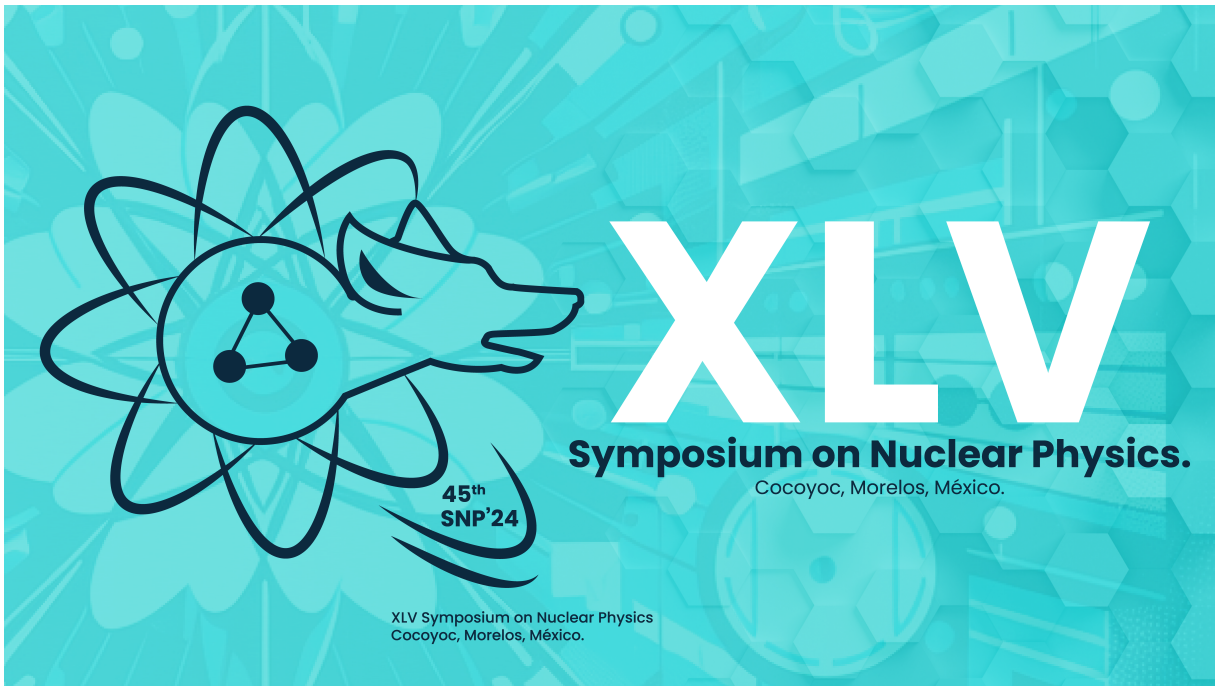

XLV Symposium on Nuclear Physics, January 8-11 2024

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Abstracts Invited Talks

1. **Luis Acosta**

   Instituto de Física, UNAM and Instituto de Estructura de la Materia, CSIC, Spain

   Title: **Recent approaches for the study of weakly bound nuclei dynamics at barrier energies**

   Abstract: The developing of technology regarding beam production, charge particle detection and data acquisition systems is allowing to revisit some reactions involving weakly bound nuclei. During the last 6 years, we have developed a number of experiments in different laboratories involving reactions with weakly bound nuclei, mostly halo nuclei, impinging in medium mass and heavy targets at energies in the vicinity of Coulomb barrier. For several years, the analysis of this kind of reaction has shown a degree of differences in the elastic scattering comparing with stable similar nuclei in the same conditions. Moreover, the reaction products have shown in particular cases, the preference to follow not always the same process, when the reaction is measured in a wide angular range. Thus, nuclei as 6He shown a particular behaviour, depending on the angular region; very preliminary evidence shows a similar situation for 15C products. The global conclusion shows that, not all the halos follow the same behaviour when their dynamics is tested at barrier energies. In the present work, recent results regarding such nuclei and other recent visited cases will be presented, as well as a brief description of the instrumentation developed for such studies.

2. **Héctor Alva-Sánchez**

   Instituto de Física, UNAM

   Title: **Understanding the intrinsic radiation in PET scanner detectors**

   Abstract: Inorganic crystals coupled to photodetectors still is the current detector technology in nuclear medicine imaging equipment. To date, most positron emission tomography (PET) scanners use lutetium oxyorthosilicate (LSO) or lutetium yttrium oxyorthosilicate (LYSO) as the scintillator material of choice owing to is convenient physical characteristics for annihilation photon detection, including its high physical density, effective atomic number, and light yield, together with a short decay time. However, lutetium-based scintillators contain a small amount of ^{176}Lu, which decays via beta minus to ^{176}Hf excited states, followed by the emission of prompt gamma rays and internal conversion electrons. The self-detection of these particles results in a background count rate of approximately 300 cps per cm^3, which produces a characteristic energy spectrum, whose structure depends on crystal size and shape. At the Laboratorio de Imágenes Biomédicas of the Instituto de Física, UNAM, we developed a model to explain the structure as a function of the volume-to-surface-area ratio of the crystal being used. The accuracy of the model has been confirmed experimentally and verified with Monte Carlo simulations. Considered previously as a nuisance, the intrinsic radiation can now be conveniently used for energy calibration and monitoring of PET detectors without the need of external radiation sources.

3. **Ani Aprahamian**

University of Notre Dame, USA

Title: **Were the superheavy elements made in space?**

Abstract: Nuclei and nuclear processes began shaping our universe a few minutes after the Big Bang until the present epoch. From the beginning of the cosmos until the present epoch, they have governed the birth, life, and death of stars. The chemical evolution of our universe in elements and isotopes that we observe today require multiple nucleosynthesis sites, ranging from the very slow and gradual processes in stars to the rapid formation of elements in cataclysmic stellar explosions. The heavy elements beyond Fe are thought to be made by both slow (s-) and rapid (r-) neutron capture processes. While the site of the s-process has been well explored, the site of the r-process had remained a challenge. A recent detection of gravitational waves – GW170817 – along with 70 electromagnetic transients identified the merging of neutron stars as a potential site for the r-process and hence the origin of the heavy element production in the universe. The light emitted as nucleosynthesis was taking place, indicated the synthesis of the elements up to the lanthanides and possibly beyond. These observations verified a decades-old predicted site for the origin of the heavy elements, opened new windows to the universe that also posed new challenges for nuclear physics.

1. Were the superheavy elements created in nature perhaps by the r-process?

2. What is the role of fission in the r-process and hence the chemical evolution of the universe?

This work is supported by the US NSF.

4. **Melina Ávila Coronado**

ANL, USA

Title: **Direct Measurements of α-Induced Reactions and their Implications in Nuclear Astrophysics**

Abstract: Several α-induced reactions on both stable and radioactive isotopes play a crucial role in nuclear astrophysics. Notably, certain α-induced reactions contribute significantly to the nucleosynthesis of the lightest elements in the rapid neutron-capture process (r-process) within neutrino-driven winds post a core collapse supernova. Additionally, some α-induced reactions are known to play a crucial role in X-ray bursts nucleosynthesis. Direct measurements of these reactions at relevant astrophysical energies pose significant experimental challenges. This is mainly due to the inherently small cross sections and the complexities associated with handling low-intensity radioactive beams essential for their study. Consequently, many of these reaction rates remains unknown. Nevertheless, recent advancements in the capabilities of radioactive ion beam facilities and experimental techniques have created new opportunities for exploring these astrophysically important reactions. In this presentation I will review recent experimental efforts and discuss the promising future possibilities for measuring these reactions.

This material is based upon work supported by the U.S. Department of Energy, Office of Science, Office of Nuclear Physics, under contract number DE-AC02-06CH11357. This research used resources of ANL's ATLAS facility, which is a DOE Office of Science User Facility.

5. **Libertad Barrón Palos**

   Instituto de Física, UNAM

   Title: **Fundamental Neutron Physics**

   Abstract: Low-energy neutros are neutrons at present being used in different experimental studies that tackle some enigmas of contemporary physics like symmetries and their role in understanding fundamental interactions and the baryon asymmetry. In this talk I will give an overview on parity and time reversal studies using neutrons.

6. **Roelof Bijker**

   Instituto de Ciencias Nucleares, UNAM

   Title: **On β- and γ-bands in deformed nuclei**

   Abstract: The study of one- and multi-phonon excitations in collective deformed nuclei continues to be a subject of much interest in nuclear structure. In this presentation I discuss the properties of β- and γ-vibrations in deformed nuclei in the framework of the IBM. The present work is an extension of a study in the rotational limit of the IBM [1,2] to the so-called consistent Q-formalism in which the same form of the quadrupole operator is used in the Hamiltonian and in the description of quadrupole transitions. The Hamiltonian in the consistent-Q formalism exhibits a first-order quantum-phase transition between a spherical and a deformed phase. It is found that for almost the entire parameter range the intrinsic energy of the β-vibration is larger than that of the γ-vibration, and that $\gamma \rightarrow g$ transitions are larger than $\beta \rightarrow g$ transitions. The consistent-Q formalism can account simultaneously for the ratio of the intrinsic energies of the β- and γ-bands in ^{162}Dy as well as the dominance of $\gamma \rightarrow g$ over $\beta \rightarrow g$ transitions observed in the same nucleus [3].

