XLVI Symposium on Nuclear Physics, January 6-9, 2025

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Abstracts Invited Talks

1. Ricardo Alarcon (Arizona State University, USA)

   Title: **Search for the neutron Electric Dipole Moment (nEDM) at Los Alamos National Laboratory (LANL)**

   Abstract: The LANL nEDM experiment searches for the electric dipole moment (EDM) of the neutron, which is a parity (P)-violating and time-reversal (T)-violating observable. It plays an important role in describing elementary particle physics for understanding the overall pattern of T- (CP-) violation and the possible cause of the observed asymmetry of matter and anti-matter in the universe. As currently proposed, the sensitivity reach of the experiment represents an improvement of about one order of magnitude with respect to the present sensitivity level of 10^{-26} e cm. The experiment utilizes ultra-cold neutrons (UCN) in an experiment based on a precision nuclear magnetic-resonance measurement using Ramsey′s separated oscillatory field method, the state-of-the-art technique to measure the neutron precession frequency relative to an external clock. The project is at an advanced stage and a status report will be presented.

2. Dinko Počanić (University of Virginia, USA)

   University of Virginia, Charlottesville, VA 22904-4714, USA

   Title: **Testing quark-lepton universality through precision measurements of neutron beta decays**

   Abstract: Neutron beta decay, one of the most fundamental processes in subatomic physics, continues to offer stringent tests of the standard model (SM) electroweak sector and, hence, of SM limits and its possible extensions. Although fully successful to date, the minimal SM based on the $SU(3)_C \times SU(2)_L \times U(1)_Y$ gauge symmetries is known to be incomplete: additional particles and phenomena must exist. Among the places to look for deviations from SM predictions are: the number and the couplings of quark generations — the Cabibbo-Kobayashi-Maskawa quark mixing matrix (CKM), couplings of lepton generations (lepton universality), and searches for non-(V–A) interactions. In these studies, nuclear physics probes complement research at high energies well, helping to complete the picture of fundamental physics at the smallest length scale.

   Experimental study of neutron beta decay provides the most sensitive means to evaluate the ratio of axial-vector to vector nucleon coupling constants $\lambda = g_A/g_V$. The precise value of λ is important in a number of applications of the theory of weak interactions, especially in astrophysics. Further, precise measurements of neutron beta decay parameters are uniquely useful in the search for new physics. Measurement of the neutron decay rate Γ_n, or lifetime $\tau_n = 1/\Gamma_n$, combined with λ, allows a determination of the CKM matrix element V_{ud} independent of nuclear models. Precise knowledge of V_{ud} is essential for testing the unitarity of the three-generation CKM matrix. CKM unitarity, in turn, provides limits on specific processes and particles not included in the standard model (new physics).

   This talk will review the state of precision neutron beta measurements, including different approaches to measuring λ, and will focus on the Nab experiment, currently taking initial physics data with unpolarized cold neutrons at the Spallation Neutron Source (SNS). Plans call for Nab to be followed by pNab, to study decays of polarized neutrons from the SNS. We will discuss Nab and pNab in the broader context of the field, including alternative methods for determining λ and V_{ud}. We will also explore the potential of Nab and pNab to produce additional SM tests, besides addressing the CKM unitarity question.

   This work is supported by grant PHY-2209484 from the US National Science Foundation.

3. Jeff W. Martin (The University of Winnipeg, Canada)

   The University of Winnipeg, Winnipeg, MB, Canada

   Title: **Cryogenic systems for the TUCAN EDM experiment**

   Abstract: The TUCAN (TRIUMF UltraCold Advanced Neutron) Collaboration is completing a new ultracold neutron (UCN) source. The TUCAN source will deliver UCNs to a neutron electric dipole moment (EDM) experiment. The EDM experiment is projected to be capable of a precision of 1×10^{-27} $e$cm, competitive with other planned projects, and a factor of ten more precise than the present world's best. The TUCAN source is based on a UCN production volume of superfluid helium (He-II), held at about 1 K, and coupled to a proton-driven spallation target. The production rate in the source is expected to be in excess of 10^7 UCN/s; since UCN losses can be small in superfluid helium, this should allow us to build up a large number of UCNs. This technology is the principal aspect making the TUCAN project unique. The superfluid production volume was recently cooled, for the first time, and successfully filled with superfluid helium. In this presentation, I will discuss the design principles of the TUCAN source, highlighting some of the challenging cryogenic milestones that we recently passed.

4. Christopher Crawford (University of Kentucky, USA)

   Title: **The BL3 experiment at NIST**

   Abstract: The neutron lifetime is important for determining the primordial abundance of ^{4}He in Big Bang Nucleosynthesis, for testing CKM unitarity of the Standard Model. However, its experimental determination is plagued by an 9.8 $\pm$ 2 second (5 sigma) discrepancy between in-flight (cold) and trapped (ultra-cold) neutron measurements. The goal of the BL3 experiment is to examine this discrepancy by improving the in-flight decay determination to 0.3 seconds, examining various systematic effects which might explain the difference. Enhancements in this experiment involve a larger proton trap with a segmented silicon proton detector to measure the absolute neutron decay rate, and a neutron detector with improved detection uniformity and absolute calibration to measure the neutron fluence of the beam. Both new detectors were designed to take advantage of the high-flux NG-C beamline at the NIST Center for Neutron Research. I will describe the in-flight decay measurement technique and some innovations of the BL3 experiment.

5. Francesco Recchia[1,2] (Dipartimento di Fisica dell'Università degli Studi di Padova, Italy)

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   Title: **Isospin-Symmetric Island of Inversion: Structure of heavy N=Z nuclei**

   Abstract: Protons and neutrons in nuclei are arranged in orbitals that follow a shell structure, with energy gaps at specific magic numbers. Experiments using radioactive beams have shown that these magic numbers vanish in some neutron-rich isotopes. This results in unusual arrangements, where configurations with nucleons scattered to higher energy orbitals are the most bound, forming what has been called "Islands of Inversion".

   We have measured the lifetimes of 2^+ states in ^{84}Mo and ^{86}Mo isotopes, discovering a dramatic structural change. This has been understood as the boundary of a "Isospin-Symmetric Island of Inversion,"where both proton and neutron excitations play an equal role and evolution of collectivity is governed by three-nucleon forces.

6. Victoria Vedia (TRIUMF, Canada)

   Title: **Probing the island of inversion at N=40 through beta-decay of Mn isotopes**

   Abstract: One of the best-known divergences from the independent-particle shell model description of the atomic nucleus is the existence of islands of inversion [1]. The IoI of the region N=40 draws particular attention since the neutron number 40 was postulated as a non-traditional "magic" number and N = 40 represents the boundary between the pf and g shells.

   Measurements of B(E2) values and E(2+) in the neutron-rich region show increased collectivity through the N = 40 shell gap, with the clear exception of ^{68}Ni [2,3]. Deformation and shape coexistence have been identified in the area and RIKEN experiments suggest the N=40 IoI extends toward N=50, paralleling the merging of N=20 and N=28 IoIs. LNPS calculations predict triple shape coexistence for ^{67}Co (N=40), with three rotational bands [4]. And recent experiments on ^{67}Fe (N=41) propose a spin-parity of 5/2+ or 1/2- for its ground state [5] which indicates a significant deformation. In addition, shape coexistence is also expected for ^{67}Fe.

   Detailed spectroscopic information of the iron, cobalt, and nickel isotopes is crucial to accurately mapping the transition to the N = 40 island of inversion and serves as a test for accuracy of theories. However, very limited information is available, so to this end, an experiment was performed at the TRIUMF-ISAC facility utilizing the GRIFFIN spectrometer [6], where the β and βn decay of ^{69}Mn, ^{68}Mn, and ^{67}Mn, populates the corresponding Fe, Co and Ni isotopes. This data set contains orders of magnitude more statistics than previous studies allowing us to build for the first time a complete level scheme of ^{68}Fe and ^{67}Fe and to improve upon the known $\beta-$ decay level schemes of ^{67}Co, by expanding the number of transitions and levels, as well as by improving the precision of branching ratios and ground-state half-life measurement. In addition, measurements of level lifetimes down to the picosecond range will allow us to investigate the band structure in these nuclei. For the ^{67}Fe isotope, the good level of statistics will make it possible to measure the energy of the identified isomeric state and improve the lifetime measurement. These results can provide further insight into the detailed structure of the states by comparison to simple models and large-scale shell model calculations in order to confirm or refute the shape coexistence picture predicted by LNPS calculations and the shrinking of the N=40 gap just one proton below ^{68}Ni.

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7. Magda Zielińska[1] (IRFU, France)

   [1]IRFU, CEA, Université Paris-Saclay, 91191 Gif-sur-Yvette, France

   Title: **Experimental studies of shape coexistence and octupole correlations in Zr nuclei**

   Abstract: Quadrupole and octupole deformation of low-lying excited states in zirconium nuclei has attracted considerable attention in the last years. Numerous theoretical studies attempted to address the unusually large $B(E3;\, 3_1^- \rightarrow 0_1^+)$ transition strength in ^{96}Zr. Moreover, an enhanced $B(E2; 2_2^+ \rightarrow 0_2^+)$ value was observed in this nucleus [1], demonstrating that an excited deformed configuration coexists with a nearly spherical ground state. This observation has been linked to the type-II shell evolution mechanism [2], i.e. reorganization of nuclear shells due to specific proton and neutron occupations. The Monte-Carlo shell-model calculations [2] that reproduced well the measured $B(E2)$ strengths in ^{96}Zr, were particularly successful in describing the rapid ground-state

shape transition occurring between ^{98}Zr and ^{100}Zr, at the same time predicting a variety of deformed configurations – prolate, oblate and triaxial ones – to appear throughout the Zr isotopic chain. A large set of experimental spectroscopic data related to the shape transition in the Zr isotopes was also satisfactorily reproduced in the framework of configuration mixing within the interacting boson model (IBM-CM) [3], invoking an *intertwined quantum phase transition.*

We pursue a broad experimental programme addressing quadrupole and octupole collectivity in even-even Zr nuclei ranging from A=90 to 100. To this aim, we combine the powerful Coulomb-excitation technique with high-statistics β decay. The measurements were performed with the GALILEO and AGATA γ-ray spectrometers at LNL (Italy), the GRIFFIN γ-ray spectrometer at TRIUMF (Canada) and Q3D magnetic spectrograph at MLL (Munich, Germany). I will present our unpublished results establishing spherical-oblate shape coexistence in ^{94}Zr, reevaluating quadrupole and octupole collectivity in ^{96}Zr, and indicating multiple shape coexistence in ^{100}Zr.

