Abstracta

Ano XXIX - N. 04

Novidades: **a partir desse número do botetim, os artigos e eventos terão links para o trabalho publicado.**

Artigos publicados

[P137-2025] "A Novel Graphyne-Like Carbon Allotrope: 2D Dewar-Anthracyne"

Laranjeira, J. A. S.; **Lima, K. A.***; Martins, N. F.; Ribeiro Junior, L. A.; **Galvao, D. S.***; Sambrano, J. R.

Anthracyne (2DDA) consists of chains of Dewar-anthracenes connected by acetylenic linkages. DFT-based simulations show that 2DDA is thermally stable and exhibits no imaginary phonon modes, confirming its dynamic stability. 2DDA is metallic with Dirac-like features near the Fermi level, dominated by C p\documentclass[12pt]{minimal} \usepackage{amsmath} \usepackage{wasysym} \usepackage{amsfonts} \usepackage{amssymb} \usepackage{amsbsy} \usepackage{mathrsfs} \usepackage{upgreek} \setlength{\oddsidemargin}{-69pt} \begin{document}$${}_z$$\end{document} orbitals. It shows marked mechanical anisotropy, with Young's modulus of 176.24 N/m (x) and 31.51 N/m (y), shear modulus up to 69.14 N/m, and Poisson's ratio varying from 0.27 to 0.87. The material also exhibits strong anisotropic optical absorption in the visible and ultraviolet ranges. Raman and IR spectra reveal intense bands at 648 cm\documentclass[12pt]{minimal} \usepackage{amsmath} \usepackage{wasysym} \usepackage{amsfonts} \usepackage{amssymb} \usepackage{amsbsy} \usepackage{mathrsfs} \usepackage{upgreek} \setlength{\oddsidemargin}{-69pt} \begin{document}$${}^{-1}$$\end{document} (Raman) and 1292 cm\documentclass[12pt]{minimal} \usepackage{amsmath} \usepackage{wasysym} \usepackage{amsfonts} \usepackage{amssymb} \usepackage{amsbsy} \usepackage{mathrsfs} \usepackage{upgreek} \setlength{\oddsidemargin}{-69pt} \begin{document}$${}^{-1}$$\end{document} (Infrared). Nanoribbon structures derived from 2DDA exhibit diverse electronic behaviors, from metals up to bandgap values of up to 0.42 eV, depending on the edge-type terminations and width. These findings demonstrate the 2DDA potential for nanoelectronic and optoelectronic applications.

JOURNAL OF INORGANIC AND ORGANOMETALLIC POLYMERS AND MATERIALS, 2025. **Acesso: https://doi.org/10.1007/s10904-025-03947-6**

[P138-2025] "Analytical Solutions of the Driven Time-Dependent Jaynes-Cummings Model"

Vidiella-Barranco, A.*; Castro, A. S. M. de; Sergi, A.; **Roversi, J. A.***; Messina, A.; Migliore, A.

This study explores the dynamics of a Driven Time-Dependent Jaynes-Cummings (DTDJC) model, in which the atom and the field are influenced by an external classical field with time-varying amplitude modulation. By applying a series of unitary transformations and establishing suitable conditions for the time-dependent parameters of the system, the Hamiltonian operator is transformed into one representing a system not driven by an external field, namely a Free TDJC (FTDJC) system. This mapping allows us to determine, in both the time-independent and time-dependent cases, forms of the pumping modulating the field and the atomic population that are amenable to exact analytical solution. The effects of an off-resonance parameter emerging from the analytical solution of the model and the intensity of the classical pumping field on the dynamics of the atomic population are investigated. The exact solution allows us to reveal a rich dynamics of the system (including long-time super-revivals) that could be of use in future quantum technologies.

ANNALEN DER PHYSIK, 2025. **Acesso: https://doi.org/10.1002/andp.202500148**. Early Access Date: JUL 2025

[P139-2025] "Anthraphenylenes: Porous 2D carbon monolayers with biphenyl-anthracene frameworks"

Lima, K. A. L.*; Laranjeira, J. A. S.; Martins, N. F.; Azevedo, S. A.; Sambrano, J. R.; Ribeiro Junior, L. A.

Carbon's versatility allows it to form diverse structures with unique properties, driven by its moderate electronegativity, small ionic radius, and ability to adopt sp, sp2, and sp3 hybridizations, individually or in combination. In this work, we introduce three novel 2D carbon allotropes - alpha, beta, and gamma-anthraphenylenes - derived from biphenylene and Dewar-anthracene motifs, investigated through density functional theory calculations. Their thermodynamic and dynamic stability are confirmed by cohesive energy (-7.02 to-7.26 eV/atom), phonon dispersion, and ab initio molecular dynamics simulations. The electronic structure analysis shows that all three anthraphenylenes display metallic behavior. The mechanical analysis highlights significant anisotropy, mainly in gamma-anthraphenylene, which exhibits the highest rigidity. These monolayers feature a porous architecture with tunable mechanical properties, making them promising candidates for nanoelectronics and energy storage applications. By expanding the family of 2D carbon materials, anthraphenylenes provide new avenues for functional nanomaterial design.

PHYSICA B-CONDENSED MATTER 713, 417299, 2025. **Acesso: https://doi.org/10.1016/j.physb.2025.417299**

[P140-2025] "Atomistic Modeling of Gap Nanowire Growth and Heat Transport via Interatomic Potential: Implications for Thermoelectric Applications"

Oliveira, D. S.; Kuritza, D. P.; **Zavarize, M.*;** Padilha, J. E.; **Cotta, M. A.***

Atomistic simulations of gallium phosphide (GaP) nanomaterials are limited by the absence of reliable and publicly available interatomic potentials. In this work, we develop and parametrize a classical angular-dependent potential for GaP based on force-matching against density functional theory reference data, enabling accurate large-scale simulations of GaP-based nanoscale systems. The developed potential effectively reproduces essential structural, elastic, and energetic properties of bulk GaP in both zinc-blende and wurtzite phases, despite some deviations from experimental reference values. Through molecular dynamics simulations, we demonstrate the potential's ability to describe key aspects of self-catalyzed vapor-liquid-solid growth in GaP nanowires, such as nucleation dynamics, temperature stability limits, and the influence of catalyst geometry. Furthermore, thermal transport simulations reveal that the model accurately captures qualitative trends regarding the impact of nanostructure size and surface morphology on thermal conductivity. Additionally, we investigate thermal rectification effects in telescopic GaP nanowires, observing measurable heat-flow asymmetries. These findings provide insights into phonon engineering strategies at the nanoscale, highlighting the relevance of GaP nanostructures for next-generation thermoelectric applications. The interatomic potential presented here will be made publicly available, offering a valuable computational tool for future investigations of GaP nanomaterials.

ACS APPLIED NANO MATERIALS 8[26], p. 13340-13348, 2025. **Acesso: https://doi.org/10.1021/acsanm.5c01892**

[P141-2025] "Chemical pressure effects on the physical properties of the quasicrystal approximants GdCd6-xZnx"

Munevar, J.; Silva, K. V. R. A.; Dutra, M. S.; **Fabris, F.***; Padron-Hernandez, E.; Rodrigues, J. N. B.; Cabrera-Baez, M.

Quasicrystal approximants (QCAs) are a class of crystalline materials that share structural and electronic similarities with quasicrystals while maintaining periodicity. Here we report on the structural, thermodynamic, electronic, magnetic, and transport properties of the QCAs of GdCd6-xZnx (x = 0.0, 0.5, and 1.0) prepared by the flux method. The substitution of Cd by Zn results in a 4.7% reduction in volume for x = 1.0, as revealed by x-ray diffraction measurements. The chemical pressure also reduces the N & eacute;el temperature (TN), as observed in specific heat, resistivity, and magnetic susceptibility measurements, which is caused by the reduction of the total density of states at the Fermi level induced by Zn doping, as suggested from density functional theory calculations. Interestingly, for a specific concentration of Zn (x = 1.0), the system behaves differently, exhibiting tunable resistance at low temperatures under different values of an external magnetic field. These observations suggest that the physical properties of the GdCd6 approximant under chemical pressure can be interpreted within an electronic multiband scenario.

PHYSICAL REVIEW B 111[17], 174408, 2025. **Acesso: https://doi.org/10.1103/PhysRevB.111.174408**

[P142-2025] "Compensation-Like Temperature and Spin-Flip Switch in Strained Thulium Iron Garnet Thin Films: Tuning Sublattice Interactions for Ferrimagnetic Spintronics"

Soares, C. C.*; Mori, T. J. A.; **Béron, F.*;** Moodera, J. S.; Cezar, J. C.; Brandao, J.; Vilela, G.

Certain rare-earth iron garnet (RIG) thin films combine desirable properties such as low magnetic damping, high magnetostriction, and, in some cases, perpendicular magnetic anisotropy (PMA), making them attractive for spintronics applications. However, the interplay between their magnetic sublattices in confined films remains poorly explored, particularly the coupling between 3d and 4f electrons. Here, we investigate the magnetic properties of a 30 nm-thick thulium iron garnet (TmIG) thin film, where tensile strain promotes PMA. SQUID magnetometry and X-ray magnetic circular dichroism measurements reveal a magnetization minimum near 50 K under moderate magnetic fields, leading to a compensation-like temperature (T comp-like), a feature absent in bulk TmIG. The presence of T comp-like is particularly relevant for controlling magnetization dynamics through compensation phenomena. Additionally, we observe a field-induced spin-flip transition in the T m sublattice, where T m moments reorient and align ferromagnetically with respect to the Fe sublattices. This mechanism can be exploited for energy-efficient magnetization reversal. These findings provide insights into strain-driven magnetic phenomena in rare-earth iron garnet thin films, highlighting the interplay between exchange interactions and anisotropy in confined geometries, which is crucial for the development of spintronic and magnonic devices.

ACS APPLIED NANO MATERIALS 8[29], p. 14567-14575, 2025. **Acesso: https://doi.org/10.1021/acsanm.5c02082**

[P143-2025] "Crystalline environment of luminescent Tb3+ions embedded in indium tin oxide thin films: a DFT and crystal field analysis assessment"

Serquen, E.; Lizarraga, K.; Enrique, L. A.; Bravo, F.; Mishra, S.; Llontop, P.; Venezuela, P.; **Tessler, L. R.***; Guerra, J. A.

We assess the local symmetry and crystal environment of trivalent terbium ions embedded in an indium tin oxide matrix with bixbyite structure. The Tb3+ ions tend to substitute In3+ ions in two different cationic sites (b and d). Density functional theory calculations suggest that the Tb3+ ions are mainly located at C2 symmetry sites, relaxing selection rules and enabling electric dipole transitions, with the 5D4 -> 7F2 transition being the most intense, providing a red color to the light emission. Photoluminescence emission spectrum under UV excitation at 83 K revealed 30 intra-4 f transitions, which were assigned to the 7FJ ground multiplet of the Tb3+ ion. Crystal field analysis shows a strong alignment between calculated and observed energy levels, yielding a standard deviation of sigma = 15.1 cm-1. We believe these results can help to understand the activation mechanisms of Tb3+ luminescent centers in transparent conductive oxides, as well as the potential to modulate Tb3+ emission color through its crystalline environment.

PHYSICAL REVIEW MATERIALS 9[5], 055202, 2025. **Acesso: https://doi.org/10.1103/PhysRevMaterials.9.055202**

[P144-2025] "Deterministic Fabrication of GaAs-Quantum--Dot Micropillar Single-Photon Sources"

Madigawa, A. A.; Jacobsen, M. A.; Piccinini, C.; Wyborski, P.; Garcia Jr, A.; **Silva, S. F. C. da***; Rastelli, A.; Munkhbat, B.; Gregersen, N.

This study investigates the performance of droplet-etched GaAs quantum dots (QDs) integrated into micropillar structures using a deterministic fabrication technique. A unity QD positioning yield across 74 devices and consistent device performanceare demonstrated. Under p-shell excitation, the QD decay dynamics within the micropillars exhibit biexponential behavior, accompanied by intensity fluctuations limiting the source efficiency to < 4.5%. Charge stabilization via low-power above-band LED excitation effectively reduces these fluctuations, doubling the source efficiency to similar to 9%. Moreover, suppression of radiation modes is introduced by implementing cylindrical rings theoretically predicted to boost the collection efficiency by a factor of 4. Experimentally, only a modest improvement is obtained, underscoring the influence of even minor fabrication imperfections for this advanced design. These findings demonstrate the reliability of the deterministic fabrication approach in producing high-yield, uniform devices, while offering detailed insights into the influence of charge noise and complex relaxation dynamics on the performance.

ADVANCED QUANTUM TECHNOLOGIES, 2025. **Acesso: https://doi.org/10.1002/qute.202500128**

[P145-2025] "Direct-photon production in inelastic and high--multiplicity proton-proton collisions at √s=13 TeV"

Acharya, S.; Agarwal, A.; **Guardiano, G. G.*; Jahnke, C.*; Liveraro, G. S. S.*; Takahashi, J.***; et al.
ALICE Collaboration

In this letter, we present the first measurement of direct photons at the transverse momentum of 1 < p(T) < 6 GeV/c at midrapidity in inelastic and high-multiplicity proton-proton collisions at a centre-of-mass energy of root s = 13 TeV. The fraction of virtual direct photons in the inclusive virtual photon spectrum is obtained from a fit to the dielectron invariant mass spectrum. In the limit of zero invariant mass, this fraction is equal to the relative contribution of real direct photons in the inclusive real photon spectrum. Contributions from decays of light-flavour neutral mesons are estimated using independent measurements in proton-proton collisions at the same energy and the same event class. For the first time at the LHC energies, a direct-photon signal is observed at low p(T) in both inelastic and high-multiplicity event classes, with a significance of 3.2 sigma and 1.9 sigma in terms of standard deviations, correspondingly. The yield of direct photons in inelastic pp collisions is compared to perturbative QCD calculations. The integrated photon yield is studied as a function of charged-particle multiplicity and is compared to the results from other experiments and theoretical calculations. The results show a significant increase of direct-photon yield with charged-particle multiplicity.

