HOHENRODA / GERMANY

EURORIB'15

JUNE 7TH – 12TH, 2015

BOOK OF ABSTRACTS

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HOHENRODA/ GERMANY

EURORIB'15

7th – 12th JUNE, 2015

European Radioactive Ion Beam Conference 2015

BOOK OF ABSTRACTS

Conference Secretariat

Luise Dörsching-Steitz (GSI)
Daniela Press (GSI)
Siglind Raiss (GSI)

Email: Eurorib-2015@gsi.de

Conference web site

https://www.gsi.de/eurorib-2015

Financial support of the following institutions is acknowledged

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Scientific topics

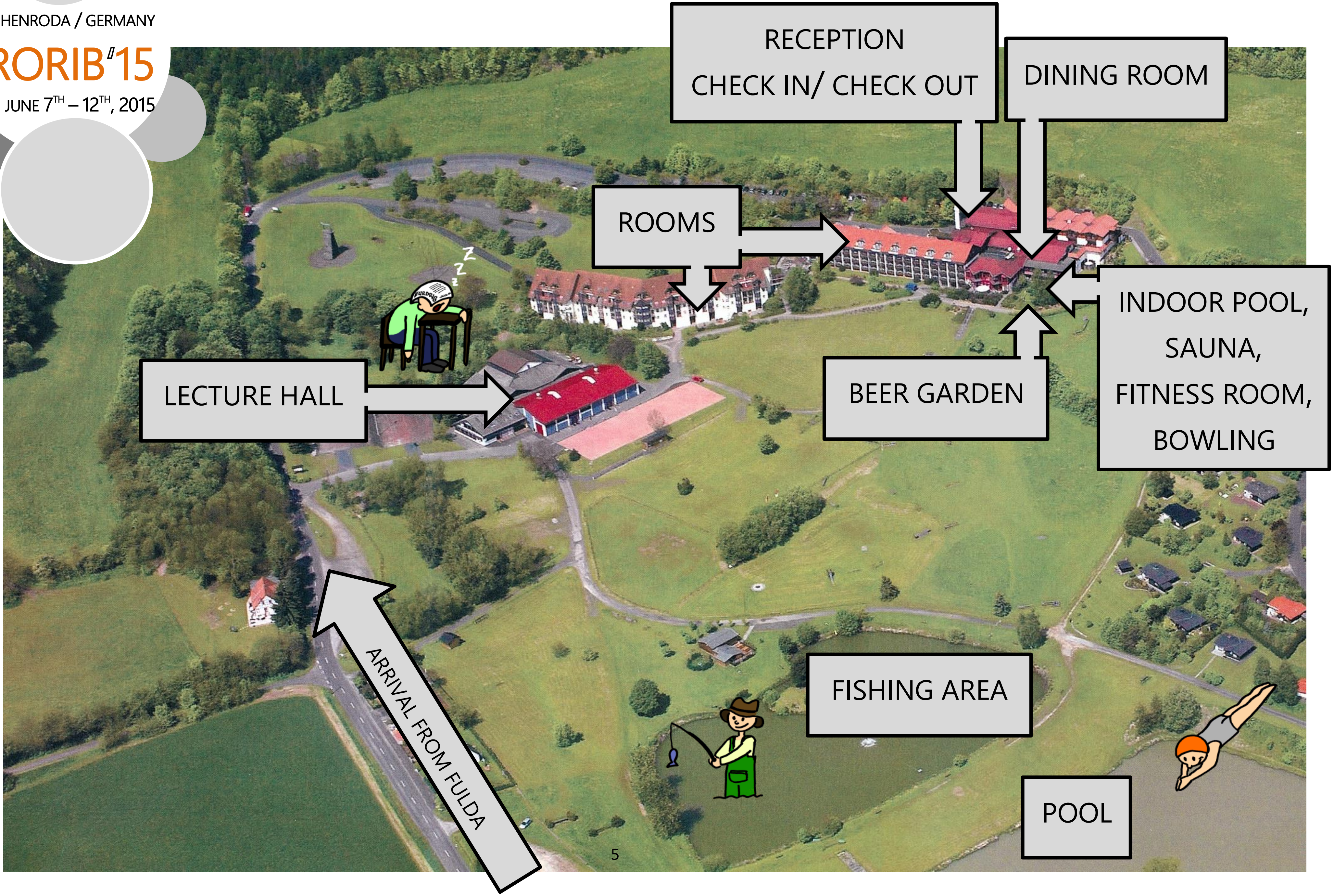
Future RIB facilities
At and beyond the dripline and new modes of radioactivity
Nuclear structure far from stability
Heavy and superheavy nuclei
Dynamics and Thermodynamics of exotic nuclear systems
Reactions with radioactive beams
Nuclear astrophysics
Fundamental interactions
Application of nuclear physics to other fields
Production and manipulation of RIB
Instrumentation

Invited speakers

Michael Block (GSI/HIM, Germany)
Yorick Blumenfeld (IPN Orsay, France)
Konstanze Boretzky (GSI, Germany)
Emmanuel Clement (GANIL, France)
Jens Dilling (TRIUMF)
Sergey Eliseev (MPI-K Heidelberg, Germany)
Tobias Engert (GSI, Germany)
Hanna Franberg (GANIL, France)
Sunchan Jeong (IBS, Korea)
Jordi José (UPC Barcelona, Spain)
Nasser Kalantar-Nayestanaki (KVI-CART/Univ. Groningen, The Netherlands)
Elias Khan (IPN Orsay, France)
Magdalena Kowalska (CERN, Switzerland)
Etienne Liénard (LPC Caen, France)
Marco Mazzocco (Univ. Padova, Italy)
Iain Moore (JYFL, Finland)
Tohru Motobayashi (RIKEN, Japan)
Alexandre Obertelli (CEA Saclay, France)
Robert Page (University of Liverpool, UK)
Gianfranco Prete (INFN Legnaro, Italy)
Riccardo Raabe (KU Leuven, Belgium)
Peter Reiter (Univ. Cologne, Germany)
Hervé Savajols (GANIL, France)
Achim Schwenk (TU Darmstadt, Germany)
Monika Stachura (CERN, Switzerland)
Fredrik Wenander (CERN, Switzerland)
Alexander Yeremin (FLNR JINR, Russia)
Deyan Yordanov (IPN Orsay, France)

HOHENRODA / GERMANY
EURORIB'15
JUNE 7TH – 12TH, 2015

POSITION PLAN



EURORIB'15 - Schedule

Sunday - June 7

Time	Session
17:00	**REGISTRATION**
19:30	**Welcome reception and Dinner**

Monday - June 8

Time	Session
	Nuclear structure far from stability
09:00	*Welcome*
09:10	**SCHWENK**
09:40	**OBERTELLI**
10:10	KLINTEFJORD
10:30	DUCHENE
10:50	**Coffee break**
	Heavy and superheavy nuclei
11:20	**YEREMIN**
11:50	**BLOCK**
12:20	GRANADOS
12:40	EBERT
13:00	**Lunch**
	Reactions with radioactive beams
14:30	**MAZZOCCO**
15:00	LE CROM
15:20	FERNÁNDEZ-GARCÍA
15:40	GNOFFO
16:00	**Coffee break**
	At and beyond the dripline and new modes of radioactivity
16:30	**PAGE**
17:00	**BORETZKY**
17:30	SHAROV
17:50	XU
18:10	**EXHIBITION INDUSTRIAL PARTNERS**
20:00	**Dinner**

Tuesday - June 9

Time	Session
	Nuclear structure far from stability
09:00	**CLEMENT**
09:30	WALTERS
09:50	MORALES LOPEZ
10:10	LYNCH
10:30	GEORGIEV
10:50	**Coffee break**
	Application of nuclear physics to other fields
11:20	**ENGERT**
11:50	**STACHURA**
12:20	DICKEL
12:40	**Lunch**
	Future RIB facilities
	"facility concert" - part 1
14:30	**SAVAJOLS**
15:00	**BLUMENFELD**
15:30	**KALANTAR-NAYESTANAKI**
16:00	**Coffee break**
	Future RIB facilities
	"facility concert" - part 2
16:30	**KOWALSKA**
17:00	**PRETE**
17:30	**ROUND TABLE DISCUSSION**
18:30	**POSTER SESSION**
20:00	**Dinner**

Wednesday - June 10

Time	Session
	Future RIB facilities
09:00	**DILLING**
09:30	**JEONG**
10:00	**MOTOBAYASHI**
10:30	**Coffee break**
	Future RIB facilities
11:00	CONSTANTIN
11:20	GEISSEL
11:40	SCHUURMANS
12:00	**Lunch**
13:30	**EXCURSION**
19:30	**Dinner**

Thursday - June 11

Time	Session
	Dynamics and thermodynamics of exotic nuclear systems
09:00	**KHAN**
09:30	TSONEVA
	Nuclear astrophysics
09:50	**JOSE**
10:20	MANEA
10:40	**Coffee break**
	Production and manipulation of RIB
11:10	**FRÅNBERG-DELAHAYE**
11:40	**WENANDER**
	Nuclear structure far from stability
12:10	**YORDANOV**
12:40	HEYLEN
13:00	**Lunch**
	Nuclear structure far from stability
14:30	**MOORE**
15:00	DELL'AQUILA
15:20	SATOU
15:40	MADURGA FLORES
16:00	**POSTER PRIZE TALKS**
16:30	**Coffee break**
19:00	**CONFERENCE DINNER**

Friday - June 12

Time	Session
	Instrumentation
09:00	**REITER**
09:30	**RAABE**
10:00	KAUFMANN
10:20	ANDREOIU
10:40	**Coffee break**
	Instrumentation and fundamental interactions
11:10	VALDRÉ
11:30	FINK
11:50	**ELISEEV**
12:20	**LIÉNARD**
12:50	*Closing remarks*
13:00	**Lunch**

Conference Programme

Sunday 7 June 2015

Registration (17:00-19:00) – Hotel reception desk
Welcome Reception and Dinner (19:30-21:30) – Dining Room

Monday 8 June 2015

Nuclear structure far from stability 1 (09:00-10:50)

09:00 Welcome (10') SCHEIDENBERGER, Christoph (GSI, Darmstadt)

09:10 Nuclear forces and their impact on matter at neutron-rich extremes (30') SCHWENK, Achim (TU Darmstadt)
09:40 Nuclear Structure far from Stability, latest results from MINOS at RIKEN (30') OBERTELLI, Alexandre (CEA Saclay)
10:10 Structure of low-lying states in 140Sm studied by Coulomb excitation (20') KLINTEFJORD, Malin (University of Oslo)
10:30 Structure beyond the N=50 shell closure in neutron-rich nuclei in the vicinity of 78Ni: The case of N=51 nuclei (20') DUCHENE, Gilbert (IPHC/CNRS - University of Strasbourg)

Coffee break (10:50-11:20)

Heavy and superheavy nuclei (11:20-13:00)

11:20 SHE synthesis experiments at Dubna (30') YEREMIN, Alexander (Joint Institute for Nuclear Research)
11:50 Mass spectrometry and laser spectroscopy of the heaviest elements (30') BLOCK, Michael (GSI, Darmstadt)
12:20 In gas laser ionization and spectroscopy of actinium isotopes (20') GRANADOS, Camilo (KU Leuven)
12:40 Experiments with 238U projectile and fission fragments at the FRS Ion Catcher (20') EBERT, Jens (GSI, Darmstadt and Justus Liebig Universität, Giessen)

Lunch break (13:00-14:30) – Dining Room

Reactions with radioactive beams (14:30-16:00)

14:30 Recent Reaction Dynamics Studies with light RIBs at Coulomb Barrier Energies (30') MAZZOCCO, Marco (University of Padova and INFN - Sezione di Padova)
15:00 Study of neutron-proton pairing in N=Z unstable nuclei through transfer reactions (20') LE CROM, Benjamin (Institut de Physique Nucléaire d'Orsay)
15:20 Analysis of reactions induced by the halo nucleus 6He at energies around the Coulomb barrier (20') FERNáNDEZ-GARCíA, Juan Pablo (INFN - LNS)
15:40 Isospin influence on the decay modes of systems produced in the 78,86Kr+40,48Ca reactions at 10AMeV (20') GNOFFO, Brunilde (INFN sez Catania)

Coffee break (16:00-16:30)

At and beyond the dripline and new modes of radioactivity (16:30-18:10)

16:30 Proton emission - new results and future prospects (30') PAGE, Robert (University of Liverpool)
17:00 Future Perspectives with R3B (30') BORETZKY, Konstanze (GSI Darmstadt)
17:30 Two-proton Decays of the 17Ne Low-lying States (20') SHAROV, Pavel (JINR)
17:50 Search for Two-Proton Radioactivity of 30Ar by Tracking its Decay Products (20') XU, Xiaodong (GSI, Darmstadt and Justus-Liebig-Universität Gießen)

Exhibition of industrial partners (18:10-20:00)

Dinner (20:00-21:30) – Lecture Hall ("Partyscheune")

Tuesday 9 June 2015

Nuclear structure far from stability 2 (09:00-10:50)

09:00 A Decade of Nuclear Structure studies with post-accelerated european RIB (30') CLEMENT, Emmanuel (CNRS/GANIL)
09:30 Identification of deformed intruder states in semi-magic 70,72Ni (20') WALTERS, William (University of Maryland)
09:50 INVESTIGATION OF THE BETA-DECAY CHAIN 70Fe->70Co->70Ni (20') MORALES LOPEZ, Ana Isabel (Università degli Studi di Milano - INFN Milano)
10:10 High-resolution CRIS and the secrets of 206Fr (20') LYNCH, Kara (ISOLDE, CERN)
10:30 Magnetic moment in self-conjugate 24Mg. Towards high-precision measurements of picosecond excited states with RIB. (20') GEORGIEV, Georgi (CSNSM Orsay)

Coffee break (10:50-11:20)

Application of nuclear physics to other fields (11:20-12:40)

11:20 Applications based on nuclear physics impacting our society (30') ENGERT, Tobias (GSI, Darmstadt)
11:50 ViTO experiment at ISOLDE-CERN (30') STACHURA, Monika (TRIUMF/CERN)
12:20 MR-TOF-MS for nuclear physics facilitate a new class of experiments in analytical mass spectrometry (20') DICKEL, Timo (GSI, Darmstadt)

Lunch break (12:40-14:30) – Dining Room

Future RIB facilities 1: Facility concert (part 1) (14:30-16:00)

14:30 GANIL/SPIRAL2 facility – Status and Future (30') SAVAJOLS, Hervé (GANIL)
15:00 EURISOL Distributed Facility: Paving the way towards the ultimate ISOL facility for EUROPE (30') BLUMENFELD, Yorick (IPN Orsay, IN2P3-CNRS, Université Paris-Sud)
15:30 Exploring the extremes with NUSTAR@FAIR (30') KALANTAR-NAYESTANAKI, Nasser (KVI-CART / Univ. Groningen)

Coffee break (16:00-16:30)

Future RIB facilities 2: Facility concert (part 2) (16:30-17:30)

16:30 News from ISOLDE and HIE-ISOLDE (30') KOWALSKA, Magdalena (ISOLDE-CERN)
17:00 The SPES project at the INFN- Laboratori Nazionali di Legnaro (30') PRETE, Gianfranco (INFN-LNL)

Future RIB facilities: Round table discussion (17:30-18:30)

Poster session (18:30-20:00)

Dinner (20:00-21:30) – Lecture Hall ("Partyscheune")

Wednesday 10 June 2015

Future RIB facilities 3 (09:00-10:30)

09:00 Future Opportunities at RIB facilities in North America (30') DILLING, Jens (TRIUMF and UBC)
09:30 Overview of Rare Isotope Beam Facilities in Asia (30') JEONG, Sunchan (Rare Isotope Science Project, Institute for Basic Science)
10:00 RIIB facilities in Japan (30') MOTOBAYASHI, Tohru (RIKEN Nishina Center)

Coffee break (10:30-11:00)

Future RIB facilities 4 (11:00-12:00)

11:00 Photofission experiments at the ELI-NP facility (20') CONSTANTIN, Paul (ELI-NP, IFIN-HH)
11:20 Present and Planned Experiments with the FRS and Super-FRS (20') GEISSEL, Hans (GSI and Univ. Gießen)
11:40 The ISOL@MYRRHA Project in Belgium (20') SCHUURMANS, Paul (SCK-CEN)

Lunch (12:00-13:30) – Dining Room

Excursion (13:30-19:30)

Dinner (19:30-21:00) – Beer Garden

Thursday 11 June 2015

Dynamics and thermodynamics of exotic nuclear systems (09:00-09:50)

09:00 Recent theoretical and experimental advances on giant resonances in unstable nuclei (30') KHAN, Elias (IPN Orsay)
09:30 Pygmy resonances and radiative nucleon captures for stellar nucleosynthesis (20') TSONEVA, Nadia (Institut für Theoretische Physik, Univ. Gießen)

Nuclear astrophysics (09:50-10:40)

09:50 Nuclear Astrophysics and Stellar Explosions (30') JOSE, Jordi (UPC Barcelona)
10:20 Recent ISOLTRAP mass measurements of medium-mass, neutron-rich nuclides in the 50-ms-half-life range (20') MANEA, Vladimir (Max-Planck-Institute for Nuclear Physics, Heidelberg)

Coffee break (10:40-11:10)

Production and manipulation of RIB (11:10-12:10)

11:10 Manipulations of the high power targets and its infrastructure: preparations, operations and maintenances (30') FRåNBERG-DELAHAYE, Hanna (GANIL)
11:40 Citius, altius, fortius - is the EBIS/T charge breeder up for the challenge? (30') WENANDER, Fredrik (CERN)

Nuclear structure far from stability 3 (12:10-13:00)

12:10 Progress and Recent Results from Collinear Laser Spectroscopy at ALTO and ISOLDE-CERN (30') YORDANOV, Deyan (IPN Orsay)
12:40 Spins and g-factors of Mn isotopes near N = 40: Significance of proton and neutron excitations in ground and isomeric states (20') HEYLEN, Hanne (KU Leuven)

Lunch break (13:00-14:30) - Lecture Hall (“Partyscheune”)

Nuclear structure far from stability 4 (14:30-16:00)

14:30 The study of nuclear structure far from stability at the IGISOL-4 facility (30') MOORE, Iain (University of Jyväskylä)
15:00 10Be and 16C structures investigated by means of break-up reactions at INFN-LNS (20') DELL'AQUILA, Daniele (Università degli Studi di Napoli "Federico II" and INFN – Sezione di Napoli)
15:20 Single particle structures of 19C and 23O (20') SATOU, Yoshiteru (Seoul National University)
15:40 Beta-delayed Neutron spectroscopy of Ga isotopes beyond the N=50 shell closure (20') MADURGA FLORES, Miguel (CERN)

Poster Prize Talks (16:00-16:30)

Coffee break (16:30-17:00)

Conference Dinner (19:00-21:30) – Dining Room

Friday 12 June 2015

Instrumentation (09:00-10:40)

09:00 Gamma-ray tracking with AGATA a new perspective for spectroscopy at RIB facilities (30') REITER, Peter (University of Cologne)
09:30 Active targets for research on exotic nuclei (30') RAABE, Riccardo (KU Leuven)
10:00 TRIGA-SPEC – recent developments and status (20') KAUFMANN, Simon (Institut für Kernchemie Uni-Mainz)
10:20 In-Trap Decay Spectroscopy for Electron Capture Branching Ratios using TITAN at TRIUMF (20') ANDREOIU, Corina (Simon Fraser University)

Coffee break (10:40-11:10)

Instrumentation and fundamental interactions (11:10-13:00)

11:10 The FAZIA telescope: from detectors to data flow (20') VALDRé, Simone (INFN - Sezione di Firenze)
11:30 In-Source Laser Spectroscopy with the Laser Ion Source and Trap for the Study of Neutron-Rich Polonium (20') FINK, Daniel (CERN)
11:50 Penning-trap mass spectrometry for neutrino physics (30') ELISEEV, Sergey (Max-Planck Institut für Kernphysik, Heidelberg)
12:20 High precision measurements in mirror beta decays at GANIL (30') LIéNARD, Etienne (LPC Caen)

12:50 Closing remarks (10') SCHEIDENBERGER, Christoph (GSI, Darmstadt)