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8. P.E Garrett (University of Guelph, Canada)

Department of Physics, University of Guelph, Guelph, ON, N1G2W1 Canada

Title: **Multi-spectroscopic studies of the Ru isotopes**

Abstract: The even-even Ru isotopes, especially those with neutron number between 54 and 60, have low-lying level schemes reminiscent of that expected for a quadrupole harmonic vibrator. In a recent survey [1], it was shown that the existing data rule out such an interpretation for the Ru isotopes with $A \geq 102$, and there is evidence that shape-coexistence occurs in these nuclei (see, e.g., Ref. [2,3]). Prior to our studies, the state of the spectroscopic data was such that for the lighter Ru nuclei their level schemes could be interpreted as being nearly harmonic vibrational in nature. While the very neutron-rich Ru isotopes have been the subject of recent studies, e.g., Ref. [4], the lighter stable ^{98,100,102}Ru isotopes have not, with only a few structure-focused measurements within the last two decades. With the goal of probing the nature of the excited states in ^{98,100,102}Ru, we have launched a program of investigation using multiple techniques.

A very sensitive spectroscopic tool to study excited nuclear states is β decay, but the parents of the neutron-deficient Ru isotopes are Rh, a refractory element from which it is difficult to produce beams at ISOL facilities. We thus used fusion-evaporation reactions, ^{12}C+^{89}Y and ^{14}N+^{89}Y, at iThemba LABS to produce activities of ^{98}Rh and ^{100}Rh, respectively, at the iThemba Decay Tape Station and studied their β decays [5]. We have also performed γ-ray spectroscopy following neutron capture reactions on targets of ^{99}Ru and ^{101}Ru using the FIPPS facility at the Institute Laue Langevin (ILL) in Grenoble taking advantage of the high efficiency of FIPPS to examine coincidences with the high-energy primary transitions, and the high granularity to perform γ-γ angular correlations. These measurements were complemented by the two-neutron-transfer reactions ^{100,102}Ru$(p,t)^{98,100}$Ru analyzed with the Q3D magnetic spectrograph of the Maier-Leibnitz Laboratorium (MLL) in Garching, Germany, as well as the ^{103}Rh(p,α) proton transfer reaction. Finally, Coulomb excitation has been used to extract excitation matrix elements that are sensitive to the nuclear shapes using the ^{32}S+^{100}Ru reaction at the Heavy Ion Laboratory of the University of Warsaw, and the ^{12}C+^{102}Ru reaction [6] using the Q3D spectrograph of the MLL.

Selected results from these studies will be presented, and set in the context of structure in the region.

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9. Xesus Pereira-López (IBS, Republic of Korea)

Title: **Experiments probing isospin symmetry**

Abstract: The formal concept of isospin has been introduced to explain the apparent exchange symmetry between neutrons and protons [1]. However, if the nuclear force were the same for protons and neutrons properties such as masses and excitation energies would depend only on the mass number A. Hence, in the absence of isospin-non-conserving effects, two isobaric analog states would be completely degenerate. Naturally, this is never the case since the Coulomb force will lift this degeneracy, but a large degree of symmetry is expected to remain in the underlying wave functions.

In recent years, many theoretical [2-4] and experimental [5-20] efforts have been devoted to study the origin of these isospin asymmetries. Isospin-symmetry-breaking probes include Triplet Energy Differences (TED) [5-11] and Mirror Energy Differences (MED) [12-21], where differences in excitation energies between isobaric analog states are analysed in all three $T_z = -1, 0, 1$ members of a $T = 1$ triplet for the former, and in mirror pairs for the latter. These studies have shown that electromagnetic effects within the shell model alone cannot explain these energy differences, suggesting other effective isospin-non-conserving (INC) interactions are missing from current models.

In this talk, recent recoil-beta-tagging experiments intended to measure low-lying excited states in proton rich nuclei using fusion evaporation reactions at Jyvaskyla Accelerator Lab will be presented, including the physics motivation, the experimental setup and the latest results on 78Zr and 94Ag. Future experiments probing isospin symmetry will also be discussed.

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10. Peter Otto Hess (UNAM, Mexico)

    Title: **A ^{162}Dy within the Semimicroscopic algebraic model for heavy nuclei**

    Abstract: The main objective of the present contribution is to describe ^{162}Dy within the Semimicroscopic Algebraic Cluster Model for heavy nuclei (SACM-h), Intentionally using an oversimplified Hamiltonian in order to provide a clear insigt into the basic structure. I show that the important ingredients is not only the Hamiltonian but more importantly the Hilbert space, taken as the shell model space. For heavy nuclei the pseudo-SU(3) model (gSU(3)) is applied. It is shown that not only the spectrum can be excellently described, but also the B(E2) transitions can be fairly explained, reproducing the decay structure. The description does not suffer from problems present in other algebraic models. which will be discussed in more detail.

11. Oscar Díaz Rizo (Universidad de la Habana, Cuba)

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    Title: **Characterization of Cuban therapeutic and Mexican commercials peloides using nuclear and related techniques**

    Abstract: Recent experiences in the study of main Cuban natural and some Mexican commercial peloides, using nuclear and related analytical techniques are presented. The environmental analysis by means of Neutron and Gamma activation analyses, X-ray Fluorescence analysis, Low Background Gamma spectrometry and related analytical techniques, allows the evaluation of the peloid‘s quality, based on established radiological norms and values from international guidelines for sediments and cosmetic products. The study provides the scientific basis for the development of future regulations for the therapeutic use of peloides in our countries.

12. Jorge Luis Rodríguez Alejandre[1] (Universidad Michoacana de San Nicolás de Hidalgo, Mexico.)

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    Title: **Long-term Performance Evaluation of a Silicon Drift Detector for Photon Spectrometry in Medical and Nuclear Applications**

Abstract: Since its invention in 1984, the continuous improvement of the performance characteristics of the Silicon Drift Detector (SDD) has revolutionized X-ray and low-energy Gamma spectrometry as well as Electron spectrometry. Its principal advantages over the conventional photon detector are better energy resolution at high count-rates and shorter shaping times, improved performance at low photon energies, and operability at non-cryogenic temperatures. However, few or no studies hitherto exist of the long-term tracking of its spectrometric figures of merit (FOM) of performance, viz. energy resolution and sensitivity, particularly in the low energy domain, where both electronic noise (EN) and incomplete charge collection (ICC) significantly contribute to peak broadening. This work presents a detailed investigation of the FOMs of a KETEK®Peltier cooled 30 mm^2 tear-drop shaped SDD housed in the S2Picofox®(Bruker GmbH) Total Reflection X-ray Fluorescence spectrometer over a 6-year time-period, as well as its response to a large amplitude mechanical shock at the end of this period. The FWHM at the 5.9 keV peak of Mn and the detection sensitivity at the 7.5 keV peak of Ni were monitored using mono-elemental Mn and Ni standards, respectively, as well as three equivalent multi-elemental standards covering the energy range of approximately 1 – 14 keV. Additionally, the following were also analyzed: effects of count-rate and the multi-elemental matrix through the Peak to Background ratio; the deconvolution of the energy-dependent total FWHM into its statistical, EN and ICC components; the effect of source dimension on the FOMs using the Ar gas peak; the dependence of the elastically scattered Bremsstrahlung peak on the elemental composition of the sample disc. Over the 6-year period prior to the mechanical shock, the FWHM (at 5.9 keV) increased by approximately $9.0\text{x}10^{-4}$ eV per day and the P/B (at 7.5 keV) showed an erratic decline of about $4.69\text{x}10^{-2}$ per day, whilst the FOMs showed a slight degradation after the shock. No significant evidence of ICC was detected. The strict control of temperature and relative humidity of the instrument's ambient along with the periodic voltage and temperature cycling of the detector, likely contributed to this favorable outcome, which in turn highlights the robustness of the SDD to long-term operation.

13. Vinicius Antonio Bocaline Zagatto[1] (Universidade Federal Fluminense, Brazil)

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    Title: **Improved Wong Formula and Reduction of Fusion Data**

    Abstract: An improved version of the Wong formula for heavy-ion fusion is presented. The parameters of the parabolic approximation of the Coulomb barrier are replaced by parameters of the ℓ-dependent potential at an effective partial-wave. A pocket formula for this ℓ-dependence based on experimental data is given. This version reproduces the fusion cross sections of quantum mechanical calculations very well, even when the original Wong formula is invalid. The same procedure is used to derive an improved expression for the classical fusion cross section, which is very accurate at above-barrier energies. Based on this classical expression, we propose a new method to reduce fusion data in this energy range. The method is compared to experimental fusion data of stable systems. The method is then applied to perform a comparative study of complete fusion suppression in collisions of weakly bound projectiles. The study indicates that the suppression of complete fusion is essentially due to the action of nuclear breakup couplings.

14. Marco Mazzocco (University of Padova, Italy)

    Title: **Reaction Dynamics Studies at Coulomb Barrier Energies with the Facility EXOTIC at INFN-LNL**

    Abstract: Light weakly-bound Radioactive Ion Beams (RIBs) induce a larger variety of nuclear processes than standard well-bound projectiles, especially in the energy range around the Coulomb barrier, where new reaction channels open up and a strong competition between direct and compound nucleus processes is present.

The facility EXOTIC has been in operation at INFN-LNL (Italy) for more than 20 years. Light RIBs are produced by means of the in-flight technique, employing heavy-ion beams delivered by the LNL-XTU tandem accelerator impinging on a gas target. Beam selection and purification are performed using 8 ion-optical elements: a first quadrupole triplet, a 30° dipole magnet, a 1-m long Wien Filter and a second quadrupole. The double selection both on magnetic rigidity and velocity helps achieving a nearly 100-% purity, at least for RIBs produced via (p, n) charge-exchange reactions.

An overview of the experiments performed with EXOTIC to investigate the reaction dynamics induced by light RIBs at near-barrier energies will be given. In particular, the presentation will concentrate on the most recent results published for the elastic scattering and inclusive production of projectile fragments for the systems ^{7}Be + ^{208}Pb and ^{8}B + ^{208}Pb.

The facility has been recently upgraded for the conjunction to the γ-ray spectrometer AGATA (presently installed 2.68 m downstream the original focal plane of EXOTIC). A new event-by-event tracking system based on two large-area position sensitive MicroChannelPlate (MCP) detectors has been developed. The perspectives for the joint operation of EXOTIC and AGATA will be described.

15. Luis Acosta[1,2] (CSIC, Spain & UNAM, Mexico)

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Title: **Searching for good benefits from Silicon and SiC detectors: the SUGAR array and the ISRS project**

Abstract: As part of the most useful tools for nuclear studies (dynamics and structure among many other topics) the silicon detectors are without any doubt, the most practical devices to get information regarding charge particles in a tremendous large range of energies, Z and masses. Nevertheless, the different new regimes and conditions of further experiments, makes important to test the toughness of such devices: they can be subjected to particular pressures (jet targets, gas targets) and high intensity beams. The first case is searching pure reactions that needs long duration; second situation are as well long-range experiments with high current. In the present work will be presented results of the thin silicon detector behavior interacting with a jet target and the characterization of SiC detectors for nuclear physics experiments, as an alternative to measure high rates of beam current, an important situation for certain projects under construction. The case of the jet target SUGAR, will be described and also, the ISRS project for the ISOLDE nuclear reactions beam line.