PHYSICS LETTERS B 868, 139645, 2025. **Acesso: https://doi.org/10.1016/j.physletb.2025.139645**

[P146-2025] "Effects of the annealing process on the physical properties of p-Terphenyl films deposited on dichroic filters for X-ARAPUCA"

Mendonca, A. P. A.*; Pagliuso, L. L.*; Merlo, R. B.*; Marques, F. C.*; Machado, A. A.*; Perotti, B. L.; Figueroa, C. A.; **Segreto, E.***

This study evaluated the adhesion behavior and efficiency of p-Terphenyl (PTP) films subjected to annealing at various temperatures. After substrate cleaning and vacuum thermal evaporation, the samples were annealed in a muffle furnace with a temperature ramp rate of 10 degrees C/min. The minimum annealing temperature was determined through thermogravimetric analysis. The samples were characterized morphologically and structurally, both before and after annealing, to investigate how these properties were influenced by the thermal process. The VUV light transmission efficiency variation of the PTP film was measured using a monochromator, while adhesion to the substrate was assessed using Scratch Test. The results indicated significant improvements in the optimization of X--ARAPUCA devices. Specific annealing processes were found to enhance the crystallinity and structural order of the films. At moderate annealing temperatures (up to 70 degrees C), both adhesion and efficiency improved. Conversely, higher temperatures led to material degradation and increased surface roughness. At 70 degrees C, efficiency increased by approximately 10%, and adhesion was optimized, as evidenced by an increase in the critical supported load, which reached 75 mN.

JOURNAL OF INSTRUMENTATION 20[6], C06006, 2025. **Acesso: https://doi.org/10.1088/1748-0221/20/06/C06006**

[P147-2025] "Electromagnetically induced transparency for a mechanical probe in a hybrid quantum circuit"

Oliveira, M. C. de*; Rossatto, D. Z.; Sa Neto, O. P. de

We investigate electromagnetically induced transparency (EIT) in a hybrid quantum circuit composed of a three-level transmon in a ladder configuration, capacitively coupled to both a transmission line resonator (TLR) and a nanoelectromechanical system (NEMS). Within the mean-field approximation, we demonstrate that this system can exhibit a narrow transparency window for a mechanical probe, controlled by an electromagnetic excitation. This configuration enables the creation of a dark state in the transmon and allows for adiabatic population transfer between its ground and excited states. Our findings reveal a new mechanism of quantum interference between hybrid mechanical and electromagnetic modes, with potential applications in quantum control of mechanical signals.

PHYSICS LETTERS A 555, 130786, 2025. **Acesso: https://doi.org/10.1016/j.physleta.2025.130786**

[P148-2025] "Energy-scaling behavior of intrinsic transverse-momentum parameters in Drell-Yan simulation"

Hayrapetyan, A.; Tumasyan, A.; Adam, W.; **Chinellato, J. A.***; et al.
CMS Collaboration

An analysis is presented based on models of the intrinsic transverse momentum (intrinsic k(T)) of partons in nucleons by studying the dilepton transverse momentum in Drell--Yan events. Using parameter tuning in event generators and existing data from fixed-target experiments and from hadron colliders, our investigation spans 3 orders of magnitude in center-of-mass energy and 2 orders of magnitude in dilepton invariant mass. The results show an energy-scaling behavior of the intrinsic k(T) parameters, independent of the dilepton invariant mass at a given center-of-mass energy.

PHYSICAL REVIEW D 111[7], 072003, 2025. **Acesso: https://doi.org/10.1103/PhysRevD.111.072003**

[P149-2025] "Engineering Graded Magnetic Anisotropy via Cation Interdiffusion in Core/Shell Nanoparticles"

Orozco-Henao, J. M.; **Almeida, A. A.*; Fabris, F.***; Addato, M. A. F.; Fonticelli, M. H.; **Muraca, D.***; Lavorato, G. C.

Spinel ferrite nanoparticles (NPs) with controlled composition, size, and morphology have offered a wide range of functional properties, but engineering nonhomogeneous composition profiles remains elusive. Here, we use Fe3O4/CoFe2O4 core/shell NPs as precursors to prepare compositionally graded NPs via controlled interfacial diffusion of metal cations. Electron-microscopy-based elemental mapping reveals that thermal annealing above 200 °C in an oxygen-rich atmosphere transforms the initially sharp core/shell interface into a compositionally graded spinel structure with a Co-rich outer layer. This cation redistribution results in pronounced changes in the magnetic properties, including a remarkable increase in coercivity and high-field susceptibility. Enhancement in the effective anisotropy is quantitatively described by modeling the time-dependent Co diffusion, enabling estimation of the cation diffusivity. These findings demonstrate a robust strategy for preparing anisotropy-graded spinel ferrite NPs, offering a broadly applicable approach to tailoring the properties of complex metal oxide nanostructures.

NANO LETTERS, 2025. **Acesso em: https://doi.org/10.1021/acs.nanolett.5c03005**. Early Access Date: AUG 2025

[P150-2025] "Exploring Biomass Waste-Derived Biochar as a Catalyst for Levulinic Acid Conversion to γ-Valerolactone: Insights into Synthesis, Characterization, and Catalytic Performance"

Macedo, J. C. A.; Shirinkar, M.; **Landers, R.***; Rosa, A. H.

The transition from fossil resources to renewable raw materials derived from lignocellulosic waste is crucial for economic and environmental sustainability. Advancing toward a bio-based economy necessitates the development of innovative heterogeneous catalysts. This study explores the use of modified sugarcane bagasse biochar, embedded with ruthenium and iron particles, as a green catalyst for converting levulinic acid (LA) to gamma-valerolactone (GVL). The efficiency of both raw and modified biochar in the LA to GVL conversion process, utilizing formic acid (FA) exclusively as the hydrogen source, was systematically assessed through characterization techniques, including XRD, TGA, XPS, and SEM/EDS. The gelification method using alginate enhanced the ruthenium and iron content on the surface of the biochar. The results demonstrate that the modified material has significant potential for efficient LA-to-GVL conversion, achieving a yield of 73.0 +/- 9.2% under optimized conditions (0.5 g of BC500Fe/3%Ru at 180 degrees C for 3 h, with 4 mmol LA, 8 mmol FA, and 10 mL of water). Iron on the biochar surface facilitated the formation of adsorption sites for LA, supporting the notion of this novel catalyst for LA conversion in an aqueous medium in the presence of FA. This research underscores the potential of this green catalyst in advancing sustainable biomass conversion and contributes to the ongoing shift towards a bio-based economy.

BIOMASS-SWITZERLAND 5[2], 29, 2025. **Acesso: https://doi.org/10.3390/biomass5020029**

[P151-2025] "Exploring light propagation in nonlinear electrodynamics: phase and group velocities and related phenomena"

Cruz, T. W.*; De Lorenci, V. A.; Guzman-Herrera, E.; Ribeiro, C. C. H.

Nonlinear electrodynamics has been an important area of research for a long time. Investigations based on nonlinear Lagrangians, such as Euler-Heisenberg and Born-Infeld, are instrumental in exploring the limits of classical and quantum field theories, providing valuable insights into strong-field phenomena. In this context, this work considers how light propagates in strong-field environments, where such nonlinearities play significant roles, offering a way to investigate events in high-energy astrophysics, quantum optics, and fundamental physics beyond classical Maxwell's framework. Here, several aspects of light propagation in nonlinear electrodynamics are discussed. Phase and group velocities are derived and several interesting behaviors are unveiled, such as birefringence, non-reciprocal propagation, and asymmetries between phase and group velocities in special configurations. Specific solutions based on commonly studied nonlinear theories are also investigated, and phenomena like slow-light and one-way propagation are discussed.

EUROPEAN PHYSICAL JOURNAL C 85[7], 761, 2025. **Acesso em: https://doi.org/10.1140/epjc/s10052-025-14476-4**

[P152-2025] "Exploring N2 capturing in Liquid Argon using Li-FAU Mol Sieve in the Iceberg Cryostat"

Bianchi Neto, P.; Soccol Junior, R.; Blaszczyk, F. de M.; Koshelev, S.; Hahn, A.; Correia, D.; Cardoso, D.; Doubnik, R.; Adamowski, M.; Montanari, D.; **Alegre, T. P. M.*; Machado, A. A.*; Segreto, E.*;** Assaf, J. M.; Motta, H. da; **Pagliuso, P. G.***; Noriler, D.

Liquefied ultrapure noble gases are typically the chosen target for neutrino and dark matter experiments. Commonly, the required grade of purity of such cryogenic liquids in terms of O-2 contamination is less than 100 ppt, which makes it necessary for the argon to circulate through adsorption columns filled, typically, with BASF Cu-0226S and Mol Sieve 4A for capturing O-2 and H2O. Another requirement that emerged during the design of LBNF-DUNE is the purity of the Liquid Argon (LAr) in terms of N-2 concentration, as it was observed that both N-2 and O-2 contaminations can cause the reduction of the LAr scintillation light emission. In particular, a decreasing behavior in the lifetime and the relative amplitude of the slow component is relevant from concentrations of 1 ppm of N-2 and 0.1 ppm of O-2. Recently, exploratory experiments performed in the Liquid Argon Purification Cryostat (PuLArC - similar to 90 L of LAr) had been successfully used to purify LAr from N-2 using an innovative solid adsorbent based on a Li-FAU Molecular Sieve. Here, we report experiments of N-2 capturing in LAr carried out at the ICEBERG Cryostat (similar to 3000 L of LAr) at Fermilab. For the experiments, several controlled injections of N-2 were made into the cryostat, and the impurity concentrations in the LAr (both for N-2 and O-2) were monitored using a calibrated gas analyzer during the purification process. The experimental data confirmed that the Li-FAU is capable of capturing the N-2 from the LAr. A numerical methodology based on the mass and energy balances of the system was applied to better understand the behavior of the adsorption process and to help with the scale-up of the process. A Pore Diffusion Model (PDM) coupled with parameter optimization was proposed to predict the N-2 concentration in the ICEBERG cryostat over time. The model parameters applied in this work were determined based on experimental data acquired in the PuLArC. The model was able to accurately reproduce the data from the ICEBERG, indicating that the mathematical model could be a valuable tool to design and operate the GAr/LAr system of LBNF-DUNE. It was possible to predict from simulations the necessary time to reach the required purity from an initial contamination concentration and also the number of purification cycles until solid saturation.

JOURNAL OF INSTRUMENTATION 20[6], C06045, 2025. **Acesso em: https://doi.org/10.1088/1748-0221/20/06/C06045**

[P153-2025] "Exploring Novel 2D Analogues of Goldene: Electronic, Mechanical, and Optical Properties of Silverene and Copperene"

Santos, E. J. A. dos; Alves, R. A. F.; Dias, A. C.; Pereira Jr., M. L.; **Galvao, D. S.***; Ribeiro Jr, L. A.

Two-dimensional (2D) materials have garnered significant attention due to their unique properties and broad application potential. Building on the success of goldene, a monolayer lattice of gold atoms, we explore its proposed silver and copper analogues, silverene and copperene, using density functional theory calculations. Our findings reveal that silverene and copperene are energetically stable, with formation energies of -2.3 and -3.1 eV/atom, respectively, closely matching goldene's -2.9 eV/atom. Phonon dispersion and ab initio molecular dynamics simulations confirm their structural and dynamical stability at room temperature, showing no bond breaking or structural reconfiguration. Mechanical analyses indicate isotropy, with Young's moduli of 73, 44, and 59 N/m for goldene, silverene, and copperene, respectively, alongside Poisson's ratios of 0.46, 0.42, and 0.41. These results suggest comparable rigidity and deformation characteristics. Electronic band structure analysis highlights their metallic nature with variations in the band profiles at negative energy levels. Despite their metallic character, these materials exhibit optical properties akin to those of semiconductors, pointing to potential applications in optoelectronics.

ACS OMEGA 10[25], p. 26892-26900, 2025. **Acesso em: https://doi.org/10.1021/acsomega.5c01823**

[P154-2025] "Exploring photon-number-encoded high-dimensional entanglement from a sequentially excited quantum three-level system"

Vajner, D. A.; Kewitz, N. D.; von Helversen, M.; Wein, S. C.; Karli, Y.; Kappe, F.; Remesh, V.; **Silva, S. F. C. da***; Rastelli, A.; Weihs, G.; Anton-Solanas, C.; Heindel, T.

The sequential resonant excitation of a two-level quantum system results in the emission of a state of light showing time-entanglement encoded in the photon-number basis: notions that can be extended to three-level quantum systems as discussed in a recent proposal [Opt. Lett. 48, 6332 (2023)]. Here, we report the experimental implementation of a sequential two-photon resonant excitation process of a solid-state three-level system, constituted by the biexciton, exciton, and ground states of a semiconductor quantum dot. The resulting light state exhibits entanglement in time and energy, encoded in the photon-number basis, which could be used in quantum information applications, e.g., dense information encoding or quantum communication protocols. By performing energy-and time-resolved correlation experiments in combination with extensive theoretical modeling, we are able to partially retrieve the entanglement structure of the generated state and extract an upper bound for the fidelity to the entangled target state of F <= 70% before loss. Published by Optica Publishing Group under the terms of the Creative Commons Attribution 4.0 License. Further distribution of this work must maintain attribution to the author(s) and the published article's title, journal citation, and DOI.

