Workshop on Active Targets and Time Projection Chambers for High-intensity and Heavy-ion beams in Nuclear Physics

Report of Contributions

https://indico.in2p3.fr/e/16443

Contribution ID: **3** Type: **not specified**

Active target MAIKo and measurement of 10C(a,a') at 75 MeV/u

Wednesday, January 17, 2018 4:05 PM (30 minutes)

Alpha cluster structures have been widely examined in self conjugate A=4n nuclei. With the recent developments of new accelerator facilities, studies on neutron/proton rich nuclei became feasible. In such nuclei, excess neutrons/protons are predicted to occupy the molecular orbitals between alpha cores and yield variety of the molecular structures. Missing mass spectroscopies with alpha inelastic scatterings have been successfully performed to measure and to search for alpha cluster states in stable nuclei. Therefore, measurements of alpha inelastic scatterings under inverse kinematics conditions should be carried out for unstable nuclei. However, such a measurement requires the detection of low-energy ($\sim$1 MeV) recoil alpha particles which is not possible with an external target.
To overcome this problem, we have developed an active target system MAIKo at RCNP. The system is based on a time projection chamber (TPC) with maicro-pixel chamber (μ-PIC). We have performed several test experiments using stable beams to study the detector performances under high counting rate. The first RI beam experiment with a ^{10}C beam at 75 MeV/u was performed in November 2017 at RCNP.
In this presentation, the setups and results of the test experiments will be discussed, and some of the preliminary results of the ^{10}C experiment will be presented.

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Presenter: FURUNO, Tatsuya (Department of Physics, Kyoto University)

Contribution ID: **4** Type: **not specified**

Building Generic Instrumentation for Nuclear Physics

Friday, January 19, 2018 9:00 AM (30 minutes)

Instrumenting nuclear physics experiments today is a challenge for a considerable number of projects. Exacting, because of the complexity in the electro-vacuum-mechanics, number of active elements, the full beam integration and of course the physics. Examples will be shown in GDS including mature, recent and project ideas of the gas devices. Also, often, the gas volumes are ringed with solid state, scintillators or spectrometers which translates into additional requirements for higher resolution and dynamic range. All this have overwhelmed the needs for many channel signal/shape recording systems with generous parameter setting, flexibility and high counting rate. Further, the data capture systems have to fit into the lab infrastructures which have yet to adopt to the huge data bandwidth and analysis platform – calling for a selective trigger. Hence an adjustable, complete, integrable and friendly electronic system. The word Generic is used to describe the approach being deployed and GET (General Electronic for TPCs) and is an example of an initiative. In the workshop, I would like to address the present status of GET with its demanding aspects that the practiced approach has required. Will denote the foresee the development over the next five years as mile-stoned with the ENSAR2/GES program. Within the generic context, I will attempt to includes the development of instruments in general.

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Presenter: Dr POLLACCO, Emanuel (IRFU/DPhN CEA Saclay)

Contribution ID: **5** Type: **not specified**

Direct measurement of fission barrier heights of unstable heavy nuclei at ISOL facilities

Wednesday, January 17, 2018 3:45 PM (20 minutes)

Fission barrier height is one of the least known nuclear parameters, with experimental data, acquired decades ago, existing only close to the line of beta-stability. Availability of heavy radioactive beam offers possibility to investigate their transfer-induced fission and thus probe their fission barriers. We will provide a brief summary of present status of the topic and then concentrate on the possibilities to stage experimental studies of fission barrier heights at new generation of ISOL facilities (EURISOLDF), which will be available in the near future. As an example we will discuss the experiment IS581, being prepared for execution at the HIE-ISOLDE facility (CERN), which will take advantage of the state of the art detection technique such as the active target TPC ACTAR.

Primary author: Dr VESELSKY, Martin (Slovak Academy of Sciences)

Co-author: Mr KLIMO, Jozef (Slovak Academy of Sciences)

Presenter: Mr KLIMO, Jozef (Slovak Academy of Sciences)

Contribution ID: **6** Type: **not specified**

Latest developments of the Warsaw Optical Time Projection Chamber

Wednesday, January 17, 2018 5:25 PM (20 minutes)

The Optical Time projection Chamber (*OTPC*) [1] was built at the Faculty of Physics of the University of Warsaw as a tool to observe rare decays modes of exotic nuclei with charged particles emission. Over the years, the OTPC has been instrumental for the first direct observation of rare phenomena like two-proton and β-delayed three proton decay [2,3]. The detection of one decay event is sufficient to unambiguously identify the decay mode and establish its branching ratio.

In our detector, the gas amplification structure consists of an electrode followed by a stack of four gas-electron multiplier foils and an anode grid. The light produced by the electrons close to the anode is collected by a PMT and a CCD camera.

Over the last couple of years, several updates were carried on to enable the use of this powerful spectroscopic tool under very different experimental conditions (e.g. half-lives of the nuclei studies from few ms to over 10 seconds). Different gas mixtures were also tested. The results of this work and a future plans will be presented.

[1] M. Pomorski et al., Phys. Rev. C 90, 014311 (2014)
[2] K. Miernik et al., Phys. Rev. Lett 99 (2007) 192501.
[3] K. Miernik et al., Phys. Rev. C 76 (2007) 041304(R).

