EURISOL-NET (ENSAR/NA03) Working Group

Monday 27 June 2011 - Tuesday 28 June 2011

CERN

Book of Abstracts

Contents

Target Material Studies / **0**

Recent results on development of the SPES production target

Author: Alberto Andrighetto[1]

[1] *Laboratori INFN Legnaro*

Corresponding Author: andrighetto@lnl.infn.it

The SPES project at Laboratori di Legnaro of INFN (Italy) is concentrating on the production of neutron-rich radioactive nuclei by the Uranium fission at a rate of 10ˆ13 fission/s . The emphasis to neutron-rich isotopes is justified by the fact that this vast territory has been little explored, at exceptions of some decay and in-beam spectroscopy following fission. The Rare Ion Beam (RIB) will be produced by ISOL technique using the proton induced fission on a Direct Target of UCx.
The most critical element of the SPES project is the Multi-Foil Direct Target. Up to day the proposed target represents an innovation in term of capability to sustain the primary beam power. The design is carefully oriented to optimize the radiative cooling taking advantage of the high operating temperature of 2000℃.
During the talk will be presented the recent developments on the fabrication, characterization, and on-line testing of uranium carbide targets; also developments related to the ion-source activities using the surface and plasma ion source techniques it will be reported. Finally test and results on thermal behavior of the target system dissipating 10 kW of power it will be shown.

Ion sources R&D / **1**

Status of R&D on ion sources at IPNO

Author: Christophe LAU[1]

Co-author: Maher Cheikh Mhamed [1]

[1] *IPN Orsay*

Corresponding Author: lau@ipno.in2p3.fr

In the framework of European projects for future facilities and for the operation of ALTO facility, IPNO achieves various studies and developments on ion sources.
For Spiral2 project, IPNO develops a plasma ion source called IRENA. For the ALTO facility, in collaboration with CERN, IPNO starts up the operation of a laser ion source.
For EURISOL project, IPNO has submitted a NuPNET proposal: the EURIMIS project.
The status of these works and the ressources involved will be described.

Target Material Studies / **2**

The R&D on target material at IPNO

Author: Evelyne Cottereau[1]

Co-authors: Ahmet Ozgümüs [1]; Botoum Hy [1]; Brigitte Roussière [1]; Christophe Lau [1]; Maher Cheikh Mhamed [1]; Nicole Barré [1]

[1] *IPN Orsay*

Corresponding Author: cotterea@ipno.in2p3.fr

IPNO is actively pursuing R&D studies to improve the properties of fission targets both in the framework of future radioactive beam facilities and for the operation of the ALTO facility. Within the Spiral2 project, IPNO is studying several synthesis modes to improve both the density and the release of UCx targets. New actinide targets are studied through the Actilab project. The status of these studies will be presented.

SCRF Cavities and Beam Diagnostics / **3**

High intensity beam diagnostics system based on novel metal micro-detectors

Author: Oleksii Kovalchuk[1]

Co-authors: Andrii Chaus [2]; Dmytro Storozhyk [2]; Lukas Tlustos [3]; Michael Campbell [3]; Michel Renier [4]; Oleg Fedorovich [2]; Oleksandr Okhrimenko [2]; Stanislav Pospisil [5]; Valery Pugatch [2]; Xavier Llopart [3]; Yolanda Prezado [4]