   [1] R. Bijker and A.E.L. Dieperink, Phys. Rev. C **26**, 2688 (1982).

   [2] D.D. Warner and R.F. Casten, Phys. Rev. C **26**, 2690 (1982).

   [3] A. Aprahamian, J. Phys. Conf. Ser. **2619**, 012005 (2023).

7. **Maxime Brodeur**

   University of Notre Dame, USA

   Title: **The Superallowed Transition Beta-Neutrino Decay Ion Coincidence Trap**

   Abstract: Nuclear beta decays provide a unique avenue for testing the electroweak part of the Standard Model through precision measurements. Physics beyond the Standard Model would manifest itself in these transitions through a variety of possible effects including a non-unitarity of the Cabibbo-Kobayashi-Maskawa quark mixing matrix, scalar or tensor currents, and interactions involving right-handed neutrinos. Probing these various effects in superallowed mixed beta decay transitions can be done through precision measurement of the beta-neutrino angular correlation parameter. As such, we are currently constructing at the Nuclear Science Laboratory of the University of Notre Dame the Superallowed Transition Beta-Neutrino Decay Ion Coincidence Trap (St. Benedict). St. Benedict will take radioactive ion beam produced by TwinSol, thermalize it in a large volume gas cell, then transport it in two separate differentially-pumped volumes using a radio-frequency (RF) carpet and a radio-frequency quadrupole (RFQ) ion guide before injecting it in an RFQ trap to create cool ion bunches for injection in the measurement Paul trap. The status on the St. Benedict development will be presented. This work is supported by the US National Science Foundation.

8. **Osvaldo Civitarese**

   University of La Plata, Argentina

   Title: **Collective description of single and double charge exchange reactions**

   Abstract: We review the formalism to describe Charge-Exchange processes in the eikonal approximation, both as one and two step processes. the target nucleus is described within the RPA (or TDA), and the projectile by the shell model. As an example, the formalism is used to describe DCX reactions on targets which are near close-shells, in order to identify the relevant degrees of freedom.

9. **Waleed A. Abuhani[1], Vijay Raj Sharma[2], Luis Manuel Villaseñor Cendejas[3] and Nabanita Dasgupta-Schubert[4]**

   [1] Alghad International Colleges for Applied Medical Science, Al Madinah, Saudi Arabia
   [2] University of Maryland, USA
   [3] Benemérita Universidad Autónoma de Puebla, Puebla
   [4] Universidad Michoacana de San Nicolás de Hidalgo, Morelia

   Title: **Heavy elements of the 5th to 7th periods in the fumarolic microecology of the Los Azufres (Mexico) volcanic complex: clues to deep-earth radioactivity?**

   Abstract: We report the use of the nuclear analytical technique of Polarized Energy Dispersive X-ray Fluorescence (PEDXRF) spectrometry as well as Inductively Coupled Plasma Atomic Emission spectrometry (ICP-AES) and Neutron Activation Analysis, to determine the concentration profiles of selected heavy elements of the 5th, 6th and 7th periods of the Periodic Table, in the biogeochemical niches of 3 geo and hydrothermal sites at the Los Azufres volcanic complex of Mexico. The elemental distributions are the result of the deposition by the fumarolic vapours of elements carried up from the Earth´s mantle to the surface. Relatively high concentrations of some otherwise rare elements, the Th/U ratio and the marked variations of these with location, were observed. The geoneutrino determinations by the Borexino and KamLAND geoneutrino experiments indicate that more than half the total heat generated by the earth´s core is radiogenic in origin. They also cite the need for a better estimate of the global Th/U ratio of the mantle. Our results are discussed in the light of this evidence of residual deep-earth radioactivity with speculation on the role of the spontaneous fission mode of decay of ^{238}U in rare element enrichment.

10. **Alfredo Galindo-Uribarri**

    ORNL, USA

    Title: **Final results of PROSPECT-I Reactor Antineutrino Experiment and future of the neutrino program at ORNL**

    The discovery of the neutrino stands as a pivotal milestone in the annals of modern physics. PROSPECT is a reactor antineutrino experiment consisting of a 4-ton liquid scintillator antineutrino detector divided into an 11x14 array of optically separated segments. The detector was designed to probe the existence of sterile neutrino oscillations and precisely measure the antineutrino spectrum resulting from U-235 fission. Data was taken in 2018 and 2019 with a first-generation detector called PROSPECT-I located on the Earth's surface roughly 7 m from the 85 MW, compact, highly-enriched High Flux Isotope Reactor at Oak Ridge National Laboratory. This dataset has already had a substantial impact by placing stringent limits on sterile neutrino oscillations at the eV scale, providing a precision U-235 spectral measurement, and demonstrating unique neutrino detection capabilities. A new analysis of the PROSPECT-I data has been performed, incorporating innovative event selection tools, resulting in a multi-period dataset marked by a significant enhancement in statistical power and improved signal-to-background ratios. This presentation will report the final results of the measurement of the antineutrino energy spectrum from the fission of U-235, as well as the ongoing efforts for a final search for eV scale sterile neutrino oscillations using the PROSPECT-I data set. I will also discuss future directions of the neutrino program at ORNL.

11. **Ronald García**

    MIT, USA

    Title: **Radioactive Molecules for Nuclear Science**

    Abstract: A precise understanding of the interactions between the atomic nucleus and its bound electrons enables the exploration of physical phenomena across a broad spectrum of energy scales. Molecules that contain nuclei with extreme proton-to-neutron ratios can be artificially created to amplify and study specific nuclear phenomena. Consequently, precision measurements of these systems can yield unique and complementary insights into the properties of the atomic nucleus, nuclear matter, and the fundamental particles and forces that govern nature.

    In this talk, I will highlight recent advancements and share perspectives from laser spectroscopy experiments of these exotic species. Additionally, I will discuss the relevance of these experiments in addressing open problems in nuclear and particle physics.

12. **Hugo García Tecocoatzi**

INFN, Genova, Italy

Title: **Heavy Baryons and new Interacting Boson Fermion Fermion Model results**

Abstract: In this talk, I will present a new application of the Interacting Boson Model (IBM) and its extensions for describing double charge exchange reactions. The study of double charge exchange reactions induced by heavy ions involving candidate nuclei for neutrinoless double beta decay is a complex task carried out by the NUMEN collaboration [1]. This investigation faces the intricacies of complex odd-odd intermediate nuclei in sequential charge exchange processes. I will offer a comprehensive description of heavy odd-odd nuclei using the Interacting Boson Fermion-Fermion Model (IBFFM). Additionally, I will outline the methodology for describing transfer operators within this framework. Finally, I will explore the potential applications of our results for describing double charge exchange reactions.

[1] F. Cappuzzello *et al.*, Prog. Part. Nucl. Phys. **128**, 103999 (2023).

13. **Arturo Gómez Camacho**

ININ, Edomex

Title: **Effect of breakup fragments of the weakly bound projectile 8B on fusion in reactions with several targets**

Abstract: A systematic study is presented on the effect of breakup fragments of the weakly bound projectile ^{8}B on total, complete and incomplete fusion for reactions with targets ^{16}O, ^{27}Al, ^{28}Si, ^{58}Ni, ^{208}Pb and ^{209}Bi. Particular attention is given to the relative effect on incomplete fusion of the projectile fragments, proton and ^{7}Be of ^{8}B. The energy dependent contributions to incomplete fusion of these fragments show a very interesting behavior when targets of different mass and charge are considered. The incomplete fusion from proton absorption becomes more important than that of ^{7}Be for light targets and for incident energies around and above the barrier. However, the inverse occurs for heavy targets. Also, comparative calculations of fusion are presented for the targets ^{27}Al, ^{28}Si, ^{208}Pb and ^{209}Bi. In this way, the effect of an additional proton to the nuclear potential of the target is determined. The calculations are performed with two different methods. The CDCC to determine the relative projectile-target radial wave functions and subsequently, the angular momentum-dependent model of fusion probabilities to calculate complete, incomplete and total fusion.

14. **B. Gongora-Servin[a,b], T. Marchi[a], D. Tagnani[c], A. Caletano[d], A. Goasduff[a], J.J. Valiente-Dobon[a], P. Aguilera[e], R. Bolzonella[b], M. Balogh[a], D. Brugnara[a], A. Ertoprak[a], F. Galtarossa[e], I. Lombardo[g], D. Mengoni[e,f], J. Pellumaj[a,b], R.M. Perez-Vidal[a,h], S. Pigliapoco[e,f], E. Pilotto[e,f], M. Polettini[e], L. Redigolo[g], M. Rossi[f], M. Sedlak[a], S. Valdre'[i], M. Vigilante[j], L. Zago[a,f], S. Carturan[a], P. Cocconi[a], A. Cogo[a], A. Gambalonga[a], D. Rosso[a], V. Volpe[a].**

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[b] Università degli Studi di Ferrara, Ferrara, Italy
[c] INFN, Sezione di Roma Tree, Roma, Italy
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[e] INFN, Sezione di Padova, Padova, Italy
[f] Università degli Studi di Padova, Padova, Italy
[g] INFN, Sezione di Catania, Catania, Italy
[h] Instituto de Física Corpuscular, Valencia, Spain
[i] INFN, Sezione di Firenze, Firenze, Italy
[j] INFN Università di Napoli Federico II e INFN Sezione di Napoli, Napoli, Italy

Title: **Searching for the anomalous internal pair creation in ^{8}Be**

Abstract: In 2016, Krasznahorkay et al. published the breakthrough of an anomaly in the Internal Pair Creation (IPC) in ^{8}Be [1]. Unexpected angular correlation distributions in the emission of the pair e^+e^- was found in the isoscalar magnetic dipole transition (18.15 MeV state ($J^\pi = 1^+$, T=1) $\rightarrow$ ground state ($J^\pi = 0^+$, T=0)). According to the model of Rose for a 17 MeV transition [2,3], the angular correlation distribution drops quickly with the relative emission angle of the leptons. In contrast, the Hungarian group reported a peak-like behavior at large angles [1]. This result was interpreted as the signature of the emission of a previously unknown neutral isoscalar particle with a mass of 16.70±0.35(stat)±0.5(syst) MeV/c^2 and $J^\pi = 1^+$.