Primary authors: Mrs SOKOŁOWSKA, Natalia (Faculty of Physics, University of Warsaw, Warsaw, Poland); FOR THE OTPC COLLABORATION (Faculty of Physics, University of Warsaw, Warsaw, Poland, JINR, Dubna, Russia)

Presenter: Mrs SOKOŁOWSKA, Natalia (Faculty of Physics, University of Warsaw, Warsaw, Poland)

Contribution ID: **7** Type: **not specified**

Performance of SPiRIT-TPC with GET readout system for heavy ion collision experiment

Wednesday, January 17, 2018 12:30 PM (30 minutes)

The SPiRIT Time Projection Chamber (TPC) was designed and constructed to perform the experiments for the constraints of the symmetry term of the Nuclear Equation of State. The state-of-art readout electronics, GET readout system, was employed as the readout system for SPiRIT-TPC 12k readout pads.
In the spring of 2016, first campaign of heavy ion collision experiments was performed at RIKEN-RIBF. In this experiment, ~10kHz Sn isotope beams of 270 MeV/u incident energy were used as projectile. I will present the overview of SPiRIT-TPC+GET system, its in-beam performance, and recent result of heavy ion collision experiments in terms of detector technology mainly.
This presentation is based on the work supported by the DOE under Grant No. DE-SC0014530, DE-NA0002923 and NSF under Grant No. PHY-1102511 and the Japanese MEXT Grant-in-Aid for Scientific Research on Innovative Area Grant No. 24105004.

Primary author: ISOBE, Tadaaki (RIKEN)

Presenter: ISOBE, Tadaaki (RIKEN)

Contribution ID: **8** Type: **not specified**

GET electronics for missing mass spectroscopy at RIBF

Thursday, January 18, 2018 12:30 PM (30 minutes)

I will report on two detector development projects that are aimed at bolstering missing mass reaction studies using radioactive isotope beams at the RIBF facility. One project is a silicon telescope array TiNA and the other an active target CAT-M, both planned to be coupled with GET electronics to read out a few thousands of channels of GEM or segmented silicon detectors. Detector concepts, project plans and results from offline and in-beam tests will be shown.

Primary author: SUZUKI, Daisuke (RIKEN Nishina Center)

Presenter: SUZUKI, Daisuke (RIKEN Nishina Center)

Contribution ID: **9** Type: **not specified**

Development of SpecMAT – active target surrounded with an array of scintillation detectors

Wednesday, January 17, 2018 5:45 PM (20 minutes)

The population of single-particle states to probe the evolution of shell closures in atomic nuclei is of great interest among research groups around the world. One of the most precise tools for the population of these states is transfer reactions. However, even nowadays with the-state-of-the-art detectors and modern nuclear radioactive ion beam facilities, precise identification of excited states in a nucleus far from stability via a transfer reaction remains a challenge for nuclear spectroscopy. SpecMAT is an active target – time projection chamber designed to overcome this challenge by an innovative combination of techniques that integrates particle energy measurements in a high magnetic field with gamma-ray spectroscopy. Thus, kinematics of the reaction can be reconstructed with the resolution of up to 100 keV from the energy of the ejectile charged particles energy. Gamma-ray resolution below 4 % at 662 keV gamma-line can be achieved from an array of scintillation detectors. Combination of both techniques in one detector gives full information about the population of excited states and their decay, information which was before only accessible by performing different experiments.
Recent progress in the development of the detector, results from the test of the components in a high static magnetic field as well as simulations in GEANT4 will be presented.

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Co-authors: Dr BABO, Mathieu (IPN Orsay); Dr CERUTI, Simone (KU Leuven); Dr DE WITTE, Hilde (KU Leuven); GRINYER, Geoffrey-Fathom (GANIL); LAFFOLEY, Alex (GANIL); MARCHI, Tommaso (INFN Laboratori Nazionali di Legnaro - Università di Padova); Mr RAJ, Alex (KU Leuven); Mr RENAUD, Maxim (KU Leuven); Dr SWARTZ, Jacobus (Aarhus University); Mr YANG, Jiecheng (KU Leuven)

Presenter: POLESHCHUK, Oleksii (KU Leuven, Institute for Nuclear and Radiation Physics)

Contribution ID: **10** Type: **not specified**

The ACTAR TPC and its Physics program

Thursday, January 18, 2018 9:30 AM (30 minutes)

The ACtive TARget and Time Projection Chamber (ACTAR TPC), is a new state-of-the-art gaseous detector founded by the European Research Council (ERC), composed of 16384 channels handled through the GET electronics. It has been recently commissioned at GANIL and is now fully operational to use for physics cases.
After introducing the ACTAR TPC, which is suitable for low rate reactions with exotic beams, I will present the wide physics program that will be done with the detector starting next Spring.

Two approved experiments will use the cubic geometry. The first one will measure the branching ratio for the $2p$ emission from the 6.15 MeV resonance in ^{18}Ne using the the $^{17}F + p$ proton resonant elastic and inelastic scattering. The decay products will be tracked with the TPC, which will be essential for identifying the $2p$ decay channel from the majority $1p$-decay events. The tracking capability will allow us to make angular correlation in order to identify the nature of the decay (sequential or simultaneous). The second one will study the spectroscopy of the unbound and unobserved proton-unbound ^{33}K through the proton resonant scattering $^{32}Ar + p$ reaction, giving insights on the $Z = 20$ and $Z = 16$ shell gap at $N = 14$.