OPTICA QUANTUM 3[1], p. 99-110, 2025. **Acesso em: https://doi.org/10.1364/OPTICAQ.538134**

[P155-2025] "Ferrimagnetic Kitaev spin liquids in mixed spin-1/2 and spin-3/2 honeycomb magnets"

Natori, W.*; Yang, Y.; Jin, H. K.; Knolle, J.; Perkins, N. B.

We explore the phase diagram of a mixed-spin Kitaev model, where spin-1/2 and spin-3/2 ions form a staggered pattern on a honeycomb lattice. Enabled by an exact mapping of local conserved flux operators onto Z2 gauge fields,

we perform a parton mean-field theory for the model with a single-ion anisotropy. The phase diagram contains four types of quantum spin liquids distinguished by quadrupolar parameters. These analytical results are quantitatively confirmed by state-of--the-art DMRG simulations. We also explore the potential experimental realization of the mixed-spin Kitaev model in materials such as Zr0.5Ru0.5Cl3. By developing a superexchange theory specifically for this mixed-spin system, we identify the conditions under which dominant Kitaev-like interactions emerge. Our findings highlight the importance of spin-orbital couplings and quadrupolar order parameters in stabilizing exotic phases, providing a foundation for exploring mixed-spin Kitaev magnets.

PHYSICAL REVIEW B 111[21], 214411, 2025. **Acesso em: https://doi.org/10.1103/PhysRevB.111.214411**

[P156-2025] "First Measurement of A=4 Hypernuclei and Antihypernuclei at the LHC"

Acharya, S.; Agarwal, A.; **Guardiano, G. G.*; Jahnke, C.*; Liveraro, G. S. S.*; Takahashi, J.*;** et al.
ALICE Collaboration

In this Letter, the first evidence of the 4((Lambda) over bar) (He) over bar antihypernucleus is presented, along with the first measurement at the LHC of the production of (anti)hypernuclei with mass number A = 4, specifically (anti)H-4(Lambda) and (anti)He-4(Lambda). In addition, the antiparticle-to-particle ratios for both hypernuclei (4((Lambda) over bar)(H) over bar /4(Lambda)H and 4((Lambda) over bar)(He) over bar/He--4(Lambda)) are shown, which are sensitive to the baryochemical potential of the strongly interacting matter created in heavy-ion collisions. The results are obtained from a data sample of central Pb-Pb collisions, collected during the 2018 LHC data taking at a center-of-mass energy per nucleon pair of root sNN = 5.02 TeV. The yields measured for the average of the charge-conjugated states are found to be [0.78 +/- 0.19(stat) +/- 0.17(syst)] x 10(-6) for the (anti)H-4(Lambda) and [1.08 +/- 0.34(stat) +/- 0.20(syst)] x 10(-6) for the (anti)He-4(Lambda), and the measured antiparticle-to-particle ratios are in agreement with unity. The presence of (anti)H-4(Lambda) and (anti) He-4(Lambda) excited states is expected to strongly enhance the production yield of these hypernuclei. The yield values exhibit a combined deviation of 3.3 sigma from the theoretical ground-state-only expectation, while the inclusion of the excited states in the calculations leads to an agreement within 0.6 sigma with the present measurements. Additionally, the measured (anti)H-4(Lambda) and (anti)He-4(Lambda) masses are compatible with the world-average values within the uncertainties.

PHYSICAL REVIEW LETTERS 134[16], 162301, 2025. **Acesso em: https://doi.org/10.1103/PhysRevLett.134.162301**

[P157-2025] "First polarisation measurement of coherently photoproduced J/ψ in ultra-peripheral Pb-Pb collisions at √sNN=5.02 TeV"

Acharya, S.; Adamova, D.; **Chinellato, D. D.*; Guardiano, G. G.*; Jahnke, C.*; Takahashi, J.***; et al.
ALICE Collaboration

The first measurement of the polarisation of coherently photoproduced J/psi mesons in ultra-peripheral Pb-Pb collisions, using data at root s(NN) = 5.02 TeV, is presented. The J/psi meson is measured via its dimuon decay channel in the forward rapidity interval -4.0 < y < -2.5 using the ALICE detector at the CERN LHC. An event sample corresponding to an integrated luminosity of 750 mu b(-1) +/- 5% (syst) is analysed. Hadronic activity is highly suppressed since the interaction is mediated by a photon. The polar and azimuthal angle distributions of the decay muons are measured, and the polarisation parameters lambda(theta), lambda(phi), lambda(theta phi) are extracted. The analysis is carried out in the helicity frame. The results are found to be consistent with a transversely polarised J/psi. These values are compared with previous measurements by the H1 and ZEUS experiments. The polarisation parameters of coherent J/psi photoproduction in Pb-Pb collisions are found to be consistent with the s-channel helicity conservation hypothesis.

PHYSICS LETTERS B 865, 139466, 2025. **Acesso em: https://doi.org/10.1016/j.physletb.2025.139466**

[P158-2025] "Fluorescent pigments for application in downshifting ultraviolet light"

Oliveira, O. J. de*; Crestani, T.; **Coutinho, N. de F.*; Modesto, A. P. de M. M.***; Silva Filho, J. M. C. da; Barros, T. A. S.; **Marques, F. das C.***

Silicon and perovskite solar cells have reached efficiencies above 26%, close to the Shockley-Queisser theoretical limit. However, further increases in efficiency are still possible by better utilizing the ultraviolet energy range of sunlight. One proposal uses a wavelength shifter to shift photons from the ultraviolet to the visible region. Furthermore, shifting these photons helps preserve the integrity of the sealants used in manufacturing the modules, which degrade with ultraviolet light. In this work, thin films of photoluminescent dye pigments were developed, and their photoemission properties were investigated. Tin dioxide (SnO2) films with incorporated pigment were also examined, aiming for their use with dual functions, anti-reflective coating, and wavelength shifters. The films showed emission in the visible spectrum range when excited in the ultraviolet region, indicating a potential for use in solar cells, increasing light absorption in the ultraviolet region, and preventing degradation of the sealant with sun exposure.Graphical abstractPhotoluminescent dye pigments currently used in cosmetics, graphic arts, and adhesives are wavelength-shifters with potential use in solar cells.

MRS ADVANCES 10, p. 1290–1295, 2025. **Acesso em: https://doi.org/10.1557/s43580-025-01301-z .**

[P159-2025] "fNIRS reproducibility varies with data quality, analysis pipelines, and researcher experience"

Yucel, M. A.; Luke, R.; **Mesquita, R. C.*; Martins, G. G.***; et al.

As data analysis pipelines grow more complex in brain imaging research, understanding how methodological choices affect results is essential for ensuring reproducibility and transparency. This is especially relevant for functional Near-Infrared Spectroscopy (fNIRS), a rapidly growing technique for assessing brain function in naturalistic settings and across the lifespan, yetone that still lacks standardized analysis approaches. In the fNIRS Reproducibility Study Hub (FRESH) initiative, we asked 38 research teams worldwide to independently analyze the same two fNIRS datasets. Despite using different pipelines, nearly 80% of teams agreed on group-level results, particularly when hypotheses were strongly supported by literature. Teams with higher self-reported analysis confidence, which correlated with years of fNIRS experience, showed greater agreement. At the individual level, agreement was lower but improved with better data quality. The main sources of variability were related to how poor-quality data were handled, how responses were modeled, and how statistical analyses were conducted. These findings suggest that while flexible analytical tools are valuable, clearer methodological and reporting standards could greatly enhance reproducibility. By identifying key drivers of variability, this study highlights current challenges and offers direction for improving transparency and reliability in fNIRS research.

COMMUNICATIONS BIOLOGY 8[1], 1149, 2025. **Acesso em: https://doi.org/10.1038/s42003-025-08412-1**

[P160-2025] "High-significance detection of correlation between the unresolved gamma-ray background and the large--scale cosmic structure"

Thakore, B.; Negro, M.; **Navarro-Alsina, A.***; et al.

Our understanding of the 7-ray sky has improved dramatically in the past decade, however, the unresolved 7-ray background (UGRB) still has a potential wealth of information about the faintest 7-ray sources pervading the Universe. Statistical cross-correlations with tracers of cosmic structure can indirectly identify the populations that most characterize the 7-ray background. In this study, we analyze the angular correlation between the 7-ray background and the matter distribution in the Universe as traced by gravitational lensing, leveraging more than a decade of observations from the Fermi-Large Area Telescope (LAT) and 3 years of data from the Dark Energy Survey (DES). We detect a correlation at signal-tonoise ratio of 8.9. Most of the statistical significance comes from large scales, demonstrating, for the first time, that a substantial portion of the UGRB aligns with the mass clustering of the Universe as traced by weak lensing. Blazars provide a plausible explanation for this signal, especially if those contributing to the correlation reside in halos of large mass (similar to 1014 M circle dot) and account for approximately 30-40% of the UGRB above 10 GeV. Additionally, we observe a preference for a curved 7-ray energy spectrum, with a log--parabolic shape being favored over a power-law. We also discuss the possibility of modifications to the blazar model and the inclusion of additional 7-ray sources, such as star-forming galaxies, misalinged active galactic nuclei, or particle dark matter.

JOURNAL OF COSMOLOGY AND ASTROPARTICLE PHYSICS [6], 037, 2025. **Acesso em: https://doi.org/10.1088/1475-7516/2025/06/037**

[P161-2025] "HOP-graphene: A high-capacity anode for Li/Na-ion batteries unveiled by first-principles calculations"

Martins, N. F.; Laranjeira, J. A. S.; **Limab, K. A. L.***; Cabral, L. A.; Ribeiro Jr, L. A.; Sambrano, J. R.

The growing demand for efficient energy storage has driven the search for advanced anode materials for lithium-and sodium--ion batteries (LIBs and SIBs). In this context, we report the application of HOP-graphene (a 5-6-8-membered 2D carbon framework) as a high-performance anode material for LIBs and SIBs using density functional theory simulations. Diffusion studies reveal low energy barriers of 0.70 eV for Li and 0.39 eV for Na, indicating superior mobility at room temperature compared to other carbon allotropes, like graphite. Full lithiation and sodiation accommodate 24 Li and 22 Na atoms, respectively, delivering outstanding theoretical capacities of 1338 mAh/g (Li) and 1227 mAh/g (Na). Bader charge analysis and charge density difference maps confirm substantial electron transfer from the alkali metals to the substrate. Average open-circuit voltages of 0.42 V (Li) and 0.33 V (Na) suggest favorable electrochemical performance. HOP-graphene also demonstrates excellent mechanical strength. These findings position HOP-graphene as a promising candidate for next-generation LIB and SIB anodes.

APPLIED SURFACE SCIENCE 710, 163737, 2025. **Acesso em: https://doi.org/10.1016/j.apsusc.2025.163737**

[P162-2025] "Interface Engineering of 3D-Printed Liquid Crystal and 2D-White Pearl Composite for Tunable Fluorescence"

Mandal, N.; Hawthorne, F.; Rao, R.; Roy, A. K.; **Galvao, D. S.***; Kochat, V.; Woellner, C. F.; McConney, M. E.; Tiwary, C. S.

The ability to tune fluorescence in polymer composites via 2D materials, dyes, or interfacial modifications provides a versatile platform for advancing optoelectronics as the underlying mechanisms offer control over emission properties, leading to innovative materials. In this work, 2D-white pearl (2D-WP) has been synthesized from naturally occurring WP. Liquid crystal polymer (LCP) composites based on liquid crystal (LC) monomer mixture E7 have been produced via 3D printing. 2D-WP has been dispersed in the LCP composite to demonstrate LC-2D interaction and generation of fluorescence. It has been shown that by introducing interfaces, a secondary emission can be obtained from 2D-dispersed LCP composites. The interactions between the four monomers in E7 and 2D-WP have been simulated, depicting a reduction in the original bandgap of 4.31 eV for 2D-WP to 2.5 eV for LCP-2D composite. In this way, 3D-printed LCP in combination with 2D-WP is shown to be an exciting prospect in further optical and photonics studies.

ADVANCED ENGINEERING MATERIALS, 2025. **Acesso em: https://doi.org/10.1002/adem.202500857. E**arly Access Date: JUL 2025

[P163-2025] "J/ψ-hadron correlations at midrapidity in pp collisions at √s=13 TeV"

Acharya, S.; Agarwal, A.; **Chinellato, D. D.*; Guardiano, G. G.*; Jahnke, C.*; Liveraro, G. S. S.*; Takahashi, J.***; et al. ALICE Collaboration

We report on the measurement of inclusive, non-prompt, and prompt J/psi-hadron correlations by the ALICE Collaboration at the CERN Large Hadron Collider in pp collisions at a center-of--mass energy of 13 TeV. The correlations are studied at midrapidity (vertical bar y vertical bar < 0.9) in the transverse momentum ranges p(T) < 40 GeV/c for the J/psi and 0.15 < p(T) < 10 GeV/c and vertical bar eta vertical bar < 0.9 for the associated hadrons. The measurement is based on minimum bias and high multiplicity data samples corresponding to integrated luminosities of L-int = 34 nb(-1) and L-int = 6.9 pb(-1), respectively. In addition, two more data samples are employed, requiring, on top of the minimum bias condition, a threshold on the tower energy of E = 4 and 9 GeV in the ALICE electromagnetic calorimeters, which correspond to integrated luminosities of L-int = 0.9 pb(-1) and L-int = 8.4 pb(-1), respectively. The azimuthally integrated near and away side yields of associated charged hadrons per J/psi trigger are presented as a function of the J/psi and associated hadron transverse momentum. The measurements are discussed in comparison to PYTHIA calculations.