[1] *Kiev Institute for Nuclear Research (Ukraine)*

[2] *Kiev Institute for Nuclear Research NASU (Ukraine)*

[3] *CERN*

[4] *ESRF*

[5] *Institute of Experimental and Applied Physics (Prague)*

Corresponding Author: lexxkov@kinr.kiev.ua

Physics principle and production technologies have been developed at KINR for the new type detectors of the charged particles as well as synchrotron radiation –Metal Foil Detectors (MFD). Microstrip MFDs –Micro-strip Metal Detectors (MMD) 0.5 –1.0 micro-meter thick were used for the beam profile monitoring of the synchrotron radiation at HASYLAB (DESY, Hamburg) as well as for the charged particles beam profile monitoring. The number of photons (mean X-ray energy 18 keV) producing out of a strip a single SEE was evaluated as (1.5 +/-0.5)*10ˆ4. The MMD has demonstrated stable operation under the X-ray flux of 4.5*10ˆ14 photons/second/mm2.
The current technology allows for production of the thin (˜1 μm) Ni-strips with a pitch of about few micrometers, providing high position resolution. Micro-strip Metal Detector technology includes some stages: micro-strip layout made by photo-lithography on silicon wafer, plasma-chemistry etching of the silicon wafer in the operating window, micro-cabling connection to the readout electronics and DAQ. The main technical features of the MMD: High Radiation tolerance (> 100 MGy); Low thickness of sensors (˜1 μm); Low operation voltage (20 V); Perfect spatial resolution (5 –25 μm); Stable operation at X-ray intensity up to 10ˆ16 photons•sˆ-1•mmˆ-2 and proton beam intensity up to 10ˆ11 protons/bunch. In comparison with the latest developments in beam profile monitoring based on the silicon micro-strip or micro-pixel detectors Metal Micro-strip Detectors have an advantage of being extremely thin and semi-transparent device. MMD could be used as a feedback element for stabilizing and/or focusing charged particles beams.
Multichannel data acquisition system based on ASIC chips VA_SCM3 (Gamma Medica –Ideas, Norway), XDAS (Sens-Tech, UK), TimePix (Medipix Collaboration) are discussed too. Design of the metal micro-detector as a multiplicity trigger in heavy-ion relativistic experiments is presented.
Characterization studies of the Metal Micro-detectors measuring in real time high level dose distribution at the Mini-beam Radiation Therapy setup (ESRF, Bio-Medical Beamline ID17) have been recently performed. The results obtained illustrate an excellent performance of the metal TimePix micro-detector providing 2D image of the dose distribution over many beams in (14 x 14) mm2 area. Peak-Valley-Ratios measured by the TimePix and gafchromic films agree well, in general. Possible reasons for some observed discrepancies are discussed.

Beam Manipulation & Purification / **4**

Ion beam production and manipulation at IGISOL

Author: Ari Jokinen[1]

[1] *Department of Physics-University of Jyvaskyla*

IGISOL-facility in the Accelerator Laboratory relies on the ion guide technique developed early 80's in the University of Jyväskylä. Since then the ion guide technique has constantly been developed and improved. Our recent studies have concentrated on the laser ionization both in the gas cell but also in the gas jet evacuating the gas volume.

The extracted ion beam can be manipulated in a various way. Recently we have developed optical pumping in the cooler, which will be discussed.

In the ion trap technology, we have developed totally new purification technique called Ramsey-cleaning and also multi-injection method, which greatly increases efficiency of trap-assisted spectroscopy. Those methods will be introduced.

Ion sources R&D / 5

Recent ion source related research and development work at JYFL

Author: Hannu Koivisto[1]

[1] *University of Jyväskylä*

Corresponding Author: pekka.suominen@cern.ch

During the recent years the JYFL ion source group has actively performed time resolved photon emission experiments in order to study the breakdown process of ECR heated plasma. The first experiments were carried out by using Ge-detectors of the Accelerator Laboratory and later by using CdTe-detectors for lower energies (about 2 keV –300 keV). In order to cover the entire energy range of photons emitted from the ion source plasma, the JYFL ion source group initiated the program to study the low energy photon emission with the aid of photon spectroscopy. The first experiments have been performed with the light ion sources and some very interesting results have been received. The group have also studied the parameters affecting the beam properties. This work includes the frequency tuning and beam compensation experiments. The development work for the metal ion beams have been done in order to further improve the the technology of induction ovens and sputtering. In this meeting the results of our work and some future prospects will be presented.

Neutron Converter Studies / 6

Designing Safety into a High-Power Neutron Spallation Source

Author: Yacine Kadi[1]

Co-author: Karel Samec [2]

[1] *CERN*

[2] *ENSI*

Corresponding Author: yacine.kadi@cern.ch

Recent testing of two advanced high-power neutron spallation sources MEGAPIE and EURISOL have yielded a wealth of experimental data and operational experience that is of relevance to efforts currently under-way to develop a safe, reliable neutron source. The neutron spallation source must be maintenance-free and inherently safe to operate. The radio-toxic inventory in the

liquid metal must at all times be contained within successive layered barriers to avert contamination in the event of an accident. The presentation reviews constraints in terms of the general layout of the neutron source and shows how liquid metal neutron source design may be improved compared to the current state of the art.

Neutron Converter Studies / **7**

Optimization Studies of the CERN-ISOLDE neutron converter – fission target system

Author: Raul Fernandes Luis[1]

Co-authors: José Marques [1]; Luca Zanini [2]; Pedro Vaz [1]; Thierry Stora [3]