Lunch/Departure (13:00-14:30) – Dining Room

EURORIB'15 - Posters

Board #	Presenter	Poster title
1	PIETRI, Stephane	Nustar DAQ
2	KIM, Jongwon	In-flight fragment separator system design for the RISP
3	MAMATKULOV, Kahramon	Recent exposures of nuclear track emulsion to radioactive nuclei, neutrons and heavy ions
4	WEICK, Helmut	Mass measurements in the CR storage ring at FAIR
5	DE ROUBIN, Antoine	PIPERADE: A Penning-trap based separator for the future low energy branch DESIR at SPIRAL2
6	MAZZOCCO, Marco	Dynamical Dipole Mode in the 40,48Ca+152,144Sm fusion-evaporation and fission reactions and perspectives with RIBs
7	CHHETRI, Premaditya	Laser Spectroscopy of the Heaviest elements
8	ANDREOIU, Corina	The GRIFFIN Facility for Decay Spectroscopy Experiments at TRIUMF
9	DICKEL, Timo	A novel isobar separator for the TITAN facility at TRIUMF
10	BABO, Mathieu	ß-delayed charged particle decays of 22Si and 23Si
11	CARDELLA, Giuseppe	Gamma-particle coincidences in reactions induced by light neutron rich nuclei using CHIMERA detector at LNS
12	KOWALSKA, Magdalena	Status of the HIE-ISOLDE Project
13	HOUNGBO, Donald	Hydrodynamics of a liquid Pb-Bi target for high-power ISOL facilities
14	WINFIELD, John Stuart	High-resolution studies with secondary reactions via dispersion-matched modes of the in-flight separator Super-FRS and its combined spectrometers
15	TETEREV, Yury	Optimization of the 6He production target in the 7Li(γ, p)6He reaction
16	VESIC, Jelena	Electron screening – still an open question
17	PURUSHOTHAMAN, Sivaji	Space-charge Effects in a Cryogenic Stopping Cell
18	MITTAL, Harish Mohan	Test of Rigid Triaxiality in 126-132Ce nuclei
19	SAMANTA, Chhanda	Tensor force and relativistic mean field calculations of multi-Lambda hypernuclei
20	STEVENS, Sam	Probing Nuclear properties of Imbalanced Fermi Systems with Quasi-free Proton Knock-out Reactions
21	MELON, Barbara	Setup for Coulomb Excitation Measurements at SPES
22	AYET SAN ANDRES, Samuel	Characterization and Diagnostic Tools for the RFQ-based Low Energy Beamline of the FRS Ion Catcher
23	HORNUNG, Christine	Performance of the MR-TOF-MS at the FRS
24	PRETE, Gianfranco	The SPES RIB production system
25	FARINON, Fabio	Resolution Studies of the FRS Spectrometer Experiment using 16O(p,d) Reaction at Energies from 400 to 1200 MeV/u

ABSTRACTS

(in chronological order)

Monday 08 June 2015

Nuclear structure far from stability 1 (09:00-10:50)

time	title
09:00	**Welcome (00h10')** *Presenter: SCHEIDENBERGER, Christoph (GSI, Darmstadt)*
09:10	**Nuclear forces and their impact on matter at neutron-rich extremes (00h30')** *Presenter: SCHWENK, Achim (TU Darmstadt)* Recent results have shown that neutron-rich nuclei become increasingly sensitive to three-body forces, which are at the forefront of theoretical developments based on effective field theories of quantum chromodynamics. This includes the formation of shell structure, the spectroscopy of exotic nuclei, and the location of the neutron dripline. Nuclear forces also constrain the properties of neutron-rich matter, including the neutron skin, the symmetry energy, and the properties of neutron stars. We first discuss our understanding of nuclear forces based on chiral effective field theory and show how this framework makes unique predictions for many-body forces. Then, we survey results with three-nucleon forces in neutron-rich oxygen and calcium isotopes and for neutron-rich matter, which have been explored with a range of many-body methods. This shows that there is an exciting connection of three-nucleon forces with the exploration of extreme neutron-rich nuclei at rare isotope beam facilities and with forefront observations in astrophysics.
09:40	**Nuclear Structure far from Stability, latest results from MINOS at RIKEN (00h30')** *Presenter: OBERTELLI, Alexandre (CEA Saclay)* The spectroscopy of very neutron-rich nuclei offers unique information on the shell structure evolution with isospin. New phenomena such as Borromean nuclei and halos have been discovered. The Radioactive Isotope Beam Factory of RIKEN is today leader in producing neutron-rich nuclei. A new device called MINOS has been built recently at CEA Saclay to maximize the luminosity for hydrogen-induced knockout reactions at intermediate incident energies while the vertex position inside the target is tracked. Since 2014, the MINOS device is being used at the RIBF of RIKEN in combination with the ZeroDegree spectrometer or the SAMURAI spectrometer and other detection systems such as the DALI2 gamma array. The most recent results obtained from experiments performed in 2014 and 2015 at the RIBF by using MINOS will be presented.
10:10	**Structure of low-lying states in 140Sm studied by Coulomb excitation (00h20')** *Presenter: KLINTEFJORD, Malin (University of Oslo)* The open-shell nuclei with Z>50 and N<82 are known to have some of the largest ground-state deformations in the nuclear chart. The shapes of the nuclei in this region are expected to be prolate, except for a small island of nuclei with Z>62 and N≈78, which are predicted to be oblate. Nuclei near 140Sm are therefore expected to be located in a transitional region between deformed and spherical shapes (as a function of N) and between prolate and oblate shapes (as a function of Z). The measurement of spectroscopic quadrupole moments and transition strengths for low-lying states represents a sensitive test for theoretical predictions in this region. Lifetimes of low-lying states in 140Sm were unknown due to the occurrence of two isomeric 10+ states . A Coulomb excitation experiment with radioactive 140Sm beam was performed at the ISOLDE facility at CERN, using the MINIBALL spectrometer coupled to a DSSSD array. The laser-ionized beam of 140Sm was quasi-pure with an average intensity of 2·10^5 particles per second. At least three excited states in 140Sm were populated during the experiment: the 2+ and 4+ states of the ground-state band and the tentatively assigned 0+ state at 990 keV excitation energy. The statistics collected during the experiment allows the analysis of differential Coulomb excitation cross sections as a function of scattering angle. In addition to the Coulomb excitation experiment a RDDS lifetime measurement was preformed at HIL, Warsaw, to determine B(E2) values in a complementary way. Using experimental lifetimes as independent spectroscopic data in the Coulomb excitation analysis enhances the sensitivity to the reorientation effect. Furthermore, the spin assignment of the state at 990 keV was revised based on angular correlations measured in a third experiment in Warsaw following the beta decay of 140Eu. The experimental B(E2) values and quadrupole moments are compared with theoretical calculations using beyond mean-field models, the shell model, and algebraic models. The results show that the triaxial degree of freedom is important for the transition from spherical shape for the N=82 isotope 144Sm to axial symmetric prolate shape for the most neutron-deficient Sm isotopes.

10:30 **Structure beyond the N=50 shell closure in neutron-rich nuclei in the vicinity of 78Ni: The case of N=51 nuclei (00h20')**

Presenter: DUCHENE, Gilbert (IPHC/CNRS - University of Strasbourg)

G. Duchêne1, F. Didierjean1, D. Verney2, G. de Angelis3, C. Fransen4, R. Lozeva1, J. Litzinger4, A. Dewald4, M. Niikura2,+, D. Bazzacco5, E. Farnea5, S. Aydin5, A. Bracco6, S. Bottoni6, L. Corradi3, F. Crespi6, E. Ellinger4, E. Fioretto3, S. Franchoo2, A. Goasduff1,++, A. Gottardo5,+++, L. Grocutt7, M. Hackstein4, F. Ibrahim2, K. Kolos2,*, S. Leoni6, S. Lenzi5, S. Lunardi5, R. Menegazzo5, D. Mengoni5, C. Michelagnoli5,**, T. Mijatovic8, V. Modamio3, O. Möller9, G. Montagnoli5, D. Montanari5,***, A. Morales6, D.R. Napoli3, F. Nowacki1, F. Recchia3, E. Sahin3,#, F. Scarlassara5, L. Sengele1, K. Sieja1, J. F. Smith7, A. Stefanini3, C. Ur5, J.J. Valiente Dobon3, V. Vandone6

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8 Ruder Boskovic Institute (Cr)
9 IKP, TU Darmstadt (D)

Recent experimental discoveries have revealed that the neutron effective single-particle evolution above 78Ni (N>50) shows peculiar or unpredicted behaviours. The aim of this work is to determine the nature of the low-lying yrast or quasi yrast 7/2+ and 9/2+ states in 32 < Z < 40, odd-neutron N=51 nuclei, in order to assess their collective” (core-particle coupled) or υ1g7/2 and υ(2d5/2)2(1g9/2)-1 single-particle origin and better constrain the relative position of the neutron single-particle states above a 78Ni core. Calculations show that there is a difference of about two orders of magnitude between core-particle coupled state and single-particle state half-lives.
A Recoil distance Doppler-shift (RDDS) experiment has been performed at LNL (Italy). The neutron-rich nuclei were produced via deep-inelastic, multi-nucleon transfer and induced fission reactions with the 82Se(@ 505 MeV) + 238U system. The setup combined the AGATA demonstrator composed of 5 triple clusters, the PRISMA fragment spectrometer and the Cologne plunger. The number of plunger distances was restricted to only two. This allowed to maximize the statistics for each degrader position while being able to provide the half-live domain (< 1 ps or several tens ps) of the states of interest, which was sufficient for the main goal of the experiment. This strategy proved to be fruitful, as will be shown in this presentation which gives half-lives results of the lowest-lying 7/2 and 9/2 states of two N=51 nuclei, 87Kr and 85Se, as well as indications of higher lying state half-lives up to spin 19/2- in 87Kr.

+ Current address (Ca): University of Tokyo (J)
++ Ca: CSNSM/CNRS-University Paris Sud-11 (F)
+++ Ca: IPNO/CNRS-University Paris Sud-11 (F)
* Ca: University of Tenessee (US)
** Ca: GANIL, CEA/DSM-CNRS/IN2P3, Caen (F)
*** Ca: IPHC/CNRS-University of Strasbourg (F)
# Ca: University of Oslo (S)

Coffee break (10:50-11:20)

Heavy and superheavy nuclei (11:20-13:00)

time	title
11:20	**SHE synthesis experiments at Dubna (00h30')** *Presenter: YEREMIN, Alexander (Joint Institute for Nuclear Research)* Results of experiments on the synthesis of superheavy nuclei in 48Ca-induced reactions are presented. The experiments were carried out at the Flerov Laboratory of Nuclear Reactions (FLNR) of the Joint Institute for Nuclear Research (Dubna) in the framework of a large collaboration with IAR (Dimitrovgrad, Russia), LLNL (Livermore, USA), ORNL (Oak-Ridge, USA). In fusion reactions of doubly magic 48Ca with actinide isotopes one can approach a region of theoretically predicted superheavy nuclei, stabilized by the influence of closed p- and n-shells with Z = 114 (or Z = 120, 126) and N = 184. The experiments started at the FLNR in 1998 using VASSILISSA electromagnetic and the Dubna gas-filled recoil separators. Beams of accelerated 48Ca ions with intensity up to 1013 s-1 were produced by the U400 heavy ion cyclotron. Enriched isotopes of U ÷ Cf were used as targets. In reactions studied in 2000 – 2011, the new heaviest isotopes of Rf, Db, Sg, Bh, Hs, Mt, Ds, Cn and isotopes of six new elements 113 ÷ 118 were produced and studied. The new isotopes populate an isolated island, which has no connection with the region of known nuclei. Thus for their unambiguous identification the analysis of generic decay links, properties of α-decays, spontaneous fission and cross-bombardments have been employed. Significant part of Dubna experiments has been reproduced in GSI (Germany) and LBNL (USA). The discovery of the elements 114 and 116 has been recognized by the IUPAC in June 2011 [1]. For more detailed study of newly synthesized nuclei improvements in accelerator, target and separation techniques are necessary. Now at FLNR JINR so-called SHE-factory (new accelerator complex on the basis of powerful DC280 cyclotron) is constructed. It will be able to produce heavy ion beams (A>40) with intensities about 5·1013 pps. The heaviest target which can be used in practice is a 251Cf one. Thus 296118 is the heaviest nuclide which can be produced in fusion reactions with 48Ca. To study heavier nuclei one must investigate reactions with heavier ions like 50Ti, 54Cr, 58Fe. Intensively discussed are also reactions with radioactive nuclei and deep inelastic transfer reactions. In the close future it is planned to perform model experiments using method of high resolution alpha spectroscopy and gamma quanta detection to study decay properties of the Rf and Db in the reactions 50Ti + 208Pb → 257Rf + 1n and 50Ti + 209Bi → 258Db + 1n. These experiments will help us to prepare full scale spectroscopy experiments aimed to the study of decay properties of the isotopes in the decay chains of 288/115 and 287Fl formed in the complete fusion reactions 48Ca + 243Am → 288115 + 3n and 48Ca + 242Pu → 287Fl + 3n. References [1] Pure Appl. Chem., Vol. 83, No. 7, pp. 1485–1498, 2011.
11:50	**Mass spectrometry and laser spectroscopy of the heaviest elements (00h30')** *Presenter: BLOCK, Michael (GSI, Darmstadt)* High-precision mass measurements are powerful method to investigate the nuclear structure evolution in exotic nuclides. Binding energies and their differences reveal nuclear structure features such as shell closures and the onset of deformation. Recent advances in slowing down high-energy beams in buffer gas cells have opened the door to extend precision measurements in ion traps to essentially all elements. Mass measurements with Penning traps are meanwhile also feasible for the heaviest elements as demonstrated by the first direct mass measurements of nobelium and lawrencium isotopes with SHIPTRAP at GSI. These results allow mapping the strength of the neutron subshell closure at N=152 and moreover provide firm anchor points pinning down alpha-decay chains in the mass surface. In addition, laser spectroscopic studies allow studying the impact of relativistic effects on the atomic structure of the heaviest elements. In the elements above fermium no atomic levels are experimentally known. By resonance ionization laser spectroscopy atomic levels can be identified and once levels have been identified isotope shift measurements and hyperfine spectroscopy give access to nuclear properties such as spins and moments as well as change in mean square charge radii. In this contribution I will review recent SHIPTRAP high-precision mass measurements and discuss the prospects for laser spectroscopy of nobelium.

12:20	**In gas laser ionization and spectroscopy of actinium isotopes (00h20')** *Presenter: GRANADOS, Camilo (KU Leuven)* The knowledge of ground-state properties around the neutron shell closure N=126 are of great importance in order to understand the nuclear structure of heavy nuclei. They give the opportunity for testing nuclear models in the region where single particle character appears to be the key factor describing, for instance, the nuclear configuration in francium and bismuth isotopes. In order to extend the understanding of the nuclear structure in this region, resonant ionization spectroscopy of {212-215,225,227}Ac was performed for the first time. {212-215}Ac were investigated in the gas cell-based laser ion source at the LISOL facility while {225,227}Ac were studied in the hot-cavity laser ion source setup at TRIUMF. Isotope shifts, magnetic dipole moments and tentative spin assignments of the nuclear ground-state for the chain of isotopes will be reported. Recent experiments on {214,215}Ac at the LISOL facility using the novel in-gas-jet laser spectroscopy technique on short lived species will be reported. The results have allowed increasing the spectral resolution by a factor of 20 with a comparable overall efficiency to that obtained by the in-gas-cell technique. From these data spin, magnetic dipole moments and also electric quadrupole moments will be reported and compared with theoretical calculations.
12:40	**Experiments with 238U projectile and fission fragments at the FRS Ion Catcher (00h20')** *Presenter: EBERT, Jens (GSI, Darmstadt and Justus Liebig Universität, Giessen)* The properties of nuclides in or close to the valley of stability are mostly well understood and described by nuclear structure models. However the theoretical predictions for properties of nuclides far away from stability differ drastically for different models. For further improvements of the models highly accurate measurements of a variety of observables of unstable nuclides are needed as input parameters and for comparisons. However, the more interesting and exotic a nuclide becomes the harder the measurement gets, because of the shorter half-life and lower production rates. At the in-flight facility FRS at GSI nuclides of interest can be produced via projectile fragmentation and fission, but the challenge is to stop and separate the ions of interest for high precision low-energy experiments without losing too many of them due to long measurement durations and inefficiencies. This is the task for the FRS Ion Catcher. The ion cocktails, produced at energies of typically 1000 AMeV, are separated in the fragment separator FRS, energy bunched, slowed down and subsequently stopped in a helium filled cryogenic stopping cell (CSC), which is the prototype of the stopping cell for the low-energy branch of the Super-FRS at FAIR. From there the ions can be transported via an RFQ ion guide to silicon detectors or a multiple-reflection time-of-flight mass spectrometer (MR-TOF-MS) for high resolution mass measurements and alpha-decay spectroscopy. The latter device additionally affords access to isomerically clean beams for further experiments. Performance and possibilities of the system have been studied in several online experiments, the latest one in October 2014. The goal of these experiments was the commissioning and investigation of the CSC characteristics including rate capabilities, operation with high areal densities and stopping of fission fragments, as well as spatial separation and mass measurement of short-lived isomers with the MR-TOF-MS. Results from this experiments will be presented. The rate capability of the CSC was tested with various beam intensities over several orders of magnitude and the CSC was operated with an areal density of up to 5.6 mg/cm2. With the MR-TOF-MS, projectile fragments such as 213Rn and 220Ra with half-lives of only 19.5 ms and 17.9 ms, respectively, and fission fragments such as 133I and 133Te in ground and isomeric states have been measured. Furthermore the spatial separation of ground and isomeric states was demonstrated and alpha-decay spectroscopy was performed. Both will be shown for the example of 211Po and 211mPo.

Lunch break (13:00-14:30)

Reactions with radioactive beams (14:30-16:00)

time	title
14:30	**Recent Reaction Dynamics Studies with light RIBs at Coulomb Barrier Energies (00h30')** *Presenter: MAZZOCCO, Marco (University of Padova and INFN - Sezione di Padova)* Light exotic nuclei often exhibit very unusual features, such as, for instance, halo structure (i.e., a matter distribution characterized by a core surrounded by a halo of rarified nuclear matter) and neutron skin structure (i.e., a thick concentration of neutrons in the region around the nuclear surface). Moreover, light Radioactive Ion Beams (RIBs) are generally very weakly-bound with breakup thresholds smaller than 1.0 MeV and well pronounced cluster structures even in the ground state. All these phenomena are strongly correlated with each other and sometimes generate conflicting effects. It is nowadays rather well established that, at Coulomb barrier energies, breakup related effects increase the total reaction cross section. The quest(ion) has now moved towards investigating what reaction mechanisms are mainly responsible for the enhancement of the reaction probability. An overview of the recent results obtained at Notre Dame (USA) for the proton-halo 8B (Sp = 0.1375 MeV), at GANIL (France) for the neutron skin nucleus 8He (S2n = 2.140 MeV) and at TRIUMF (Canada) for the two-neutron halo 11Li (S2n = 0.30) will be given. Within this framework, we developed at INFN-LNL (Italy) a small facility, named EXOTIC, for the in-flight production of light RIBs. The production scheme employs inverse-kinematics reactions induced by heavy-ion beams delivered by the LNL-XTU tandem accelerator on a light gas target. So far, secondary beams of 7Be, 8Li, 8B, 15O and 17F in the energy range 2-6 MeV/u have been produced. An overview of the most recent achievements in the study of 7Be(S4He = 1.584 MeV)-induced reaction dynamics on medium-mass (58Ni) and heavy (208Pb) targets will be presented.
15:00	**Study of neutron-proton pairing in N=Z unstable nuclei through transfer reactions (00h20')** *Presenter: LE CROM, Benjamin (Institut de Physique Nucléaire d'Orsay)* Nucleon-nucleon pairing can occur in T=0 and T=1 isospin channels: particle-like pairing (n-n or p-p) which is quite well-known can occur only in the isovector channel, whereas neutron-proton pairing can be in both T=1 and T=0 channels. Isovector n-p pairing should be similar to particle-like pairing due to charge invariance but isoscalar n-p pairing is mostly unknown. The over-binding of N=Z nuclei could be a manifestation of n-p pairing. We have studied neutron-proton pairing through transfer reactions. Indeed, the cross-section for a n-p pair transfer is expected to be enhanced if there is an important n-p pairing. Neutron-proton pairing is expected to be important in N=Z nuclei with high J orbitals. We have used 52Fe and 56Ni beams at 30A MeV because current radioactive ion beam facilities cannot produce beams of 0g9/2 nuclei with enough intensity to measure two nucleon transfer reactions. The measurement was performed at GANIL with radioactive beams produced by fragmentation of a 75A MeV 58Ni beam on a 185 mg.cm-2 Be target purified by the LISE spectrometer. An efficient set-up based on the coupling of the MUST2 and TIARA Silicon arrays for charged particle detection with the EXOGAM gamma-ray detector was used. Using 52Fe (N=Z=26) which is a partially occupied 0f7/2 shell nucleus and 56Ni (N=Z=28) which has a fully occupied 0f7/2 shell will allow us to compare n-p pairing according to shell occupancy. We measured two transfer reactions: (p,3He) which will populate T=0 and T=1 states and (d,α) which is selective for ΔT=0. Results from the 56Ni(p,d)55Ni reaction will be shown in order to validate the analysis procedures. First information on the nature of the n-p pairing will be discussed based on the relative intensities of the 0+ and 1+ states populated in 54Co in the 56Ni(p,3He) reaction.