JOURNAL OF HIGH ENERGY PHYSICS [7], 023, 2025. **Acesso em: https://doi.org/10.1007/JHEP07(2025)023**

[P164-2025] "Keeping the photon in the dark: Enabling quantum dot dark state control by chirped pulses and magnetic fields"

Kappe, F.; Schwarz, R.; Karli, Y.; Bracht, T.; Axt, V. M.; **Silva, S. F. C. da*;** Rastelli, A.; Remesh, V.; Reiter, D. E.; Weihs, G.

Dark excitons in quantum dots are not directly optically accessible, which has limited their use in practical applications. Nevertheless, they offer promising features such as substantially longer lifetimes compared to bright excitons, making them attractive candidates for quantum information processing. While previous theoretical and experimental studies have explored their potential, their full capabilities remain largely untapped. In this work, we demonstrate an all-optical storage and retrieval of the spin-forbidden dark exciton in a quantum dot from the ground state using chirped pulses and an in-plane magnetic field. Our experimental findings are in excellent agreement with theoretical predictions of the dynamics calculated using state-of-the-art product tensor methods. Our scheme enables an all-optical control of dark states without relying on any preceding decays. This opens up an unexplored dimension for optimal quantum control and time--bin entangled photon pair generation from quantum dots.

SCIENCE ADVANCES 11[28], eadu4261, 2025. **Acesse em: https://doi.org/10.1126/sciadv.adu4261**

[P165-2025] "Lattice stability and elastic evolution of CdTe membranes fabrication using III-V heterostructures as a substrate"

Inoch, W. F.; Campos, E. P. M.; Muniz, M. C. I.; Malachias, A .; Rodrigues, G Jr Rodrigues-Junior, G.; Ferreira, S. O.; **Deneke, C.*;** Archanjo, B. S.; Pimenta, E. P.; Moura, L. G.; Araujo, E. N. D.; Rodrigues, L. N.

CdTe is a key binary compound for II-VI semiconductor systems since the precise control of its growth over different semiconductor materials of different orientations provides a general roadmap for telluride compounds, ranging from optically active layers to diluted magnetic semiconductors and topological insulators. The precise understanding of its epitaxy, film orientation and built-in strain is crucial for II-VI layer integration with commercial hosting substrates used for the latest semiconductor process nodes such as Si and GaAs. In this work, we show that it is feasible to use CdTe:GaAs/InGaAs/GaAs released membranes yielding high-quality crystalline layers. A combination of Raman scattering and X-ray diffraction results provide a concise scenario of evolution along different growth stages. Surface roughness and contact potential are evaluated by atomic force and Kelvin-probe microscopy, respectively. The coexistence of faceting types (001) and (111) becomes clear using AFM and KPFM near the edge of a CdTe membrane. At such edges the local cleavage of the membrane is probed, exposing several layer steps and reflecting the growth history of CdTe. In this condition, KPFM clearly differentiates faceting (throughout contact potential difference) more accurately than height profiles, allowing a qualitative explanation of the nucleation evolution in our system. Finally, the occurrence of a 4% in-plane interfacial compressive strain is observed by nanomembrane release and modelling with finite element methods. The results showing the flexibility of high-quality CdTe layers here can improve optoelectronic integration of II-VI semiconductors.

NANOSCALE 17[25], p. 15279-15288, 2025. **Acesso em: https://doi.org/10.1039/D4NR05029K**

[P166-2025] "Magnetically Tunable Polariton Cavities in van der Waals Heterostructures"

Mayer, R. A.*; Chen, X. Z.; Jing, R.; Tsuneto, M.; Zhou, B. Y.; Zhou, Z. J.; Zheng, W. J.; Pu, R.; Xu, S. H.; Liu, T.; Yao, H. L.; Wehmeier, L.; Dong, Y. N.; Sun, D. H.; He, L.; Cadore, A. R.; Heinz, T.; Fan, J. A.; Dean, C. R.; Basov, D. N.; Du, X.; Freitas, R. O.; Liu, M. K.

Nanophotonic cavities are the foundation for a broad spectrum of applications, including quantum sensing, on-chip communication, and cavity quantum electrodynamics. In van der Waals (vdW) materials, these cavities can harness polaritons, which are quasiparticles emerging from photon interactions with excitons, plasmons, or phonons that are confined in microscopic sample flakes. Hybrid phonon-plasmon cavities leverage the long lifetimes of phonons and good tunability of plasmons, but their reconfigurability remains fundamentally limited. Here, we introduce a magnetic-field-tuning mechanism for polaritonic cavities in a vdW heterostructure. Specifically, we demonstrate that the primary Landau transition in magnetized charge-neutral graphene can be harvested for controlling polaritonic cavity modes in a graphene-based phononic heterostructure. Additionally, we predict a magnetic-field--induced topological transition in the polariton isofrequency contour, causing a nontrivial cavity mode profile redistribution. Our study underscores the versatility of Landau-based nanophotonic cavities, offering new paradigms for the design and manipulation of light-matter interactions at the nanoscale.

NANO LETTERS, 2025. **Acesso em: https://doi.org/10.1021/acs.nanolett.5c02168.** Early Access Date: JUL 2025

[P167-2025] "Measurement of f1(1285) production in pp collisions at √s=13 TeV"

Acharya, S.; Agarwal, A.; **Guardiano, G. G.*; Jahnke, C.*; Liveraro, G. S. S.*; Takahashi, J.***; et al.
ALICE Collaboration

This study presents the first measurement of the f(1)(1285) resonance using the ALICE detector in inelastic proton-proton collisions at a center-of-mass energy of 13 TeV. The resonance is reconstructed at midrapidity (vertical bar y vertical bar < 0.5) through the hadronic decay channel f(1)(1285) -> (KSK +/-)-K-0 pi(-/+). Key measurements include the determination of its mass, transverse-momentum integrated yield, and average transverse momentum. Additionally, the ratio of the transverse--momentum integrated yield of f(1)(1285) to pion is compared with calculations from the canonical statistical hadronization model. The model calculation, assuming a zero total strangeness content for f(1)(1285), reproduces the data within 1 sigma deviation, shedding light on the quark composition of f(1)(1285).

PHYSICS LETTERS B 866, 2025. 139562, 2025. **Acesso em: https://doi.org/10.1016/j.physletb.2025.139562**

[P168-2025] "Measurement of the double-differential inclusive jet cross section in proton-proton collisions at √s=5.02 TeV"

Hayrapetyan, A.; Tumasyan, A.; **Chinellato, J. A.*;** et al.
CMS Collaboration

The inclusive jet cross section is measured as a function of jet transverse momentum p(T) and rapidity y. The measurement is performed using proton-proton collision data at root s = 5.02 TeV, recorded by the CMS experiment at the LHC, corresponding to an integrated luminosity of 27.4 pb(-1). The jets are reconstructed with the anti-k(T) algorithm using a distance parameter of R = 0.4, within the rapidity interval |y| < 2, and across the kinematic range 0.06 < p(T)< 1 TeV. The jet cross section is unfolded from detector to particle level using the determined jet response and resolution. The results are compared to predictions of perturbative quantum chromodynamics, calculated at both next-to-leading order and next-to-next-to-leading order. The predictions are corrected for nonperturbative effects, and presented for a variety of parton distribution functions and choices of the renormalization/factorization scales and the strong coupling alpha(S).

JOURNAL OF HIGH ENERGY PHYSICS [1], 011, 2025. **Acesso em: https://doi.org/10.1007/JHEP01(2025)011**

[P169-2052] "Measurement of the Higgs boson mass and width using the four-lepton final state in proton-proton collisions at √s=13 TeV"

Hayrapetyan, A.; Tumasyan, A.; **Chinellato, J. A.***; et al.
CMS Collaboration

A measurement of the Higgs boson mass and width via its decay to two Z bosons is presented. Proton-proton collision data collected by the CMS experiment, corresponding to an integrated luminosity of 138 fb(-1) at a center-of-mass energy of 13 TeV, is used. The invariant mass distribution of four leptons in the on--shell Higgs boson decay is used to measure its mass and constrain its width. This yields the most precise single measurement of the Higgs boson mass to date, 125.04 +/- 0.12 GeV, and an upper limit on the width Gamma(H) < 330 MeV at 95% confidence level.

A combination of the on- and off-shell Higgs boson production decaying to four leptons is used to determine the Higgs boson width, assuming that no new virtual particles affect the production, a premise that is tested by adding new heavy particles in the gluon fusion loop model. This result is combined with a previous CMS analysis of the off-shell Higgs boson production with decay to two leptons and two neutrinos, giving a measured Higgs boson width of 3.0(-1.5)(+2.0) MeV, in agreement with the standard model prediction of 4.1 MeV. The strength of the off-shell Higgs boson production is also reported. The scenario of no off-shell Higgs boson production is excluded at a confidence level corresponding to 3.8 standard deviations.

PHYSICAL REVIEW D 111[9], 092014, 2025. **Acesso em: https://doi.org/10.1103/PhysRevD.111.092014**

[P170-2025] "Measurement of the inclusive isolated-photon production cross section in pp collisions at √s=13 TeV"

Acharya, S.; Adamová, D.; **Chinellato, D. D.*; Guardiano, G. G.*; Jahnke, C.*; Liveraro, G. S. S.*; Takahashi, J.*;** et al.
ALICE Collaboration

The production cross section of inclusive isolated photons has been measured by the ALICE experiment at the CERN LHC in pp collisions at centre-of-momentum energy of root s = 13 TeV collected during the LHC Run 2 data-taking period. The measurement is performed by combining the measurements of the electromagnetic calorimeter EMCal and the central tracking detectors ITS and TPC, covering a pseudorapidity range of vertical bar eta(gamma)vertical bar < 0.67 and a transverse momentum range of 7 <p(T)(gamma) < 200 GeV/c. The result extends to lower p(T)(gamma) and x(T)(gamma) = 2p(T)(gamma)/root s ranges, the lowest x(T)(gamma) of any isolated photon measurements to date, extending significantly those measured by the ATLAS and CMS experiments towards lower p(T)(gamma) at the same collision energy with a small overlap between the measurements. The measurement is compared with next-to-leading order perturbative QCD calculations and the results from the ATLAS and CMS experiments as well as with measurements at other collision energies. The measurement and theory prediction are in agreement with each other within the experimental and theoretical uncertainties.

EUROPEAN PHYSICAL JOURNAL C 85[1], 98, 2025. **Acesso em: https://doi.org/10.1140/epjc/s10052-024-13506-x**

[P171-2025] "Measurement of the inclusive WZ production cross section in pp collisions at √s=13.6 TeV"

Hayrapetyan, A.; Tumasyan, A.; **Chinellato, J. A.*;** et al.
CMS Collaboration

The inclusive WZ production cross section is measured in proton-proton collisions at a centre-of-mass energy of 13.6 TeV, using data collected during 2022 with the CMS detector, corresponding to an integrated luminosity of 34.7 fb(-1). The measurement uses multileptonic final states and a simultaneous likelihood fit to the number of events in four different lepton flavour categories: eee, ee mu, mu mu e, and mu mu mu. The selection is optimized to minimize the number of background events, and relies on an efficient prompt lepton discrimination strategy. The WZ production cross section is measured in a phase space defined within a 30 GeV window around the Z boson mass, as sigma(total) (pp -> WZ) = 55.2 +/- 1.2 (stat) +/- 1.2 (syst) +/- 0.8 (lumi) +/- 0.3 (theo) pb. In addition, the cross section is measured in a fiducial phase space closer to the detector-level requirements. All the measurements presented in this paper are in agreement with standard model predictions.

JOURNAL OF HIGH ENERGY PHYSICS [4], 115, 2025. **Acesso em: https://doi.org/10.1007/JHEP04(2025)115**

[P172-2025] "Measurement of the production cross section of prompt Ξc0 baryons in p-Pb collisions at √sNN=5.02 TeV"

Acharya, S.; Adamová, D.; **Chinellato, D. D.*; Guardiano, G. G.*; Jahnke, C.*; Liveraro, G. S. S.*; Takahashi, J.***;** et al.
ALICE Collaboration

The transverse momentum (p(T)) differential production cross section of the promptly produced charmstrange baryon Xi(0)(c) (and its charge conjugate <(Xi(0)(c))over bar>) is measured at midrapidity via its hadronic decay into pi(+)Xi(-) in p-Pb collisions at a centre-of-mass energy per nucleon-nucleon collision root s(NN) = 5.02 TeV with the ALICE detector at the LHC. The Xi(0)(c) nuclear modification factor (R-pPb), calculated from the cross sections in pp and p-Pb collisions, is presented and compared with the RpPb of Lambda(+)(c) baryons. The ratios between the p(T)-differential production cross section of Xi(0)(c) baryons and those of D-0 mesons and Lambda(+)(c) baryons are also reported and compared with results at forward and backward rapidity from the LHCb Collaboration. Themeasurements of the production cross section of prompt Xi(0)(c) baryons are compared with a model based on perturbative QCD calculations of charm-quark production cross sections, which includes only cold nuclear matter effects in p-Pb collisions, and underestimates the measurement by a factor of about 50. This discrepancy is reduced when the data is compared with a model that includes string formation beyond leading-colour approximation or in which hadronisation is implemented via quark coalescence. The p(T)-integrated cross section of prompt Xi(0)(c)--baryon production at midrapidity extrapolated down to p(T) = 0 is also reported. These measurements offer insights and constraints for theoretical calculations of the hadronisation process. Additionally, they provide inputs for the calculation of the charm production cross section in p-Pb collisions at midrapidity.

