HK 19: Accelerators and Instrumentation II

Time: Monday 16:30–19:00 Location: H-ZO 90

Group Report HK 19.1 Mo 16:30 H-ZO 90

The ISOLDE facility - Recent radioactive ion beam development — •Alexander Herlert — CERN, Geneva, Switzerland

The ISOLDE facility at CERN provides a large variety of radioactive ion beams for the investigation of, e.g., nuclear structure, nuclear ground state properties, solid state physics, and fundamental interactions. The radioactive ion beam development has played a key role in the successful physics program at ISOLDE. Recent target and ion source development comprises tests of new nanostructured target materials for the production of C and Kr beams. In addition, a new plasma FEBIAD ion source was constructed that delivers ion beams with up to ten times higher ionization efficiency for light noble gases, which enabled the first observation of ^{229}Rn. The ISCOOL radiofrequency quadrupole cooler and buncher, which is part of the HIE-ISOLDE upgrade, has been applied throughout the 2008 running period and enhanced significantly the beam quality. For the resonance ionization laser ion source RILIS a new solid state laser system has started operation, which is dedicated to obtain better ion beam stability and higher ionization efficiencies, e.g., as is the case of Ga. Finally, the number of available post-accelerated beams at REX-ISOLDE has been increased, now also including for instance ^{10}C on the low-mass side and ^{204}Rn on the high-mass side. An overview of recent achievements will be presented. The support from the ISOLDE collaboration and the ISOLDE technical group is acknowledged.

Group Report HK 19.2 Mo 17:00 H-ZO 90

Developments of dedicated plunger devices for lifetime measurements of excited states in exotic nuclei — •A. Dewald[1], Th. Pissulla[1], M. Hackstein[1], C. Fransen[1], W. Rother[1], H. Iwasaki[1], J. Jolie[1], K.-O. Zell[1], A. Gadea[2], J. J. Valiente Dobón[2], K. Starosta[4], W. Korten[5], A. Görgen[5], C. A. Ur[3], and P. Petkov[6] — [1]IKP Köln, Germany — [2]INFN-LNL Legnaro, Italy — [3]University of Padova, Padova, Italy — [4]NSCL, MSU, US — [5]SPhN, CEA Saclay, France — [6]INRNE, Sofia, Bulgaria

The recoil distance Doppler-shift (RDDS) method is an important technique for the measurement of lifetimes of excited nuclear states from which absolute transition strengths can be derived. In order to use this technique for nuclei far from stability it has to be adapted to the special requirements imposed by the specific nuclear reactions in which these exotic nuclei can be produced and excited. E.g., reactions with radioactive beams or deep inelastic reactions have been successfully applied for this purpose in the past. In this presentation we want to give an overview over recent developments of plunger experiments with radioactive beams at intermediate energies (≈100 MeV/u). In addition we will report on recent developments made for measurements at PRISMA-CLARA (LNL, Legnaro, Italy) and EXOGAM-VAMOS (GANIL, Caen, France) where deep inelastic reactions have been used. Future plans for plunger experiments at PRESPEC and HISPEC (GSI) will be discussed. Supported partly by: DFG, contr.n. DE1516/1; GSI,Fu.E, OK/JOL; EC, I3-EURONS contr.n.RII3-CT-2004-506065

HK 19.3 Mo 17:30 H-ZO 90

Monte Carlo simulation tool for the ^{7}Li(p,n) reaction — •Rene Reifarth[1,2], Michael Heil[1], Franz Käppeler[3], and Ralf Plag[1,2] — [1]GSI, Darmstadt, Germany — [2]Goethe Universität Frankfurt, Germany — [3]FZK, Karlsruhe, Germany

The ^{7}Li(p,n) reaction in combination with a 3.75 MeV Van-de-Graaff accelerator was routinely used at FZK to perform activation as well as time-of-flight measurements with neutrons in the keV-region. Planned new setups with much higher proton currents like SARAF and FRANZ and the availability of liquid-lithium target technology will trigger a renaissance of this method. A detailed understanding of the neutron spectrum is not only important during the planning phase of an experiment, but also during the analysis of activation experiments.