16. Carlos Bertulani (Texas A&M, USA)

Title: **Nuclear Fragmentation at the Future Electron-Ion Collider**

Abstract: We study low-energy nuclear physics at the future Electron-Ion Collider (EIC) at Brookhaven. By comparing the standard theory of electron-nucleus scattering with the equivalent photon method applied to Ultraperipheral Collisions (UPC) at the Large Hadron Collider (LHC) at CERN, we extract valuable insights into both processes. In the limit of extremely high beam energies and small energy transfers, very transparent equations emerge. We apply these equations to analyze nuclear fragmentation in UPCs at the LHC and eA scattering at the EIC, demonstrating that the EIC could facilitate unique photonuclear physics studies.

17. Renato Higa (University of Sao Paulo, Brasil)

Title: **Update on radiative capture reactions with Halo/Cluster EFT**

Abstract: Solar neutrinos provide crucial information about nuclear reactions and chemical composition in the interior of the sun. They are able to put strong constraints both in refining the standard solar model and, due to the phenomenon of neutrino oscillations, in the standard model of particle physics. Dedicated detectors on earth are mostly sensitive to solar neutrinos from the reactions ^{7}Be$(p,\gamma)^8$B and ^{3}He$(\alpha,\gamma)^7$Be, which ought to be known around the respective Gamov energies $E_G \sim 20$ keV to a precision better than 3% to provide the above mentioned constraints. Since direct experiments are difficult and only limited to data much above the Gamov window, a reliable and model-independent low-energy extrapolation of data down to E_G is a necessity.

Given the predominant two-body halo structure of the ^{8}B and ^{7}Be nuclei, halo/cluster effective field theory (halo/cluster EFT) is an ideal framework to achieve the desired low-energy extrapolation of data with controlled error estimates dictated by the EFT power-counting. I will present recent developments of halo/cluster EFT with updated results for the astrophysical S factor for these two important reactions.

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18. Alfredo Estrade (Central Michigan University, USA)

Title: **Nuclear physics experiments for r-process nucleosynthesis**

Abstract: The nature and astrophysical site of the rapid neutron-capture process, which is responsible for the nucleosynthesis of roughly half oh the heavy elements in the cosmos, is one of the outstanding questions in nuclear astrophysics. The last decade the study of the r-process has seen significant break-thoughts from observational astronomy, with the identification of an r-process event by the observation of a kilonova associated with a neutron star merger and a growing sample of metal-poor stars in the galaxy where the abundance of heavy r-process elements has been measured. Encoded in the isotopic and elemental abundances of r-process isotopes is the information on the nucleosynthesis process that produced them. The challenge to decipher the mechanism and astrophysical site of the r-process is that the observational data must be compared to models sensitive to many parameters and subject to uncertainties in both the nuclear input data and models of the astrophysical site. With steady progress on the capabilities of particle accelerators and experimental techniques, such as the Facility for Rare Isotope Beams (FRIB), modern nuclear physics laboratories can now reach regions of the nuclear chart directly relevant to r-process nucleosynthesis. In this talk I will discuss recent result on measurements of nuclear masses and beta-decay properties on neutron-rich isotopes for experiments motivated by r-process nucleosynthesis, and discuss the perspective for how experiments over the next decade will significantly reduce the nuclear physics uncertainty of r-process models.

19. G.G. Rapisarda[1,2] (University of Catania, Italy)

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Title: **Investigation of the astrophysically relevant ^{19}F(p,α)^{16}O reaction via THM**

Abstract: Fluorine is one of the most interesting elements in nuclear astrophysics. Its abundance can provide important hints to constraint the stellar models since fluorine production and destruction is strictly connected to the physical conditions inside the stars. ^{19}F(p,α)^{16}O reaction is one of the fluorine burning process and the correct evaluation of its reaction rate is of pivotal importance to evaluate the fluorine abundance. Moreover, the ^{19}F(p,α)^{16}O reaction rate can have an impact on the production of elements heavier than fluorine that are observed in Population III stars. Recently, new results on the ^{19}F(p,$\alpha\gamma$)^{16}O cross section suggested a strong increase of the astrophysical factor below about 100 keV with potential astrophysical implications. In this framework, the Trojan Horse method (THM) was used to investigate the ^{19}F(p,α)^{16}O reaction cross section at energies of astrophysical interest, by extracting the quasi-free contribution to the ^{2}H(^{19}F,α^{16}O)n three-body reaction. After a brief description of the main features of the THM, an overview of the experimental results obtained for the (p,α_0) channel will be provided together with the preliminary results of the study of the (p,$\alpha\gamma$) channel.

20. Dario Lattuada[1,2] (INFN, Italy)

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Title: **Coulomb Explosion for Nuclear Astrophysics**

Abstract: The laser amplification technology has made significant strides, unlocking new paradigms in ion acceleration that can be applied to nuclear physics studies. This talk introduces a novel approach for performing in-plasma measurements of nuclear reaction cross-sections of astrophysical interest. The method relies on the interaction of high-intensity femtosecond laser pulses with a cryogenically cooled, pressurized cluster-gas target. When ionized by the laser, the resulting plasma achieves thermodynamic states resembling those found in astrophysical environments. Published data and new preliminary results on D-D fusion reactions will be discussed, highlighting their implications for stellar nucleosynthesis and future experimental designs. Ongoing developments at the INFN LNS and LNF laboratories, including advancements in target design, diagnostic techniques, and laser systems, aim to provide a unique method for studying nuclear reactions of astrophysical interest directly in plasma, ultimately expanding the frontiers of electron screening studies.

21. G. Kaminski (JINR, Russia)

Flerov Laboratory of Nuclear Reactions, JINR, Dubna, Russia

Title: **Research with light exotic nuclei at the FLNR, JINR**

Abstract: Studies of the light exotic nuclei is an important part of scientific program of Flerov Laboratory of Nuclear Reactions (JINR, Dubna, Russia). In 1996-2017 it was realized at ACCULINNA fragment separator based on U-400M accelerator. Within two decades it produced a variety of bright results for such systems as ^{4,7}H, $^{4-10}$He, ^{6}Be, ^{17}Ne, and others [1]. In 2018 the new in-flight facility for low energy 20-50 A MeV primary beams with $3 \leq Z \leq 36$ -ACCULINNA-2 - was commissioned [2]. The novel results concerning quite "problematic" lightest neutron-rich systems ^{4}n [3], ^{6}H [4], ^{7}H

[5,6], and ^{7}He [7] were obtained at ACCULINNA-2 in the recent years. In 2024 the scientific program of ACCULINNA-2 facility restarts with commissioning of U-400M accelerator after massive upgrade. Scientific opportunities for the forthcoming experimental campaign at ACCULINNA-2 are strongly enhanced by the new "heavy" equipment: radio frequency velocity filter, zero angle spectrometer, new-generation cryogenic tritium target and new detector arrays for charged particles and neutrons. The potential of light radioactive ion beam research at ACCULINNA-2 will be discussed [8].

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22. A.S. Doroshkevich[1,2,3] (JINR, Russia)

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Title: **Scientific research and applied work at the EG-5 accelerator at JINR (Dubna, Russia) in the aspect of the development of international cooperation**

Abstract: The report will consider the technical capabilities and methodological basis of the accelerator complex based on the upgraded electrostatic accelerator EG – 5 at JINR (Dubna, Russia). The scientific program of the Nuclear Physics Materials Science and Ion Beam Nanotechnology Sector of the Nuclear Physics Department of the FLNP JINR and the prospects for its development will be outlined. Key scientific results will be reported and promising directions for the development of international cooperation will be proposed. The purpose of the report is to familiarize colleagues with the work carried out at JINR using the EG-5 electrostatic accelerator and to find proposals for possible cooperation.

23. Emile Cantacuzène (IJCLab, France)

Title: **Structure beyond neutron emission threshold in nuclei of interest for r-process produced at ALTO**

Abstract: As nuclei get richer in neutron number, their $Q_{\beta^- n}$ window gets larger, allowing them to emit one to several neutrons after undergoing a β^--decay. Integrated properties linked to this process such as P_n and $T_{\frac{1}{2}}$ are important for nuclear astrophysics modeling of the r-process but also for the understanding of nuclear structure. The study of structure beyond neutron emission threshold is part of a physics program based at the ALTO facility in Orsay, France. The theoretical framework usually used to describe neutron emission after a β-decay is the Hauser-Feshbach model which is based on statistical arguments. Recent studies have shown that statistical models are not in agreement with experimental data for some nuclei near shell closures and that "doorway states"had to be taken into account. I will be presenting recent results of an experiment using the slow neutron counter TETRA [1] and a future experiment where it is planned to take advantage of the new time of flight neutron spectrometer MONSTER [2] both taking place at ALTO. Additionally, the TETRA's response function has been thoroughly studied and compared to Monte-Carlo simulations in order to retrieve new experimental information about β^--delayed neutron emission.

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24. Andrea Richard (Ohio University, USA)

    Title: **Cosmic Conundrums: Nucleosynthesis, the i-Process, and Neutron-Capture Reactions**

    Abstract: Neutron-capture nucleosynthesis occurs via a variety of processes depending on the astrophysical sites and conditions. Recent observations and stellar evolution models of carbon-enhanced metal poor stars (CEMP) and Rapidly Accreting White Dwarf stars (RAWDs) suggest that an intermediate process, known as the i-process, exists between the traditional s- and r-processes, and is necessary to explain observed abundances in these environments. i-process nucleosynthesis is impacted by various nuclear data inputs, of which the main source of uncertainty arises from neutron-capture reaction rates. Direct neutron-capture measurements are only feasible for long-lived nuclei, while for short-lived nuclei, indirect techniques are required. In this presentation, I will discuss techniques that have been developed over the last few years, and how they can be applied across the nuclear chart at facilities such as the Facility for Rare Isotope Beams, CARIBU at Argonne National Laboratory, and TRIUMF to address i-process nucleosynthesis.

25. Jason Holt (TRIUMF, Canada)

    Title: **First-principles nuclear theory for new physics searches**

    Abstract: Answers to some of the fundamental questions in nature, such as the mass of the neutrino, the nature of dark matter, or why there's an abundance of matter over antimatter in the universe, might well reside in the physics of the atomic nucleus. As the role of atomic nuclei in unraveling such mysteries continues to deepen, first-principles quantum simulations, beginning from only underlying nuclear and electroweak forces, are currently undergoing nothing short of a revolution.

    In this talk I will outline this modern, ab initio, approach to nuclear theory, spotlighting several recent milestone advances in structure/astrophysics, which now allow global, open-shell calculations as far as the ^{208}Pb region. I will then focus on how parallel developments are driving first ab initio predictions of neutrinoless double-beta decay, WIMP-nucleus scattering, symmetry-violating moments, and superallowed beta decay, with quantifiable uncertainties, for essentially all nuclei relevant in searches for new physics.

