Alme	Christopher	Managing Supercomputing Challenge Website Content	Computing	38
Archuleta	Amanda	Print Management	Computing	39
Black	Eric	Electronic Software Distribution	Computing	40
Esquibel	Le'andrea			
Montoya	Daniel			
Boyer	Colby	Real Time Digital Signal Processing of Radio Telescope Signals for a Full Sky FX Correlator	Computing	41
Brashear	Joshua	Pueblo Complex Print Server	Computing	42
Cortez	Mandy	Data Query Tool (DQT)	Computing	43
DeMaria	Francisco	Collaboration Station: The Tripod Project	Computing	44
Flemming	David			
Diaz	Francine	The New Engineering Navigator	Computing	45
Doll	Erich	High Speed Interconnection Network Performance Studies	Computing	46
Owen	Taylor			
Salazar	Ruben			
Elfman	Mary	Computer Graphics Visualization and Animation used in Scientific and Facility Modeling	Computing	47
Salas	Julian			
Gossens	Dan	Network Access Control: Symantec LAN and Gateway Enforcers	Computing	48
Gutierrez	Samuel	OpenSpeedShop: A Scalable Parallel Performance Analysis Framework	Computing	49
Herrera	Rocky	HDCS Print Server Project	Computing	50
He	Meiyun	Entropy Based Closures for P_N equations	Computing	51
Kang	James	High Performance Computing and Cluster Management	Computing	52
Leeseberg	Evan			
Nystrom	Katherine			
Liu	HsingHui	You've Got Mail! Managing LANL-wide eMail Migration	Computing	53

Madrid	Jamie			
Lopez	Veronica	Reverse Engineering Malware	Computing	54
Luce	Curtis	Performance and Feasibility of Virtual Machines	Computing	55
Lucero	April	Implementing ClearCube PC Blades	Computing	56
Martinez	Ashley	Network DNA	Computing	57
Rivera	Richard			
McCormick	Kimberly	Cluster Monitoring Tools	Computing	58
Morse	Caleb	Migrating Clustermatic to Perceus	Computing	59
Munoz	Amanda	Diskless Computing	Computing	60
Torres	Nickolas			
Roybal	Frank			
Murthy	Abhishek	A Realistic Power-Profile of Communication Nodes in Wireless Ad-hoc/Sensor Networks (WANETs)	Computing	61
Pack	Scott			
Recla	Nichoals	Securing Vista to FDCC & LANL Standards	Computing	62
Romero	Adrian	LANL HPC Monitoring	Computing	63
Salas	Sherry	Software Evaluation of SCAP Validated Products	Computing	64
Simpson	Zachary	Desktop Replacement and Sunray Deployment	Computing	65
Soysal	Onur	CatNap: A Self-Stabilizing Low-Power Sleep-Wake Up Protocol for Wireless Ad-hoc/Sensor Networks	Computing	66
Valdez	Roxane	Active Directory Integration with Macintosh	Computing	67
Vigil	Blaine	Analyzing Applications U sing O pen|SpeedShop	Computing	68
Vigil	Stephanie	Managing the Life Cycle of Desktop Computers	Computing	69
Webber	Michael	Shrinkwrap GUI	Computing	70
Whitehouse	Jeffrey	Print Server for a Heterogeneous Client Environment	Computing	71
Levy	Philippe	Unveiling Terrestrial Microorganic Carbon Cycling Using Tunable Diode Laser Spectroscopy and Automated Microcosms	Earth and Space Science	75
Palmer	Bryant	Dynamic Modeling of Earthquake Ruptures	Earth and Space Science	73
Rush	Wade			
Slutzky	Samantha	The Ecohydrological Response of a Piñon-Juniper Woodland to Piñon-Pine Mortality	Earth and Space Science	74
Stutz	Samantha	Assimilation-weighted Gas Exchange Parameters	Earth and Space Science	75
Torney	Angela	Carbon Cycle Responses of a Pinon-Juniper Woodland to Drought	Earth and Space Science	76

Adams	Bradley	Electron Sweeping via Magnetic Field	Engineering	77
Babcock	Bryan	Coordination Analysis of TA-55 Power Systems	Engineering	78
Bailon	Marcus	Helium Leak Test of an Induction Heating Bell Jar Assembly	Engineering	79
Rector	Stuart			
Baker	Gregory	Inventory Managment	Engineering	80
Bhatty	Azmat	Sphere Cleanout Robot Programming	Engineering	81
Blaylock	Joe	Development of a new Pu-238 Heat Standard	Engineering	82
Bolton	Caroline	Low-Power Tests of Water Cooled RF Loads with Chemical Additives	Engineering	83
Cardon	Devin			
Cappiello	Marcus	The Effects of Plastic Deformation on Microstructural Development in HT-9 and T-91	Engineering	84
Donati	Diana	Strain Rate Dependent Mechanical Properties of Textured Beryllium	Engineering	85
Dozier	Benjamin	Ultrasonic Imaging of Niobium Targets used in Radioisotope Production	Engineering	86
Fowers	Spencer	Improving AngelFire Using a Real-Time, FPGA-based Feature Tracker	Engineering	87
Gallegos	Iris	Ergonomic Analysis of Oval Gloveports Versus Round Gloveports Using V5 Delmia Human Software	Engineering	88
Garcia	Selina	Lifting LANL's Legacy Fiber Plant Limits	Engineering	89
Knauss	Carl			
Purdy	Jennifer			
Geb	David	A Micro-Fluidic Flow-Control Mechanism for DNA-Based Clinical Diagnostics	Engineering	90
Marshall	Justin			
Gibbs	Paul	A Comparison of Two Mold Designs for Uranium Casting	Engineering	91
Knapp	Cameron			
Guerra	Jorge	TRU Waste Facility Interim Alternatives Project	Engineering	92
Gurule	James	Volume Minimization and Inventory Reduction of LANL's Classified Parts	Engineering	93
Haines	Tim	Mechanical Aspects of Thermal Storage System	Engineering	94
Height	Jonathan	Facilities Management	Engineering	95

Herrera	Brandon	PF-4 Trolley Research & Documentation Compilation	Engineering	96
Howard	Cameron	He-3 Permeability of Inertial Confinement Fusion Targets	Engineering	97
Krause	Andrew	Preventive Maintenance Programs for Pit Manufacturing Equipment	Engineering	98
Leyva	Maria	Use of Extend Software to Model the Plutonium Recovery and Discard Processes	Engineering	99
Logan	David	Plutonium Facility Ventilation Simulation	Engineering	100
Medina	Erlinda	Aerosol Deposition on the Detector Face of the Thermo-Fisher Alpha-7 Continuous Air Monitor	Engineering	101
Monson	Joshua	Frequency Triggering of a Snapshot Recorder	Engineering	102
Nekimken	Kyle	Dynamic Alpha Particle Source	Engineering	103
Nelson	Michael	Building Spare Drift Tubes for the LANSCE-R Project	Engineering	104
Pugh	Michael	Rotary Uninterruptible Power Supply	Engineering	105
Rand	Dana	Temperature Monitoring and Control System	Engineering	106
Reynolds	Jesse	Reconfiguring the Piping in the Chloride Line Extraction and Actinide Recovery (CLEAR) Glovebox Line in Room 420	Engineering	107
Rivera-Lopez	Ricardo	ASME HEPA Filter	Engineering	108
Robinson	Aaron	Benefits of SharePoint in Manufacturing Configuration Management	Engineering	109
Ruf	Tanner	X-Ray Diffraction of Hygroscopic Salts Found in Impure Pu Oxides Stored in 3013 Containers	Engineering	110
Simpson	Justin	SabreECAM Type Testing	Engineering	111
Steinfeld	Bryan	Design & Implementation of a User-Friendly Robotic Controller	Engineering	112
Unzueta	Michael	Glovebox Temperature Distribution Test	Engineering	113
Welsh	Aaron	Improving a Turning Process Using Piezoelectric Actuators and Ultrasonic-Assisted Machining	Engineering	114
Wulf	Nicholas	Image Tiling, Reduction, and Compression at 600 Million Pixels Per Second Using FPGA Based Hardware	Engineering	115
Bizzozero	David	Faster-than-Light Electromagnetic Sources	Mathematics	116
Haack	Jeffrey	The Parity Splitting Formulation for the P_N Approximation of Transport Equations	Mathematics	117
Oka	Jude	Gap Analysis between the Weapons Quality Assurance Program Production Agency and the Manufacturing Administrative Procedures	Non-Technical	118

Sahm	Douglas			
Powers	Seth	Security Communications	Non-Technical	119
Araya	Yonathn	Development of A Robust Chamber for A High-Throughput Flow Based Magnetic Spectrometer	Physics	120
Breiner	Anna	Microstructural and Rate Effects on the Shear Localization of Copper	Physics	121
Chen	Frank	Ultrafast Control of Ferromagnetic Nanowires	Physics	122
Cortez	Ross	Measurements of the Magnetic Field Profile of a Translating Field-Reversed Configuration Experiment Using an Axial Magnetic Field Probe	Physics	123
Croce	Mark	Nuclear Characterization of Nanocomposite Scintillators	Physics	124
Schear	Melissa			
Ellison	Paul	Data Analysis of Neutron Capture Measurements on 75As Using DANCE	Physics	125
Fuller	Megan	Microcalorimeter Detectors for X and Gamma Ray Spectroscopy	Physics	126
Hammon	Jessica	Towards an Ultra-low Field MRI Scanner Based on Atomic Magnetometer	Physics	127
Hessler	Katelyn	Probing the Quark-Gluon Plasma at the Large Hadron Collider at CERN	Physics	128
Jeffs	David	Relay Switch Arrays	Physics	129
Looker	Quinn	1-Dimensional Position Reconstruction Using Gamma Ray Backscatter Technique	Physics	130
Murray	Roy	Calcium Detection in 3013 Containers	Physics	131
Ogren	John	Optical Pumping of Multiple Ytterbium2+ States with a Hollow Cathode Lamp	Physics	132
Peterson	Sean	Testing the FLAG Ejecta Model	Physics	133
Reindel	Andrew	Applying Fourier, Wavelet and Variable Sine Algorithmic Analysis to Solar Cycles	Physics	134
Sanchez	Nathaniel	Shock Initiation Properties of the HMX based Explosive PBXN-9	Physics	135
Shibley	Brandon	Non-invasive Acoustical Monitoring of Fluid Parameters Using a Digital Phase-lock Technique.	Physics	136
Siebe	Craig	Calculations of the CP Violating Dipole Moment of HE3	Physics	137
Vogt	Adam	Time Evolution of the Non-Linearly Saturated Kink Mode in a Current Carrying Plasma	Physics	138
Weflen	Daniel	Double Photoionization of the H_2: Double Slit Interference?	Physics	139
Weldon	David	High Pressure Deformation of Zirconium	Physics	140

Talks *Page #*

Guimond	Steve	Remote Sensing and Modeling of Hurricane Intensification	Earth and Space Science	163
Nelson	Sarah	Wind Turbine Interaction with the Surrounding Atmosphere	Earth and Space Science	164
Sauer	Jeremy	Interaction of Atmosphere and Fire in Heterogeneous Canopies	Earth and Space Science	165
Atamturktur	Sezer	A Discussion on Predictive Maturity of Computer Models Using Functional and Multivariate Output	Engineering	166
Day	Paul	Automated Testing Platform for Microstructure Adhesives	Engineering	167
Kalma	Corey	Design and Tooling Engineering for Tools, Fixtures and Gages	Engineering	168
Kammerman	Jeffrey	An Analysis of the Forrest Fire Reactive Burn Model	Engineering	169
Kiedrowski	Brian	Measurement and Reduction of Variance Bias in MCNP k-Effective Calculations	Engineering	170
Kienitz	Brian	The Effects of Cationic Contamination of Polymer Electrolyte Membrane Fuel Cells	Engineering	171
Kullback	Brendan	Strength Models, Temperature, and Impactor Velocity Effects on Large Strain Rate Deformation	Engineering	172
Niemeyer	Alyson	Interdigitated Photoconductors Using Organic and Small Molecule Materials	Engineering	173
Spencer	Joshua	Charged Particle Benchmarking of the Merged MCNP Code	Engineering	174
Swenson	Hunter	Distortion of Vacuum Carburized Steel Assessed by Systematic Process Variations	Engineering	175
Vigil	Shelly	Direct Observations of Plasticity within Several Crystalline Forms of Acetaminophen	Engineering	176
Bornn	Luke	Structural Health Monitoring with Autoregressive Support Vector Machines	Mathematics	177
Coxe	Julianne	A Nano-Sculptor's Knife: Cutting into Infinite Space	Mathematics	178
Gyrya	Vitaliy	New Mimetic Finite Difference Method for Stationary Stokes Equation.	Mathematics	179
Barefield	Melanie	The Effects of Traffic on Worker Stress	Non-Technical	180
Albert	Victor	Electronic Structure of CdSe Quantum Dots and Ru Complexes	Physics	181
Berkelbach	Timothy	Theoretical Investigations of Xenon Plasma Kinetics and Spectroscopy	Physics	182
Difley	Seth	Extending the Lifetime of Organic Solar Cells and Light Emitting Devices	Physics	183
Jackson	Austin	Investigating the Optical Properties of Platinum Plated PMTs for use in a Low Background Dark Matter Experiment	Physics	184
Kotas	Jakob	Plasma Temperature and Density Dependence for Collisional Cross Section Calculations	Physics	185
Lu	Qiming	Damage Spreading in Spatial and Small-world Random Boolean Networks	Physics	186

Martin	Kyle	Modeling the Emission from the Supermassive Black Hole in the Galactic Center with GRMHD Simulations.	Physics	187
Mastbaum	Andrew	Dark Matter and the miniCLEAN Experiment	Physics	188
Schmidt	Andrea	Radiation Theory of Astronomical Sources that Move Faster than Light: Applications to Pulsars	Physics	189
Soo	Michael	Electrostatic Analysis for the Neutron Electric Dipole Moment Project	Physics	190
VanMaanen	David	Oscillations of Visual Stimuli in the Primary Visual Cortex	Physics	191
Wachtor	Adam	Proper Orthogonal Decomposition of Variable Density Turbulent Flow	Physics	192

Poster Presentations

Name: Marissa Anderson
Program: UGS
School: New Mexico Tech
Group: B-9
Mentor: Claire Sanders
Category: Bioscience
Type: Group Poster Presentation

Name: Mary Irving
Program: UGS
School: University of New Mexico
Group: B-9
Mentor: Claire
Category: Bioscience
Type: Group

Flow Cytometric Analysis of Intrinsic Cellular Fluorescent Lifetime

Autofluorescence by naturally occurring fluorophores within cells is often a burden to flow cytometry assays. Endogeous fluorophores will absorb and emit energy at similar wavelengths as exogenous species and may falsely contribute to the emission signal obtained with extrinsic dyes. In this experiment we use Phase-sensitive Flow Cytometry (PSFC) to determine the lifetime of fluorophores present in different growth phases; the average lifetime values of bulk intrinsic fluorophores within viable cell suspensions is measured. Previous PSFC studies indicate a significant lifetime difference between the exponential and plateau phase of rat fibroblast cells when excited in the blue-visible range (488 and 496 nm). Therefore, using four additional cell lines (i) Chinese ovarian hamster cells (CHO-K1), (ii) mouse macrophages (J774A.1), (iii) human melanoma cells (MEL28), and (iv) human skin fibroblasts (HSF), we explore the lifetime further and confirm the growth stage by growth curve and cell cycle analysis. Growth curves were prepared using standard protocol and doubling times of 14 hours, 15 hours, 12 hours, and 21 hours, were found for the CHO-K1, J774A.1, MEL28, and HSF cell lines, respectively. Additionally, the DNA content of all lines was measured by standard flow cytometry using the DNA intercalating dye, Propidium Iodide (PI). The cell cycle analysis confirmed that the cells were in exponential or plateau phase at the time of analysis. Continuing this experiment we hope to collect data supporting previous experiments done performed on the PSFC with cells growing exponential phase. Analyzing our data we hope to gain knowledge on more practical applications for PSFC.

Name: Monika Bhatt
Program: HS Co-Op
School: Virginia Commonwealth
Group: T-10
Mentor: Catherine Macken

Category: Bioscience

Type: Individual Poster Presentation

Expanding the Information Content of the Influenza Sequence Database

Improved treatment and preventive measures for influenza infections are possible only if we understand the virus pathology better; such improved understanding depends upon accurate and reliable data. The Influenza Sequence Database (ISD), started at LANL in 1998, is a consolidated database of influenza viral genetic sequences from various sources including GenBank. In recent years, an enormous increase in influenza viral research has amplified the number of records and the database needs to be updated daily with the new records. As more is known about the influenza virus, more information is incorporated into GenBank records; this additional information needs to be added to the ISD. GenBank records from researchers in multiple formats with possibly complete or partial absence of data. The challenge, therefore, is to be able to parse and interpret the non-standard data in GenBank records so that information can be handled correctly and missing information can be noted. My project is to understand and analyze the different keywords and data fields encountered in GenBank records, and to write code to identify this information. The code must be robust and manage data accurately in spite of it irregular format. My work will lead to a substantial increase in richness of data in the ISD and therefore provide greater support for influenza research.

Name: Hillary Briggs
Program: UGS
School: University of Redlands
Group: B-6
Mentor: Lance Green
Category: Bioscience
Type: Individual Poster Presentation

Sequencing of Bacterial Genomes: An Emphasis on Wet Lab Techniques and Biology as an Information Science

In 2003, after three billion dollars and thirteen years of international work, the sequence of the human genome was completed. Presently, with the large demand for energy, alternative ideas for waste management, and the advancing ease and efficiency of sequencing, the Joint Genome Institute (JGI) is far from finished. The methodology central to genomic sequencing has changed drastically, and with the acceleration of technology will continue to do so for years to come. The original techniques functioned via breaking up the genome into many fragments, amplifying them, and using capillary electrophoresis to phosphoresce fluorescently labeled DNA. This system uses 384 well plates, each of which holds five to eight micro liters of a sample, and is still in use today. The contemporary procedures use plates with millions of wells and pico liters of volume. It is quite easy to imagine, therefore, the vast expansion in sheer numbers of base pairs sequenced. As one gear in the vast machine of sequencing, the Los Alamos branch of the JGI and my contribution therein, have focused on the many variety of sequencing techniques, the fundamental and innate science that enables these methods, the flow of organisms through the sequencing systems, and the abundance of information being produced by genetics. In this poster I will look into the processes that are used today, the movement of a species through the JGI, and the consistent and laborious task of perpetually maintaining masses of data.

Name: Cesar Coronado
Program: UGS
School: Northern New Mexico
Group: B-8
Mentor: Srinivas Iyer
Category: Bioscience
Type: Individual Poster Presentation

Analysis of iTRAQ Ratios Upon Macrophage Exposure to Fullerenes.

Fullerenes can be synthetically modified in a controlled fashion using a number of different approaches, and the resulting tunability of properties has made them attractive targets for use in diagnostics, therapeutics and drug-targeting. However, substantial concern and uncertainty exist regarding the interactions of nanomaterials with biological systems and any potential long-term health and environmental impact. Systematic studies of biological impact will further the development of technological applications and mediate potential future issues related to their widespread use. As part of a larger effort to elucidate the bio-impact of modified fullerenes, our group performed a comprehensive differential proteomic analysis of human differentiated macrophages in response to functionalized fullerenes. Such analysis serves two major roles: first, to provide a mechanistic foundation of observed gross cellular responses and second, to point to yet unobserved effects that can be the target of future studies. These experiments looked at protein changes in response to two types of modified fullerenes and one unmodified control. The analysis resulted in huge datasets listing relative changes.
The focus of this student project was to perform a computational analysis of this dataset. Data from multiple experiments were sorted and compared with respect to iTRAQ ratios in increasing order and focusing on proteins with the most upregulation and downregulation (at least 25% to that of control). In addition, duplication in protein identification were singled out and reviewed further to provide validation of the results. In this poster, we summarize the results of this analysis.

Name: Ezekiel Crenshaw
Program: UGS
School: Cheyney University of Pennsylvania
Group: B-9
Mentor: Chang Kim
Category: Bioscience
Type: Individual Poster Presentation

Purification of MBP Fused Mycobacterium Tuberculosis Proteins

Mycobacterium tuberculosis/ (Mtb) is a bacterium that causes tuberculosis (TB), a bacterial infection that mainly affects the respiratory system. In 2007, 13,293 new TB cases were reported in the United States alone. TB is a treatable disease; however, treatment TB with current drugs is a slow process indicating a need to develop new drugs. The objective of the TB Structural Genomics Consortium is to determine the structure of Mtb proteins related to disease, with the aim of discovering the function associated with those structures which could potentially lead to new treatments.
In order to find the structure of those proteins, we need to obtain highly purified proteins achieved through protein purification. Protein purification is a series of processes intended to isolate a single protein from a complex mixture. Protein purification is important to determine the characteristics of the function, structure, and interactions of the protein of interest. Our method of purifying proteins is through Maltose Binding Protein (MBP) Purification. The use of MBP fusion enables us to increase expression level and the solubility of our protein of interest. The first step is to express the fusion protein with MBP. The next step is to isolate the fusion protein through His-tag affinity chromatography. We then cleave the fusion protein with TEV Protease. After the cleavage has taken place, we remove the MBP from the target protein and if further purification is needed, we use MBP affinity chromatography and/or Gel Filtration Chromatography. Once our final product is obtained, a purified protein, is used for crystallization.

Name: Nathan Lee Duval
Program: GRA
School: University of Denver
Group: D-3
Mentor: Alina Deshpande
Category: Bioscience
Type: Individual Poster Presentation

Characterization of Environmental Persistence of Bacillus thuringiensis var. kurstaki (Btk)

Bacillus thuringiensis var kurstaki (Btk), used as an organic biological pesticide against the invasive Lymantria dispar (gypsy moth), can be used as a surrogate when studying the environmental fate of Bacillus anthracis, an organism of concern as a biothreat. Understanding the fate of biological threat agents in the environment may be critical in the development of remediation strategies following a wide area release.

LANL conducted an experiment in Seattle, WA to study the persistence of Btk in the environment. Aerial and ground application of Btk was used in Seattle by the Washington State Department of Agriculture as part of the gypsy moth eradication program. Over 1,000 surface and bulk samples from historical spray sites in Kent (2007) Madison (2006) and Rosemont (2006) Seattle were collected and analyzed for the presence of Btk DNA and viable spores. After extracting and purifying the DNA from the samples the presence of Btk DNA was determined by qPCR using two Btk-specific primers. Samples that passed this molecular screen were selected for viability analysis by broth or plate culture methods using Trypticase Soy media. Samples were tested by qPCR and a novel flow cytometry-based assay (MOL-PCR) using nine Btk specific and Bt genus specific probes to confirm that viable organisms were Btk.

A preliminary analysis of results from the historical sites suggests that not only is Btk DNA present in the environment for at least two years, but it is viable for at least two years post spray. Further sampling and lab analysis will need to be conducted to determine the persistence and viability beyond two years.

Name: Noopur Goyal
Program: UGS
School: University of New Mexico
Group: EES-6
Mentor: Hakim Boukhalfa
Category: Bioscience
Type: Individual Poster Presentation

Metal Toxicity and Effect on Bioremediation Bacteria

Subsurface environments with radionuclides often contain additional organic/inorganic contaminants and other toxic metals. The ability of environmental bacteria to maintain active populations and influence the speciation of radionuclides is likely to be strongly affected by their ability to resist the toxicity of radionuclides and other toxic metals. In this study we examined the toxicity of copper and zinc to two different soil bacteria /P. putida/ and /P. mendocina/. These bacteria are representatives of the /pseudomonas/ family often present in subsurface environments with radionuclide contaminants. The toxicity was examined by monitoring growth and cell viability under variable concentration conditions in liquid cultures and in biofilms. We found that zinc and copper strongly inhibit /P. putida/ and /P. mendocina/ growth at metal concentrations ranging from 60 to 200 μM. The toxicity of zinc and copper were similar in biofilms and liquid cultures. Additional studies are planned to examine the metabolic response of these bacteria to toxic metals including radionuclides and the effect of the metabolites produced on the speciation toxic metals.

Name: Lisa Anne Hendricks
Program: HS Co Op
School: Los Alamos High School
Group: D-3
Mentor: Kristin Omberg
Category: Biosciences
Type: Individual Poster Presentation

Characterization of Transport, Deposition and Building Infiltration of Bacillus thuringiensis var. kurstani

Bacillus anthracis, or anthrax, is well known for its potential use as a biological weapon. With precaution, Bacillus anthracis can be studied in a laboratory environment, but what about in a natural environment? By studying how a genetically related cousin to Bacillus anthracis, Bacillus thuringiensis (Btk), behaves when released into the environment, research can illuminate how the more threatening Bacillus anthracis would behave. The Gypsy Moth Eradication Program, that uses the biological insecticide Btk, offers a unique opportunity to acquire information regarding the persistence of a biological agent with properties similar to Bacillus anthracis in a wide area environment.
In May 2008, Fairfax, Virginia sprayed Btk into the Fairfax area. Samples were taken from various indoor locations, as well as areas directly outside buildings, to determine whether or not Btk is able to infiltrate indoor environments. Four different buildings with various levels of air filtration systems in Fairfax were tested. Samples were taken from Portable Sampling Units (PSUs) which pull air over a filter, vacuums from HVAC filters, and swipes from flat and electrostatic surfaces inside the buildings. A total of 225 samples were taken and sent to LANL for analysis. Samples were first processed for DNA extraction and tested for Btk DNA by RT-PCR. Those samples that passed the molecular screen (RT-PCR) were cultured to determine the viability of detected Btk. Results of these tests will help to determine whether or not indoor environments, as well as which kind of filtration systems, are penetrated after a Btk release. An analysis of this data will be presented in this poster.

Name: Tiffany Kautz
Program: UGS
School: New Mexico State University
Group: B-7
Mentor: Norman Doggett
Category: Bioscience
Type: Individual Poster Presentation

Building a Collection of Bacteria from Different Orders for Use in Testing Assay Effectiveness

Of the 94 different orders of bacteria, 23 are considered to contain pathogenic members. Of those 23 orders, 16 contain bacteria that can be considered a possible biothreat. The Doggett lab, where I am working this summer, develops assays that can detect these pathogenic species, such as Bacillus anthracis. Currently, this lab is attempting to grow one species of bacteria per Order for use at Los Alamos National Laboratory. These bacteria will be used in this lab to test how accurately newly developed assays can detect their target bacteria. So far, this entails providing 47 different optimum environments (different media, temperatures, pH, etc.) for these bacteria to grow in. Further, DNA extracts will be prepared (work in progress) from liquid cultures and maintained as a stock in Doggett lab, rm 160. During this project, I will be learning several procedures, such as running a PCR, electrophoresis, gel extraction of bands, cloning and preparing samples for sequencing. I will also get hands on experience using the autoclave, centrifuge, PCR thermocycler, ABI real time PCR machine (ABI training completed), and electrophoresis unit. This project is a work in progress, so there are relatively few results as of now. Hopefully, this database will prove effective at helping to improve the accuracy of the pathogenic bacterial assays that this group produces.

Name: Jessica Kubicek
Program: UGS
School: University of New Mexico
Group: C-PCS
Mentor: Aaron Anderson
Category: Biosciences
Type: Individual Poster Presentation

Detection of Antigen 85, a Biomarker for Tuberculosis, using a Waveguide-based Optical Biosensor

One third of the world's population is estimated to be infected with Mycobacterium tuberculosis, the causative agent of Tuberculosis (TB). 5-10 % of infected individuals develop active disease in their lifetime, and almost 2 million people die from the disease each year. Current diagnostic methods are inadequate because they are time consuming, insensitive, and expensive. There is an immediate need for a rapid and accurate diagnostic tool for TB in order to make global progress in controlling the disease. Several biomarkers specific to M. tuberculosis have been found in urine samples of infected patients. There is potential for a non-invasive diagnostic based on the detection of these biomarkers, and such a method could avoid many of the disadvantages associated with current diagnostic techniques. The antigen 85 (Ag85) complex is one such biomarker. It is comprised of a group of proteins associated with virulence in M. tuberculosis, and is a potential indicator of active disease. This presentation will discuss the development of a sandwich immunoassay on our optical biosensor for the detection of this antigen in urine. This effort represents the first successful detection of Ag85 in a sandwich immunoassay format. In addition to the Ag85 assay, we hope to optimize assays for other TB-specific biomarkers in order to develop a multi-analyte detection platform. This multiplex format is necessary to accurately evaluate disease status and progression due to the variable levels of biomarker expression that can occur during the M. tuberculosis life cycle. Such a technique could potentially distinguish between latent and active infection, as well as between drug resistant and sensitive strains of bacteria, which allows for improvements in treatment, control and prognosis.