Therefore a Monte-Carlo based program was developed, which allows the simulation of neutron spectra considering the geometry of the setup and the proton energy distribution. The program was developed and tested while accompanying a number of recent activation experiments at FZK. A comparison with measured data, examples of past usages, and potential future applications will be presented.

This project is supported by the HGF Young Investigators Project VH-NG-327.

HK 19.4 Mo 17:45 H-ZO 90

Photon/Neutron Discrimination with Digital Pulse Shape Analysis* — •Bastian Löher[1], M. Miklavec[2], N. Pietralla[1], D. Savran[1], and M. Vencelj[2] — [1]Institut für Kernphysik, Technische Universität Darmstadt, Darmstadt, Germany — [2]Institut Jožef Stefan, Ljubljana, Slovenia

The discrimination of photons against neutrons is a long-standing issue in nuclear instrumentation. The availability of powerful digital hardware makes it possible to use self learning algorithms to find signal classes. The research in this field is a fundamental necessity for a wide range of experimental applications.

In this work digital pulse shape discrimination is implemented based on a Fuzzy C-Means Clustering algorithm [1]. This way the determination of signal classes is achieved offline in an automated and universally applicable manner. The suitability of this algorithm for discrimination was validated using TOF measurements. The dependence of the *Figure of Merit* on external parameters such as detector high voltage, ADC sampling rate and bit resolution was investigated.

[1] R. O. Duda, P. E. Hart and D. G. Stork: Pattern Classification. John Wiley and Sons Inc., 2nd Ed., New York 2001

* Supported by DFG (SFB 634)

HK 19.5 Mo 18:00 H-ZO 90

A cryogenic gas catcher for high energy radioactive ions — •M. Ranjan[1], P. Dendooven[1], S. Purushothaman[1], I. Moore[2], H. Penttila[2], A. Saastamoinen[2], J. Aysto[2], W. Plass[3], C. Scheidenberger[3,4], H. Weick[4], J. Neumayr[5], P. Thirolf[5], and A. Popov[6] — [1]KVI, University of Groningen, The Netherlands — [2]University of Jyvaskyla, Finland — [3]Justus Liebig University, Giessen, Germany — [4]GSI, Darmstadt, Germany — [5]Ludwig Maximilians University, Munich, Germany — [6]Petersburg Nuclear Physics Institute, Russia

The Facility for Antiproton and Ion Research (FAIR) in Darmstadt, Germany, will allow studies of radioactive isotopes using laser techniques and ion traps. For this purpose, we are developing an ion catcher device that will stop high-energy ions from the Super-FRS in helium gas and extract them as a low-energy beam using DC and RF electric fields. The high purity of the helium gas will be ensured by operation at low temperature.

In order to demonstrate a cryogenic system that stops high-energy ions and extracts them as a low-energy beam, a cryogenic ion guide operating at liquid nitrogen temperature has been developed and has been tested at the IGISOL facility in Jyväskylä, Finland. The performance of this simplified prototype at low temperature and using a high-energy ion beam will be discussed. The operational parameters for a cryogenic gas catcher have been analysed defining the electrical and mechanical specifications of the system. A conceptual design of a cryogenic gas catcher will be presented.

HK 19.6 Mo 18:15 H-ZO 90

A Monolithic Detector Telescope Assembly with Multiplexed Electronic Readout — •Olof Tengblad[1], Miguel Madurga Flores[1], Mariano Carmona Gallardo[1], and Göran Nyman[2] — [1]IEM-CSIC, Madrid, Spain — [2]Chalmers Univ., Göteborg, Sweden

The study of excited states of unbound light nuclei includes the simultaneous detection of several charge particles emitted with very low energy. This puts sever constrains on the detection system to be used. For the detectors, high segmentation is needed to be able to detect several coincident particles, very thin dead layers to reduce the cut-of energy in combination with thin detectors to minimize sensitivity to beta and neutral particles.