15:20	**Analysis of reactions induced by the halo nucleus 6He at energies around the Coulomb barrier (00h20')** *Presenter: FERNáNDEZ-GARCíA, Juan Pablo (INFN - LNS)* Reactions induced by neutron halo nuclei have been intensively studied in the last years. The weakly bound neutron-halo structure can affect the dynamics of reactions at energies around the Coulomb barrier producing a significant reduction of the elastic scattering cross section with respect to the Rutherford prediction. This effect can be associated with couplings to breakup channels, since the continuum of such nuclei is close to the ground state. One method to obtain a complete theoretical description of such collisions is the Continuum Discretized Coupled Channels (CDCC) formalism, where the breakup process is considered as an inelastic excitation of the projectile in the continuum. The halo nucleus 6He is composed by an alpha core and two weakly bound neutrons (S=0.97 MeV). These two neutrons have a large probability to be far away from the alpha core, producing the so-called nuclear halo. New experimental elastic cross sections for the reaction 6He+64Zn at energies around the Coulomb barrier have been measured and compared with Optical Model (OM) and CDCC calculations. In addition, CDCC calculations taking into account only Coulomb or nuclear couplings have been perfomed. The results show an important effect of the coupling to the continuum states, where nuclear couplings have been found more relevant than that of Coulomb. This effect has been also obseved in the OM calculations, where the inclusion of an analytical Coulomb dipole polarization potential has no influence. In the case of reactions with a heavy target, 6He+208Pb, as a consequence of the strong electric field produced by the target, the effect of the dipole Coulomb breakup has been observed larger than for the reaction with a medium mass target, 6He+64Zn. On the other hand, elastic angular distributions and quasielastic barrier distributions with the stable weakly bound 6Li, on the same target 64Zn, have been also analyzed within the CDCC method, showing non neglible effects of couplings to breakup channels, although not as strong as in the 6He case.

15:40	**Isospin influence on the decay modes of systems produced in the 78,86Kr+40,48Ca reactions at 10AMeV (00h20')** *Presenter: GNOFFO, Brunilde (INFN sez Catania)* Isospin influence on the decay modes of systems produced in the 78,86Kr+40,48Ca reactions at 10AMeV B. Gnoffo2, S. Pirrone2, G. Politi1,2, M. La Commara3,4, J.P. Wieleczko5, E. De Filippo2, P. Russotto1,2, M. Vigilante3,4, G. Ademard11, F. Amorini6, L. Auditore7,8, C. Beck9, I. Berceanu10, E. Bonnet5, B. Borderie11, G. Cardella2, A. Chibihi5, M. Colonna6, A. D'Onofrio4,12, J. D. Frankland5, E. Geraci1,2, E. Henry13, E. La Guidara1,14, G. Lanzalone15,6, P. Lautesse16, D. Lebhertz5, N. Le Neindre17, I. Lombardo3, K. Mazurek5, A. Pagano2, M. Papa2, E. Piasecki18, F. Porto1,6, M. Quinlann13, F. Rizzo1,6, E. Rosato3,4,†, W. U. Schroeder13, G. Spadaccini3,4, A. Trifirò7,8, J. Toke13, M. Trimarchi7,8, G. Verde2. 1Dipartimento di Fisica e Astronomia, Università di Catania, Italy 2INFN Sezione di Catania, Italy 3Dipartimento di Fisica, Università Federico II Napoli, Italy 4INFN Sezione di Napoli, Italy 5GANIL Caen,France 6INFN Laboratori Nazionali del Sud, Italy 7 Dipartimento di Fisica, Università di Messina, Italy 8INFN Gruppo collegato di Messina, Italy 9IN2P3 - IPHC Strasbourg, France 10IPNE, Bucharest, Romania 11IN2P3 - IPN Orsay, France 12Dipartimento di Matematica e Fisica - Seconda Università di Napoli,Caserta, Italy 13University of Rochester, USA 14Centro Siciliano Fisica Nucleare e Struttura della Materia, Catania, Italy 15Università Kore, Enna, Italy 16IN2P3 - IPN Lyon, France 17IN2P3 - LPC Caen, France 18University of Warsaw, Poland 19INFN Laboratori Nazionali di Legnaro, Italy † deceased The results of the analysis of the experimental data of the collisions 78Kr+40Ca and 86Kr+48Ca at 10AMeV are presented. The experiment was performed at the INFN Laboratori Nazionali del Sud (LNS) in Catania with the beams delivered by the Superconductive Cyclotron and the 4π multidetector CHIMERA. The composite systems formed in these reactions are different for 16 neutrons, the maximum value possible with stable beams for these systems; the various disintegration paths and in particular the isospin effects on the decay modes of the two produced systems are studied. The neutron richness of the composite nucleus is in fact expected to play a crucial role in the competition between various de-excitation channels, thus providing information about fundamental nuclear quantities such as level density, fission barrier and viscosity. With the purpose to investigate systems with an higher ratio N/Z, a LOI for the use of RIBs delivered by the facility SPES was presented: the reactions 88-94Kr + 40-48Ca at 10 AMeV will be studied for a comparison with the results obtained with stable beams.

Coffee break (16:00-16:30)

At and beyond the dripline and new modes of radioactivity (16:30-18:10)

time	title
16:30	**Proton emission - new results and future prospects (00h30')** *Presenter: PAGE, Robert (University of Liverpool)* Proton emission is the radioactive decay mode that is expected to determine the limit of observable proton-rich nuclei for most elements. Considerable progress has been made in the study of proton-emitting nuclei since the first observation of direct proton emission nearly 50 years ago. This has led to improvements in our understanding of this decay process and provided invaluable nuclear structure data far from the valley of beta stability. This talk will review the current status of the field, including some recent results, and consider some exciting prospects for future studies of proton-emitting nuclei at radioactive ion beam facilities.
17:00	**Future Perspectives with R3B (00h30')** *Presenter: BORETZKY, Konstanze (GSI Darmstadt)* The R3B (Reactions with Relativistic Radioactive Beams) experiment at FAIR will enable kinematically complete measurements of reactions with relativistic beams up to energies of approximately 1 AGeV. In this contribution I will focus on the investigation of dipole response of exotic nuclei using the precursor of R3B, named ALADIN-LAND or R3B-LAND setup, the transition from this setup to the R3B setup at GSI and the future possibilities using the fully equipped R3B experiment at the FAIR facility. The dipole response of exotic nuclei can be ideally studied using Coulomb excitation in inverse kinematics, enabling the investigation of excitation energies spanning the pygmy (PDR) and giant dipole resonance (GDR). The electric dipole polarizability αD, being very sensitive to the low-lying dipole strength, is correlated to the neutron skin thickness in a robust and less model-dependent manner [1]. Recently, for the stable nucleus, 208Pb the neutron skin thickness was extracted from the measured αD [2]. Here, a first experimental determination of the electric dipole polarizability αD in an unstable nucleus, namely 68Ni, and the derivation of its neutron-skin thickness will be reported [3]. [1] P.-G. Reinhard and W. Nazarewicz, Phys. Rev. C 81, 051303 (2010). [2] A. Tamii et al., Phys. Rev. Lett. 107, 062502 (2011). [3] D. Rossi et al., Phys. Rev. Lett. 111, 242503 (2013).
17:30	**Two-proton Decays of the 17Ne Low-lying States (00h20')** *Presenter: SHAROV, Pavel (JINR)* The structure of 17Ne nucleus is attracting a lot of interest for a long time. The multiple efforts to investigate it, both theoretical and experimental, have not yet provided convincing clarity about its properties. There are several questions of special interest connected with this nucleus which are actually tightly interwoven. One of them is two-proton decay of 17Ne first excited state. First excited state of 17Ne (3/2-) is located only 344 keV higher than 2p-decay threshold and it 2p-decay partial width is greatly lesser then gamma-decay partial width. Existing experimental threshold for the gamma-width/2p-width ratio 7.7e-3 [1] is few order of magnitude grater then theoretical predictions 0.9e-6 - 2.5e-6 [2]. In the recent experiment at the ACCULINNA fragment-separator [3] the two-proton decays of the low-lying states of 17Ne populated in the p(18Ne,d)17Ne transfer rea ction were studied. Original method for registration of the 2p-decay events with a high sensitivity was used in the experiment. As a result the new threshold for gamma-width/2p-width ratio 1.3e-4 has been achieved. Details of data analysis and perspectives of the method will be reported. References 1. M.J. Chromik et. al. PRC 55, 1676 (2002) 2. L.V. Grigorenko et. al. PRC 76 014008 (2007) 3. http://aculina.jinr.ru/

17:50	**Search for Two-Proton Radioactivity of 30Ar by Tracking its Decay Products (00h20')** *Presenter: XU, Xiaodong (GSI, Darmstadt and Justus-Liebig-Universität Gießen)* Two-proton (2p) radioactivity is an exotic nuclear decay mode resulting in a simultaneous emission of two protons. It was predicted for a number of neutron-deficient nuclei beyond the proton drip line. The ground-state (g.s.) 2p radioactivity was discovered in the decay of 45Fe in 2002. Later, this novel decay mode was also found in the decays of 48Ni, 54Zn, and 19Mg. In 2012, an in-flight decay experiment aimed to investigate the 2p radioactivity of a previously unknown nucleus 30Ar was performed with the fragment separator FRS of GSI. By tracking the decay products with silicon micro-strip detectors, 2p decays of 30Ar in-flight have been observed for the first time. The decay vertices were reconstructed through the measured 28S + p + p trajectories. For the calibration purpose, 2p decays of 19Mg have also been re-measured by tracking 17Ne + p + p trajectories and new data on this known 2p precursor have been obtained. In order to deduce the nuclear structure information such as decay energy and half-life of 30Ar as well as of 19Mg, the angular correlations of decay fragments were analyzed. By comparing the measured angular p-17Ne correlations with those obtained from the corresponding Monte-Carlo simulations, the 2p decay energy of g.s. of 19Mg has been deduced and several low-lying excited states of 19Mg have been identified. The results are consistent with the previously reported data. Spectroscopic information on several low-lying states of 30Ar has been obtained as well.

Exhibition (18:10-20:00)

Dinner (20:00-21:30)

Tuesday 09 June 2015

Nuclear structure far from stability 2 (09:00-10:50)

time	title
09:00	**A Decade of Nuclear Structure studies with post-accelerated european RIB (00h30')** *Presenter: CLEMENT, Emmanuel (CNRS / GANIL)* A bit more than one decade ago, large scale post-accelerated radioactive beam facilities have been put in operation in Europe for experiment at and below the Coulomb barrier. The REX-ISOLDE and SPIRAL1 facilities associated to the development of new instruments have produced numerous results which will be discussed in the present talk. A second generation of RIB facilities is under preparation in Europe with SPIRAL2, HIE-ISOLDE and the SPES project. Prospectives will be presented with the use of these new facilities.
09:30	**Identification of deformed intruder states in semi-magic 70,72Ni (00h20')** *Presenter: WALTERS, William (University of Maryland)* The structures of semi-magic 70Ni42 and 72Ni44 were investigated following complementary multinucleon-transfer and secondary fragmentation reactions. Changes to the higher-spin, presumed negative-parity states based on observed γ-ray coincidence relationships improve the agreement with shell-model calculations using effective interactions in the neutron f5/2•p•g9/2 model space. The second 2+ and (4+) states in 70Ni42 can only be successfully described when proton excitations across the Z = 28 shell gap are included. Monte-Carlo shell-model calculations suggest that the latter two states are part of a prolate-deformed intruder sequence, establishing an instance of shape coexistence at excitation energies lower than those observed recently in neighboring 68Ni40. Including U. of Maryland ANL - MSU - U. of Tokyo - U. of Padua - LBNL - U. of Edinburgh - U. of Aizu Orsay – JAEA - Central Michigan U collaboration Based on work supported in part by the USDOE (DE-FG02-94ER40834, DE-AC02-06CH11357, DE- AC02-05CH11231), NSF (PHY-1102511), and NNSA (DE-NA0000979).
09:50	**INVESTIGATION OF THE BETA-DECAY CHAIN 70Fe->70Co->70Ni (00h20')** *Presenter: MORALES LOPEZ, Ana Isabel (Università degli Studi di Milano - INFN Milano)* The rapid evolution of shell structure observed in the nuclear region defined by Z<28 and 40< N<50 has been the subject of many experimental and theoretical investigations in the last years. It has been correctly pointed out that the main driving mechanism is the monopole tensor force, responsible for the quenching of the classic magic gap at Z=28 with the filling of the g9/2 neutron orbital [Ots05]. This feature gives rise to interesting changes driven by both particle-hole excitations and Z or N evolution [Tsu14]. An illustrative example is the “doubly-magic” nucleus 68Ni: Two low-lying 0+ states at 1604 keV and 2511 keV, related to oblate and prolate shapes, have been observed [Rec13]. Low-lying deformed 0+ states are also expected to appear in heavier Ni isotopes, though they have not been yet experimentally observed. The work presented in this contribution aims at investigating the low-lying structure of neutron-rich nuclei with 40< N<50 from beta-delayed gamma spectroscopy. Nuclei in the isotopic chains of Cu, Ni, Co and Fe were produced by in-flight fission of a 345 AMeV 238U stable beam at the Radioactive-Isotope Beam Factory (RIBF) facility at RIKEN, as part of the EURICA campaign [Nis12,Sod13]. The reaction residues were identified using the large-acceptance magnetic spectrometer BigRIPS [Fuk13], and were sent to a beta-decay station consisting of the WAS3ABi active stopper [Nis12] and the EURICA spectrometer [Sod13]. An array of 18 LaBr3 scintillation detectors was also mounted around the WAS3ABi active stopper to perform fast-timing measurements [Pat14]. New beta-decay information and gamma spectroscopy data are available for nearly 20 isotopes. In particular, results will be shown for the decay chain 70Fe->70Co->70Ni. Based on the observed feeding patterns, new (non-yrast) 0+ and 2+ states in 70Ni will be proposed. As well, the nature of the low-spin beta-decaying isomer in 70Fe will be discussed. The new information will be compared to the neighbour decay chain 68Fe->68Co->68Ni [Fla15]. This will shed light on the evolution of the low-energy structure of the even-even neutron-rich Ni isotopes. [Ots05] T. Otsuka et al., Phys. Rev. Lett. 95 (2005) 232502 [Tsu14] Y. Tsunoda et al., Phys. Rev. C 89 (2014) 031301 [Rec13] F. Recchia et al., Phys. Rev. C 88 (2013) 041302(R) [Nis12] S. Nishimura: Prog. Theor. Exp. Phys. 2012, 03C006 (2012) [Sod13] P.-A. Söderström et al., Nucl. Instr. and Meth. B 317, 649 (2013) [Fuk13] N. Fukuda et al., Nucl. Instr. Methods B 317 (2013) 323 [Pat14] Z. Patel, et al., RIKEN Acc. Prog. Rep. 47 (2014), in print. [Fla15] F. Flavigny et al., Phys. Rev. C (2015), in print

10:10	**High-resolution CRIS and the secrets of 206Fr (00h20')** *Presenter: LYNCH, Kara (ISOLDE, CERN)* The Collinear Resonance Ionization Spectroscopy (CRIS) experiment at the ISOLDE facility, CERN, combines laser spectroscopy and nuclear-decay spectroscopy to provide nuclear-structure measurements of exotic isotopes. At CRIS, the high resolution innate to collinear laser spectroscopy is combined with the high efficiency of ion detection to provide a highly sensitive technique to probe an isotope's hyperfine structure. In addition to hyperfine-structure studies, ionization of the isotope of interest allows the (ground state or isomeric) ion beam to be deflected to a decay-spectroscopy station for alpha-decay tagging of the hyperfine components. The first measurements of the neutron-deficient francium isotopes achieved a linewidth of 1.5 GHz, allowing the structure of isotopes down to 202Fr to be studied [1,2]. Recently, high-resolution laser spectroscopy with linewidths as low as 20 MHz have been achieved, without a significant reduction in experimental efficiency [3]. This has allowed the measurements of electric quadrupole moments, in addition to magnetic moments and isotope shifts. Here we report on the latest results from the francium experimental campaign: the achievement of high-resolution laser spectroscopy and the nuclear structure insights this resolution provides in the case of the low-lying states of 206Fr [4]. [1] K.T. Flanagan et al., PRL 111 (2013) 222501 [2] K.M. Lynch et al., PRX 4 (2014) 011055 [3] R.P. de Groote et al., In preparation [4] K.M. Lynch et al., In preparation
10:30	**Magnetic moment in self-conjugate 24Mg. Towards high-precision measurements of picosecond excited states with RIB. (00h20')** *Presenter: GEORGIEV, Georgi (CSNSM Orsay)* For many years, the g factors of the first-excited states of self-conjugate nuclei, with equal numbers of protons and neutrons (N = Z), were expected to be very close to g = 0.5. This behavior occurs because protons and neutrons occupy the same orbits and the intrinsic-spin moments of the nucleons largely cancel, leaving the orbital motion of the protons to produce the nuclear magnetism. Recent shell model calculations, however, predict departures from g = 0.5 by up to 10 % for the first-excited 2+ states in the N = Z sd-shell nuclei from 20Ne to 36Ar. These departures stem from three mechanisms, namely, configuration mixing in the shell-model space; the Coulomb interaction between protons leading to isospin mixing; and meson exchange effects. In an experiment, performed at the ALTO facility in Orsay, we applied a modified version of the Time Dependent Recoil In Vacuum (TDRIV) method using the ORGAM Ge-detectors array and the Orsay Universal Plunger System (OUPS). The use of predominant H-like ions allowed determining the strong hyperfine field (29 kT) created at the nuclear site with very high accuracy, thus obtaining a high precision g-factor value, one of the most precise ever obtained for picosecond nuclear states. In this measurement we used "radioactive-beam configuration", in which the beam was not stopped in the center of the experimental setup but allowed to go through a thin "reset" foil. This modification of the TDRIV technique would allow its further application with radioactive ion beams. The obtained g factor, g(2+, 24Mg) = 0.538 (13) [1], differs by three standard deviations from the 0.5 value, expected in the simple shell-model picture. In order to reproduce the experimental result it is necessary to take into account all three above-mentioned contributions (wave-function configuration mixing; modification of the free-nucleon magnetic moment operator due to meson-exchange effects; and isospin-mixing effects). This is the first experimental results, obtained with sufficient accuracy to allows testing the nuclear-theory predictions in fine details. [1] A. Kusoglu et al., Phys. Rev. Lett. 114, 062501 (2015)

Coffee break (10:50-11:20)