Name: Sarah Maurer
Program:GRA
School: University of California- Santa Cruz
Group:EES-6
Mentor: Hans Ziock
Category: Bioscience
Type: Individual Poster Presentation

Stabilization of Fatty Acid Membranes by Monoacylglycerols

It has been hypothesized that simple fatty acids (FAs) preceded phospholipids as the cellular membrane because of their ability to form vesicles in aqueous solution when the pH is close to the pKa and their availability on early earth. Alone, these membranes are rather sensitive to environmental factors. However, it is known that the stability of these bilayers can be increased by adding uncharged amphiphiles [e.g. monoacylglcerols (GMAs)] to the FAs. We investigated the stability differences between pure FA vesicles made of FAs from 8 to 18 carbons long and that of monoacylglcerols (GMAs)/FA (1:2 ratio) mixtures of equal length. Stability characteristics studies included the concentration needed to form bilayers (CVC), the ability to encapsulate small molecules, and the temperature stability of vesicles. The dynamics of these systems at various temperatures were measured by determining the mixing between two vesicle populations, each marked with one member of a FRET pair. The CVC was decreased 5 to 10 fold, depending on the length of the carbon chain, when GMA was present. The ability to encapsulate both tRNA and carboxyfluoroscein was also increased when GMAs were added. Less marker mixing was observed when GMA was added to vesicles at temperatures from 20 to 45 °C. Mixing was also affected by chain length and is most probably caused by the fusion of vesicles. For a variety of membrane characteristics, GMAs are a stabilizing component, however it is possible that amphiphiles other than GMAs are better suited for stabilization and should be explored.

Name: Breanna Padilla
Program:UGS
School: University of California-Irvine
Group:B-7
Mentor: Anu Chaudhary
Category: Bioscience
Type: Individual Poster Presentation

Expression and Purification of Extracellular Domain of Toll-like Receptors

Toll-like receptors (TLRs) function as pathogen detectors on human cells, and this recognition is a key component of our innate immune response. Pathogen detection initiates a proficient inflammatory response against the foreign agent. TLRs are type 1 transmembrane glycoprotein receptors with an intercellular and an extracellular segment. In the cytoplasm, intercellular signaling pathways begin with the highly conserved TIR (toll-interleukin-1 receptor) domain, which initiates signal transduction upon pathogen detection by the extracellular segment. The conserved extracellular domains consist of leucine-rich repeats (LRR) and a cysteine-rich sequence that function as pattern-recognition receptors (PRRs) to detect pathogen-associated molecular patterns secreted by bacteria, viruses and fungi. There are a total of 10 human TLRs each with a specific LRR sequence that binds to particular pathogen-associated molecular patterns. The extracellular domain of TLRs has tremendous potential for development of a pathogen sensor for the specific detection of pathogen components. In an attempt to study in-vitro ligand-mediated dimerization of these receptors, we are expressing and purifying the extracellular domains of TLRs 1, 2, 4 and 6 from mammalian cells.

Name: Deóis Ua Cearnaigh
Program:UGS
School: New Mexcio State University
Group:ACRSP
Mentor: Donald Reed
Category: Bioscience
Type: Individual Poster Presentation

Biodegradation of Organic Chelating Agents by the Model Halophilic Archaeon Halobacterium salinarium in Environmentally Relevant Brines

Halite formations in the desert southwest have been stable on the order of 2.5x10^8 years, with isotopic analyses showing the complete absence of mass transfer within deposits. Carved volumes collapse on the order of decades, environmentally isolating contents for the lifetime of the formation. Due to the radiochemical properties of the halite, radiative emissions are rapidly extinguished, and decay products are trapped. These formations are generally free of significant biological activity, and are isolated from traffic and population centers. Evaporite deposits are therefore ideal for the long-term disposal of radioactive wastes. However, such wastes often contain organic chelating agents which have been determined to be of environmental concern in the event of catastrophic disruption of a repository. Extremophilic organisms are both indigenous and introduced to the site in the course of repository operation. This study reports that in the presence of introduced oxygen, as well as under post-repository anoxic conditions, the radio-tolerant halophilic model archæon _Halobacterium salinarium_ degrades key organic acids to negligible concentrations, extirpating chelating agents in the repository environment and significantly lowering the solubility of free metal ions.

Name: John Auxier II
Program:UGS
School: University of New Mexico
Group:AAC
Mentor: Donivan Porterfield
Category: Chemistry
Type: Individual Poster Presentation

Improved Methods of Nuclear Spectrometry for Sample Characterization

Techniques such as alpha and gamma spectrometry are commonly used for the characterization of radioactive and nuclear materials. Alpha spectrometry is a very useful technique for the characterization of samples containing alpha emitters such as americium and plutonium but overlapping peaks can result when multiple isotopes are present, e.g.,238Pu, 239Pu and 241Am. Chemical separations such as solvent extraction are typically used to reduce the potential for interfering peaks but can result in the generation of hazardous and regulated waste streams that require costly disposition. The potential for performing complex de-convolutions of overlapping alpha peaks is being investigated. Commercial software, such as Ortec® AlphaVision-32®, is being used in this effort. Gamma spectrometry is a well established technique for the non-destructive analysis (NDA) of radioactive and nuclear material within a sealed container. One important application is the ability to image the location of such material within a sealed container. While such commercial systems exist they are primarily designed around large waste containers, e.g., 55 gallon drums, to meet waste characterization requirements. Unfortunately the spatial resolution of such systems is not adequate for container mapping of smaller items. In response to the need to forensically examine a small sealed container, a system to manually drive a sample in front of a tungsten slit collimator and a high-performance germanium (HPGe) detector was constructed. In order to enhance this capability a much more automated system for acquiring many one-dimensional HPGe spectral slices of small sealed containers requiring forensic analysis is being developed. This also requires the ability to efficiently extract needed information from many hundreds of HPGe spectral files and present it in a useful manner. A combination of Ortec GammaVision®, Origin Labs© data analysis and plotting package, and Visual Basic code is being used.

Name: Caroline Coggeshall
Program:UGS
School: St. Olaf College
Group:C-IIAC
Mentor: Bill Crooks
Category: Chemistry
Type: Individual Poster Presentation

Lead Free Glovebox Gloves

Glovebox gloves are necessary to prevent contamination from alpha-emitting actinides and other radionuclides. Lead is the material currently used in glovebox gloves to protect workers from gamma and X-ray radiation. However, the toxic characteristics of lead results in making glovebox gloves a mixed hazardous waste, which is costly to discard. Further, since Americium-241 gamma and X-rays are a primary source of radiation exposure for Los Alamos National Laboratory personnel working with plutonium, gloves designed specifically to shield against this radiation would be most beneficial. To decrease exposure to radiation and minimize mixed hazardous waste, we propose manufacturing glovebox gloves with materials other than lead. After calculations with dynamic absorption coefficients of the K and L-shell electrons for gamma and X-rays, we find that a mixture of a non-toxic rare-earth element erbium and a heavy metal element bismuth, provide better protection than lead. The erbium and bismuth mixture absorbs 76% of the 60 KeV γ-rays compared to only 48% absorbed by lead. Even though lead is easier to procure, bismuth is not a RCRA metal and erbium is not toxic therefore ultimately their disposal is more economical because it is not regulated as a mixed waste. An additional safety feature of a colored sublayer can be added to the gloves so as to notify the worker if the glove is cracked or worn in any place. If there is a need for a glovebox glove designed specifically to attenuate a certain type of radiation, a simple algorithm can be used to find the ideal shielding element and the appropriate thickness of attenuating materials.

Name: Victoria Hansen
Program:UGS
School: University of Puget Sound
Group:C-PCS
Mentor: Aaron Anderson
Category: Chemistry
Type: Individual Poster Presentation

1. Synthesis, Characterization, and Use of a Novel Silane
2. Covalent Capture of Small Molecules on Patterned Thin Film

The LANL Biosensor Team has been working towards a general method for detecting variety of antigens using optical waveguide-based fluorescence spectroscopy. The waveguides are coated with thin films, which can be either lipid bilayers or silane-based self-assembled monolayers (SAMs). Thin films composed of phospholipid bilayers are resistant to non-specific binding and are easy to prepare. However, they deteriorate in the presence of detergents and lack stability over time. To overcome these problems we replaced the phospholipid bilayer thin films with silane-based, polyethylene glycol (PEG)-modified SAMs, which resist non-specific binding, are stable in air over long periods of time, and withstand treatment with detergents.

Though our current SAMs work well, there may be room for improvement. There are several promising modifications that can be made to the silane, such as increasing alkyl chain length, altering PEG chain length, and removing amide groups. This presentation will discuss the synthesis, characterization, and use of a silane with an amine-terminated, 11-carbon alkyl chain.

This presentation also describes the covalent capture of a small fluorescent molecule on a surface. This project supports our ongoing effort toward influenza detection using thin films on magnetic beads. Even though influenza detection on beads appears to be successful, the surface chemistry must be validated to ensure that it is behaving as expected. To this end, we used fluorescence microscopy to interrogate a patterned surface, which replicates the surface chemistry on the magnetic beads while integrating a negative control. With this method, we can be sure that influenza binding is not only due to adsorption to a surface, but is in fact binding to our covalently-bound surface receptors.

Name: Jenna Lilyquist
Program:UGS
School: Dakota State University
Group:N-1
Mentor: Minesh Bacrania
Category: Chemistry
Type: Individual Poster Presentation

Basics of Light Scattering

Dynamic light scattering uses the theory of Brownian motion to decipher the size of the particles in solution. In order to find the particle size, the light scattering machine uses the diffusion coefficient, which is inversely proportionate to particle size. By using 40nm, 100nm, and 200nm standards, the optimum concentration for solutions were determined, along with testing the accuracy of the machine through use of means and standard deviations. Solutions with combinations of the three standards were also used to test how well the machine can distinguish between different sized particles.

Name: Pawan Rastogi
Program:UGS
School: Columbia University
Group:CINT
Mentor: Jennifer Hollingsworth
Category: Chemistry
Type: Individual Poster Presentation

Sensitizing and Protecting Lanthanide Ion Emission Using Optically Active Nanocrystals

Lanthanide ions (Ln^{3+}) are characterized by their ultra-narrow band emissions of visible to near-infrared light with long luminescence lifetimes. This makes them ideal candidates for applications in lasing, up-conversion, and bioimaging. However, Ln^{3+} ions have specific and narrow absorption bands characterized by small cross sections, and their luminescence is vibrationally quenched in common solvents, thus making such applications difficult. To date, two optically active matrices have been explored as nanoscale hosts for Ln^{3+} ions c YVO_4 and In_2O_3. Specifically, Eu, Tb, Nd, Ho, Yb/Er, Ce/Er were doped into an YVO_4 matrix at varying concentrations (0 – 10%) following a modified *aqueous synthesis route*. Doped YVO_4 nanoparticles were capped with citrate ligands to afford water-soluble and thermally stable particles averaging 22 nm in size. Eu^{3+} luminescence was observed by way of energy transfer (ET) from the YVO_4 host matrix after excitation of the YVO_4, thus confirming sensitization of the Eu^{3+} ions toward absorption. Particles possessed high quantum yields (up to 16%) and were stable at temperatures above 200 ^{o}C. Additionally, a novel annealing technique using a microwave reactor was implemented to synthesize this class of nanoparticles, reducing reaction time by 70%. Second, a *non-aqueous synthesis route* developed in our laboratory was used to prepare In_2O_3:Eu nanocrystal quantum dots (NQDs) with clear red emission. Photoluminescence excitation spectroscopy was used to demonstrate sensitization of the Eu^{3+} emission by way of the semiconductor In_2O_3 matrix, and time-resolved spectroscopy of the doped NQDs compared with various control samples confirmed the "protective" nature of the NQD matrix. Doping In_2O_3 NQDs with other Ln^{3+} ions has also been attempted, as well as Ln^{3+} incorporation into In_2O_3 nanowires (higher absorption cross sections). Efforts are ongoing to further enhance sensitization (optimizing ET) and protection of Ln^{3+} emission, while expanding the accessible spectral window by increasing the number of successful nanocrystal-lanthanide combinations.

Name: Jesse Resnick
Program:UGS
School: Westminster College
Group:C-PCS
Mentor: Aaron Anderson
Category: Chemistry
Type: Individual Poster Presentation

Regeneration and Expedited Preparation of Polyethylene Glycol Terminated Thin Films

The Los Alamos National Laboratory Biosensor Team employs phospholipid bilayers and polyethylene glycol (PEG) terminated self-assembled monolayers (SAMs) in waveguide-based assays for the detection of biological molecules. The detection of biomarkers either unique to a pathogen (e.g, protective antigen for detection of Bacillus Anthracis) or up-regulated during the course of a disorder (e.g, carcinoembryonic antigen for the detection of breast cancer in nipple aspirate fluid) is potentially a fast, sensitive, and inexpensive means to diagnose a variety of illnesses. Phospholipid bilayers perform adequately in assays involving simple media, but are degraded by complex samples containing compounds with non-polar regions. Furthermore, they cannot endure exposure to air or detergents, or long-term storage. PEG terminated SAMs overcome these limitations by combining a hydrophobic alkyl layer with a hydrophilic PEG layer; this structure creates a highly stable film that is resistant to biofouling. However, our current SAMs require a 4 step, 2 day long process to prepare. To address this limitation, two novel silanes were designed. The first contains a 3 unit PEG region with a methoxy cap which should prevent non-specific binding. The second contains a 7 unit PEG region capped by a chemically reactive functional group. The design, syntheses, and analyses of these compounds are presented in this poster. A film comprised of a mixture of these two molecules could be applied to a slide in a single step and may enhance resistance to non-specific binding. Another limitation of phospholipid bilayer films is that they can only be used once. In contrast, the robust and detergent-resistant nature of SAMs makes them a promising target for a number of regenerative techniques. This poster presents exploratory research toward a variety of chemical, biological, and physical mechanisms for regenerating PEG-terminated SAMs.

Name: Christopher Alme
Program:UGS
School: Rice University
Group:HPC-3
Mentor: David Kratzer
Category: Computing
Type: Individual Poster

Managing Supercomputing Challenge Website Content

My summer work has consisted of modifying and updating content on the Supercomputing Challenge website. My work has included implementing a Wiki for the Challenge's Summer Teacher Institute so teachers can upload and share resources and information relating to the institute. In the future, students sharing information pertaining to their projects with their mentors and teammates can use the Wiki. I always implemented a Drupal for the teachers to be able to comment on their day-to-day thoughts and feelings on the institute. I have updated the challenge page, making it more intuitive and giving it a more modern look and feel. This has included feel including implementing a site-wide google search and automatically updating quote section on each page. I've worked to reorganize much of the site's information to become more accessible for students and teachers. In the future, I will work with integrating yellowcab into the challenge registration to make registration more secure by protecting participant's personal identifiable information.

Name: Amanda Archuleta
Program:UGS
School: University of New Mexico
Group:CTN-3
Mentor: Lynette Maestas
Category: Computing
Type: Individual Poster Presentation

Print Management

As a system administrator on the ECS field team one must implement tools that will better assist in performing tasks that are common to all administrators CTN wide. One such tool is a Print Management snap-in in Microsoft Management Console (MMC). While Print Management provides a single interface that administrators can use to administer multiple printers and print servers the MMC allows you to install, view, and manage all of the printers in your organization Windows Server. Instead of having to install each printer manually the MMC tool saves the administrator a significant amount of time, by giving the option of installing printers remotely.
The way Print Management is used here at LANL is with a Group Policy Object (GPO). Configuring and deploying a GPO for printers alleviates time and effort for a system administrator. For example, in Active Directory you can deploy a GPO for printers and apply it to the users or computer container. At this point, an administrator would simply assign a specific GPO to a pool of users, and from there the users would log-in and automatically be connected to the required printers. This tool is being utilized to better assist administrators in completing duties more effectively and efficiently. Without this tool in place an administrator would be forced to touch each computer and connect them to a printer manually.

Name: Eric Black
Program:UGS
School: DePaul University
Group:CTN-1
Mentor: Rosie Romero
Category: Computing
Type: Group Poster Presentation

Name: Le'Andrea Esquibal
Program:UGS
School: New Mexico Highlands University
Group:CTN-1
Mentor: Rosie Romero
Category: Computing
Type: Group Poster Presentation

Name: Daniel Montoya
Program:UGS
School: Colorado Technical University
Group:CTN-1
Mentor: Rosie Romero
Category: Computing
Type: Group Poster Presentation

Electronic Software Distribution

The responsibilities of Electronic Software Distribution team are vital in the management of software and licenses at Los Alamos National Laboratory. Laboratory employees require a system of installing products in a timely and efficient manner. In addition, the laboratory must ensure these products are obtained legally and each user is in compliance with software licensing guidelines. In order to meet these objectives, ESD Lab-Wide Service was created. The ESD team is composed of a Team Leader, Network Administrator, Product Manager, Programmers and a Financial Analyst. Our primary job assignment as students is to assume the roles of Programmers and Product Manager. This involves communicating with the other members of the ESD team and interacting with software publishers in order to provide a world-class solution for the laboratory.

Name: Colby Boyer
Program: UGS
School: University or California-Berkeley
Group: HPC-5
Mentor: Andy DuBois
Category: Computing
Type: Individual Poster Presentation

Real Time Digital Signal Processing of Radio Telescope Signals for a Full Sky FX Correlator

A real time full sky FX correlator for a large radio telescope array poses a daunting streaming problem because of the large amounts of data the telescope array produces and the enormous number of computations required for the correlation. The F portion of the FX correlator uses a filter bank to separate each antenna's baseband signal stream into multiple frequency channels. The Fast Fourier Transform is used to compute the DFT (Discrete Fourier Transform) coefficients of each frequency channel and the X portion uses the DFT coefficients to correlate each antenna pair.

Real time signal processing of radio astronomy data requires large amounts of computational power and bandwidth to process the large data sets. Custom hardware such as Field Programmable Gate Arrays and Digital Signal Processing chips can meet the computation, bandwidth, power and space requirements of the radio telescope station. However, developing such a system is time consuming, difficult, and inflexible to design changes. IBM's CBE (Cell Broadband Engine) offers large amounts of computational power and bandwidth with the ease of developing with the C programming language. The architecture of the CBE consists of one PowerPC processor and 8 SPEs (Synergistic Processing Elements) connected together with a high bandwidth bus. Each SPE has a 128 bit wide data path, a large register file and can execute floating point vector operations. This distributed architecture allows for computation to be efficiently distributed over the all the processing elements.

Implementation and performance analysis of the F portion of the full sky correlator will be done on both the CBE and a standard x86-64 processor (e.g. AMD Opteron). The efficiency of the CBE compared to a standard processor will be measured by comparing the number of Flops (floating point operations per second) of the standard processor to the number of Flops the CBE can sustain. Future work will incorporate IBM's DaCS (Data Communication and Synchronization) to enable integration between x86-64 processors and CBEs in a hybrid system environment.

Name: Joshua Brashear
Program:UGS
School: New Mexico Tech
Group:CTN-2
Mentor: Stephanie Lovato
Category: Computing
Type: Individual Poster Presentation

Pueblo Complex Print Server

The CTN-2 Downtown Team at Pueblo Complex supports approximately 200 users, situated both at TA-00 and TA-21. Employees of these areas are responsible for air, soil, and water sampling analysis and reporting. Reports must be submitted under deadline to the Department of Energy (DOE) and the New Mexico Environmental Department (NMED). If these deadlines are not met, substantial fines are levied against LANL. Recently a backup server was brought online in response to the failure of the primary print server. It was decided that a redundant solution was necessary to prevent downtime in the event that a print server should go offline unexpectedly. A secondary print server was installed and printer information and drivers were duplicated between them using Microsoft Print Migrator 3.1.

Name: Mandy Cortez
Program:GRA
School: New Mexico Highlands University
Group:HPC-1
Mentor: Douglas Coombs
Category: Computing
Type: Individual Poster Presentation

Data Query Tool (DQT)

The Data Query Tool (DQT) is a web based tool that was developed for the Nuclear Atomic and EOS Data Team, X-1 NAD. This tool allows users to specify the criteria for Ad Hoc queries against nuclear data stored in a relational database via an intuitive form-driven interface. DQT provides several types and versions of nuclear data for querying. It automates a tedious part-manual and part-automated process used formerly to generate PDF reports that are published world-wide as part of the LANL MCNP (a general-purpose Monte Carlo N-Particle code) tool and allows users internal to LANL online Ad Hoc access at the same time on both the yellow and secure networks. I have enhanced DQT to use a generic search interface that can be easily adapted to search any normalized data in any relational database using standard SQL. I have written several PHP libraries to aid in the dynamic creation of the search interface, parse the search criteria entered for errors, and to display search criteria.
X-1 NAD plans to reuse these libraries in other PHP tools they use on a daily basis. DQT was developed using PHP, Javascript, Perl, and PostgreSQL. PHP and Javascript were used to provide the web interface and query the PostgreSQL database. Perl was used to extract data from flat files and load data into the database.

Name: Francisco DeMaria
Program: UGS
School: University of New Mexico
Group: HPC-1
Mentor: Myles Fitzgerald
Category: Computing
Type: Group Poster Presentation

Name: David Fleming
Program: UGS
School: New Mexico State University
Group: HPC-1
Mentor: Myles Fitzgerald
Category: Computing
Type: Group Poster Presentation

Collaboration Station: The Tripod Project

We were presented with the challenge to facilitate collaboration between the three different laboratories, Los Alamos, Sandia, and Laurence Livermore, on either administrative or technical projects by utilizing web based content management tools. The main objective for this tool is to host and share the work projects that will become available as soon as the laboratories begin collaborating. The content management tool that we focused on for this effort was Plone. Without this type of tool, employees are restricted to communication via email, attachments and telephone conferences which open the potential for lost communication and data. Our focus was to implement and set up Plone as intuitively as possible so that the three laboratories will be able to quickly and easily collaborate.

Name: Francine Diaz
Program:UGS
School: Santa Fe Community College
Group:CENG
Mentor: Grewal Gurinder
Category: Computing
Type: Individual Poster Presentation

The New Engineering Navigator

The LANL Conduct of Engineering (CoE) Office mission, in part, is to provide tools to guide engineers through formal engineering policies and procedures. For the engineer, this process has generally required sorting through a large amount of information to identify the correct processes to follow, and with no easy way to document the path taken through the process. The advents of collaborative software like Microsoft SharePoint and InfoPath have given us ways to streamline this process into a user-friendly interface between a user and CoE processes. One result is the new Engineering Navigator, a browser-compatible application that can be accessed by everyone through SharePoint and used as a tool to determine the correct engineering procedure(s) to follow quickly, accurately, and easily. When the Engineering Navigator is deployed it will ensure that the necessary procedures are invoked for the type of project undertaken, and should save much time and effort, increasing productivity in LANL engineering processes. This method may also be useful in many other departments, increasing consistency and efficiency of complex administrative processes throughout the Laboratory.

Name: Eric Doll
Program: UGS
School: University of New Mexcio
Group: HPC-5
Mentor: Andree Jacobson
Category: Computing
Type: Group Poster Presentation

Name: Taylor Owen
Program: UGS
School: New Mexico State University
Group:HPC-5
Mentor: Andree Jacobson
Category: Computing
Type: Group Poster Presentation

Name: Ruben Salazar
Program: UGS
School: Unversity of New Mexico
Group:HPC-5
Mentor: Andree Jacobson
Category: Computing
Type: Group Poster Presentation

High Speed Interconnection Network Performance Studies

The goal of this project is to evaluate application performance at the network level. This experiment will perform real-world performance evaluations using the Fastest Fourier Transform in the West (FFTW) subroutine library accompanied by Message Passing Interface Profiling (MPIP). This benchmark will measure the bandwidth, latency, etc. Application performance can depend heavily on the interconnect between computational nodes. Several types of network interconnects will be compared to see which one shows the best performance. The network cards that will be tested include the Mellanox Infiniband, in Single Data Rate (SDR) and Double Data Rate (DDR) configurations, and the Mellanox 10-Gigabit Ethernet. The results of this experiment can be used to make applications finish sooner and increase the overall productivity of the cluster.

Name: Mary Elfman
Program: UGS
School: University of the Incarnate Word
Group: N-4
Mentor: Richard Rothrock
Category: Computing
Type: Group Poster Presentation

Name: Julian Salas
Program: UGS
School: University of the Incarnate Word
Group:N-4
Mentor: Richard Rothrock
Category: Computing
Type: Group Poster Presentation

Computer Graphics Visualization and Animation Used in Scientific and Facility Modeling

The arena of high fidelity graphics and animation technology has grown significantly in recent years based on work in the computer graphics and entertainment industries.
Animation and photo-realistic graphics to enhance nuclear safeguards and other sciences was explored, as well as utilizing the medium to easily convey challenging ideas to an audience, be it fellow scientists or a layman.
Technologies explored included animation and interactive virtual reality elements using commonly available cost effective tools. Combining programmable interactive capabilities in computer graphics with elements and topics in science not typically understood by many of our sponsors or end users has proven an effective communication utility to explain complex topics, ideas, and concepts. Examples include nuclear facility operation and material process flows for training International Atomic Energy Association (IAEA) inspectors and member state contingents, as well as proposed space borne scientific experiments.

Name: Dan Gossens
Program:UGS
School: Michigan Technologial University
Group:CTN-1
Mentor: David Sanchez
Category: Computing
Type: Individual Poster Presentation

Network Access Control: Symantec LAN and Gateway Enforcers

There is a need at Los Alamos National Laboratory to control and manage compliant systems on the internal network. By using Symantec LAN and Gateway Enforcers, we are able to control which machines meet criteria based upon numerous custom and pre defined rules and allow them to access the network. A LAN Enforcer, internally, controls this access directly from Layer 2 on edge switches using the 802.1x protocol to enable, disable, or switch VLANs on each port based upon the rules that are set in the Symantec Policy Manager. Gateway Enforcers are mostly used on VPN connections and are placed behind the VPN Concentrator. All of the traffic runs through the enforcer, which allows the traffic to be inspected. If a rule set fails, it will immediately deactivate the connection and notify the user that they are non-compliant. With both the LAN and Gateway Enforcers, users can be directed to a remediation area to become compliant, whether it's installing the client, updating virus definitions, running a custom script, and more. Once this is completed, the user will be automatically switched back onto the network and can continue working.

Name: Samuel Gutierrez
Program:GRA
School: University of New Mexico
Group:HPC-3
Mentor: David Montoya
Category: Computing
Type: Individual Poster Presentation

OpenSpeedShop: A Scalable Parallel Performance Analysis Framework

Massively parallel computer systems are typically utilized in a wide variety of research areas as a means to solve and understand complex problems. The demand for increased computational resources, for use in a broad range of research areas, has been a catalyst in the development of large parallel computing systems consisting of tens of thousands of processors. Unfortunately, the vast majority of tools commonly used to uncover application performance bottlenecks in small-scale environments tend to scale poorly as applications and systems increase in size. OpenSpeedShop, an open source performance analysis framework, is aimed at addressing a wide variety of challenges developers face when attempting to gather and analyze performance data from large-scale application runs all from within one common tool infrastructure.