The ACTAR TPC is also planned to be used in a different geometry (cuboid with a rectangular pad plane), mainly to study the $2p$-decay of proton-rich isotopes. In particular to measure the proton-proton correlations in the decay of ^{54}Zn and ^{48}Ni that is planned at GANIL and to establish the two-proton radioactivity nature of ^{67}Kr in RIKEN.

Primary author: MORFOUACE, Pierre (GANIL)

Presenter: MORFOUACE, Pierre (GANIL)

Contribution ID: **11** Type: **not specified**

Commissioning of the ACTAR TPC

Thursday, January 18, 2018 11:35 AM (25 minutes)

The ACtive TARget and Time Projection Chamber (ACTAR TPC) is a gas-filled detection system whose construction was finished a few weeks ago at the Grand Accélérateur National d'Ions Lourds (GANIL). The detector benefits from new technologies required for its mechanical design as well as a state-of-the-art electronics system (GET) that enables high pixel densities with fully digitized signals for each channel. This provides the possibility to discriminate between multiple tracks superimposed in time or in space. Commissioning of the ACTAR TPC has been performed in-beam just after its construction. 18O was sent onto a target of isobutane to study the well known resonant scattering 18O(p,p'). First experimental results and comparison to previous data will be shown as well as simulations to characterize the detector capacities.

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Presenter: MAUSS, Benoît (Grand Accélérateur National d'Ions Lourds)

Contribution ID: **12** Type: **not specified**

Search for clustering in proton-rich nuclei with the Prototype AT-TPC

Thursday, January 18, 2018 3:55 PM (20 minutes)

Clustering in light nuclei is an important structural feature that has important implications for nuclear theory and understanding nucleosynthesis in astrophysical environments. But more data on where clustering exists, especially in light unstable nuclei, is needed to constrain nuclear models and understand the conditions necessary for prominent cluster structure. In order to look for clustering in proton-rich light nuclei, we have performed a resonant alpha scattering measurement using the 10C(a,a)10C reaction to search for cluster states in 14O using the Prototype AT-TPC at the University of Notre Dame. Challenges and progress in the analysis of this experiment including the development of tracking algorithms and their effectiveness will be presented as well as planned future developments for future experiments related to reactions with radioactive nuclei in the light mass region.

Primary author: AHN, Tan (University of Notre Dame)

Presenter: AHN, Tan (University of Notre Dame)

Contribution ID: **13** Type: **not specified**

Sputtering and heating of targets and foils in high-intensity heavy-ion beam experiments

Wednesday, January 17, 2018 6:05 PM (20 minutes)

Sputtering of targets and target backing foils irradiated by intense heavy ion (HI) beams in long-term experiments has been considered on the grounds of available models and experimental data. Experiments on synthesis of superheavy nuclei (SHN), which are carried out in Dubna with Gas-Filled Recoil Separator (DGFRS), are the examples of such kind of experiments. High fluxes of HIs and heat generation, which are realized within a relatively small area and thickness of these elements of DGFRS, are inherent in such experiments. At present, the 48Ca beam with the intensity of about 1 pμA allows obtaining several atoms of SHN per month at their production cross section of several pb and the efficiency provided by DGFRS. The detailed study of properties of SHN produced in the experiments with complete fusion reactions induced by the 48Ca projectile on actinide target nuclei, which lead to nuclei with 112≤Z≤118, implies the use of HI beams with intensities significantly higher than those used in the discovery experiments [1]. Moreover, synthesis of SHN with Z>118 implies the use of the heavier than 48Ca beam particles (50Ti, 54Cr etc.). One may expect the production cross section values less than 0.05 pb for SHN formed in the fusion-evaporation reactions with these projectiles. It means that for the observation of two decay events of SHN produced with the cross section of 0.05 pb one should collect the beam dose of 10^20 particles, using the target of 0.4 mg/cm2 in thickness and having total detection efficiency of 40%. This dose of particles passed through a stationary target may cause total disappearance of radioactive target material at the end of the experiment if the sputtering yield of the material is estimated as 0.01 atom/ion. In the case of the rotating target one can essentially reduce the yield of sputtered atoms due to the gain in the irradiation area.
Heating the target and target backing foil as a single whole caused by an intense HI beam can be estimated with the use of some approximations. The temperature of the target and target backing is calculated as a function of time in the conditions of pulse heating followed by subsequent cooling with radiation emitted from their surfaces. Such pulsing mode corresponds to the rotating target irradiated by a continuous HI beam in the experiments. Estimates show that radiative cooling in the conditions of pulse heating can be the most effective way of heat transfer to the surroundings at the temperature of several hundred degrees. Such temperatures can be reached on the surfaces of the target and foils irradiated by HI beams at the intensities exceeding 10^13 particle/s [2].
[1]. Yu.Ts. Oganessian, V.K. Utyonkov, Nucl. Phys. A 944 (2015) 62.
[2]. R.N. Sagaidak, Physics of Particles and Nuclei Letters 14 (2017) 747, Pleiades Publishing, Ltd., 2017.