At the Laboratori Nazionale di Legnaro (Istituto Nazionale di Fisica Nucleare, Italy), a dedicated array to detect leptons coming from IPC was designed and built [4]. The project aims to measure the angular correlation distribution of the emission of the pair e^+e^- from the transition studied in ^{8}Be at Atomki Laboratories. The material used in the manufacturing of the detectors is the plastic scintillator EJ200. The in-beam commissioning of the setup demonstrated that the array is able to measure leptons with energies higher than 10 MeV and to detect the incident position of the particles in the front face of the detector. On the other hand, the Geant4 simulation is consistent with the experimental data and the angular correlation distribution of the IPC of the transition $0^+ \rightarrow 0^+$ in ^{16}O was obtained. This transition is used as a calibration point, since the cross-section is order of magnitudes higher than the one in ^{8}Be. A new method to study the lepton correlation was development and tested, showing important results in the coincidence detection analysis of the pair emitted. During the end of November and beginning of December, the first complete experiment has been carried out at the AN2000 Accelerator. LiF targets from 50-950 μm/cm^2 were irradiated with a 1.09 MeV proton beam and a 500 nA current. The population of the state of interest and the integrity of the target was monitoring with four $LaBr_3$ detectors.

[1] A.J. Krasznahorkay et al., Phys. Rev. Lett., 116:7, 2016.

[2] M.E. Rose, Phys. Rev., 76:678, 1949.

[3] M.E. Rose, Phys. Rev., 78:184, 1950.

[4] B. Gongora-Servin et al., Annual Report 2022, LNL-INFN, page 49, 2023.

15. **Erika Holmbeck**

Carnegie Institution for Science, USA

Title: **The Fission Fragments in Our Stars**

Abstract: The rapid neutron capture ("r") process is able to access the heaviest elements on and possibly beyond the periodic table. These massive elements are expected to undergo fission, though such heavy elements are poorly understood, if not inaccessible to modern experimental techniques. Meanwhile, without experimental data, theoretical models of these elements remain unconstrained. In this talk, I present an alternative piece of evidence that may be used to understand the behavior of heavy, fissile elements: the abundance patterns of metal-poor stars. Metal-poor stars encode the nucleosynthetic history of r-process events in the distant past, including possibly the earliest supernovae and neutron star mergers. We have found correlations of overabundances of r-process elements in these abundance patterns between elements with mass numbers $A = 99 - 110$ and those with $A > 150$ (but not $A = 110 - 150$). I will discuss how we believe these overabundances are indicative of two primary fission fragments of transuranium elements with $A > 260$ that are produced in r-process events and how metal-poor stars provide invaluable constraints on both theoretical and experimental data. However, stars are not the only astronomical sources of heavy-element data; I will also discuss a possible method of detecting the presence of transuranic elements in the kilonovae that proceed neutron star merger events. Between quiescent stars, multi-messenger observations, current theoretical models, and upcoming experiments, we may be able to understand properties of the most exotic nuclei that may exist in nature.

16. **Jason Holt**

Triumf, Canada

Title: **Global ab initio calculations for the structure of exotic and heavy nuclei**

Abstract: Breakthroughs in our treatment of the many-body problem and nuclear forces are rapidly transforming modern nuclear theory into a true first-principles discipline. This allows us to address some of the most exciting questions at the frontiers of nuclear structure and physics beyond the standard model.

In this talk I will briefly outline our many-body approach, the valence-space in-medium similarity renormalization group, and how recent advances now allow for global converged calculations of open-shell nuclei to the ^{208}Pb region and beyond. I will focus on key topics in nuclear structure such as predictions of the proton and neutron driplines and evolution of magic numbers throughout the light and medium-mass regions, including new insights on the nature and existence of ^{28}O including continuum degrees of freedom. In addition, I will discuss how correlation of the neutron skin and dipole polarizability in heavy nuclei to ^{208}Pb provide first ab initio constraints on symmetry energy parameters for determining neutron star properties as well as opening paths to predictive nuclear theory for new physics searches.

17. **David Jenkins[1], P. Adsley[2], S. Courtin[3] and M. Heine[3]**

[1] York, UK
[2] Texas A&M, USA
[3] Strasbourg, France

Title: **Extending the Hoyle-state paradigm to ^{12}C+^{12}C fusion**

Abstract: Carbon burning is a key step in the evolution of massive stars, Type 1a supernovae and superbursts in x-ray binary systems. Nevertheless, our understanding of this critical fusion reaction is not as complete as might be desirable to fully constrain astrophysical models. This limitation centres of the difficulty in determining the ^{12}C+^{12}C fusion cross section at energies corresponding to the Gamow window for these different scenarios as it relies on extrapolation of direct measurements made at higher energies. Such direct fusion measurements are complicated by the presence of resonances at and below the Coulomb barrier. These resonances have traditionally been associated with the formation of short-lived molecular states based on ^{12}C+^{12}C or similar alpha-conjugate systems. Despite study of these resonances over many years, a comprehensive theoretical model accounting for their existence and structure is presently lacking.

Given the difficulties associated with direct fusion studies of the ^{12}C+^{12}C reaction, indirect studies which can identify potential resonances within the respective Gamow windows are of high value. In this respect, a study of the ^{24}Mg(α,α')^{24}Mg reaction has identified several 0^+ states in ^{24}Mg, close to the ^{12}C+^{12}C threshold, which predominantly decay to ^{20}Ne(ground state) + α [1]. Not only were these states newly identified but surprisingly they were not observed in previously well-studied ^{20}Ne(α,α_0)^{20}Ne resonance scattering, potentially suggesting that they have a dominant ^{12}C+^{12}C cluster structure. Given the very low angular momentum associated with sub-barrier fusion, these states, which sit in the Gamow window for massive stars, may play a decisive role in ^{12}C+^{12}C fusion. We present estimates of updated ^{12}C+^{12}C fusion reaction rates based on likely parameters for such resonances [1].

A fascinating aspect of the identification of these potential 0^+ cluster states in ^{24}Mg close to the break-up threshold for ^{12}C+^{12}C and similar channels such as ^{16}O+^{8}Be is the circumstantial similarity to the situation in ^{12}C with the Hoyle state at the break-up threshold and the critical role that it plays in in helium burning.

[1] P. Adsley, M. Heine, D.G. Jenkins *et al.* Phys. Rev. Lett. **129**, 102701 (2022).

18. **Kanchan Khemchandani**

Universidade Federal de São Paulo, Brazil

Title: **Intriguing aspects of light baryon resonances**

Abstract: In this talk I discuss how the properties of some baryon resonances are related to each other. Specific is the case of $N*(1890)$, which lies close to the threshold of kaon-light hyperon resonances. Due to such properties, $N*(1890)$ decays to $K\Lambda(1405)$ with branching ratio which is comparable to πN. Thus, photoproduction of light hyperon resonances can be used as a source of information on this nucleon resonance. I will also discuss that the description of the properties of $N*(1890)$ as well as light hyperon resonances essentially requires the consideration of meson-baryon dynamics.

19. **Marco La Cognata**

LNS, INFN, Italy

Title: **Using indirect methods to explore low-energy fusion cross sections in nuclear astrophysics**

Abstract:

20. **Roberto Linares**

Instituto de Física, Universidade Federal Fluminense, Brazil

Title: **Nucleon-nucleon correlations in transfer reactions induced by heavy ions**

The atomic nucleus is a system of highly interacting nucleons within a tiny volume and the interactions between them are important to understand the static properties observed throughout the nuclide chart. One key component of the nucleon-nucleon (NN) interaction is pair correlation between two nucleons. This feature leads to the characteristic $J^\pi = 0^+$ of the nuclear ground state of all even-even nuclei and the characteristic odd-even staggering in the binding energies of nuclei.

At short distances and high energies, the pair correlations are slightly different for nn, pp and pn. On a fundamental basis, differences arise from the up and down quark masses. However, at ordinary nuclear densities as in atomic nuclei and neglecting the electric forces and mass differences between proton and neutron, it is often assumed that pair interactions are nearly similar between the pp, nn and pn pairs. This leads to the concept of charge symmetry of the nuclear forces that holds at low-energy nuclear physics.