OpenSpeedShop currently supports two types of data collection and instrumentation mechanisms; both of which can be applied to unmodified application binaries running on Linux clusters. The first mechanism utilizes dynamic instrumentation technology developed at the Universities of Wisconsin and Maryland and is capable of instrumenting a running process or an existing application binary. The second mechanism utilizes LD_PRELOAD – or static relinking when necessary – to load data collection libraries into the application binary at runtime.

Currently OpenSpeedShop provides several performance experiment plugins including: program counter (PC) sampling, hardware counter sampling, MPI call tracing, IO call tracing, and floating-point exception (FPE) tracing. OpenSpeedShop also provides an application programming interface (API) that facilitates the creation of custom performance experiment plugins.

Our current research focus is geared towards assessing the viability of performance data gathered utilizing OpenSpeedShop's collection mechanisms on a variety of lab-sized simulation codes.

Name: Meiyun He
Program:GRA
School: University of Maryland-College Park
Group:CNLS
Mentor: Robert Lowrie
Category: Computing
Type: Individual Poster Presentation

Entropy Based Closures for P_N Equations

In kinetic and transport theory, entropy based methods are used to approximate a function from a given set of moments. These methods can be used to derive a closed system of partial differential equations by solving an unconstrainted strict convex optimization problem. Unfortunately, the optimization can be very inefficient. We show results for various optimization methods. Our objective is to solve the entropy based closure efficiently for a large number of moments and apply it to the P_{N} equations for neutron transport.

Name: Rocky Herrera
Program:UGS
School: Northern New Mexico College
Group:CTN-3
Mentor: Carlos Martinez
Category: Computing
Type: Individual Poster Presentation

HDCS Print Server Project

To reach compliance with the NAPS set by DOE, I am working with my teammates to complete a project to put all the printers for customers my team supports on a print server for versatility and secure reasons. All printers will be moved to a non-routable network ("printer net"), by doing this it will free up IP addresses for usage. By then adding all the printers to a print server, we will be able manage the printers in a user-friendly environment and meet requirements being set by the NAPS Compliance Order.

Name: James Kang
Program: UGS
School: University of New Mexico
Group:HPC-5
Mentor: Andree Jacobson
Category: Computing
Type: Group Poster Presentation

Name: Evan Leesburg
Program: UGS
School: Michigan Technological University
Group: HPC-5
Mentor: Andree Jacobson
Category: Computing
Type: Group Poster Presentation

Name: Katherine Nystrom
Program: UGS
School: Unversity of New Mexico
Group:HPC-5
Mentor: Andree Jacobson
Category: Computing
Type: Group Poster Presentation

High Performance Computing and Cluster Management

This research project investigates two configuration management tools, Cfengine and Puppet, and evaluates their strengths and weaknesses. Cfengine is presently used on LANL clusters and Puppet is being considered for use on future clusters. Both Cfengine and Puppet have large user communities and offer different approaches to configuration management. Each configuration management tool was implemented on separate Virtual Local Area Networks and run on designated servers to execute configuration scripts and reinstall nodes in the event of a failure.

Name: HsingHui Liu
Program: UGS
School: University of New Mexico
Group: CTN-1
Mentor: Beth Dermer
Category: Computing
Type: Group Poster Presentation

Name: Jamie Madrid
Program: UGS
School: University of New Mexico
Group:CTN-1
Mentor: Beth Dermer
Category: Computing
Type: Group Poster Presentation

You've Got Mail! Managing LANL-wide eMail Migration

Los Alamos National Laboratory email system Eudora is in use by several thousand users at LANL. As of October 31st, 2007, QualComm stopped support for Eudora, thus LANL recognized the need to migrate its existing email system and convert the entire email users to another email system. Switching to another email system is not an easy task. It has several challenges: user training, address book conversions, message migrations, client satisfaction, and system configuration.
Our research is to help LANL email users transition off of Eudora to one of the selected email system-Thunderbrid, an open source solution. The key advantage of migrate to Thunderbird is : One of Thunderbirds extension projects " Penelope" obtained 6 previous QualComm employees who were Eudora developers. Since the program will be developed on Thunderbird's code, Penelope developers plan to share features and functionality with Thunderbird. Through my discussion, LANL email users will be able to easily understand the key features of Thunderbird, including its junk mail filters, anti-phishing protection, advanced security, updates, and the customization of Thunderbird.
We are creating a poster with power point slides to demonstrate the key features, the uses, the installation, and migration of Thunderbird to help LANL computer technician and all of email users at this transition stages.

Name: Veronica Lopez
Program:UGS
School: University of New Mexico
Group:CTN-5
Mentor: Evelyn Roybal
Category: Computing
Type: Individual Poster Presentation

Reverse Engineering Malware

Maintaining the Laboratory's classified and unclassified computer networks is our mission at CTN-5. Along with maintenance, support, and management of LANL's networks, we are also primarily responsible for computer security at the Laboratory. One main goal in computer security is to protect the LANL computer networks by detecting and responding to computer security incidents involving LANL computers. When detecting a potential malware incident it is important to first constrain the system and then attempt to clean up the affected computer. In order to prevent a spreading of the malware to other computer users in the LANL network, reverse engineering takes place on the virus, worm or trojan. Reverse engineering is the process of analyzing the malware code, and its behavior to identify its components and their dependencies to extract its design information. With this in mind, my research entails the use of techniques and tools used to detect and investigate a well known and documented windows virus.

Name: Curtis Luce
Program: UGS
School: New Mexico State University
Group: CTN-1
Mentor: Roy Nielsen
Category: Computing
Type: Individual Poster Presentation

Performance and Feasibility of Virtual Machines

The goal of any system is to perform well and be available when needed.
Benchmarking software IOzone and LMbench where used to test virtual machines hardware, operating system and development while the performance data are used to judge the feasibility of the virtual machines. Tests included exercising memory latency, file system latency, disk, network, read and write tests on the virtual machine.
One major test performed compared virtual machines on a network file system to virtual machines on a physical disk. Performance is an important concept except on a system that can have faults that create downtime that impacts deadlines. A system fault can be caused by internal or external factors. Internal factors can be design error or a component wear out. External factors can be operator error or a natural disaster. A high availability system provides fault detection and correction procedures to maximize the availability of the critical services and applications provided by the system. High availability systems require little to no manual, human intervention to identify a failed component, execute a procedure to avert a system failure and notice the averted failure. High availability increases uptime of a system by reducing the time it takes to recover from a system failure ensuring that deadlines are meet. Research shows that virtual machines are feasible for our build environment and capable of high availability performance.

Name: April Lucero
Program:UGS
School: Northern New Mexico College
Group:CTN-3
Mentor: Kelly Vigil
Category: Computing
Type: Individual Poster Presentation

Implementing ClearCube PC Blades

Recently, Los Alamos National Laboratory has decided to deploy ClearCube PC Blades to increase security, comply with government regulations, and meet hardware space constraints. The main areas of focus for LANL are worker safety, security, environmental protection, and national defense. By using ClearCube PC Blades, LANL will be serving each focus area.
ClearCube PC Blades provide a managed desktop environment from a centralized rack mounted environment. This improves manageability, agility, and security. User experience is the same as with a traditional PC; however, through ClearCube PC Blades it is a diskless PC. ClearCube provides each individual with a dedicated machine and the hard drive is rack mounted in a data center. These machines are referred to as CPU Blades. There are several benefits to using ClearCube PC Blades which are: they reduce downtime; they increase productivity due to fewer trips to the desktop, faster time to configure new users, and faster moves, adds, changes, and upgrades; and they decreases the number of PCs IT staff.

Name: Ashley Martinez
Program: UGS
School: University of New Mexico
Group:CTN-5
Mentor: Tony Maestas
Category: Computing
Type: Group Poster Presentation

Name: Richard Rivera
Program: UGS
School: New Mexico Institute of Mining and Technology
Group: CTN-5
Mentor: Ricardo Romero
Category: Computing
Type: Group Poster Presentation

Network DNA

Network Topology signifies the way in which intelligent devices in the network see their logical relations to one another. The use of the term "logical" here is significant. That is, network topology is independent of the "physical" layout of the network. In example, Even if networked computers are physically placed in a linear arrangement, if they are connected via a hub, the network has a Star topology, rather than a Bus Topology. In this regard the visual and operational characteristics of a network are distinct; the logical network topology is not necessarily the same as the physical layout. This generates a problem when updating or designing network documentation based upon the topology. We present a redesign method based upon the Open Systems Interconnection Basic Reference Model (OSI Model). The redesign factors include; the mapping of physical devices, physical and logical addressing through the LANL database, and the connectivity and reliability of the network. The widespread use of computer networking has resulted in considerable attention being paid to a variety of network-related problems; the generation of efficient and up-to-date documentation is an essential tool to successful networking. An enhanced approach of documenting the network here at LANL could essentially boost our ability to understand and resolve network related problems more efficiently.

Name: Kimberly McCormick
Program:UGS
School: University of New Mexico
Group:T-8
Mentor: Andree Jacobson
Category: Computing
Type: Individual Poster Presentation

Cluster Monitoring Tools

Cluster monitoring tools are used to diagnose the condition and configuration of clusters and cluster hosts. The purpose of this project is to analyze the differences between two open source tools: Nagios and Ganglia. These tools will be used on our 12-node cluster to help the users check the availability and performance of the system on which their applications are running. With feedback from the users, I hope to determine which tool is better for monitoring our cluster.

Name: Caleb Morse
Program:UGS
School: University of New Mexico
Group:CTN-1
Mentor: Aaron Morrison
Category: Computing
Type: Individual Poster Presentation

Migrating Clustermatic to Perceus

As the software on a cluster ages it becomes increasingly difficult to maintain, and eventually makes it difficult, if not impossible to run modern jobs or the software on the cluster begins to reach end of life . The existing cluster is running Fedora Core Linux, Bproc, clustermatic, and LinuxBIOS. Clustermatic was picked because at the time because it was being widely implemented on a number of clusters at LANL. Clustermatic has not been actively developed since November 2004 and the cluster running an old version of Fedora Core 3 that is no longer officially supported.
Additionally, the kernel installed and supported by Clustermatic 5, does not implement posix threads which are required for the newer applications the customer is required to use.
To test the feasibility of the migration a cluster with a single head node and two compute nodes was set up using Perceus on Red Hat Enterprise Linux 5. Once the feasibility has been assessed a migration plan that minimizes end user impact, and maintains scalability and reliability will be developed.
Finally, pending time remaining and migration results, do the actual migration.

Name: Amanda Munoz
Program: UGS
School: New Mexico Institute of Mining and Technology
Group: HPC-5
Mentor: Andree Jacobson
Category: Computing
Type: Group Poster Presentation

Name: Frank Roybal
Program: UGS
School: New Mexico Highlands University
Group:HPC-5
Mentor: Andree Jacobson
Category: Computing
Type: Group Poster Presentation

Name: Nickolas Torres
Program: UGS
School: Unversity of New Mexico
Group:HPC-5
Mentor: Andree Jacobson
Category: Computing
Type: Group Poster Presentation

Diskless Computing

The purpose of an extreme computing cluster is to achieve the highest level of performance possible. In order to achieve this goal the number of components in modern computer clusters has greatly increased resulting in lower reliability. Today, in an effort to increase reliability, most extreme computing clusters are being built without hard drives. There are several competing diskless management solutions currently available for cluster administrators to use when configuring these diskless computing clusters. One of these cluster managements systems, which is currently being used on Roadrunner, is Perceus. We will test Perceus and several other competing diskless cluster management systems to determine which is the most efficient and easiest to use.

Name: Abhishek Murthy
Program: UGS
School: University at Buffalo- SUNY
Group: CCS-3
Mentor: Sami Ayyorgun
Category: Computing
Type: Group Poster Presentation

Name: Scott Pack
Program: UGS
School: Middle Tennessee State University
Group:CCS-3
Mentor: Sami Ayyorgun
Category: Computing
Type: Group Poster Presentation

A Realistic Power-Profile of Communication Nodes in Wireless Ad-hoc/SensorNetworks (WANETs)

WANETs are at present a promising technology due to low cost, resilient, and localized solutions to problems faced in various domains such as in defense, security, agriculture, civil engineering, etc. A significant portion of research in WANETs revolves around optimizing energy consumption and operational lifetime with severely limited resources involving computation (e.g. memory and CPU), communication (e.g. transceiver capabilities, data rates), and energy (e.g. battery) to power the nodes. The TelosB mote platform, which uses an IEEE 802.15.4 (i.e. ZigBee) compliant radio named CC2420, has increasingly become popular in the WANET research community. Our contribution has been verifying a realistic power-profile reported in [1]for the TelosB motes, which is critical for research to be validated on this prevalent platform. Obtaining a detailed power-profile of the TelosB mote involved study of its various high-level components. A simple current-measuring circuit was used to examine each component. TinyOS programs, written in nesC, were used to access the different components under standard operating conditions. Also the mote behavior in outdoor environments was studied. A TinyOS application was developed to investigate the effect of protective cases on the signal, indexing through the CC2420 radio's 32 power-levels. Measurements were taken at different deployment heights to investigate the ground-effect phenomenon, as the ground greatly attenuates 802.15.4 radio signals. The radio transmission profile would aid in experimental WANET deployments in semi-forest terrain in the vicinity of Los Alamos National Laboratory. The empirical model resulting from the power measurements promises to be realistic and will help the research community to determine various realistic trade-offs, as well as appropriate protocol development, in real-world deployments of WANETs.

[1] Sami Ayyorgun, Jing Ai. "Towards a Self-organizing Stochastic-Communications Paradigm for Wireless Ad-hoc Networks", in Proc. of the IEEE International Conference on Mobile Ad-hoc and Sensor Systems (MASS) 2008. (Best-paper nominee).

Name: Nichoals Recla
Program:UGS
School: Michigan Technological University
Group:CTN-1
Mentor: Mark Lyon
Category: Computing
Type: Individual Poster Presentation

Securing Vista to FDCC & LANL Standards

OMB has required Microsoft Vista to contain certain standard settings created by the FDCC (Federal Desktop Core Configuration). It is my job to evaluate the compatibility of these settings in a LANL environment. Specific tasks include creating Virtual PC Machines & testing the FDCC settings with standards LANL software such as MS Office, Citrix, Adobe Acrobat, and many other widely used programs as well as basic Administrator tasks.

Name: Adrian Romero
Program:GRA
School: New Mexico Highlands University
Group:HPC-1
Mentor: Douglas Coombs
Category: Computing
Type: Individual Poster Presentation

LANL HPC Monitoring

Appropriate monitoring for high-performance computing clusters goes beyond real-time alerts. The appropriate sifting of data, convenient access to system data for event investigation, and an accurate historical record of issues are all monitoring . Correlated information from disparate data sources is vital in determining the overall health of these complex systems. The data generated via these machines provide the clues necessary in resolving past, present and future problems. Use of an effective monitoring tool will boost the ability to understand and resolve problems, help identify potential problems, reduce costs by increasing efficiency of existing personnel. This increase in efficiency allows the management of more complex systems without additional staff.

Name: Sherry Salas
Program:GRA
School: New Mexico Highlands University
Group:CTN-1
Mentor: Giacomo Brussino
Category: Computing
Type: Individual Poster Presentation

Software Evaluation of SCAP Validated Products

The Central Services and Development (CSD) team works on improving LANL desktop security, reliability, usability, and supportability. In our efforts, we must incorporate the use of both homegrown and production software. The growing trend of incorporating production software in our systems has created a need to effectively and efficiently evaluate production software. The CSD team has created a guideline to evaluate software before implementing it at LANL.
Security Content Automation Protocol (SCAP) is a suite of open standards that enumerate software and configuration security issues. In our efforts to improve desktop security, the CSD team is working to implement the SCAP NIST 800-68 checklist. There are a list of SCAP validated tools that can be used to implement the SCAP checks. The CSD team has used the software evaluation guidelines to select an applicable tool to implement at LANL.

Name: Zachary Simpson
Program:UGS
School: Michigan Technological University
Group:CTN-1
Mentor: Tay Naish
Category: Computing
Type: Individual Poster Presentation

Desktop Replacement and Sunray Deployment

Ever since the creation of the modern network, Workstations have been a vital part of the computing infrastructure. As time passes, servicing and supporting these aging machines becomes increasingly difficult as manufactures discontinue support, and newer more hardware intensive applications appear. The solution to this problem is to upgrade and replace these machines with newer devices. Doing this is not the most economical or efficient task to complete. One solution to this is to replace client desktops with thin client devices and connect them to servers in the datacenter. Doing this has many advantages, specifically a lower cost for deployment because you are replacing a $1000+ machine with a $300 box, and you are only replacing the severs (about $3000 each) when they need replacement. These devices are also extremely power efficient, which brings even more savings. The total amount spend in maintance is less also. Instead of wasting time administering problems on many different machines, all that needs to be administered is the servers. These devices are also more secure, because no actual data is stored on them, if they get stolen no data is lost or compromised.

Name: Onur Soysal
Program:GRA
School: University of Buffalo-SUNY
Group:T-CNLS
Mentor: Sami Ayyorgun
Category: Computing
Type: Individual Poster Presentation

CatNap: A Self-Stabilizing Low-Power Sleep-Wake Up Protocol for Wireless Ad-hoc/Sensor Networks

Radios in Wireless Ad-hoc/Sensor Networks (WANETs) nodes are the most power-consuming components. Furthermore, keeping the radio turned-on while awaiting a packet uses almost the same power as transmitting at full power by the radio. This leads to one of the key challenges in WANETs: reducing the time that the radio needs to stay turned-on. This becomes even more challenging when the communication scheme has randomness, which causes a non-deterministic pattern of packet arrivals. In order to deal with this problem, we introduced a low-power sleep-wakeup protocol called CatNap. We analyzed and implemented CatNap for novel random communication-scheme, called BSTeR, introduced in [1]. CatNap utilizes information about packet arrivals and probability distributions of routes to predict packet arrival times. This prediction is then used to turn radios off when no packets are expected. We exploit pseudo-randomness of the random number generators and packet generation rate to significantly reduce uncertainty in expected packet arrival times. Furthermore, a single packet is sufficient to restart and synchronize a node in the network. This allows transient errors such as missing packets to be corrected automatically since the next packet will reinitialize the protocol. We apply CatNap protocol to WANETs using greedy geographic routing on top of the BSTeR scheme. Geographic routing uses spatial and topological information about the communication nodes to decide the routing, and is deterministic by nature. BSTeR scheme on the other hand stochastically modulates topology of the network through smart transmission power control. Combination of geographic routing and BSTeR creates a random routing protocol. CatNap uses topology information in geographic routing and the probability distributions in BSTeR to predict packet arrivals. We implemented these protocols on TelosB motes using TinyOS. We study end-to-end delay and power efficiency of the network. We then compare our results with a simple, retry based low power listening protocol.

Name: Roxane Valdez
Program:UGS
School: Northern New Mexico Community College
Group:CTN-1
Mentor: Crystal Salazar
Category: Computing
Type: Individual Poster Presentation

Active Directory Integration with Macintosh

My project is based on integrating the Macintosh computers in our current computing environment with Active Directory. By integrating the Mac's with Active Directory we will provide redundancy, fault tolerance, security and control of these systems over the network. This mechanism would become very useful to access and manage all the network's resources within our team.

Name: Blaine Vigil
Program:UGS
School: University of New Mexico
Group:HPC-3
Mentor: David Montoya
Category: Computing
Type: Individual Poster Presentation

Analyzing Applications Using Open|SpeedShop

One of the challenges in developing applications for High Performance Computing Environments is to collect data in order to analyze performance and identify areas of the application to adjust for better efficiency. Open|SpeedShop is an open source application performance tool that supports performance analysis on single node and large scale multi-node programs. It is co-funded by the Department of Energy and is in the process of being integrated as one of the performance analysis applications used at Los Alamos National Laboratory, Law rence Livermore National Laboratory, and Sandia N ational Laboratory. Functionality included in Open|SpeedShop includes M PI call tracing, experiments using counters to analyze CPU hardw are performance, and exclusive and inclusive user time metrics. Open|SpeedShop contains three modes of operation (batch, command line interface, and graphical user interface) including an API for python users to allow Open|SpeedShop to be used in python applications. The area w here w e w ill focus that may benefit code developers is to integrate into nightly regression test suites. Expectations are to utilize the batch features of Open|SpeedShop to analyze both single node and multi node applications with various collector experiments. Once these tests have been completed, databases w ill exist w ith the detailed performance data. We w ill develop processes to mine this data for specific elements of interest specified by the developer. This w ill then be tracked for analysis through time to identify if impacts are occurring during the development process.

Name: Stephanie Vigil
Program:UGS
School: Northern New Mexico College
Group:CTN-1
Mentor: Cindy Kelley
Category: Computing
Type: Individual Poster Presentation

Managing the Life Cycle of Desktop Computers

The purpose of this research is to learn how we put together computer systems here at CTN-4. I will be explaining how to keep your computer up to date when the warranty on the computer expires, how to run a query and get results of who's warranty is outdated. I will also illustrate how to build a new system,including the check list we use here at CTN-4. How to setup up a new system after removing the old one. Salvage the system after you have replaced it for a new one (remove hard drive and check CD Drive). Then you will want to test the system before you leave the employees workstation. In the end you will have a new system that should be running top notch with no system errors.

Name: Michael Webber
Program:UGS
School: North Carolina A&T State University
Group:ISR-2
Mentor: Paul Pope
Category: Computing
Type: Individual Poster Presentation

SHRINKWRAP GUI

LANL is doing remote sensor simulations (the ability to measure physical data without touching the object) by using 3D models. Each object is made up of triangular elements. The problem with the mesh of the original triangles is the inconsistently of the size and number of triangles that represent the object . The goal is to take these original triangles and replace them with a refine mesh. These smaller triangles will make up the object's surface. A nontechnical point of view of finding the objects surface is to take a pallet of freight and wrap it in plastic to give you a detailed surface. In a mathematical way to find the surface of the object, we must find the center of the model, normalize the dimensions, define the normalized sphere, define a projection point, perform the projection, define metadata, and export the object. To make this happen, a Graphical User Interface (GUI) called "SHRINKWRAP" was designed to help take original data and convert it into usable data. The GUI is used to obtain input/output files, define geometrical parameters, and set metadata. There is also a status window, a progress bar and "before" and "after" visuals of the object to show the user each step of the process. There is also a manual for first time users.

Name: Jeffrey Whitehouse
Program:UGS
School: Michigan Technological University
Group:CTN-1
Mentor: Fatima Woody
Category: Computing
Type: Individual Poster Presentation

Print Server for a Heterogeneous Client Environment

In many areas of Los Alamos National Labs a very complex heterogeneous network is used. This leads to many problems for centralizing computing resources and authentication. The area I worked in this summer was improving the printing system of the network out in the Los Alamos Neutron Science Center (LANSCE). My aims were to set up a system that is more flexible, easier to configure, and that works with all of the three major operating systems which see daily use in LANSCE. I reviewed first and third party print server options for all of these operating systems including Line Printing Daemon, Internet Printing Protocol, and Server Message Blocks. The print server decided on was a Windows Server 2003 platform with the additional software package PaperCut NG. This platform makes for a much more convenient end user experience, with authentication, while offering many more features than a basic direct connection to a printer, or Server 2003 alone provide.

Name: Philippe Levy
Program:UGS
School: University of California- Berkeley
Group:EES-2
Mentor: Nate McDowell
Category: Earth and Space Science
Type: Individual Poster Presentation

Unveiling Terrestrial Microorganic Carbon Cycling Using Tunable Diode Laser Spectroscopy and Automated Microcosms

In an effort to better understand the role of microorganism communities in terrestrial carbon cycling, we conducted experiments looking at the stable isotopic composition of carbon dioxide evolved from the metabolic activity of these microbes. We used tunable diode laser spectroscopy (TDLS) in conjunction with a soil microcosm to determine changes in both respiration rates of CO2 and in the stable isotopic ratios (delta 13C and delta 18O) of the gas. The EES-2 tunable diode laser (TDL) provides real-time, high frequency data of stable isotope abundances of respired CO2 that allows for analyses of microbial respiration with unprecedented temporal resolution, capturing rapid, transient responses to the simulated environmental stimuli of the microcosm. The soil microcosm we created began as a canning jar with an inlet and outlet, evolving into a singular system of Swagelok valves and tubing, culminating in a multi-chambered, fully automated apparatus capable of rapid, periodic measurement with little supervision. Coupling a hand-made microcosm with the TDL presents technical and engineering challenges that must be overcome before extensive measurements can be made. Concerns of CO2 diffusion and isotopic fractionation, leakage, and appropriate conditions for microbes were addressed in this study. The final apparatus will measure various soil samples with varied amounts of stimulation from glucose solutions, providing high resolution data that will offer new insight into the role of soil microbial communities in the ecosystem carbon cycle. With the completed and well-documented construction of this flexible, interchangeable apparatus, the opportunities for future research are staggering.

Name: Bryant C. Palmer
Program: UGS
School: Shippensburg University
Group: EES-11
Mentor: Christopher R. Bradley
Category: Earth and Space Science
Type: Group Poster Presentation

Name: Wade Rush
Program: GRA
School: University of Kansas
Group: EES-11
Mentor: Christopher R. Bradley
Category: Earth and Space Science
Type: Group Poster Presentation

Dynamic Modeling of Earthquake Ruptures

Geophysicists have invested considerable effort in understanding the physics involved in how earthquake ruptures fundamentally work. The driver of this investment is to provide early warning for safety, mitigate infrastructure damage, and posture critical infrastructure resources in less hazardous earth quake zones. If seismologists can more accurately predict the seismic magnitude, duration and location, infrastructure could be better designed to survive hazardous seismic zones.
This poster focuses specifically on the dynamics involved in earthquake rupture.
Tectonic outside forces creates stress and strain on the rocks which essentially stores energy like a spring. Once the strain exceeds the fault yield strength, the rock ruptures and this potential 'spring' energy is released to the system. Based on conservation of energy and momentum, we show the elastodynamic equation of motion and how it is applied to our problem. Two methods have been used to dynamically model an actual earthquake rupture based on the 2000 Tottori, Japan earthquake. The two methods are the Finite Difference and the Finite Element Methods (FEM). This poster provides a short theoretical discussion about the two methods as it relates to earthquake ruptures.
In our study, only the Finite Element method is presented to model the Tottori earthquake. A three-dimensional model of the fault was built in ABAQUS® (FEM) where the boundary conditions, such as friction and pre-stress, could be changed to alter the release of energy from the rupture of the fault. These results are then compared to actual data collected from the Tottori earthquake.
Based on these models, seismologists can better predict the energy and duration of seismic events. The more accurate the predictions, the better the community can prepare for these events.

Name: Samantha Slutzky
Program: UGS
School: New Mexico Tech
Group: EES-2
Mentor: Nathan McDowell
Category: Earth and Space Science
Type: Individual Poster Presentation

Investigation of Boundary Condition Impacts on Solutions of the Two-dimensional Incompressible Navier-Stokes Equations with a Buoyancy Source

It is a notorious fact that boundary conditions immensely affect results in computational fluid dynamics. Implementation of different boundary condition types can transform final results drastically. Using a finite differencing model for solving the two dimensional, incompressible Navier-Stokes equations, the diverse impacts of various boundary condition types will be investigated. In these demonstrations, the physical and/or numerical source of problems that inevitably arise when boundary conditions are altered will be examined, and potential mitigation techniques for such boundary condition issues will be tested. In order to examine and assess the boundary condition impacts, an ensemble of simulations is performed and the results are analyzed, visualized, and discussed.