Application of nuclear physics to other fields (11:20-12:40)

time	title
11:20	**Applications based on nuclear physics impacting our society. (00h30')** *Presenter: ENGERT, Tobias (GSI, Darmstadt)* Nuclear physics collaborations are using a lot of expertise and novel equipment for understanding exotic nuclei. Based on this, “Development of....” is one of the most used wordings at the beginning of a lot of theses or publications. However, these novel developments can not only be used in experiments and accelerators, these developments can often be used for applications for the society, too. Furthermore, all collaborations and facilities are writing status reports for funding agencies and stakeholders. For instance, GSI produces >140 official reports per year (Status 2013; without third-party reports!). In most of this reports performance numbers like publications, students, patents, spin-offs, return on investments, etc. are very important: the impact for the society is enquired! These performance numbers are used for national and international rankings. Moreover, a lot of funding programs in Horizon 2020 are based on innovations or impact for the society. This presentation gives an overview of GSI Validation Projects based on nuclear structure physics, which we developed in synergy with the experiments used to impact our society. It will be shown how beneficial such projects can be both for science and public.
11:50	**ViTO experiment at ISOLDE-CERN (00h30')** *Presenter: STACHURA, Monika (TRIUMF/CERN)* ViTO experiment at ISOLDE-CERN Versatile Ion polarized Techniques Online (ViTO) is a dedicated beamline for producing nuclear-polarized beams and for conducting experiments on a wide range of sample environments at ISOLDE-CERN. ViTO experiment is a modification of the formerly existing UHV beamline hosting the ASPIC apparatus and once fully operational it will open a wide range of possibilities for carrying out versatile and multidisciplinary experiments in the areas of nuclear and solid-state physics, fundamental interaction physics and biophysics. After the intended upgrade ViTO will provide three end stations: ASPIC, the β-asymmetry end station where highly-polarized ions will be available, and an open station for travelling experiments requiring rare polarized atoms (or ions). The latter station, if not occupied, will be used for monitoring spin-polarization during β-NMR or β-asymmetry experiments on the β-asymmetry beamline. The UHV and low temperature ASPIC station will remain for PAC studies on sensitive surfaces and interfaces and shall later be extended for β-NMR spectroscopy. Finally, the bio-β-NMR station will be equipped with a strong differential pumping system allowing for online β- NMR on liquid and online PAC spectroscopy in volatile matter, such as biochemically relevant aqueous solution. Furthermore, after chamber exchange, the station will allow for other, non-biological experiments. A short overview of future experiments will be presented during the talk.
12:20	**MR-TOF-MS for nuclear physics facilitate a new class of experiments in analytical mass spectrometry (00h20')** *Presenter: DICKEL, Timo (GSI, Darmstadt)* The developments of mass spectrometers for ever higher performance has historically been driven by the needs from nuclear physics. One of the latest developments are multiple-reflection time-of-flight mass spectrometers (MR-TOF-MS) that have recently been installed at different low energy radioactive ion beam facilities. They are used as isobar separators with high ion capacity and/or mass spectrometers with high mass resolving power and accuracy for short-lived nuclei. The devices also have a wide potential in other research fields such as space science, medicine, biology, chemistry and homeland security. Based on the MR-TOF-MS[1] developed for the FRS Ion Catcher Experiment at GSI, Germany, a mobile MR-TOF-MS dedicated for in-situ analytical measurements has been developed at the Justus-Liebig-University Giessen[2,3]. The device including all electronics, roughing pump and data-acquisition has a volume of 0.8 m^3, a mass resolving power up to 400,000 and is equipped with an atmospheric pressure inlet. Thus, in-situ measurements can be performed without the need of any sample preparation. In addition to highly resolved and accurate mass measurements, the device offers unique tandem mass spectrometry capability via mass selective ion re-trapping with (ultra)-high mass separation power ($R > 50,000$). By tandem mass spectrometry structural information and unambiguous identification are provided. Mass selective ion re-trapping offers more than an order of magnitude higher separation power than commercially available mass separators. Thereby a new class of experiments with higher selectivity and sensitivity becomes possible in various fields of life science. Envisaged applications are in environment sciences (e. g. to monitor the water and air quality on hot spots) and in medicine (e. g. to instantaneously distinguish between healthy and cancerous tissue during surgery). [1] T. Dickel et al., Nucl. Instrum. Methods A 777 (2015) 172-188 [2] T. Dickel et al., Nucl. Instrum. Methods B 317 (2013) 779-784 [3] J.Lang, PhD thesis in preparation

Lunch break (12:40-14:30)

Future RIB facilities 1: Facility concert (part 1) (14:30-16:00)

time	title
14:30	**GANIL/SPIRAL2 facility – Status and Future (00h30')** *Presenter: SAVAJOLS, Hervé (GANIL)* The first phase of the SPIRAL 2 facility [1], a major extension of the GANIL accelerator complex, is now in its final stage of development and will be completed in 2015. On December 2014, a first protons beam was produced after the ion source at an intensity of 6,8 mAe in pulsed mode. This first success sets SPIRAL2 on its path forward for delivering the highest beam intensity for light ions, up to energy of 40 MeV with a beam current up to 5 mAe and for heavy ions with beam currents up to 1 mAe and maximum energy 14.5 MeV/u. The next phases for the full operation of the SPIRAL2 Phase 1 comprises, in the coming months, the acceleration of light and heavy ions through all the accelerator components to reach the nominal energy. Two new experimental halls Neutron For Science and S3 will allow for a new class of experiments with a high flux of fast neutron and high intensity heavy ion beams, respectively. Simultaneously, an important upgrade of the current SPIRAL1 ISOL facility will be accomplished by 2016/2017 allowing for production and acceleration of RIB of isotopes of about 20 light and medium light elements. A dedicated new experimental hall called DESIR used for experiments with low energy RIB provided by SPIRAL1 and S3 is currently in the detailed design phase. An ambitious scientific program at GANIL/SPIRAL2 imposes a use of the most efficient and innovative detection systems as a new separator/spectrometer S3, the upgraded magnetic spectrometer VAMOS, the 4π Gamma array EXOGAM2, charged particle detectors like ACTAR-TPC, FAZIA and GASPARD as well as the European gamma ray tracking array AGATA that will stay at GANIL until end of 2018. A short-term scientific program as well as future operation modes of the GANIL/SPIRAL2 complex as a multiuser facility will be presented. REFERENCES [1] http://pro.ganil-spiral2.eu/
15:00	**EURISOL Distributed Facility: Paving the way towards the ultimate ISOL facility for EUROPE (00h30')** *Presenter: BLUMENFELD, Yorick (IPN Orsay, IN2P3-CNRS, Université Paris-Sud)* The EURISOL concept was designed to provide radioactive ion beams through the ISOL method with unprecedented intensities and with post accelerated energies up to 150A MeV. ISOL facilities currently under construction or design in Europe, in particular HIE-ISOLDE, ISOL@MYRRHA, SPES and SPIRAL2 will provide the scientific and technological stepping stones towards an ultimate single site EURISOL facility. In order to better integrate the exploitation and upgrade of these facilities five laboratories or agencies (BEC – Belgian EURISOL Consortium, CERN, COPIN- Poland, GANIL, and INFN) have signed a Memorandum of Understanding to establish a EURISOL Distributed Facility (DF) which would have the following goals: • Prepare a strong scientific case for RIB science and applications • Support, upgrade, optimize and coordinate ISOL-based European facilities and projects as a necessary step towards EURISOL • Foster R on RIB production and Instrumentation towards EURISOL • Place EURISOL-DF on the ESFRI list as a candidate project by 2018 • Have EURISOL as a single site facility as a long term goal In this talk, after a brief reminder of the characteristics of EURISOL defined during the Design Study, I will discuss the contributions of the different facilities to the DF and the planned upgrades of these facilities to be carried out in the context of the DF. I will present the organization and timeline leading towards the inclusion of the DF on the ESFRI list and touch upon a few possibilities for its legal structure.

15:30	**Exploring the extremes with NUSTAR@FAIR (00h30')** *Presenter: KALANTAR, Nasser (KVI-CART / Univ. Groningen)* The upcoming FAIR facility in Darmstadt, Germany, will produce intense high- energy beams of exotic nuclei which will be used to explore the properties of new regions of the chart of nuclides of key importance for the investigation of nuclear structure and reactions, and nuclear astrophysics. Several experiments have been planned with the aim of addressing the scientific challenges. These experiments use a variety of techniques to answer the fundamental questions in the field. They are brought together in the NUSTAR (NUclear STructure Astrophysics and Reactions) collaboration which maximizes the synergy amongst the sub-collaborations performing various experiments. With more than 800 scientists from more than 180 institutes located in 38 countries, the collaboration is well advanced and ready with the state-of-the-art instrumentation to start the measurements in the next few years. The physics case and challenges for all the NUSTAR experiments will be briefly discussed in this presentation. 1) http://www.fair-center.eu/for-users/experiments/nustar.html

Coffee break (16:00-16:30)

Future RIB facilities 2: Facility concert (part 2) (16:30-17:30)

time	title
16:30	**News from ISOLDE and HIE-ISOLDE (00h30')** *Presenter: KOWALSKA, Magdalena (ISOLDE-CERN)* ISOLDE is the CERN laboratory for research with radioactive ions. Thanks to on-going target and ion source developments and upgrades and additions of new experimental techniques and setups, it has provided for physics close to 1000 isotopes of 70 chemical elements. The first part of the talk will cover the latest technical achievements which allowed providing new, more intense and more pure beams for research. The HIE-ISOLDE project for post-accelerating the radioactive beams and for providing high-intensity and purity beams and its status will be also presented, as well as the MEDICIS project for producing radionuclides for medical studies. In the second part, new additions to ISOLDE experimental setups will be presented together with physics highlights which were achieved thanks to these upgrades. To these belong new beamlines IDS and VITO and the addition of an electrostatic trap to ISOLTRAP.
17:00	**The SPES project at the INFN- Laboratori Nazionali di Legnaro (00h30')** *Presenter: PRETE, Gianfranco (INFN-LNL)* The SPES Radioactive Ion Beam (RIB) facility is in the construction phase at INFN-LNL. The SPES project has the aim to provide high intensity and high-quality beams of neutron-rich nuclei as well as to develop an interdisciplinary research center based on the cyclotron proton beam. It is based on a dual exit high current Cyclotron, with proton beam energy 35-70 MeV and 0.2-0.5 mA, used as proton driver to supply an ISOL system. A Direct UCx Target, able to sustain a power of 10 kW, was developed. As the cyclotron can deliver two beams at the same time, an applied physics facility, mainly devoted to the production of radioisotopes for medicine and neutron beams for irradiation and material study, will be supplied. The ISOL system will produce neutron-rich radioactive ions by proton induced fission in the UCx target. The expected fission rate in the target is in the order of 1013 fissions per second. The exotic isotopes will be re-accelerated by the ALPI superconducting LINAC at energies of 10 AMeV and higher, for masses in the region of A=130 amu, with an expected rate on the secondary target of 107 – 109 pps. The expected SPES beam intensities, quality and energies together with the up to date experimental apparatuses, which are at present and will be in the near future available at LNL, will permit performing forefront research to study nuclear structure and nuclear dynamics in a region of the nuclear chart far from stability. The actual status of the project will be presented focusing on the schedule and the specificity of the project in the European and international frame

Future RIB facilities: Round table discussion (17:30-18:30)

Poster session (18:30-20:00)

title	board
Nustar DAQ (01h30') *Presenter: PIETRI, Stephane (GSI, Darmstadt)* The Nuclear physics collaboration in FAIR (Nuclear Structure, Astrophysics and Reactions) will be operating a rather diverse type of experiments ranging from experiments in storage rings, reactions at relativistic energies to mass measurements in Penning traps. All of those experiments are dependent on the high-intensity radioactive beams delivered by the new Super-Fragment Separator (Super-FRS). To perform successful experiments it will be required to correlate all the information of the Super-FRS with data from individual experiments. This motivates the development of the same data acquisition system for NUSTAR : NUSTAR DAQ (NDAQ). NDAQ will be an evolution based on the present MBS DAQ used in most of GSI to assure a smooth transition from legacy equipment to new development. It will present itself as several stations (NDAQ nodes) alongside the facility where the equipment will be connected. A NDAQ system will comprise of several nodes. Each node will provide basic services ranging from run control to timestamping and data flow handling. The goal is to have a system completely modular where it will be easy to add and remove nodes from running acquisitions without stopping it. It will allow to couple synchronous and asynchronous systems. One main difference compared to the current NUSTAR data acquisition is the development of control events, which will be included in the data stream, and store any change of configuration in the setup. We will present the status of the development and the results of the first test of this new data acquisition system. In the EURORIB spirit we are open to synergies with other facilities.	1
In-flight fragment separator system design for the RISP (01h30') *Presenter: KIM, Jongwon (Institute for Basic Science)* An in-flight fragment separator has been designed for the rare isotope science project (RISP) in Korea to provide rare isotope beams with worldwide users. The beam energy of 238U is 200 MeV/u in the initial phase and will be increased to 400 MeV/u so that we set the maximum rigidity to be around 9.5 Tm. The primary beam power is 400 kW at maximum, which is reflected in the radiation heating calculation and shielding design. The development of major components, which includes graphite target, beam dump made of water drum, and superconducting magnets using LTS and HTS, are underway. As the building design was started, the layout of the facility has been detailed with an architectural company. Although we finalized the overall configuration of the separator for the building, we continue to study different configurations of the separator. The overall progress of the in-flight system's design and prototyping will be presented along with the results of beam optical study.	2
Recent exposures of nuclear track emulsion to radioactive nuclei, neutrons and heavy ions (01h30') *Presenter: MAMATKULOV, Kahramon (Joint Institute for Nuclear Research, Dubna)* Featuring excellent sensitivity and spatial resolution a nuclear track emulsion (NTE) maintains a position of universal and inexpensive detector for survey and exploratory research (http://becquerel.jinr.ru/) in microcosm physics. Use of this classical technique on beams of modern accelerators and reactors turns out highly productive. In a number of important tasks completeness observations provided in NTE remains unachievable for electronic detection methods. Computerized microscopes will enable one to approach at a new level to application of NTE. In particular, clustering features of the wholesome family of light nuclei including radioactive ones were investigated using NTE. New data on the charge topology of 11C dissociation are presented and compared with data on the nuclei 7Be, 8,10B, 9,10C and 14N. Probabilities of occurrence of a variety of ensembles of fragments allow one to reveal their structural weights. When testing the novel NTE a variety of physics tasks related with measurements of alpha-particle tracks were addressed. Decays of stopped 8He nuclei, breaking-ups of 12C nuclei by thermonuclear neutrons are analyzed. Splittings induced by thermal neutrons are studied in boron enriched emulsion. There arises a problem calibration of ranges of heavy ions for ternary fission studies. For this purpose Kr and Xe ions are implanted into emulsion at the JINR cyclotrons. Progress of analysis of NTE samples exposed to Am and Cf sources is presented.	3

Mass measurements in the CR storage ring at FAIR (01h30') *Presenter: WEICK, Helmut (GSI, Darmstadt)* The ILIMA measurements in the isochronous CR ring at FAIR The ILIMA collaboration as a part of the NUSTAR programme aims at investigating Isomers and measure LIfetimes and MAsses in the storage rings of FAIR. In the first construction phase the CR storage ring without an electron cooler is foreseen. Instead it is designed to run an isochronous mode which can be used for IMS (isochronous mass spectrometry) either with time-of-flight (ToF) detectors or Schottky pick-ups. In another mode also fast stochastic cooling of up to 10^8 injected ions will be possible, good enough for creating a narrow beam from which decay products can be recorded on particle detector next to the beamline. The ILIMA experiment programme will be shown. Compared to existing isochronous storage rings like ESR at GSI or CSRe at IMP Lanzhou the acceptance of the new ring should be orders of magnitude larger. This can be achieved by an increased acceptance in longitudinal and both transverse directions of beam phase space. However, this also means that a higher order correction scheme must be foreseen which will be explained in the presentation. These considerations are also valid for the smaller multi-reflection ToF mass spectrometers. An advantage of the measurements with a large variety of ions in a storage ring is the coverage of larger areas of nuclides and a direct connection to calibration masses. But at fixed magnetic rigidity ions of different mass-to charge ratio (m/q) cannot all be equally isochronous. To overcome this problem two ToF detectors providing an additional velocity measurement shall be employed. The measurement procedure will be explained, it will increase the efficiency and accuracy of the measurements. For better efficiency of the detector itself a new enlarged detector design has been worked out.	4
PIPERADE: A Penning-trap based separator for the future low energy branch DESIR at SPIRAL2 (01h30') *Presenter: DE ROUBIN, Antoine (MPIK, Heidelberg and CENBG, Gradignan)* The DESIR facility at SPIRAL2 is dedicated to low energy nuclear studies using exotic nuclei currently not accessible. Nuclear structure and astrophysics studies will be performed on these nuclides using beta decay spectroscopy, laser spectroscopy and trap-based experiments. In order to achieve the targeted precision, extremely pure samples of these exotic nuclides are needed. PIPERADE, a system consisting of a radiofrequency (RFQ) cooler and buncher and a double Penning trap, will be located at the entrance of the DESIR beamline to purify the radioactive ion beams from undesired contaminants. The RFQ will create ion bunches with a transverse and longitudinal emittance about 3 π.mm.mrad and 10 eV.µs respectively. Thereafter the first Penning trap will perform isobaric purification and the second Penning trap will accumulate the ions of interest. Design and current status will be presented. The challenge for PIPERADE is to separate very large amounts of short-lived nuclei (10^5 ions per bunch) while maintaining the resolving power of 10^5 for isobar selection. For this purpose, studies on space charge effects and new excitation schemes are ongoing and will be presented.	5
Dynamical Dipole Mode in the 40,48Ca+152,144Sm fusion-evaporation and fission reactions and perspectives with RIBs (01h30') *Presenter: MAZZOCCO, Marco (University of Padova and INFN - Sezione di Padova)* The Dynamical Dipole mode (DD) is a pre-equilibrium large amplitude collective oscillation of protons against neutrons of the dinucleus formed in charge asymmetric heavy-ion collisions [1-4]. The study of its gamma decay gives us valuable information on the reaction dynamics and could shed light on the density dependence of the symmetry energy in the nuclear matter Equation of State at sub-saturation densities [5]. We will present results on the DD excitation in a heavier composite system than those studied up to now: the 192Pb nucleus formed in the fusion-evaporation and fission 40Ca + 152Sm and 48Ca +144Sm reactions at Elab = 440 MeV and 485 MeV, respectively. The experiment was performed at Laboratori Nazionali del Sud, Italy. The gamma rays and the light charged particles emitted in the reaction were detected by using the MEDEA apparatus [6] while the heavy reaction fragments were detected by position sensitive Parallel Plate Avalanche Counters placed symmetrically around the beam direction. The analysis of the gamma ray spectra and angular distributions evidenced in a model independent way the DD excitation in such a heavy composite system in both exit channels: fusion-evaporation and fission. The possible implications of observing DD gamma radiation in the evaporation channel of a heavy composite system in the super-heavy element quest will be discussed. On the other hand, the observation of DD gamma radiation also in the fission exit channel (never observed before) provides innovative information on the DD excitation at higher partial waves, setting thus new severe constraints on theoretical models. The use of radioactive beams permits to reach much larger N/Z asymmetries in the entrance channel than previously done with stable beams while the combination of radioactive and stable beams results in a very large number of target-projectile combinations giving us the opportunity to perform a systematic study of the DD features and to probe the Equation of State of the nuclear matter. Ideas in this direction will be discussed. [1] S. Flibotte et al., PRC77 (1996)1448 [2] F. Amorini et al., PRC69 (2004) 014608 [3] D. Pierroutsakou et al., PRC71 (2005)054605, PRC80(2009)024612, B. Martin et al., PLB664 (2008)47 [4] A. Corsi et al., PLB679 (2008)197, A. Giaz PRC90 (2014) 014609 [5] V. Baran et al., PRC79 (2009)021603(R) [6] E. Migneco et al., NIMA314 (1992)31	6