Two-nucleon transfer reactions allow us to investigate the properties of pair strength. Nevertheless, experimental information is scarce for the pp and pn sectors due to typical low detection efficiency for neutron ejectiles, as in the (^{3}He,n) reactions, for instance.

In this talk I will show that transfers induced by heavy ions offer a unique scenario to treat nn, pp and pn pair transfers on the same theoretical footing. In transfer reactions, the basic idea is that transfer cross sections are related to the pair strength. However, the detailed mechanisms and the configuration mixing of single-particle states must be properly addressed. As an example, I will discuss some recent results for the two-proton transfer in the ^{28}Si+^{16}O system.

21. **Eilens López Saavedra**

ANL, USA

Title: **Near Threshold resonance in ^{11}B and the puzzle of an exotic decay**

Abstract: The study of near-threshold resonances in weakly bound systems is an exciting topic in experimental and theoretical nuclear physics since they provide important information on the interaction of discrete states with the continuum. Recent theoretical developments aim to describe the continuum interaction. However, questions on the behavior, structure, and properties of the many-body systems close to the particle emission threshold remain open, making the experimental studies of near-threshold states and its characteristics crucial for constraining the theoretical efforts. In particular, a near-threshold proton resonance in ^{11}B has long been sought since it would provide a less exotic explanation to the controversial observation of the unexpectedly large $\beta - p+$ branching ratio in ^{11}Be. In this talk, I will discuss two recent experiments carried out at the John D. Fox Superconducting Linear Accelerator Laboratory at Florida State University. In the first one, a near-threshold proton state was observed at a resonance energy of 211 keV in ^{11}B via the ^{10}Be(d,n)^{11}B reaction. Preliminary results from a second experiment realized using the Enge Split-Pole Spectrograph (SPS) at FSU where the alpha decay from ^{11}B was studied with the ^{7}Li(^{7}Li,t)^{11}B reaction will also be presented.

22. **Alberto Martínez Torres**

Universidade de São Paulo, Brazil

Title: **The properties of $\phi(2170)$ and its three-body nature**

Abstract: In this talk I will review some of our recent works about $\phi(2170)$ and its decay properties and show that the recent results obtained by the BESIII collaboration hint towards a three-body nature for $\phi(2170)$.

23. **E. Masha, D. Bemmerer, A. Boeltzig, K. Schmidt and A. Yadav**

Helmholtz-Zentrum Dresden-Rossendorf, Germany

Title: **Underground nuclear astrophysics: Status and recent results from Felsenkeller laboratory**

For almost three decades is known that the study of astrophysically important nuclear reactions between stable ions requires the use of low-background, underground accelerator laboratories. The Felsenkeller underground laboratory in Dresden, shielded by a 45 m thick rock cover, hosts a 5 MV Pelletron ion accelerator with an external sputter ion source (able to provide ^{12}C and other beams) and an internal radio-frequency ion source (providing proton and alpha beams). The reduced neutron and gamma-ray background achieved both with natural and active shielding situate the laboratory well in line with deep underground accelerator labs worldwide and allows highly sensitive nuclear reaction experiments. Currently measurements affecting the solar fusion and Big Bang nucleosynthesis are ongoing.

In addition to in-house research by HZDR and TU Dresden, the lab is an open facility for scientific users worldwide, with beam time applications reviewed by an independent science advisory board. Furthermore, EU-supported transnational access is available via the ChETEC-INFRA network for nuclear astrophysics.

In this talk I will provide a brief introduction to underground nuclear astrophysics, discuss the status of the Felsenkeller laboratory and present some recent results.

24. **Chiara Mazzocchi**

University of Warsaw, Poland

Title: **Photo-dissociation reactions at astrophysical energies - the case of $^{16}\mathbf{O}(\gamma,\alpha)^{12}\mathbf{C}$**

Abstract: Thermonuclear reactions that power the stars take place at different energies according to their respective stellar environments. Such energies are well below the Coulomb barrier and the respective cross-sections are incredibly small, often below experimental reach. Modelling energy production in stars requires experimental data on cross-sections for low energies; these data are sparse. As a consequence, extrapolations are made, which suffer from a large degree of unavoidable uncertainty. Of special interest are (p,γ) and (α,γ) reactions, in particular those that regulate the ratio of C and O and those that burn ^{18}O and, therefore, regulate the ratio between ^{16}O and ^{18}O in the Universe. One of the key reactions in this context is the $^{12}\mathrm{C}(\alpha,\gamma)^{16}\mathrm{O}$ at energies down to 1 MeV in the center-of-mass reference frame. A new active target detector (time-projection chamber, TPC) optimised for experiments with high-intensity γ-ray beams was developed and built at the University of Warsaw [1]. Time-reverse photo-disintegration processes induced by high energy photons on the CO_2 gas in the TPC detector were studied at the High Intensity Gamma-Ray Source (HIγS) facility at the Triangle Universities Nuclear Laboratory (TUNL), Durham, NC, USA. The charged reaction products from the dissociation of ^{16}O, namely ^{12}C and α particles, were detected, and their momenta reconstructed in 3D. With the ultimate goal being the mapping experimental determination of the astrophysical S-factor over a wide range of energies, down to energies as close as experimentally feasible to the Gamow peak, beam-energies ranging from 8.5 to 13.9 MeV were employed. The principles of the experiment will be illustrated, together with preliminary results. An outlook on future plans to go beyond the presently established lower limits will be given.

[1] M. Ćwiok et al., Acta Phys. Pol. 49 (2018) 509.

[2] M. Ćwiok et al., Eur. Phys. J. Web of Conf. 279 (2023) 04002.

25. **Dan Melconian and the ^{6}He-CRES collaboration**

Texas A & M University, USA

Title: **^{6}He-CRES: Recent progress and future plans**

Abstract: The Fierz interference parameter, b_{Fierz}, is sensitive probe of beyond-the-standard-model (BSM) physics. The ^{6}He-CRES experiment based at the University of Washington CENPA aims to measure b_{Fierz} to a precision of $\leq 10^{-3}$; this level of precision is sensitive to scalar and tensor contributions to the standard-model $(V-A)$ weak interaction. The ^{6}He-CRES experiment at the University of Washington CENPA aims to precisely measure β spectra of ^{6}He (pure Gamow-Teller) and ^{19}Ne (mixed Fermi/Gamow-Teller) to search for exotic currents in the weak interaction, representing a violation of standard model physics. The ^{6}He-CRES experiment is based on Cyclotron Radiation Emission Spectroscopy (CRES), a technique developed by the Project 8 collaboration to improve sensitivity to the neutrino mass in Tritium decay. The basic idea is a determination of the β energy by measuring the cyclotron frequency of βs in a magnetic field. The CRES technique does not involve interactions with physical volumes to measure the energy (unlike semiconductor or scintillator detectors), reducing sources of systematic uncertainties common to previous experiments.

The talk will present an overview of the 6He-CRES experiment, recent progress, and plans towards applying the CRES technique to ions confined in a Penning trap.

26. **M. Papa[1], C. Maiolino[2], E. Geraci[1,3], L. Acosta[4], G. Cardella[1], E. De Filippo[1], F. Favela[1], B. Gnoffo[1,3], C. Guazzoni[5], N.S. Martorana[1], A. Pagano[1], E.V. Pagano[2], S. Pirrone[1], G. Politi[3], F. Risitano[1,3,6], F. Rizzo[2,3], P.Russotto[2] and C.Zagami[2,3,7]**

[1] INFN, Sezione di Catania, Italy
[2] INFN, Laboratori Nazionali del Sud - Catania, Italy
[3] Dipartimento di Fisica e Astronomia "Ettore Majorana", Università di Catania, Italy
[4] Instituto de Física, UNAM
[5] Dipartimento di Elettronica Informazione e Bioingegneria Politecnico Milano
[6] Dipartimento di Scienze MIFT, Univ. di Messina, Italy
[7] Centro Siciliano di Fisica Nucleare e Struttura della Materia, Catania, Italy

Title: **Isospin dynamics and Dipolar degree of freedom in HIC at the Fermi energies**

Abstract: In this contribution, a study aimed at understanding the average dynamics, at the Fermi energies, associated with the isospin equilibration processes and its connection with the main parameters describing the density dependence of the symmetry energy [1,2] will be presented. ^{48}Ca/^{40}Ca+^{27}Al at 40 MeV/A collisions were performed by means of the superconductor cyclotron at the INFN- Laboratori Nazionali del Sud. The charged fragments were detected by using the CHIMERA multi-detector [3]. The dynamics of the isospin equilibration process (beyond the statistical behaviour) is investigated by reconstructing the total dipolar signal of the fragmented system obtained by measuring the charge and velocity of the various fragments produced in well-reconstructed events. Different reaction mechanisms, from binary to incomplete fusion processes, were selected according to the degree of dissipation and to the multiplicity of the produced fragments. Comparison with calculations performed with the Constrained Molecular Dynamics model CoMD [4] for binary processes are also presented.

[1] M. Papa et al., Phys. Rev. C 91, 041601(R) (2015).

[2] G. Cardella et al., Phys. Rev. C 85, 064609 (2012) and references therein.

[3] A. Pagano et al., Nucl. Phys. A 734, 504 (2004); Nucl. Phys. News 22, 25 (2012).