Name: Samantha Stutz
Program:UGS
School: University of Wyoming
Group:EES-2
Mentor: Nate McDowell
Category: Earth and Space Science
Type: Individual Poster Presentation

Assimilation-weighted Gas Exchange Parameters

Theoretical relationships between foliar photosynthesis (A), stomatal conductance (g), transpiration (E), sub-stomatal CO2 (Ci) and carbon isotope ratios (δ13C) are well-developed and form the basis for global carbon cycle modes; however, technical limitations have prevented testing of underlying assumptions. We tested theory underlying prediction of assimilation-weighted A, g and E from knowledge of foliar photosynthetic capacity and δ13C. In a greenhouse study using Ricinus communis (Caster beans), foliar respired δ13C was quantified using Tunable Diode Laser Spectroscopy and applied to calculate Ci, which was then used to predict A from the relationship between A and Ci (A/Ci curve), and subsequently g and E were estimated from A. Results were compared to independent gravimetric estimates. We observed failure of numerous assumptions; however all of these could be corrected with our empirical data. After correction, the theoretical approach to calculating foliar gas exchange was robust. Application of isotopic carbon cycling models must account for errors in these assumptions.

Name: Angela Torney
Program:UGS
School: Stanford University
Group:EES-2
Mentor: Nathan McDowell
Category: Earth and Space Science
Type: Individual Poster Presentation

Carbon Cycle Responses of a Pinon-Juniper Woodland to Drought

The stable carbon isotope ratio of ecosystem-respired CO2 (d13CR) carries a record of the response of ecosystem carbon cycling to climatic variation, including drought impacts. We examined the response of d13CR of a piñon-juniper woodland located at LANL to drought over multiple years. Tunable diode laser (TDL) spectroscopy was used to determine d13CR. TDL spectroscopy allows high frequency atmospheric sampling, and LANL operates one of the only TDL's in the world. Ambient CO2 is a mixture of atmospheric and ecosystem-respired CO2, and ambient measurements can be separated into their two source components through the use of the Keeling plot approach, a two-ended mixing model. The ecosystem-respired d13CR values generated by the model were then compared with parameters associated with drought, including vapor pressure deficit and soil water content measured on-site. Results indicated that drier conditions led to higher d13CR, an indicator of photosynthetic stress. High resolution TDL spectroscopy enables atmospheric sampling and examination of the effects of climate on ecosystems.

Name: Bradley Adams
Program:UGS
School: University of Illinois
Group:ISR-1
Mentor: Jane Burward-Hoy
Category: Engineering
Type: Individual Poster Presentation

Electron Sweeping via Magnetic Field

In the past space-based instrumentation did not have severe weight restrictions. It was common for energetic particle monitors to use large heavy horseshoe magnets with holes bored through one end. These devices cleanly separated different energies of particles. The problem today is particle monitors must be small light and use limited power. For the energies between 20 and 200 keV, particle are measured by a ZPS-hi. Which uses a 7.5 kV stepped bias needing a power supply, is roughly 5000 cc in volume, and weighs approximately 1.2 kg without supporting materials. The proposed solution uses a concentrate magnetic field from a small cylindrical Halbach array to deflect unwanted energies of particles. However, space flight is a rigorous adventure with strong accelerations, so the arrays need to vibration tested to insure flight survival. The arrays are held fast to a plate that connects to a cube on an Unholtz-Dickie vibration exciter. The plate was machined in house and has three different ways the arrays can attach to it. One method of attachment in holding it in a tight fitting bore hole with an internal snap ring, another is by surrounding the array with electreleasing adhesive inside another bore hole, the final method is to adhere it to a half bore on the top of the plate making it easier for removal. The plate is attached to the cube by four ½ -13 bolts and the cube allows for quick easy transfer of axes for the testing. All three principle axes will be tested up to 20g random acceleration. The magnetic field will be tested before and after the vibration to ensure that the magnets did not move out of the array. It is important that stray magnetic fields are minimized, as to not interfere with other instruments on the host satellite.

Name: Bryan Babcock
Program: GRA
School: Colorado School of Mines
Group: SE
Mentor: Dan Pennington
Category: Engineering
Type: Individual Poster Presentation

Coordination Analysis of TA-55 Power Systems

The goal of my project was to perform a coordination analysis of the breaker systems in TA-55. A coordination analysis generates a current versus time plot of electrical equipment. This plot is used to insure that, within a group of breakers, only the most localized breaker to a fault source will trip (the breakers coordinate). This isolates the power outage, insuring other areas on the same main breaker remain operational. This is very important in TA-55, where much of the equipment is vital to the safety of the facility. To perform the analysis I used PowerTools, a power system simulation software package. My first step was to draw the one line diagrams of the power system. Then parameters for each piece of equipment must be entered. An equipment library within the software can automatically generate many of these parameters, given the equipment make/model. Other parameters, such as transmission line lengths, were found in documentation or in the field. Once the necessary data was entered, an arc flash evaluation could also be performed with virtually no additional effort. This evaluation determines the level of arc flash danger on a given piece of equipment and what protection is required when working on/around that equipment. From this data, warning labels can then be printed and placed on the equipment. The result of my project is continued, increased safety to the facility by insuring breaker trip isolation and enhanced personnel protection via the addition of arc flash warning labels on electrical equipment.

Name: Marcus Bailon
Program: UGS
School: New Mexico Institute of Mining and Technology
Group: WCM-2
Mentor: Ray Krause
Category: Engineering
Type: Group Poster Presentation

Name: Stuart Rector
Program: UGS
School: New Mexico State University
Group:AET-5
Mentor: Ray Krause
Category: Engineering
Type: Group Poster Presentation

Helium Leak Test of an Induction Heating Bell Jar Assembly

Preventative maintenance was performed on two vacuum pumps in order to ensure a properly working vacuum system. This system is utilized in numerous processes involved in induction heating. Specifically the bell jar assembly needs a vacuum to the amount of 5X10-6 torr to ensure non-oxidation of high temperature molten metals. Experimentally the bell jar assembly could not attain the proper vacuum pressure, thus leading to further troubleshooting i.e. preventative maintenance on the vacuum pumps and helium leak checks of the bell jar assembly. Once the vacuum pumps were rebuilt with new seals, gaskets, and fluids, enough pressure can be obtained in order to complete a helium leak test. Attached to the bell jar assembly was a separate vacuum pump and helium detector. A helium emitting probe was then used to examine connections and fittings for any possible leaks where helium could enter the bell jar system and be detected. Any leaks found were then sealed and thus proper performance of the vacuum system was attained.

Name: Gregory Baker
Program:UGS
School: New Mexico State University
Group:PPC
Mentor: Nancy Fresquez
Category: Engineering
Type: Individual Poster Presentation

Inventory Managment

All businesses whether privately owned or a large corporations, must maintain accurate inventory. If businesses do not keep track of inventory they do not know when to order new supplies, if they have enough or too many supplies, or if a worker or outside source is stealing their supplies. There are two main methods of maintaining inventory accuracy; the most common is periodic inventory audit, and the other is cycle counting. Periodic inventory audits must be physically counted by a worker to identify the financial value of inventory. The problem with periodic inventory audits is that production is disrupted if not stopped completely during the count and usually not accurate due to inexperienced personnel. Cycle counting is a way to physically count a selected list of on-hand material throughout the year; categorized by its value and importance, usually by the ABC categories. A category is the highest ranked, B in the medium category, and C the lowest category. The most expensive material is A category which is counted more frequently than the B and C categorized material. Cycle counting still requires an individual to physically count the inventory; however the material that is not important or valuable is not counted often, if at all. The advantages of cycle counting are time efficient counting of supplies with little to no loss of production time, due to not shutting down the factory.

Name: Azmat Bhatty
Program: GRA
School: University of New Mexico
Group:AET-5
Mentor: Troy harden
Category: Engineering
Type: Individual Poater Presentation

Sphere Cleanout Robot Programming

Formerly spherical dynamic experiment containers containing radioactive debris were manually cleaned at a specialized glovebox station. This process was time consuming, ergonomically challenging for those who were cleaning the sphere interior, and not as thorough as desired. Currently an improved process that utilizes a 7 degree of freedom robotic arm is under development. This process will use the robot in both teleoperated and automatic modes to assist in cleaning loose debris and fixed contamination from the spheres. Once the loose contamination is removed, the walls of the sphere are automatically brushed to loosen fixed contamination. One major portion of the development work is writing programs to automate the brushing operations. The programs consist of position vectors (along with other robot-specific information) that define four types of moves: linear moves that positions the robot via Cartesian Coordinates, joint moves that control the individual joints of the robot, arc moves in which the robot end-effecter traces an arc, and orbit moves that reposition the elbow of the arm with no end-effecter motion. A combination of these moves results in a “sweep path” of the robot. For this project in particular, the robot entry port and the area immediately surrounding it are to be brushed. The challenge lies with positioning the robot in a manner that brushing can be achieved with no collision or joint limit errors. Initial testing of the program demonstrates that brushing the area in question is feasible.

Name: Joe Blaylock
Program:UGS
School: University of New Mexico
Group:PMT-5
Mentor: Paul Moniz
Category: Engineering
Type: Individual Poster Presentation

Development of a new Pu-238 Heat Standard

Like all materials, working with Plutonium-238 produces waste that must be properly handled and discarded. Unlike standard materials, nuclear waste must be handled by specialized processes and disposed of at a specialized facility. The Waste Isolation Pilot Plant (WIPP) near Carlsbad New Mexico is the final resting place for much of the waste generated by PMT-5, the 238-Pu Science and Engineering Group here at Los Alamos National Laboratory. The TRUPACT-II containers that are used for transporting waste to WIPP have wattage limits to restrict the amount of Plutonium-238 they can safely convey. PMT-5 s waste shipments must be checked against this limit through the use of standards. The size of the standards currently used to characterize waste imposes a limit that is significantly less than that of the TRUPACT-II. Development of a new standard will allow PMT-5 to fit more waste into each drum sent for disposal. This will minimize the number of drums needed to ship and store Plutonium-238 waste at WIPP. PMT-5 decided to develop a new higher wattage standard to achieve greater effectiveness in waste disposal. This new standard will enclose approximately 27 grams of Plutonium-238 and generate 10 watts of thermal energy. The Plutonium-238 in the source will decay and emit alpha particles (helium nuclei) that will collect and build up a significant amount of pressure. This design challenge was met by engineering a primary containment vessel that will survive design basis accident scenarios.

Name: Caroline Bolton
Program: UGS
School: University of New Mexico
Group: RFE
Mentor: Karen Yong
Category: Engineering
Type: Group Poster Presentation

Name: Devin Cardon
Program: UGS
School: New Mexico State University
Group:RFE
Mentor: Karen Yong
Category: Engineering
Type: Group Poster Presentation

Low-Power Tests of Water Cooled RF Loads with Chemical Additives

This paper presents results of low-power radio frequency (RF) absorption tests using ionized cooling water in the 201.25 MHz RF system at LANSCE. Ionized water is used in the 201.25 MHz RF system to dissipate the power absorbed in the load. In the past the RF loads at LANSCE used industrial water that circulated through an evaporative cooling tower. As the water circulated through the cooling tower, it became ionized as a result of exposure to the elements. In addition to ions, dirt and other particulates were mixed into the water. The additional ions due to dirt and particulates absorbed RF power but created a sludge that accumulated and needed to be removed frequently. These cleanings were expensive, time-consuming and abrasive to the system. To eliminate these problems a closed loop system was built to test chemical additives that provided the required ions. These additives needed to meet the environmental requirements for sanitary disposal. During the summer of 2007, tests were conducted using two additives: Corrshield MD 401 made by GE, and WEST C-441 developed by WEST Inc. The 2007 test results showed that both chemicals had good RF absorption between concentrations of 0.04% and 0.1% by weight. Both additives passed the environmental disposal requirements at these concentrations. The manufacturer of WEST C-441 recommended using concentrations between 0.6% and 1.2% for optimum corrosion protection. The experiments were continued in the summer of 2008 using higher concentrations of WEST to determine if higher concentrations can be used. The test results from 2007 and 2008 will be used to determine the optimum concentration to maximize corrosion protection and RF absorption.

Name: Marcus Cappiello
Program:UGS
School: Orgen State University
Group:MST-8
Mentor: Stuart Maloy
Category: Engineering
Type: Individual Poster Presentation

The Effects of Plastic Deformation on Microstructural Development in HT-9 and T-91

Forging and rolling are two plastic deformation methods that can be used to change the properties of materials. In forging, a compressive stress is applied to the material at elevated temperature until the material changes its shape. After forging, hot rolling can be applied to the material. There, the material is drawn through two rollers at a temperature below its recrystallization temperature shaping the material into a sheet to a desired thickness. Forging and the rolling methods were performed on alloy T-91 (9Cr-1Mo) and HT-9 (12Cr-1Mo). Both alloys are ferritic-martensitic steels. After each processing step, these steels were examined using an optical microscope focusing on microstructural differences between the samples. This analysis revealed that grains in the rolled samples were much smaller and more elongated compared to the as cast material (T-91 and HT-9). The grain structure in the cast HT-9 and T 91 showed exactly how each grain grew during the recrystallization period. Also, prior austenite was found in both materials and all states (cast, forged, and rolled, yet in different quantities and formations). After optical analysis, hardness measurements were taken to further examine the different properties of each sample.

Name: Diana Donati
Program:UGS
School: University of Califorina- Davis
Group:INST-OFF
Mentor: Donald Brown
Category: Engineering
Type: Individual Poster Presentation

Strain Rate Dependent Mechanical Properties of Textured Beryllium

In this work, the evolution of mechanical properties, microstructure and texture of beryllium were observed during compression at varying strain rates from 0.0001/sec to 5000/sec to strains of ~20%. Because of their low symmetry, hexagonal metals, such as beryllium, cannot deform solely by dislocation emission and motion, but may accommodate enforced deformation through activation of twinning under certain conditions. We expect deformation twinning to be favored at high strain rates, and this assumption is borne out. By monitoring the texture evolution on the Spectrometer for MAterials Research at Temperature and Stress (SMARTS), the switch of parent to daughter grains is seen through the changes of diffraction peak intensities corresponding to each crystallographic direction. Multiple parent directions (distinct grain orientations) are possible, and the data clearly shows that grains with (100) crystallographic plane normals parallel to the straining direction preferentially twin first.

Name: Benjamin Dozier
Program:UGS
School: Harvard University
Group:AET-6
Mentor: Tom Claytor
Category: Engineering
Type: Individual Poster Presentation

Ultrasonic Imaging of Niobium Targets used in Radioisotope Production

Niobium target capsules used in proton-irradiated radioisotope production have experienced high failure rates in a recent study. When irradiated the capsules are exposed to intense radiation, thermally induced stress, and chemicals for extended periods. The structural integrity of the target capsules is of crucial importance for containing the accelerator-produced radioisotopes. The capsule material needs to be as light and transparent to the proton beams as possible and preferably does not become significantly activated under proton irradiation. In addition, the material needs to be as defect-free as possible. It was not previously known if the isotope producing target material wets the encapsulating material and if it does, to what degree. We show that local areas of wetting occur between the gallium starting material and the niobium capsule. We use high-resolution ultrasonic images from various lots of niobium capsule material to assess the integrity of the capsules, identifying voids and wetting as well surface dents. These results illustrate the utility of non destructive testing in detecting defects that may result in mechanical failures of the capsules during radioisotope production.

Name: Spener Fowers
Program: GRA
School: Brigham Young University
Group:CCS -1
Mentor: Justin Tripp
Category: Engineering
Type: Individual Poster Presentation

Improving AngelFire Using a Real-Time, FPGA-based Feature Tracker

AngelFire is a wide area persistent surveillance system developed for the marine corps. AngelFire uses a bank of six high-resolution cameras mounted inside an airplane to take surveillance images of a wide area. The images from these six cameras are then stitched together, compressed, and transmitted to viewers on the ground. The AngelFire system uses a commercial inertial measurement unit (IMU) to know the orientation of the camera with respect to the ground. This information is used to determine the location on the ground that is being imaged, allowing it to be overlayed onto a three-dimensional elevation map. Although AngelFire is wildly successful, the data could be more useful if the information from the IMU were improved, resulting in more accurate image overlays. If the IMU information has any significant error, it causes apparent movement of inanimate ojbects such as buildings and roads. I developed a feature-tracking system to augment the IMU sensors and improve video quality. This system uses the Harris feature detection algorithm to detect features in an image and track those features over time. The point correspondences between frames are used to develop a transformation matrix containing information on the movement of points from one frame to the next. This transformation matrix is then fed into the AngelFire system to improve the accuracy of the images.

Name: Iris Gallegos
Program:UGS
School: University of New Mexico
Group:PMPP-DO
Mentor: Starr Johnsom
Category: Engineering
Type: Indiviual Poster Presentation

Ergonomic Analysis of Oval Gloveports Versus Round Gloveports Using V5 Delmia Human Software

Traditional round gloveports have been in use at Los Alamos National Laboratory (LANL) since glovebox work was first introduced. Glovebox designers have recently begun work on another type of gloveport, an oval gloveport. Oval gloveports are said to be more ergonomically friendly than that of the round gloveport. LANL Standards have allowed the use of oval gloveports but the design authority desires concrete validation that oval gloveports are indeed more ergonomically viable before introducing oval gloveports. The goal for this project is to produce an ergonomic analysis for a gloveport evaluation. The analysis consists of evaluating the ergonomic efficiencies and degrees of freedom on oval gloveports versus traditional round gloveports. The analysis is conducted using V5 Delmia DPM Human Software. Using American Glovebox Society (AGS) recommendations and LANL Glovebox Design Standards, a machining glovebox is being used in the simulations, which has been modified to the following specifications: Gloveport height of 48 inches simulated with both a centerline of 16 ½ and 18 inches. In addition, a gloveport height of 52 inches will also be simulated with both a centerline of 16 ½ and 18 inches. In order to test whether oval or round gloveports are more efficient the standard tasks of loading a part onto a machine and the cleaning of the glovebox are being simulated. These tasks are standard tests used to determine the efficiency of a machining glovebox. Through anthropometric customization mannequins will be created using the AGS recommendations and Ergonomic Standards. For a multi-user population, the glovebox should be designed to fit a user population ranging from the 5th percentile female through 95th percentile male. During each simulation, the Rapid Upper Limb Assessment (RULA) will also be generating data. RULA is ergonomic technique that evaluates a human's exposure to postures, forces and muscle activities that have been shown to contribute to Repetitive Strain Injuries (RSIs). RULA distributes a score indicating the level of strain and stress on a particular body part. The scores from each simulation will be evaluated carefully to determine the total score for each gloveport (oval and round).

Name: Selina Garcia
Program: UGS
School: New Mexico State University
Group: CTN-4
Mentor: Leonard Valerio
Category: Engineering
Type: Group Poster Presentation

Name: Carl Knauss
Program: UGS
School: Michigan Technology University
Group:CTN-4
Mentor: Bruce Peterson
Category: Engineering
Type: Group Poster Presentation

Name: Jennifer Purdy
Program: UGS
School: University of New Mexico-Los Alamos
Group:CTN-4
Mentor: Denise Lopez
Category: Engineering
Type: Group Poster Presentation

Lifting LANL's Legacy Fiber Plant Limits

To accomplish a complete transition to Nortel Edge switching and Force 10 router fabrics within Los Alamos National Laboratory (LANL), certain infrastructure limitations must be addressed. The primary restriction is the Laboratory's legacy fiber plants, which are 62.5µm multimode (MM) cables over 20 years old, hampering new technology upgrades. To overcome the limitations of the fiber plants and reduce the time, effort, cost and footprints of the upgrades, a new product MRV-MMX or MRV Multimode Extenders are being considered. These modules from MRV Communications Inc. will extend the 550 meter limitation placed upon Gigabit Ethernet (over 62.5µm MM cable) by 3-5 times. We are conducting cost/benefit analysis, evaluating fiber footprints, and conducting field tests in two phases to ensure that the MRVs are reliable, capable, and up to LANL standards. Phase I was to confirm that the MRV-MMX modules are able to operate within the company's stated specifications. Phase II was to stress test the documented limitation of the MRV-MMX across the circuit at distance of 2.562km. Concluding the field test and studying the results, it is recommended that this technology be adopted by LANL. Judging from the overall throughput of these devices and their costs versus that of upgrading the existing fiber plant, these modules hold the potential to save LANL hundreds of thousands of dollars or more. The MRV-MMX modules will also extend the life of the existing multimode fiber plants an additional 3-5 years. These interfaces are cost effective and will greatly reduce the planning, design, and labor associated with network upgrades.

Name: David Geb
Program:UGS
School: University of California-Los Angeles
Group:C-CDE
Mentor: Torsten Staab
Category: Engineering
Type: Group Poster Presentation

Name: Justin Marshall
Program:UGS
School: Tuskegee University
Group:C-CDE
Mentor: Torsten Staab
Category: Engineering
Type: Group Poster Presentation

A Micro-Fluidic Flow-Control Mechanism for DNA-Based Clinical Diagnostics

The development of a disposable test cartridge for DNA-based clinical diagnostics will afford a better alternative to current protein-based tests. DNA-based clinical diagnostics is significantly more accurate than the protein-based alternative. Moreover, a cheap, effective, disposable test cartridge will allow this technology to be accessible to more patients throughout the world. In order for the proper bio-chemical reactions to take place inside this handheld cartridge, an effective micro-fluidic flow-control mechanism is needed. This mechanism must be reliable, cheap, and controlled by a microprocessor. In particular, a micro-fluidic valve must be developed. One method of creating this valve involves the use of a shape memory alloy (SMA) as an actuator. Shape memory alloys can be smaller and cheaper than motors or solenoids capable of the same amount of work. A NiTi alloy known by the commercial name Flexinol is the preferred SMA for this application. When powered electrically it heats up due to its internal electrical resistance and contracts, when allowed to cool it elongates back to its original position under a bias force. The challenge is to obtain reliable and repeatable results when using these novel materials as actuators controlling a valve. Currently, prototype models are being developed and the abilities of SMAs in different valve mechanisms are being observed. After a functional and reliable flow-control mechanism is developed and the rest of the "Dip Stick" is completed, a user-friendly, affordable, and accurate device will be the result. Its technology will provide a solution for clinical diagnostics in the field and in physician offices worldwide.

Name: Paul Gibbs
Program: GRA
School: Colorado School of Mines
Group: MST-6
Mentor: Deniece Korzekwa
Category: Engineering
Type: Group Poster Presentation

Name: Cameron Knapp
Program: UGS
School: San Diego State University
Group:MST-6
Mentor: Deniece Korzekwaaestas
Category: Engineering
Type: Group Poster Presentation

A Comparison of Two Mold Designs for Uranium Casting

Computer simulations were run to compare two mold designs for use in the manufacture of a cast uranium hemisphere. The initial mold design places an emphasis on generating a high thermal gradient across the solidifying part to promote bottom to top solidification, and uses a stack design that has been shown to work effectively in the LANL foundry. Test castings of this design were performed by the MST-6 Foundry Team to confirm the validity of the model. The second design incorporates a stabilizing ring to support the crucible during loading and heating. It was thought that this new design would heat soak and not promote bottom to top solidification of the part. The Truchas code, developed at LANL, was used to run induction heating and solidification simulations. The casting characteristics of the two designs were compared to determine the most effective casting condition.

Name: Jorge Guerra
Program:UGS
School: New Mexcio State University
Group:INP-SMS
Mentor: Mark Dinehart
Category: Engineering
Type: Individual Poster Presentation

TRU Waste Facility Interim Alternatives Project

The Solid Transuranic (TRU) Waste Facility (WF) Interim Alternatives Study Project identifies the activities required to develop a set of alternatives to the current scope of the TRU WF project. The project is currently designed as a new facility to be constructed at TA-52. The project will enable LANL to meet the requirements of the New Mexico Environment Department (NMED) Consent Order for Area G closure at TA-54. The alternatives selected for consideration are dependent on a number of strategic decisions for interim waste management of all hazardous and radioactive wastes until the new facility is completed. To properly consider the interim alternative configurations for this project, requires validation of the basic design inputs such as anticipated volumes and capacities. There are many interim alternatives being considered including extending the lifetime of existing waste processing facilities like RANT and WCRRF, using temporary facilities on LANL property, or leasing space to a private company to complete the project under an NRC license. This project will evaluate these different alternatives, select a subset for further evaluation, and provide a recommendation for management consideration.

Name: James Gurule
Program:UGS
School: New Mexico State University
Group:MST-6
Mentor: Deniece Korzekwa
Category: Engineering
Type: Individual Poster Presentation

Volume Minimization and Inventory Reduction of LANL's Classified Parts

Here at LANL we have many classified and sensitive parts. In addition, there are costs associated with storing these parts. To lower the cost of storage and minimize the classified inventory, DOE is moving to minimize the total volume. MST-6's Machining and Foundry team has been tasked with minimizing the volume and declassifying these parts.

The best method to consolidate and declassify miscellaneous parts is to melt them. Although melting is a great method, scientists have been faced with problems of economic efficiency and material behavior. Because many parts are made up of different materials, one of the tasks was to determine which parts could be melted together and which parts should be melted alone. Lower melting point materials can be melted together to reduce heating and cooling times and energy costs. Also, certain high melting point materials can be melted together to lower the overall melting point.

Another problem with melting is preserving reusable hardware. High temperature graphite crucibles are used to melt parts, then emptied, and reused. The diverse materials reacted differently with the graphite. Coatings are put on the graphite to prevent the metal from bonding with the crucible. The crucibles used for stainless steel melts require an aggressive layer of coating, while crucibles used for copper or aluminum only need a thin layer of coating. By melting the parts LANL can minimize the total volume while reducing the classified inventory.

Name: Timothy Haines
Program:UGS
School: New Mexcio Tech
Group:INP-SMS
Mentor: Mark Dinehart
Category: Engineering
Type: Individual Poster Presentation

Mechanical Aspects of Thermal Storage System

The Radiological Laboratory Utility and Office Building (RLUOB) is a vital element of the Chemistry and Metallurgy Research Replacement Project (CMRR). RLUOB is currently in construction and once it is completed will be used for by Los Alamos National Laboratory for at least 50 years. This new building will house nearly 20,000 square feet of radiological laboratory space, office space for 350 personnel, as well as a training center. All of this space will be kept cool by a thermal storage system that uses dramatically less energy than a conventional cooling system. Using large ice tanks to store thermal energy allows the system to consume very little electrical energy to cool the building during the day. The system uses electrical energy during the night to allow the ice storage tanks to refreeze in preparation to cool the building the next day. Using electrical energy during non peak hours allows the building to receive energy at a fraction of the price in comparison to peak hours of operation.
Not only is the system exceedingly more energy efficient but it is also more environmentally friendly. The chillers, located on the roof of the building, do not use the common refrigerating element R22 Freon. R22 is harmful to environment because it breaks apart ozone molecules in the atmosphere. The chillers that are being used for the RLUOB use hydrofluorocarbons as chemical refrigerants. The hydrofluorocarbon used for these chillers is R-134a, a chemical compound that does not deplete the ozone.
These factors will help RLUOB earn a U.S. Green Building Council LEED certification for new construction. A LEED Certification for new construction is designed to guide and distinguish buildings with exceptional energy conservation and low environmental impact.

Name: Jonathan Height
Program:UGS
School: New Mexico State University
Group:HPC-2
Mentor: Michael O'Neill
Category: Engineering
Type: Individual Poster Presentation

Facilities Management

A great deal of important research occurs within the facilities of the laboratory. Facilities need a wide array of support in order to conduct research efficiently. This support can come in many forms such as cryogenic gases or air conditioning and heating systems.
Cryogenic gasses, for example, are used throughout the laboratory in a variety of experiments, and many times in small quantities. Since gas shipments come on large trucks, a gas plant was constructed to help facilitate the needs of the various orders. This plant includes tanks, pumps, and filling stations. An extensive knowledge base is required to properly engineer the piping systems within this gas plant and account for all of the usual plumbing factors in addition to site specific factors like insulating the pipes to prevent heat exchange or shrinking and constricting of the metal pipes due to the cold nature of the liquid gasses. Vibrations due to the reciprocating pump also need to be considered, as well as the different materials used and how each reacts (independently and collectively) when exposed to severe cold.