EUROPEAN PHYSICAL JOURNAL C 85[1], 86, 2025. **Acesso em: https://doi.org/10.1140/epjc/s10052-024-13531-w**

[P173-2025] "Measurement of the t(t)over-barH and tH production rates in the H -- b(b)over-bar decay channel using proton-proton collision data at √s=13 TeV"

Hayrapetyan, A.; Tumasyan, A.; **Chinellato, J. A.*;** et al.
CMS Collaboration

An analysis of the production of a Higgs boson (H) in association with a top quark-antiquark pair (t (t) over barH) or a single top quark (tH) is presented. The Higgs boson decay into a bottom quark-antiquark pair (H -> b (b) over bar) is targeted, and three different final states of the top quark decays are considered, defined by the number of leptons (electrons or muons) in the event. The analysis utilises proton-proton collision data collected at the CERN LHC with the CMS experiment at root s = 13 TeV in 2016-2018, which correspond to an integrated luminosity of 138 fb(-1). The observed t (t) over barH production rate relative to the standard model expectation is 0.33 +/- 0.26 = 0.33 +/- 0.17(stat) +/- 0.21(syst). Additionally, the t (t) over barH production rate is determined in intervals of Higgs boson transverse momentum. An upper limit at 95% confidence level is set on the tH production rate of 14.6 times the standard model prediction, with an expectation of 19.3(-6.0)(+9.2). Finally, constraints are derived on the strength and structure of the coupling between the Higgs boson and the top quark from simultaneous extraction of the t (t) over barH and tH production rates, and the results are combined with those obtained in other Higgs boson decay channels.

JOURNAL OF HIGH ENERGY PHYSICS [2], 097, 2025. **Acesso em: https://doi.org/10.1007/JHEP02(2025)097**

[P174-2025] "Measurement of ω meson production in pp collisions at √s=13 TeV"

Acharya, S.; Adamova, D.; **Chinellato, D. D.*; Guardiano, G. G.*; Jahnke, C.*; Liveraro, G. S. S.*; Takahashi, J.***; et al.
ALICE collaboration

The p(T)-differential cross section of omega meson production in pp collisions at root s = 13 TeV at midrapidity (vertical bar y vertical bar < 0.5) was measured with the ALICE detector at the LHC, covering an unprecedented transverse-momentum range of 1.6 < p(T)< 50 GeV/c. The meson is reconstructed via the omega -> pi(+)pi(-)pi(0) decay channel. The results are compared with various theoretical calculations: PYTHIA8.2 with the Monash 2013 tune overestimates the data by up to 50%, whereas good agreement is observed with Next-to-Leading Order (NLO) calculations incorporating omega fragmentation using a broken SU(3) model. The omega/pi(0) ratio is presented and compared with theoretical calculations and the available measurements at lower collision energies. The presented data triples the p(T) ranges of previously available measurements. A constant ratio of C-omega/pi 0 = 0.578 +/- 0.006 (stat.) +/- 0.013 (syst.) is found above a transverse momentum of 4 GeV/c, which is in agreement with previous findings at lower collision energies within the systematic and statistical uncertainties.

JOURNAL OF HIGH ENERGY PHYSICS 4, 067, 2025. **Acesso em: https://doi.org/10.1007/JHEP04(2025)067**

[P175-2025] "Measurements of inclusive and differential cross sections for top quark production in association with a Z boson in proton-proton collisions at √s=13 TeV"

Hayrapetyan, A.; Tumasyan, A.; **Chinellato, J. A.***; et al.
CMS Collaboration

Measurements are presented of inclusive and differential cross sections for Z boson associated production of top quark pairs (t (t) over barZ) and single top quarks (tZq or tWZ). The data were recorded in proton-proton collisions at a center-of-mass energy of 13 TeV, corresponding to an integrated luminosity of 138 fb(-1). Events with three or more leptons, electrons or muons, are selected and a multiclass deep neural network is used to separate three event categories, the t (t) over barZ and tWZ processes, the tZq process, and the backgrounds. A profile likelihood approach is used to unfold the differential cross sections, to account for systematic uncertainties, and to determine the correlations between the two signal categories in one global fit. The inclusive cross sections for a dilepton invariant mass between 70 and 110 GeV are measured to be 1.14 +/- 0.07 pb for the sum of t (t) over barZ and tWZ, and 0.81 +/- 0.10 pb for tZq, in good agreement with theoretical predictions.

JOURNAL OF HIGH ENERGY PHYSICS [2], 177, 2025. **Acesso em: https://doi.org/10.1007/JHEP02(2025)177**

[P176-2025] "Measurements of Pion and Muon Nuclear Capture at Rest on Argon in the LArIAT Experiment"

Hernandez-Morquecho, M. A.; Acciarri, R.; **Kemp, E.*;** et al.
LArIAT Collaboration

We report the measurement of the final-state products of negative pion and muon nuclear capture at rest on argon by the LArIAT experiment at the Fermilab Test Beam Facility. We measure a population of isolated MeV-scale energy depositions, or blips, in 296 LArIAT events containing tracks from stopping low-momentum pions and muons. The average numbers of visible blips are measured to be 0.74 + 0.19 and 1.86 + 0.17 near muon and pion track endpoints, respectively. The 3.6 sigma statistically significant difference in blip content between muons and pions provides the first demonstration of a new method of pion-muon discrimination in neutrino liquid argon time projection chamber experiments. LArIAT Monte Carlo simulations predict substantially higher average blip counts for negative muon (1.22 + 0.08) and pion (2.34 + 0.09) nuclear captures. We attribute this difference to GEANT4's inaccurate simulation of the nuclear capture process.

PHYSICAL REVIEW LETTERS 134[13], 131801, 2025. **Acesso em: https://doi.org/10.1103/PhysRevLett.134.131801**

[P177-2025] "Mechanical strength and strain-induced optical shifts in monolayer azugraphene"

Bessa, M.; **Dantas, D. G. de M.*;** Gomes, D. da S.; Pereira Junior, M. L.; Azevedo, S.; Machado, L. D.

Azugraphene is a carbon allotrope with remarkably low energy per atom, predicted in 2019. Despite this, its mechanical properties and strain-dependent behavior remain largely unexplored. In this work, we perform first-principles calculations to investigate the mechanical, electronic, and optical properties of azugraphene under uniaxial strain. Our results show that azugraphene exhibits stiffness and strength comparable to graphene, with an isotropic mechanical response for small deformations. They also reveal that azugraphene evolves from a zero-gap semiconductor to a metallic state under high tensile deformation. Azugraphene also exhibits high reflectivity in the infrared and optical absorption peaks in the visible and ultraviolet ranges, which shift to lower energies in proportion to the applied tensile strain. Conversely, compressive strain shifts the absorption peaks to higher energies. The possibility of applying strain to tune the position of the visible light absorption peaks suggests azugraphene applications in optical sensors and solar cells.

COMPUTATIONAL MATERIALS SCIENCE 258, 114087, 2025. **Acesso em: https://doi.org/10.1016/j.commatsci.2025.114087**

[P178-2025] "Medium-induced modification of groomed and ungroomed jet mass and angularities in Pb-Pb collisions at √sNN=5.02 TeV"

Acharya, S.; Agarwal, A.; **Guardiano, G. G.*; Jahnke, C.*; Liveraro, G. S. S.*; Takahashi, J.*;** et al.
ALICE Collaboration

The ALICE Collaboration presents a new suite of jet substructure measurements in Pb-Pb and pp collisions at a center-of-mass energy per nucleon pair root s(NN) = 5.02 TeV. These measurements provide access to the internal structure of jets via the momentum and angle of their constituents, probing how the quark--gluon plasma modifies jets, an effect known as jet quenching. Jet grooming additionally removes soft wide-angle radiation to enhance perturbative accuracy and reduce experimental uncertainties. We report the groomed and ungroomed jet mass m(jet) and jet angularities lambda(kappa)(alpha) using kappa = 1 and alpha > 0. Charged-particle jets are reconstructed at midrapidity using the anti-k(T) algorithm with resolution parameter R = 0.2. A narrowing of the jet mass and angularity distributions in Pb-Pb collisions with respect to pp is observed and is enhanced for groomed results, confirming modification of the jet core. By using consistent jet definitions and kinematic cuts between the mass and angularities for the first time, previous inconsistencies in the interpretation of quenching measurements are resolved, rectifying a hurdle for understanding how jet quenching arises from first principles and highlighting the importance of a well--controlled baseline. These results are compared with a variety of theoretical models of jet quenching, providing constraints on jet energy-loss mechanisms in the quark-gluon plasma.

PHYSICS LETTERS B 864, 139409, 2025. **Acesso em: https://doi.org/10.1016/j.physletb.2025.139409**

[P179-2025] "Meson spin alignment and baryon polarization from coalescence with spin-vorticity nonequilibrium"

Gonçalves, K. J.*; Torrieri, G.*; Ryblewski, R.

We estimate both the polarization of spin 1/2 baryons and the spin density matrix coefficients of spin 1 mesons using a thermal model that incorporates vorticity and polarization to describe quarks, along with a coalescence formalism where spin and vorticity are not in equilibrium. We find that while our model is not predictive due to its considerable number of free parameters, it has the potential to explain several seemingly puzzling features of experimental spin measurements, such as the absence of baryon polarization alongside significant vector meson spin alignment. We suggest measuring meson spin off-diagonal matrix elements, and examining the dependence of polarization observables on azimuthal angles, as methods to falsify this model and gain insights into the freeze-out details of baryon and meson spin structure.

PHYSICAL REVIEW C 112[1], 014901, 2025. **Acesso em: https://doi.org/10.1103/gsv6-zydk**

[P180-2025] "Metallic Nitride Microfluidic e-Tongue: A Novel Selective Approach for the Detection of Macronutrients in Soil"

Boeira, C. D.*; Leidens, L. M.*; Carvalho Costa, E. E.*; Goncalves, M. H.*; Perillo, A. S.*; Ferraz, F. A.*; Marchi, M. C.; **Shimizu, F. M.*;** Amaral, L. R.; **Alvarez, F.*; Riul Junior, A.***

The growing global demand for food requires optimizing agricultural practices and more rational use of natural resources without expanding cropping areas. Precision agriculture (PA) tools are essential for accurately applying fertilizers and herbicides, reducing costs, and avoiding environmental impacts. Standard macronutrient mapping methods are costly and time-consuming, limiting denser sampling collection in the field. Consequently, devices employing new materials with specific properties matching sensitivity to agricultural nutrients, robustness to face intensive climatic variations, and economical manufacturing viability are mandatory. In this sense, microfluidic impedimetric e-tongues have emerged as practical tools in PA due to their high sensitivity, adaptability, affordability, and ease of use. These sensors provide rapid qualitative and quantitative results in liquid media, with applications extending to food analysis, environmental monitoring, and biosensing. Here, metallic nitride thin films (CrN, BN, and TiN) deposited via physical vapor deposition (PVD) using the glancing angle deposition (GLAD) technique are applied as sensing units presenting high sensitivity, controlled micro- and nanostructures, durability, reproducibility, and mechanical robustness, essential characteristics for future on-site soil analyses. The GLAD technique allows precise control over the micro- and nanostructures deposited on gold interdigitated electrodes to create molecular sieves for a possible capture of target species (e.g., K+, Na+, Mg2+, Ca2+, PO43-) from soil samples. We demonstrate the feasibility of using distinct nitrides as sensing units in a microfluidic e-tongue tested with soil samples with distinct compositions diluted in water without pretreatments. The sensor successfully differentiated all samples tested, showing higher K and Mg macronutrient resolution. These findings demonstrate the high potential to detect minute changes (<1 mmol·L-1) in soil fertilization, with results compared by four prediction models, paving the way for future in situ analyses envisaging a controlled delivery of macronutrients during fertilization.

ACS SENSORS, 2025. **Acesso em: https://doi.org/10.1021/acssensors.5c00921.** Early Access Date: AUG 2025

[P181-2025] "Microfluidic Electronic Tongues Based on High-Entropy Nitride Films"

Leidens, L. M.*; Boeira, C. D.*; Gonçalves, M. H.*; Costa, E. E. C.*; Marchi, M. C.; Zanatta, A. R.**; Alvarez, F.*; Riul Jr, A.***

High-entropy nitrides (HENs) are emerging as promising materials for sensing applications due to their exceptional chemical stability, diverse electrical properties, and highly tunable surface and bulk characteristics. This study integrates HEN thin films, deposited via RF sputtering, into an impedimetric microfluidic electronic tongue (e-tongue), designed to assess their potential for high sensitivity and robust detection of various analytes. The active films displayed a distinct oxide-rich surface and nitride-rich sublayer, directly influencing sensor performance. As a proof-of-concept, the unique electrical response of the HEN-based e-tongue enabled precise discrimination between similar ions (Na+ and K+) and basic human tastes (sweet, salty, bitter, umami, and sour) at concentrations near or below the human palatability threshold. Moreover, after repeated use, the films maintained their chemical and structural integrity, ensuring long-term stability and reproducibility. These results highlight the potential of HENs as versatile materials for advanced sensing applications, demonstrating their promise for next-generation e-tongue systems and expanding the range of applications for this class of materials.