26. M. Block (Johannes Gutenberg University Mainz, Germany)

    GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany

    Helmholtz Institute Mainz, Mainz, Germany and

Johannes Gutenberg University Mainz, Mainz, Germany

Title: **Exploring the heaviest nuclei through laser spectroscopy and mass spectrometry**

Abstract: Exploring the boundaries of nuclear existence is a central focus in contemporary nuclear physics. For over 50 years, research at GSI in Darmstadt has advanced our understanding of superheavy nuclei, culminating in the discovery of six new elements. Recently, the program has expanded to include a comprehensive study of the atomic, nuclear, and chemical properties of the heaviest elements. Pioneering experiments in Penning-trap mass spectrometry and resonance ionization laser spectroscopy have yielded valuable data for elements ranging from fermium to dubnium. Accurate mass measurements have enabled the study of nuclear shell structure evolution near the $N = 152$ deformed shell gap. The high mass resolution of the mass spectrometer SHIPTRAP also facilitated investigations of longer-lived nuclear isomers with low excitation energies, specifically in nobelium, lawrencium, and rutherfordium isotopes. Additionally, isotope-shift measurements by laser spectroscopy have provided insights into changes in nuclear charge radii across a chain of fermium and nobelium isotopes. In this presentation, I will highlight key results from recent measurement campaigns at GSI, using the SHIPTRAP, RADRIS, and JetRIS setups, and discuss future directions in this exciting research field.

27. Jörn Kleemann (TU-Darmstadt, Germany)

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Title: **Investigating the Nature of the Giant Dipole Resonance through Nuclear Resonance Fluorescence Experiments**

Abstract: The giant dipole resonance (GDR) is one of the most fundamental nuclear excitations and it dominates the dipole response of all nuclei. Since its discovery in the early days of nuclear physicist has consistently attracted a great deal of attention. Its evolution from a single-humped structure in spherical nuclei to a double-humped one in deformed nuclei is considered one of the prime signatures of nuclear deformation. This phenomenon is commonly explained through the geometrical model, which depicts the GDR as an isovector oscillation of the proton against the neutron body. However, the geometrical model also makes strong predictions about the γ decay behavior of the GDR. Yet, despite decades of research on the GDR, its γ decay, though a key property of the resonance, remains poorly characterized, leaving these predictions largely untested.

To address this long-standing issue, photonuclear experiments on the γ decay of the GDR of the well-deformed nuclide ^{154}Sm and the spherical ^{140}Ce were recently conducted at the High Intensity γ-ray source (HIγS). Individual regions of the GDR were selectively excited using intense, linearly-polarized and quasi-monochromatic γ-ray beams provided by HIγS. This enabled an excitation-energy-resolved determination of the GDR's elastic and 21 + Raman γ-scattering cross sections.

The data obtained from these experiments allow for a novel close experimental assessment of the geometrical model of the GDR, in particular for ^{154}Sm with its double-humped GDR and respective K-quantum-number assignments. The findings establish γ decay of the GDR as an observable sensitive to both the structure of the resonance and the nuclear shape.

This research has been funded by the German state of Hesse's Ministry of Higher Education, Research and the Arts (HMWK) under grant No. LOEWE/2/11/519/03/04.001(0008)/62, by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) – Project-ID 499256822 – GRK 2891, by the German Federal Ministry of Education and Research (BMBF) under grant No. 05P21RDEN9, and by the U.S. Department of Energy, Office of Nuclear Physics, under grant Nos. DE-FG02-97ER41041 (UNC) and DE-FG02-97ER41033 (TUNL/Duke)

28. Shelly R. Lesher (University of Wisconsin-La Crosse, USA)

    Title: **The status of collective behavior in rare earth nuclei**

    Abstract: As basic building blocks of matter, nuclei show some emergent collective behavior across isotopic and isobaric chains and are known to be deformed in shape in regions of the chart of nuclides away from closed shell. One mode of collective behavior is the existence of vibrational degrees of freedom superimposed on rotational and is one of the open questions in nuclear structure physics today. Varying models and theories address the existence or absence of different vibrational degrees of freedom. Of great interest is the nature of 0+ states, particularly in the rare-earth region of the chart of nuclide where the 4+/2+ ratio ground state energy ratio approaches 3.3 indicating a well-deformed nucleus. In the past decades, multiple experiments have added to this discussion by observing multiple 0+ states below 2 MeV in several deformed nuclei. This talk will discuss the information known about this region, how 0+ states are identified and characterized, and what experimental information is still required to address this issue.

29. T. Zanatta-Martínez[a] (IJCLab, France)

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    Title: **Cluster structure of the ground state of light exotic nuclei beyond α clustering**

    Abstract: To investigate the cluster structure of the ground state of light neutron-rich nuclei beyond alpha-clustering an experiment was recently performed at GANIL. It focused on studying triton clustering in neutron-rich beryllium isotopes: ^{10}Be and ^{12}Be through triton (p, α) and alpha $(d, ^6\mathrm{Li})$ transfers. This experiment has been motivated by recent calculations performed in infinite nuclear matter that suggest that light clusters such as: deuterons, tritons, and helium isotopes form at low nuclear saturation densities, typically found in the surface region of nuclei. Moreover, preliminary results obtained at RIKEN may indicate significant triton formation at the surface of the halo nucleus ^{14}Be.

    The experiment was performed using the LISE fragmentation beam line of GANIL, making use of the MUGAST-EXOGAM-ZDD setup which ensure accurate measurement of charged particles and gamma-rays. In this experiment MUGAST was used to measure the energies and scattering angles of all the recoil particles (^{6,7}Li and ^{4,6}He) to allow the full kinematical reconstruction of the reactions and EXOGAM was used to infer the contribution of excited states in the lithium residues.

    The experiment is currently under analysis, its goal is to compare the measured differential cross-sections with DWBA calculations performed using microscopic and cluster wave-functions derived from models such as AMD or THSR. This ongoing analysis aims to provide quantitative insights into

triton clustering in neutron-rich beryllium isotopes. In his contribution I will present the detection setup, its performances as well as some preliminary and online results.

30. Bertis C. Rasco (ORNL, USA)

    Title: **The Many Impacts of Total Absorption Spectroscopy**

    Abstract: Total Absorption Spectroscopy is a relatively recent type of detector used in nuclear physics research and represents a change in detector philosophy, with an emphasis on maximizing detector efficiency. Total Absorption Spectroscopy was created to solve the difficult problem of measuring beta-feeding patterns in complex beta decays. Many of the complex decays are produced in nuclear reactors, where most beta-decay products (betas and gammas) create decay heat inside the reactor where understanding the balance of gamma and beta energy is needed to model nuclear reactors. Antineutrinos are also produced in these complex beta decays and they can be detected outside of the nuclear reactor. Understanding the decay energy for each decay component is paramount to understanding beta decay, and fully understanding beta decay has been and continues to be a major goal in nuclear physics. I will focus on recent results of Oak Ridge National Laboratory's Modular Total Absorption pectrometer including measuring for the first time the direct to ground-state feeding of 40K and plans for measuring beta-energy spectra.

31. Dimitra Pierroutsakou[1] (INFN - Sezione di Napoli, Italy)

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    Title: **Status of the NUMEN Construction**

    Abstract: The NUMEN project at the INFN-Laboratori Nazionali del Sud is dedicated to obtaining quantitative information on the Nuclear Matrix Elements relevant to neutrinoless double beta decay ($0\nu\beta\beta$), a promising probe to determine the Majorana or Dirac nature of neutrino and evaluate its effective mass [1,2]. This goal will be realized by measuring Double Charge Exchange (DCE) reaction cross sections induced by intense heavy-ion beams on selected isotopes that are candidates for $0\nu\beta\beta$ decay.

    The requirement for measuring extremely low DCE cross sections with high statistical significance has driven an extensive upgrade of the entire INFN-LNS infrastructure to produce heavy-ion beams with an intensity as high as 10^{13} pps [3] and of the focal plane detectors of the existing MAGNEX spectrometer [4]. A new setup for the target system and novel detectors are under development to identify and track heavy ions at an expected rate of 5.10^6 Hz at full intensity and to measure γ-rays [5].

    This presentation will provide an overview of the current status of the NUMEN project construction and highlight the latest results from various developments and characterization campaigns for nuclear targets and detectors.

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    [3] C. Agodi, et al., The NUMEN project: Toward new experiments with high intensity beams, Universe 2021 **7** (2021) 72, http://dx.doi.org/10.3390/universe7030072

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32. Fernando Silveira Navarra (University of São Paulo, Brasil)

    Title: **The $X(3872)$ to ψ(2S) yield ratio in heavy-ion collisions**

    Abstract: In this work we show how to evaluate the $X(3872)$ to $\psi(2S)$ yield ratio ($N_X/N_{\psi(2S)}$) in Pb Pb collisions, taking into account the interactions of the $\psi(2S)$ and $X(3872)$ states with light mesons in the hadron gas formed at the late stages of these collisions. We employ an effective Lagrangian approach to estimate the thermally-averaged cross sections for the production and absorption of the $\psi(2S)$ and use them in the rate equation to determine the time evolution of $N\psi(2S)$. The multiplicity of these states at the end of mixed phase is obtained from the coalescence model. The multiplicity of X(3872), treated as a bound state of $(D\bar{D}^* + c.c.)$ and also as a compact tetraquark, was already calculated in previous works. Knowing these yields, we derive predictions for the ratio $NX/N\psi(2S)$ as a function of the centrality, of the center-of-mass energy and of the charged hadron multiplicity measured at midrapidity $[dN_{ch}/d\eta(\eta < 0.5)]$. Finally, we make predictions for this ratio in Pb Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV to be measured by the ALICE Collaboration in the Run 3. This contribution is based on the paper arXiv:2401.11320 and contains more discussion on the results.

    This work was supported by Fundação de Amparo à Pesquisa do Estado de São Paulo - FAPESP, grant 2020/04867-2.

33. Osvaldo Civitarese (University of La Plata, Argentina)

    Department of Physics. University of La Plata. Argentina and IFLP-CONICET, La Plata. Argentina

    Title: **About OMC reactions and $0\nu\beta\beta$ decays**

    Abstract: A central problem in today's physics is the determination of neutrino properties, e.g; its mass and Majorana nature. The problem is just in the intersection between nuclear and particle physics, both experimental and theoretical ones. The $0\nu\beta\beta$ decay is a proper tool to extract the value of the neutrino mass. In this talk we shall discuss an alternative to fix the uncertainties attributed to the nuclear structure part of the problem and it consists of the calculation of ordinary muon capture processes leading to nuclei which participate in nuclear double beta decay chains.

34. Silvia Murillo (Triumf, Canada)

    Title: **Exciting opportunities with the GRIFFIN spectrometer at TRIUMF-ISAC**

    Abstract: The GRIFFIN spectrometer at TRIUMF-ISAC is a high-efficiency system comprised of an array of sixteen Compton-suppressed HPGe clover detectors in a $\sim 4\pi$ configuration. It also incorporates a series of state-of-the-art ancillary detector sub-systems that in conjunction with the HPGe detectors allow studies of nuclear structure, nuclear astrophysics, and fundamental symmetries. These detector suites include a set of eight $LaBr_3$(Ce) scintillators and a fast β-scintillator for fast-timing measurements, plastic scintillators for beta tagging, an array of five cryogenic lithium-drifted silicon detectors for internal conversion electron measurements and a neutron detector system for β-delayed neutron-emission studies. A number of new or upgraded ancillary detectors are coming online for GRIFFIN. In the last year, an array of eight DSSSD detectors, the Regina Cube for Multiple Particles (RCMP), was successfully commissioned for an experiment looking to study the β-delayed charged-particle emission from the proton drip-line nucleus ^{20}Mg. The latest experiments will be discussed, including a study on the first evidence of axial shape asymmetry and configuration coexistence in ^{74}Zn.