Laser Spectroscopy of the Heaviest elements (01h30') *Presenter: CHHETRI, Premaditya (TU Darmstadt)* Laser spectroscopy of the heaviest elements allows the study of the evolution of relativistic effects on their atomic structure. In addition, nuclear properties such as spins and nuclear moments can be obtained. In our experiments at the GSI we exploit the Radiation Detected Resonance Ionization Spectroscopy in a buffer-gas filled stopping cell and use a two-step photoionization process to search for the 1P1 level in 254No. In this poster the results from a recent measurement campaign will be presented.	7
The GRIFFIN Facility for Decay Spectroscopy Experiments at TRIUMF (01h30') *Presenter: ANDREOIU, Corina (Simon Fraser University)* GRIFFIN [1], the Gamma-Ray Infrastructure For Fundamental Investigations of Nuclei is the newly commissioned decay spectroscopy array located at TRIUMF, Canada's National Laboratory for Nuclear and Particle Physics, in Vancouver, Canada. GRIFFIN consists of 16 large-volume hyper-pure germanium (HPGe) clover detectors assisted by a custom-built digital data acquisition system. A suite of ancillary detector systems can be coupled to GRIFFIN for comprehensive decay spectroscopy experiments with radioactive beams delivered by the TRIUMF ISAC facility. In November-December 2014, the early-implementation experiments with radioactive beams were performed with the GRIFFIN array, coupled to SCEPTAR [2], an array of plastic scintillators for beta-tagging, and PACES [2], an array of lithium-drifted silicon detectors for high-resolution internal conversion electron spectroscopy. Additional arrays of lanthanum bromide scintillators for fast gamma-ray timing measurements, called DANTE [2], and neutron detectors for beta-delayed neutron-emitting nuclei, called DESCANT, [3] are also available for future experiments. Preliminary results obtained with the GRIFFIN spectrometer near and far from stability using beta decay of beams of 115g,mAg [4], 46,47K [5,6] and 32Na [7] will be presented along with a discussion of future opportunities. The GRIFFIN spectrometer is funded by the Canada Foundation for Innovation, TRIUMF, and the University of Guelph. TRIUMF receives federal funding via a contribution agreement through the National Research Council of Canada. This research is supported by the Natural Sciences and Engineering Research Council of Canada. References [1] C.E. Svensson and A.B. Garnsworthy, Hyperfine Interactions 225, 127 (2014). [2] A.B. Garnsworthy and P.E. Garrett, Hyperfine Interactions 225, 121 (2014). [3] P.E. Garrett, Hyperfine Interactions 225, 137 (2014). [4] R. Dunlop et al., to be published. [5] J.L. Pore et al., to be published. [6] J. Smith et al., to be published. [7] F. Sarazin et al., to be published.	8
A novel isobar separator for the TITAN facility at TRIUMF (01h30') *Presenter: DICKEL, Timo (GSI, Darmstadt)* At TRIUMF's Ion Trap for Atomic and Nuclear science (TITAN) mass measurements and in-trap decay spectroscopy of exotic nuclei are performed. The reach to even more exotic nuclei is often hampered or made impossible by strong isobaric contamination. Multiple-reflection time-of-flight mass spectrometers (MR-TOF-MS) have been shown to be ideal tools to overcome these limitations. Recently, several MR-TOF-MS have been installed at rare ion beam facilities around the world. It has been demonstrated that these systems can achieve outstanding performance, such as high transmission efficiency (up to 50%), mass resolving power as high as 600,000 FWHM, mass accuracies down to the 0.1 ppm level, repetition rates up to 400 Hz and high sensitivity. An MR-TOF-MS has been developed to extend TITAN's capabilities and facilitate measurements of very short-lived nuclei (half-life longer than a few ms) that are produced in very low quantities (a few detected ions overall) in the presence of strong isobaric contamination. In order to enable the installation of an MR-TOF-MS in the restricted space at the TITAN facility, novel mass spectrometric methods have been developed. Ion transport into and out of the device is performed using an RFQ-based ion beam switchyard. Mass selection is performed using a dynamic re-trapping technique after time-of-flight analysis in an isochronous reflector system. Only due to the combination of these novel methods has the realization of an MR-TOF-MS based isobar separator at TITAN become possible. The system will be installed parallel to the existing TITAN beam line without requiring changes to the existing ion optics of TITAN. An isobarically clean beam can be provided to the TITAN EBIT and to the Penning trap. The exotic ions can be merged with ions from several offline ion sources for calibration and optimization of ion transport. The system has been commissioned at the University of Gießen, Germany and installation at the TITAN facility is underway. First results of the commissioning will be presented.	9

β-delayed charged particle decays of 22Si and 23Si (01h30') 10

Presenter: BABO, Mathieu (GANIL)

Delayed charged particle spectroscopy following the β decay of nuclei at, or near, the proton drip line provides an excellent technique for studying the evolution of nuclear structure and testing isospin symmetry in weakly bound nuclei. The β decays of 22,23Si are particularly attractive cases since these are the lightest (bound) nuclei with ground-state isospin projections of Tz=-3 and Tz=-5/2, respectively. Based on their large decay Q-values, a number of exotic charged-particle decay channels are potentially open including β-delayed proton (βp), β2p, and β3p. To date, very limited spectroscopic information is available for the decays of these exotic nuclei.

In this work, a novel arrangement of three double-sided Si strip detectors (DSSD) surrounded by 16 high-purity Ge detectors of the Segmented Germanium Array (SeGA) was employed at the National Superconducting Cyclotron Laboratory (NSCL, USA) to characterize the β-delayed charged-particle decays of 22Si, and 23Si. Coincidences between the emitted charged particles detected in the DSSD and the γ rays detected in SeGA have revealed several previously unknown excited states in the daughter nuclei 22Al and 23Al, respectively. Evidence for previously unobserved decay pathways have also been deduced including several weak β-delayed proton branches and even the existence of β-delayed two proton emission from 22Si. In this presentation, I will present the detailed level schemes that have been deduced for the decays of 22Si and 23Si and discuss how this measurement will be used to provide one of the first experimental determinations of the ground-state masses of these nuclei.

Gamma-particle coincidences in reactions induced by light neutron rich nuclei using CHIMERA detector at LNS (01h30') 11

Presenter: CARDELLA, Giuseppe (INFN Sez Catania)

Neutron rich exotic beams (6,8He, 8,9Li, 10,11Be, 13B, 16,17C, 68Ni), produced through in-flight fragmentation are available at LNS [1]. Using the CHIMERA detector [2,3], recently implemented by the FARCOS array [4] we have begun various experiments to study elastic scattering transfer and break-up reactions. The kinematical coincidence method was used to extract high resolution angular distributions of binary reactions from the measured light particle energy spectra [5]. In the last experiment performed in March 2015 we expect improved resolution due to the use, at forward angles, of the highly segmented FARCOS array. In all these measurements we can profit of □-ray coincidence measurements, to better discriminate elastic and inelastic processes. □-rays are detected using the CsI(Tl) detectors belonging to the spherical part of the CHIMERA array (from 30° to 176°). Very clean □-rays angular distributions can be extracted using such high efficiency apparatus[6]. Preliminary results obtained in various reaction channels will be reported.

References:

[1] see http://fribs.lns.infn.it/upgrade-results.html
[2] A.Pagano et al, Nucl. Phys. A 734 (2004) 504
[3] A.Pagano, Nuclear Physics News International, 22:1(2012)25.
[4] G.Verde et al, Journal of Physics: Conference Series 420 (2013) 012158.
[5] L.Acosta et al, NIM A 715 (2013) 56.
[6] G.Cardella et al submitted to NIM.

Status of the HIE-ISOLDE Project (01h30') 12

Presenter: KOWALSKA, Magdalena (ISOLDE-CERN)

After 20 years of successful ISOLDE operation at the PS-Booster at CERN, a major upgrade of the facility, the HIE-ISOLDE (High Intensity and Energy ISOLDE) project was launched in 2010. It is divided into three parts; a staged upgrade of the REX post-accelerator to increase the beam energy from 3.3 MeV/u to 10 MeV/u using a super-conducting linac, an evaluation of the critical issues associated with an increase in proton-beam intensity and a machine design for an improvement in RIB quality.This presentation aims to provide an overview of the present status of the overall project by providing; an insight to the infrastructure modifications, as well as progress on the installation and hardware commissioning of the super-conducting linac and high-energy beam transfer lines.

Hydrodynamics of a liquid Pb-Bi target for high-power ISOL facilities (01h30') 13

Presenter: HOUNGBO, Donald (SCK-CEN)

In the context of the forthcoming next generation of Radioactive Ion Beams (RIBs) facilities based on the Isotope Separation On Line (ISOL) method, the development of production targets capable of dissipating the high power deposited by the primary beam is a major challenge. EURISOL and ISOL@MYRRHA are examples of such facilities. Within this framework, the concept of a high-power target based on a liquid Pb-Bi loop incorporating a heat-exchanger, a pump and a release chamber was proposed and is currently being developed within the LIEBE project. In this target the irradiated Pb-Bi containing short-lived isotopes is promptly spread into a shower of droplets, thereby reducing by two orders of magnitude the diffusion length of isotopes.
Yet, ensuring an efficient release of isotopes is still of crucial importance and several delay-inducing processes have to be optimized. This requires design-optimization of both the irradiation volume and the release chamber. LBE evacuation from the irradiation volume of this target is one such process that needs to be carefully studied. The optimization of the flow of liquid Pb-Bi in the compact and complex geometry of the irradiation volume will be discussed in this presentation. The full target geometry and its dimensions have been set as design variables. Among other aspects, this includes optimizing the number and positions of the target inlets and outlets. The following quality criteria were considered: a residence time of LBE inside the irradiation volume bellow 100 ms, a uniform distribution of velocity vectors through the few thousands outlet apertures and a reduced cavitation risk. Several constraints were taken into account, such as a maximum pressure-drop limit and maximum limits on target dimensions.
Three-dimensional computer simulations of the LBE flow have been used for the evaluation of design modifications. Results pertaining to the initial design geometries have revealed issues such as long residence time due to irradiated LBE recirculation, non-uniform distribution of LBE-velocity vectors at outlet apertures and regions with pressure dropping below the vapor pressure of LBE. Thorough analysis of the results led to successively-improved target-design options. Among other improvements, the design of a feeder volume equipped with a feeder grid was required in order to uniformly distribute the high-momentum inlet jet over the irradiation volume. Two different optimized target geometries were eventually obtained. Each of them showcases a different way to deal with the jet effect initially observed due to the high-momentum inlet liquid stream.
Calculations of the thermo-mechanical effects of the impact of a proton pulse will be presented for the optimized geometries. Under the assumptions of a rigid irradiation-volume-container and not accounting for potential cavitation effects, temperature and pressure fields inside the irradiation volume have been determined.

High-resolution studies with secondary reactions via dispersion-matched modes of the in-flight separator Super-FRS and its combined spectrometers (01h30') 14

Presenter: WINFIELD, John Stuart (GSI, Darmstadt)

High-resolution measurements with relativistic fragments present a challenge for in-flight rare isotope facilities such as the future Super-FRS at FAIR. An elegant way to overcome the large longitudinal and transverse emittance of high-energy beams is to use a dispersion-matched ion-optical mode with an Analyser part before the secondary target, coupled with a following Spectrometer part. One scheme for the Super-FRS is to use the Main Separator as the analyser and the Energy Buncher in the Low Energy Branch as the spectrometer. In this case, the 1st-order momentum resolving power is about 10,000 for particles with a magnetic rigidity up to 7 Tm.

Optimization of the 6He production target in the 7Li(γ, p)6He reaction (01h30') 15

Presenter: TETEREV, Yury (Joint Institute for Nuclear Research)

The facility for the exotic 6He nuclei production in the 7Li(γ, p)6He reaction was built in the Flerov Laboratory of Nuclear Reactions in Dubna. As the target material the fine salt of Li2CO3 and LiF were used. The ECR ion source was included in the facility to ionize the 6He atoms and produce the heavy ion beam. The measured value of the 6He at the entrance of the ECR source was (1,7±0,2) 107 atoms/s per1 μA of electron beam current. The ECR source efficiency of the 6He ionization was 8%, as the result - the value of the 6He ions was obtained at the level of (1.4±0.2)×106 ions/s per 1 μA of electron beam current. Series of dedicated tests were done to examine the diffusion and effusion effects on the helium transportation delay from the production target (Ø83 mm, 300 mm length)to the ECR source. It was found that the main 6He losses were occurred due to effusion processes. The estimation value of the diffusion losses were not more than 10%. The detailed overview of the facility and the features of diagnostic set-up used for 6He production parameters evaluation and control during tests are discussed. State of art and future plans are presented.

Electron screening – still an open question (01h30') *Presenter: VESIC, Jelena (Jozef Stefan Institute Ljubljana)* Our understanding of energy generation in stars and primordial and stellar nucleosynthesis strongly depends on reliable knowledge of nuclear reaction rates at low energies. However, at low energies, barrier penetration leads to a steep energy dependence of the cross section thus making the cross section measurements extremely difficult. Also, the influence of surrounding electrons is very poorly understood in still experimentally unachievable stellar plasmas. Therefore, it is of crucial importance to measure the bare cross sections as well as possible. In recent years, the availability of high-current low energy accelerators together with improved target and detection techniques have allowed for a reaction rate measurements at very low energies. However these measurements are also complicated by the presence of atomic electrons which alter the Coulomb barrier by screening the nuclear charge and lead to enhancement of cross section at low energies compared to the case of bare nuclei. Experimental studies of various nuclear reactions in metallic environments [1-4] have shown the expected cross section enhancement at low energies. However, the enhancements in metallic targets were significantly larger than expected from the adiabatic limit, which is thought to provide the theoretical maximum for the magnitude of electron screening. Therefore, the size of electron screening has to be measured for each metallic environment and each target separately. Recently, we performed an extensive experimental campaign, with an aim to study the electron screening in the laboratory for various nuclear reactions and involving both low and high Z targets. The 1H(7Li,α)4He fusion reaction was studied for hydrogen implanted Pd, Pt, Zn and Ni targets. Large electron screening, of a few keV was observed in all targets. On the contrary, no large electron screening was observed in the following proton induced reactions: 55Mn(p,γ)56Fe, 55Mn(p,n)55Fe, 113Cd(p,n)113In, 115In(p,n)115Sn, 50V(p,n)50Cr and 51V(p,γ)52Cr. Moreover, no shift in resonance energy for metallic compared to insulator environment was observed for the studied (p,n) and (p,γ) reactions. These results are quite surprising and do not follow expected trends [4]. In order to further study the interplay between nuclei and their surroundings we further studied the 1H(7Li,α)4He reaction in W, Pd and C environments. In addition, we also focused on studies of electron screening in the 1H(19F,αγ)16O reaction in the same targets (in both normal and inverse kinematics). Preliminary results showed unexpectedly large electron screening values (of the order of 10 keV), pointing to a dependence of the electron screening potential on the position of the target nuclei in metallic lattice as well as to a non-linear scaling (instead of widely accepted linear one) of electron screening potential with the charge number of the target. In a continuation of our experimental campaign, we aim to investigate 1H(11B, γ)12C reaction in order to thoroughly investigate the stated hypotheses. If correct, these results would have a profound effect on the understanding of the “laboratory” electron screening effect and would eventually lead to the more correct bare cross sections extracted from laboratory measurements. Until plasma experiments become feasible in the laboratory, the study of electron screening in a metal - the plasma of a poor man [2], is the only means of study that will hopefully successfully point towards the correct interpretation of the electron screening and further understanding of immensely important fusion processes in stellar environments. A review of previous results, as well as newly obtained ones will be presented. [1] J. Cruz et al., Phys. Lett. B624, 181 (2005). [2] C. Rolfs, AIP Conf. Proc. 847, 245 (2006). [3] F. Raiola et al., Eur. Phys. J. A 19, 283 (2004). [4] K. U. Kettner et al., J. Phys. G 32, 489 (2006).	16
Space-charge Effects in a Cryogenic Stopping Cell (01h30') *Presenter: PURUSHOTHAMAN, Sivaji (GSI Darmstadt)* At the Low-Energy-Branch (LEB) of the Super-FRS at FAIR, projectile and fission fragments will be produced at relativistic energies, separated in-flight, range-bunched, slowed-down and thermalized in a cryogenic stopping cell filled with ultra-pure helium gas, featuring enhanced cleanliness and high extraction efficiencies. Thermalised ions are extracted out of the stopping cell using a combination of DC and RF electric fields and gas flow. A prototype CSC for the LEB has been successfully commissioned at the FRS Ion Catcher at GSI. Ionization of He buffer gas atoms during thermalization of energetic ions creates a region of high space charge in the stopping cells. Space charge creation has an adverse effect on extraction efficiency and extraction time of stopping cells as the high amount of charge distorts the applied DC electric drag fields. Thus understanding of space charge effects is of greatest importance to make full use of the high yields at the future rare ion beam facilities like FAIR. For this purpose a detailed study of space charge effects in the CSC was performed using the ion optical simulation software SIMION. Experimental parameters such as ion beam Intensities, electric fields, buffer gas density, buffer gas temperature and spill structures used during the online experiments are used for this simulations and results shows excellent agreement with the experimental results. Comparison between simulated results and online data and its implication for the final CSC for the Low Energy Branch at FAIR will be presented.	17

Test of Rigid Triaxiality in 126-132Ce nuclei (01h30') *Presenter: MITTAL, Harish Mohan (Dr. B. R. Ambedkar National Institute of Technology Jalandhar)* The structure of neutron deficient (N<82) light nuclei lying far from β-stability line are one of the most challenging and interesting area of the nuclear physics. These nuclei are short lived and the information on their nuclear spectra has become available only recently from the in-beam nuclear reaction experiments. The level pattern of these nuclei differs basically from (N>82) nuclei and thus their study is of current interest. The study of γ-g interband B(E2) ratios with Asymmetric Rotor Model (ARM) (also known as Davydov-Filippov (DF) Model) in medium and light mass even-even nuclei versus the asymmetric parameter γ0. Due to less availability of experimental data, only 134-136Ce nuclei were studied. Now with advancement in experimental techniques, we extend the search of rigid triaxiality in 126-132Ce nuclei using asymmetric parameter γ0. The values of E(2g), E(2γ), Eγ and Iγ are taken from NNDC website. The experimental B(E2) ratio for (2γ → 0/2) transition is plotted vs. γ0. The DF model predicts monotonic fall for B(E2,2γ → 0/2) with increasing γ0. The new data points lie in the region 16 ≤ γ0 ≤ 24. 132Ce nucleus for which R(4g/2g) = 2.64, γ0= 24.29 and the B(E2) ratio approaching the vibrational limit (ratio → 0). It indicates that 132Ce nucleus is γ-soft or O(6) in nature. 126-128Ce nuclei lie far from the DF curve with R(4g/2)=3.06, 2.93 and γ0 = 16.45, 18.89, respectively and the B(E2) ratios lie above the vibrational limit, it indicates that these nuclei are not rigid triaxial in nature. References [1] A.S. Davydov and G.F. Filippov, Nucl. Phys. 8, 237 (1958). [2] J.B. Gupta and S. Sharma, Phys. Scr. 39, 50 (1989). [3] H.M. Mittal, S. Sharma and J.B. Gupta, Phys. Scr. 43, 558 (1991). [4] http://www.nndc.bnl.gov/	18
Tensor force and relativistic mean field calculations of multi-Lambda hypernuclei (01h30') *Presenter: SAMANTA, Chhanda (Virginia Military Institute)* We use a microscopic self-consistent relativistic mean field theory with effective interactions to calculate the Lambda-hyperon separation energies of different hypernuclei. Such a microscopic framework has already been found to be successful in explaining different properties of normal nuclei. Calculations for hypernuclei are found to be in excellent agreement with the experimental data of single-Lambda and Lambda-Lambda separation energies of different single and double-Lambda hypernuclei when a tensor interaction term (T=1.1) is added, implying a change in nuclear potential in presence of Lambda hyperon(s).	19
Probing Nuclear properties of Imbalanced Fermi Systems with Quasi-free Proton Knock-out Reactions (01h30') *Presenter: STEVENS, Sam (Department of Physics and Astronomy, Ghent University)* Quasi-free knockout reactions in inverse kinematics offer great opportunities to probe the mean-field properties of imbalanced nuclei. We have developed a reaction model for quasi-free A(p, pN)B reactions with unstable nuclei. Such a model makes it possible to connect experimental data from (p, pN) measurements in inverse kinematics at radioactive-beam facilities [1], to the mean-field properties (spectroscopic factors and single-particle wave functions). The cross sections are calculated in a factorised way, following the approach developed in Refs. [2] and [3]. The general idea in this approach is to calculate the hard scattering part as a free pN scattering cross section with a phase-space correction, multiplied by the momentum probability distribution for the struck nucleon. To incorporate the effect of the soft initial- and final-state interactions, a Relativistic Multiple Scattering Glauber Approximation (RMSGA) is used [3]. In the RMSGA, these soft interactions are calculated in an eikonal approximation using the free scattering cross sections. The role of charge-exchange effects is computed in a semi-classical way. The single-particle wave functions used to calculate the momentum distributions are from a mean-field shell-model calculation. The results of the model are compared to the momentum distributions obtained at the HIMAC accelerator in the National Institute of Radiological Sciences in Chiba, Japan [4]. In this experiment, the momentum distributions for (p, 2p) Reactions on 9−16C isotopes at 250 MeV/A were measured for the knock-out of both s-state and p-state protons. By comparing the theoretical cross sections to these distributions, we can study the evolution of the shell-model parameters as a function of Z/N . The model that is developed can serve to analyse the resulting data from experiments with relativistic radioactive beams [1] conducted at GSI. References [1] T. Aumann, Prog. Part. Nucl. Phys. 59 (2007) 3. [2] T. Aumann, C.A. Bertulani and J. Ryckebusch, Phys. Rev. C 88 (2013) 064610. [3] B. Van Overmeire, W. Cosyn, P. Lava, and J. Ryckebusch, Phys. Rev. C 73 (2006) 064603. [4] T. Kobayashi, K. Ozeki, K. Watanabe, Y. Matsuda, Y. Seki, T. Shinohara, T. Miki and Y. Naoi et al., Nucl. Phys. A 805 (2008) 431.	20