[4] M. Papa, Nucl. Phys. A 1041, 122780 (2024); https://authors.elsevier.com/a/1i3EA1LUmKcYph.

27. **Jorge Piekarewicz**

FSU, USA

Title: **Heaven and Earth: Nuclear Astrophysics after GW170817**

Abstract: The historical detection of gravitational waves from the binary neutron star merger GW170817 is providing fundamental new insights into the astrophysical site for the creation of the heaviest elements in the cosmos and the equation of state on neutron-rich matter. Since then, electromagnetic observations of neutron stars together with measurements of the properties of neutron-rich nuclei at terrestrial facilities are placing stringent constraints on the dynamics of neutron-rich matter. It is this unique synergy between heaven and earth that will be the focus of this presentation.

28. **Marek Ploszajczak**

GANIL, France

Title: **Atomic nucleus at the edge of stability**

Abstract: Loosely bound nuclei are currently at the centre of interest in low-energy nuclear physics. The deeper understanding of their properties provided by the shell model for open quantum systems changes the comprehension of many phenomena and offers new horizons for spectroscopic studies of nuclei from the driplines to the valley of β-stability, for states in the vicinity and above the first particle emission threshold [1,2]. Systematic studies in this broad region of masses and excitation energies will extend and complete our knowledge of atomic nuclei at the edge of stability. In this talk, I will review recent progress in the open quantum system shell model description of nuclear states. In particular, I will present selected applications of the real-energy continuum shell model, the so-called Shell Model Embedded in the Continuum, and the complex-energy continuum shell model, the so-called Gamow Shell Model in the Coupled Channel basis. Salient generic features of open quantum systems will be illustrated on examples of (i) near-threshold collectivity and clustering, (ii) chameleon resonances, (iii) modification of effective NN interactions and shell occupancies in weakly bound/unbound states, (iv) exceptional point singularities in the continuum, (v) change of the electromagnetic transitions by the coupling to decay channels, and (vi) low-energy reactions of astrophysical interest.

[1] N. Michel, M. Płoszajczak, Gamow Shell Model - The Unified Theory of Nuclear Structure and Reactions, Lecture Notes in Physics 983 (Springer, Cham, 2021).

[2] N. Michel, W. Nazarewicz, M. Płoszajczak and T. Vertse, J. Phys. G: Nucl. Part. Phys., 36 (2008) 013101.

29. **Zsolt Podolyák**

University of Surrey, UK

Title: **Structure of heavy neutron-rich nuclei in the vicinity of ^{132}Sn**

Abstract: Neutron-rich nuclei around doubly-magic ^{132}Sn are of great interest for contemporary nuclear physics. They are important for nuclear structure, as they test and refine shell model interactions. The region is also of astrophysical interest as the N=82 shell closure is connected to the r-process abundance peak at mass A$\sim$130.

The RIKEN facility in Japan provides the highest intensity primary ^{238}U beam to be used in in-flight fission studies. The recent HiCARI campaign brought a high-resolution HPGe array for the first time to RIKEN to be employed in fast-beam experiments. One of the experiments was devoted to study nuclei "south" of ^{132}Sn. Highlights of the work include:

(i) the extension of the level scheme of the N=82 nucleus ^{130}Cd, therefore test of the proton-proton effective interaction,

(ii) test of the proton-neutron interaction in the Z<50, N<82 quadrant based on the observation of excited states in ^{130}In, and

(iii) in ^{132}In the identification of excited states with dominant configurations of $\pi g_{9/2}\nu f_{7/2}$, $\pi p_{1/2}\nu f_{7/2}$ and $\pi p_{3/2}\nu f_{7/2}$ provided an excellent test of the proton-neutron interaction for the Z<50, N>82 quadrant of the nuclide chart. This benchmarking is essential for a reliable prediction of the properties of the r-process waiting point nuclei in the region.

The presentation will report recent results, focusing on those obtained from the aforementioned HICARI experiment [1], highlighting their significance to the field.

[1] T. Parry, Zs Podolyák et al., to be published.

30. **Andrew M. Rogers and and S. Waniganeththi**

University of Massachusetts Lowell, USA

Title: **Exploring the light rare-earths and search for the elusive 158Pm isomer**

Probing the intrinsic and collective structure of nuclei in the light rare-earth region provides important insight into the evolution of nuclear deformation and the properties of neutron-rich nuclei far from stability. This understanding is critical for exploring the formation of the rare-earth peak in the r-process abundance pattern, where new data can influence constraints on the possible astrophysical sites and conditions. The odd-odd nucleus ^{158}Pm is a particularly interesting case as a predicted isomeric state has yet to be clearly established. Investigating such isomers is critical to determining their structure as well as to remove ambiguities that can arise in direct mass measurements. To investigate this region a $\beta\gamma$-coincidence experiment was performed at Argonne National Laboratory (ANL) using the HPGe clover detectors of X-Array (XA) combined with the SATURN moving tape system. Radioactive ions produced by the Californium Rare Isotope Breeder Upgrade (CARIBU) facility were isobarically separated and delivered to the XA+SATURN decay station. Various tape cycles were optimized for the decay of a given species, with a focus on ^{158}Pm and ^{160}Sm. In this talk, I will present evidence addressing the missing ^{158}Pm isomer as well as new β-decay data on the relevant A=158 and 160 isobars.

This work is supported by the U.S. Department of Energy, Office of Science, Office of Nuclear Physics under award No. DE-FG02-94ER40848(UML), DEAC02-06CH11357 (ANL), DE-SC0021315(LSU) and DE-AC52-07NA27344 (LLNL).

31. **Christian Schubert**

UMSNH, Morelia

Title: **Pair creation in electromagnetic fields**

Abstract: Sauter-Schwinger pair creation in electromagnetic fields is a fundamental prediction of QED and one of the motivations for the present efforts in constructing super-strong lasers. I will give a historical review of the subject, and then discuss two recent developments. The first one is the worldline instanton formalism, a sophisticated version of the WKB approximation that makes it possible to calculate the piar creation rate for complicated field configurations. The second one is an adaptation of the Wigner formalism suitable for a detailed study of the formation of real particles in time and space.

32. **Alessandro Spatafora**

INFN, Catania, Italy

Title: **Experimental and theoretical multi-channel study of direct nuclear reactions: a tool to provide data driven information on neutrinoless double-beta decay**

Abstract: The search for neutrino-less double beta ($0\nu\beta\beta$) decay has attracted much interest in the last years due to the extraordinary consequences that could derive from its observation. In the view to provide experimental information on the nuclear matrix elements involved in the expression of $0\nu\beta\beta$-decay half-life, the NUMEN project is measuring cross-sections of double charge exchange and other quasi-elastic nuclear reactions using the MAGNEX magnetic spectrometer. The recent studies on the ^{20}Ne + ^{76}Ge, ^{18}O + ^{76}Se and ^{18}O + ^{12}C networks of nuclear reactions at 15.3 AMeV incident energy will be presented during the seminar. In particular, the newly proposed multichannel approach, applied both to the experimental and theoretical analysis, will be discussed. The holistic nature of this technique is the main feature and novelty of this work together with the first experimental measurement of the absolute double charge exchange (DCE) cross section for these systems.

33. **Eric Swanson**

Pittsburg, USA

Title: **Is an Effective Description of Nonperturbative Gluonics Possible?**

Abstract: I review properties of gluodynamics that have been revealed in lattice calculations and assess the feasibility of string and quasiparticle descriptions in modelling them.

34. **Smarajt Triambak**

University of the Western Cape, South Africa

Title: **Nuclear structure studies relevant for new physics searches with xenon detectors**

Abstract: Xenon detector experiments have provided some of the most sensitive searches of physics beyond the standard model (BSM). These campaigns have placed emphasis on observing dark matter interactions and/or neutrinoless double beta decays ($0\nu2\beta$). Several next-generation experiments aim to build on this work and probe for BSM physics with significantly improved sensitivity. In relation to the above, this talk will present results from recent two-nucleon transfer studies in the $A = 136$ region. The measurements are used to robustly test predictions made with Hamiltonians that are also used to evaluate the nuclear matrix element for ^{136}Xe $0\nu2\beta$. Further implications concerning the detection of solar neutrinos and fermionic dark matter candidates in large xenon-based detectors will also be briefly presented.

35. **Michael Wiescher**

University of Notre Dame, USA

Title: **The Manhattan Project and the development of ideas in Nuclear Astrophysics**

Abstract: This talk will provide a historical analysis of the impact of the US Manhattan Project from 1942 to 1945 and the subsequent nuclear test program 1945-1970 towards the development of the field of Nuclear Astrophysics and the interpretation of nuclear reaction processes in stars and explosive stellar environments.

36. **José Wudka**

UC Riverside, USA

Title: **Neutrinoless double-beta decay as a probe of physics beyond the SM**

Abstract: Neutrinoless double-beta decay has been long recognized as the best and simplest way of determining the nature of neutrino masses. But these experiments gives information about new physics that is much more diverse than measuring or limiting Majorana masses. In this talk I will describe the types of physics that can be probed by these experiments, with some of the consequences implied by the current and near future limits, including a few comments on the prospects for the presence of lepton number violation at relatively low scales.

