RIA Summer School '06
Wednesday Talks
July 19, 2006

Time	Title
19:30	Application Specific Integrated Circuits (ASIC) Implementation for ORRUBA (Swan, et. al.)
19:40	The Gas Stopping Station at NSCL/MSU (Pang, et. al.)
19:50	First Observation of ^{109}I Alpha Decay (Simpson, et. al.)
20:00	High-K Bands and Gamma-Ray Directional Angular Corelation Measurements ^{168}Hf (Yadav)
20:10	New Results for the Intensity of Bimodal Fission in Barium Channels of the Spontaneous Fission of ^{252}Cf (Goodin, et. al.)
20:20	γ _ γ Angular Correlations and g-factor Measurements from Spontaneous Fission of ^{252}Cf with Gammasphere (Goodin, et. al.)
20:30	Spin Polarization Produced in Projectile Fragmentation Reactions (Pinter, et. al.)

Application Specific Integrated Circuits (ASIC) Implementation for ORRUBA

Tom Swan [1], Dan Bardayan [2], Bob Charity [3] Jon Elson [3], Robert Hatarik [1], Kate Jones [1], Steve Pain [1], Lee Sobotka [3]

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The Oak Ridge Rutgers University Barrel Array (ORRUBA) is a large solid angle silicon detector array comprising of two rings of 12 position-sensitive silicon detector telescopes, symmetrically covering angles forward and backward of 90 degrees. ORRUBA is currently in its design phase and detector testing is underway.

With such a large detector array it is worth considering alternate options to a conventional system of individual pre-amps, shaping amps, triggers and ADCs. Such an alternative is presented with ASIC chips each of which comprise eight channels of pre-amps, shaping amps and triggers allowing each ORRUBA detector to be processed by a single ASIC chip. A single ADC can be used to digitize the complete array because the ASIC system outputs two chains of multiplexed analog signals, one for time and one for energy, which contain data from all the detectors.

Testing of ORRUBA detectors using the ASIC chips was carried out at Washington University in the spring. The visit confirmed that the chips are compatible with our detectors. Energy and position resolutions for the detectors were determined during the visit. I will present results from these tests and report on the status of the project.

This work was supported in part by the US Department of Energy, the National Science Foundation, and the LDRD program of ORNL.

The Gas Stopping Station at NSCL/MSU

G.K. Pang, M. Facina, C.M. Folden III, D.J. Morrissey

The gas stopping station at the National Superconducting Cyclotron Laboratory / Michigan State University (NSCL/MSU) converts ~100 MeV/u beams from the A1900 fragment sepator into low-energy beams suitable for precision experiments. The ~100 MeV/u beams are slowed down by a set of glass degraders, a Be window, and up to 1 bar of high-purity He.

The present gas cell uses a static electric field to drift ions to the nozzole for extraction. The radioactive ions are overwhelmed by He^+ ions created during the stopping process. A new dynamic system using funnel-shaped electrodes can provide some discrimination against the light ions and may improve the efficiency.

First observation of ^{109}I alpha decay

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Charged particle spectroscopy can provide insight into the nuclear structure of exotic nuclei. Far away from the valley of stability nuclei become difficult to produce and observe. Short lifetimes and low count rates make experiments very challenging. One way to do these experiments is by implanting a nucleus into a silicon detector and observing its alpha or proton decay. At short lifetimes, the implantation induced signal distorts the energy measurement of the decay pulse. An algorithm was designed to correct this effect, making possible the observation of ^{109}I alpha decay. The method and preliminary results will be presented.

HIGH-K BANDS AND GAMMA-RAY DIRECTIONAL ANGULAR CORRELATION MEASUREMENTS ^{168}Hf

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Abstract

Two experiments were performed at Argonne National Laboratory employing the ^{96}Zr(^{76}Ge,4n) reaction. A self-supporting ^{96}Zr foil (thin target) was used in the first experiment, while the ^{96}Zr target material was evaporated onto a thick Au backing (backed target or thick target) in the second. The decay γ-rays were measured with GAMMASPHERE. Three- and four-dimensional histograms (cube and hypercube) were constructed for γ-ray coincidence analysis using the RADWARE package. As a result, the three previously observed high-K bands were linked to known structures. Spin and parity for these high-K bands were assigned using alignment properties and angular correlation measurements (DCO ratios). Details of this work will be presented.

New Results for the Intensity of Bimodal Fission in Barium Channels of the Spontaneous Fission of ^{252}Cf

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(Dated: July 8, 2006)

Triple coincidence data from the fission of ^{252}Cf were used to deduce the intensity of the proposed "hot" mode in barium channels. $\gamma-\gamma-\gamma$ and $\alpha-\gamma-\gamma$ fission data were analyzed to find the neutron multiplicity distribution for several binary and ternary charge splits. The binary channels Xe-Ru and Ba-Mo were analyzed, as well as the Ba-α-Zr, Mo-α-Xe, and Te-α-Ru ternary channels. An improved method of analysis was used in order to avoid many of the complexities associated with fission spectra. With this method, we were unable to confirm the second mode in the either the Ba-Mo or Ba-α-Zr splits.

PACS numbers: 25.85.Ca, 27.90.+b

$\gamma - \gamma$ Angular Correlations and g-factor Measurements from Spontaneous Fission of ^{252}Cf with Gammasphere

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Measurements of g-factors of excited states have been of interest for decades for the investigation of nuclear structures. The g-factors of excited states in several neutron-rich nuclei have been determined by measuring attenuated γ-ray angular correlations from spontaneous fission of ^{252}Cf with the Gammasphere detector array. A ^{252}Cf fission source was sandwiched between two iron foils (10 mg/cm^2) and placed at the center of Gammasphere. For successive transitions in a cascade with the lifetime of the intermediate state much greater than the stopping time of the fission fragments, it is assumed that the fission fragments are implanted into the iron foils before emitting γ-rays. By measuring the time-integral attenuation coefficients, the mean Larmor precession angle of the intermediate state is obtained, which is proportional to the lifetime and g-factor of the state and the hyperfine field acting on the nucleus. Lifetimes of several states have been measured by using the triple γ coincidence technique. We will present details of this technique and compare our results with previous measurements.

Spin polarization produced in projectile fragmentation reactions

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Projectile fragmentation is a demonstrated technique for producing fast beams of rare isotopes independent of chemical properties. With selection of appropriate reaction parameters, projectile fragmentation can produce isotopes with some degree of spin polarization. A kinematical model based on the conservation of linear and angular momentum qualitatively describes the polarization data [1]. The model was implemented into a Monte Carlo simulation code [2], and we have extended this code to improve its quantitative accuracy by including the process of nucleon evaporation, realistic angular distributions, de-orientation caused by γ-ray emission and by correcting for the out-of-plane acceptance [3]. We will discuss ongoing improvements to the simulation code, including: migration to ROOT analysis software to view the simulation results, alternative treatments of evaporation and mean deflection angle calculations, and the implementation of nucleon pickup in the polarization mechanism [4]. This work is supported in part by the National Science Foundation PHY0110253.

[1] Asahi et al., Phys. Lett. B 251, 488 (1990). [2] Okuno et al., Phys. Lett. B 335, 29 (1994). [3] D.E. Groh, Ph.D. Thesis (2002). [4] D.E. Groh et al., Phys. Rev. Lett. 90, 202502 (2003).