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Presenter: Dr SAGAIDAK, Roman (Flerov Laboratory of Nuclear Reactions, Joint Institute for Nuclear Research)

Contribution ID: **14** Type: **not specified**

Testing quantum mechanics fundamental principles with time projection chambers

Wednesday, January 17, 2018 5:05 PM (20 minutes)

A new research project is presented. It consists in a deterministic quantum statistical model of gaseous track detectors, in particular time-projection chambers. Such detectors are indeed perfect tools to test fundamental principles of quantum mechanics: what is the solution to the Mott problem [1], i.e. the measurement of linear tracks for a spherical radioactive decay? More generally, where, when and why does decoherence take place in such detectors? Could quantum decoherence and quantum measurement be deterministic phenomena?

The model will explore the hypothesis that the microscopic state of the measurement apparatus, for instance the positions of atoms and molecules in gas detectors, could fix individual measurement results in a deterministic way [2]. It will be based on a solution of the Schrödinger equation for scattering states of the measured particle in the complex apparatus environment, with simplifying hypotheses.

First results obtained in a one-dimensional model with point interactions [3] are presented [4, 5]. Two types of localizations are identified: the first one associated with the random distribution of the detector atoms (Anderson localization), the second one associated with the state space of the detector when atom excitations are introduced in the quantum model.

These results open the way to a new calculation of the stopping power at low energy, for which experimental data would be welcome. Preliminary results from the ACTAR collaboration suggest that usual low-energy corrections [6] are not sufficient to precisely reproduce experimental data.

The difficulties anticipated to reach a fully operational three-dimensional model are finally discussed.

[1] N. F. Mott, Proc. R. Soc. Lond. A 126 (1929) 79
[2] J.-M. Sparenberg, R. Nour and A. Manço, EPJ web of conferences 58 (2013) 01016
[3] R. Carlone, R. Figari, C. Negulescu, Commun. Comput. Phys. 18 (2014) 247
[4] J.-M. Sparenberg and D. Gaspard, preprint arXiv:1609.03217 (2016)
[5] R. Ceulemans, Master Thesis, KU Leuven (2016)
[6] J. F. Ziegler, J. Appl. Phys 85 (1999) 1249

Primary author: SPARENBERG, Jean-Marc (Université libre de Bruxelles (ULB))

Co-authors: Mr GASPARD, David (Université libre de Bruxelles (ULB)); Mr CEULEMANS, Ruben (KU Leuven)

Presenter: SPARENBERG, Jean-Marc (Université libre de Bruxelles (ULB))

Contribution ID: **15** Type: **not specified**

Space-charge distortions in the ALICE TPC with continuous readout

Thursday, January 18, 2018 5:15 PM (30 minutes)

The operation of TPCs is steadily pushed to cope with higher rates.
This forces to consider the influence of space charge which is produced
in the ionisation of the drift gas as well as by ions possibly flowing back
from the amplification region.
The influence of the gas choice as well as a comparison between conventional
multi-wire proportional chambers and multi-pattern gas detectors will be
discussed.
At the example of the ALICE TPC upgrade to a GEM based read-out system
the impact of space charge on the space-point reconstruction will be shown.
Additionally, the correction methods developed to minimize the impact on the
distortions will be discussed.

Primary author: Dr WIECHULA, Jens (Institut für Kernphysik Goethe-Universität Frankfurt)

Presenter: Dr WIECHULA, Jens (Institut für Kernphysik Goethe-Universität Frankfurt)

Contribution ID: **16** Type: **not specified**

An overview of the analysis software for SπRIT experiments

Thursday, January 18, 2018 3:15 PM (20 minutes)

Measuring reaction fragments from radioactive heavy-ion collisions is crucial to study the nuclear symmetry energy in higher densities than the saturation density. To achieve the goal, developing the analysis software dedicated to the detector system is as important as constructing the detector.

SAMURAI Pion Reconstruction Ion-Tracker Time Projection Chamber (SπRIT TPC) was constructed for measuring the reaction fragments and the first series of SπRIT experiment was performed in Spring 2016 at RIBF-RIKEN. First, GETDecoder was developed to unpack the binary data from state-of-the-art GET electronics more efficiently. The dedicated analysis software, SpiRITROOT, has been developed by embedding the GETDecoder. In this presentation, an overview of SpiRITROOT will be presented from binary data to the physical observables.

This material is based on work supported by the DOE under Grant No. DE-SC0014530, DE-NA0002923 and NSF under Grant No. PHY-1102511 and the Japanese MEXT Grant-in-Aid for Scientific Research on Innovative Area Grant No. 24105004.

Primary authors: JHANG, Genie (National Superconducting Cyclotron Laboratory); Dr CERIZZA, Giordano (NSCL); Mr ESTEE, Justin (MSU/NSCL); Mr LEE, Jung Woo (Korea University); THE SIIRIT COLLABORATION

Presenter: JHANG, Genie (National Superconducting Cyclotron Laboratory)

Contribution ID: **17** Type: **not specified**

Highlights of the SpiRIT Time Projection Chamber

Thursday, January 18, 2018 11:10 AM (25 minutes)

In order to maximize the science potentials of low intensities rare isotope beams, we need a new generation of high resolution detectors with high efficiency. Time Projection Chambers (TPC) with large angular coverage and good energy and position resolution can be used in experiments across a broad range of beam energies and extend the scientific reach of radioactive beams.

