Plenary Sessions

Monday AM I: Opening Plenary and Distinguished Plenary A

Session Chair D. Sutter, University of Maryland

Physics Beyond LHC
H. Murayama, University of California, Berkeley

Future of R&D for Very High Energy Colliders
T. Raubenheimer, Stanford Linear Accelerator Center

Monday AM II: Distinguished Plenary B

Session Chair I. Ben-Zvi, Brookhaven National Laboratory

Laboratory Astrophysics
P. Chen, Stanford Linear Accelerator Center

Laser Technology
C. Barty, Lawrence Livermore National Laboratory

Monday PM I: Plenary C

Session Chair C. Clayton, University of California, Los Angeles

Advanced Accelerating Structures and their Interaction with Electron Beams
Wei Gai, Argonne National Lab

In this presentation, we give a brief description of several advanced accelerating structures, such as dielectric loaded waveguide, photonic band gap, meta-materials and improved iris-loaded cavities. We describe wakefields generated by passing high current electron beam through these structures, and wakefield applications to advanced accelerator schemes. One of the keys to success for the high gradient wakefield is to develop the high current drive beam sources. As an example, the high current RF photo injector at the Argonne Wakefield Accelerator, passed ~ 80 nC electron beam through a high gradient dielectric loaded structure that achieved 100 MV/m. We will summarize recent related experiments on beam-structure interactions and also discuss high current electron beam generation and propagation and their applications to wakefield accelerations.

Laser-Driven Plasma Accelerator Experiments: Injection And Guiding
Cameron G.R. Geddes, Lawrence Berkeley National Laboratory

With demonstration of narrow energy spread and GeV energies, LWFA beam quality, stability, and tunablity must be improved to meet application requirements. Experiments are hence optimizing LWFA performance by controlling electron injection into the wake and by guiding the laser pulse to extend and control the accelerator structure. Electron beam injection has been controlled through self trapping, density structures, and colliding laser pulses producing stability, reduced momentum spread and tunability. Laser pulses have been guided over > 10 diffraction ranges, extending acceleration length, using preformed plasma channels using hydrodynamic shock, capillaries, and magnetic restriction of heat transport. Experiments have also now demonstrated self guiding of ultrashort laser pulses. Staging of controlled injection and structures to improve beam quality is now in progress.

Beam-Driven Plasma Accelerator Experiments
T. Katsouleas, Duke University

Tuesday AM I: Plenary D

Session Chair J.-L. Vay , Lawrence Berkeley National Laboratory

Particle Beam Radiation Diagnostics

Ralph B. Fiorito, University of Maryland

I review the state of the art of diagnostics based on radiation produced by charged particle beams, which are currently being used to measure their transverse and longitudinal parameters. The properties and diagnostic capabilities of the incoherent and coherent forms of these radiations are described. Examples of diagnostics for electron and proton beams using transition, diffraction and synchrotron radiation are presented.

Ion Acceleration

M. Zepf, Queen's University Belfast

New Developments in the Simulation of Advanced Accelerator Concepts

David Bruhwiler, Tech-X Corporation

Improved computational methods are essential to the diverse and rapidly developing field of advanced accelerator concepts. An overview of recent work will be presented, organizing the wide range of approaches and techniques through consideration of a few important themes. Use of simulations to help advance the field via idea generation and support of experiments will be the primary theme. Novel numerical techniques that have been successful recently or show significant promise for the future will be emphasized. We will also discuss algorithms for reduced models that can be orders of magnitude faster than their higher-fidelity alternatives, as well as important on-going efforts to include more realistic physical processes that were previously neglected.

Wednesday AM I: Plenary E

Session Chair C. Joshi, University of California, Los Angeles

Structure Breakdowns

G. Nusinovich, University of Maryland

Laser Wakefield Acceleration: Novel Diagnostics and PW-Class Experiments

Stuart Mangles, Imperial College London

P P Rajeev, K Ertel. S Hawkes, C J Hooker. B Parry, M Streeter (STFC Rutherford Appleton Laboratory); N Bourgeois. T Ibbotson, S Hooker, T Rowlands-Rees (University of Oxford); S Kneip, S R Nagel, C Bellei, A E Dangor, C Kamperidis, A G R Thomas, C Palmer, L Willingale, Z Najmudin, J Schreiber (Imperial College London); D Urner, G Ducas, N Delarue (John Adams Institute, University of Oxford); O Chekov, E J Divall (STFC Rutherford Appleton Laboratory)