Name: Brandon Herrera
Program:UGS
School: New Mexico State University
Group:ES-SE
Mentor: Ronald Aguilar
Category: Engineering
Type: Individual Poster Presentation

PF-4 Trolley Research & Documentation Compilation

Equipment Data Books (EDB's) are used to organize information concerning a particular piece of equipment, material or system used in a work environment. Comprehensive indexing and detailed organization of documents, facilitates the use for an engineer, technician or anyone interested in obtaining information about a particular system, easy access to the material. Over the years, the trolley system at TA-55 PF-4 has undergone various repairs, maintenance updates, and new installation protocols, that have resulted in documentation (design schematics, work orders, incidents etc.) becoming highly unorganized and/or being scattered over multiple Technical Areas. Detailed compilation of trolley related information into an EDB was needed. Technical engineering research was conducted at TA-55 to document how the system has evolved and what parts/components have been amended or replaced. Detailed diagrams and schematics (as well as various forms of media) of PF-4 (Area 100, 200, 300 & 400) were obtained. These were used to illustrate the orientation and layout of the trolley system. Mechanical, structural and electrical system and subsystem documentation was obtained via the TA-50 ARTIC archival records room, as well as other available sources. This information was then indexed and recorded. Both a hardcopy and electronic version of the EDB were created. Finalizing the EDB for the trolley system will be a valuable asset to those given the task of maintaining and troubleshooting the PF-4 trolley system.

Name: Cameron Howard
Program:UGS
School: University of Nevada- Reno
Group:WT-11
Mentor: Steve Paglieri
Category: Engineering
Type: Individual Poster Presentation

He-3 Permeability of Inertial Confinement Fusion Targets

Fused silica Inertial Confinement Fusion (ICF) targets having a diameter of 1.1 mm and a wall thickness of 0.005 mm were first filled with 5-9.5 atm of deuterium-tritium (DT). Each ICF target was then filled with 1-5 atm of 3He and opened under vacuum in a vacuum chamber of known volume. As 3He began to permeate the ICF target wall and expanded into the system, the pressure of the evacuated system increased linearly. However, as 3He continued to permeate the target wall, the pressure rise in the system became non-linear. The permeability of each ICF target was calculated by numerically solving two differential equations simultaneously. One of the equations represented the pressure increase in the system and the other represented the pressure decrease in the target. The experimental results were compared with similar fused-silica targets that were measured in 2007. An overview of the 2007 ICF campaign conducted at the OMEGA laser at the University of Rochester, Laboratory for Laser Energetics (LLE) will also be presented.

Name: Andrew Krause
Program:UGS
School: University of New Mexico-Los Alamos
Group:AET-5
Mentor: Kurt Beckman
Category: Engineering
Type: Individual Poster Presentation

Preventive Maintenance Programs for Pit Manufacturing Equipment

There are approximately 250 systems involved in the production of nuclear weapon warhead pits. These systems must function properly in order to meet the current LANL goal of manufacturing ten pits per year. The Preventative Maintenance Programs (PMPs) allow routine maintenance to be performed on the systems critical to pit production, and ensure that the systems will perform properly while in use. Developing PMPs for each system ensures that sufficient funding is available to properly maintain equipment essential to meeting LANL pit production goals. The process of developing PMPs has been standardized so that every PMP is in the same format. This helps to ensure that personnel can easily understand exactly what is required to properly perform preventive maintenance on many different systems. This, in turn, guarantees the reliability of the equipment critical to making the pits.

Name: Maria Leyva
Program:GRA
School: New Mexico State University
Group:PMT-2
Mentor: Cynthia Kowalczyk
Category: Engineering
Type: Individual Poster Presentation

Use of Extend Software to Model the Plutonium Recovery and Discard Processes

Besides proliferation concerns, the recovery of plutonium is in the best interest of society due to its environmental, economical and health characteristics. PMT-2 leads the efforts of safely and efficiently processing plutonium and other actinide compounds to meet national program requirements while expanding the scientific understanding of actinide science and producing the next generation of nuclear engineers and scientists. By doing this, it reduces the need to dispose of plutonium residues to Waste Implementation Pilot Program (WIPP), which is costly and not eco-friendly. The recovery of plutonium in pyrochemical salts is done by a number of processes in the Experimental Chloride Extraction Line (EXCEL) in Room 420. Previous work was done on modeling the plutonium recovery and discard processes to select the optimal condition regarding waste, cost and dose.
Extend, which is the simulation software that aids in developing dynamic models of real-life processes in a wide variety of fields, was used to create the first process simulation ten years ago. It was used to change assumptions to arrive at an optimum solution. The development of a technical rationale for determining when residues could be considered unattractive for proliferation purposes, and establishing plutonium-concentration based discard ceilings of unimmobilized residues and richer discard ceilings for immobilized waste forms was essential on finding the optimal condition.
The purpose of this project is to update the simulation in the newest version of the Extend in order to continue optimizing the aqueous chloride processes and to help identify critical parameters of the Chloride Line Extraction and Actinide Recovery (CLEAR) glovebox line, which should come online in FY09. The implementation of the CLEAR Line is expected to drop the generation of the caustic transuranic waste generated by EXCEL by more than 90 percent by recovering the actinides (americium and plutonium) in the waste stream.

Name: David Logan
Program:UGS
School: Georgia Institute of Technology
Group:PMPP-DO
Mentor: Dann Alison
Category: Engineering
Type: Individual Poster Presentation

Plutonium Facility Ventilation Simulation

A ventilation system is a critical safety system in a plutonium facility. Failure of this system can place lives, environment, and capital assets at risk. It is necessary to ensure that the ventilation system can maintain integrity and continue operation in various situations. Mapping of this system, using a simulation software package called CONTAM, will establish a baseline for simulation efforts and other "what-if" scenarios. The system has been partially completed with another simulation software, but after discussions with Savannah River the use of CONTAM was deemed more advantageous for this project. The mapping of the North Basement in PF-4 was chosen to be a summer student project. The goal of this project is to provide a simulation module that will support the TA-55 system engineers. In order to map the ventilation system, one must familiarize himself with the system through System Design Documents, AutoCAD Drawings, and fan performance curves. Once the entire mapping is complete, the first level and the entire basement, the simulations can be run to produce accurate results. Due to limited time, the final result of this summer student project would be the initiation of the mapping of the entire facility in CONTAM in order to ensure the integrity of the system.

Name: Erlinda Medina
Program:UGS
School: New Mexico State University
Group:RP-2
Mentor: Jim Bland
Category: Engineering
Type: Individual Poster Presentation

Aerosol Deposition on the Detector Face of the Thermo-Fisher Alpha-7 Continuous Air Monitor

The Thermo-Fisher Alpha-7A Continuous Air Monitor (CAM) is used in LANL (Los Alamos National Laboratory) facilities to provide early warning to workers exposed to airborne releases of alpha-emitting radionuclides in order to reduce the internal dose that would be inhaled. LANL currently has 300 Alpha-7 CAM samplers (valued at $10,000 each) in operation. However, there are "ghost peaks" seen in the instrument alpha-energy spectrum, which is related to deposition of aerosol particles onto the instrument detector face. These "ghost peaks" affect the computational software algorithm for providing safety alarms for LANL employees.

To measure the amount of aerosol deposition the Thermo-Fisher CAM will be tested in the Aerosol Engineering Facility wind tunnel at LANL. Additionally, a CAM sampler manufactured by the Bladewerx company will be evaluated. The Bladewerx CAM sampler has a similar air inlet design to that of the Thermo-Fisher. However, the Bladewerx company modified the air flow path of their inlet design (with a trial and error method, coupled with an amount of basic airfoil-performance knowledge) to eliminate the "ghost peak" phenomenon. With the information gathered from this present study, coupled with a possible computational effort, a manageable retrofit for the Thermo-Fisher unit will be attempted.

Name: Joshua Monson
Program: UGS
School: Brigham Young University
Group: ISR-5
Mentor: Zachary Baker
Category: Engineering
Type: Individual Poster Presentation

Frequency Triggering of a Snapshot Recorder

While performing experiments scientists are often required to sift through large amounts of uninteresting data waiting for a brief event. When utilizing a constant stream of data an effective method for sifting is an event triggering scheme. The data stream is constantly monitored and a snapshot recorder is activated when the trigger conditions are met. For instance, a frequency trigger activates the snapshot recorder based on the power of the desired frequency bands
Field Programmable Gate Arrays (FPGA) are devices composed of thousands of repeated functional tiles. They can be programmed to implement any functionality including Signal Processing. The core of many Digital Signal Processing applications is the Fast Fourier Transforms (FFT); which is the main component of the Frequency Trigger.
An effective frequency trigger is able to detect and activate on small signals in noisy environments. The trigger's ability to detect small signals can be enhanced by increasing the number of samples in the FFT. However, increasing the size of the FFT can be costly. Since FPGA resources are limited it is important to know the cost of incremental improvements in performance.
By varying the sample size of the FFTs the frequency trigger's ability to detect highly attenuated input signals can be compared to the number of hardware resources used by the frequency trigger. This process yields a resource cost versus performance benefit curve indicating the optimal size for the FFT.

Name: Kyle Nekimken
Program:UGS
School: California Poyltechnic State University
Group:RP-2
Mentor: Murray Moore
Category: Engineering
Type: Individual Poster Presentation

Dynamic Alpha Particle Source

At Los Alamos National Laboratory, the use of continuous air monitors (CAMs) is vital for ensuring safe working conditions in environments containing radioactive material. To provide optimum performance for the detection of airborne radioactive contamination, CAMs must be properly designed and evaluated. In the past, a portion of the design and evaluation required expensive tests at a facility capable of generating diagnostic plutonium aerosols. Downsides to this procedure include a cost of about $10,000 per test and a complex testing arrangement because of the dangers associated with airborne radioactive particles.

With the development of a dynamic alpha particle source (DAPS), it will be possible to perform bench-top testing for CAM design and evaluation. The DAPS simulates the time-varying behavior of accidental releases of plutonium aerosol into gaseous environments that are characteristic of both chronic and puff release scenarios. In a recent (not yet published) evaluation by LANL, an electroplated source was placed at the filter location in two different CAM samplers. Visual observation of the alpha energy spectrum during these tests indicated that the CAMs should have alarmed much sooner than they actually did. To improve the design and evaluation of CAM systems, software developers can use the DAPS system to validate new detection algorithms.

After an application for US and foreign patent rights, it is expected the DAPS could be marketed for approximately $2,000. Since it is a reusable system and can be safely operated without special protection, the DAPS system would facilitate major advancements in CAM sampler performance.

Name: Michael Nelson
Program:UGS
School: Rice University
Group:AET-1
Mentor: Gretchen Ellis
Category: Engineering
Type: Individual Poster Presentation

Building Spare Drift Tubes for the LANSCE-R Project

Many projects at LANL depend on the linear accelerator at the Los Alamos Neutron Science Center (LANSCE). These include stockpile stewardship, condensed matter neutron scattering, fundamental physics, performance of semiconductors exposed to neutrons, and proton radiography. The LANSCE-R project is an effort to manufacture a set of spare drift tubes for the accelerator; the original drift tubes may be nearing the end of their operational lives and no spares exist. The sole literature pertaining to the manufacture of the original drift tubes is a lab notebook and a paper (LA-4276) written by two former employees who worked on the project, and scans of original engineering drawings of parts made for the drift tubes. The main elements of this project are: to reformulate the potting cement so that it can withstand the temperatures required to braze the outside of the drift tube body; to convert the drawings of parts into CAD models for possible redesign; to remake the tools needed for assembling the magnet coil windings for the drift tubes; to fabricate the actual drift tube bodies; and to braze the outside joints of the drift tubes and have them leak-checked. Completion of the LANSCE-R project will allow the linear accelerator at LANSCE to function well into the future and continue to perform important experiments in fields vital to national security and stockpile stewardship, among others.

Name: Michael Pugh
Program: UGS
School: New Mexico State University
Group:HPC-2
Mentor: Edmund Waite
Category: Engineering
Type: Individual Poster Presentation

Rotary Uninterruptible Power Supply

The need for clean, safe, and reliable power is a must for high performance computers. Feeding equipment with power straight from the main utility line simply will not do. The solution to this problem is to power the equipment from a source such as a rotary uninterruptible power supply (RUPS). A RUPS unit will be able to provide a clean sine wave of power through many common problems such as a power failure, spike, or sag. When using a RUPS unit, power is fed from the utility line to the RUPS. A pony motor turns a large flywheel within the unit which stores rotational energy to feed the equipment that needs clean power in case a problem occurs with the utility power. The RUPS is able to do this because a voltage spike or sag will not have a significant impact on the rotation of the flywheel. If power completely goes out, the RUPS will be able to power the equipment for a brief period of time until the flywheel slows down. As long as a major power failure does not occur, the RUPS will be able to provide the reliable power needed by the equipment.

Name: Dana Rand
Program:UGS
School: New Mexicos State University
Group:AET-5
Mentor: Laura Cartelli
Category: Engineering
Type: Individual Poster Presentation

Temperature Monitoring and Control System

Certain gloveboxes in TA-55 PF-4 must be kept at a specific temperature in order to keep sensitive measuring equipment within specifications. In past years one particular room containing gloveboxes has been in and out of regulation. In order to keep these gloveboxes within specifications, the Induction Heating Team is currently introducing a temperature monitoring and control system. To monitor the temperature, resistance temperature detectors (RTD's), which have very high accuracy, are being used to take temperature measurements. These RTD measurements will be run through signal isolators which convert the temperature signal to a current signal for noise immunity. The signals are then recorded with a data logger at desired intervals and displayed as temperature readings. Thermoelectric coolers (TEC's) will be attached to the outside of the gloveboxes in order to maintain the inside temperature at the desired value. The TEC's are turned on by a process controller when a pre-programmed temperature has been reached. Various room and equipment temperatures are currently being recorded, and the final system design will be documented and installed in the next few weeks.

Name: Jesse Reynolds
Program:UGS
School: West Texas A&M University
Group:PMT-2
Mentor: Cynthia Kowalczyk
Category: Engineering
Type: Individual Poster Presentation

Reconfiguring the Piping in the Chloride Line Extraction and Actinide Recovery (CLEAR) Glovebox Line in Room 420

The Chloride Line Extraction and Actinide Recovery (CLEAR) gloveboxes were initially designed to reduce activity levels in the waste stream by extracting the actinides (plutonium, americium, and uranium) out of the waste stream. Recently, with the increase in demand of Am from the oil/gas logging operations, Am is a viable marketing element in which LANS could pair up with private industry companies.

The CLEAR line is a set of three gloveboxes that was placed in Room 420 in the early 1990's. The premise for the line is to process the solvent extraction raffinate (waste stream) through the gloveboxes to (a) reduce the activity level of the stream in the finished state, (b) recover the americium that would be captured on the extraction chromatography columns and (c) reduce worker dose. The implementation of the CLEAR Line is expected to drop the generation of the caustic transuranic waste generated by Experimental Chloride Extraction Line (EXCEL) by more than 90 percent by recovering the actinides (americium and plutonium) in the waste stream.

The purpose of this project is to aid in the reconstruction of the CLEAR glovebox piping and configuration so that Room 420 personnel can prepare the Management Self-Assessment (MSA) documents and eventually, in FY09, use this glovebox line. Throughout the years, piping and valves were removed, leaving many lines without clear routing of its original purpose. Reviewing past P&IDs were required and then evaluating them with room personnel were vital in order to determine current operational requirements. The objective was to use all input in order to maximize the effectiveness of the CLEAR glovebox line's mission.

Name: Ricardo Rivera-Lopez
Program:UGS
School: Universidad del Turabo
Group:RP-2
Mentor: Murray Moore
Category: Engineering
Type: Individual Poster Presentation

ASME HEPA Filter

The ASME (American Society of Mechanical Engineers) Committee on Nuclear Air and Gas Treatment (CONAGT) has requested assistance from the LANL Aerosol Engineering Facility. In particular, the ASME AG-1 2003 Code on Nuclear Air and Gas Treatment is inconsistent in its use of SCFM (standard cubic feet per minute) and ACFM (actual cubic feet per minute) when designating air flow rate through HEPA (High Efficiency Particulate Air) filters. The CONAGT committee drafted a test plan to reconcile these inconsistencies, specifically to correct the measurement errors that result when the numerical value for the filter air flow is held at a constant ACFM value or SCFM value under differing temperature and pressure conditions.

The proposed experiments would determine HEPA filter performance under controlled conditions. At LANL, the experiments would measure the pressure, temperature, flow and filter collection efficiency values at 7300 feet altitude, and the results will be compared with those from a sea-level facility in Maryland. Analysis of these results will help formulate correction factors for HEPA filter operation under various conditions.

A consistent procedure should be obtained which would replace the flawed portions of the ASME AG-1 Code. This work is necessary for the nuclear air community because it defines a consistent method for the designation of HEPA filters and removes the errors in nuclear air cleaning applications.

Name: Aaron Robinson
Program:UGS
School: University of New Mexico
Group:PMPP-PPC
Mentor: Nancy Fresquez
Category: Engineering
Type: Individual Poster Presentation

Benefits of SharePoint in Manufacturing Configuration Management

Configuration management systems may contain a great deal of data and documents that need to be organized and managed as efficiently as possible. While network shared drives are simple to implement, methods that utilize network shared drives are time consuming and prone to error. By nature the network drive approach provides little organization as each time a document is revised or edited the whole file must be uploaded with the new version included in the name. Almost everything done on network drives, from uploading to approval, requires the user to complete manually. Using Microsoft Office SharePoint Server 2007 software will help to streamline the process and ensure the accurate maintenance of data. SharePoint servers are designed to streamline business processes and contain many customizable features and tools that can automate many difficult business processes. Automated workflows, version histories, and alerts are just a few of the benefits that SharePoint brings to manufacturing configuration management by allowing users the ability to more effectively edit and manage documentation. SharePoint optimizes many aspects of configuration management more effectively and provides stronger data integrity than the utilization of network shared drives for processes that require configuration management.

Name: Tanner Ruf
Program:UGS
School: University of Nevada- Reno
Group:PMT-1
Mentor: Laura Worl
Category: Engineering
Type: Individual Poster Presentation

X-Ray Diffraction of Hygroscopic Salts found in Impure Pu Oxides Stored in 3013 Containers

The DOE 3013 storage standard requires nested, welded 300 series stainless steel containers to store plutonium-bearing materials for up to 50 years. The packaged contents include stabilized plutonium-bearing residues that could contain mixtures of chloride salts including Na, K, Mg, and possibly Ca with up to 0.5 weight % moisture content. These chloride salts can exist in both binary and ternary phases that are very sensitive to humidity and hydrating to the point of deliquescence is some cases. Studies of these containers in small scale experiments have shown that hydrogen gas generation as well as corrosion (pitting and stress corrosion cracking), are occurring in certain conditions. The determination of the salt composition and phases present as a function of relative humidity will lead to a better understanding of the condition of the large stockpile of these 3013 containers from numerous sites. X-ray Diffraction studies will be performed under controlled conditions at specific relative humidities to determine the salt phase present. These samples have been prepared in an inert glove box and kept in an environmental chamber for X-ray diffraction analysis. Comparing the XRD patterns from the anhydrous to the highest subjected humidity will allow the determination of the change in crystal structure as the salts hydrate.

Name: Justim Simpson
Program:UGS
School: University of New Mexico
Group:RP-2
Mentor: Murray Moore
Category: Engineering
Type: Individual Poster Presentation

SabreECAM Type Testing

In late 2007, Los Alamos National Laboratory purchased fourteen SabreTM ECAM (Environmental Continuous Air Monitors) air samplers from the BladewerxTM Corporation (Rio Rancho, NM) The project described here will perform conformance testing on these air sampling devices according to the ANSI N42.17B-19891 technical standard. This testing will determine the suitability of these air samplers for regular usage at Los Alamos.

According to the ANSI N42.17B-1989 standard, instruments that monitor for airborne radioactive contamination must satisfy certain operational and technical requirements. These include air sampling capability; power, electronic, and alarm capabilities; radiation and interfering responses; and environmental factors including temperature, humidity, and ambient pressure.

In this effort, the ANSI standard was examined and most of the necessary tests and checks were performed to certify that the system meets these standards. The internal customer (LANL Group WES-EDA) did not require execution of all of the tests mentioned in the ANSI standard. This CAM (Continuous Air Monitor) satisfies many of the requirements, but it possesses some deficiencies. Current work is being performed with a non-approved radioactive check source, and some tasks will be repeated at a later date upon receipt of an approved radioactive calibration check source.

(1) ANSI N42.17B-1989 (American National Standard Performance Specifications for Health Physics Instrumentation-Occupational Airborne Radioactivity Monitoring Instrumentation)

Name: Bryan Steinfield
Program:GRA
School: University of Texas-Austin
Group:AET-5
Mentor: Troy Harden
Category: Engineering
Type: Individual Poster Presentation

Design & Implementation of a User-Friendly Robotic Controller

As part of the CVD project, a customized Robotics Research K-1207 manipulator is being developed to clean spherical dynamic experiment containment vessels. The robot will be used to perform debris removal operations, sampling operations, and brushing of the sphere. Debris are removed from the sphere into an attached glovebox workstation. The current robot controller is complex and requires extensive training to operate efficiently. In order to improve efficiency and reduce the likelihood of damaging the manipulator, simpler control software designed for operators with minimal training and little to no robotics background needs to be implemented. The software developed streamlines the user interface, allowing for minimal confusion and operator error while conducting typical operations for the CVD project. It automates the process of safely returning the manipulator to a dextrous pose and a predefined 'home' position. In addition, a model-based collision detection algorithm developed at the University of Texas-Austin is implemented in order to check for collisions between robot joints and between the manipulator and the containment vessel.

Name: Michael Unzueta
Program:UGS
School: University of New Mexico
Group:AET-5
Mentor: Ernest Salazar
Category: Engineering
Type: Individual Poster Presentation

Glovebox Temperature Distribution Test

Gloveboxes are used in Los Alamos National Laboratory's (LANL) PIT Manufacturing Program for performing hazardous tasks and are also crucial in providing protection for plutonium facility workers. One important element within gloveboxes is temperature. Glovebox temperatures are usually important for assisting in the control of processes being done inside the glovebox. My experiment is designed to test the ability of a stationary cooling point outside the glovebox and its effect on temperature distribution throughout the interior of the glovebox. A variety of atmospheric situations were tested in an effort to gather accurate data while also testing the ability of the cooling source in most situations one would encounter while using a glovebox. The usage of thermocouples being read by a Yokogawa Temperature Recorder throughout the glovebox assisted in measuring temperatures in different areas of the within the glovebox. Data was collected and compiled.

Name: Aaron Welsh
Program:GRA
School: Pennsylvania State University
Group:WCM-2
Mentor: Matthew Bement
Category: Engineering
Type: Individual Poster Presentation

Improving a Turning Process Using Piezoelectric Actuators and Ultrasonic-Assisted Machining

Historically the manufacturing of parts with precision finishes has been broken into separate processes: first machining is performed with mills or lathes to create overall shapes and then grinding and polishing is performed to create the desired surface finish. In some cases, additional processing to improve surface finish quality after machining, such as grinding or polishing, are either not feasible or are not cost-effective. The focus of this research is on development of improved turning processes which use active vibration control and ultrasonic assisted machining (USM) methods; both of which are capable of improving surface finish quality in a facing operation. The first method employs a high bandwidth piezoelectric actuator with adaptive positive position feedback control algorithms for vibration control and chatter reduction. The second method explores ultrasonic assisted machining, where a standard turning process is transformed into a high frequency vibro-impact process with the use of piezoelectric stack actuators. The performance of these methods is evaluated in facing operations on metal workpieces. The resulting surface finish will be measured using non-contact profilometry, and the results from each test will be compared to a control run using a standard setup.

Name: Nicholas Wulf
Program:GRA
School: University of Florida
Group:CCS-1
Mentor: Justin Tripp
Category: Engineering
Type: Individual Poster Presentation

Image Tiling, Reduction, and Compression at 600 Million Pixels Per Second Using FPGA Based Hardware

AngelFire is a wide area persistent surveillance system developed for the marine corps that uses six high-resolution cameras mounted on an airplane to surveil a wide area on the ground. The current system requires several large power hungry computers to process image data. In order to reduce the power, size, weight, and heat of the current system, a new design based on FPGA hardware processing has been proposed.

The Tiling, Reduction, and Compression project is one of several that will all come together in the end to form the new FPGA based AngelFire system. This project is broken into two parts. The first part needs to be able to receive 156 million pixel packets per second, each of which comes from one of six different images. Each of these packets contains the intensity values of four pixels as well as where to place them. The system uses this data to fill a large bitmap which is effectively the composite of all 6 original images. The second part of the design is responsible for taking the composite image from memory, running it through JPEG compressors (designed by my mentor), outputting the compressed data, and then reducing the image to a fourth of its original size. With the new smaller image, the compression/reduction process repeats 5 more times. The final result is an output of six JPEG compressed images based on the original composite image and at lesser and lesser resolutions.

Name: David Bizzozero
Program:GRA
School: University of New Mexico
Group:AET-2
Mentor: Joseph Fasel
Category: Mathematics
Type: Individual Poster Presentation

Faster-than-Light Electromagnetic Sources

Laboratory experiments have shown that superluminal (i.e. faster-than-light in vacuo) electromagnetic sources exist and can be modeled by the three-dimensional wave equation. This phenomenon is the result of patterns of electromagnetic radiation or currents that travel superluminally. The radiation emitted from such sources is subject to the same effect that occurs in sound sources moving supersonically in a medium. By special relativity, these electromagnetic sources cannot be used to transmit information superluminally but can be created by overlapping subluminal (i.e. slower-than-light in vacuo) sources in a controlled pattern that emulates superluminal motion. Of particular interest is the case where a source accelerates from slower-than-light to faster-than-light speeds, and thus creates a shockwave analogous to a sonic boom as the source exceeds the speed of light. This emission process can be applied to various astrophysical models such as pulsars and gamma ray bursts and potentially other systems where an emitting wave pattern travels faster than the wave speed.

Name: Jeffrey Haack
Program:GRA
School: University of Wisconsin-Madison
Group:CNLS
Mentor: Robert Lowrie
Category: Mathematics
Type: Individual Poster Presentation

The Parity Splitting Formulation for the P_N Approximation of Transport Equations

The P_N equations describe neutron and photon transport in a material medium.Numerical simulations of these equations with conventional methods in collision-dominated regimes have issues with stiffness and excessive numerical dissipation. To alleviate these issues we derive the P_N equations from a parity form of the underlying transport equation, which suggests a straightforward splitting that separates the fast and slow behaviors and provides structure for efficient numerical simulation. Furthermore, the resulting scheme captures the proper diffusion limit in collision-dominated regimes.Results are shown for linear neutron transport equations and nonlinear radiative transfer equations.

Name: Jude Oka
Program: UGS
School: University of New Mexico
Group:MQ-2
Mentor: Marvin Montoya
Category: Non-Technical
Type: Group Poster Presentation

Name: Douglas Sahm
Program: UGS
School: University of Illinois
Group: MQ-2
Mentor: Marvin Montoya
Category: Non-Technical
Type: Group Poster Presentation

Gap Analysis between the Weapons Quality Assurance Program Production Agency and the Manufacturing Administrative Procedures

The Department of Energy (DOE) has a contract with Los Alamos National Laboratory (LANL) which essentially is the agreement between DOE and LANL governing how the lab must be operated. The Production Agency Weapons Quality Assurance Program (WQAP-PA) was written to describe how LANL fulfills the requirements in the Weapons Quality Policy QC-1(DOE policy related to weapons manufacturing). A series of Manufacturing Administration Procedures (MAPs) were written to implement the WQAP-PA. Thus, in order for LANL to execute the requirements, the MAP procedures must meet every requirement of the WQAP-PA. The project intent is to identify areas of deficiency in the primary implementing procedures to the WQAP-PA, where the requirements of the WQAP-PA are not met. Each section of the WQAP-PA is dissected into individual requirements and crosswalked with the MAPs. Areas in which the crosswalk reveals that the MAPs do not meet or partially meet the WQAP-PA requirements are compiled into a gap analysis document. Results show that gaps do exist and the MAP procedures should be changed to comply with the requirements. If the WQAP-PA is ever changed, the corresponding changes in the MAPs can easily be identified using the crosswalk document. Using the gap analysis document can help prove that LANL is accomplishing all requirements of QC-1. In addition, revising the MAPs can also help improve the MAP's usability.