ACS APPLIED ELECTRONIC MATERIALS 7[12], p. 5537-5548, 2025. **Acesso em: https://doi.org/10.1021/acsaelm.5c00489**

[P182-2025] "Multimessenger Studies with the Pierre Auger Observatory"

Lundquist, J. P.; **Bonneau Arbeletche, L.*; Chinellato, J. A.*; Dobrigkeit, C.*; Fauth, A. C.*; Payeras, A. Machado*; Reginatto Akim, J. V.*;** et al.
Pierre Auger Collaboration

The Pierre Auger Observatory, the world's largest ultra-high-energy (UHE) cosmic ray (CR) detector, plays a crucial role in multi-messenger astroparticle physics with its high sensitivity to UHE photons and neutrinos. Recent Auger Observatory studies have set stringent limits on the diffuse and point-like fluxes of these particles, enhancing constraints on dark-matter models and UHECR sources. Although no temporal coincidences of neutrinos or photons with LIGO/Virgo gravitational wave events have been observed, competitive limits on the energy radiated in these particles have been established, particularly from the GW170817 binary neutron star merger. Additionally, correlations between the arrival directions of UHECRs and high-energy neutrinos have been explored using data from the IceCube Neutrino Observatory, ANTARES, and the Auger Observatory, providing additional neutrino flux constraints. Efforts to correlate UHE neutron fluxes with gamma-ray sources within our galaxy continue, although no significant excesses have been found. These collaborative and multi-faceted efforts underscore the pivotal role of the Auger Observatory in advancing multi-messenger astrophysics and probing the most extreme environments of the Universe.

PARTICLES 8[2], 45, 2025. **Acesso em: https://doi.org/10.3390/particles8020045**

[P183-2025] "Multimuons in cosmic-ray events as seen in ALICE at the LHC"

Acharya, S.; Agarwal, A.; **Guardiano, G. G.*; Jahnke, C.*; Liveraro, G. S. S.*; Takahashi, J.*;** et al.
ALICE Collaboration

ALICE is a large experiment at the CERN Large Hadron Collider. Located 52 meters underground, its detectors are suitable to measure muons produced by cosmic-ray interactions in the atmosphere. In this paper, the studies of the cosmic muons registered by ALICE during Run 2 (2015-2018) are described.

The analysis is limited to multimuon events defined as events with more than four detected muons (N-mu > 4) and in the zenith angle range 0 degrees < theta < 50 degrees. The results are compared with Monte Carlo simulations using three of the main hadronic interaction models describing the air shower development in the atmosphere: QGSJET-II-04, EPOS-LHC, and SIBYLL 2.3d. The interval of the primary cosmic-ray energy involved in the measured muon multiplicity distribution is about 4x10(15) < E-prim < 6x10(16) eV. In this interval none of the three models is able to describe precisely the trend of the composition of cosmic rays as the energy increases. However, QGSJET-II-04 is found to be the only model capable of reproducing reasonably well the muon multiplicity distribution, assuming a heavy composition of the primary cosmic rays over the whole energy range, while SIBYLL 2.3d and EPOS-LHC underpredict the number of muons in a large interval of multiplicity by more than 20% and 30%, respectively. The rate of high muon multiplicity events (N-mu > 100) obtained with QGSJET-II-04 and SIBYLL 2.3d is compatible with the data, while EPOS-LHC produces a significantly lower rate (55% of the measured rate). For both QGSJET-II-04 and SIBYLL 2.3d, the rate is close to the data when the composition is assumed to be dominated by heavy elements, an outcome compatible with the average energy E--prim similar to 10(17) eV of these events. This result places significant constraints on more exotic production mechanisms.

JOURNAL OF COSMOLOGY AND ASTROPARTICLE PHYSICS [4], 009, 2025. **Acesso em: https://doi.org/10.1088/1475-7516/2025/04/009**

[P184-2025] "Nanocrystalline Hexagonal Boron Nitride Thin Films Deposited by Dynamic Glancing Angle Deposition for UV-Emitting Devices and Detectors"

Mello, S. R. S. de*; Cemin, F.*; Echeverrigaray, F. G.*; Jimenez, M. J. M.*; Piroli, V.; **Costa, F. J. R.*; Boeira, C. D.*; Leidens, L. M.*; Riul Jr, A.*;** Figueroa, C. A.; **Zagonel, L. F.*;** Zanatta, A. R.; **Alvarez, F.***

This study investigates thin films of hexagonal boron nitride (h-BN), a promising material for the development of UV optoelectronic and wide-band gap semiconductor applications. A comprehensive analysis of the structural and optical properties of h-BN films deposited by radio frequency sputtering, using both stationary and Dynamic Glancing Angle Deposition (DGLAD) techniques, demonstrates that the film nanostructure can be effectively tailored by controlling key deposition parameters such as substrate bias, deposition plasma composition, and substrate oscillation. The introduction of hydrogen into the deposition atmosphere promotes the formation of turbostratic polycrystalline films with tunable crystallite sizes and significantly impacts the bonding environment, leading to a controlled shift of the optical band gap from similar to 3.7 to similar to 4.2 eV. Substrate oscillation modulates the angle of precursor impinging on the substrate, influencing the nano- and microstructure of the films and their optical properties. The physical characteristics introduced by the specific method of preparation of h-BH, such as morphological and topographical features, were characterized via SEM and AFM. At the same time, photoluminescence (PL) measurements revealed defect-related emission states, highlighting the influence of structural disorder on radiative transitions. Importantly, the DGLAD approach emerges as a useful strategy to engineer the structural and optical features of the h-BN films. The reported findings provide valuable insights into the correlation between growth dynamics, crystallographic disorder, and optoelectronic properties, reinforcing the potential of h-BN for integration into UV photodetectors, light-emitting devices, and other possible wide-bandgap electronic applications such as sensors.

ACS APPLIED NANO MATERIALS 8[23], p. 12380-12392, 2025. **Acesso em: https://doi.org/10.1021/acsanm.5c02214**

[P185-2025] "Neutrino interaction vertex reconstruction in DUNE with Pandora deep learning"

Abud, A. A.; Acciarri, R.; **Adriano, C.*; Bazetto, M. C. Q.*; Borges Merlo, R.*; Aguiar, R. de*; Almeida, P. de*; Holanda, P. C. de*; Gelli, B.*; Gratieri, D. R.*; Guzzo, M. M.*; Kemp, E.*; Machado, A. A.*; Marques, F. das C.*; Mendonca, A. P.*; Peres, O. L. G.*; Pimentel, V. L.*; Paixao, L. G. P.*; Segreto, E.*;** et al.
DUNE Collaboration

The Pandora Software Development Kit and algorithm libraries perform reconstruction of neutrino interactions in liquid argon time projection chamber detectors. Pandora is the primary event reconstruction software used at the Deep Underground Neutrino Experiment, which will operate four large-scale liquid argon time projection chambers at the far detector site in South Dakota, producing high-resolution images of charged particles emerging from neutrino interactions. While these high-resolution images provide excellent opportunities for physics, the complex topologies require sophisticated pattern recognition capabilities to interpret signals from the detectors as physically meaningful objects that form the inputs to physics analyses. A critical component is the identification of the neutrino interaction vertex. Subsequent reconstruction algorithms use this location to identify the individual primary particles and ensure they each result in a separate reconstructed particle. A new vertex--finding procedure described in this article integrates a U-ResNet neural network performing hit-level classification into the multi-algorithm approach used by Pandora to identify the neutrino interaction vertex. The machine learning solution is seamlessly integrated into a chain of pattern-recognition algorithms. The technique substantially outperforms the previous BDT-based solution, with a more than 20% increase in the efficiency of sub-1 cm vertex reconstruction across all neutrino flavours.

EUROPEAN PHYSICAL JOURNAL C 85[6], 697, 2025. **Acesso em: https://doi.org/10.1140/epjc/s10052-025-14313-8**

[P186-2025] "Next-Generation Ultrasound Propagation in Suspended Core Optical Fibers"

Silva, R. E. da*; Webb, D. J.

We demonstrate the temporal propagation of high-frequency ultrasonic pulses inside of a suspended core fiber (SCF) for the first time. An SCF composed of a 5 mu m core suspended by nano bridges and four air holes is analytically and numerically investigated using the 2D and 3D finite element method. We reveal the propagation of ultrasonic modes in the SCF and describe the variation of their properties with increasing frequency from 1 to 100 MHz. Ultrasonic Gaussian-modulated pulses traveling with distinct frequencies (25 and 72 MHz) and bandwidths (56 and 10 MHz) are evaluated along the SCF length and time. The induced strain, pressure, and sensing responsivity are reviewed and discussed. Analytical and numerical results show highly confined effective single-mode propagation in the SCF core, amplifying strains along the fiber (up to 18 times) and pressures at the fiber output (up to 3 times). Compared to previous studies, the demonstrated SCF provides the widest 86 MHz high-responsivity bandwidth (with a -218 dB average and -75 dB maximum responsivity at 93 MHz). These achievements are promising for developing smaller, faster, and more efficient acousto-optic modulators for fiber lasers, enhancing simultaneous light-sound guidance and spatial resolution of fiber-based optoacoustic imaging sensors and neurostimulators in biomedicine.

IEEE ACCESS 13, p. 127411-127422, 2025. **Acesso em: https://doi.org/10.1109/ACCESS.2025.3589995**

[P187-2025] "On the contact size and geometry used in the electrical resistivity measurements by montgomery method"

Coelho, L. C.; **Oliveira, F. S.*;** Santos, C. A. M. dos

The influence of the electrical contact size and shape on the electrical resistivity measurements performed with Montgomery method is evaluated by the COMSOL Multiphysics software. Results obtained with point or small size contacts (<= 1% of the sample length) reproduce the expected electrical resistivity value. The simulations are compared with previous literature and experimental data obtained from copper plates. Contacts of up to 10% of the sample length are excellent choices for electrical resistivity measurements using Montgomery method, as the standard deviations are less than 1%, no matter the contact shape. When larger electrical contacts are required, triangle and concave arch contact geometries yield the lowest error and standard deviation, while square and circle should be avoided.

ENGINEERING RESEARCH EXPRESS 7[2], 025366, 2025. **Acesso em: https://doi.org/10.1088/2631-8695/addba1**

[P188-2025] "Ordered and disordered skyrmion states on a square substrate"

Souza, J. C. B.; Reichhardt, C. J. O.; Reichhardt, C.; **Vizarim, N. P.*;** Venegas, P. A.

We examine the ordering of skyrmions interacting with a square substrate created from a modulation of anisotropy using atomistic simulations. We consider fillings of f = 1.5, 2.0, 2.5, 3.0, and 3.5 skyrmions per potential minimum as a function of magnetic field and sample size. For a filling of f = 2.0, we find various dimer orderings, such as tilted dimer states, as well as antiferromagnetic ordering that is similar to the colloidal dimer ordering seen on square substrates. The ability of the skyrmions to change shape or annihilate produces additional states that do not occur in the colloidal systems. For certain parameters at f = 2.0, half of the skyrmions can annihilate to form a square lattice, or a superlattice of trimers and monomers containing skyrmions of different sizes can form. At lower fields, ordered stretched skyrmion states can appear, and for zero field, there can be ordered stripe states. For f = 3.0, we find ferromagnetic ordered trimers, tilted lattices, columnar lattices, and stretched phases. For fillings of f = 1.5 and 2.5, we find bipartite lattices, different ordered and disordered states, and several extended disordered regions produced by frustration effects.

EUROPEAN PHYSICAL JOURNAL B 98[7], 159, 2025. **Acesso em: https://doi.org/10.1140/epjb/s10051-025-01010-4**

[P189-2025] "Overview of high-density QCD studies with the CMS experiment at the LHC"

Hayrapetyan, A.; Tumasyan, A.; Adam, W.; **Chinellato, J. A.*;** et al.
CMS Collaboration

We review key measurements performed by CMS in the context of its heavy ion physics program, using event samples collected in 2010-2018 with several collision systems and energies. These studies provide detailed macroscopic and microscopic probes of the quark-gluon plasma (QGP) created at the LHC energies, a medium characterized by the highest temperature and smallest baryon-chemical potential ever reached in the laboratory. Numerous observables related to high-density quantum chromodynamics (QCD) were studied, leading to some of the most impactful and qualitatively novel results in the 40-year history of the field. Using a dedicated high-multiplicity trigger in the first pp run, CMS discovered that small collision systems can exhibit signs of collectivity, a generic phenomenon with significant implications and presently understood to affect essentially all soft physics processes. This observation opened new paths to understand how fluidity and plasma properties emerge in QCD matter as a function of system size. Measurements of jet quenching have reached a completely new level of detail by directly assessing, for the first time, the medium modification of parton showers, as opposed to simply observing leading hadrons or di-hadrons. The first fully reconstructed beauty hadron and heavy-flavor jet nuclear modifications were also measured. The large size of the event samples, the precision of the measurements, and the extension of the probed kinematical phase space, allowed many other hard probes of the QGP medium to be explored in detail, leading to multiple groundbreaking findings. In particular, the seminal measurements of bottomonium suppression patterns answer fundamental questions that have been actively pursued, both theoretically and experimentally, by the community since the mid-1980s. We conclude by outlining the opportunities offered by the continuation of this physics program at the LHC.