Abstracts Poster Session

1. **U. Carachure[1], R. Espejel[1], R. Gleason[1], J. Mas-Ruiz[2], C. Valencia[1], E. Andrade[1] and E. Chávez[1]**

   [1] Instituto de Física, UNAM
   [2] Instituto de Ciencias Nucleares, UNAM

   Title: **Measurement of the thickness of a supersonic jet in a vacuum using the Schlieren technique**

   Abstract: In 2015, the SUGAR (SUpersonic Gas jet TaRget) windowless gaseous target was inaugurated. This system allows the direct presentation of gaseous substances for interaction with accelerated particle flows, without windows or barriers to contain it. Moreover, it is virtually indestructible, as atoms are continuously replaced as the gas flows. This paper describes an arrangement of the Schlieren technique that will be installed within the SUGAR's vacuum chamber to measure aerial density (atoms/cm^2).

   This work has been made possible thanks to financial support from the PAPIIT-UNAM projects IG102023, IG101423, IN112023. The authors appreciate the support received from the Central Laboratory of Electron Microscopy at UNAM, under the coordination of Samuel Tehuacanero, with the participation of technician Diego Quintero. The authors are indebted to Sergio Martínez Gonzales for his assistance in preparing graphite cathodes. JMR wishes to acknowledge the scholarship received from LEMA-CICUNAM.

2. **U. Carachure[1], R. Espejel[1], R. Gleason[1], J. Mas-Ruiz[2], E. Andrade[1] and E. Chávez[1]**

   [1] Instituto de Física, UNAM
   [2] Instituto de Ciencias Nucleares, UNAM

   Title: **New ion source control system for the 5.5 accelerator using lasers**

   Abstract: One of the key features that makes the 5.5 MV Van de Graaff accelerator more significant in our region (Mexico) is the use of deuterium and noble gas nuclei (Ne, Ar, Kr, Xe) as projectiles. This is because it is the only facility equipped with the capacity and radiological safety for their utilization. However, the accelerator faces a limitation inside the tank due to unknown operating conditions. This arises from the difficulty in transmitting signals outside the tank because of the high voltage. To address this challenge, a laser-based communication system has been constructed. This system allows the transmission of operational status (voltages, currents, temperatures, etc.) of the ion source and other components to the outside of the tank. This contributes to greater certainty and confidence in the control of gases, especially deuterium.

   This work has been made possible by financial support from PAPIIT-UNAM projects with numbers IG102023, IG101423, IN112023. The authors acknowledge the support received from the UNAM Central Electron Microscopy Laboratory under the coordination of Samuel Tehuacanero and the involvement of technician Diego Quintero. The authors are grateful to Sergio Martínez Gonzales for assistance in the preparation of graphite cathodes. JMR wishes to acknowledge the scholarship received from LEMA-CICUNAM.

3. **Omar Alejandro Díaz Caballero**

   Instituto de Ciencias Nucleares, UNAM

   Title: **Isospin effects on the $2\alpha + 2$ Nuclei on the CSM**

   Abstract: In the framework of the Cluster Shell Model, the ^{10}Be, ^{10}B and ^{10}C nuclei have similar wavefunctions, the isospin component can be symmetric or antisymmetric, depending on the nuclei, this determines the allowed values of angular momentum projection in the intrinsic reference system, hence the Carbon and the Beryllium have the same structure being mirror nuclei with, while Borom has a richer structure, here we will show the eigenstates of these three nuclei.

4. **J. Rodrigo Fuentes Carreón[1], L. Acosta[1], J. Cruz[2], L.Y. Reyes-Miranda[1], A. Huerta[1], D.J. Marín-Lámbarri[1], J. Mas-Ruiz[3], S. Muhl[2] and E. Chávez[1]**

   [1] IF-UNAM
   [2] IIM-UNAM
   [3] ICN-UNAM

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

   Abstract: For the measurement of the cross section of the 28Si$(d,\alpha)^{26}$Al reaction at energies close to and below the Coulomb barrier, of interest for stellar nucleosynthesis calculations, it is required to have very thin Silicon targets. Isotopically pure ^{28}Si targets have been produced by implantation in a graphite matrix. New targets have been studied, produced by depositing on a surface, also graphite, natSi atoms (silicon atoms with the isotopic distribution found in nature) detached from a thick plate by atomic ablation (sputtering). The characterization of these new targets was reported using the RBS technique (Rutherford Backscattering Spectrometry). Proton beams, ^{12}C and ^{28}Si at different energies, were used for different targets. The experimental device was described and set up in the Nuclear Physics line of the Laboratory of Mass Spectrometry with Accelerators (LEMA), located at the UNAM Physics Institute. The thicknesses of the silicon targets obtained as a result of the data analysis and their interpretation with the spectrums simulation commercial program "SIMNRA" were reported.

   The motivation of this work is the characterization of thin silicon targets produced as part of a collaboration with the Research Institute in Materials and the IFUNAM Microscopy Laboratory. With the aim of being used in nuclear reactions with interest in nuclear astrophysics.

5. **D. Godos-Valencia[1,5], L. Acosta[1,6], P. Ascher[2], B. Blank[2], J. Giovinazzo[2], F. de Oliveira Santos[3], C. Fougères[4] and A.M. Sánchez-Benítez[5]**

[1] Instituto de Física, Universidad Nacional Autónoma de México, Mexico
[2] LP2i-Bordeaux France
[3] GANIL, France
[4] ANL, USA
[5] CEAFMC, Universidad de Huelva, Spain
[6] Instituto de Estructura de la Materia, CSIC, Spain

Title: **Advances in the beta-decay experimental studies of the ^{46}Mn β^+ decay channel**

Abstract: Core Collapse Supernova (CCSN) explosion is the final process suffer by starts with initial mass greater than 8 $M_\odot$. In such processes the ^{44}Ti nucleosynthesis takes place, doing the isotope a good gamma tracer of Supernovae events, due to its characteristic gamma decay chain. The comparison between observations and models of the synthetized ^{44}Ti in CCSN gives important constrains to the models in which reaction networks are used for modelling nucleosynthesis occurring in the last stages of those stars with thermonuclear reaction rates as its inputs [1,2,3].

One of the candidates to be sensitive to nucleosynthesis of ^{44}Ti in CCSN explosions is the ^{45}V(p,γ)^{46}Cr reaction. However, reach a direct study of the reaction cited, is a difficult task for the current nuclear labs. In this context, the indirect methods as the β-delayed proton emission, is one of the opportunities to approach narrow isolated resonances which is the case [1,4,5].

In this work we present new advances and results of analysing the ^{46}Mn decay channel as a way to study the ^{45}V(p,γ)^{46}Cr reaction. The ^{46}Mn was selected among other species in the cocktail beam delivered by LISE fragment separator at GANIL (Caen, France) in order to study its β decay and the excited states of his daughter nucleus ^{46}Cr. We present the proton and gamma emission peaks related to the ^{46}Mn decay and compare them with the work from references [6,7]. Also, we present a p-γ coincidence study to identify the processes linked to the γ emission. Furthermore, we obtained the intensities of the γ peaks for the pure beta emitters, ^{42}Ti and ^{46}Cr which were also detected in this experiment, to corroborate our results.

This work is supported by DGAPA-UNAM IG101423 and CONACyT 314857 projects.

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6. **A. Huerta, L. Acosta, E. Andrade, D.J. Marín-Lámbarri, S. Martínez, G. Reza, M.G. Rodríguez Ceja, C. Solís, C. Valencia and E. Chávez**

   Instituto de Física, UNAM

   Title: **Available beam menu at the isotopic separator of Laboratorio Nacional de Espectrometría de Masas con Aceleradores (LEMA) at IF-UNAM**

   Abstract: Through ten years of continuous operation of the 1 MV tandem accelerator of the LEMA (Laboratorio Nacional de Espectrometría de Masas con Aceleradores) we have had the need and opportunity to develop different species of ion beams in a wide range of energies and intensities for a variety of applications. The commissioning of the NBL (Nuclear Beam Line) allowed us to perform research projects with the classical solid beam-target configuration, from basic science to technological development. In this work we present a catalog for the beams and their characteristics (Ion species, charge states, energy, main intensity) developed at LEMA as well as their application.

7. **O.E. López-López[1], D.J. Marín-Lámbarri[1], F. Quintero-Villegas[1], E. Chávez[1], A. Huerta[1], J. Mas-Ruíz[2] and C. Valencia[1]**

   [1] Instituto de Física, UNAM
   [2] Instituto de Ciencias Nucleares, UNAM

   Title: **Measurement of the ^{nat}Mg(p,γ) nuclear reaction at low energies with high resolution gamma-ray spectroscopy**

   Abstract: Nuclear reactions of interest in astrophysics occur at low energies and can be studied through the measurement of the emitted gamma-rays. In the present work we show preliminary results of the measurement of incident protons in a ^{nat}Mg target in a 500 to 1000 keV beam energy range, using high resolution gamma-ray spectroscopy. We used the 1 MV Tandetron accelerator of the Accelerator Mass Spectrometry Laboratory (LEMA) at IFUNAM and a High Purity Germanium (HPGe) detector for gamma-rays identification. Measurements were performed with and without Compton suppression and data was acquired using a UCS30 USB Computer Spectrometer and CAMAC data acquisition system.

   Authors acknowledge financial support from DGAPA-UNAM throgh contract number IG102023.