35. Kevin Lee (University of NotreDame, USA)

    Title: **Development of fIREBAll, TROPIC, and a New Target Fabrication technique**

    Abstract: The nature of 0+ states in deformed nuclei has been an open question in nuclear structure studies. This question arose from the viability of superimposed vibrations on a deformed nucleus. Experimental data needed to answer this question are transfer reaction cross sections, lifetime measurements, and E0 transitions. This talk will discuss work that has been done to improve the capability of making these measurements at the University of Notre Dame Nuclear Science Laboratory. ICEBall, a mini-orange spectrometer, has been upgraded to fIREBall for improved electron detection efficiency. A new and reliable method of fabricating pure thin metal foil targets was developed to obtain good energy resolution in the spectra. Finally, a new program, TROPIC, was created to provide a modern and efficient method to extract transition probabilities from lifetimes.

    This work was supported by the US NSF Grant PHY-2310059 and MRI Grant PHY-1919364.

36. Leonid Serkin (UNAM, Mexico)

    Co-authors: Diego Martinez-Montiel, Guy Paic and Luis Xavier Gonzalez-Mendez

    Title: **Auroras over Mexico City: detecting solar phenomena with a new cosmic ray detector**

    Abstract: Unusual auroral activity was recently observed in Mexico, coinciding with intense geomagnetic storms. These phenomena, linked to increased solar activity from solar cycle 25, rank among the most powerful geomagnetic events recorded in the past two centuries. In this talk I will present a new cosmic ray detector located at the Institute of Nuclear Sciences in Mexico City that measures the muonic component of secondary cosmic rays. Using data collected over more than a year since September 2023, we quantified fluctuations in muon data, uncovering patterns linked to solar storms. We identified variations in the pressure-corrected muon flux that exhibit a pattern similar to those observed by a neutron cosmic ray detector in Mexico City. Through extensive analysis of publicly available geomagnetic data, we correlated these variations with a phenomenon known as Forbush decreases and associated them with recent auroral activity in Mexico.

37. A.N. Trifonov[1] (JINR, Russia)

    Co-authors: S. Abou El-Azm[1], A.E. Brukva[1], V.V. Glagolev[1], M.I. Gostkin[1], U.G. Kruchonak[1], V.V. Kobets[1], M.A. Nozdrin[1], O.L. Seroshtanov[1], S.V. Svslesarev[1], V.G. Shabratov[1], D.S. Shokin[1], A.A. Ulankin[1], K.E. Yunenko[1], P.P. Zhuravlyov[1]

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    Title: **Development of the test zone for research with electron beams based on the LINAC-200 linear accelerator at the DLNP JINR**

    Abstract: Preparation of experiments at future accelerators requires the creation of new types of detectors capable of handling large loads and ensuring the required accuracy and reliability of particle registration. The development of new detectors is also important for applied research based on the use of synchrotron radiation sources and intense X-ray facilities. The ability to test detector prototypes on test beams plays a key role in achieving progress in the creation of new types of electromagnetic calorimeters and coordinate detectors for future MPD and SPD experiments at the NICA collider at JINR, photon image detectors, radiation- hardened detectors and dosimetric devices.

    The linear accelerator LINAC-200 at JINR is a new facility constructed to provide electron test beams to carry out particle detectors R&D, to perform studies of advanced methods of electron beam

diagnostics, and for applied research. The facility is based on the reconstructed MEA accelerator used at NIKHEF. The key subsystems of the accelerator were redesigned or deeply modernized.

The report presents a project for creating a test zone for research on electron beams with an energy in the range of 5–200 MeV and a maximum pulse current of up to 80 mA based on the LINAC-200 accelerator.

Abstracts Poster Session

1. A.O. Valdez-Guerrero (UNAM, Mexico)

   Co-authors: G. Reza, J. Mas-Ruiz, E. Andrade, U. Carachure, R. Gleason, A. Huerta, D.J. Marín-Lámbarri, A. Martínez, R. Espejel, R. Pérez-Damián, L.Y. Reyes, R. Rizo, S. Sandoval, C. Valencia, and E. Chávez

   Instituto de Física, UNAM. Ciudad Universitaria, Coyoacán, 04510, México.

   Title: **Development of a Fast Neutron Spectrometer: Coincidence Studies Between Plastic Scintillators**

   Abstract: The determination of the complete kinematics of two-body scattering processes and the reconstruction of fast neutron energy requires the development of equipment and techniques capable of detecting these measurements in coincidence. This work focuses on validating coincidence techniques between two plastic scintillator detectors (ND1 and ND2), each coupled to photomultiplier tubes (PMTs). These initial tests represent a critical step toward the construction of a fast neutron spectrometer, which will incorporate the MONDE-II detector, aiming to ensure the reliability of the detection system.

   Neutrons produced by an AmBe source are moderated using a paraffin tank and detected by ND1 and ND2, positioned in front of the source and at a 45-degree angle, respectively, 1 meter from the source. The detectors used are BC-408 plastic scintillators. Coincidence measurements and the Amplitude signals are simultaneously recorded with an acquisition system (CAMAC), where ND1 provides the start signal and the system trigger.

2. Alberto Acevedo-Rentería (UNAM, Mexico)

   Title: **BULLKID-DM: Searching for Dark Matter with Kinetic Inductance Detectors**

   Abstract: Detection of dark matter has proven difficult because it requires measuring nuclear recoils of a few keV, which requires very low background environments. Novel technologies and experimental methods have been developed aiming to solve the mystery of dark matter. BULLKID-DM is an experiment using silicon absorbers, where interactions are sensed by phonon-mediated kinetic inductance detectors (KIDs) made of aluminum. The experimental arrangement consists of silicon dice of $5.4\times5.4\times5$ mm^3, each with a mass of 0.34 grams. The dice are carved into a 3-inch diameter and 5-mm thick wafer, with a 0.5 mm common base holding them together. The design of the experiment allows for the enhancement of the active mass of silicon while keeping a low background due to its segmented design. BULLKID-DM will be sensitive to dark matter masses below 3 GeV/c^2 and as low as 0.4 GeV/c^2 with an energy threshold of 160 eV. The experiment will be installed in the Laboratori Nazionali del Gran Sasso, Italy, consisting of 16 wafers of 10 cm diameter, reaching a total silicon mass of 0.6 kg.

3. A. R. Rodríguez-Hernández, (UAMEX, Mexico)

   Co-authors: T. L. Belyaeva

   Universidad Autónoma del Estado de México Av. Instituto Literario 100, C. P. 50000, Toluca, Estado de México, México

   Title: **The coupling of elastic and inelastic (2^+, 1.98 MeV) channels in the $\alpha + ^{18}O$ scattering at 21.4 MeV**

   Abstract: The $\alpha + ^{18}O$ elastic and inelastic (to the 2^+, 1.98 MeV first excited state) angular distributions has been analyzed within the coupled-reaction-channels method using the code FRESCO [1]. The data at $E_{lab} = 21.4$ MeV were available from the work [2], where the nuclear optical model (OM) and the distorted wave Born approximation were used to analyze the obtained data.

The main goal of our work was to re-analyze these data and reveal a possible coupling between elastic and inelastic channels and its influence on the differential cross sections. A coupled-channel analysis of the inelastic scattering took into account the internal excitation of the target 18O nucleus to the first excited 2^+, 1.98 MeV state. A collective form factor with a deformation parameter $\beta = 0.27$ and $\beta R = 1.15$ (R=4.193 fm) for this state was accepted. The data were fit with the standard optical potential (OP) of the Woods-Saxon form found in Ref. [2], but the imaginary part of the OP was significantly reduced due to inelastic coupling.

Our analysis showed that the coupling of elastic and inelastic channels significantly influences each other, and these processes cannot be considered independently. Thus, taking into account the coupling with the inelastic channel had significant impact on the elastic cross section, allowing us to fully describe the elastic and inelastic cross sections over the entire angular range in accordance with the data. In particular, the calculated cross sections were able to explain the significant increase in the yield at large angles compared to independent elastic and inelastic calculations in good agreement with the data.

[1] I. J. Thompson, Computer Physics Reports, 7 (1988) 167–212.

[2] H. F. Lutz and S. F. Eccles, Nucl. Phys. 81 (1966) 423–432.

4. Araceli García-Flores (UNAM, Mexico)

   Co-authors: D.J.Marín-Lámbarri, E. Chávez, A. Huerta, C. Solís, and G. Ramírez-Pérez

   Title: **Iron and Nickel beams characterization by AMS**

   Abstract: The "Laboratorio Nacional de Espectrometría de Masas con Aceleradores"(LEMA) at the Institute of Physics of the National Autonomous University of Mexico (IFUNAM) consists of two mass spectrometers coupled to a 1 MV tandem accelerator [1], the first one, mainly used for ^{14}C dating and other cosmogenic isotopes; ^{10}Be, ^{26}Al, ^{129}I, ^{239}Pu and the second spectrometer belongs to the nuclear physics experimental beam line [2]. In this facility it is possible to get a highly stable, elemental and molecular ion beams with a wide range of low energies, depending on the charge state and current intensities, from nA to few μA. In the present work we present the characterization and production of Fe and Ni beams. The isotopic species for Fe and Ni were defined by charge state, energy, mass and were identified and counted one by one using the Rutherford Back Scattering (RBS) technique.

   [1] Solís C. et. al. “A new AMS facility in Mexico”. In: Nucl. Inst. and Met. in Phys. Res. B 331 (2014), p. 233. doi: https://doi.org/10.1016/j.nimb.2014.02.015.

   [2] Reza G. et. al. “Characterization of the new hybrid low-energy accelerator facility in Mexico”. In: Eur. Phys. J. Plus 134:590 (2019). doi: https://doi.org/10.1140/epjp/i2019-12950-1.

5. Arcadio Huerta (UNAM, Mexico)

   Title: **Using a Beam Profile Monitor (BPM) as Charge Integrator**

   Abstract: As part of the activities at "Laboratoriode Espectrometría de Masas con Aceleradores"(LEMA), monitoring the beam current dein the target or substrate is required and a movable Faraday cup along the line is used, and for such measurement the beam has to be blocked, making the process impractical, time consuming. A Beam Profile Monitor, was tested as charge integrator we lose time, so we tested the BPM as a charge integrator. The results are described in the present work.

6. B. Navarro Hurtado[1,2] (UAMEX, Mexico)

   Co-authors: M. Maldonado Velázquez[2], H. J. Mendoza Nava[2] and J. C. Morales Rivera[1]

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   [2]Departamento de Metrología de Radiaciones Ionizantes, Instituto Nacional de Investigaciones Nucleares, Carretera México-Toluca S/N, La Marquesa, C.P. 52750 Ocoyoacac, México

   Title: **Experimental determination of the neutron scatter contribution to the neutron reference field of the SSDL-ININ**

   Abstract: Room scattering was measured at the SSDL-ININ neutron's room, by using a calibrated ^{241}Am-Be source and a Berthold D7547 Wildbad spherical detector placed in a $10\,in$ moderator. The contribution of scattered radiation was determined through two methods: the shadow-cone method, consisting in the placement of a shadow-cone in the direct path between the source and the detector; and the semiempirical method, a mathematical formulation, based on the assumption that the scattered contribution of the neutron spectrum can be deduced from the inverse-square law. Additionally, Monte Carlo calculations were made to simulate the transport of neutrons in the room, obtaining results consistent with those experimentally.