PHYSICS REPORTS-REVIEW SECTION OF PHYSICS LETTERS 1115, p. 219-367, 2025. **Acesso em: https://doi.org/10.1016/j.physrep.2024.11.007**

[P190-2025] "Passive demultiplexed two-photon state generation from a quantum dot"

Karli, Y.; Avila Arenas, I.; Schimpf, C.; Garcia Junior, A. J.; Manna, S.; Kappe, F.; Schwarz, R.; Undeutsch, G.; Aigner, M.; Peter, M.; **Covre da Silva, S. F.*;** Rastelli, A.; Weihs, G.; Remesh, V.

High-purity multi-photon states are essential for photonic quantum computing. Among existing platforms, semiconductor quantum dots offer a promising route to scalable and deterministic multi-photon state generation. However, to fully realize their potential, we require a suitable optical excitation method. Current approaches to multi-photon generation rely on active polarization-switching elements (e.g., electro-optic modulators, EOMs) to spatio-temporally demultiplex single photons. Yet, the achievable multi-photon rate is fundamentally limited by the switching speed of the EOM. Here, we introduce a fully passive demultiplexing technique that leverages a stimulated two-photon excitation process to achieve switching rates only limited by the quantum dot lifetime. We demonstrate this method by generating two-photon states from a single quantum dot without requiring active switching elements. Our approach significantly reduces the cost of demultiplexing while shifting it to the excitation stage, enabling loss-free demultiplexing and effectively doubling the achievable multi-photon generation rate when combined with existing active demultiplexing techniques.

NPJ QUANTUM INFORMATION 11[1], 139, 2025. **Acesso em: https://doi.org/10.1038/s41534-025-01083-0**

[P191-2025] "Petal-Graphyne: A novel 2D carbon allotrope for high-performance Li and Na ion storage"

Lima, K. A. L.*; Laranjeira, J. A. S.; Martins, N. F.; Azevedo, S. A.; Sambrano, J. R.; Dias, A. C.; Sambrano, J. R.; **Galvao, D. S.*;** Ribeiro Junior, L. A.

Using density functional theory simulations, this study introduces Petal-Graphyne (PLG), a novel multi-ring metallic structure composed of 4-, 8-, 10-, and 16-membered rings. Its structural, electronic, and lithium/sodium storage properties were comprehensively investigated. PLG exhibits a high theoretical capacity of 1004 mAh/g for Li, Na, and mixed-Li/Na--ions, surpassing conventional graphite anodes. The material remains metallic, with multiple band crossings at the Fermi level. The optimal energy barriers for Li (0.28 eV) and Na (0.25 eV) on PLG and favorable diffusion coefficients in both monolayer and multilayer configurations are unveiled. The open circuit voltages are 0.47 V for Li, 0.51 V for Na, and 0.54 V for mixed-ion storage, suggesting stable electrochemical performance. These results highlight PLG as a promising candidate for next-generation lithium and sodium-ion batteries, combining high storage capacity and efficient ion transport.

JOURNAL OF ENERGY STORAGE 130, 117235, 2025. **Acesso em: https://doi.org/10.1016/j.est.2025.117235**

[P192-2025] "pH-Dependent Pitting Corrosion in Nickel Thin Films"

Lima, A. A. da S.*; Murillo, D. M.*; von Zuben, A. A. G.*; Landers, R.*; Oliveira, D. S.; **Cotta, M. A.***

Nickel thin films are widely used in applications requiring corrosion resistance, but in chloride environments, localized breakdown of the passive layer can lead to pitting corrosion. This study investigates the pitting behavior of Ni thin films in chloride solutions with glycine and calcium ions as inhibitors, under varying pH. Oxygen plasma treatment induced surface defects that modulated pit density. At low pH, severe corrosion was observed, while higher pH led to passivation via nickel oxide and calcium carbonate formation. Microscopy and XPS analyses revealed pH-dependent changes in pit morphology and density. Under intermediate pH, localized redeposition of nickel was detected at pit centers, forming nanoscale features. Finite element simulations confirmed that pit geometry creates a chemical potential gradient driving inward metal flux. These results advance the understanding of pitting corrosion in nickel films and highlight the influence of pH, inhibitors, and surface condition on corrosion processes.

MATERIALS AND CORROSION-WERKSTOFFE UND KORROSION, 2025. **Acesso em: https://doi.org/10.1002/maco.12004.** Early Access Date: JUN 2025

[P193-2025] "Physicochemical characterization of a new porous 2D semiconductor carbon allotrope, C16: an investigation via density functional theory and machine learning-based molecular dynamics"

Lima, K. A. L.*; Alves, R. A. F.; Moujaes, E. A.; Dias, A. C.; Galvão, D. S.; Pereira Jr., M. L.; Ribeiro Jr, L. A.

This study comprehensively characterizes, with suggested applications, a novel two-dimensional carbon allotrope, C16, using density functional theory and machine learning-based molecular dynamics. This nanomaterial is derived from naphthalene and bicyclopropylidene molecules, forming a planar configuration with sp2 hybridization and featuring 3-, 4-, 6-, 8-, and 10-membered rings. The cohesive energy of -7.1 eV per atom, the absence of imaginary frequencies in the phonon spectrum, and the retention of the system's topology after ab initio molecular dynamics simulations confirm the structural stability of C16. The nanomaterial exhibits a semiconducting behavior with a direct band gap of 0.59 eV and anisotropic optical absorption in the y direction. Assuming a complete absorption of incident light, it registers a power conversion efficiency of 13%, demonstrating relatively good potential for applications in solar energy conversion. Excluding the vacuum effect along the non-periodic z direction, the planar lattice thermal conductivity kappa L reaches ultralow values of 1.90 x 10-2 W (m K)-1, 0.90 x 10-2, and 0.59 x 10-2 for T = 300 K, 600 K, and 1000 K, respectively along both x and y directions. Very close to the Fermi level, the thermoelectric figure of merit (zT) can reach a maximum value of 0.93 at room temperatures along both planar directions, indicating an excellent ability to convert a temperature gradient into electrical power. Additionally, C16 demonstrates high mechanical strength, with Young's modulus values of 500 GPa and 630 GPa in the x and y directions, respectively. Insights into the electronic, optical, thermoelectric, and mechanical properties of C16 reveal its promising capability for energy conversion applications.

NANOSCALE 17[24], p. 14660-14675, 2025. **Acesso em: https://doi.org/10.1039/D5NR01282A**

[P194-2025] "Pressure tuning of Kitaev spin liquid candidate Na3Co2SbO6"

Poldi, E. H. T.; **Tartaglia, R.***; Fabbris, G.; Nguyen, N.; Park, H.; Liu, Z.; van Veenendaal, M.; Kumar, R.; Jose, G.; Samanta, S.; Bi, W.; Xiao, Y.; Popov, D.; Wu, Y.; Kim, J. W.; Zheng, H.; Yan, J.; Mitchell, J. F.; Hemley, R. J.; Haskel, D.

The search for Kitaev's quantum spin liquid in real materials has recently expanded with the prediction that honeycomb lattices of divalent, high-spin cobalt ions could host the dominant bond-dependent exchange interactions required to stabilize the elusive entangled quantum state. The layered honeycomb Na3Co2SbO6 has been singled out as a leading candidate provided that the trigonal crystal field acting on Co 3d orbitals, which enhances non-Kitaev exchange interactions between Jeff=12\documentclass[12pt]{minimal} \usepackage{amsmath} \usepackage{wasysym} \usepackage{amsfonts} \usepackage{amssymb} \usepackage{amsbsy} \usepackage{mathrsfs} \usepackage{upgreek} \setlength{\oddsidemargin}{-69pt} \begin{document}$${J}_{{{\rm{eff}}}}=\frac{1}{2}$$\end{document} spin-orbital pseudospins, is reduced. Here we show that applied pressure leads to anisotropic compression of the layered structure, significantly reducing the trigonal distortion of CoO6 octahedra. Ferromagnetic correlations between pseudospins are enhanced in the spin-polarized (3 Tesla) phase up to about 60 GPa. Higher pressures drive a high-spin to low-spin transition destroying the Jeff=12\documentclass[12pt]{minimal} \usepackage{amsmath} \usepackage{wasysym} \usepackage{amsfonts} \usepackage{amssymb} \usepackage{amsbsy} \usepackage{mathrsfs} \usepackage{upgreek} \setlength{\oddsidemargin}{-69pt} \begin{document}$${J}_{{{\rm{eff}}}}=\frac{1}{2}$$\end{document} moments required to map the spin Hamiltonian into Kitaev's model. The spin transition strongly suppresses the low-temperature magnetic susceptibility and appears to stabilize a paramagnetic phase driven by frustration. The possible emergence of frustrated magnetism of localized S=12\documentclass[12pt]{minimal} \usepackage{amsmath} \usepackage{wasysym} \usepackage{amsfonts} \usepackage{amssymb} \usepackage{amsbsy} \usepackage{mathrsfs} \usepackage{upgreek} \setlength{\oddsidemargin}{-69pt} \begin{document}$$S=\frac{1}{2}$$\end{document} moments opens the door for exploration of novel magnetic quantum states in compressed honeycomb lattices of divalent cobaltates.

COMMUNICATIONS PHYSICS 8[1], 310, 2025. **Acesso em: https://doi.org/10.1038/s42005-025-02174-2**

[P195-2025] "Probing a Z′ gauge boson via neutrino trident scattering in the Forward Physics Facility at the LHC and FCC"

Francener, R.*; Gonçalves, V. P.; **Gratieri, D. R.***

The study of neutrino physics at the Large Hadron Collider is already a reality, and a broad neutrino physics program is expected to be developed in forthcoming years at the Forward Physics Facility (FPF). In particular, the neutrino trident scattering process, which is a rare Standard Model process, is expected to be observed for the first time with a statistical significance of 5 sigma using the FASER nu 2 detector. Moreover, similar studies are expected to be performed in the proposed Future Circular Collider (FCC). Such perspectives motivate the investigation of the impact of New Physics on the predictions for the corresponding number of events. In this letter, we consider the L mu-L tau model, which predicts an additional massive neutral gauge boson, Z ', that couples to neutrino and charged leptons of the second and third families, and estimate the production of a dimuon system in the neutrino trident scattering at the FASER nu 2 assuming different models for the incoming neutrino flux at the LHC and FCC energies.

We derive the associated sensitivity and demonstrate that the FPF@LHC is not able to improve the current bounds on the L mu-L tau model, while a future measurement of the dimuons produced in neutrino trident events in the FPF@FCC will extend the coverage of the parameter space in comparison to previous experiments.

EUROPEAN PHYSICAL JOURNAL C 85[5], 601, 2025. **Acesso em: https://doi.org/10.1140/epjc/s10052-025-14337-0**

[P196-2025] "Promotion effect of nickel on the stability of NiMnAl catalysts for the PET glycolysis"

Nascimento, H. S.; França, R. H. M.; Lima, S. H.; Arcanjo, A. P.; Franca, E. J.; Castro, A. M.; Dias, M. L.; **Landers, R.***; Barbosa, C. M. B. M.; Frety, R.; Pimentel, M. F.; Pacheco, J. G. A.

NiMnAl oxides catalysts obtained from coprecipitated precursors were used in the PET glycolysis depolymerization reaction. These precursors exhibited different phases, including LDH, hausmannite, and rhodochrosite depending on the synthesis conditions. The NiMnAl trimetallic oxides displayed higher surface area and pore diameter than MnAl bimetallic oxide. Sodium-based precipitants formed a more crystalline manganese oxide phase and a higher synthesis yield than the ammonium carbonate/ hydroxide. Catalysts containing a lesser Ni/ Mn molar ratio exhibited higher activity for PET glycolysis. The presence of nickel in NiMnAl oxide improved from 49 % to 96 % the catalyst recovery after the reaction. This property relates to a strong electronic interaction between nickel and manganese and the suppressed Jahn-Teller distortion effect. The best catalyst was Ni0,22Mn0,45Al0,33-Sod, reaching 100 % PET conversion and 85 % BHET yield in the following conditions: 60 min, catalyst: PET = 0.5 %, EG: PET = 5:1. This catalyst demonstrated high performance after 5 cycles of reuse without calcination between cycles. Kinetic modeling revealed an initial shrinking core behavior changing to a pseudo-first-order model at the later stage of the reaction.

CATALYSIS TODAY 458, 115376, 2025. Acesso em: **https://doi.org/10.1016/j.cattod.2025.115376**

[P197-2025] "Proton emission in ultraperipheral Pb-Pb collisions at √sNN=5.02 TeV"

Acharya, S.; Agarwal, A.; **Guardiano, G. G.*; Jahnke, C.*; Liveraro, G. S. S.*; Takahashi, J.***; et al.
ALICE Collaboration

The first measurements of proton emission accompanied by neutron emission in the electromagnetic dissociation (EMD) of Pb-208 nuclei in the ALICE experiment at the Large Hadron Collider are presented. The EMD protons and neutrons emitted at very forward rapidities are detected by the proton and neutron zero degree calorimeters of the ALICE experiment. The emission cross sections of zero, one, two, and three protons accompanied by at least one neutron were measured in ultraperipheral Pb-208 - Pb-208 collisions at a center-of-mass energy per nucleon pair root s(NN) = 5.02 TeV. The 0p and 3p cross sections are described by the RELDIS model within their measurement uncertainties, while the 1p and 2p cross sections are underestimated by the model by 17-25%. According to this model, these 0p, 1p, 2p, and 3p cross sections are associated, respectively, with the production of various isotopes of Pb, Tl, Hg, and Au in the EMD of Pb-208. The cross sections of the emission of a single proton accompanied by the emission of one, two, or three neutrons in EMD were also measured. The data are significantly overestimated by the RELDIS model, which predicts that the (1p,1n), (1p,2n), and (1p,3n) cross sections are very similar to the cross sections for the production of the thallium isotopes Tl-206,Tl-205,Tl-204.