8. **Diego Martínez Montiel**

   Instituto de Ciencias Nucleares, UNAM

   Title: **Measurement of muon flux variations with scintillators in Mexico City**

   Abstract: In this work results from the observed periodic variations of the muon flux in a period between September and December 2023 are presented. The measurements are realized at ICN-UNAM in Mexico City at the geographical coordinates 19.32°N 99.18°W with an altitude of 2268 meters above sea level. The experimental setup consists of two scintillators measuring 0.5 m x 1.0 m, located at a distance of 0.1 m from each other. The value of the barometric coefficient is determined from data and corresponds to -0.76%/mb. After the flux is corrected for pressure, periodic trends in the datasets are identified, revealing significant variations in daily cycles and seasonal trends in the muon flux observed by the detector. The relationship between solar radiation emission from sunspots and geomagnetic storms on muon flux are examined and a Forbush decrease is observed.

9. **L.E. Martínez-Navarro[1], D.J. Marín-Lámbarri[1], B. Leal-Acevedo[2], E. Chávez[1], R. Gleason[1], A. Huerta[1] and C. Valencia[1]**

[1] Instituto de Física, UNAM
[2] Instituto de Ciencias Nucleares, UNAM

Title: **Design, construction and characterization of an organic scintillator for in situ measurements of intense gamma radiation fields**

Abstract: The present work describes the design, construction, and characterization of a plastic scintillator detector for intense gamma radiation fields. The detector consists of three main components: a BC - 408 plastic scintillator, a PMMA optical guide (serving as a coupling between the plastic scintillator and a photomultiplier). The assembly of these components utilized 3D-printed parts specifically designed for experiment coupling. Tests were performed with various lengths of optical fiber and different sizes of the coupled scintillator with cylindrical geometry with well known gamma-ray sources. Additionally, the integration of counts associated with each test was observed, establishing a relationship between the count rate and the size of the scintillators.
Authors acknowledge financial support from DGAPA-UNAM throgh contract number IG102023.

10. **Javier Mas Ruiz**

Instituto de Ciencias Nucleares, UNAM

Title: **Probing the elastic scattering differential cross section for Al + p at backward angles in a low energy regime**

Abstract: We report on the absolute differential cross section for proton elastic scattering on aluminum in the energy range of 0.8 MeV to 2.1 MeV. In the literature we have found previously published data that follow similar trends but are not consistent with one another. The present measurements also fall within that range, moreover, covering angular regions where there were no reported data, improving databases such as IBANDL. Different methods for the optical model calculations are shown where angular distributions at backward angles are in good agreement, allowing one to fix the optical potential parameters. The calculation results, as well as their data fit, differ significantly as one would expect for the energy range covered in this work, where the nuclear part of the interaction contribution is almost zero. Our data, as well as previous reports, suggest an increase with higher energies for the value of the elastic cross section at backward angles. Further work is required from both experimental and theoretical fronts.

11. **J. Méndez García[1], D.J. Marín-Lámbarri[1], H. Alva-Sánchez[1], L.C. Álvarez-Nuñez[2], E. Chávez[1], A. Farah-Simón[2], A. Huerta[1], T. Murrieta-Rodríguez[1] and C. Valencia[1]**

[1] Instituto de Física, UNAM
[2] Instituto de Astronomía, UNAM

Title: **Characterization of a silver coated BC-408 organic scintillator for gamma-ray detection as an active shield**

Abstract: An organic scintillator was coated with silver, part of a gamma-ray detection array for nuclear physics experiments at low energies. The scintillator will be used as an active shield, detecting background radiation allowing it to identify unequivocally those gamma-rays coming from the nuclear reaction of interest. The silver coating will allow to maximize the efficiency due to the photons' multiple reflections. The prototype will include a PMT (Photomultiplier Tube) and will be replaced by a couple of SiPM (Silicon Photomultiplier). In this work we present the response of the scintillator with well known gamma-ray sources.
Authors acknowledge financial support from DGAPA-UNAM throgh contract number IG102023.

12. **Marco A. Ortiz V., J. Madrigal-Melchor and Daniel Chávez V.**

Universidad Autónoma de Zacatecas (UAZ), Zacatecas

Title: **Design and Modeling of a Superconducting Magnet System for an Electron Cyclotron Resonance Ion Source using Cable-In-Conduit**

Abstract: SECRAL (Superconducting ECR ion source with Advanced design at Lanzhou) is a superconducting ECRIS able to produce intense highly charged ion beams, that has achieved record beam currents for very high charge states. In this work, the Applied Superconductivity Research Group at Universidad Autónoma de Zacatecas (UAZ) presents a design of a superconducting magnetic system for an ECRIS that shares some characteristics with SECRAL. Cable-In-Conduit technology was implemented to reduce the amount of superconducting cable, reduce helium consumption, and increase the magnetic field operational range within the chamber without compromising its design. Finite element analysis simulations were carried out to optimize the magnetic field distribution within a plasma chamber of similar dimensions as SECRAL. The proposed design is capable of producing a maximum axial magnetic field of 4 T using two solenoids formed with 4 layers of CIC, each layer having 20 turns around the plasma chamber. Radial confinement of plasma is achieved by means of a magnetic sextupole at the center of the plasma chamber. Furthermore, we present a mechanical analysis of the force distribution within the superconducting coil, and its effect on current degradation.

13. **José Antonio Pérez-Velasco[1], J.C. Morales-Rivera[1] and E. Martínez-Quiroz[2]**

[1] UAEM, Estado de México
[2] ININ, Estado de México

Title: **Asymptotic normalization coefficient for the study of the mirror nuclei ^{7}Li and ^{7}Be**

Abstract: The present work is a theoretical study of the structure of the mirror nuclei ^{7}Li and ^{7}Be by using the asymptotic normalization coefficient method (ANC). These nuclei were studied through the transfer reactions ^{6}Li(d,p)^{7}Li and ^{6}Li(^{3}He,d)^{7}Be as cluster structures. For these reactions we calculated the elastic scattering and the transfer angular distributions, for the ground and the first excited states of both nuclei. In this analysis, we used the FRESCO code, which was created to perform coupled reaction channel calculations for the three-body interactions. With this program, it was possible to calculate the angular distributions that fit the experimental data, thus allowing us to extract the ANC for the simple particle model. For this analysis, we considered all the possible spin and parity sets for the residual nucleus, to calculate each of their contributions to the transfer angular distribution, so we can determine the corresponding spectroscopic factor. From this, we obtained the nuclear ANC for both states of each nucleus. In this way, it is possible to determine the asymptotic behavior of this mirror nuclei.

14. **F. Quintero-Villegas, D.J. Marín-Lámbarri, O.E. López-López, E. Chávez, A. Huerta and C. Valencia**

Instituto de Física, UNAM

Title: **Design of a prototype detector array for gamma-ray spectroscopy for nuclear physics experiments at low energies**

Abstract: The design, construction and assembly of the experimental arrangement that will be used to measure the radiation produced by a nuclear reaction was carried out, allowing the extraction of information as effective sections of interest in nuclear astrophysics. These prototypes are the basis for the construction of the final model that will be more efficient and mobile.
Authors acknowledge financial support from DGAPA-UNAM throgh contract number IG102023.

15. **L. Reyes-Miranda[1], J. Fuentes[1], R. Gleason[1], A. Huerta[1], J. Mas-Ruiz[2], D.J. Marín-Lámbarri[1], G. Reza[1], C. Valencia[1], E. Andrade[1], E. Chávez[1]**

[1] Instituto de Física, UNAM
[2] Instituto de Ciencias Nucleares, UNAM

Title: **Position resolution of MONDE-II with an AmBe source**

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 (En ¿ 1MeV) 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.

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[3] P. Santa Rita, "MOmentum Neutron DEtector: MONDE", Tesis de Licenciatura, UNAM (2008).

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16. **A.O. Valdéz-Guerrero, G. Reza, J. Mas-Ruiz, R. Gleason and E.R. Chávez L**

Instituto de Física, UNAM

Title: **Global Survey of Single-Ended Electrostatic Accelerators: Quantity and Condition**

Abstract: The most popular configuration for electrostatic accelerators is one where the ion source is positioned externally. Its easy accessibility facilitates more efficient maintenance and troubleshooting. The trade-off, however, is that it must produce negative ions, limiting the ability to generate beams for a few elements, particularly noble gases. In contrast, the single-ended configuration necessitates a source of positive ions, allowing for the production of beams for all elements. If the goal is to produce high-quality beams of noble gases, this becomes the sole option. The downside is that the ion source is located within the accelerator. Originally, tandem accelerators were believed to provide higher energies than their single-ended counterparts with the same terminal voltage. This scenario may no longer be the case with the introduction of Electron Cyclotron Resonance Ion Sources (ECRIS). ECRIS produces positive ions in a very high charge state before injection into the accelerator, surpassing the charge state achieved by tandem accelerators. This is accomplished through the use of 'charge exchange canals' (strippers) in the middle of the acceleration procedure.

In this presentation, we have gathered as much information as possible regarding the current distribution of single-ended electrostatic accelerators worldwide and present this information in the form of maps and tables.