7. Carlos Valencia (UNAM, Mexico)

   Title: **Design and construction of components and equipment for nuclear physics experiments using 3D CAD modeling parametric programs**

   Abstract: Instrumentation modeling with 3D CAD for nuclear physics experiments was performed using parametric programs such as Autodesk Inventor Professional 2025©, in particular, the following designs were made: The "LEMA EXPRESS" with two configurations, adaptation of a sample holder for analysis with PIXE, development of a collimator for the IBA chamber and a dispersion chamber for analysis in an international collaboration.

8. D. C. Robles (UNAM, Mexico)

   Co-authors: V. H. Hernández, E. Andrade and J. Cruz

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   Title: **Characterization of natural and modified zeolites using ion beam analysis techniques**

   Abstract: Zeolites are very important materials in catalysts and in industrial processes. Natural, modified and synthetic zeolites have a wide range of uses because of their good adsorption capacity and their ion exchange, molecular sieve and catalytic properties. Mexico is an important source of zeolites; however, their utilization in the natural form is limited due to the presence of impurity trace metals. For example, metals such as vanadium and chromium inhibit the elimination of hydrogen and sulfur in hydrocarbons. In this work, we report the elemental characterization of natural and modified zeolites using different ion beam techniques. Scanning Electron Microscopy coupled with Energy dispersive X-ray (SEM-EDS) is a very common technique used to obtain the major element composition of a mineral sample. However, this technique is not very sensitive to determine heavy trace element. We applied ion beam (IBA) techniques focused to measure O, C, other major elements and trace elements. RBS technique using a 3He beam was applied to measure the matrix element. A 2H beam was used as an independent determination of O and to measure the C concentration by nuclear reaction analysis (NRA). PIXE and SEM-EDX were used to measure trace element content (Mg, V, Cr, Co, Mn, Fe, Cu, Zn, Sr, Zr, Pb, etc.). X-ray diffraction (XRD) was also applied to study the zeolite materials.

9. D.L. Serrano-Juárez[a] (UNAM, Mexico)

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   Title: **X-ray production cross sections by carbon ions impact: Influence of projectile mass**

   Abstract: K X-ray production cross sections of Co, Ni, and Zn and L X-ray production cross sections of Ag due to the impact of 2.48 MeV to 3.98 MeV $^{12}C^{3+}$ and $^{13}C^{3+}$ ions were experimentally determined using the thick target and thin target approaches, respectively. Targets were irradiated with ion beams produced by the Tandetron accelerator at the Accelerator Mass Spectrometry Laboratory, Instituto de Física. It was possible to observe differences in the cross sections due to the distinct mass of the ions. Cross sections are higher for ^{12}C ions when they have the same energies as ^{13}C ions, because they penetrate more the target atom inner shells. A reduced variable v_1/v_{2s}, where v_1 is the ion velocity and v_{2s} is the (Bohr) electron orbital velocity, was considered to scale the ion energies. When the data were plotted as a function of the reduced variable, together with previously published experimental results, a single curve was obtained for all targets and both isotopes. Comparisons with several models as the ECPSSR theory [1] and the adiabatic perturbation approach [2] were also made, including corrections due to united atom [3], electron capture [4], multiple ionization [5] and molecular orbitals formation [6].

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   [6] O. Benka et al., J. Phys. Coll. 48(C9) (1987) C9-251-C9-254.

10. Diego Martinez-Montiel (UNAM, Mexico)

    Co-authors: Leonid Serkin, Guy Paic and Luis Xavier Gonzalez-Mendez

    Title: **Study of muon fluctuations and solar phenomena with a new cosmic ray detector in Mexico City.**

    Abstract: Data from a new muon detector in Mexico City have been statistically analyzed over a one-year period, from September 2023 to October 2024. Measurements were conducted using an array of scintillators at the Institute of Nuclear Sciences in Mexico City, located at an altitude of 2268 meters with geographical coordinates of 19.32°N, 99.18°W, and a cutoff rigidity of 8.24 GV. To account for fluctuations in air pressure, we calculated the barometric coefficient, averaging the data using statistical techniques, and determined it to be (-0.248 ± 0.07)% mbar^{-1}. A new muon flux was calculated, yielding 98.29 ± 0.87 ± 2.6 m^{-2} s^{-1} sr^{-1}, which is consistent with other measurements at this location. Using Mexico's regional geomagnetic-activity indices, we quantified fluctuations in the muon data, performed a geomagnetic analysis that included geomagnetically quiet periods, and identified multiple Forbush decreases during the data-taking period. Several solar storms were detected and analyzed through muon counting rates, including some intense solar storms in May and October 2024, which were related to auroral activity observed in Mexico.

11. E.A. Romero-Sánchez-del-Valle (UNAM, Mexico)

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    Instituto de Física, Universidad Nacional Autónoma de México (UNAM), C.U., Investigación Científica, Coyocán, 04510, Cd. De México, México.

    Title: **Geant4 simulations for a HPGe and $LaBr_3$ detectors**

    Abstract: The simulation of HPGe and $LaBr_3$ detectors in environments such as Geant4 enables the exploration and optimization of their response to gamma radiation without the need for extensive experimental trials. In this work, a comprehensive model of a high-purity germanium detector was developed, integrating aspects such as detailed geometry, physical interactions, and operational conditions. The results demonstrate how these simulations can be used to predict detector performance in various configurations, opening new possibilities for the design of nuclear experiments and technological applications.

12. Erika Ruíz-Martínez (UNAM, Mexico)

    Co-authors: Libertad Barrón-Palos

    Title: **Simulation ofthe Magnetic Environmentfor Neutron Electric Dipole Moment Search Using COMSOL Multiphysics®**

    Abstract: CP violation is a key focus in many experiments aimed at understanding the origin of baryonic matter, with the neutron Electric Dipole Moment (nEDM) being one of the most sought-after observables. These experiments require extremely careful shielding from external magnetic elds to ensure accurate measurements. In the nEDM@SNS experiment, a Magnetic Shield Enclosure (MSE) was developed, consisting of two layers of μ-metal and a coil system designed to compensate forthe Earth's magnetic eld at the external surface of the MSE. Using COMSOL Multiphysics®, we simulate the performance of this shielding system under real-world conditions at the experiment site. In this work, we present the results of these simulations and propose an optimization strategy aimed at minimizing magnetic eld gradients within the MSE.

13. F. Quintero-Villegas[1] (UNAM, Mexico)

    Co-authors: D. J. Marín-Lámbarri[1], Ó. E. López-López[1], E. Chavez[1], A. Huerta[1] and C. Valencia[1].

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    Title: **Detector array prototype for gamma-ray spectroscopy for nuclear physics experiments at low energies.**

    Abstract: The design and assembly of a prototype detector array for gamma-ray spectroscopy was performed at the "Laboratorio Nacional de Espectrometría de Masas con Aceleradores" (LEMA). The array was tested with the ^{nat}Mg(p, γ) nuclear reaction, the preliminary analysis of the results are presented. This was the basis for the design of a new, more robust model, to which a number of adaptations were added to improve the mobility of the experimental set-up, consisting of a metal base for transporting the lead shielding on an AW 6060 aluminum structure for Bosch profiles that will serve to move the array which will consist of a HPGe detector or a $LaBr_3$ detector. This prototype will be commissioned at LEMA for nuclear physics experiments at low energies and tested with known nuclear reactions.

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14. Frida Rojas-Hernández (UNAM, Mexico)

    Title: **Behaviour study of a plastic scintillator under untense Gamma-Ray fields**

    Abstract: BC-408 plastic scintillators can be directly exposed to radiation produced by a nuclear reactor, industrial irradiators and accelerators of different nuclear research centers where the radiation fields are intense. BC-408 withstands high radiation doses compared to other polymers. In order to know the behaviour of this material caused by radiation, it is necessary to characterize the energy supplied as a function of the absorbed dose through absorbance. In the present work, the absorption edge and the material recovery time have been measured. An increase in absorbance has been found as the dose increases and a color change that is related to a change in the photometric response and efficiency of the material. The spectrophotometric analyses were performed with the UV-VIS EVOLUTION 600 equipment to quantify the radiation damage.

15. G. Ramírez−Pérez (UNAM, Mexico)

    Co-authors: A. García−Flores, D. J. Márin−Lámbarri, E. F. Chávez, A. Huerta and C. Solís

    Title: **Radioactivity Analysis with Python**

    Abstract: The motivation of the present work is the measurement of the neutron capture cross-sections for a wide range of neutron energies in ^{9}Be, ^{13}C, ^{54,59}Fe, ^{59}Co, ^{58}Ni, ^{63,65}Cu and ^{64}Zn, with the combination of two techniques: Activation Followed by Accelerator Mass Spectrometry (AFAMS). Given that the AMS technique requires a concentration from 10^{-10} to 10^{-15} atoms, it was necessary to calculate the neutron irradiation times. At first a thermal neutron flux about 2.5 $\times$ 10^{13}n/cm^{2}s was employed in the calculations, with an energy of 25 meV, like that provided by a nuclear reactor, secondly, neutron with different energies and fluxes, like those provided by the High Flux Accelerator-Driven Neutron Facility at the University of Birmingham, United Kingdom, were employed. The activity from the different reaction products was calculated with Python using the capture cross-sections found in the literature [1,2].

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    [2] https://atom.kaeri.re.kr/old/ton/.

16. G. Reza[1,2] (UNAM, Mexico)

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    Title: **Radiocarbon dating of coastal sediments from the Yucatan Peninsula**

    Abstract: The Yucatan Peninsula in Mexico has numerous RAMSAR ecosystems that are wetlands of great interest due to their great capacity to store large amounts of organic carbon (blue carbon); a particular case are the mangroves, ecosystems studied in this work.

    To quantify carbon sequestration rates or mean sea level changes, it is necessary to know the climatological history of the site. The evolution of the coastal zone over time can be obtained from sediments, which constitute a comprehensive record of the changes that have occurred in a region over time, storing information about the environment and its variations.

Dating with radionuclides such as ^{210}Pb and ^{14}C have proven to be useful in the study of different coastal processes such as carbon sequestration rates. However, coastal ecosystems are dynamic regions that change with time and pose a challenge for dating. The carbon accumulated in the sediments can come from several sources. This may result in ages that are too old due to the presence of carbon (humic fraction) remobilized from the catchment.