Name: Seth Powers
Program:UGS
School: New Mexico State University
Group:PS-2
Mentor: Luce Salas
Category: Non-Technical
Type: Individual Poster Presentation

Security Communications

My work at LANL as a Communications Analyst Intern for Security requires that I prepare various products and documents to promote security awareness among LANL workers. Our small team's communications include policy and procedure, as well as shorter, conveniently placed reminders such as: Security Tips, LINKS, Security Smarts, and Anatomy of an Incident articles. We are also in charge of maintaining the content of the Associate Directorate for Security and Safeguards (ADSS) website. My primary focus is the Security Smart mini-posters. These posters cover a vast range of security topics, from badge holder responsibilities to counterintelligence. Security Smarts summarize larger policies to remind workers about security and to provide resources for more information on a given topic. All published Security Smarts are located on the Security home page and can be printed for training, posting or security meetings.

All Security Smarts are reviewed by a Subject Matter Expert (SME) for accuracy before publication. Part of my job is to research policies and procedures, and create products that are interesting and attention grabbing. To make the content more accessible, I find, edit, and create images that are appropriate to the content. I use several different programs such as Adobe Photoshop and Illustrator to create or edit images, and I use Adobe InDesign primarily for the layout. By combining a well-edited summary of larger documents with graphic design techniques I create single-page documents suitable for a diverse readership of 10,000+ LANL workers.

Name: Yonathan Araya
Program:UGS
School: Ryerson University
Group:P-21
Mentor: Michelle Espy
Category: Physics
Type: Individual Poster Presentation

Development of A Robust Chamber for a High-Throughput Flow Based Magnetic Spectrometer

Magnetic separation techniques have provided promising solutions to applications ranging from medical diagnostics to earth sciences. Removal of the magnetic particles in solution suspension by use of magnetic fields is an efficient process exploited in the use of immunoassays, magnetic resonance imaging, drug delivery, hyperthermia, and mining. We have developed a flow based magnetic spectrometer capable of high-throughput and high-parallel separation of magnetic microspheres for bioassay applications. Our approach incorporates a flow chamber located inside a magnetic gradient capable of separating superparamagnetic and ferromagnetic microspheres based on their magnetic moment. Exit bins have particle collections with narrow distribution of magnetic moments that can be used for eventual functionalization. Here we discuss our chamber fabrication process; techniques that have enabled an increase in sorting capabilities from 8 to 25 channels. The flow chamber consists of a sample inlet, differential sheath stream, and 25 bins for particle collection.
Previous chamber designs were limited to flow rates of 5 mL/min, not allowing for adequate particle separation of microspheres with high permeability. Our flow chamber incorporates the use of a double sided adhesive to join two outer acrylic layer sheets to an interior glycol-modified polyethylene terephthalate (PETG) thermoplastic. The two outer acrylic layer sheets overlap the interior PETG sheet allowing for a continuous seam around the edge of the chamber, of which is filled with epoxy glue. Maximum flow rates obtainable without chamber failure are 20-25 mL/min. We present data for the separation and sorting of magnetic microspheres and subsequent resorting of selected bins to demonstrate reproducibility and recovery.

Name: Anna Breiner
Program:UGS
School: New Mexico Tech
Group:MST-8
Mentor: John Bingert
Category: Phyics
Type: Individual Poster Presentation

Microstructural and Rate Effects on the Shear Localization of Copper

Material damage and failure is frequently initiated by an instability that results in strain localization, or the transition from homogeneous to heterogeneous deformation typically in the form of a shear band. Understanding the effect of microstructure on material instability is critical to developing damage models for use in predictive computations. Toward this goal, the effect of strain hardening, shear direction, and strain rate were investigated through constrained shear mechanical testing of pure copper. Altering shear direction provided a means of exploring the effect of crystallographic texture and grain morphology on shear band development. Samples from the as-received half-hard plate, along with those from a highly deformed upset-forged condition were tested along the through-thickness and in-plane directions. Since instability is an especially important consideration at high strain-rates, tests were performed at both quasi-static (10-3 s-1) and dynamic rates in the 103 s-1 regime, the latter accomplished with a Split-Hopkinson Pressure Bar apparatus. Samples were subjected to post-mortem analysis by optical microscopy and electron backscatter diffraction in order to quantify the shear localization microstructure as a function of initial structure and test conditions. Characterization results reveal correlations between microstructural parameters and shear band properties.

Name: Frank Chen
Program:UGS
School: Rice
Group:CINT
Mentor: John O'Hara
Category: Physics
Type: Individual Poster Presentation

Ultrafast Control of Ferromagnetic Nanowires

To address the demand for smaller and faster electronic devices, the developing field of spintronics utilizes the spin of electrons and their associated magnetic moments to carry information. The manipulation of electron spin may enable electronic devices to operate at the nanometer length and picosecond time scales. Unfortunately, the control and detection of these magnetic moments on such short time scales has proven to be extremely difficult. Due to its ferromagnetic properties at room temperature, manganese arsenide (MnAs) is a promising material for spintronic devices. In particular, thin films of MnAs exhibit a series of parallel nanowires during the phase transition from ferromagnetic to a paramagnetic state. In turn these nanowires produce anisotropy in the resistivity and optical properties of the film. Using terahertz time-domain spectroscopy (THz-TDS), one can measure the anisotropy of the THz transmission of MnAs on an ultrafast time scale. By taking transmission data with the THz electric field polarized parallel and perpendicular to the nanowires, it is possible to observe the formation and destruction of the nanowires as a function of temperature. Indeed, the difference between parallel and perpendicular transmission is maximized at temperatures where the nanowires exist. Furthermore, excitation of the MnAs film with an optical pump can create or destroy these nanowires. This event occurs extremely quickly (less than 2 picoseconds) as evidenced by THz measurements. Thus, optical pumping and THz-TDS provide a new method for ultrafast magnetic manipulation and characterization in MnAs, a significant step forward in spintronics.

Name: Ross Cortez
Program:UGS
School: University or Alabama- Huntsville
Group:P-24
Mentor: Glen Wurden
Category: Physics
Type: Individual Poster Presentation

Measurements of the Magnetic Field Profile of a Translating Field-Reversed Configuration Experiment Using an Axial Magnetic Field Probe

Compressing a Field-Reversed Configuration (FRC) is a highly promising path toward Magnetized Target Fusion (MTF). The Field-Reversed Configuration eXperiment with Liner (FRX-L) at Los Alamos National Laboratory (LANL) has recently been modified, and now requires measurements detailing the magnetic profile of the new magnetic geometry. Here, we present data obtained using an internal magnetic probe inserted along the z-axis of the FRX-L. This probe scan measures both axial and radial magnetic fields in the absence of a plasma. These measurements, in conjunction with measurements from radial magnetic field probes during plasma discharges, will enable us to study in detail the structure of the FRC and how it evolves while traveling through the translation region. This work is supported by the Office of Fusion Energy Sciences, and DOE/LANL contract DE-AC52-06NA25396.

Name: Mark Croce
Program: UGS
School: University of California- Santa Barbra
Group: N-1
Mentor: Minesh Bacrania
Category: Physics
Type: Group Poster Presentation

Name: Melissa Schear
Program: GRA
School: University of Illinois, Urbana-Champaign
Group:N-1
Mentor: Minesh Bacrania
Category: Physics
Type: Group Poster Presentation

Nuclear Characterization of Nanocomposite Scintillators

Gamma-ray spectroscopy is an extremely important method of identifying and characterizing nuclear materials. Nanocomposite scintillators hold considerable promise in improving upon the detector properties of bulk scintillator material, with increased light output, larger scalability, reduced cost, and excellent energy resolution. We are developing a variety of experimental techniques to study the absolute light yield, energy resolution and linearity of both nanocomposite and bulk scintillators. The ideal scintillator has a large absolute light yield (given by photons per deposited gamma-ray energy) that is constant for all gamma-ray energies and gives high energy resolution. In reality, the light output with respect to gamma-ray energy is nonlinear. In order to understand and improve the characteristics of the scintillator material, it is important to measure this radiation response. We measure the absolute light yield of a scintillator directly, with a calibrated photomultiplier tube (PMT), and compare nanocomposite materials with the standard bulk materials BGO, LaBr3, LaCl3, NaI:Tl, and plastic scintillator. Energy resolution can be determined from the shape of the photopeak, as measured with the PMT and a charge integrating analog-to-digital converter. Non-proportionality of scintillator light output with respect to gamma-ray energy is measured using the Compton coincidence technique. This non-proportionality can be quantified absolutely through the use of the calibrated PMT. Additionally, by measuring the shape of the scintillation pulse measured by the PMT, information about the scintillation mechanism can be extracted.

Name: Paul Ellison
Program:GRA
School: University of California-Berkeley
Group:C-NR
Mentor: August Keksis
Category: Physcis
Type: Individual Poster Presentation

Data Analysis of Neutron Capture Measurements on 75As using DANCE

Arsenic has been used as a radiochemical detector in the NTS test program to obtain neutron fluence and device performance information. It is also relevant to the rapid and slow -processes of nucleosynthesis. For these reasons it is desirable to have precise measurements of the neutron-induced reaction cross sections on both its stable and radioactive isotopes.

In September 2007, an initial neutron capture measurement on 75As was taken using the Detector for Advanced Neutron Capture Experiments (DANCE) at LANSCE. Since then, the data has only been analyzed in a preliminary fashion to study background and determine optimal acquisition settings for the irradiation of a thicker 75As target to take place in 2008. It has been my main summer goal to thoroughly analyze this 75As neutron capture data taken in 2007.

The thorough analysis of this data involves several steps. First, each of the 160 BaF2 detectors must be properly calibrated in both energy and time. Then, the background rates in the detectors must be determined by the analysis of data taken under the same experimental conditions as the 75As target, but without the 75As target material. Analysis of the individual neutron energy resonances allows for the calculation of the efficiency of the DANCE array for a given set of conditions.

Upon completion, this data will be used in conjunction with the measurements of thicker 75As targets taken in 2008 to get the best experimental value for its neutron capture cross section.

Name: Megan Fuller
Program:UGS
School: Brigham Young University
Group:N-1
Mentor: Minesh Bacrania
Category: Physics
Type: Individual Poster Presentation

Microcalorimeter Detectors for X and Gamma Ray Spectroscopy

Microcalorimeter arrays present a method for ultra-high resolution measurement of x and gamma rays. They are based on superconducting cryogenic transition-edge sensors coupled to bulk tin absorbers. The absorbers convert the energy deposited by incident x and gamma rays into heat, causing a change in the resistance of the sensors. The system is voltage-biased, so the change in resistance produces a current pulse that is proportional to the energy of the radiation.
Between 40 and 130keV, the spectroscopic resolution is ten to twenty times what can be achieved with a standard high-purity Ge detector.
This resolution allows for a more precise determination of the isotopic composition of special nuclear materials for a variety of safeguard purposes. We will present our work on efficient, automated, and unbiased ways to select and process data for large detector arrays.

Name: Jessica Hammon
Program:UGS
School: University of California- Santa Barbara Alumni
Group:P-21
Mentor: Michelle Espy and Igor Savukov
Category: Physics
Type: Individual Poster Presentation

Towards an Ultra-low Field MRI Scanner Based on Atomic Magnetometer

Magnetic resonance imaging (MRI) has myriad applications including medical diagnostics. However, current MRI systems are extremely expensive and use very strong magnetic fields, making such systems limited in their utility and portability. One promising method for reducing the cost and increasing the portability of the system is to employ an ultra-low field MRI technique that uses a sensitive atomic magnetometer (AM) for read-out. The first ever MRI images with AM have been recently obtained in our lab. While the quality of the images is below that of traditional high-field MRI, there remain areas for system improvement. The main problem with AM is their high sensitivity to ambient magnetic fields. One solution we successfully tested is the use of a flux transformer. The current project focuses on improving the sensitivity of the AM by optimizing the flux transformer and shielding the ambient magnetic field noise. This includes design considerations and experimental investigation of the properties of the transformer. In particular, several coil designs were investigated to test the theory that inter-turn capacitance limits the sensitivity of the coils. We found that the coils with different inter-turn capacitance had similar frequency dependence--disproving the hypothesis that capacitance is the main limiting factor. To study the shielding of ambient magnetic fields and methods for increasing the shielding factor of the AM MRI system, measurements were taken of the fields with different shielding methods —leading to the understanding that good conductivity between interfaces is essential for efficient shielding. Further study of flux transformer optimization and shielding will eventually lead to a more sensitive AM MRI system.

Name: Katelyn Hessler
Program:UGS
School: Lehigh University
Group:P-25
Mentor: Gerd Kunde
Category: Physics
Type: Individual Poster Presentation

Probing the Quark-Gluon Plasma at the Large Hadron Collider at CERN

Physicists have been getting closer and closer to figuring out what happened during and after the Big Bang. Currently, we know that within 10^{-20} seconds after the Big Bang there existed a state of matter called a quark-gluon plasma with a temperature of trillions of degrees. The extreme temperature and density of this matter allowed quarks and gluons to act independently of each other; something which does not occur in normal matter, as the strong force keeps quarks and gluons confined within hadrons. However, we can now recreate this quark-gluon plasma in the laboratory using heavy ion colliders, such as the Large Hadron Collider at CERN. We can probe the quark gluon plasma by searching for events that contain a Z^0 boson and a jet of other particles. We know that the Z^0 does not interact via the color charge, but that the particles in the jet do interact via the color charge. We can then use the Z^0 as a tagging particle and to figure out how the jet has been changed by the interactions in the quark-gluon plasma. We will then compare the properties of these modified jets to those of jets in proton-proton collisions. We can use any differences that we find to learn about the properties of the quark-gluon plasma. We will study this by running Monte Carlo simulations of such events and looking at the angular and rapidity distributions of the Z^0 and the jet.

Name: David Jeffs
Program:UGS
School: Brigham Young University
Group:P-21
Mentor: Michelle Espy
Category: Physics
Type: Individual Poster Presentation

Relay switch arrays

In high power MRI tests, a large polarizing field of at least one Tesla is used for both the polarization of hydrogen atoms and in the measurement of the various population densities of these atoms (thus the capability to differentiate between various tissues). However, in low field MRI, the polarization field is separate from the measurement field(s) and in order to produce a large a large pre-polarizing field (B¬p) in the short intervals required for MEG/MRI arrays, it is necessary to utilize large switch arrays. Without these specially designed switches, turning the pre-polarizing coil off would render all data completely useless. This undesirable distortion is caused by the arc all common switches create as they are turned on or off. The arc produces its own field, changing the spins of the hydrogen atoms, wreaking havoc on all magnetic signatures being produced by the test subject and recorded by highly sensitive instruments. However, the switch I fabricated used 96 mosfet transistors in thermal avalanche mode. These transistors allowed the coil to be activated and deactivated in relatively short time periods while effectively dissipating the excess energy in the harmless form of heat.

Name: Quinn Looker
Program:GRA
School:
Group:ISR-1
Mentor: Mark Wallace
Category: Physics
Type: Individual Poster Presentation

1-Dimensional Position Reconstruction Using Gamma Ray Backscatter Technique

Many methods exist for remotely imaging objects through solid material, but nearly all of these methods require access to the object of interest from multiple directions and only provide a 2-dimensional projection of density. However, using backscattered gamma rays from a positron source, an object can be imaged using an apparatus entirely contained in a single location while providing 3-dimensional density information. A Germanium-68 positron source is used to produce nearly collinear 511 keV gamma rays, one of which is directly detected, while the other backscatters from the object of interest. By measuring the time difference between the two detections, the interaction position of the backscattered gamma ray can be determined. Testing of a laboratory backscatter system revealed its ability to distinguish multiple objects at least ~3cm apart, even behind barriers such as a sheet of steel or drywall. This poster shows results of time-of-flight measurements that give position information along the gamma ray direction of travel and discusses work toward a 3-dimensional backscatter imaging system.

Name: Roy Murray
Program:UGS
School: New Mexico Tech
Group:PMT-1
Mentor: Sammi Owens
Category: Physics
Type: Individual Poster Presentation

Calcium Detection in 3013 Containers

Plutonium oxides have recently been placed into long term storage in triple layer stainless steel 3013 containers per DOE-STD-3013-2004 for up to 50 years. These oxides contain chloride salts, including CaCl2. The presence of calcium has been identified as a problem that can lead to gas generation and degradation of the 3013 container. Non destructive assay (NDA) methods, mainly reading gamma radiation coming from alpha reactions, have been used in the past to identify other chloride salts such as Na, K, and Mg. Unfortunately, this method has not been found to work for identification of calcium. After researching the problem through literature and modeling software, it appears that alpha induced gamma identification may be possible using longer gamma count times if the calcium is in high concentrations. Alternatively, calcium is a good candidate for neutron activation analysis. Having run a model, we plan to perform an experiment using a californium neutron source to irradiate the 3013 containers and activate the calcium. Once converted into different isotopes, the calcium should decay and release gamma rays that will be detectable with a standard gamma detector. If calcium proves to be easily identifiable, either through long count times or neutron activation, the procedure will be implemented at DOE sites across the country that use 3013 containers.

Name: John Ogren
Program: GRA
School: Boston university
Group:P-23
Mentor: Justin Torgerson
Category: Physics
Type: Individual Poster Presentation

Optical Pumping of Multiple Ytterbium^{2+} States with a Hollow Cathode Lamp

Identification and spectroscopy of Ytterbium^{2+} (Yb^{2+}) using the $^1S_0$-$^3P_1$ transition at 252nm is being sought using ions in a linear quadrupole trap. Many decay paths exist out of the $^3P_1$ state into metastable states which are dark to 252nm radiation. We propose to use an Ytterbium Hollow Cathode Lamp (HCL) to pump ions back into the $^1S_0$ state. When a voltage is placed across the HCL in excess of the breakdown voltage, plasma of carrier gas and Yb atoms in various ionic and electronic states spans the cathode-anode gap. We modified an HCL to include a UV transmittive window (200nm and larger) and a valved stem to allow for changing of the carrier gas. By examining the emission with different carrier gasses using an automated LabVIEW program, we show that there are spectral lines in the plasma that are representative of Yb^{2+}. With Ne and He as carrier gasses we observe no evidence of Yb^{2+} lines, but when Kr is used as the carrier gas the 403nm Yb^{2+} line is seen with the 370nm Yb^+ and the 399nm Yb lines. This result strongly suggests that the HCL with Kr produces enough Yb^{2+} to emit a sufficient spectral density of the deep UV lines to pump the Yb^{2+} out of the metastable states. Recently we have shown, by means of examining the response of a cloud of ions to varying RF drive frequencies that Yb^{2+} is present. The search for 252nm fluorescence of that Yb^{2+} is still ongoing at this time.

Name: Sean Peterson
Program:UGS
School: Brigham Young University
Group:X-3
Mentor: Alan Harrison
Category: Physics
Type: Individual Poster Presentation

Testing the FLAG Ejecta Model

Modeling fluid behavior was never a simple task, and computing shockwaves through fluids and solids presents a formidable project. A useful tool for such is a Lagrange/ALE compressible hydrodynamics program called FLAG (Free Lagrange), which accurately models even complex material behavior with ease and speed. However, some experiments involve more puzzling problems than just shockwaves. For instance, driving a shockwave through certain materials creates ejecta, or minute material that flies off of the target due to imperfections in its surface. The highly-developed FLAG code already has a rich suite of material models to solve fluid-based problems, but a new physics capability, called simply "ejecta," is underway to analyze these ejecta complications. Because ejecta often acts as particles instead of a fluid (even if molten)– each tiny piece with its own velocity, mass, drag force, and other dynamics– the new ejecta package in FLAG has the singular task of fusing the fluid components with a particulate model of the ejecta. Test problems are built to ensure that the new functions harmonize with the expected mathematical analysis and are validated against actual experiments. Testing in this way verifies that new code reflects the desired new functionality, and that the model also (most importantly) reflects reality. This process of reviewing the newly-written code, called quality assurance, greatly aids to speed the development of this new ejecta capability, which will ultimately open many doors to unprecedented modeling possibilities with the FLAG program

Name: Andrew Reindel
Program:UGS
School: Cornell College
Group:X-2
Mentor: Paul Bradley
Category: Physics
Type: Individual Poster Presentation

Applying Fourier, Wavelet and Variable Sine Algorithmic Analysis to Solar Cycles

Observations of sunspots and other solar indicators have revealed varying periods and amplitudes that may be better understood. A sunspot is a dark spot on the surface of the sun of relatively higher magnetic field and lower radiation output because they are cooler. Next to sunspots are brighter regions; when there are many sunspots the brighter regions cause the Sun to be slightly brighter than when there are few sunspots. These phenomena are caused by a varying solar magnetic field that has a roughly 11 year cycle. We will analyze the solar cycle by applying various Fourier analysis techniques to solar data corresponding to the cycle, such as the sunspot observations, luminosity variations, and carbon 14 readings from tree rings (which vary in response to the sun's luminosity and can be measured over a long timescale). The data will be analyzed using Fourier transforms (FT), wavelet analysis (WA) and variable sine algorithmic analysis (VSAA). FT will analyze the data over an infinite time scale to be composed of sine waves, where as WA uses the same idea, but looks at data with finite endpoints. The VSAA algorithm was discussed by Tsantilas and Rovithis-Livaniou at the recent HELAS asteroseismology workshop in Poland in June 2008 (see also arXiv:0709.3224) and analyzes data to be composed of one varying sine wave. From these results we hope to gain a better understanding of solar cycle variations and to gain insights that might be useful at predicting future solar cycle variations.

Name: Nathaniel Sanchez
Program: UGS
School: University of New Mexico
Group:DE-9
Mentor: Daniel Hooks
Category: Physics
Type: Individual Poster Presentation

Shock Initiation Properties of the HMX based Explosive PBXN-9

The goal of this study is to determine the shock initiation properties of the Navy explosive PBXN-9. PBXN-9 is a plastic bonded explosive based upon cyclotetramethylene tetranitramine (HMX), with larger particle sizes and different binders than the DOE explosive PBX 9501. PBX 9501 consists of 95 wt% HMX, 2.5 wt% Estane & 2.5 wt% nitroplasticizers with a density of 1.834 g/cm^3 & 1.4% voids, while PBXN-9 consists of 92 wt% HMX, 2 wt% Hycar 4054 & 6 wt% dioctyl adipate with a density of 1.75 g/cm^3 & 0.8% voids. This material has been chosen as part of a much larger effort to understand the properties of HMX based plastic bonded explosives in varying formulations, and there are several other characterization efforts on PBXN-9 underway at other parts of LANL. The experiments are designed to understand the shock to detonation transition in PBXN-9, revealing the specifics of wave evolution and the run distance to detonation as a function of input shock pressure (or "Pop Plot"). These experiments were conducted on gas guns at TA-40 in order to vary the input shock pressure accurately. The primary diagnostics were embedded magnetic gauges which are based on Faraday's law of induction along with Photon Doppler Velocimetry (PDV). Preliminary results from literature show that PBXN-9 should be less sensitive to shock initiation than PBX 9501, which is believed to be attributed to the lower void content.

Name: Brandon Shibley
Program:UGS
School: Washington State University
Group:MPA-11
Mentor: Dipen Sinha
Category: Physics
Type: Individual Poster Presentation

Non-invasive Acoustical Monitoring of Fluid Parameters Using a Digital Phase-lock Technique.

Sound speed in a fluid can be used as a sensitive measurement parameter to monitor fluid characteristics. An accurate way to determine sound speed is to measure the phase difference of an acoustic signal propagating through the fluid sample. Normally, this phase is detected using a lock-in amplifier or a network analyzer (both expensive).
Using an off-the-shelf, computer-based digital oscilloscope/function generator and custom-written software, we are able to monitor resonance peaks by continuously tracking the phase change of waves sent through a liquid sample. This allows us to continuously track sound speed changes as the sample's temperature, salinity, and other characteristics change. As the function generator may be employed to produce the probe wave, its frequency can be changed to keep the phase shift constant by way of PID control. This allows an extremely precise null-measurement technique. With these techniques, shifts as small as one part in 10^4 may be tracked and adjusted for, making it a useful tool where sensitive measurements are necessary.

Name: Craig Siebe
Program:UGS
School: Univeristy of California Davis
Group:T-16
Mentor: Anna Hayes
Category: Physics
Type: Individual Poster Presentation

Calculations of the CP Violating Dipole Moment of HE3

The existence of an electric dipole moment of an atom requires violation of CP symmetry. In this project we have been examining the effect of a CP-violating interaction between the electrons and nucleus of 3He. For this we examined numerical techniques for solving the two-electron-nucleus problem in a harmonic oscillator basis. To test the technique we first solved the hydrogen atom.

Name: Adam Vogt
Program:UGS
School: Truman State University
Group:P-24
Mentor: Glen Wurden
Category: Physics
Type: Individual Poster Presentation

Time Evolution of the Non-Linearly Saturated Kink Mode in a Current Carrying Plasma

The magenetohydrodynamic (MHD) kink-mode is an instability that arises in current-carrying plasmas both in nature and in the laboratory. In the Reconnection Scaling eXperiment (RSX) at the Los Alamos National Laboratory, non-linear saturation effects have been found to prevent the disruption of plasma even after the linear kink has been formed at plasma current levels above the Kruskal-Shafranov (KS) limit. Currents at this non-linear saturation level produce a perturbed magnetic amplitude □B□□ at 5-10% of the axial magnetic field Bz amplitude. Using the RSX setup, we provide experimental "B-dot" and triple probe measurements of the time evolution of the kink mode. The measured plasma has a non-line-tied axial boundary and current levels both in the non-linearly saturated regime and in the transition region between the KS and saturation limits. Measurements are taken of the cross section of the helically kinked plasma at multiple axial positions for a profile of the time evolution.

Name: Daniel Weflen
Program:UGS
School: Drake University
Group:T-4
Mentor: Daniel Horner
Category: Physics
Type: Techincal Talk

Double Photoionization of the H_2: Double Slit Interference?

We used the method of exterior complex scaling and a discrete variable representation basis to calculate differential cross-sections for double photoionization of the Hydrogen molecule. These methods allow us to solve unbound quantum problems in an efficient manner on massively parallel computers. Results of these calculations were then used to help resolve a current scientific controversy. Specifically, we looked at the "dielectron" momentum distribution, which exhibited a characteristic shape that experimentalists attributed to double slit interference. We will offer an alternate interpretation.

Name: David Weldon
Program:GRA
School: Rose-Hulman Institute of Technology
Group:LANCE-LC
Mentor: Sven Vogel
Category: Physics
Type: Individual poster Presentation

High Pressure Deformation of Zirconium

Room temperature investigation on the elastic modulus and defromation mechanisms of omega-Zr are performed in situ at 5 GPa using synchrotron diffraction and the D-DIA apparatus at APS. Mechanical properties, and deformation mechanisms of alpha-Zr are well known at STP. HOwever, Zr experiences a phase transformation at around 2 GPa leaving physical properties at high pressures unknown. In situ high pressure study is a unique way to study the otherwise unknown physical properties of omega-Zr.

Name: Ian Wisher
Program:UGS
School: University of Illinois Urbana-Champaign
Group:T-16
Mentor: Anna Hayes
Category: Physics
Type: Individual Poster Presentation

Uncertainties in Reactor Neutrino Spectra

We calculate the relevant reactor neutrino spectra using ENDFB/VI and JEFF nuclear data files and compare them with those used in neutrino oscillation experiments. We also calculate the neutrino spectra of nuclides that are previously unpublished. We evaluate how the discrepancies in the data files, as well as the approximations used for nuclei with unknown endpoint energies, affect the predicted aggregate beta and neutrino spectra. We find that nuclear reactor spectra are not as well known as previously thought and that further evaluation is required. The increase on the uncertainties in the spectra directly affect conclusion in neutrino oscillation experiments.