17. **O.A. Rico-Trejo[1], T. Yepez-Martínez[2], P.O. Hess[1], and O. Civitarese[3]**

[1] Instituto de Ciencias Nucleares, UNAM
[2] Instituto de Educación Media Superior, CDMX
[3] Universidad La Plata, Argentina

Title: **Meson-like spectrum at low energies: the use of many-body methods for the description of hadronic masses and their associated widths**

The study of properties for the low-energy regime of hadronic spectra is a challenging task; even today, the realm of non-perturbative QCD remains a difficult subject to approach using existing methods. In this work, we present preliminary results of employing many-body techniques to endow effective mass to the quarks and anti-quarks composing mesonic particles, followed by the calculation of the spectrum and its associated widths. This effort is motivated by previous works that explored the scope of a model structured in the $SO(4)$ symmetry group for calculating these same mesonic-type spectra.

18. **R. Rizo, E. Andrade , R. Gleason, J. Mas, D.J. Marín, G. Reza, R. Espejel, L. Acosta, C. Valencia and E.R. Chávez L.**

Instituto de Física, UNAM

Title: **Ions in high charge states of charge in an Electron Cyclotron Resonance plasma as an ion source for a Van de Graaff accelerator**

Abstract: This work presents the status of the IFUNAM-JINR collaboration for the design, construction and installation of an ECRIS (Electron Cyclotron Resonance Ion Source). This device will provide ions in very high charge states, for instances: $^{40}Ar^{16+}$ or $^{179}Au^{60+}$ to our 5.5 MV Van de Graaff accelerator, resulting in beams of 90 or 300 MeV respectively. Ion Beams with these energies open the door to new research areas in basic, applied, and interdisciplinary science. In nuclear physics, we can take advantage of the high energy beams to study nuclear reactions using the inverse kinematics technique. For instance:
- In astrophysics: the measurement of nuclear reaction cross sections of interest in stellar nucleosynthesis calculations.
- In nuclear dynamics: the determination of hadronic radius of different nuclei.
- Study of the internal structure of light nuclei (cluster states for instances)
Also, the production of isotopically selected implanted targets for different applications becomes possible, especially the case of noble gases.

19. **Jorge Luis Rodríguez Alejandre[1], Vijay R. Sharma[2] and Nabanita Dasgupta Schubert[1]**

[1] Facultad de Ciencias Físico Matemáticas, Universidad Michoacana de San Nicolás de Hidalgo, Morelia
[2] Department of Radiation Oncology, School of Medicine, University of Maryland, USA

Title: **The Ar peak as a unique sample-less signature of detector performance in TXRF spectrometry**

Abstract: Over the last decade, the Silicon Drift Detector (SDD) has revolutionized x-ray, low energy gamma ray and electron spectroscopy because of its excellent resolution while not needing cryogenic cooling, as well as its ability to sustain high count-rates. One area that has inadequately been studied, is the long-term performance of an SDD detector. The 2 important spectrometric figures of merit (FOM) – the resolution (FWHM) and sensitivity (P/B) are affected by not only the detector's characteristics but also the sample's. In commercial spectrometric units, the detector lies completely enclosed within a custom housing that includes the sample stage. Thus, customary methods of obtaining the pure detector response, as through the use of a precision pulser etc., are largely inaccessible or difficult at best. As a first, we report the FOM diagnostics of a 30 mm^2 SDD detector over a five year period without interference from the sample stage in a Total Reflection X-ray Fluorescence (TXRF) spectrometer with air ambient using the Ar peak as benchmark. The x-ray counts from Ar arise mainly from the optical paths of the incident and reflected x-rays and the standing wave field (the "magic triangle") above the sample. Monte Carlo modeling via GEANT4 allowed an estimation of the aforesaid FOMs. The status of the detector after 5 years of moderate use is reported in a detailed manner

20. **L.R. Romero[1] and C.G. Méndez-García[2]**

[1] Facultad de Ciencias, UNAM
[2] Instituto de Física, UNAM

Title: **Preliminary analysis for Pu isotopes measurements by AMS**

Abstract: A variety of isotopes of plutonium (Pu) are present in the environment due to their applications in nuclear energy, mainly on account of emissions from nuclear reactors, accidents related to these, and exposure from weapons tests. The measurement of the isotopic ratios of Pu isotopes (^{240}Pu/^{239}Pu) in environmental samples has provided valuable information on the characteristics of their origin and the remaining contribution caused by the uses of this radioisotope, as well as its possible impact on health human. The measurement of Pu using alpha spectrometry is limited by its resolution, which makes Accelerator Mass Spectrometry (AMS) the optimal tool given its high sensitivity and low uncertainty. This research aims to optimize the radiochemical treatment and the electrodeposition process of Pu radioisotopes to open the research line of this element at the National Laboratory of Mass Spectrometry with Accelerators (LEMA).

21. **Erika Ruiz and Libertad Barrón Palos**

Instituto de Física, UNAM

Title: **Simulation of a Supersonic Gas Jet Target by COMSOL Multiphysics**

Abstract: SUGAR (SUpersonic GAs jet taRget) is a windowless gas jet target for nuclear physics experiments developed in Mexico. It has been used in the past at the 5.5 MV Van de Graaff accelerator of Instituto de Física of the UNAM, and soon it will be moved to the INFN Laboratori Nazionali di Legnaro in Italy, were in combination with particle, gamma and neutron detection systems will be used to study different nuclear reactions. The original geometry of the system has to be modified for its installation at Legnaro. We are working on COMSOL Multiphysics®simulations to reproduce the original system and to model the supersonic jet once its geometry is modified, so that we can optimize it in the new conditions. I will describe the modifications to the system as well as the current status of the simulations.

22. **M.F. Silva García[1], D. Godos[1], L. Barrón[1], E. Ruíz[1], J.J. Gómez[1], O. López[1], F. Quintero[1] , G. Reza[1], R. Gleason[1], C. Valencia[1] and L. Acosta[1,2]**

[1] Instituto de Física, UNAM

[2] Instituto de Estructura de la Materia, CSIC, Spain

Title: **Evaluation of thin detectors behavior when interacting witha supersonic jet target**

Abstract: Commissioned since 2015, the SUGAR (SUpersonic GAs jet-taRget) system is a device developed at IF-UNAM, Mexico City [1,2]. Nevertheless, to carry out the coupling of SUGAR with the European array for gamma spectroscopy experiments, AGATA (Advanced Gamma Tracking Array) in Legnaro, Italy, as part of the SUGAR@LNL Project, it is essential to run a flux simulation as well as an evaluation of the detectors behavior to be used. For this reason, in this work we present the preliminar results regarding flux simulations inside SUGAR chamber as well as 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 at Legnnaro Laboratory, during the campaign tought to be performed there in the near future, as part of the SUGAR@LNL Collaboration research program.

This research is partially funded by the Projects: DGAPA-UNAM IG101423 and CONACyT 314857.

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

[2] J. Favela, Ph.D. thesis, Instituto de Física UNAM (2016)

45th Symposium on Nuclear Physics, Hacienda Cocoyoc, January 8-11, 2024

Day	Monday January 8	Tuesday January 9	Wednesday January 10	Thursday January 11
08:00 - 09:00		Breakfast	Breakfast	Breakfast
Chair		Session 3: N. Dasgupta	Session 7: T. Yépez	Session 9: L. Acosta
09:00 - 09:30		Zsolt Podolyák	Eric Swanson	Héctor Álva
09:30 - 10:00		David Jenkins	Kanchan Khemchandani	Nabanita Dasgupta
10:00 - 10:30	Bus to Cocoyoc Ritz "Centro Histórico"	Andrew Rogers	Alberto Martínez Torres	Arturo Gómez Camacho
10:30 - 11:00		Roelof Bijker	Christian Schubert	Marek Ploszajczak
11:00 - 11:30		Coffee break	Coffee break	Coffee break
Chair		Session 4: A. Galindo	Session 8: L. Barrón	Session 10: E. Chávez
11:30 - 12:00		Jason Holt	Ani Aprahamian	Luis Acosta
12:00 - 12:30	Registration, Fee Payment, Hacienda Cocoyoc Check-in	Smarajt Triambak	Marco La Cognata	Eilens López Saavedra
12:30 - 13:00		Maxime Brodeur	Eliana Masha	Benito Góngora
13:00 - 13:30		José Wudka	Erika Holmbeck	Massimo Papa
13:30 - 15:30	LUNCH	LUNCH	LUNCH	LUNCH
Chair	Session1: R. Bijker	Session 5: P. Hess		
15:30 - 16:00	Jorge Piekarewicz	Dan Melconian	FREE AFTERNOON	15:00 Bus to Mexico City
16:00 - 16:30	Melina Ávila Coronado	Alfredo Galindo Uribarri		
16:30 - 17:00	Chiara Mazzocchi	Libertad Barrón Palos		
17:00 - 17:30	Michael Wiescher	Ronald García		
17:30 - 18:00	Coffee break	Coffee break		
Chair	Session 2: D. Marín	Session 6		
18:00 - 18:30	Alessandro Spatafora	POSTER SESION		
18:30 - 19:00	Roberto Linares			
19:00 - 19:30	Hugo García Tecocoatzi			
19:30 - 20:00	Osvaldo Civitarese			
20:00 - 21:00	DINNER	DINNER	DINNER	
		DFN meeting		