This study focuses on the ^{210}Pb and ^{14}C dating of different matrix fractions of sediments to determine the origin of carbon sources. In this way we seek to know which fraction of the sediment is the one that gives us real age. The sediments used come from two sites with different geological and hydrological characteristics: Jaina, Campeche and Ría Lagartos, Yucatán. Dating with ^{210}Pb was carried out in bulk fractions, while radiocarbon dating was performed on fractions such as macrofossils, total organic matter, charcoal and humic acids, at both sites' depths below where ^{210}Pb activity was no longer detectable.

The results show that the sediment from Jaina, Campeche is very young compared to the sediment from Ría Lagartos, Yucatán. Regarding the dated fractions, it was the total organic matter and charcoal that served as age verification with the age measured with ^{210}Pb, both fractions have the potential to establish a more reliable age.

17. Hugo García Márquez (UNAM, Mexico)

    Co-authors: Roelof Bijker

    Title: **Semi-leptonic beta decay of heavy barions**

    Abstract: In this contribution, we present the values of the beta decay process considering barions with two light quarks (u,d) and one heavy charm quark (c), grouped in a sextet and an anti-triplet. The studied decay modes are classified into one among the members of the sextet, one among the members of the anti-triplet, and one between the sextet and anti-triplet.

18. J. Rodrigo Fuentes Carreón[1] (UNAM, Mexico)

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    [3] Instituto de Ciencias Nucleares, Universidad Nacional Autónoma de México (UNAM), Mexico City, Mexico.

    Title: **Characterization of thin ^{nat}Si targets**

    Abstract: The ^{26}Al isotope serves as direct evidence of stellar nucleosynthesis processes. To study the production of ^{26}Al through the ^{28}Si(d, α) reaction at energies near and below the Coulomb barrier, thin silicon targets are required. This work reports the characterization of thin silicon targets for the study of ^{26}Al production. The characterization is conducted using Rutherford Backscattering Spectrometry (RBS) with proton, ^{12}C, and ^{28}Si beams, at a scattering angle of 140° and within an energy range from 841 keV to 7105 keV. The experiment was carried out at the Nuclear Physics beamline of the National Laboratory of Accelerator Mass Spectrometry (LEMA) at the Institute of Physics, UNAM. Four targets were characterized: C11, C21, and C31, fabricated at the Institute of Materials Research (IIM-UNAM), and F11, fabricated at the Microscopy Laboratory of the Institute of Physics (IF-UNAM). The C11, C21, and C31 targets have a thickness of 10^{16} atoms/cm^2, while the F11 target has a thickness of 10^{17} atoms/cm^2, making it the most suitable for subsequent studies on ^{26}Al production.

19. J. Méndez García (UNAM, Mexico)

    Title: **Improvement of a plastic scintiilator with different coatings for Gamma-Ray detection**

    Abstract: A gamma-ray detector, composed of an organic plastic scintillator, an acrylic light guide, and a photomultiplier tube (PMT), was tested and different coating materials were used to cover the plastic scintillator to investigate its response. Organic scintillators are commonly used in a wide range of detector arrays as an active shielding in low-energy nuclear physics experiments. This scintillator will be used as an active shielding to attenuate the background radiation component. The appropriate coating will enhance photon transmission from the plastic scintillator to the photomultiplier tube.

20. J. Cruz[1] (UNAM, Mexico)

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    [3] Universidad de Guadalajara. Blvd. Marcelino García Barragán 1421, Col. Olímpica, Guadalajara, Jalisco, C. P. 44430, México

    Title: **An RBS study of the SYA phenomenon and a HEA deposited by DC magnetron sputtering**

    Abstract: In this work, the experiments were divided into two related parts. In the first, we studied a phenomenon called Sputtering Yield Amplification, SYA. This phenomenon is related to doping of a sputtering target with atoms of different atomic mass. A consequence of this is that the sputtering yield of the target increases. We present work on SYA of Si using the addition of small pieces of Cu, Mo, and Ta to the surface of the racetrack, as a function of the working gas pressure. In the second part, we studied the synthesis of a multi-element alloy by magnetron sputtering, focusing on the possibility of producing a new high entropy alloy, HEA, of CCuMoTiTa. The synthesis was carried out by adding small pieces of the different elements on the racetrack of a Ti target and we attempted to take into account any effects due to SYA. After deposition, the films were annealed for one hour at 800℃ using an Annealsys Rapid Thermal Processing (RTP) system. The thin films were analyzed in the Accelerator Mass Spectrometry Laboratory, LEMA (from the name in Spanish) of the Institute of Physics, UNAM, with the Rutherford Backscattering Spectrometry technique. In this way, we measured the total number of atoms deposited on the substrates. The results, showed significant Si SYA doped with Cu, Mo, and Ta. Those results may be interesting for materials that have both lower sputtering yield and have important applications in the thin films industry.

21. K. Y. Rojas – Hernández[1] (UNAM, Mexico)

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    Title: **Analysis of ^{10}Be in rainfall and the relationship with climatic and elemental variables**

Abstract: The analysis of ^{10}Be in rainfall is a valuable tool for studying atmospheric and climatic processes. This radioactive isotope has a relatively long half-life and is sensitive to solar activity and weather conditions. Studying ^{10}Be in precipitation allows to correlate its concentration with climatic variables such as temperature, precipitation, and cloud cover, as well as elemental factors like the chemical composition of the air and the influence of solar activity. In addition, the study of ^{10}Be will help us and serve as an indicator of changes in atmospheric circulation, helping to predict extreme weather events or changes in climate.

The analysis of ^{10}Be is primarily carried out using Accelerator Mass Spectrometry (AMS), a highly sensitive technique that allows for the detection of very low levels of ^{10}Be in rainfall samples. AMS provides precise measurements of ^{10}Be concentrations, facilitating the tracking of variations over time and their correlation with climatic and solar factors. This technique is essential for improving our understanding of past and present climate changes, as well as for predicting potential future trends.

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    Title: **Optimization of measurement time ^{210}Pb in an HPGe system for small marine sediment samples**

    Abstract: ^{210}Pb naturally occurs in small amounts in marine sediments, where its radioactive activity decreases over time due to decay. Because of its relatively short half-life, ^{210}Pb is used to date surface sediment layers (typically up to about 100-150 years old), making it particularly useful for studying recent environmental changes in the oceans, contaminant accumulation, or sediment dynamics.In marine sediment analyses, the radioactive activity of ^{210}Pb is measured at different depths to determine sedimentation rates and the age of sediment layers. This analysis can be performed using techniques such as gamma spectrometry. The main objective of this research is to establish the optimum time of analysis of ^{210}Pb in small samples of marine sediments for dating.

23. L.F. Gonzalez[1,2] (UAMEX, Mexico)

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    [2] Departamento de Aceleradores y Estudio de Materiales, Instituto Nacional de Investigaciones Nucleares

    Title: **Fusion Cross Sections for the ^{7}Li + ^{27}Al System: Fusion at Energies Around the Coulomb Barrier**

    Abstract: We report the fusion cross sections for the ^{7}Li + ^{27}Al system, measured at beam energies around the Coulomb barrier (from 8.0 MeV to 11 MeV). The experiment was performed at the Tandem Accelerator facility of ININ, Mexico. Gamma ray analysis was used to determine the presented results. This experiment is part of more extensive systematic studies, carried out by the Heavy Ions group at ININ, of reactions of ^{7}Li, ^{9}Be, $^{(10,11)}$B projectiles with ^{27}Al, ^{51}V and other targets. A comparison with predictions of fusion-evaporations codes PACE2, LILITA and CASCADE is also presented.

24. L. R. Romero[1] (UNAM, Mexico)

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Title: **Reevaluation of Pu electrodeposits for measurement of environmental samples by Accelerator Mass Spectrometry**

Abstract: A variety of isotopes of plutonium (Pu) are present in the environment due to their applications in nuclear energy, mainly as result of nuclear reactor emissions, accidents related to them and exposure from weapons testing. Since Pu is considered a tracer in environmental samples, Accelerator Mass Spectrometry (AMS) is the optimal tool for its measurement due to its high sensitivity and low uncertainty. Through the isotope ratios of Pu isotopes (^{240}Pu/^{239}Pu), valuable information can be obtained about its origin, remaining contributions, impact on human health, contamination records, variations in water quality and climatic factors, among other aspects. The present work analyzes the optimization of the Pu extraction protocol through the characterization of Pu electrodeposits and its subsequent recovery for its measurement by AMS for the opening of the line of study of this element at the National Laboratory of Mass Spectrometry with Accelerator (LEMA).

25. Luis E. Martínez Navarro (UNAM, Mexico)

Title: **In situ measurement of intense gamma radiation fields**

Abstract: This work describes the design, construction, and characterization of a plastic organic scintillator detector for the in situ measurement of intense gamma radiation fields. The detector is composed of a BC-408 plastic scintillator cylinder coupled to a PMMA optical guide, and a photomultiplier tube (PMT). The assembly of these components utilized 3D-printed parts designed for experimental coupling. Measurements were performed with optical guides of different lengths and cylindrical scintillators of different sizes using certified gamma-ray sources of various intensities and isotopes such as ^{60}Co, ^{137}Cs, and ^{241}Am. The number of counts per channel was extracted each measurement, establishing a relationship between the counting rate and size of the scintillators. An in situ measurement of an intense gamma radiation source was also performed.

26. Luis Yaid Reyes Miranda[1,2] (UNAM, Mexico)

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Title: **Characterization and Simulation of a Fast Neutron Detector**

Abstract: MONDE-II is an organic scintillator detector designed and built at IFUNAM as complementary equipment for experiments with beams from the 5.5 MV Van de Graaff accelerator (the 5.5, located in the IFUNAM tower) in basic and applied nuclear physics research. It has the ability to detect fast neutrons ($E_n > 1\,MeV$) and is position sensitive. When there is a temporal reference (coincidence or RF) it is possible to obtain complete information on the moment vector of the detected neutron. This work presents the characterization of the positional resolution of the system,

using a radioactive AmBe source. We describe the experimental device, electronics, data, their reduction and interpretation along with results and conclusions.

This work has been possible thanks to the financial support from PAPIIT-UNAM projects numbers IG102023, IG101423, IN112023.

27. M.F. Silva García[1,*] (UNAM, Mexico)

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Title: **Evaluating the possible deterioration of extremely thin silicon detectors within a gas jet target environment.**

Abstract: The SUGAR system (SUpersonic GAs jet-taRget) is a device developed at IF-UNAM, Mex- ico City and put into service since 2015. To evaluate the potential of SUGAR for the charge particle identification inside the jet chamber it is essential to perform an analysis on the energy resolution of thin silicon detectors when they are exposed to the jet in action. For this reason, in this work we present the final results obtained from the analysis of three different types of silicon detectors: Passivated Planar Implanted Silicon (thick PIPS of a 500 micron use as E detector in a telescope), a surface barrier detector (really thin one around 12 micron, use as ΔE detector in a telescope) and a Double-Sided Silicon Strip Detector (DSSSD) of a 60 micron. Detectors were tested for a number of hours inside the jet enviroment, controlling everytime the detector behavior, by using radiactive sources and their spectroscopic data. The results shown here will determine the kind of detectors and detection array for charge particles to be used inside the SUGAR chamber, for further experments, in local accelerator but also in facilities abroad.