[1] *ITN*

[2] *PSI*

[3] *CERN*

Corresponding Author: raul.fernandes.luis@cern.ch

The ISOLDE facility at CERN has been one of the premier ISOL facilities worldwide since it started operating in 1967. More than 1000 isotopes have been produced at ISOLDE, following the bombardment of various primary targets with a pulsed proton beam of energy 1.4 GeV and an average intensity of 2 μA. A tungsten solid neutron converter has been used for ten years to produce neutron rich-fission fragments in UCx targets. However, somewhat reduced beam intensities result from the present layout. In this work, the Monte Carlo code FLUKA was used to study the current layout of the neutron converter –fission target system of the ISOLDE facility. The production rates of neutron-rich isotopes of Zinc and Cadmium were calculated and compared with experimental data. An optimization of the layout of the target system is proposed, that maximizes the production of the mentioned neutron-rich isotopes while reducing the contamination by proton rich isobars that affect the purity of the beams. The Monte Carlo simulations reported in this study show that the ratios of beam over impurities 80Zn/80Rb and 130Cd/130Cs can be increased by more than one order of magnitude with respect to the present layout. Since the absolute figure of merit for any radioactive ion beam facility comes from both its delivered beam intensities and their purities, this work provides a good example on how future increases of the primary beam intensities and energies at HIE-ISOLDE and EURISOL can be best exploited to deliver high rates of pure beams around the doubly magic nuclei 78Ni and 132Sn.

Beam Manipulation & Purification / **8**

Low intensity beam diagnostics at INFN-LNS

Author: Luigi Cosentino[1]

Co-author: Luigi Celona [2]

[1] *LNS - INFN*

[2] *LNS-INFN*

Corresponding Author: cosentino@lns.infn.it

The aim of the EXCYT (EXotics with CYclotron and Tandem) facility is the production and acceleration of radioactive ion beams. A primary beam provided by the K-800 Superconducting Cyclotron produces the required nuclear species in a target-ion source complex, which can be used for low energy experiments (up to 300 keV) and higher energy, by accelerating them by means of the 15 MV Tandem. The nuclear experiments have been started in July 2006 with the experiments BIGBANG and RCS, using the post-accelerated 8Li ions. 8Li, 9Li and 21Na beams have been already produced

and next beams have been planned, according to the experimental proposals, with intensities ranging between 10^4 to 10^6 pps. In order to have a high sensitivity beam diagnostics for the low intensity radioactive beams, suitable devices have been developed with characteristic of reliability and easy to use. In the talks will be presented a description of the diagnostics devices with the results under realistic operative conditions.

Target Material Studies / **9**

Uranium Carbide Material Developments at CERN-ISOLDE

Author: Alexander Gottberg[1]

Co-authors: Alberto Andrighetto [2]; Christophe Lau [3]; Hanna Franberg [4]; Ines Guenther-Leopold [5]; Thierry Stora [1]; Vladimir Panteleev [6]

[1] *CERN*

[2] *INFN*

[3] *IPNO*

[4] *GANIL*

[5] *PSI*

[6] *PNPI*

Corresponding Author: alexander.gottberg@cern.ch

UCx targets have long been used in ISOL-type facilities to deliver a large range of different radioisotopes. Such targets are also central in the operation of next generation facilities, such as SPES, HIE-ISOLDE, SPIRAL2, and ultimately EURISOL. Within the FP7-ENSAR Joint Research Activity ActILab a large collaboration, including members from CERN, GANIL, INFN, IPNO and PSI, is working on novel and innovative technologies to further improve the performance of this promising target material.
Activities at CERN involve the exploration of new kinds of material synthesis, online tests of recent types of actinide targets and finally comprehensive studies of structural, crystallographic and chemical evolution during target operation. In this context some developments will be presented, such as a recent feasibility study for applying micro probe investigations using synchrotron absorption spectroscopy to these materials and the results of a direct comparison between beams produced from classical UCx and micro grained high density uranium mono carbide targets tested at ISOLDE towards the end of 2010.

Target Material Studies / **10**

Latest progress for the RIB production for the future activities at GANIL/SPIRAL2

Author: Hanna Franberg Delahaye[1]

[1] *GANIL*

An overview of the production station and some of the results achieved for the ion sources, targets and neutron converter will be discussed.

11

ENSAR and EURISOL-NET

Introduction / **12**

EURISOL-NET Task 1 R&D Coordination

Ion sources R&D / **14**

Status of the EXCYT facility at INFN-LNS

The aim of the EXCYT (EXotics with CYclotron and Tandem) facility is the production and acceleration of radioactive ion beams. A primary beam provided by the K-800 Superconducting Cyclotron produces the required nuclear species in a target-ion source complex, which can be used for low energy experiments (up to 300 keV) and higher energy, by accelerating them by means of the 15 MV Tandem. The nuclear experiments have been started in July 2006 with the experiments BIGBANG and RCS, using the post-accelerated 8Li ions. 8Li, 9Li and 21Na beams have been already produced and next beams have been planned, according to the experimental proposals, with intensities ranging between 10ˆ4 to 10ˆ6 pps. In order to have a high sensitivity beam diagnostics for the low intensity radioactive beams, suitable devices have been developed with characteristic of reliability and easy to use. In the talk will be presented the current status of the facility .