Setup for Coulomb Excitation Measurements at SPES (01h30') *Presenter: MELON, Barbara (INFN-Sezione di Firenze)* Low-energy Coulomb excitation provides a well-understood means of exciting atomic nuclei, allowing the study of the e.m. properties (such as transition probabilities and quadrupole moments) of low-lying excited levels. In particular, for collective excitations, these properties are very sensitive to the underlying nuclear shape and their experimental study contributes significantly to the understanding of the nuclear many-body problem. The basic assumption of Coulomb excitation is that the excitation of nuclear states is caused solely by the electromagnetic field acting between the colliding nuclei, without the contribution of short range nuclear forces. The process can be thus described by the well-established theory of the electromagnetic interaction allowing the nuclear structure to be studied in a model-independent way. The set-ups used for Coulomb excitation experiments, at the different ISOL facilities, are rather similar: germanium detectors are utilized to detect gamma rays while an annular strip silicon detector is used a few centimeters downstream from the target to detect the scattered projectiles and/or recoiling target nuclei. If the projectile and target nuclei have different mass, they can be identified by the energy deposited in the silicon detector, and the kinematics of the scattering process can be fully reconstructed. To this aim we have developed and assembled an apparatus to be used at the SPES facility which consists of 8 sector shaped silicon detectors (aperture angle about 45 degrees) arranged in a pie shape. Each sector is segmented into eight independent annular strips on the front surface. This Silicon PIe DEtectoR (SPIDER) will provide a clean trigger to an array of germanium detectors (like GALILEO or AGATA). We will report on the status of the project and we will show the results of the preliminary tests we performed on SPIDER elements.	21
Characterization and Diagnostic Tools for the RFQ-based Low Energy Beamline of the FRS Ion Catcher (01h30') *Presenter: AYET SAN ANDRES, Samuel (GSI, Darmstadt)* At the FRS ion catcher facility, in-flight separated exotic ions are produced by projectile fragmentation or fission, thermalized in a cryogenic stopping cell (CSC), extracted by using DC and RF fields and transported though a versatile RFQ beamline to a multiple-reflection time-of-flight mass spectrometer (MR-TOF-MS) where mass measurements and isobar or isomer separation for mass selective decay spectroscopy can be performed. In the vicinity of gas-filled stopping cells, pressures are typically too high for efficient ion transport using an electrostatic beamline. A compact (~1 m length) RFQ-based beamline enables efficient ion transport, identification, mass separation, cooling, bunching, beam mixing and beam splitting. The beamline can easily be divided in two independent vacuum domains by using a gate valve and a movable platform where RFQs are mounted. The resolving power of an RFQ mass filter included in the beamline is as high as > 100 at a pressure of up to 10-2 mbar allowing a mass-dependent characterization of the extraction efficiency of the CSC. A novel component in the beamline is an RFQ-based switchyard, which allows beam splitting into five different directions, for example, splitting thermalized ions from the CSC to two different detectors for simultaneous α-spectroscopy and mass spectrometry, as well as mixing five different beams into one direction, for example, mixing thermalized ions from the CSC with calibrant ions for high accuracy mass measurements in the MR-TOF-MS. Examples of the use of the characterization and diagnostic tools will be presented.	22
Performance of the MR-TOF-MS at the FRS (01h30') *Presenter: HORNUNG, Christine (II. Physikalisches Institut, Justus-Liebig-Universität Gießen)* Recently multiple-reflection time-of-flight mass spectrometer (MR-TOF-MS) have been established as important tools for direct mass measurements and for isobar separation at several facilities for research on exotic nuclei. They combine short measurement cycles with high mass resolving power. The MR-TOF-MS is part of the FRS Ion Catcher, which is a test facility for the future Low-Energy Branch (LEB) of the Super-FRS at FAIR. At the FRS Ion Catcher, projectile and fission fragments are produced at relativistic energies, separated in-flight and energy-focused with the FRS. Further they are slowed-down and thermalized in a cryogenic stopping cell (CSC) and transported to the MR-TOF-MS. In the MR-TOF-MS the ions are accumulated, cooled and injected in bunches by a linear RF-trap. In the analyzer they are reflected multiple times to enlarge their flight path by orders of magnitude to achieve a high time-of-flight resolution. The MR-TOF-MS can perform high precision mass measurement and in addition it can spatially separate the ions of interest from isobaric contaminations for further experiments. It is a well suitable diagnostic device for operation of the CSC and in combination with the latter for particle identification of the FRS. Recently, the performance of the MR-TOF-MS was improved: The kinetic energy of the ions in the time-of-flight section of the MR-TOF-MS has been increased to 1300 eV. Mass resolving powers (FWHM) for 133Cs of 120,000, 220,000 and 420,000 have been obtained in 2.3 ms, 4.6 ms and 18.3 ms, respectively. The repetition rate of the system has been increased up to 500 Hz. This opens up new possibilities for spectroscopy of short lived nuclei. The performance of the MR-TOF-MS as a high- resolution mass separator has been investigated and characterized with alpha-emitting ions from a 223Ra source detected behind the Bradbury-Nielsen gate by a Si-detector. The time resolution as well as the suppression ratio have been measured.	23

The SPES RIB production system (01h30') *Presenter: PRETE, Gianfranco (INFN-LNL)* SPES (Selective Production of Exotic Species) is a project approved and financed by INFN aimed to produce neutron-rich Radioactive Ion Beams (RIBs) according to the ISOL technique. The core of the SPES facility, now in construction phase, is constituted by the TIS (Target - Ion Source) system that converts a stable proton beam into a RIB. The SPES production target is an innovative multi-foil direct target, composed of 7 UCx co-axial disks. The production target is impinged by a 40 MeV, 0.2 mA proton beam that generates approximately 1013 fissions per second. In the framework of the SPES project, two different kinds of ion source will be adopted: a Surface ion source (used for both surface and laser ionization), and a Plasma ion source. The SPES TIS system is installed inside a water-cooled vacuum chamber, and works approximately at 2000°C. High temperatures are fundamental to enhance the aforementioned diffusion-effusion processes, and to dissipate efficiently by thermal radiation the important amount of power deposited by the primary proton beam. In this presentation, all the specific issues related to the SPES TIS complex will be appropriately presented and commented, showing the results obtained making use of both the theoretical and the experimental approaches. Also all SPES RIB systems, as laser systems, target-handling devices and the front end, they will be presented in detail, with an accurate description of the related experimental apparatus. A particular attention is dedicated also to safety issues that are of primary importance in the context of ISOL facilities.	24
Resolution Studies of the FRS Spectrometer Experiment using 16O(p,d) Reaction at Energies from 400 to 1200 MeV/u (01h30') *Presenter: FARINON, Fabio (GSI, Darmstadt)* The influence of the nuclear tensor force was investigated via the 16O(p,d) reaction[1] with the fragment separator FRS at different energies from 400 MeV/u to 1200 MeV/u. The important observable is the deuteron spectrum reflecting the ground state and various excitation levels of 15O. The required high momentum resolution was achieved by operating the FRS as a spectrometer in an overall dispersive ion-optical mode[2], where the resolving power of all dipole magnet stages are added. The object size of the spectrometer was restricted by a stripe target of 1mm and no other matter was placed in the optical system up to the final focal plane. The influence of the longitudinal and transverse phase of the primary beam, the reaction kinematics, the target thickness, the optical aberrations and the influence of the position-sensitive tracking detectors are investigated in simulation and compared with the experimental data. [1] H.J. Ong et al. Phys. Lett. B 725 (2013) 277. [2] H. Geissel et to be published	25

<u>Dinner</u> (20:00-21:30)

Wednesday 10 June 2015

Future RIB facilities 3 (09:00-10:30)

time	title
09:00	**Future Opportunities at RIB facilities in North America (00h30')** *Presenter: DILLING, Jens (TRIUMF and UBC)* Major upgrades are currently carried out or planned at RIB facilities in North America. This is includes complete new installation of infrastructure as well as additions to existing accelerator facilities. In this talk I will present the current status of the RIB facilities in the US and Canada, and present plans and science opportunities.
09:30	**Overview of Rare Isotope Beam Facilities in Asia (00h30')** *Presenter: JEONG, Sunchan (Rare Isotope Science Project, Institute for Basic Science)* A brief overview of the rare isotope beam (RIB) facilities in Asia (excluding Japan) will be given. Key instrumentations and possible future plans for each facility will be covered. The main focus will be on the status of three RIB facilities under construction in Asia: Rare Isotope Science Project (RISP) in Korea, low energy part of High Intensity heavy ions Accelerator Facility (HIAF) in China, and Advanced National facility for Unstable and Rare Isotope Beams (ANURIB) in India.
10:00	**RIIB facilities in Japan (00h30')** *Presenter: MOTOBAYASHI, Tohru (RIKEN Nishina Center)* An overview of existing and new Japanese RIIB facilities is presented. In Japan, radioactive ion beams are available at several institutions. Among them, the largest is the RIKEN RI Beam Factory (RIBF), which has currently the highest capability of RI beam production for many isotopes far from the stability. Since 2007, when the new cyclotron complex started to provide fast (100-300 MeV/nucleon) RI beams using projectile fragmentation and/or in-flight fission, variety of experiments have been performed. Lower energy RI beams are also available at RCNP, Osaka University and CNS, University of Tokyo in the RIBF site. ISOL-based RI is being developed for the SCRIT (Self Confined RI Target) experiment for electron-RI scattering at RIKEN. Plans for future upgrade of RIBF and other programs will also be discussed.

Coffee break (10:30-11:00)

Future RIB facilities 4 (11:00-12:00)

time	title
11:00	**Photofission experiments at the ELI-NP facility* (00h20')** *Presenter: CONSTANTIN, Paul (ELI-NP, IFIN-HH)* The possibilities for photofission experiments at the new ELI-NP facility will be discussed. At ELI-NP, high power laser systems together with a very brilliant gamma beam are the main research tools [1-3]. The status of the project will be reported. The γ-beam system and the expected performance of the electron accelerator and the production lasers will be discussed. The targeted operational parameters of the γ beam will be described. At ELI-NP, next to research on fission barriers through measurements of transmission resonances [4,5] and investigation of rare fission events, such as ternary photofission [6], the possibilities for studies of the structure of neutron-rich exotic nuclei are considered. Two types of experiments related to the structure of fission fragments will be discussed, in-beam spectroscopy of fission fragments and separation of the isotopes of interest with the IGISOL technique, and experiments with them, such as β-decay or mass measurements. Four basic set-ups are under consideration for these studies, namely a double Bragg TPC, a general purpose charge-particle detector array, based on THGEM technology for fragment identification, an IGISOL beam line and the ELIADE Ge detector array, coupled to different ancillary detectors for in-beam spectroscopy will be discussed, taking into consideration the optimal use of the γ beam. References: [1] ELI-NP White Book, http://www.eli-np.ro/documents/ELI-NP_WhiteBook.pdf [2] N.V. Zamfir, EPJ Web of Conferences 66, 11043 (2014) [3] D.L. Balabanski et al., Acta Phys. Pol. B 45, 483 (2014) [4] P.G. Thirolf et al., EPJ Web of Conferences 38, 08001 (2012) [5] L. Scige et al., Phys. Rev. C 87, 044321 (2013) [6] M. Verboven, E. Jacobs, D. De Frenne, Phys. Rev. C 49, 991 (1996) * This work is supported by Extreme Light Infrastructure – Nuclear Physics (ELI-NP) – Phase I, a project co-financed by the European Union through the European Regional Development Fund.
11:20	**Present and Planned Experiments with the FRS and Super-FRS (00h20')** *Presenter: GEISSEL, Hans (GSI and Univ. Gießen)* A projectile fragment beam, separated in flight has an inevitable large emittance due to their stochastic creation processes and the atomic interactions in the production target, degrader and detector materials. Therefore, high-resolution spectrometer experiments require the use of dedicated ion-optical operation modes, or methods which reduce the phase space by cooling and energy bunching. Recent momentum and mass measurements with the fragment separator FRS have demonstrated the success of these efforts and will be reported in this contribution. The measurements described are pilot experiments which will be continued with the super-conducting fragment separator Super-FRS at FAIR. The physics program with the Super-FRS as a high-resolution ion-optical system will be pre-sented in this contribution as well. The maximum kinetic energies of the uranium projectiles will be 500 MeV/u higher compared to the present facility. This requirement sets a clear pri-ority and opportunity to the heaviest, fully ionized projectile fragments in the planned exper-iments and assures that the Super-FRS will be unique worldwide. The search of new isotopes and the measurements of their properties will be a central activity as they are now at the FRS. The Super-FRS can be operated in dispersive, achromatic or dispersion-matched ion-optical modes which can be applied for high-resolution momentum measurements in combination with secondary reaction studies. Basic atomic collision studies will be performed to contribute to the basic knowledge of heavy-ion interaction with matter and to enable an efficient separa-tion performance in the enlarged energy domain. The energy range corresponding to up to 20 Tm opens up new fields for studies of hyper-nuclei, delta-resonances in exotic nuclei and spectroscopy of atoms characterized by bound mesons. Rare decay modes like multiple-proton or neutron emission and the investigation of the role of the nuclear tensor force are also research topics covered with the Super-FRS. The in-flight radioactivity measurements in the picosecond range, pioneered at the FRS, will be extended with the proposed program.

11:40	**The ISOL@MYRRHA Project in Belgium (00h20')** *Presenter: SCHUURMANS, Paul (SCK-CEN)* ISOL@MYRRHA at SCK•CEN in Mol, Belgium, is a project for a next-generation Isotope Separation On-Line (ISOL) facility that will use a fraction of the proton beam of the MYRRHA accelerator to produce radioactive nuclei for fundamental and applied research. In the current conceptual design, ~0.2-mA beam of 600MeV will be used on a ruggedized target-ion source system, which allows the use of a range of materials (including actinides) dissipating the high power deposited by the beam. A two-stage mass separator incorporating a radio-frequency cooler and buncher will deliver high quality and high purity radioactive ion beams (RIBs) at an energy around 60 keV. An increase in RIB yields of up to two orders of magnitude for fission fragments may be reachable. Currently, a full technical design of the facility is being prepared at SCK•CEN. The project is supported also through the Belgian Research Initiative on Exotic Nuclei (BriX), a network of the Interuniversity Attraction Poles (IAP) Programme, which brings together the Belgian expertise on nuclear physics, nuclear astrophysics and accelerator-driven systems. An important requirement of the MYRRHA linear accelerator is reliability over long periods: the beam interruptions of more than 3 seconds should be limited to less than one every ten days, on typical cycles of three months of operation. This will allow stable operation of the ISOL@MYRRHA target-ion source for extended periods of time. The physics programme will take advantage of this feature prioritizing experiments which require extended beam times and operation in very stable conditions. The physics case of ISOL@MYRRHA is addressed in a number of dedicated workshops taking place yearly at SCK•CEN. The availability of very long beam times is of interest for most of the research fields making use of RIBs. Examples include high-precision measurements for fundamental interaction studies, nuclear structure spectroscopy studies with very high resolution or studies of very rare phenomena, long systematic studies on samples for condensed matter and biology applications and systematic production of isotopes for nuclear-medicine studies. This presentation will give an overview of ISOL@MYRRHA, discussing the facility design and the status of the project.

Lunch (12:00-13:30)

Excursion (13:30-19:30)

Dinner (19:30-21:00)

Thursday 11 June 2015

Dynamics and Thermodynamics of exotic nuclear systems (09:00-09:50)

time	title
09:00	**Recent theoretical and experimental advances on giant resonances in unstable nuclei (00h30')** *Presenter: KHAN, Elias (IPN Orsay)* These last years, significant progresses have been made in the investigation on giant resonances physics related to unstable nuclei. This predictive sector of nuclear physics benefits from several new theoretical approaches. For instance the role of deformation and neutron excess on giant resonances and their low-energy component are better understood. New modes of excitations have also been predicted. Advances in experimental methods have opened a new field of study such as for the compression mode in exotic nuclei. Recent astrophysical impact on the r-process and neutron stars physics will also be underlined.
09:30	**Pygmy resonances and radiative nucleon captures for stellar nucleosynthesis (00h20')** *Presenter: TSONEVA, Nadia (Institut für Theoretische Physik, Univ. Gießen)* The significance of low-energy multipole excitations and pygmy resonances for the nucleosynthesis is investigated. For this purpose, a microscopic theoretical approach based on self-consistent density functional theory and QRPA formalism extended with multi-phonon degrees of freedom, is implemented in studies of radiative neutron and proton capture processes in medium and heavy nuclei of astrophysical importance. The advantage of the method is the fully microscopic nuclear structure input for unified description of low-energy multi-phonon excitations, pygmy and giant resonances. Calculations of radiative capture cross sections of (n,\gamma) and (p,\gamma) reactions in N=50 isotones and Pt isotopes are discussed in comparison with the experiment. For the reactions ^{89}Zr(n,γ)^{90}Zr and ^{91}Mo(n,γ)^{92}Mo theoretical predictions are made.

Nuclear astrophysics (09:50-10:40)

time	title
09:50	**Nuclear Astrophysics and Stellar Explosions (00h30')** *Presenter: JOSE, Jordi (UPC Barcelona)* Nuclear astrophysics aims at understanding the cosmic origin of the chemical elements and the energy generation in stars. It constitutes a truly multidisciplinary arena that combines tools, developments and achievements in theoretical astrophysics, observational astronomy, cosmochemistry and nuclear physics: supercomputers have provided astrophysicists with the required computational capabilities to study the evolution of stars in a multidimensional framework; the emergence of high-energy astrophysics with space-borne observatories has opened new windows to observe the Universe, from a novel panchromatic perspective; cosmochemists have isolated tiny pieces of stardust embedded in primitive meteorites, giving clues on the processes operating in stars as well as on the way matter condenses to form solids; and nuclear physicists have measured reactions near stellar energies, through the combined efforts using stable and radioactive ion beam facilities. This talk will provide a comprehensive insight into the nucleosynthesis accompanying stellar explosions, with particular emphasis on thermonuclear supernovae, classical novae, and type I X-ray bursts.
10:20	**Recent ISOLTRAP mass measurements of medium-mass, neutron-rich nuclides in the 50-ms-half-life range (00h20')** *Presenter: MANEA, Vladimir (Max-Planck-Institute for Nuclear Physics, Heidelberg)* Binding energies of neutron-rich nuclei are important for understanding the change of nuclear structure with neutron-to-proton (N/Z) asymmetry. One and two-nucleon separation energies are sensitive to the evolution of energy gaps in the effective single-particle spectrum. In mid-shell regions of intrinsic deformed configurations they are, in turn, key for the interpretation of complementary ground-state properties and of the low-lying excited states. One-neutron separation energies are also a direct input for r-process calculations, their precise knowledge being crucial for the correct prediction of r-process abundances. In this contribution, we present recent results obtained with the mass spectrometer ISOLTRAP at ISOLDE. We discuss recent measurements of the masses of cadmium isotopes up to $A = 131$, which have direct consequences on the description of the natural abundance of the $A \approx 130$ r-process nuclides. We also present new masses of strontium and rubidium isotopes up to $A = 102$, which are the farthest exploration of the low-Z part of the region of deformed $A \approx 100$ nuclides. The multi-reflection time-of-flight mass spectrometer (MR-TOF MS) of ISOLTRAP was essential in performing these measurements, acting either as fast beam purifier for Penning-trap mass spectrometry, or directly as the tool for precision mass measurements. Recent developments of ISOLTRAP's MR-TOF MS will be presented.