This research is partially funded by the Projects: DGAPA-UNAM IG101423 and CONAHCyT ApoyosLNC-2023-58.

[1] Favela, J., et. al Physical Review Special Topics-Accelerators and Beams 18, 123502. (2015)

[2] Favela, J. Tesis de doctorado, Instituto de Física UNAM. (2016)

28. O. A. Rico-Trejo (UNAM, Mexico)

Co-authors: T. Yepez-Martínez, P. O. Hess, O. Civitarese.

Title: **The use of many-body methods for the calculation of meson-like spectra.**

Abstract: The study of properties for the low-energy regime of hadronic spectra is a challenging task; e.g. meson-like states require the introduction of effective degrees of freedom, a condition resulting from confinement. This work presents the results of adopting a non-perturbative scheme where quarks are treated as quasiparticles. These quasiparticles interact between them and by employing many-body techniques, we can describe a spectrum of meson-like states as a collective superposition of quasiquark-pairs followed by the calculation of their widths. The result of the calculations shows that this scheme is a suitable one to describe meson states up to energies of the order of a couple of GeV.

29. Omar Alejandro Díaz Caballero (UNAM, Mexico)

    Co-authors: Roelof Bijker

    Title: **Two Alpha plus k nucleons in the Cluster Shell**

    Abstract: This work consists of an application of the Cluster Shell Model to Beryllium, Boron and Carbon isotopes. The cluster Shell model describes the nuclei as clusters of alpha particles plus some nucleons, we focus on the cases $2\alpha + k$.In this model, Beryllium, Boron, and some Carbon isotopes have the same structure of $2\alpha-$ clusters, and differ in the number of nucleons k. Using experimental data to determine some parameters and then finding the best fit, we calculate eigenstates for the case of one or two extra nucleons. An important part of this work is to include the residual interaction for the case of two extra nuclei and the role of isospin symmetry. This nonspherical structure opens the possibilities for describing light nuclei without heavy ab initio calculations, while obtaining very good results, making this model an excellent approximation to the nuclear structure.

30. O.E. López-López (UNAM, Mexico)

    Title: **Characterization of the first 1/2+ excited state in ^{9}B through R-matrix analysis**

    Abstract: Although the ^{9}Be | ^{9}B isospin doublet has been studied along many years, the observation and prediction of the first $1/2+$ state in ^{9}B remains inconclusive. Different reactions have been used, where the experimental values oscillate between 0.80 to 1.90 MeV.

    An experiment was proposed to measure the charge exchange reaction of ^{9}Be(^{3}He,t)^{9}B at the K600 spectrometer, iThemba LABS. This experiment combines the high-resolution spectrometer (K600) at 0° and a high efficiency detector array CAKE. Data analysis is performed by reconstruction of the low-lying excitation region in ^{9}B through the momentum-analysis of the tritons, detected at the FOCAL PLANE in coincidence with the detection of the protons by CAKE.

    Future work includes R-matrix analysis, required to unambiguously identify the first $1/2+$ state in ^{9}B.

31. Rajan Anderson (UNAM, Mexico)

    Title: **Dark Matter Absorption Search with PICO Detectors**

    Abstract: The PICO collaboration has built bubble chamber detectors at the forefront of dark matter searches, and has placed world leading limits on spin-dependent dark matter. These bubble chambers, which operate by detecting bubble nucleation from particle interactions, provide a unique method for sensitive particle detection. As the parameter space of the traditional WIMP is further and further excluded there is more and more interest in exotic dark matter. Here we present limits on dark matter that absorbs onto the nuclear targets used in the PICO-60 detector. This is done using a model of dark matter already constrained by PANDA-X, CDEX and MJD, as well as in a more model independent way using non-relativistic effective field theory.

32. R. Rizo* (UNAM, Mexico)

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    Title: **A Penning Ion Source for a single-ended electrostatic accelerator**

    Abstract: We present a progress report on the commissioning of the new Ion Source of the 5.5 MV single-ended electrostatic (Van de Graaff) accelerator. The new source of the PIG kind (Penning Ion Gauge) brings the possibility of providing more intense beams and of higher energy (ions in higher charge states).

This new PIG source also ends a long and productive era with the original radiofrequency ion source, that lasted for over 30 years.

In this work we present a thorough review of the components, circuits, and voltages used by this ion source. Also, we discuss the update needed to the laser communication system (monitor and control).

Today the accelerator is back in operation. In its new configuration it will provide better support to research and development projects in, among others:

- Fundamental Nuclear Physics: structure and dynamics.
- Fundamental Physics: standard model, fundamental forces, symmetries.
- Atomic and molecular physics: mostly dynamics (ionization cross sections).
- Materials Sciences: characterization (IBA techniques), modification (Implantation).
- Nuclear technology: Materials and instruments.
- Interdisciplinary research.
- Applications.
- Services.

Additionally, the accelerator continues to contribute to the development of students in the experimental field of nuclear physics, from bachelors to PhD. An invitation to participate in upcoming projects is open to all interested, contact the authors.

This work was possible thanks to the financial support from CONAHCYT through contract number "ApoyosLNC-2023-58" and from UNAM-PAPIIT through contracts numbers IG101016, IG101120 and IG102023".

33. Rodrigo Córdoba Mendoza[2] (UNAM, Mexico)

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[2]Facultad de Ciencias, UNAM, Código Postal 04510 Coyoacán, Ciudad de México, México.

Title: **Gamma Scanning: radiodiagnosis of oil refinery towers**

Abstract: In Mexico, oil extraction is a fundamental part of its economy, that is why oil refinery towers are still in use, and in order to operate under the required quality standards, they need a meticulous and efficient maintenance; then, the use of the "gamma scanning" technique is proposed to study the profile of the refinery pipes, being this an accurate and non-invasive diagnosis.

In this work, the CAD model of the device and the first studies of a gamma scanner prototype are presented. The results of the calibration in efficiency of the source-detector system, varying the distance using a NaI detector and a ^{137}Cs point source, are shown and compared with the Monte Carlo simulation.

34. S. Gómez-Rivera[1,2] (UAMEX, Mexico)

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Title: **Role of absorption inside the barrier for different weakly bound systems**

Abstract: An analysis of the effects of the very short-range potential Wint, included in the Extended Optical Model Framework (EOM), has been carried out in this investigation. This study is focused on the analysis of the elastic scattering experimental data for several weakly bound systems, namely ^{6}He + ^{64}Zn, ^{9}Be + ^{28}Si, ^{14}N + ^{9}Be and ^{9}Be + ^{12}C. This approach also includes the nuclear potential calculated with the SPP (São Paulo Potential), the Coulomb and two polarization potentials describing the effects of direct and fusion reactions over the elastic scattering.

First, the geometric parameters were obtained for the direct reaction polarization potential. Once we obtained these geometric parameters, the optimization of the strength parameters was carried out for both polarization potentials using the code Sfresco. The parametrization must reproduce the elastic scattering experimental data, fusion cross sections and satisfy the dispersion relation.

The influence of this absorptive potential Wint has been described from the point of view of Angular Distributions (where different strengths of the absorptive potential reproduce oscillations of the differential elastic scattering cross section mainly at medium and large angles) and reflection coefficients for each partial wave. Finally, we have included a semiclassical approximation for the deflection function in order to provide information about the oscillatory behavior of the angular distribution in terms of each partial wave.

35. U. Carachure* (UNAM, Mexico)

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    Title: **Optical remote-control system for the single-ended 5.5 MV electrostatic accelerator at IFUNAM.**

    Abstract: In this work we present an option to replace the pulley-string mechanical system used to remotely control the ion source at the high voltage terminal of a single ended electrostatic accelerator with an optical system based on a simple laser emitter and receiver.

    We developed this system to monitor a Radiofrequency ion source and later we further developed to monitor and control a “Penning” ion source.

    This work was possible thanks to the financial support from CONAHCYT through contract number “ApoyosLNC-2023-58” and from UNAM-PAPIIT through contracts numbers IG101016, IG101120 and IG102023".

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    Title: **Characterization of natural and modified zeolites using ion beam analysis techniques**

    Abstract: Zeolites are very important materials in catalysts and in industrial processes. Natural, modified and synthetic zeolites have a wide range of uses because of their good adsorption capacity and their ion exchange, molecular sieve and catalytic properties. Mexico is an important source of zeolites; however, their utilization in the natural form is limited due to the presence of impurity trace metals. For example, metals such as vanadium and chromium inhibit the elimination of hydrogen and sulfur in hydrocarbons. In this work, we report the elemental characterization of natural and modified zeolites using different ion beam techniques. Scanning Electron Microscopy coupled with Energy dispersive X-ray (SEM-EDS) is a very common technique used to obtain the major element

composition of a mineral sample. However, this technique is not very sensitive to determine heavy trace element. We applied ion beam (IBA) techniques focused to measure O, C, other major elements and trace elements. RBS technique using a 3He beam was applied to measure the matrix element. A 2H beam was used as an independent determination of O and to measure the C concentration by nuclear reaction analysis (NRA). PIXE and SEM-EDX were used to measure trace element content (Mg, V, Cr, Co, Mn, Fe, Cu, Zn, Sr, Zr, Pb, etc.). X-ray diffraction (XRD) was also applied to study the zeolite materials.

37. X. A. Mendoza-Arriaga[1] (UAMEX, Mexico)

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[2]Departamento de Aceleradores y Estudio de Materiales, Instituto Nacional de Investigaciones Nucleares

Title: **Experimental elastic scattering analysis for the ^{6}Li+^{27}Al system: looking for the BTA phenomenon**

Abstract: In this study, we present both theoretical and experimental analyses of the elastic scattering angular distributions for the ^{27}Al(^{6}Li,^{6}Li) system. The experiment was conducted at the Tandem Accelerator of the Instituto Nacional de Investigaciones Nucleares (ININ) in Mexico, utilizing beam energies of 8.5, 9.0, and 10.0 MeV. The elastic scattering angular distributions were calculated using the FRESCO code, employing the São Paulo and Woods-Saxon form factor potentials. These theoretical calculations were then compared with our experimental data. The results are in good agreement with previously reported energies for the same system. Furthermore, the Breakup Threshold Anomaly (BTA) was studied to elucidate its effects at low energies.

38. Yendali Viridiana Fajardo Zavala (UNAM, Mexico)

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Title: **Characterization for a $LaBr_3$ Detector**

Abstract: A $LaBr_3$(Ce) detector (38×38 mm in diameter and length) was characterized. The goal was to described its performance for gamma-ray spectroscopy. The operational voltage range was established between 400-700 V, with the optimal resolution of 3% at 662 keV from a ^{137}Cs source achieved at 600 V. Laboratory background radiation was measured under two conditions: with the detector unshielded and shielded by a 1 cm thick Pb layer, demonstrating the shielding's effectiveness in background. Gamma-ray spectra for certified ^{137}Cs and ^{60}Co sources were acquired, enabling the calibration of the detector's energy response. The calibration confirmed the detector's capability to resolve key gamma-ray energies with high precision. These results highlight the $LaBr_3$(Ce) detector's potential for applications requiring accurate gamma-ray detection and energy resolution.