The first part of this talk will discuss some of the techniques we have used to diagnose laser wakefield acceleration experiments. These include using measurements of the electron beam profile and wavebreaking radiation to aid understanding of the self-injection process; studying x-ray betatron radiation as a diagnostic of direct laser acceleration and studying the dynamics of plasma wave formation through the effect on the laser pulse after the interaction. The second part of the talk will present data taken from the first experiments on the new PW Class Astra Gemini laser system at the STFC Rutherford Appleton Laboratory, UK. The first experiments, performed at up to 180 TW (10 J in 55 fs), examined the scaling of self-guiding, self-injecting LWFA to these higher powers. We will present data showing centimeter scale self-guided channels producing well collimated quasi-monoenergtic beams of electrons up to 0.4 - 0.8 GeV. Preliminary measurements of x-rays generated by betatron oscillation of the beam inside the plasma will also be presented. Early analysis shows an improvement in the beam stability compared with earlier experiments on the 20 TW Astra laser system. The results will be compared with non-linear wakefield scaling theory and particle-in-cell simulations of the experiments.

Particle Beam Dynamics in Plasma Accelerators
W. Mori, University of California, Los Angeles

Thursday AM I: Plenary F

Session Chair R. Temkin, Massachusetts Institute of Technology

Generation and Control of Electron Beams
Philippe Piot, Northern Illinois University and Fermi National Accelerator Laboratory
Many advanced acceleration and light source concepts rely on the production of bright electron beams. Generating and transporting such high brightness electron beams at low energy is challenging due to nonlinear space charge forces. One approach, recently explored, calls for generating idealized particle distributions capable of providing emittance preserving, linear space charge forces; however, these techniques are not without their shortcomings. In other applications it is advantageous to "repartition" the six-dimensional phase space to individually "match" the required two-dimensional phase spaces. Finally, there exist still other applications, such as the PWFA, DWFA schemes, whose performances (measured in term of the "transformer ratio") could be considerably enhanced if driven by a linearly ramped bunch or a train of bunches with linearly increasing charge. The generation of a micro-bunched electron beam could also have application in the production of superradiant radiation. Several groups are tackling these various challenges and in this report we attempt to give a review of the current state of the art.

Optical Accelerator Structures
Benjamin Cowan, Tech-X Corporation
Dielectric accelerator structures operating at optical frequencies have the potential to attain order-of-magnitude improvement in accelerating gradient over conventional RF structures due to high damage thresholds. Phase-matching the electromagnetic fields to a relativistic particle beam, along with manufacturing constraints at optical lengthscales, requires novel structure geometries. We discuss recent and ongoing developments in optical structure design. The concept of photonic crystal confinement is presented, and

we describe theoretical and experimental work on both three-dimensional and fiber structures. We also discuss side-pumped grating geometries. In addition, we present a mechanism for confining a particle beam transversely in micron-scale structures.

High Performance Modeling of Advanced Accelerators in the Era of Petascale Computing

Brian J. Albright, Los Alamos National Laboratory
Kevin J. Bowers, Lin Yin, Benjamin Bergen, William Daughton, Thomas J. T. Kwan (Los Alamos National Laboratory)

In June 2008, the Roadrunner supercomputer moved to the head of the TOP500 Supercomputer list, evincing for the first time petaflop/s-scale computing--that is, a million billion operations per second. Built by IBM for the National Nuclear Security Agency and housed at the Los Alamos National Laboratory (LANL), Roadrunner employs a "hybrid" architecture employing 12260 IBM PowerXCell 8i chips, derived from the chips powering the Sony Playstation III video game console, as well as 6562 dual-core AMD Opteron chips. Hybrid supercomputers offer significant advantages in system footprint and power consumption. such systems, which employ deep memory hierarchies, appear to be the most viable path for the future of supercomputing—exascale computing and beyond. The LANL VPIC kinetic plasma modeling code is a general-purpose, relativistic, explicit, electromagnetic particle-in-cell code that has been used extensively for modeling laser-plasma interaction and advanced accelerators. Over the past year, my team has modified VPIC to take advantage of the Roadrunner architecture. This has involved several changes to the codebase, to be elaborated on in this talk, that not only enable our effective use of Roadrunner, but also "future-proof" the application for rapid deployment and efficient use of future systems as well. Shortly after the LINPACK benchmark was achieved by IBM, the LANL VPIC team were among three code teams able to run on the full Roadrunner system. We measured significant speedup—typically as much as an order of magnitude--over that obtained on AMD Opteron supercomputers. One calculation of laser-plasma interaction employed over one trillion computational macro-particles, using 42 TBytes of RAM, and sustained performance in excess of 374 teraflop/s. In addition to the above, in this talk, we'll discuss where I see high performance supercomputing heading and what we as a community can do to position ourselves to take full advantage of these systems. The software design considerations we encountered in deploying VPIC on Roadrunner, which will be common to other platforms and algorithms, will also be discussed, together with some of the lessons we learned and our plans for the future.