Talks

Name: Michael Jablin
Program:UGS
School: Haveford College
Group:LC
Mentor: Jaroslaw Majewski
Category: Bioscience
Type: Technical Talk

Model Lipid Bilayers on a Thermoresponsive Surface-Tethered Poly(N-isopropylacrylamide) Network

The interaction of model lipid bilayer composed of dipalmitoyl-phosphatidylcholine (DPPC) with a surface-tethered poly(N-isopropylacrylamide) (poly(NIPAAm)) network was explored with neutron reflectometry. Vesicle fusion was used to deposit a lipid bilayer of DPPC onto a thin layer of a poly(NIPAAm) quartz coated substrate. Previous experiments demonstrated that the structure and hydration of the poly(NIPAAm) network is sensitively dependent on temperature. Low temperatures (15-28 °C) cause the thickness of the network to swell while high temperatures (32-44 °C) result in the collapse of the network. The poly(NIPAAm) network expels water as it collapses. Neutron reflection measurements were used to determine the combined structure of the lipid bilayer and the poly(NIPAAm) as a function of temperature. Our preliminary measurements suggest that a poly(NIPAAm) thin film is capable of supporting a lipid bilayer and through its thermoresponsive characteristics, controlling the volume and hydration of the space between the solid support and the model membrane. The separation of the lipid bilayer from the solid support of a substrate constitutes a significant step towards a more realistic model of membranes.

Name: Dominique Price
Program:UGS
School: New Mexico State University
Group:C-PCS
Mentor: Aaron Anderson
Category: Biosciences
Type: Technical Talk

Detection of Lipoarabinomannan, a Mycobacterium Tuberculosis Biomarker Using the Waveguide-based Optical Biosensor

Tuberculosis (TB) is one of the oldest and most challenging diseases threatening mankind. Currently more than one third of the world population is infected with M. tuberculosis, the bacterium causing TB, and more than 1.5 million people die from the disease each year. The unique pathology and physiology of the bacterium makes the disease difficult to diagnose. Current diagnostic methods are plagued by insensitivity, lack of specificity, long completion times, and high cost. Meanwhile, there is an upsurge in the cases of TB patients co-infected with HIV and in patients suffering form drug resistant variants of the organism. There is thus an immediate need for an accurate and efficient diagnostic for the disease.

Of the several strategies being explored, biomarker detection is a promising candidate, displaying a potential to eradicate most or all problems with current TB tests. One such biomarker for TB is Lipoarabinomannan, an intrinsic component of the bacterial cell wall and virulence factor involved in the disease pathology. Here, at LANL, the biosensor team uses a waveguide-based optical biosensor and specific ligand interactions to detect target molecules in a sandwich immunoassay format. We report here the development of a sensitive, specific and rapid assay for the detection of LAM and demonstrate detection of the biomarker in a small cohort of patient urine samples. We hope to extend this approach to other TB-specific biomarkers such as antigen 85 complex and early secretory antigen 6 in order to develop a multi-analyte detection platform for the disease. Such an approach, if successful, will be a sensitive, specific, rapid, relatively inexpensive, potentially quantitative and non-invasive diagnostic platform for TB.

Name: Jessica Saiz
Program:GRA
School: Fort Lewis College
Group:LANSCE-LC
Mentor: Jaroslaw Majewski
Category: Bioscience
Type: Technical Talk

Investigating the Structure of Single Phospholipid Bilayers on Polymer Cushions Using Neutron Reflectivity

Lipid bilayers at the solid-liquid interface are frequently used as model systems to study biological cellular membranes. One advantage of this model system is its potential to investigate protein-membrane interactions. However, when investigating interactions between membranes and proteins, scientists often run into trouble when the solid interface on the hydrophilic side of the inner leaflet interferes with a transmembrane structure or event. To compensate for this, we created a hydrated "cushion" composed of polyethylene glycol (PEG) between the second leaflet and the solid, quartz surface. This was accomplished by incorporating a small mole percent of lipids containing polymers attached to the heads into the bilayer. For our experiments, a bilayer of 1,2-Distearoyl-sn-Glycero-3-Phosphoethanolamine (DSPE) of which 5-10 mole percent was 1,2-Diacyl-sn-Glycero-3-Phosphoethanolamine-N -[Methoxy(Polyethylene glycol)-2000] (mPEG 2000 PE) or 1,2-Diacyl-sn-Glycero-3-Phosphoethanolamine-N -[Methoxy(Polyethylene glycol)-5000] (mPEG 5000 PE) was created using the Langmuir-Blodgett/Langmuir-Schaeffer method on a solid-liquid interface. With neutron reflectivity experiments, which probe the in-plane structure of the bilayer, we were able to see that the polyethylene glycol polymer created a "cushion" of about 10Å between the solid interface and the lipid. This "cushioned" bilayer will allow future experiments which observe protein interactions with the bilayer and will serve as a building block for the development of biosensors.

Name: Hillary Smith
Program:GRA
School: California Institute of Technology
Group:LANSCE-LC
Mentor: Jaroslaw Majewski
Category: Bioscience
Type: Technical Talk

Early Stages of Oxidative Stress-induced Membrane Permeabilization: a Neutron Reflectometry Study

Neutron reflectometry was used to probe *in-situ* the structure of supported lipid bilayers at the solid-liquid interface during the early stages of UV-induced oxidative degradation. Single component supported lipid bilayers composed of gel-phase, Dipalmitoyl-sn-Glycero-3-Phosphocholine (DPPC), and fluid phase, 1-Palmitoyl-2-Oleoyl-sn-Glycero-3-Phosphocholine (POPC), phospholipids were exposed to low-dose oxidative stress generated by UV light and their structures examined using neutron reflectometry. An interrupted illumination mode, involving exposures in 15 minute increments with 2 hour intervals between subsequent exposures, and a continuous mode involving a single 60 (or 90) minute exposure period were employed. In both cases, pronounced differences in the structure of the lipid bilayer after exposure were observed. Interrupted exposure led to a substantial decrease in the membrane coverage, but preserved its total thickness at reduced scattering length densities. These results indicate that the initial phase during UV-induced membrane degradation involves the formation of hydrophilic channels within the membrane. This is consistent with the loss of some lipid molecules we observe and attendant reorganization of residual lipids forming hemi-micellar edges of the hydrophilic channels. In contrast, continuous illumination revealed a graded interface of continuously varied scattering length density (and hence hydrocarbon density) extending 100-150 angstroms into the liquid phase. Exposure of a DPPC bilayer to UV light in the presence of a reservoir of unfused vesicles showed low net membrane disintegration during oxidative stress presumably because of surface back-filling from the bulk reservoir.

Name: Christina Brady
Program:UGS
School: University of California-San Diego
Group:CDE
Mentor: Stephen Doorn
Category: Chemistry
Type: Technical Talk

Multiplexed Nanoparticle Assemblies for SERS-Detection Applications

In detection applications and microscopic analysis, Raman techniques offer advantages over well-established fluorescence techniques; however, low signal strength from Raman spectroscopy has limited its practical applications.To overcome these weak signal strengths, Surface Enhanced Raman Scattering (SERS), using metal nanoparticles as substrates for the attachment of the signal dye, has become increasingly utilized. To optimize the Raman signal, aggregation of silver (Ag) nanoparticles using salts enhances the Raman signal due to overlap of surface plasma resonance between the particles. Currently, alternative methods to control inter-particle distance using magnetic particles are also being researched. The strong signals from the Ag aggregates have allowed for combinations of different signal dyes for a single SERS-active nanoparticle. To achieve this, current research at Los Alamos National Laboratory involves synthesis of multiplexed nanoparticle assemblies to give a combination of signals. Ag nanoparticles approximately 60nm in diameter were tagged with a particular Raman dye, aggregated, and silica coated. The tagged Ag particles were attached to silicon microspheres via biotin-avidin interactions in different dye ratios. Raman spectroscopy and Raman microscopy were used to measure and characterize the signal strength of the particles. Results showed that the combination of different dye ratios on multiplexed nanoparticle assemblies maintained their fingerprint spectra, and the intensities of the individual peaks could be controlled by varying the concentration of dye added. Multiplexed nanoparticles can be used in further experiments requiring SERS-detection of different substrates simultaneously. Future synthesis of multiplex particles with different combination of dyes will allow for a larger array of dye spectra than currently available.

Name: David Bigelow
Program:GRA
School: Unviersity of California-Santa Cruz
Group:HPC-5
Mentor: Hsing-Bung Chen
Category: Computing
Type: Technical Talk

Storage Systems for High-Bandwidth, Low-Lifetime Data

There exist certain systems which generate high-bandwidth streaming data, but do not necessarily require its long term storage under normal conditions. An example of this type of system is the proposed “Long Wavelength Array,” a network of telescopes which will initially generate a planned 30 gigabits of data per second, and may eventually be several orders of magnitude larger. All of this collected data may be safely discarded after a set amount of time, unless a significant “event” is detected, at which point all accumulated data must be saved for future analysis while not interrupting the task of continually storing new data. Traditional storage systems are not designed to cope with this problem,which involves low-lifetime write-only files that are continually overwritten as new data is generated. Instead of these traditional systems, a large-scale ring buffer storage system should be employed, albeit with the appropriate provisions to ensure data can be permanently stored at a moment's notice. This type of storage system must utilize large numbers of hard drives to keep up with data generation and ensure data security for those times when hard drives inevitably suffer mechanical failures. A certain amount of these storage resources must also be reserved in order to access data A prototype system is currently under development.

Name: Clayton Chandler
Program: GRA
School: Louisiana Tech University
Group:HPC-5
Mentor: Nathan DeBadeleben
Category: Computing
Type: Technical Talk

Towards Resilient High Performance Computing Systems Through Lightweight, Dynamic Metric Collection

One of the overarching obstacles encountered in creating resilient HPC applications is a substantial lack of existing performance data. In order to develop an understanding of how and why high-end computing distributions fail, one must conduct some form of historical trending and analysis on contemporary machines and the programs that run on them. Currently, there is an effort from others within the HPC research community to make sense of existing high performance application failure logs. However, these are rather labyrinthine documents that, even with the assistance of intelligent data mining algorithms, translate poorly to human discern. In further detriment to failure analysis efforts, contemporary HPC application logging is not a standardized effort, which results in single system events triggering drastically different messages in logs originating from divergent applications. This makes cross-job failure characterization extremely difficult, leading to frustrating and troublesome root cause analysis efforts. Furthermore, this endeavor is largely limited to reactive, postmortem triage, as the enormous size of these documents prevents efficient real time interaction.

Thus, there exists a strong need for the provision of accurate, concise, real time application performance information. Moreover, the means of reporting this data must be sufficiently lightweight and nonintrusive, as to successfully-yet-discretely attach itself to the multiple processes running on multiple cores within tens or even hundreds of thousands of compute nodes. Lastly, this information should be presented in a standardized manner, with terminology and metric derivation consistent amongst all applications running on the target architecture. This accomplishes both clearer human understanding of application state, as well as providing a non-target application specific layer of performance information, which in turn may be fed into a more robust resilience provision framework. This research proposes the creation a dynamic application instrumentation module (utilizing SLI's Open|SpeedShop(tm) software stack) aimed at successfully achieving these goals.

Name: Chris Collord
Program:GRA
School:ASUNM
Group:CTN-2
Mentor: Jeff Click
Category: Computing
Type: Technical Talk

Looking Forward - Server 2008 and Vista

Microsoft Windows Server 2008 and Vista have improvements that can make our work environment safer, smarter, and more efficient. The goal of my research will be to see how compatible these new operating environments are with much of the legacy hardware the LANL has around. I will also research how features in the new operating systems can be used to make our information safer without adding complexity, as well as adding the capacity to save money and time.
I am setting up a small network using a Windows 2008 server, and two workstations: one using Windows XP, the other using Windows Vista. I hope to find that Vista and 2008 can function flawlessly on an older system, and that having a mix with Windows XP on the network will not cause any networking problems.

Name: Brian Douglass
Program:GRA
School: University of New Mexico
Group:HPC-1
Mentor: Steven Painter
Category: Computing
Type: Technical Talk

Social Engineering: New Answers for an Old Problem

Social engineering, a method of gaining access or information by manipulating the human element in a security setup, has been an effective method of attack for thousands of years. The most famous historical example comes from Homer's Illiad. The Trojan Horse demonstrates the core aspect of a social engineering attack. The Greeks were able to bypass all of the Trojans' security measures, their walls for example, and make a successful attack on Troy by manipulating the human element in the Trojans' defenses. This type of strategy is still being used in the technical world today. Social engineers work by taking their victims' natural inclinations to be helpful and trusting and using this as a weapon against them to get information or access to systems. The standard counter to these types of attacks is to educate likely victims and raise their awareness of social engineering techniques. However, many of the standard education techniques simply do not equip people to recognize social engineering attacks. The foundation of an effective education plan to combat social engineering needs to be founded on the psychology of influence. Only when people are aware of how they can be manipulated will they be able to detect when a social engineering attack is being made.

Name: Aaron McPhall
Program:UGS
School: Michigan Technological University
Group:ACS-PO
Mentor: Justin Doak
Category: Computing
Type: Technical Talk

Dynamic SQL Generation and Data Validation from Configuration Files

Configuration that is hard-coded or programmed into a system creates rigidity that is difficult to update and maintain. Moving the configuration out of many code files into a few files editable by non-programmers increases the flexibility and robustness of the system.
All of the configuration for the Framework for Responding to Network Security Events (FRNSE) system was distributed in various portions of the codebase. This made updating FRNSE cumbersome since it required a developer to modify code. In order to solve this issue, we moved the alert syntax, data validation, and database structure into flat files. The data from these configuration files also enables us to dynamically modify and query the database. A Python class named Alert was re-written to incorporate the following abilities: load configuration from files, configuration file and database sanity checks, dynamic query generation, parse Extensible Markup Language (XML), validate data, and access Alert instance data. The result is an easy to use interface that encompasses all necessary actions that an Alert object may have.

Name: Dylan Merrigan
Program:UGS
School:NMIMT
Group:CTN-4
Mentor: Erik Anderson
Category: Computing
Type: Technical Talk

Broad Gigabit Data Network Upgrade Design and Implementation

Los Alamos National Laboratory is upgrading its data communication network to provide advanced features such as gigabit connections, power over Ethernet, and Voice over IP to customers. These features are implemented with the strategy of minimizing network downtime, being cost effective, and increasing coverage. The upgrade affects all aspects of the network including its electronics, fiber circuits, copper cabling, and enclosures. These components each present their own challenges and require particular solutions. The design and implantation of this upgrade balances the network's challenges with the user's needs. One of the first areas to be upgraded is TA54. It features over a hundred network switches, fiber optic spans over three miles long, and over sixty communication closets. The upgrade design reorganizes and consolidates switch stack arrangements while simultaneously activating more ports. Three fiber technologies; 1000BaseSX, 1000BaseLX, and MRV-MMX, are used over both multimode and single mode circuits to solve attenuation limitations associated with the wide range of fiber circuit lengths. Both 3Com and Nortel edge switches are used in the design to balance cost and availability resources with upgrade demands. Innovative installation solutions are required to cope with diverse structural limitations of communication closets and enclosures. The current progress of the upgrade shows that the design is not only feasible, but that it is having a greater impact on network performance and reliability.

Name: Esteban Molina-Estolano
Program:GRA
School: University of California
Group:HPC-5
Mentor: John Bent
Category: Computing
Type: Technical Talk

Taming Pseudorandom Data Placement

In distributed storage systems, files are split into a number of parts and stored across nodes in a cluster; typically, allocation tables record the locations of these parts. Using pseudorandom data placement removes the need for such a table: a pseudorandom function uses a small amount of file metadata, along with information about the state of the storage cluster, to calculate file locations instead of looking them up. The pseudorandom function distributes files evenly among the nodes. This offers considerable scalability advantages over allocation tables: There is considerably less metadata, and the metadata changes less frequently. Thus, a storage system using pseudorandom placement can grow much larger without metadata management becoming a bottleneck. However, pseudorandom data placement makes dynamic load balancing more complicated, since data cannot be moved arbitrarily among nodes. The Ceph distributed storage system, developed at UC Santa Cruz, uses pseudorandom data placement. To better understand the behavior of such storage systems under different workloads, and determine likely overload scenarios, we are creating a simulator using Ceph's CRUSH (Controlled Replication Under Scalable Hashing) placement function. To feed the simulator, we use trace data from various workloads, such as LANL scientific computing workloads and web hosting workloads from Dreamhost. Using the trace data, we characterize imbalance and overload situations under different types of workloads, and different cluster sizes and numbers of placement groups. We are also comparing load balance with existing filesystems that do not use pseudorandom data placement.

Name: Daniel Orozco
Program: GRA
School: University of Delaware
Group:HPC-5
Mentor: Brett Kettering
Category: Computing
Type: Technical Talk

Sweep 3D Benchmark for Multicore Supercomputers

The use benchmarks applications is a standard way to measure computer and supercomputer performance. However, benchmarks become obsolete as new computer technologies become available, or they measure parameters that are no longer relevant. When this happens, either new benchmarks have to be developed, or existing ones have to be upgraded. In particular, with the multi-core revolution, many benchmarks designed to test supercomputer performance were written at a time where it was not known that communication between cores in a single processor chip can be orders of magnitude faster than between nodes in a distributed system. The work presented here describes how Sweep3D, a benchmark based in Neutron Transport algorithms, is upgraded to effectively measure the performance of supercomputers whose nodes have multi-core architectures. To do so, the original source code was rewritten to ensure better readability, then a profiler was used to identify the bottlenecks of the application, and finally, the application was redistributed to take advantage of the data locality present inside a multi-core chip. Future work focuses on porting this benchmark to revolutionary architectures such as Cell or Cyclops 64. As an aside, the algorithm is studied to propose changes that could result in the acceleration of the convergence of the solution.

Name: Christopher Quinn
Program:GRA
School: University of Illinois
Group:HPC-5
Mentor: John Daly
Category: Computing
Type: Technical Talk

Resilience in Computer Arithmetic

Numerous computer simulations performed at national laboratories require large computer clusters working together for long periods of times. Mechanical problems, electrical noise, software bugs, and a number of other issues can cause a running application to crash. The field of resilience aims to make applications robust to failures, so, in presence of failures, the application will continue running.
While there has been work on detecting and correcting errors in computer arithmetic, all known cases involve special, redundant hardware or large software overhead. We examined new techniques in software that could have reduced overhead. We designed and ran test simulations for detecting and correcting errors in integer and floating point arithmetic. For integer arithmetic, we applied the Chinese remainder algorithm to reduce an integer (32 bit) calculation to char (8 bit) calculations, which are about 4x faster, in various moduli, and then reconstructed the result using different moduli groups to identify and correct errors. Similarly, single precision floating point (32 bit) is on most architectures at least twice as fast as double precision floating point (64 bit), and we suspect that half precision will likely be about 2x faster than single precision on future architectures. We designed a means of performing double precision calculations additionally in single precision for comparison up to a user-specified tolerance.

Name: Scott Ramsey
Program: GRA
School: University of Illinois at Urbana-Champaign
Group:X-3
Mentor: James Kamm
Category: Computing
Type: Technical Talk

Evaluation of the Guderley Converging Shock Wave Standard Solution Mode

The self-similar converging-reflecting shock wave problem first examined by G. Guderley in 1942 is re-examined in a verification study of the Eulerian hydrodynamics code RAGE. In this investigation we will briefly review the formulation of a converging shock wave problem that leads to a self-similar solution mode. Following this development, we will conduct a brief discussion regarding the manipulations necessary to convert exact solution results to a form consistent with RAGE input and output. The investigation will conclude with a presentation of exact solution results, corresponding results from RAGE, a discussion of notable differences between the two data sets, and convergence analyses.

Name: Julia Schevel
Program:UGS
School: Rice University
Group:T-04
Mentor: Christof Teuscher
Category: Computing
Type: Technical Talk

Needs-based Agent Activity Generation by Means of Genetic Algorithms

A recurring problem in agent-based modeling is the optimization of the daily activity schedule of an agent given a set of possible activities. This optimization question becomes even more pressing as populations of agents increase to large population scales and long durations (simulation of 1 million or more agents for one year). In a break from the purely utility-motivated approach that has been favored in the past, we propose to model an agent's behavior based on fulfilling a set of basic but competing needs: sleep, hunger, health, social interaction, and happiness. This needs-based approach is more closely derived from first principles of human behavior, and so may better resemble human decision making processes. We model each need as a numeric value that decreases with a function over time and increases by doing activities that fulfill each need. Using genetic algorithms, we optimize the parameters of each "need function" for a moving 24-hour simulation period; the solutions will be used to obtain the initial agent simulation parameters. With the addition of temporal constraints on the activities, we obtain daily schedule results in agreement with the utility-based schedules. Future work will incorporate further refinement of the activity selection mechanism through the implementation of reinforcement learning; future extension of the travel capabilities of the agents will also more closely model everyday human behavior. The ultimate goal will be to incorporate this technique into a large-scale agent simulation.

Name: Christopher Smith
Program:UGS
School: New Mexcio Tech
Group:ACS-PO
Mentor: Justin Doak
Category: Computing
Type: Technical Talk

Facilitating Dynamic Policy For Handling Network Security Events

The purpose of the Framework for Responding to Network Security Events (FRNSE) is to gather and correlate data from various sensors and log files in order to respond in near real-time to potential security threats. FRNSE currently has several important, hard-coded elements including policy, alert syntax, and database configuration. This structure is fairly rigid, making it difficult to adapt FRNSE to a constantly changing security environment. New sensors and network rules are needed to keep pace, and it is impractical for these changes to be made by anyone other than the FRNSE developers because they require software modifications. The focus of our project is to abstract these elements into configuration files, while keeping FRNSE's core a black box. The goal is that individuals with minimal knowledge of FRNSE's architecture will be able to easily tailor the system to best counteract current security threats.

Name: Aaron Torres
Program: GRA
School: New Mexico Tech
Group:HPC-5
Mentor: Meghan Wingate
Category: Computing
Type: Technical Talk

Storage of Large File System Data and Statistics Generation Processing for Parallel Program

Storage of Large File System Data
When working with extremely large file systems containing many files like those found in LANL clusters, it's often useful to perform statistical analysis on many aspects of the file system. For example, it may be advantageous to determine the size of files across the clusters or the distribution of files in directories for future planning and understanding users habits and needs. There are immediate practical applications for these statistics as well, such as deleting unused files that are taking up valuable space. Due to the sheer size of the file system, it's impractical to inspect every file whenever information about the file system is needed. This can be partially dealt with by storing data associated with the files into a database. In addition, this stored data can later be used for historical analysis.
Statistics Generation Processing for Parallel Program
A secondary data analysis problem in HPC storage management stems from the proliferation of benchmarking programs. Each program reports different metrics of the storage system in a different format making analysis difficult and generalizations across programs almost impossible. A generic framework for outputting and structuring the data is needed. By manipulating the programs to output key value pairs, the data may then be stored in a database, which allows for easier graphing and analysis of the results.

Name: Alyssa Brooks
Program:UGS
School: New Mexico State University
Group:EES-2
Mentor: Rod Linn
Category: Earth and Space Science
Type: Technical Talk

Investigation of Boundary Condition Impacts on Solutions of the Two-dimensional Incompressible Navier-Stokes Equations with a Buoyancy Source

It is a notorious fact that boundary conditions immensely affect results in computational fluid dynamics. Implementation of different boundary condition types can transform final results drastically. Using a finite differencing model for solving the two dimensional, incompressible Navier-Stokes equations, the diverse impacts of various boundary condition types will be investigated. In these demonstrations, the physical and/or numerical source of problems that inevitably arise when boundary conditions are altered will be examined, and potential mitigation techniques for such boundary condition issues will be tested. In order to examine and assess the boundary condition impacts, an ensemble of simulations is performed and the results are analyzed, visualized, and discussed.

Name: Jesse Canfield
Program:GRA
School: Florida State University
Group:EES-2
Mentor: Rodman Linn
Category: Earth and Space Science
Type: Technical Talk

Grass Fires in an Unstable Boundary Layer Over Flat Terrain

Wildland fires tend to occur in summer months during unstable atmospheric conditions. Solar heating of the earth's surface leads to unstable boundary layer growth during daylight hours and stable boundary layer growth in the evening hours. It has been speculated that wildfire activity intensifies under unstable boundary layer conditions. HIGRAD/FIRETEC, a coupled hydrodynamics-wildfire model, was used to investigate the differences in wildfire behavior between an unstable boundary layer (negative vertical potential temperature gradient) and a neutral boundary layer (zero vertical potential temperature gradient). Four situations were simulated. All four involved a homogeneous layer of fuel representative of grass. Each case started as a wind field that was initialized with an exponential shear profile that approached ~ 8 (m s-1) at the top of the surface layer (~ 100 meters above the ground). Two of the cases represented a neutral boundary layer and the other two cases involved an unstable boundary layer. One of the unstable cases was simulated with the effects of Coriolis while the other was calculated without it. The neutral cases were split up in the same fashion: one with Coriolis and the other without. The motivation behind comparing fires in the presence of Coriolis to those without presents itself with the fact that a growing boundary layer has a change in direction of the wind vector within tens of meters above the ground under the influence of Coriolis. Fire Spread rate, fire intensity, temperature distribution, and turbulence are a few of the metrics that will be used to compare these four scenarios.

Name: Steve Guimond
Program:GRA
School: Florida State University
Group:EES-2
Mentor: Jon Reisner
Category: Earth and Space Science
Type: Technical Talk

Remote Sensing and Modeling of Hurricane Intensification

Hurricanes, such as Katrina (2005), can have a detrimental effect on life and property as well as the energy industry. Mitigation of these risks relies heavily on accurate, timely forecasts of hurricane track, intensity and structure. Although track forecasts have improved significantly over the last decade, intensity and structure forecasts remain poor with little improvement. One main reason for the lack of forecast skill is an incomplete understanding and observation of physical processes occurring within the hurricane core and environment.

In order to address these problems, we utilize unique airborne Doppler radar data collected in the core of rapidly intensifying Hurricane Guillermo (1997) along with a state-of-the-art atmospheric model that solves the compressible Navier-Stokes equations. The radar data is used to retrieve the four-dimensional latent heating field, which forces the model to achieve an accurate depiction of the evolution of the storm.

The simulation results highlight the importance of incorporating remote sensing observations into a model for improved understanding of hurricane intensity and structure change. The use of LANL's new dual-frequency lightning array as a means to infer latent heating structure when and where radar data areunavailable will be discussed.

Name: Sarah Nelson
Program:UGS
School: New Mexico State University
Group:EES-2
Mentor: Rod Linn
Category: Earth and Space Science
Type: Technical Talk

Wind Turbine Interaction With the Surrounding Atmosphere

By the year 2030, the US Department of Energy wants to use wind power to supply 20% of the nation's energy. This has made wind the fastest developing renewable energy source. Because of this goal, it is necessary to improve wind energy technology and make wind turbines more efficient and longer-lasting. This means it is critical to understand the interaction between wind fields and turbines. The main influences on this interaction are shear, turbulence, and wind direction. Using an atmospheric hydrodynamics code, HIGRAD, adapted for wind turbine simulations, the impacts of upstream wind conditions on the turbines are explored. Different environmental factors can affect these conditions, namely topography and vegetation. This work explores the main effects of these conditions on the torque around the hub, the forces on the blades (including fatigue), and the downwind velocity and vorticity fields. From this data, we will hopefully be able to make improvements to wind turbine design and aid DOE in reaching this wind energy supply goal.