The SAMURAI Pion Reconstruction and Ion-Tracker (SπRIT) TPC was designed to constrain the symmetry-energy term in the nuclear Equation of State which is not only important for the fundamental understanding of nuclei but also for understanding the dynamics of the neutron star mergers. The first experimental campaign to measure charged fragments including pions emitted from the reactions of 132,124,112,108Sn (beam at 270 MeV/nucleon)+ 124,112Sn (target) was successfully carried out in the Spring of 2016 at the Radioactive Isotope Beam Factory (RIBF) at RIKEN. In this talk, I will give highlights of the design, construction and performance of the SpiRIT TPC.

This material is based on work supported by the DOE under Grant No. DE-SC0014530, DE-NA0002923 and NSF under Grant No. PHY-1102511 and the Japanese MEXT Grant-in-Aid for Scientific Research on Innovative Area Grant No. 24105004.

Primary authors: TSANG, Betty (NSCL/Michigan State University); COLLABORATION, SpiRIT

Presenter: TSANG, Betty (NSCL/Michigan State University)

Contribution ID: **18** Type: **not specified**

First results of NEXT-NEW and the NEXT future

Thursday, January 18, 2018 12:00 PM (30 minutes)

NEXT is an experiment to search for the hypotetical double-beta decay without neutrinos of 136Xe nuclei in a high pressure gas TPC. A prototype detector, NEXT-NEW, has been operated at Canfranc Underground Laboratory during 2016. We present the first results and the future prospects of NEXT.

Primary author: HERNANDO, Jose A (Universidade de Santiago de Compostela)

Presenter: HERNANDO, Jose A (Universidade de Santiago de Compostela)

Contribution ID: **19** Type: **not specified**

Application of the active target technique - from nuclear to particle physics

Thursday, January 18, 2018 9:00 AM (30 minutes)

Active targets have been used for a variety of nuclear and particle physics experiments since many years. Most of those are ionization chambers (without gas amplification) or TPCs (with gas amplification). Active targets have been proved to be an extremely useful tool for the investigations of light-ion induced reactions using radioactive beams in inverse kinematics, in particular in the region of low momentum transfer. This technique was used for a series of scattering experiments by the IKAR collaboration between PNPI, Gatchina and GSI Darmstadt, studying the halo structure of light neutron-rich nuclei. Using the ionization chamber allowed to measure the energy of the recoil particles with the best possible precision except the EXL technique with stored beams. A few results of first and recent experiments will be given. The experimental conditions at the future international facility FAIR will provide outstanding opportunities for nuclear structure and nuclear astrophysics studies on nuclei far off stability. Two versions of active targets, dedicated for investigations at the R3B/FAIR setup within the ACTAF project, are presently under design and will be discussed. An application of the similar technique for a particle physics experiment at the MAMI accelerator (Mainz University) is an interesting example of the cross-disciplinary value of the active targets. The experiment is designed to measure recoil protons in coincidence with scattered electrons for elastic electron scattering off hydrogen, aiming an extraction of the proton radius with higher precision than it was achieved before with electron beams. The concept of the experiment, design of the high-pressure active target and the results of the first test experiment will be presented.

Primary author: KISELEV, Oleg (GSI Darmstadt)

Presenter: KISELEV, Oleg (GSI Darmstadt)

Contribution ID: **20** Type: **not specified**

Fission investigations in the MAYA active target

Wednesday, January 17, 2018 3:15 PM (30 minutes)

This work addresses the first inverse-kinematics fission measurements in a gaseous active target [1]. A 238U beam was sent into the MAYA active target, where fusion and transfer-induced fission reactions occured with 12C nuclei of the gas filling the detection volume. A telescope of Si detectors was included in the setup to measure the target-like transfer partner and identify the fissioning system and its excitation energy.
The main results of this experiment and the performance of MAYA will be discussed in this contribution, with a view to next-generation active target systems.
Specific modifications to the setup were required due to the high ionization created by the 238U beam. In particular, an electrostatic mask along the beam axis was used to contain the electrons and positive ions produced by the beam, and preserve the uniformity of the electric field [2].
A remarkable response of the setup was achieved at beam intensities of several millions of pps, which allowed the accurate reconstruction of the fission-fragment trajectories. Moreover, a complete charac- terization of the different 238U +12C transfer channels was obtained, and the slowing down of 238U projectiles in the gas was used to explore the dissipation of energy as a function of the energy in the entrance channel [3]. The competition between fusion-and transfer-induced fission cross-sections could also be investigated.
Beyond the interest of the measured physical observables, technical aspects to be considered for the preparation of future experiments were studied, and the the limits of the performance of the electrostatic mask were established.
The detection of target-like products in MAYA was especially challenging. The higher amplification re- quired to detect these lighter nuclei could only be achieved at the cost of scaling down the beam intensity. However, the main difficulties were identified and possible solutions will be discussed.
In summary, this work showed the capabilities of active targets for investigations that require heavy-ion beams, and some of the challenges to be faced by future projects.
[1] C. Rodríguez-Tajes et al., Nucl. Phys. A 958 (2017) 246.
[2] C. Rodríguez-Tajes et al., Nucl. Instr. Meth. A 768 (2014) 179.
[3] G. Scamps et al., Phys. Rev. C 95 (2017) 024613.