Coffee break (10:40-11:10)

Production and manipulation of RIB (11:10-12:10)

time	title
11:10	**Manipulations of the high power targets and its infrastructure: preparations, operations and maintenances (00h30')** *Presenter: FRåNBERG-DELAHAYE, Hanna (GANIL)* The continuous search for the most exotic radioactive ion beams is on-going since decades. The need to understand the fundamental physics around us leads us to try to reproduce the very first elements that existed in the beginning. While the research are ongoing and with the beams delivered new techniques for detection and manipulations of the beams are developed. With new beam and intensity requests also the production targets and its environment has to be upgraded To minimize the risks for the environment and the persons working in our RIB facilities modern techniques are used to construct, handle and survey the production stations, this is imposed not only by laws and regulations (which are not the same in all countries) but also by our knowledge of the risks we are taking. In new facilities under construction these requirement are taken into account from the planning for the facilities, for older installations - adaptations or new inventions are necessary to continue the work. The challenges are many - and often the inverse to industry using the same techniques - making the developments in this field highly interesting and important: complex interfaces not adapted to nuclear environment, accessibility, delays, non routine operations and high radiations are just a few of the issues.
11:40	**Citius, altius, fortius - is the EBIS/T charge breeder up for the challenge? (00h30')** *Presenter: WENANDER, Fredrik (CERN)* The use of an Electron Beam Ion Source/Trap as charge breeder for radioactive ions is by now a well-established concept. The operational experience at REX-ISOLDE has highlighted strengths, the main being the purity of the extracted beam, but also short-comings, such as complexity. A summary of the standard breeder performance will be given in this paper. Since a few years CERN is actively pursuing the development of an upgrade of the REXEBIS charge breeder. Future challenges to be met are the faster breeding in order to reduce to increase the repetition rate, higher charge states (even fully stripped in case injected into a storage ring), and higher radioactive beam intensities. Results from recent tests addressing some of these issues will be presented. The R programme focussing on improving the electron beam characteristics, and in the extension the breeder performance, will also be presented.

<u>Nuclear structure far from stability 3</u> (12:10-13:00)

time	title
12:10	**Progress and Recent Results from Collinear Laser Spectroscopy at ALTO and ISOLDE-CERN (00h30')** *Presenter: YORDANOV, Deyan (IPN Orsay)* For more than three decades collinear laser spectroscopy has been an essential instrument in the inquiries of the atomic nucleus with the ability to detect the nuclear electromagnetism, size, and angular momentum. At the foot of the 21st century a number of innovations have emerged, such as: multiple orders of magnitude background suppression by beam cooling and bunching, wavelengths ever closer to the elusive boundary of 200 nm, an application of a frequency comb for ultimate frequency calibration, and resonant laser ionization in collinear geometry. Much of the progress in the field has been associated with the successes in isotope production and purification at ISOLDE/CERN. This contribution will report on the measurements of 100-130Cd. h11/2 isomers have been observed and characterized up to 129Cd. A comprehensive picture has emerged on the relative degree of collectivity between ground and isomeric states from a consistent analysis of charge radii and quadrupole moments. Highlights from recent measurements on the isotopes of potassium and cadmium will be presented as well. Accélérateur Linéaire auprès du Tandem d'Orsay (ALTO) is an electron-driven ISOL system dedicated to the production of neutron-rich radioactive beams by the interaction of a 50-MeV-10-μA electron beam with a UCx target. Some 10^11 fissions/sec inside the target-ion source are utilized for the production of exotic radioactive beams. As such, ALTO is the first electron-driven photo-fission facility operated in the world. This contribution will offer a short overview of the local project for laser spectroscopy with emphasis on the development of laser-induced nuclear orientation for β-delayed spectroscopy.
12:40	**Spins and g-factors of Mn isotopes near N = 40: Significance of proton and neutron excitations in ground and isomeric states (00h20')** *Presenter: HEYLEN, Hanne (KU Leuven)* The neutron-rich Mn isotopes (Z = 25) were studied using bunched-beam collinear laser spectroscopy at ISOLDE, CERN. In this experiment, the hyperfine spectra of the 57-64Mn ground states and the isomeric states in 58,60,62Mn were measured for the first time. From these spectra the spins and g-factors could be model-independently extracted, providing valuable nuclear structure information up to N = 39. Previously all spins beyond N = 33 were only tentatively assigned. By our direct measurement we firmly establish a I = 5/2 ground state spin for 59,61,63Mn and a I = 1 low-spin state and I = 4 high-spin state in 58,60,62,64Mn. The high-spin state in 64Mn could not be measured due to its short half-life. As a result of their sensitivity to the nuclear configuration, g-factors offer an important tool for understanding the rapid shell structure evolution in the region south of 68Ni (Z < 28, N ≈ 40). A comparison of our experimental results with shell model calculations performed with the GXPF1A [1] and LNPS [2] effective interactions illustrates that an adequate description of neutron-rich Mn requires neutron excitations across N = 40. In addition, proton excitations across Z = 28 become increasingly important towards N = 40. [1] M. Honma et al., Eur. Phys. J A 25, 499 (2005) [2] S. Lenzi et al., Phys. Rev. C. 82, 054301 (2010)

Lunch break (13:00-14:30)

Nuclear structure far from stability 4 (14:30-16:00)

time	title
14:30	**The study of nuclear structure far from stability at the IGISOL-4 facility (00h30')** *Presenter: MOORE, Iain (University of Jyväskylä)* Since the successful commissioning of the new IGISOL-4 facility, Jyväskylä, in 2012-2013 [1], the past year has seen a move towards full operation and first experiments have been performed. The gradual evolution of the ion guide method for a universal production of both volatile and non-volatile elements has been driven by the pursuit of physics research on both sides of the valley of beta stability. The on-going development of new ion manipulation techniques as well as new production methods at the IGISOL-4 facility has been driven by the needs of the evolving scientific programme. This contribution will provide an overview of the current experimental programme, highlighting some of the important experiments performed in 2014-2015. Our decay spectroscopy programme has been initiated in earnest in collaboration with scientists from York, Aarhus and Madrid. A cubic array of Double-Sided Silicon Strip Detectors was used to search for the elusive second excited 2+ state in 12C – a key contribution to our understanding of the triple-alpha process. Using the purification capabilities of JYFLTRAP a number of trap-assisted spectroscopy experiments have been performed in combination with novel experimental equipment. This includes the new segmented total absorption spectrometer (DTAS), designed for NUSTAR, FAIR. DTAS was used in the study of beta decays relevant for the prediction of reactor neutrino spectra. The BELEN-48 4π neutron counter has been used to study the beta-delayed neutron emission of neutron-rich nuclei which play a role in the safe control of nuclear power plants as well as of interest to the astrophysical r-process path. The laser spectroscopy programme has commenced with optical studies of bunched beams of doubly-charged ions. A new ultra-low energy electrostatic ConeTrap device has been installed to complement the laser station, which has been shown to successfully store cooled ions on millisecond timescales. Resonance ionization of Pu isotopes obtained from the Mainz TRIGA reactor, in collaboration with Mainz and Leuven, initiates a programme towards optical spectroscopy of heavy elements, with the first collinear laser spectroscopy of Pu+ ions expected in 2015. I will also briefly look towards the future with exciting new developments designed to keep the IGISOL facility at the forefront of nuclear and atomic structure research. This includes the status of the neutron converter project, designed to provide a high neutron flux for fission and thus the production of the most neutron-rich fragments. A new Multi-Reflection Time-of-Flight Mass Spectrometer (MR-TOF-MS) is planned which will be used both at IGISOL and the future low-energy branch of the MARA recoil separator. Finally, new opportunities are planned in collaboration with the University College London, for the first cold atom experiment at IGISOL. [1] I.D. Moore et al., Nucl. Instrum and Meth. In Phys. Res. B 317 (2013) 208.

15:00	**10Be and 16C structures investigated by means of break-up reactions at INFN-LNS (00h20')** *Presenter: DELL'AQUILA, Daniele (Università degli Studi di Napoli "Federico II" and INFN - Sezione di Napoli)* Very recent theoretical and experimental investigations [1,2,3] show the possible presence of exotic structures, such as molecular states or triangle configurations, in Beryllium and Carbon neutron-rich isotopes. These structures are characterized by very large deformation, with alpha clusters bounded by valence neutrons [1,3]. We studied the spectroscopy of 10Be and 16C nuclei by using projectile sequential break-up reactions. The exotic beams were produced by the FRIBs facility at INFN – LNS [4,5]. Break-up products have been detected and identified by using the Chimera 4pi array [6], thanks to its good angular segmentation and its total azimuthal coverage. From the study of 1,2H,12C(10Be,6He+4He), 1,2H,12C(16C,6He+10Be), 1,2H,12C(16C,6He+6He+4He) reactions, we reconstructed 10Be and 16C excitation energy spectra. Peaks on these spectra may indicate the presence of excited states characterized by cluster structure. From the analysis of experimental spectra we found some peaks corresponding to excited states of 10Be known in literature and a new possible state at about 13.5 MeV. Investigations of the corresponding 6He-4He angular correlations revealed a possible 6+ assignement for this state, in agreement with the recent work [7]. In this case, it may represent a further member of the 10Be molecular rotational band [3]. Finally, from binary (6He+10Be) and ternary (4He+6He+6He) cluster decompositions of 16C we found, respectively, the indication of possible new states at about 20.6 MeV and 34 MeV. To continue the experimental investigations here discussed, a new experiment, with higher angular resolution and better statistics, has been performed very recently at LNS by using the Farcos array [8]. References [1] W. von Oertzen, M. Freer and Y. Kanada-En'yo, Phys. Rep. 432 (2006) 43 [2] Y. Kanada-En'yo, Phys. Rev. C 91 (2015) 034303. [3] M. Freer et al, Phys. Rev. Lett. 96 (2006) 042501 [4] G. Raciti et al, Nucl. Instrum. Meth. Phys. Res. B 266 (2008) 4632 [5] L. Acosta et al, Nucl. Instrum. Meth. Phys. Res. A 715 (2013) 56 [6] A. Pagano, Nucl. Phys. News 22 (2012) 25 [7] G.V. Rogachev et al, J. Phys. Conf. Ser. 569 (2014) 012004 [8] L. Acosta et al, IEEE NSS/MIC (2012) 1547-1553
15:20	**Single particle structures of 19C and 23O (00h20')** *Presenter: SATOU, Yoshiteru (Seoul National University)* Nuclear structure in the vicinity of neutron drip line offers a unique opportunity to study underlining residual nuclear interactions by isolating specific, rarely investigated parts of them, such as the three-nucleon forces and the neutron pairing interaction for shallow binding orbits. In this work single particle structures of near drip-line 19C and 23O nuclei, as probed via one-neutron knockout on 20C [1] and 24O [2], respectively, are discussed. Experiments were performed at the RIKEN RIBF laboratory by using the setups for invariant mass spectroscopy (SAMURAI for 19C and RIPS for 23O) involving detection of neutrons, decay in flight. Very sharp neuron resonances were observed at E_x=~0.6 and 2.78(11) MeV for 19C and 23O, respectively, which exhibit a clear d-wave character in their longitudinal momentum distributions of the cross section. These states were formerly reported in studies of multi-nucleon knockout reactions [3,4]. Since the ground state Jπ of these nuclei is 1/2+, the energies characterize the respective ν1s1/2-ν0d5/2 shell gaps. The presentation will focus on the following observations: (i) the decreasing trend of the gap from Oxygen to Carbon at N=13 approximately follows that of N=11 and 9, (ii) the ordering of the 1/2+ and 5/2+ states in 19C is not correctly predicted by the presently available ab initio shell-model calculation, which takes into account the three-body forces from the chiral effective-field theory [5], (iii) there is a strong correlation between the shell-gap and the one-neutron separation energy in these nuclei. [1] J.W.Hwang et al., ARIS2014 proceedings, and in preparation. [2] K.Tshoo et al., Phys. Lett. B739 (2014) 19. [3] M.Thoennessen et al., Nucl. Phys. A912 (2013) 1. [4] A.Schiller et al., Phys. Rev. Lett. 99 (2007) 112501. [5] G.R.Jansen et al., Phys. Rev. Lett. 113 (2014) 142502.

15:40	**Beta-delayed Neutron spectroscopy of Ga isotopes beyond the N=50 shell closure (00h20')** *Presenter: MADURGA FLORES, Miguel (CERN)* The study of beta-decay properties close to the doubly magic 78Ni has recently been spurred by the availability of new species at fragmentation and ISOL type facilities. The observation of faster-than-expected decay half-lives [1-3] and large neutron emission probabilities [4,5] suggests an important role of nuclear structure far away from stability. In order to understand the role of nuclear structure in the decay one has to move away from integrated properties such as the half-life and measure the decay strength in detail. Of course, in neutron rich regions far away from stability a substantial fraction of the decay strength will populate neutron unbound states. The neutron time-of-flight spectrometer, VANDLE, was developed at Oak Ridge National Laboratory as a high efficient modular array of plastic scintillators for decay and reaction studies [6]. Here we present results from the study of the beta-decay of the A=83,84 isotopes of Gallium. In both cases half of the neutron emission is unexpectedly observed at energies higher than 2 MeV. The large emission energy indicate the neutron emission is dominated by the decay from neutrons deep across the N=50 gap. This research was sponsored in part by the National Nuclear Security Administration under the Stewardship Science Academic Alliances program through DOE Cooperative Agreement No. DE-FG52-08NA28552.This research was also sponsored by the Office of Nuclear Physics, U. S. Department of Energy under contracts DE-AC05-00OR22725 (ORNL), DE-FG02-96ER40983 (UTK) and DE-FG-05-88ER40407 (VU). [1] S. Nishimura et al., Phys. Rev. Lett. 106, 052502 (2011). [2] M. Madurga et al., Phys. Rev. Lett. 109, 112501 (2012). [3] Z. Y. Xu et al. Phys. Rev. Lett. 113, 032505 (2014). [4] J.A. Winger et al., Phys. Rev. Lett. 102, 142502 (2009). [5] K. Miernik et al., Phys. Rev. Lett. 111, 132502 (2013). [6] W.A. Peters et al., submitted for publication (2015).

Poster Prize Talks (16:00-16:30)

Coffee break (16:30-17:00)

Conference Dinner (19:00-21:30)

Friday 12 June 2015

Instrumentation (09:00-10:40)

time	title
09:00	**Gamma-ray tracking with AGATA a new perspective for spectroscopy at RIB facilities (00h30')** *Presenter: REITER, Peter (University of Cologne)* The Advanced GAmma Tracking Array is a next generation high-resolution gamma-ray spectrometer for nuclear structure studies based on the novel principle of gamma-ray tracking. It is built from a novel type of high-fold segmented germanium detectors which will operate in position-sensitive mode by employing digital electronics and pulse-shape decomposition algorithms. The unique combination of highest detection efficiency and position sensitivity allows sensitive spectroscopy studies with instable beams of lowest intensity. AGATA will be employed at the leading infrastructures for nuclear structure studies in Europe. The first implementation of the array consisted of five AGATA modules; it was operated at INFN Legnaro. A larger array of AGATA modules was employed at GSI for experiments with unstable ion beams at relativistic energies. The presentation will describe the novel gamma-ray tracking method. Examples of physics cases from the two different exploitation sites demonstrate the opportunities given by the new spectrometer.
09:30	**Active targets for research on exotic nuclei (00h30')** *Presenter: RAABE, Riccardo (KU Leuven)* Active targets are gaseous time-projection chambers designed for reaction and decay studies with nuclei far from stability. In reaction studies, the nuclei of the detection gas are also the targets of the reaction of interest, allowing for a large target thickness without compromising on energy resolution. This class of instruments, initially developed for high-energy physics, has found profitable applications in medium- and low-energy nuclear physics. Following the precursor IKAR detector [1], important results have been achieved in the last ten years by the Maya [2] and CENBG-TPC detectors [3]. A new generation of instruments of this kind are being developed at several facilities, to improve on crucial aspects such as maximum allowed beam intensity, efficiency, counting rates, and dynamic range of detectable signals. Many of the new devices share a purpose-built integrated electronics (GET: General Electronics for TPCs) which addresses most of the issues listed above. The advances in Micro-Pattern Gas Detectors technology is exploited through the use of Micromegas [4] and GEMs [5] as amplification devices. In some cases the active target is complemented by auxiliary systems for the detection of charged particles or gamma rays. Thanks to their versatility, the physics scope of the new-generation active targets is broad. For direct reaction studies in inverse kinematics the advantage lies in the high luminosity. Resonant reaction measurements benefit from the detection of all kinematic parameters. A very low energy threshold for the detection of scattered particles makes them ideal instruments for the measurement of low-momentum transfer reactions, such as inelastic excitations to giant resonances. The talk will review some of the instruments and the focus of their physics programme. [1] G. D. Alkhazov et al., Phys. Rev. Lett. 78, 2313 (1997). [2] C. E. Demonchy et al., Nucl. Instrum. Methods Phys. Res. A 573, 145 (2007). [3] B. Blank et al., Nucl. Instrum. Methods Phys. Res. B 266, 4606 (2008). [4] Y. Giomataris, P. Rebourgeard, J. Robert, and G. Charpak, Nucl. Instrum. Methods Phys. Res. A 376, 29 (1996). [5] F. Sauli, Nucl. Instrum. Methods Phys. Res. A 386, 531 (1997).