For particle mass identification different techniques can be applied; Time of Flight, pulse shape analysis, or telescopes. At low energy heavy particles are easily stopped in the delta E, this makes the pulse shape technique very difficult to apply due to very weak signal and high noise level. A recent approach is using extremely thin DE detectors in monolithic assembly on a thick E detector both doped into the same wafer.

The high segmentation of the detectors leads to experiments with an increased amount of electronic channels. Optimized electronic and the use of multiplexing of the signals makes a high packing ratio possible while still keeping spectroscopy resolution. Detector and electronic developments made in parallel to experimental studies of multi particle break-up of excited states will be discussed.

HK 19.7 Mo 18:30 H-ZO 90

Fission-fragment timing with poly-crystalline diamond detectors — •Stephan Oberstedt[1], Ruxandra Borcea[1], Franz-Josef Hambsch[1], Andreas Oberstedt[2], Wouter Geerts[1], and Marzio Vidali[1] — [1]European Commission JRC-IRMM, B-2440 Geel — [2]Örebro University, S-70182 Örebro

For the investigation of prompt and delayed neutron emission in neutron-induced fission the two-arm time-of-flight spectrometer VERDI for high resolution fission-fragment spectrometry is being built at the Institute for Reference Materials and Measurements (IRMM). The ultimate goal is to achieve a mass resolution $A/\Delta A \approx 120$ in conjunction with a reasonable counting efficiency. One pre-requisite for such a device is the use of ultra-fast timing detectors, which may be operated at high radiation doses. For this purpose poly-crystalline chemical vapour deposited (pcCVD) diamond detectors have been tested for the first time as time pick-up for binary fission fragments. This type of detectors has demonstrated radiation hardness against a mix of alpha-particles, fission-fragments and prompt fission neutrons at radiation doses typically achieved during one fission experiment. For a 1×1 cm^2 large and 100 μm thick pcCVDD detector an intrinsic timing resolution better than 300 ps has been obtained. Present limitations and possible improvements will be discussed.

HK 19.8 Mo 18:45 H-ZO 90

Development of slowed down beams at GSI. — •Plamen Boutachkov[1], Fabio Farinon[1], Magdalena Górska[1], Jürgen Gerl[1], Katarzyna Hadynska[2], Rudo Janik[3], Ivan Kojouharov[1], Nikolai A. Kondratyev[4], Alvarez Marcos A. G.[5], Ivan Mukha[6], Pawel Napiorkowski[2], Farheen Naqvi[1], Chiara Nociforo[1], Daniel Pietak[2], Wawrzyniec Prokopowicz[1], Stephane Pietri[1], Andrej Prochazka[1], Henning Schaffner[1], Peter Strmen[3], and Helmut Weick[1] — [1]GSI, Darmstadt, Germany — [2]Warsaw University, Warsaw, Poland — [3]Komenského University, Bratislava, Slovakia — [4]FLNR, JINR, Dubna, Russian Federation — [5]CNA, Seville, Spain — [6]Seville University, Seville, Spain

The NUSTAR/HISPEC slowed down beam project[1] at GSI/FAIR is dedicated to rare isotopes with energies of upto 10 MeV/u. These radioactive beams will be used for spectroscopy and reactions studies. The setup for slowing down will utilize a thick degrader positioned after the FRS/Super-FRS separators at GSI/FAIR, followed by transmission detectors for energy and trajectory reconstruction. As a test, Coulomb excitation of a slowed down ^{64}Ni beam on a gold target was performed in Sep-Oct 2008 at GSI. TPC and MCP detectors were used for the tracking of the beam before and after slowing it down. The gold target, placed after the tracking setup, was surrounded partially with two DSSSDs and NaI γ-detectors. The results from the test experiment and a comparison to simulations will be presented.

[1] http://www-linux.gsi.de/ ˜wwwnustar/tech_report/09-hispec_despec.pdf * Supported by the MEC, Spain, project FPA2006-13807-C02-01