Primary author: Dr RODRÍGUEZ-TAJES, Carme (USC, GANIL)

Presenter: Dr RODRÍGUEZ-TAJES, Carme (USC, GANIL)

Contribution ID: **21** Type: **not specified**

Operation of an optical TPC at high pressure and ultra-clean conditions: the experience of NEXT

Friday, January 19, 2018 10:00 AM (25 minutes)

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Primary author: Dr MONRABAL, Francesc (IFIC)

Presenter: Dr MONRABAL, Francesc (IFIC)

Contribution ID: **22** Type: **not specified**

Extending Dynamic Range, Calculating and Calibrating dE/dx in the SπRIT TPC

Thursday, January 18, 2018 3:35 PM (20 minutes)

This presentation will present a, simple, novel technique to extend the dynamic range and recover the charge information from saturated electronics resulting from large energy losses in a TPC. I will also present the software we use to simulate, and calibrate, the dE/dx distributions for the correct particle identification (PID) in the SAMURAI Pion-Reconstruction and Ion-Tracker (SπRIT) TPC. At some point a track with low momentum, large charge, or both will saturate the electronics of one or several pads in the readout plane, limited by our dynamic range. While the information in these saturated pads are lost, the total charge can estimated by fitting the adjacent unsaturated pads, or the tail of the pad response distribution. Using a simple fit, we have successfully recovered the central saturated pad charge value, correcting the PID shape and effectively extending the dynamic range from a signal to noise ratio of about 700:1 to 1400:1. It is essential for good PID that we predict the correct dE/dx distribution. I have implemented the same relativistic Photo Absorption Ionization (PAI) model of energy loss used in the STAR and ALICE TPC's PID. Having a true theory of the energy loss distribution allows us to predict the full dE/dx distributions and avoid the pitfalls of fitting empirical functions to dE/dx distributions to perform PID. Like the ALICE TPC, we find good agreement between theory and data and I will present the findings of the preliminary calibration of SπRIT TPC. This material is based on work supported by the DOE under Grant No. DE-SC0014530, DE-NA0002923 and NSF under Grant No. PHY-1102511 and the Japanese MEXT Grant-in-Aid for Scientific Research on Innovative Area Grant No. 24105004

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Presenter: ESTEE, Justin (NSCL/Michigan State University)

Contribution ID: **23** Type: **not specified**

State-of-the-art TPCs and rare searches

Friday, January 19, 2018 9:30 AM (30 minutes)

A review of the main techniques and enabling assets for imaging rare processes with gaseous TPCs will be made.

Primary author: GONZALEZ DIAZ, Diego (IGFAE)

Presenter: GONZALEZ DIAZ, Diego (IGFAE)

Contribution ID: **24** Type: **not specified**

Low-pressure TPC detector for studying photonuclear reactions at astrophysical energies with gamma-ray beams at ELI-NP

Thursday, January 18, 2018 10:00 AM (20 minutes)

The Extreme Light Infrastructure-Nuclear Physics (ELI-NP) facility will provide monochromatic, high-brilliance and polarized gamma-ray beams, which can be used to study nuclear reactions of current astrophysical interest through the inverse photo-dissociation processes and detailed balance principle. In particular, of special interest are (p, γ) and (α, γ) reactions that regulate the ratio of C and O and those that burn ^{18}O and, therefore, regulate the ratio between ^{16}O and ^{18}O in the Universe. For instance, the benchmark inverse kinematic reaction ^{12}C(γ, α)^{16}O can be investigated down to 1 MeV in the centre-of-mass reference frame, where experimental data from direct experiments are sparse.

A dedicated Time Projection Chamber (ELITPC) with an active gaseous target kept under low pressure is being developed at University of Warsaw, IFIN-HH/ELI-NP and University of Connecticut. The active target volume of ELITPC will be about 35 $\times$ 20 $\times$ 20 cm^3 and will be centered around gamma-beam axis. The reaction products stopped in the gas will produce primary electrons that drift towards charge amplification structures made of Gas Electron Multiplier (GEM) foils. The three-dimensional kinematics of the photo-dissociation events will be reconstructed from about 10^3 signal strips, arranged into redundant, 3-coordinate system.

High intensity γ beams are expected to be available at ELI-NP ($\sim$10^7 photons/bunch, 100 Hz bunch repetition rate). The beam-induced background has been studied using Monte Carlo techniques for different γ beam profiles, in order to optimize the expected signal to background ratio. Several scaled demonstrator detectors were constructed and tested with alpha-particle and X-ray sources.

The results from ongoing R&D activities for this project will be presented.

Primary author: Dr CWIOK, Mikolaj (University of Warsaw)

Presenter: Dr CWIOK, Mikolaj (University of Warsaw)

Contribution ID: **25** Type: **not specified**

The SpecMAT magnetic active target for the spectroscopy of exotic nuclei

Wednesday, January 17, 2018 12:00 PM (30 minutes)

The SpecMAT project aims at using nucleon-transfer reactions to study crucial regions of the chart of nuclei, to understand the features of the underlying forces that drive shell evolution. Initially, we will focus on the neutron-rich nuclei around nickel (Z=28) and, for the first time, the neutron-deficient nuclei around lead (Z=82). SpecMAT is an active-target detector that combines high luminosity, high efficiency and a very large dynamic range and allows detection of both charged-particle and gamma-ray radiation. Advanced technologies are exploited in its design, concerning the use of electronics, gaseous detectors and gamma-ray detectors in a magnetic field. The detector will be installed in the ISS magnetic solenoid, at the HIE-ISOLDE facility for the production and post-acceleration of radioactive ion beams at CERN in Geneva.
The main physics cases will be briefly presented, along with an overview of the status of the project.