10:00	**TRIGA-SPEC – recent developments and status (00h20')** *Presenter: KAUFMANN, Simon (Institut für Kernchemie Uni-Mainz)* The TRIGA-SPEC experiment [1] at the research reactor TRIGA Mainz consists of a Penning-trap experiment for mass measurement (TRIGA-TRAP) and a collinear laser spectroscopy setup (TRIGA-LASER). These setups are the prototypes for the MATS- and the LASPEC-Experiments at FAIR [2] and are also used for technical developments to improve the sensitivity and accuracy of the techniques. For TRIGA-SPEC short-lived isotopes produced by neutron-induced fission of 235U, 239Pu or 249Cf in a target chamber located close to the reactor core are available. The fission products are transported to the on-line surface ionization source by a gas jet [3], where they are ionized. The ions are accelerated to 30 keV and mass-separated in a dipole magnet. To increase the detection efficiency of both experimental branches, a radiofrequency-quadrupol cooler and buncher (RFQCB) [4] is included in the common beamline. The energy spread and temporal width of the bunches have been characterized and optimized by time resolved collinear laser spectroscopy in the optical detection region of the TRIGA-LASER setup. This is very important for the injection into the Penning-trap system for precision mass spectrometry as well as for collinear laser spectroscopy. Besides the on-line capabilities both experiments are equipped with off-line ion sources: a laser ablation source on the TRIGA-TRAP branch and a surface ion source on the TRIGA-LASER branch. Besides serving for the off-line development of the system, they were recently also used for mass measurements of trans uranium elements [5] and collinear laser spectroscopy of stable Ca+ ions were performed with improved accuracy compared to previous measurements. A short overview of the TRIGA-SPEC setup and latest results will be presented. [1] J. Ketelaer et al., Nucl. Instr. Meth. A 594, 162 (2008) [2] D. Rodriguez et al., Eur. Phys. J. Special Topics 183, 1-123 (2010) [3] M. Eibach et al., NIMA 613, 226 (2010) [4] T. Beyer et al., Appl. Phys. B 114, 129 (2014) [5] M. Eibach et al., Phys. Rev. C 89, 64318 (2014) Supported by the max-Planck-Society, the Helmholtz Association, the Bundesministerium für Bildung und Forschung, PRISMA cluster of excellence, HIC for FAIR.
10:20	**In-Trap Decay Spectroscopy for Electron Capture Branching Ratios using TITAN at TRIUMF (00h20')** *Presenter: ANDREOIU, Corina (Simon Fraser University)* A novel technique to measure weak electron capture branching ratios (ECBRs) in a set of odd-odd nuclei involved in double beta decay (ββ) using ion traps has been developed at TRIUMF, Canada's National Laboratory for Nuclear and Particle Physics located in Vancouver, Canada. The aim of this program is to extract the nuclear matrix elements (NME) involved in the EC process, and benchmark the theoretical calculations for both 2νββ- and 0νββ-decay modes. These calculations are used to predict the rate of the neutrinoless (0νββ) decay process, which if observed, can elucidate the nature of the neutrino. This is one of the pressing questions in contemporary physics. The EC often compete with a strong beta-decay component that hinders the observation of characteristic low-energy photons emitted in EC decay, and they are also altered by the attenuation of the x-rays in the implantation environment of the sample. To overcome these problems encountered in past experiments, this program takes advantage of an electron-beam ion trap (EBIT) part of the TITAN ion trap facility, and up to seven custom-made Si(Li) detectors to observe low-energy photons from daughter nuclei involved in EC decay [1]. The high-intensity radioactive beams provided by the ISAC facility at TRUMF decay in the backing-free environment of the trap, with the trap's high magnetic field guiding the electrons from the competing beta decay outside the trap, and thus allowing for a low background in the region of interest for x-rays. The set-up for ECBR measurements has been designed, implemented, and commissioned with an A = 124 cocktail beam [2], and was followed by subsequent experiments with a 116In beam [3]. In the fall of 2015 an experiment to measure the 0.3% ECBR of 110Ag will be performed. In anticipation of such weak ECBRs measurements numerous updates and Monte Carlo simulations have been implemented to enhance the sensitivity and monitor the performance of the experimental set-up [4]. In this talk the updates of the TITAN facility, the obtained results and milestones, and future directions of the program will be presented. References [1] K.G. Leach et al., Nucl. Instr. Meth. A 780, 91-99 (2015) [2] A. Lennarz et al., Phys. Rev. Lett. 113, 082502 (2014) [3] K.G. Leach et al., JPS Conf. Ser. (in press) (2015) [4] S. Seeraji et al., to be published

Coffee break (10:40-11:10)

Instrumentation and Fundamental interactions (11:10-13:00)

time	title
11:10	**The FAZIA telescope: from detectors to data flow (00h20')** *Presenter: VALDRé, Simone (INFN - Sezione di Firenze)* FAZIA is a modern apparatus based on Si-Si-CsI(Tl) telescopes designed to have excellent particle identification capabilities with relatively low energy thresholds and high efficiency. In order to get low thresholds, pulse shape discrimination of digitized signals will be applied to the first telescope stage. To achieve the desired goals, besides the use of carefully designed and selected detectors, a state-of-the-art digitizing front-end electronics is mandatory. Compact and integrated front-end cards are used to implement many functions just next to the telescopes, under vacuum. Moreover, digital signal processing techniques are used to extract every possible information from signal shapes. Such an advanced front-end electronics is accompanied with a modern acquisition system to reconstruct the event and to handle high data throughput. In my contribution I will review the operation and the performance of a typical FAZIA module from the detectors to the data transport, featuring a fast optical link to the acquisition electronics. I'll focus on the characteristics which make FAZIA a cutting-edge apparatus in the panorama of heavy-ions experiments with stable and radioactive beams. Simone Valdré for the FAZIA collaboration
11:30	**In-Source Laser Spectroscopy with the Laser Ion Source and Trap for the Study of Neutron-Rich Polonium (00h20')** *Presenter: FINK, Daniel (CERN)* At the isotope separator facility ISOLDE, the Laser Ion Source and Trap (LIST) unit is now applied routinely for the production of ultra-high purity ion beams of neutron-rich polonium isotopes [1]. The LIST significantly reduces the remaining amount of unwanted surface-ionized contaminants in radioactive ion beams produced by the Resonance Ionization Laser Ion Source (RILIS) [2]. For this purpose, it involves an electrostatic ion-repeller electrode and a radiofrequency-quadrupole ion-guide structure, which is coupled to the ISOLDE thick-target assembly immediately downstream of the hot cavity [3,1]. On-line application of the LIST offers two modes of operation: In so-called LIST mode, a positive potential at the repeller electrode prevents any ions from leaving the hot atomizer cavity and entering the RFQ. Correspondingly, selective ionization by the RILIS lasers exclusively takes place on neutral atoms, which have diffused into the LIST cavity. This way, an increase in selectivity of more than a factor of 1000, associated with an acceptable reduction of laser-ionization efficiency of only a factor of 20 has been achieved [1]. In ion-guide mode, a negatively charged repeller even favors the passage of ions into the RFQ and, in terms of efficiency and selectivity, guarantees a similar performance to that of the standard RILIS configuration. Application of the LIST at ISOLDE enabled studies on the previously inaccessible neutron-rich isotopes 217,219Po. Laser-spectroscopy directly inside the LIST revealed the hyperfine structure and isotope shift of 217Po, which contributes to the understanding of octupole nuclei above Z=82 and N=126 [4], while nuclear spectroscopy was performed on 219Po for the first time [5]. A summary of the LIST technology and the results of these on-line experiments are given, together with an outlook for the planned future applications and on-going modifications and upgrades of the LIST. [1] D. A. Fink, S.D. Richter et al. NIMB 344 83 (2015) [2] V. N. Fedosseev, Yu. Kudryavtsev, and V. I. Mishin, Phys. Scr. 85, 058104 (2012). [3] K. Blaum et al. NIMB 204 331 2003 [4] L. P. Gaffney, Nature 497, 199 (2013) [5] D. A. Fink. T. E. Cocolios et al. PRX 5, 011018 (2015)

11:50	**Penning-trap mass spectrometry for neutrino physics (00h30')** *Presenter: ELISEEV, Sergey (Max-Planck Institut für Kernphysik, Heidelberg)* The discovery of neutrino oscillations has proven neutrinos are massive particles. However, this does not provide information on the type of the neutrino and its mass. An answer to these questions lies in a study of beta transitions, i.e., beta- and double-beta- decays as well as electron and double-electron captures. A crucial parameter in this study is the Q-value of the beta transitions, which has to be measured with an accuracy of 100 eV in the case of the determination of the neutrino type and better than 1 eV if the neutrino mass is concerned. Tremendous progress in Penning traps has finally allowed such high precision Q-value measurements. This contribution will be an overview of the results of the measurements performed with the Penning-trap mass spectrometer SHIPTRAP and present a physical program for the next generation Penning-trap mass spectrometer PENTATRAP, which is under construction at Max-Planck Institute for Nuclear Physics/Germany. The contribution can be divided into two parts. The first part comprises the results of our search for the nuclide with the largest probability for neutrinoless double-electron capture. We have determined the Q-values of a large number of potentially suitable nuclides with SHIPTRAP by Penning-trap mass-ratio measurements. So far two interesting transitions have been discovered. The double-electron capture in 152Gd has been determined to have the smallest half-life of about 1e27 years for a 1 eV neutrino mass among all known double-electron-capture transitions, which makes 152Gd the most suitable candidate for the search for neutrinoless double-electron capture. In 156Dy a multiple resonant enhancement of neutrinoless double-electron-capture transitions to four nuclear excited states has been discovered, which may open a way to a weighting of contributions of different mechanisms to this process. Recently, the novel mass-measurement technique PI-ICR developed at SHIPTRAP has been successfully employed to measure, for instance, the Q-values of 187Re beta-decay and of electron capture in 163Ho with a relative uncertainty of about 2e-10. The second part - the culmination of our activity - is a creation of the Penning trap mass spectrometer PENTATRAP for measurements of the Q-values of 187Re beta-decay and of electron capture in 163Ho with an uncertainty below 1 eV for a determination of (anti)neutrino mass.
12:20	**High precision measurements in mirror beta decays at GANIL (00h30')** *Presenter: LIéNARD, Etienne (LPC Caen)* The LPCTrap setup, presently installed at the low energy beam line (LIRAT) of the SPIRAL facility at GANIL, was designed to perform precise beta-neutrino correlation measurements in nuclear beta decays [1]. The radioactive nuclei are confined in a transparent Paul trap, allowing the detection of the recoil ions in coincidence with the beta particles. The beta-neutrino angular correlation parameter is deduced from the time-of-flight distribution of the recoil ions. Experiments with 35Ar and 19Ne were successfully performed. The final data analysis is ongoing, based on the development of new simulation tools [2]. The statistics recorded during the experiments should enable the determination of the beta-neutrino correlation coefficients with unprecedented precision in these decays. These coefficients constitute sensitive observables to search for new physics beyond the Standard Model or to test its consistency. The precise measurement of such a coefficient in a mirror transition allows the accurate determination of the mixing ratio [3]. The matrix element Vud can be deduced from the latter with a high precision to test the unitarity of the CKM matrix, if the masses of the involved nuclei, the half-life and the branching ratio of the transition are also well known. For 35Ar, the result should induce a significant gain (~ 1.7) on the Vud precision deduced from the study of mirror decays. This perspective motivates future measurements at GANIL, using new beams which are presently under development, such as 33Cl and 37K. In these two cases, precisions similar to the 35Ar experiment are expected, considering an upgraded LPCTrap setup with increased detection efficiency, which is currently under investigation. The first experiments would be performed at LIRAT in the coming years, while later, the program will continue at DESIR where LPCTrap will be installed, with other setups dedicated to mass (MLLTRAP), half-life and branching ratio (BESTIOL) measurements. This program on mirror beta transitions study will be discussed during the conference. [1] G. Ban et al., Ann. Phys. (Berlin) 525 (2013) 576. [2] X. Fabian et al., TCP14 conference proceedings, submitted to Hyperfine Interact. [3] N. Severijns and O. Naviliat-Cuncic, Phys. Scr. T152 (2013) 014018.
12:50	**Closing remarks (00h10')** *Presenter: SCHEIDENBERGER, Christoph (GSI, Darmstadt)*

Lunch (13:00-14:30)

LIST OF PARTICIPANTS

Last name	First name	Email	Institution	Country
Adhikari	Kiran	sunlightforce@gmail.com	Golden Gate International College(Tribhuvan University)	NEPAL
Andreoiu	Corina	corina_andreoiu@sfu.ca	Simon Fraser University	CANADA
Ayet San Andres	Samuel	s.ayet@gsi.de	GSI	GERMANY
Babo	Mathieu	babo@ganil.fr	GANIL	FRANCE
Block	Michael	m.block@gsi.de	GSI / HIM / JGU	GERMANY
Blumenfeld	Yorick	yorick@ipno.in2p3.fr	Institut de Physique Nucléaire Orsay	FRANCE
Boretzky	Konstanze	k.boretzky@gsi.de	GSI	GERMANY
cardella	Giuseppe	cardella@ct.infn.it	INFN Sez Catania	ITALY
Chhetri	Premaditya	p.chhetri@gsi.de	TU Darmstadt	GERMANY
Clément	Emmanuel	clement@ganil.fr	CNRS-GANIL	FRANCE
Constantin	Paul	paul.constantin@eli-np.ro	ELI-NP/IFIN-HH	ROMANIA
de Roubin	Antoine	deroubin@mpi-hd.mpg.de	Max-Planck-Instiut für Kernphysik	GERMANY
Dell'Aquila	Daniele	dellaquila@na.infn.it	Università degli Studi di Napoli and INFN-Napoli	ITALY
Dickel	Timo	t.dickel@gsi.de	II. Physical Institut, Justus-Liebig-University	GERMANY
Dilling	Jens	JDilling@triumf.ca	TRIUMF / UBC	CANADA
DUCHENE	Gilbert	gilbert.duchene@iphc.cnrs.fr	IPHC-CNRS/UDS	FRANCE
Dörsching-Steitz	Luise	l.doersching-steitz@gsi.de	GSI, Darmstadt	GERMANY
Ebert	Jens	jens.ebert@physik.uni-giessen.de	Justus-Liebig-Universität Gießen	GERMANY
Eliseev	Sergey	sergey.eliseev@mpi-hd.mpg.de	Max-Planck Institut für Kernphysik	GERMANY
Engert	Tobias	t.engert@gsi.de	GSI	GERMANY
Farinon	Fabio	F.Farinon@gsi.de	GSI	GERMANY
Fernández-García	Juan Pablo	fernandez@lns.infn.it	INFN-LNS	ITALY
Fink	Daniel Andreas	daniel.fink@cern.ch	CERN	SWITZERLAND
Franberg Delahaye	Hanna	hanna.franberg@ganil.fr	GANIL	FRANCE
G Borge	Maria J	mgb@cern.ch	ISOLDE-PH, CERN	SWITZERLAND
Geissel	Hans	h.geissel@gsi.de	GSI / Justus-Liebig University Gießen	GERMANY
Georgiev	Georgi	georgi.georgiev@csnsm.in2p3.fr	CSNSM/CNRS	FRANCE
Gerl	Jürgen	j.gerl@gsi.de	GSI/FAIR	GERMANY
gnoffo	Brunilde	brunilde.gnoffo@ct.infn.it	INFN sezione di Catania	ITALY
Granados	Camilo	Camilo.GranadosBuitrago@fys.kuleuven.be	KU Leuven	BELGIUM
Harakeh	Muhsin	m.n.harakeh@kvi.nl	KVI-CART	NETHERLANDS
Herlert	Alexander	alexander.herlert@fair-center.eu	FAIR	GERMANY
Heylen	Hanne	hanne.heylen@fys.kuleuven.be	Instituut voor Kern-en Stralingsfysica, KU Leuven	BELGIUM
Hornung	Christine	christine.hornung@physik.uni-giessen.de	Justus-Liebig-Universität Gießen	GERMANY
HOUNGBO	Donald	dhoungbo@sckcen.be	SCK-CEN	BELGIUM

Last name	First name	Email	Institution	Country
Jeong	Sunchan	scjeong@ibs.re.kr	Rare Isotope Science Project, Institute for Basic Science	REPUBLIC OF KOREA
Jose	Jordi	jordi.jose@upc.edu	Dept. Physics and Nuclear Engineering, UPC Barcelona	SPAIN
Kalantar-Nayestanaki	Nasser	nasser@kvi.nl	KVI-CART/Univ. of Groningen	NETHERLANDS
Kaufmann	Simon	s.kaufmann@uni-mainz.de	nuclear chemistry Mainz	GERMANY
Khan	Elias	khan@ipno.in2p3.fr	Institut de Physique Nucleaire	FRANCE
Kim	Jongwon	jwkim@ibs.re.kr	Institute for Basic Science	REPUBLIC OF KOREA
Klintefjord	Malin	malin.klintefjord@fys.uio.no	University of Oslo	NORWAY
Kowalska	Magdalena	kowalska@cern.ch	ISOLDE-CERN	SWITZERLAND
La Rana	Giovanni	giovanni.larana@na.infn.it	University of Naples Federico II and INFN	ITALY
LE CROM	Benjamin	lecrom@ipno.in2p3.fr	Institut de Physique Nucléaire d'Orsay	FRANCE
Lewitowicz	Marek	lewitowicz@ganil.fr	GANIL	FRANCE
Liénard	Etienne	lienard@lpccaen.in2p3.fr	LPC Caen	FRANCE
Lynch	Kara Marie	kara.marie.lynch@cern.ch	CERN	SWITZERLAND
Madurga Flores	Miguel	Miguel.madurga@cern.ch	CERN	SWITZERLAND
Mamatkulov	Kahramon	kahramon@lhe.jinr.ru	Joint Institute for Nuclear Research, Dubna, Moscow region, Russia	RUSSIA
Manea	Vladimir	vladimir.manea@cern.ch	Max-Planck-Institute for Nuclear Physics	GERMANY
Mazzocco	Marco	marco.mazzocco@pd.infn.it	University of Padova	ITALY
Melon	Barbara	melon@fi.infn.it	INFN Firenze	ITALY
Mitrofanov	Semen	mitrofanov@nrmail.jinr.ru	FLNR JINR	RUSSIA
Mittal	Harish Mohan	mittal.hm@lycos.com	Ambedkar National Institute of Technology, Jalandhar, Punjab	INDIA
Moore	Iain	iain.d.moore@jyu.fi	University of Jyväskylä	FINLAND
Morales Lopez	Anabel	anaisabel.morales@mi.infn.it	Università degli Studi di Milano - INFN Sezione di Milano	ITALY
Motobayashi	Tohru	motobaya@riken.jp	RIKEN Nishina Center	JAPAN
Münzenberg	Gottfried	g.muenzenberg@gsi.de	GSI	GERMANY
Neff	Thomas	t.neff@gsi.de	GSI	GERMANY
Obertelli	Alexandre	alexandre.obertelli@cea.fr	CEA Saclay	FRANCE
Page	Robert	rdp@ns.ph.liv.ac.uk	University of Liverpool	UNITED KINGDOM
Pietri	Stephane	s.pietri@gsi.de	GSI	GERMANY
Pirrone	Sara	sara.pirrone@ct.infn.it	INFN-Sezione di Catania	ITALY
Press	Daniela	d.press@gsi.de	GSI	GERMANY
Prete	Gianfranco	prete@lnl.infn.it	INFN Laboratori Nazionali di Legnaro	ITALY
Purushothaman	Sivaji	s.purushothaman@gsi.de	GSI	GERMANY
Raabe	Riccardo	raabe@kuleuven.be	KU Leuven, Instituut voor Kern- en Stralingsfysica	BELGIUM
Raiss	Siglind	s.raiss@gsi.de	GSI	GERMANY
Reiter	Peter	preiter@ikp.uni-koeln.de	University of Cologne	GERMANY

Last name	First name	Email	Institution	Country
SAMANTA	CHHANDA	chhanda.samanta@gmail.com	VIRGINIA MILITARY INSTITUTE	USA
SATO	Yoshiteru	satou@phya.snu.ac.kr	Institute for Nuclear and Particle Astrophysics, Seoul National University	REPUBLIC OF KOREA
Savajols	Hervé	savajols@ganil.fr	GANIL	FRANCE
Scheidenberger	Christoph	c.scheidenberger@gsi.de	GSI	GERMANY
Schuurmans	Paul	Paul.Schuurmans@sckcen.be	SCK-CEN	BELGIUM
Schwenk	Achim	schwenk@physik.tu-darmstadt.de	TU Darmstadt	GERMANY
Sharov	Pavel	pavlsh@mail.ru	Joint Institute for Nuclear Research	RUSSIA
Simon	Haik	h.simon@gsi.de	GSI	GERMANY
Stachura	Monika	monika.stachura@cern.ch	ISOLDE-CERN	CANADA
Stevens	Sam	sam.stevens@ugent.be	Department of Physics and Astronomy, Ghent University, Belgium	BELGIUM
Tetereva	Tatiana	tetereva@msu.dubna.ru	Lomonosov Moscow State University	RUSSIA
Teterev	Yury	teterev@jinr.ru	Joint Institute for Nuclear Research	RUSSIA
Tsoneva	Nadia	tsoneva@theo.physik.uni-giessen.de	Institut für Theoretische Physik	GERMANY
Turzo	Ketel	turzo@ganil.fr	GANIL	FRANCE
Valdré	Simone	valdre@fi.infn.it	Università degli studi di Firenze and INFN - Sezione di Firenze	ITALY
Van Duppen	Piet	piet.vanduppen@fys.kuleuven.be	KU Leuven - Instituut voor Kern- en Stralingsfysica	BELGIUM
Vesic	Jelena	jelena.vesic@ijs.si	Jozef Stefan Institute, Ljubljana, Slovenia	SLOVENIA
Walters	Barbara S	bawlers@umd.edu	Univ. of Maryland	USA
Walters	William B	wwalters@umd.edu	University of Maryland	USA
Weick	Helmut	h.weick@gsi.de	GSI Helmholtzzentrum	GERMANY
Wenander	Fredrik	fredrik.wenander@cern.ch	CERN	SWITZERLAND
Winfield	John Stuart	j.winfield@gsi.de	GSI	GERMANY
Xu	Xiaodong	x.xu@gsi.de	GSI Darmstadt and Justus-Liebig-Universität Gießen	GERMANY
Yeremin	Alexander	eremin@jinr.ru	Joint Institute for Nuclear Research	RUSSIA
Yordanov	Deyan	yordanov@ipno.in2p3.fr	Institut de Physique Nucléaire	FRANCE

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