Name: Jeremy Sauer
Program:GRA
School: Florida State University
Group:EES-2
Mentor: Rod Linn
Category: Earth and Space Science
Type: Technical Talk

Interaction of Atmosphere and Fire in Heterogeneous Canopies

The development of internal boundary layers in atmospheric flows over largely homogeneous forested regions is well described in literature. By specifying velocity profiles and turbulent kinetic energy (TKE) boundary conditions based on these results to a limited domain, coupled atmospheric dynamics/ wildfire model (HIGRAD/FIRETEC), simulations are performed providing insight into the effect of non-uniform canopy structure on wildfire propagation. Several numerical experiments investigating realistic canopy heterogeneity are performed, and the interaction of internal boundary layer dynamics and wildfire show increased fire spread rate and burned area under certain conditions of canopy fuel distributions. Results obtained show the cause and effect relationship between extensive canopy discontinuity and either decreased or increased surface winds and TKE, which yield subdued or amplified fire spread situations. This information provides firefighters and land managers new insight into beneficial fire mitigation and tree-thinning strategies, and moreover far-reaching awareness of less intuitive, potentially catastrophic canopy structure regimes.

Name: Sezer Atamturktur
Program:UGS
School: Pennsylvania State University
Group:X-3
Mentor: Francois Hemez
Category: Engineering
Type: Technical Talk

A Discussion on Predictive Maturity of Computer Models using Functional and Multivariate Output

Computer simulations are valued in science and engineering because they enable us to gain insight about phenomena which would otherwise be very difficult to predict. The indispensable role of modeling and simulation in decision-making motivates the attempts to assess the predictive maturity of the multi-scale multi-physics simulation models. This typically involves forward and backward statistical inference, which combines the results of repeated model simulations and physical experiments. In the framework of Bayesian calibration, the model can be improved in two principal ways. The first way is the "parameter calibration" approach, which captures the inaccuracy of the input parameters. The second way is the "bias correction" approach, which captures the inadequacy of the model itself. In our work, we can simultaneously calibrate the imprecisely known input parameters and quantify the inadequacies in the model. The dependency on simulations primarily stems from our inability to conduct a sufficient number of experiments within the desired settings or with enough detail due to various reasons. However if we were able to conduct a large enough number of experiments, we could reduce the uncertainty in our knowledge down to uncontrolled natural variability. What this implies in our case is that unless the model is missing a fundamental component to represent the relevant physics as new experimental data-set is added to the calibration process, the calibrated parameters should converge to their true values, and thus the test and analysis disagreement should be reduced down to the bias. We illustrate our approach on physical data-sets from the non-linear Preston-Tonks-Wallace material model of plastic deformation. The experimental data are the stress-strain curves of Tantalum and Beryllium collected at various settings of temperatures and strain rates. Results suggest that this approach can provide insight into the predictive maturity of numerical models.

Name: Paul Day
Program:GRA
School: Stanford
Group:PMT-4
Mentor: Cameron Turner
Category: Engineering
Type: Techincal Talk

Automated Testing Platform for Microstructure Adhesives

The field of climbing robotics has become a popular area of research in recent years due to the wide range of applications for such platforms. One proposed application of these robots is the automation of mundane, repetitive, and ergonomically stressful glovebox applications such as cleaning and contamination testing.

Climbing robots utilizing 'directional dry adhesives' are of particular interest to LANL because of their small footprint and their ability to adhere to smooth, non-magnetic surfaces. This special class of adhesives generates adhesion only in the presence of tangential loading on the sample. Furthermore, the amount of adhesion generated is directly proportional to the tangential load applied. This property makes it ideal for climbing robots by allowing zero detachment force when the tangential loading decreases to zero.

Insofar, these adhesive have only been tested in open air laboratories. An adhesive testing platform is therefore necessary to examine adhesive performance under a variety of glovebox conditions and determine if directional dry adhesives are appropriate for this application. Such a platform is being built at LANL for PMT-4 and its construction and proposed testing will be discussed.

Name: Corey Kalma
Program:UGS
School: New Mexico Tech
Group:WCM-4
Mentor: Deborah Lucero
Category: Engineering
Type: Technical Talk

Design and Tooling Engineering for Tools, Fixtures and Gages

Tooling, fixtures and gages coordination and engineering for War Reserve involves everything from meeting with a weapons customer in order to decide form, fit and function, and technical requirements to completion and use of a tool fixture and gage. Once the technical requirements are determined and customer expectations are provided then a design of the tool, fixture or gage can be created. Material requisition, fabrication, inspection, and acceptance of the tool, fixture or gage are to be satisfied. These processes include detailed processes, steps and procedures that must be applied and completed before any fabrication can take place.

Name: Jeffrey Kammerman
Program:UGS
School: University of Texas- Austin
Group:X-4
Mentor: Mark Carrara
Category: Engineering
Type: Technical Talk

An Analysis of the Forrest Fire Reactive Burn Model

In this study, the Forrest Fire reactive burn (FFRB) model is analyzed, in conjunction with the BKW equation of state, to calculate the shock initiation properties of various high explosives with particular emphasis on PBX-9502. Results are compared to experimental Pop-Plot data showing the run distance to detonation as a function of pressure. The effects of mesh resolution, artificial viscosity, and variations of the cut-off pressure parameter in the FFRB model is studied. It is found that the results from the FFRB model are strongly mesh dependent. However, mesh convergence is observed at relatively high resolution. Furthermore it is found that the for coarse mesh resolution, increasing artificial viscosity leads to a decrease in detonation pressure and increase in run distance to detonation. It is found that results are relatively insensitive to cut-off pressure in the FFRB model, and overall computational results agree well with the experimental data over large ranges of mesh resolution.

Name: Brian Kiedrowski
Program: GRA
School: University of Wisconsin-Madison
Group:X-3
Mentor: Forrest Brown
Category: Engineering
Type: Technical Talk

Measurement and Reduction of Variance Bias in MCNP k-Effective Calculations

The variance estimates in the Monte Carlo n-Particle (MCNP) code k-effective calculations are underestimated due to the correlation of source distributions between iterations. Tally variances calculated by MCNP are especially biased. The Wielandt method, an alterative to the power iteration method, stochastically extends the number of fission generations tracked within a cycle and claims to reduce the bias in the variance estimates. This assertion is confirmed by directly computing actual variances of mesh tally results via numerous different random number seeds and comparing them to the variances computed by the Wielandt method.
The mutual information is a metric to assess inter-cycle correlation. The mutual information is proportional to the directly computed variance biases as the number of fission generations is varied with Wielandt's method. The time required for the cycle source distribution correlation to decay increases asymptotically as the dominance ratio approaches unity. A wide range of criticality test problems are assessed and an empirical relationship of the dominance ratio versus required fission chain length is obtained that may help guide the selection of the Wielandt parameter.

Name: Brian Kienitz
Program:GRA
School: Case Western Reserve University
Group:MPA-11
Mentor: Fernando Garzon
Category: Engineering
Type: Technical Talk

The Effects of Cationic Contamination of Polymer Electrolyte Membrane Fuel Cells

Hydrogen polymer electrolyte membrane fuel cells hold the potential to provide clean and efficient energy while lessening our dependence on foreign oil. The mass commercialization of hydrogen fuel cells requires improvements in fuel cell durability. Durability in fuel cells can be limited by catastrophic events such as pin holes in the membrane but durability is also limited by degradation processes that occur slowly over longer times. Cationic contamination is an example of the latter type of degradation. Cationic contaminants originating from fuel lines, component corrosion, or impinging salts can cause serious performance degradation to polymer electrolyte membrane (PEM) fuel cells. This degradation is caused because these cations replace protons attached to sulfonate groups in the ionomer phase. Over longer times, the buildup of contaminant cations in the ionomer can result in significant performance losses. The mechanisms causing performance losses are not well known beyond the fact that protons in the ionomer phase are replaced by foreign cations. Typical and alternative fuel cell configurations were utilized to determine the exact mechanisms causing performance degradation. These mechanisms were then modeled using a mathematically based physical treatment.

Name: Brendan Kullback
Program:UGS
School: University of Colorado-Coloardo Springs
Group:X-4
Mentor: Mark Carrara
Category: Engineering
Type: Technical Talk

Strength Models, Temperature, and Impactor Velocity Effects on Large Strain Rate Deformation

In this study, large strain rate deformation of cylindrical copper rods as a function of impactor strength model, initial material temperature and impactor velocity is analyzed. Considered in the study are the Steinberg-Guinan (SG), Mechanical Threshold Stress (MTS), Johnson-Cook and Preston-Tonks-Wallace (PTW) strength models. Results are shown for each strength model as a function of increasing initial impactor temperature and initial velocity. It is found that increasing initial temperature leads to increased impactor deformation at constant velocity; and increasing impactor velocity leads to increased deformation at constant temperature.

Name: Alyson Niemyer
Program:GRA
School: University of Florida
Group:MPA-11
Mentor: Brian Crone
Category: Engineering
Type: Technical Talk

Interdigitated Photoconductors Using Organic and Small Molecule Materials

In this study we present research results on interdigitated organic / small molecule photoconductors. Organic semiconductors are promising materials for large area photodetectors not only because of their low cost large area processability, but also because they can have relatively large bandgaps, and low dielectric constants which enable low capacitance (and hence low noise) interdigitated device structures. We investigate photoconductivity in interdigitated lateral photoconductors with aluminum contacts, using (1) a spin-coated organic blend and (2) evaporated organic multilayers as the active layer. The effects of (1) polymer ratio in the blend, (2) number of bilayers, interdigitated diode finger spacing, aluminum thickness, polymer film thickness, and applied voltage on diode performance are discussed. The spin-coated devices are made with a blend of a poly[2-methoxy-5-(2-ethylhexyl-oxy)-1,4-phenylene-vinylene] [MEH-PPV] and {6}-1-(3-(methoxycarbonyl) propyl)-{5}-1-phenyl-[6,6]-C61 [PCBM]. We demonstrate quantum efficiencies over 70% in 5 □m devices. The evaporated devices are made from layers of alpha-sexithiophene [□-6T] and C60. Information on trapping and exciton diffusion can be calculated from a model of the intensity of the light absorbed into each layer. Design guidelines for optimum photoconductor characteristics are also discussed.

Name: Joshua Spencer
Program: GRA
School: University of Illinois
Group:X-3
Mentor: Tim Goorley
Category: Engineering
Type: Technical Talk

Charged Particle Benchmarking of the Merged MCNP Code

The MCNP team at Los Alamos National Laboratory is now deeply entrenched in the process of merging the two distinct development tracks of the famed MCNP code namely MCNP5 and MCNPX. Traditionally the focus of the former has been on the transport of neutrons and photons and electrons while the latter has worked extensively to extend the capability of MCNP to transport a larger array of charged particles as well as other exotic particles over a very broad energy range. The goal of this merger then is to bring all of the many varied features and functionality of each of the parent codes into a single new code, MCNP6. The goal of the work presented here is to conduct a validation and verification study of the charged particle component of the merged MCNP6 code. The particular points being benched marked here will be: ranges, stopping forces (powers), energy deposition and straggling of ions transported in a variety of materials.

Name: Hunter Swenson
Program:GRA
School: Colorado School of Mines
Group:MST-6
Mentor: Deniece Korzekwa
Category: Engineering
Type: Technical Talk

Distortion of Vacuum Carburized Steel Assessed by Systematic Process Variations

Carburized steels provide desired mechanical properties of high surface hardness while maintaining elevated toughness in the core material. During heat-treating, carburization and quenching cycles generate complex process histories where thermal and phase transformation induced volume changes occur and potentially lead to unacceptable component distortion.

The effects of systematic process variations on distortion of vacuum carburized gear steels were evaluated using Navy C-ring test samples. Three commercially produced alloys were tested: SAE 4320H, SAE 8620, and SAE 9310. A Taguchi matrix of experimental heat-treating and quenching parameters was utilized to assess the primary processing variables that contributed to distortion and distortion variability. Additional controlled parameters examined included part location and orientation with respect to the loading fixture and quenching rate as controlled by comparing gas and oil quenching. Dimensional data obtained from a coordinate measuring machine facilitated direct comparison between the before and after carburizing conditions.

Several specific comparisons were made between alloys and processing parameters. For example, samples subjected to gas quenching exhibited greater distortion than observed in those quenched in oil, but demonstrated lower distortion variability. Differences in distortion and distortion variability were interpreted based on a consideration of the effect of cooling medium on cooling rate profiles during quenching of the Navy C-rings. Observed effects of alloying and processing on response during heat treating are discussed relative to the effects of steel chemistry and process parameters during vacuum carburizing, and the potential applicability of the Navy C-ring results to interpret material response during component heat treating is evaluated.

Name: Shelly Vigil
Program:UGS
School: New Mexico State University
Group:DE-9
Mentor: Daniel Hooks
Category: Engineering
Type: Technical Talk

Direct Observations of Plasticity within Several Crystalline Forms of Acetaminophen

The structurally dependent mechanical properties of several forms of pharmaceutical acetaminophen are being investigated to demonstrate the relationship between deformation mechanisms, tableting quality, and co-crystallization using chemical analogs. Acetaminophen is of great interest to the pharmaceutical industry, as it is the biologically active ingredient in Tylenol®, and continues to be investigated thoroughly as a prototypical pharmaceutical material. Orthorhombic, monoclinic, and several co-crystalline forms have been identified. Currently the enhanced tableting properties of the orthorhombic form have been attributed to its plastic deformation response without definitive evidence and the effect of additives is unknown. Nanoindentation, microhardness indentation, scanning probe microscopy, and solvent etching have been conducted on several different crystalline forms of acetaminophen to determine and compare deformation mechanisms.

Name: Luke Bornn
Program: GRA
School: University of British Columbia
Group:CCS-6
Mentor: Todd Graves
Category: Mathematics
Type: Technical Talk

Structural Health Monitoring with Autoregressive Support Vector Machines

The use of statistical methods for anomaly detection has become of interest to researchers in many subject areas. Structural health monitoring in particular has benefited from the versatility of statistical damage-detection techniques. I will present residual-based approaches for damage-detection, in particular some novel methods relying on non-linear autoregressive ideas to improve model fit and detection rate. I will also discuss ideas for combining sensory output to increase detection power.

Name: Julianne Coxe
Program:UGS
School: James Madison University
Group:LANSCE-LC
Mentor: Thomas Proffen
Category: Mathematics
Type: Technical Talk

A Nano-Sculptor's Knife: Cutting into Infinite Space

To find the atomic structure of a given sample, neutron scattering is often employed. The pair distribution function is often used to determine the local structure of complex materials. However, normally the sample is large compared to the length scale r used in the PDF analysis and the finite shape of the particles is not taken into account. This becomes a problem when running measurements on nano-size samples which can have different shapes such as sphere, sheets, tubes and belts. In the paper "Finite size effects of nanoparticles on the atomic pair distribution functions" by K. Kodama et al., functions have been derived to correct for the finite size of simple geometries. This project focused on using this function for a nanotube. This takes the limits of its radius into account but it is still assumed that the tube is infinitely long. At the time this paper above was published, no computer program had been available to calculate this specific function and eventually integrate it into existing refinement codes. Since the function cannot be analytically integrated, a program was developed to carry out the numerical integrations. Future extensions might include the introduction of particle size distributions.

Name: Vitaliy Gyrya
Program:GRA
School: Pennsylvania State University
Group:T-7
Mentor: Konstantin Lipnikov
Category: Mathematics
Type: Technical Talks

New Mimetic Finite Difference Method for Stationary Stokes Equation

We develop a new Mimetic Finite Difference (MFD) method for a stationary Stokes equation on general polygonal meshes and use it to model the motion and interaction of self-propelled bacteria as well as computing the effective viscosity of a bacterial suspension.
Physical experiments suggest that a collection of self-propelled bacteria can drastically (up to ten times) decrease the effective viscosity of the fluid. This effect can have vast practical applications, hence requiring good understanding and quantification. For instance, it may be used to facilitate drag delivery or to construct micro-fluidic devices that dynamically adjust the effective viscosity of the fluid depending on the Ph levels or other chemical properties distinguished by a particular strand of bacteria. Computing the effective viscosity for a suspension with intermediate concentration of self-propelled bacteria is virtually impossible analytically. Hence, effective numerical methods of solving Stokes equation are required. The new MFD method is designed to be just such a method. It works on general polygonal meshes and has second order convergence.
Polygonal (polyhedral) meshes have major advantages over triangular (tetrahedral) meshes. They result in a more efficient partitioning of the space and are better suited for mesh refinement and resolution of complex geometries (moving fronts, narrow gaps, etc.). Results published in the literature demonstrate that modeling of fluid flows on polyhedral meshes, as a rule, requires about half the memory and five to ten times less computation time than on triangular (or tetrahedral) meshes. We expect similar results for Stokes equation.
We present the preliminary results of the numerical simulations, highlight some of the difficulties involved in developing the new MFD method and compare it with existing Finite Element methods.

Name: Melanie Barefield
Program:UGS
School: Spelman College
Group:HIS-DO
Mentor: Theresa Cull
Category: Non-Technical
Type: Non-Technical Talk

The Effects of Traffic on Worker Stress

Worker health, both mental and physical, is vital to enhanced productivity. For this reason, many large companies invest money in equipment to make sure workers are comfortable. However, the commute to and from work can cause stress, which has been known to produce adverse physical and mental effects. Through methods of survey, by means of an interview, and naturalistic observation, the link between a worker's journey to the workplace and his/her reactions/feelings toward the experience can be uncovered. Graphs of the traffic data and survey questions shed light on the results. The results, subsequently, pave the way toward formulating a solution.

Name: Victor Albert
Program:UGS
School: University of Florida
Group: T-CNLS
Mentor: Sergei Tretiak
Category: Physics
Type: Technical Talk

Electronic Structure of CdSe Quantum Dots and Ru Complexes

We have attempted to determine the effect of ligands on the electronic structure and phonon-induced relaxation in semiconductor quantum dots (QD). This includes creation and geometry optimization of QD systems passivated by different ligands [P(CH3), NHCH3, NH-CH-CH2], pyridines, and others. I am focusing primarily on calculations of the electronic structure and optical spectra of the systems. Binding energies and ionization potentials have also been calculated to analyze the effect of ligands on the opt-electronic properties of the QDs.

Name: Timothy Berkelbach
Program:UGS
School: New York University
Group:T4
Mentor: Joseph Abdallah
Category: Physics
Type: Technical Talk

Theoretical Investigations of Xenon Plasma Kinetics and Spectroscopy

The use of atomic clusters as sources for ultrashort laser-produced plasmas has been of considerable interest lately due to the cluster's more efficient energy absorption than in gaseous or solid counterparts. Applications include the industrial production of X-rays, medicine and biology, and even nuclear fusion. As such, the ability to accurately explain and predict the associated plasma kinetics and spectroscopy is highly desirable. In this work, we employ the Los Alamos atomic physics codes to model the X-ray emission spectrum of xenon clusters and compare results with those of experimentalist collaborators utilizing femtosecond laser pulse spectroscopy. We find that the commonly employed configuration average approximation breaks down and significant spin-orbit splitting necessitates a detailed level accounting. Additionally, in seeking to quantify the plasma's electron temperature and ion density, we discover a non-uniformity often times neglected; to accurately match the experimental spectrum we must employ a temperature gradient which allows for the presence of all relevant peaks and generates a subsequent theoretical spectrum in very good agreement with experiment. Continuing work includes exploring fully relativistic atomic structure and its effect on the generated spectrum.

Name: Seth Difley
Program:GRA
School: Masschusetts Institute of Technology
Group:CNLS
Mentor: Sergei Tretiak
Category: Physics
Type: Technical Talk

Extending the Lifetime of Organic Solar Cells and Light Emitting Devices

Organic solar cells and light emitting devices are an exciting alternative to traditional inorganic devices. Increasing the operational lifetimes of these devices is one of the challenges to using them in large scale commercial applications. In this talk, we will discuss why these devices fail after a relatively short time and efforts to extend their operational lifetimes.

Name: Austin Jackson
Program:UGS
School: Queens University
Group:P-23
Mentor: Andrew Hime
Category: Physics
Type: Technical Talk

Investigating the Optical Properties of Platinum Plated PMTs for use in a Low Background Dark Matter Experiment

Photo Multiplier Tubes (PMTs) are very efficient at detecting individual 'blue' photons, which makes them prime candidates for the detection of scintillation light. The MiniCLEAN experiment is attempting to directly detect WIMPs by detecting the photons given off by the WIMP inelastically scattering off of an atom of liquefied Argon or Neon thus releasing scintillation light. Platinum is added to the PMTs to allow them to function down to 27 Kelvin. I will be discussing the experimental results of the optical tests on the Platinum PMTs, and comparing the optical effect of sandblasted glass to regular glass.

Name: Jakob Kotas
Program:UGS
School: Cornell University
Group:T-4
Mentor: James Colgan
Category: Physics
Type: Technical Talk

Plasma Temperature and Density Dependence for Collisional Cross Section Calculations

In modeling dense plasmas, the probability of an electron-ion or photon-ion collision is calculated and expressed using a cross section. For most applications, each collisional process is treated as independent of the ambient conditions of the plasma medium. Our research aims at introducing plasma temperature and density dependence into the cross section calculations to give a more accurate depiction of the occurrent collisions. At high densities, the presence of other ions nearby effectively partially screens the target ion as seen by the incoming particle. The LANL atomic collision codes GIPPER and ACE have been modified to include the static Debye-Hückel screening factor (which is a function of both temperature and density.) Two types of collisions have been considered to date: electron-impact ionization and electron-impact excitation. Results will be discussed and comparisons made with previous work where possible.

Name: Qiming Lu
Program: GRA
School: Rensselaer Polytechnic Institute
Group:CCS -3
Mentor: Christof Teuscher
Category: Physics
Type: Technical Talk

Damage Spreading in Spatial and Small-world Random Boolean Networks

Random Boolean Networks (RBNs) are often used as generic models for certain dynamics of complex systems, ranging from social networks, neural networks, to gene or protein interaction networks. Traditionally, RBNs are interconnected randomly and without considering any spatial arrangement of the links and nodes. However, most real-world networks are spatially extended and arranged with regular, small-world, or other non-random connections. Here we explore the RBN network topology between extreme local connections, random small-world, and random networks, and study the damage spreading with small perturbations. We find that spatially local connections change the scaling of the relevant component at very low connectivities (<k> << 1) and that the critical connectivity of stability K_s changes compared to random networks. At higher <k>, this scaling remains unchanged. We also show that the relevant component of spatially local networks scales with a power-law as the system size N increases, but with a different exponent for local and small-world networks. The scaling behaviors are obtained by finite-size scaling. We further investigate the wiring cost of the networks. From an engineering perspective, our new findings provide the key trade-offs between damage spreading (robustness), the network wiring cost, and the network's communication characteristics.

Name: Kyle Martin
Program:UGS
School: University of New Mexico
Group:T-6
Mentor: Siming Liu
Category: Physics
Type: Technical Talk

Modeling the Emission from the Supermassive Black Hole in the Galactic Center with GRMHD Simulations.

Sagittarius A* is a compact radio source at the galactic center, powered by accretion onto a supermassive black hole of ~4 million solar masses. The radio emission cannot be produced through thermal synchrotron processes in a gravitationally bounded flow. General relativistic magneto-hydrodynamical simulations of black hole accretion show that there are strong unbounded outflows in accompany with the accretion. With the flow structure around the black hole given by GRMHD simulations, we investigate whether thermal synchrotron emission from these outflows may account for the observed radio emission and discuss the implications of this study on GRMHD simulations of the accretion flow in Sagittarius A* and possible production of non-thermal particles by this source.

Name: Andrew Mastbaum
Program:UGS
School: Lehigh University
Group:P-23
Mentor: Andrew Hime
Category: Physcis
Type: Technical Talk

Dark Matter and the miniCLEAN Experiment

It is now firmly established that the matter content of the Universe is largely comprised of an unknown and non-luminous form. Astronomical observations and particle theory place WIMPs (Weakly Interacting Massive Particles) among the foremost of dark matter particle candidates. LANL scientists are currently leading efforts to develop a novel dark matter detector, which will observe WIMPs through recoils in a cryogenic noble liquid scintillation medium. In the current phase, the collaboration is developing miniCLEAN-360, a 360 kg LAr/LNe detector with a 100 kg fiducial volume. Full detector simulations, supported by experimental tests of detector components are key to the success of this project. An overview of dark matter research and this project will be presented, as well as methods and results of detector simulations and component testing.

Name: Andrea Schmidt
Program:GRA
School: University of New Mexico
Group:AET-2
Mentor: Joseph Fasel
Category: Physics
Type: Technical Talk

Radiation Theory of Astronomical Sources that Move Faster than Light: Applications to Pulsars

Recent experimental and theoretical work has established that patterns of electric charges and currents can be animated to travel faster than the speed of light in vacuo and that these superluminal distribution patterns emit tightly focused packets of electromagnetic radiation that are fundamentally different from the emissions by previously known terrestrial radiation sources. Novel antennae that employ extended distributions of polarization currents moving faster than light have been demonstrated to be effective emitters of electromagnetic radiation and are currently tested for applications in radar and low-power, secure communication technologies here at LANL.
Inspired by the construction of these machines we have carried out analytical and numerical studies of the radiation emitted by localized faster-than-light sources of various trajectories. Our initial results strongly suggest that superluminal emission is not only a human artifact but an important and likely ubiquitous process in the observable universe that may represent significant amendments to standard models of many astronomical objects. Here we valuate and visualize the radiation field generated by a localized charge in superluminal circular motion and compare our studies to astronomical observations of pulsars – rapidly spinning, highly magnetized neutron stars. We show that virtually all of the enigmatic features of pulsar radiation – the polarization properties, image structure, apparent radiation temperature and peak spectral frequencies – can be explained using a single, elegant model with few input parameters and no external assumptions.

Name: Michael Soo
Program:UGS
School: University of Illinois Champaign-Urbana
Group:P-25
Mentor: Takeyasu Ito
Category: Physics
Type: Technical Talk

Electrostatic Analysis for the Neutron Electric Dipole Moment Project

Though the Standard Model (SM) of Particle Physics has been able to predict a considerable amount of particle behavior, it has shown to be insufficient to describe the baryon asymmetry of the universe (BAU). A non-zero measurement of the Neutron Electric Dipole Moment (EDM) above that which is predicted by the SM could lead to an explanation of the BAU. The proposed experiment involves the application of a weak uniform magnetic field and a strong uniform electric field to the neutrons that, should a large EDM exist, will cause the neutrons to process. The signature for the EDM will be a change in the precession frequency due to the electric field. A uniform field strength of is required throughout the measurement cell to suppress systematic errors and prevent sparks. Three-dimensional field modeling reveals high voltage problems and non-uniformity before the experiments take place and provides a reference for what to expect in the current designs.

Name: David Van Maanen
Program:UGS
School: Pennsylvania State University
Group:T-4
Mentor: Garret Kenyon
Category: Physics
Type: Technical Talk

Oscillations of Visual Stimuli in the Primary Visual Cortex

The visual pathways in the brain are only slightly understood. The best computer models at present can only match human performance in basic speed of sight tests. These models lack some of the basic mechanisms in the brain, such as feedback and spiking dynamics. Experimental data seems to indicate that the spike timing is important and is often seen in the form of oscillations. Taking this into account, it is safe to think that these oscillations may play a role in the visual system, such as in object detection and numeracy. To test this, a spiking computer model of the primary visual cortex, V1, with co-circular excititory interactions was modified to include co-circular inhibitory ineractions as well. This model was then compared against psychophysical data of new speed of sight tasks. This should show the importance of spike timing in the visual cortex.

Name: Adam Wachtor
Program:GRA
School: University of California- Irvine
Group:X-3
Mentor: Fernando Grinstein
Category: Physics
Type: Technical Talk

Proper Orthogonal Decomposition of Variable Density Turbulent Flow

Variable density flows are abundant in nature and found in a wide range of industry applications. Variable density turbulent mixing of two miscible fluids is analyzed in the context of a homogeneous flow through the Proper Orthogonal Decomposition (POD). The POD is used to decompose the scalar density and vector velocity fields into eigenfunctions with corresponding eigenvalues. By substituting time in the domain of integration for the POD integral equation, instead space which is typically the case, the eigenfunctions produced from the POD analysis correspond directly to optimal evolutions of the flow with the the eigenvalues describing how much density variance or kinetic energy is associated with each evolution process given by the decomposition. A brief description of the POD is presented and results from the POD of the scalar and velocity fields are discussed.