Primary authors: RAABE, Riccardo (KU Leuven); THE SPECMAT GROUP AT THE KU LEUVEN

Presenter: RAABE, Riccardo (KU Leuven)

Contribution ID: **26** Type: **not specified**

ACTAR TPC for decay studies

The ACTAR TPC device is being developed in order to perform various types of nuclear physics experiments, based on nuclear reactions studies (“active target”) or on radioactive decays. Since the events topology may be different according to the kind of experiment, two detector geometries are considered in the project, sharing the same electronics (GET).
The first chamber (“reaction”) has been built at GANIL, and a first in-beam test was performed in November 2017, mainly for a commissioning of the “active target” running of the detector, using a light 18O beam. In addition, some data have been taken with a heavier beam of 136Xe, in order to test some specific issues of the decay studies.
The presentation aims to introduce the physics program that can be addressed with decay experiments using ACTAR TPC, with a focus on the specific difficulties of such experiments. Related to this point, we will present some preliminary analysis of the test at GANIL. Finally, the current status of the “decay chamber”, the second ACTAR TPC geometry under construction, will be shown.

Primary author: Dr GIOVINAZZO, Jérôme (CENBG CNRS/IN2P3 / University of Bordeaux)

Presenter: Dr GIOVINAZZO, Jérôme (CENBG CNRS/IN2P3 / University of Bordeaux)

Contribution ID: **27** Type: **not specified**

Study of giant resonances with active targets

Thursday, January 18, 2018 10:20 AM (20 minutes)

The presence of coherent motions of particles in many-body systems, i.e. collective motions, is a common feature in several branches of physics. In atomic nuclei, a particular case of nuclear collective motion is represented by the giant resonances (GR) [1], which are the subject of this presentation. These resonance states play a key role in the understanding of the nuclear structure because of their connection with the bulk properties of atomic nuclei.
Giant resonances can be macroscopically viewed as a quantum oscillation of two fermionic liquids (neutron and protons) involving spatial (L), spin (S) and isospin (I) degree of freedom. In the case of an isoscalar oscillation (ΔI=0) neutron and protons move together in phase. On the other hand, in an isovector oscillation (Δ I =1) neutron and protons move in opposite direction.
The isoscalar giant monopole resonance (ISGMR) measures the collective response of the nucleus to density fluctuations (ΔI, ΔS, ΔL=0) [1]. The ISGMR is particularly interesting for its connection with the incom- pressibility of the nucleus KA, which, in turn, can be linked to the incompressibility of nuclear matter K∞, an important ingredient of the nuclear-matter equation-of-state (EOS). The EOS, essentially, describes the binding energy per nucleon as a function of nuclear density and it plays an important role in the description of heavy-ion nuclear collision, the collapse of the heavy stars in super novae explosion and the description of neutron stars [2]. In order to improve the understanding of this nuclear mechanism, new experimental data in unstable nuclei far from the stability are needed [3].
The reaction mechanism used to excite the ISGMR is the inelastic scattering of the nuclei of interest on an hadron isosclar probe, typically an α particle. The use of an active target coupled with silicon detectors allows to measure the α particles at forward angles (where the maximum of the cross section is located) and with a very small kinetic energy [4].
In addition, the (α,α') reaction can be also used to excite isoscalar dipole states (L=1, I=0) around the neutron separation energy [5]. These states, also called pygmy dipole resonance (PDR), are of great interest for the impact on astrophysical phenomena, such as r-process nucleosynthesis [6]. The nature of the PDR is largely debated. SpecMAT [7], an active target placed in a high magnetic field and coupled with scintillation detectors, will be a powerful detector to observe PDR in unstable nuclei.
In this presentation the use of active targets to study ISGMR and PDR will be shown.
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[3] E. Khan, J. Margueron and I. Vidana, Phys. Rev. Lett. 109, 092501 (2012).
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[7] R. Raabe, SpecMAT ERC Consolidator Grant (2014).

Primary authors: Dr CERUTI, Simone (KU Leuven); Mr RAJ, Alex (KU Leuven); RAABE, Riccardo (KU Leuven); Dr DE WITTE, Hilde (KU Leuven); POLESHCHUK, Oleksii (KU Leuven, Institute for Nuclear and Radiation Physics); Mr RENAUD, Maxim (KU Leuven); Mr YANG, Jiecheng (KU Leu-

ven)

Presenter: Dr CERUTI, Simone (KU Leuven)

Contribution ID: **30** Type: **not specified**

Design and Commissioning of Texas Active Target (TexAT) detector system

Wednesday, January 17, 2018 10:00 AM (30 minutes)

Texas Active Target detector system (TexAT) is designed for nuclear structure, nuclear reactions and nuclear astrophysics studies with rare isotope beams. It consist of a planar time projection chamber (TPC) that is based on the microMegas technology. The TPC is complemented by the Silicon detectors shell and the CsI(Tl) detectors shell. The readout is based on GET electronics. Data analysis is performed using a special computer cluster with data local architecture. We will overview the design and performance of the TexAT detector system and discuss preliminary results of the commissioning run in which the excitation function for ^{8}B+p resonance elastic scattering was measured.