Beam Manipulation & Purification / **15**

Beam Manipulation and Purification at ISOLDE and REX-ISOLDE

Author: Fredrik Wenander[1]

[1] *CERN*

Corresponding Author: fredrik.wenander@cern.ch

At ISOLDE and REX-ISOLDE a large number of projects are on-going in order to improve the beam characteristics of the low-energy and post-accelerated beams. The area covers as diverse topics as low-intensity beam identification, beam purification methods in REXTRAP, development of polarized beams and, charge breeder upgrade plans among other things. A brief overview of some of these beam manipulation and beam purification activities at ISOLDE and REX-ISOLDE will be given.

SCRF Cavities and Beam Diagnostics / **17**

Superconducting Radio-Frequency Recent Developments at IPN Orsay

Author: Sebastien BOUSSON[1]

[1] *CNRS/IN2P3/IPN Orsay*

Corresponding Author: bousson@ipno.in2p3.fr

IPN Orsay is strongly involved in several R&D programs and projects based on SCRF cavities, which are the framework for many developments on superconducting cavity technology.
For the Spiral-2 project, IPNO is in charge of the high energy part of the Linac, composed of 14 quarter-wave SC cavities resonators. All series cavities have been tested and the first series cryomodule is currently being tested.
Within the EURISOL-DS EU program, spoke cavities have been developed for the intermediate energy part of the linac. The last prototype, a triple-spoke resonator has been designed and fabricated and is currently being prepared for chemical treatment.
Within the FP7 EUCARD program, two developments are performed:
- a 700 MHz, 5 cells,beta 0.65 elliptical cavity for the SPL has been designed and will be fabricated
- a new test cavity and associated test-stand has been developed in order to measure and characterize the fundamental properties of new superconducting thin films.
In this paper, we will report on the recent achievements on these ongoing SCRF activities.

18

NOT YET AVAILABLE

Introduction / **20**

ENSAR and EURISOL-NET

Author: Yorick Blumenfeld[1]

[1] *CERN*

Corresponding Author: yorick.blumenfeld@cern.ch

The aims of the EURISOL-NET network within ENSAR will be presented. Other current initiatives related to EURISOL will be mentioned.

Neutron Converter Studies / **21**

Converter targets for high power spallation neutron sources

Author: Etam Noah Messomo[1]

[1] *ESS AB*

Corresponding Author: etam.noah@cern.ch

The last decade has seen the commissioning and operation of two spallation neutron source facilities, SNS and J-SNS, where the mercury neutron converter targets receive pulsed proton beams in the MW range. The European Spallation Source planning first neutrons for 2019 has been exploring a range of targets and is converging towards the choice of a baseline target and a back-up solution. This paper presents the target selection process, describing requirements for an ESS target and outlining the advantages and disadvantages of the various neutron converter targets considered.

SCRF Cavities and Beam Diagnostics / **22**

Beam diagnostics developments for the HIE-ISOLDE linac

Author: Francesca Zocca[1]

[1] *Inst. de Estructura de la Materia-Consejo Superior de Investiga*

Corresponding Author: francesca.zocca@cern.ch

A silicon detector monitor has been developed and tested in the frame of the beam diagnostics development program for the HIE-ISOLDE superconducting upgrade of the REX-ISOLDE heavy-ion linac at CERN. The monitor is intended for beam energy and timing measurements as well as for phase scanning of the superconducting cavities. Tests have been performed with a stable ion beam, composed of carbon, oxygen and neon ions accelerated to energies from 300 keV/u to 2.85 MeV/u. The energy measurements performed allowed for beam spectroscopy and ion identification with a resolution of 1.3 % rms. The achieved resolution is suited for cavity phase scanning, which was demonstrated with the REX 7-gap resonator. The time structure of the beam, characterized by a bunch period of 9.87 ns, was measured with a resolution better than 200 ps.

SCRF Cavities and Beam Diagnostics / 23

SRF activities at CERN

Author: Matteo Pasini[1]

[1] *CERN*

Corresponding Author: matteo.pasini@cern.ch

Different SCR activities are ongoing at CERN: spare LHC cavities, SPL elliptical cavities, fundamental research with the Quadrupolar resonator and the HIE-ISOLDE QWR cavities.
The talk will report on the status mainly of the HIE-ISOLDE cavities, on the RF design, the mechanical conception and the sputtering technology. The testing facility will be presented as well as first preliminary results.

Ion sources R&D / 24

Metallic beams and charge breeding

Corresponding Author: franberg@ganil.fr