Primary authors: Prof. ROGACHEV, Grigory (Texas A&M University, USA); Dr KOSHCHIY, Evgeniy (Texas A&M University, USA); Dr AHN, Sunghoon (Texas A&M University, USA); Dr POLLACCO, Emmanuel (CEA, France); Dr UBERSEDER, Ethan (Texas A&M University, USA); Mr HOOKER, Joshua (Texas A&M University); Mrs JAYATISSA, Heshani (Texas A&M University); Mr UPADHYAYULA, Sriteja (Texas A&M University); Mr HUNT, Curtis (Texas A&M University)

Presenter: Prof. ROGACHEV, Grigory (Texas A&M University, USA)

Contribution ID: **31** Type: **not specified**

Round table

Friday, January 19, 2018 11:00 AM (1 hour)

Contribution ID: **32** Type: **not specified**

Concluding remarks

Friday, January 19, 2018 12:00 PM (30 minutes)

Presenter: Dr ALVAREZ POL, Héctor (Universidade de Santiago de Compostela)

Contribution ID: **33** Type: **not specified**

AT TPC

Wednesday, January 17, 2018 10:30 AM (30 minutes)

Presenter: SANTAMARIA, Clémentine (NSCL)

Contribution ID: **34** Type: **not specified**

Towards an Active Target at SPES

Wednesday, January 17, 2018 11:35 AM (25 minutes)

Presenter: MARCHI, Tommaso (INFN Laboratori Nazionali di Legnaro - Università di Padova)

Contribution ID: **35** Type: **not specified**

Welcome

Wednesday, January 17, 2018 9:30 AM (30 minutes)

Contribution ID: **36** Type: **not specified**

Towards building a gas detector with gas amplifiers

Presenter: MEHL, Bertrand (Irfu-CEA)

Contribution ID: **37** Type: **not specified**

Active targets CAT's for missing mass spectroscopy with high-intensity beams

Wednesday, January 17, 2018 2:45 PM (30 minutes)

I will introduce the active targets CAT-S and CAT-M for missing mass spectroscopy with high-intensity beams and their physics programs. Both active targets are based on GEM-TPC coupled with silicon detectors and designed to be used in combination with high-intensity medium-heavy nuclei beams more than 500-kcps. The first experiment at RIBF with CAT-S and the commissioning of CAT-M at HIMAC will be reported.

Primary author: OTA, Shinsuke (Center for Nuclear Study, the University of Tokyo)

Presenter: OTA, Shinsuke (Center for Nuclear Study, the University of Tokyo)

Contribution ID: **38** Type: **not specified**

Next generation experiments with the Active Target Time Projection Chamber

Thursday, January 18, 2018 2:45 PM (30 minutes)

Active Targets have gained popularity with the advent of state-of-the-art radioactive beam facilities capable of providing the most exotic nuclear species. Several facilities are deploying novel Active Targets as part of their broad and competitive experimental program. At the National Superconducting Cyclotron Laboratory (NSCL) our collaboration has successfully commissioned the Active Target Time Projection Chamber (AT-TPC) with 4He and 46Ar beams delivered by the ReA3 accelerator, to perform elastic scattering reactions on alpha particles and protons, respectively. The performance of the detector, analysis of data and results obtained in these experiments will be discussed during this talk. In addition, future experiments with fast and slow beams will be presented, as well as a novel type of micro pattern gas detectors based on stacks of thick Gas Electron Multipliers (MTHGEM) that our collaboration is developing for next generation experiments.

Presenter: Dr AYYAD, Yassid (LBNL)

Contribution ID: **39** Type: **not specified**

Towards building a micro pattern gas detector.

Thursday, January 18, 2018 4:45 PM (30 minutes)

In practically all trackers and TPCs designed today, Micro Pattern Gas amplifiers are used.

In my presentation, after an introduction to the detector lab at CERN, I will cover very briefly the basic technologies that are presently being used in MPGD.

Emphasis will be made on the conceptual designs that have been modified to adapt the instruments to the needs of nuclear physics.

New concepts being developed today at CERN will also be mentioned.

Primary author: MEHL, Bertrand (CERN EP-DT-EF)

Presenter: MEHL, Bertrand (CERN EP-DT-EF)

Contribution ID: **40** Type: **not specified**

FEANICS?: Parameterisable Dynamic - Dynamic Range Pre-amplifier

Thursday, January 18, 2018 5:45 PM (20 minutes)

Presenter: BOUYJOU, Florent (CEA Saclay - DSM/IRFU/SEDI)

Contribution ID: **41** Type: **not specified**

Active targets CAT's for missing mass spectroscopy with high-intensity beams

I will introduce the active targets CAT-S and CAT-M for missing mass spectroscopy with high-intensity beams and their physics programs. Both active targets are based on GEM-TPC coupled with silicon detectors and designed to be used in combination with high-intensity medium-heavy nuclei beams more than 500-kcps. The first experiment at RIBF with CAT-S and the commissioning of CAT-M at HIMAC will be reported.

Primary author: OTA, Shinsuke (Center for Nuclear Study, the University of Tokyo)

Presenter: OTA, Shinsuke (Center for Nuclear Study, the University of Tokyo)