PHYSICAL REVIEW C 111[5], 054906, 2025. **Acesso em: https://doi.org/10.1103/PhysRevC.111.054906**

[P198-2025] "Quantum superposition of boundary conditions in PAdS2"

Pitelli, J. P. M.; **Felipe, B. S.*;** Dappiaggi, C.; Winstanley, E.

We explore the quantum superposition of boundary conditions in the context of the Poincare patch of the two-dimensional anti-de Sitter space. Focusing on Robin (mixed) boundary conditions, we investigate the response function of the Unruh-DeWitt (UDW) detector interacting with two or more scalar fields, each respecting a different boundary condition. The role of this quantum superposition is twofold: (i) it may represent different fields propagating on the same spacetime and interacting with an UDW detector or (ii) it may describe an UDW detector on a superposition of spacetimes, each one with an inequivalent propagating field.

PHYSICAL REVIEW D 111[12], 125011, 2025. **Acesso em: https://doi.org/10.1103/3nfv-lhs1**

[P199-2025] "Relativistic Motion of the Electron and the Heaviest Element"

Santos, C. A. M. dos; Luz, M. S. da; **Oliveira, F. S.*;** Rousselle, O.

The relativistic motion of the electron in the toroidal model is reported. The different motions of the center of mass and the charge provide a direct way to describe the relativistic effect on the helical motion of the electron. The momentum-energy relation is deduced in easy manner, which led to a simple interpretation of the electron energy. The relativistic effect on the helical motion due to the ratio of the Compton and the Bohr radii in the Bohr atom with Z protons is compared with the nucleus radius, providing a way to estimate the heaviest element of the periodic table, which is found to be between Z = 122 and 137.

JOURNAL OF CONDENSED MATTER NUCLEAR SCIENCE 39, p. 1-13, 2025. **Acesso em: https://doi.org/10.70923/001c.133962**

[P200-2025] "Revealing the Crystallization Pathways of Mixed-Halide Low-Dimensional Perovskites: A First Step Toward Solar Cell Applications"

Guaita, M. G. D.; Szostak, R.; **Silva, F. M. C. da*;** Feng, Z. H.; Scalon, L.; Teixeira, V. C.; Kodalle, T.; Sutter-Fella, C. M.; Jang, S. S.; Tolentino, H. C. N.; Nogueira, A. F.

Ruddlesden-Popper perovskites (RPPs) are promising materials for optoelectronic devices. While iodide-based RPPs are well-studied, the crystallization of mixed-halide RPPs remains less explored. Understanding the factors affecting their formation and crystallization are vital for optimizing morphology, phase purity, and orientation, which directly impact device performance. Here, we investigate the crystallization and properties of mixed-halide RPPs (PEA)2FAn-1Pbn(Br1/3I2/3)3n + 1 (PEA = C6H5(CH2)2NH3+ and FA = CH(NH2)2+) (n = 1, 5, 10) using DMSO ((CH3)2SO) or NMP (OC4H6NCH3) as cosolvents and MACl (MA = CH3NH3+) as an additive. For the first time, the presence of planar defects in RPPs is directly observed by in situ grazing-incidence wide-angle X-ray scattering (GIWAXS) and confirmed through the simulation of the patterns that matched the experimental. GIWAXS data also reveals that DMSO promotes higher crystallinity and vertical orientation, while MACl enhances crystal quality but increases halide segregation, shown here by nano X-ray fluorescence (nano-XRF) experiments. For low-n RPPs, orientation is crucial for solar cell efficiency, but its impact decreases with increasing n. Our findings provide insights into optimizing mixed-halide RPPs, guiding strategies to improve crystallization, phase control, and orientation for better performance not only in solar cells but also in other potential optoelectronic devices.

SOLAR RRL 9[14], 2500404, 2025. **Acesso em: https://doi.org/10.1002/solr.202500404**

[P201-2025] "Reweighting simulated events using machine--learning techniques in the CMS experiment"

Hayrapetyan, A; Tumasyan, A; **Chinellato, J. A.*;** et al.
CMS Collaboration

Data analyses in particle physics rely on an accurate simulation of particle collisions and a detailed simulation of detector effects to extract physics knowledge from the recorded data. Event generators together with a geant-based simulation of the detectors are used to produce large samples of simulated events for analysis by the LHC experiments. These simulations come at a high computational cost, where the detector simulation and reconstruction algorithms have the largest CPU demands. This article describes how machine-learning (ML) techniques are used to reweight simulated samples obtained with a given set of parameters to samples with different parameters or samples obtained from entirely different simulation programs. The ML reweighting method avoids the need for simulating the detector response multiple times by incorporating the relevant information in a single sample through event weights. Results are presented for reweighting to model variations and higher--order calculations in simulated top quark pair production at the LHC. This ML-based reweighting is an important element of the future computing model of the CMS experiment and will facilitate precision measurements at the High-Luminosity LHC.

THE EUROPEAN PHYSICAL JOURNAL. C, PARTICLES AND FIELDS 85[5], 495, 2025. **Acesso em: https://doi.org/10.1140/epjc/s10052-025-14097-x**

[P202-2025] "Scaler Rates from the Pierre Auger Observatory: A New Proxy of Solar Activity"

Halim, A. A.; Abreu, P.; **Bonneau Arbeletche, L.*; Chinellato, J. A.*; Dobrigkeit, C.*; Fauth, A. C.*; Machado Payeras, A.*; Reginatto Akim, J. V.***; et al.
Pierre Auger Collaboration

The modulation of low-energy galactic cosmic rays reflects interplanetary magnetic field variations and can provide useful information on solar activity. An array of ground-surface detectors can reveal the secondary particles, which originate from the interaction of cosmic rays with the atmosphere. In this work, we present an investigation of the low-threshold rate (scaler) time series recorded in 16 yr of operation by the Pierre Auger Observatory surface detectors in Malarg & uuml;e, Argentina. Through an advanced spectral analysis, we detected highly statistically significant variations in the time series with periods ranging from the decadal to the daily scale. We investigate their origin, revealing a direct connection with solar variability. Thanks to their intrinsic very low noise level, the Auger scalers allow a thorough and detailed investigation of the galactic cosmic-ray flux variations in the heliosphere at different timescales and can, therefore, be considered a new proxy of solar variability.

ASTROPHYSICAL JOURNAL 987[1], 41, 2025. **Acesso em: https://doi.org/10.3847/1538-4357/adccc3**

[P203-2025] "Search for a diffuse flux of photons with energies above tens of PeV at the Pierre Auger Observatory"

Halim, A. A.; Abreu, P.; **Bonneau Arbeletche, L.*; Chinellato, J. A.*; Dobrigkeit, C.*; Fauth, A. C.*; Machado Payeras, A.*; Reginatto Akim, J. V.***; et al.
Pierre Auger Collaboration

Diffuse photons of energy above 0.1PeV, produced through the interactions between cosmic rays and either interstellar matter or background radiation fields, are powerful tracers of the distribution of cosmic rays in the Galaxy. Furthermore, the measurement of a diffuse photon flux would be an important probe to test models of super-heavy dark matter decaying into gamma-rays. In this work, we search for a diffuse photon flux in the energy range between 50PeV and 200PeV using data from the Pierre Auger Observatory. For the first time, we combine the air-shower measurements from a 2km(2) surface array consisting of 19 water-Cherenkov surface detectors, spaced at 433 m, with the muon measurements from an array of buried scintillators placed in the same area. Using 15 months of data, collected while the array was still under construction, we derive upper limits to the integral photon flux ranging from 13.3 to 13.8km(-)2 sr(-)1 yr(-1) above tens of PeV. We extend the Pierre Auger Observatory photon search program towards lower energies, covering more than three decades of cosmic-ray energy. This work lays the foundation for future diffuse photon searches: with the data from the next 10 years of operation of the Observatory, this limit is expected to improve by a factor of similar to 20.

JOURNAL OF COSMOLOGY AND ASTROPARTICLE PHYSICS [5], 061, 2025. **Acesso em: https://doi.org/10.1088/1475-7516/2025/05/061**

[P204-2025] "Search for heavy long-lived charged particles with large ionization energy loss in proton-proton collisions at √s=13 TeV"

Hayrapetyan, A.; Tumasyan, A.; **Chinellato, J. A.*;** et al.
CMS Collaboration

A search for heavy, long-lived, charged particles with large ionization energy loss within the silicon tracker of the CMS experiment is presented. A data set of proton-proton collisions at a center of mass energy at root s = 13 TeV, collected in 2017 and 2018 at the CERN LHC, corresponding to an integrated luminosity of 101 fb(-1), is used in this analysis. Two different approaches for the search are taken. A new method exploits the independence of the silicon pixel and strips measurements, while the second method improves on previous techniques using ionization to determine a mass selection. No significant excess of events above the background expectation is observed. The results are interpreted in the context of the pair production of supersymmetric particles, namely gluinos, top squarks, and tau sleptons, and of the Drell-Yan pair production of fourth generation (tau ') leptons with an electric charge equal to or twice the absolute value of the electron charge (e). An interpretation of a Z' boson decaying to two tau ' leptons with an electric charge equal to 2e is presented for the first time. The 95% confidence upper limits on the production cross section are extracted for each of these hypothetical particles.

JOURNAL OF HIGH ENERGY PHYSICS [4], 109, 2025. **Acesso em: https://doi.org/10.1007/JHEP04(2025)109**

[P205-2025] "Search for Quasiparticle Scattering in the Quark-Gluon Plasma with Jet Splittings in pp and Pb-Pb Collisions at sqrt[s_{NN}]=5.02TeV"

Acharya, S.; Agarwal, A.; **Chinellato, D. D.*; Guardiano, G. G.*; Jahnke, C.*; Liveraro, G. S. S.*; Takahashi, J.***; et al.
ALICE Collaboration

The ALICE Collaboration reports measurements of the large relative transverse momentum (k_{T}) component of jet substructure in pp and Pb-Pb collisions at center-of-mass energy per nucleon pair sqrt[s_{NN}]=5.02TeV. Enhancement in the yield of such large-k_{T} emissions in head-on Pb-Pb collisions is predicted to arise from partonic scattering with quasiparticles of the quark-gluon plasma. The analysis utilizes charged-particle jets reconstructed by the anti-k_{T} algorithm with resolution parameter R=0.2 in the transverse-momentum interval 60<p_{T,ch,jet}<80GeV/c.

The soft drop and dynamical grooming algorithms are used to identify high transverse momentum splittings in the jet shower. Comparison of measurements in Pb-Pb and pp collisions shows medium-induced narrowing, corresponding to yield suppression of high-k_{T} splittings, in contrast to the expectation of yield enhancement due to quasiparticle scattering. The measurements are compared to theoretical model calculations incorporating jet modification due to jet-medium interactions ("jet quenching"), both with and without quasiparticle scattering effects. These measurements provide new insight into the underlying mechanisms and theoretical modeling of jet quenching.

PHYSICAL REVIEW LETTERS 135[3], 031901, 2025. **Acesso em: https://doi.org/10.1103/PhysRevLett.135.031901**

[P206-2025] "Search for the Higgs boson decays to a ρ0, φ, or K*0 meson and a photon in proton-proton collisions at √s=13 TeV"

Hayrapetyan, A.; Tumasyan, A.; **Chinellato, J. A.*;** et al. CMS Collaboration

Three rare decay processes of the Higgs boson to a rho(770)(0), phi(1020), or K-* (892)(0) meson and a photon are searched for using root s = 13 TeV proton-proton collision data collected by the CMS experiment at the LHC. Events are selected assuming the mesons decay into a pair of charged pions, a pair of charged kaons, or a charged kaon and pion, respectively. Depending on the Higgs boson production mode, different triggering and reconstruction techniques are adopted. The analyzed data sets correspond to integrated luminosities up to 138 fb(-1), depending on the reconstructed final state. After combining various data sets and categories, no significant excess above the background expectations is observed. Upper limits at 95% confidence level on the Higgs boson branching fractions into rho(770)(0) gamma, phi(1020)gamma, and K-*(892)(0)gamma are determined to be 3.7 x 10(-4), 3.0 x 10(-4), and 3.0 x 10(-4), respectively. In case of the rho(770)(0)gamma and phi(1020)gamma channels, these are the most stringent experimental limits to date.

PHYSICS LETTERS B 862, 139296, 2025. **Acesso em: https://doi.org/10.1016/j.physletb.2025.139296**

[P207-2025] "Selective Tracking of Charge Carrier Dynamics in CuInS2 Quantum Dots"

Burgos-Caminal, A.; Vale, B. R. C.; Fonseca, A. F. V.; Collet, Elisa P. P.; Hidalgo, J. F.; García, L.; Watson, L.; Borrell-Grueiro, O.; Corrales, M. E.; Choi, T. K.; Katayama, T.; Fan, D. X.; Vega-Mayoral, V.; Garcia-Orrit, S.; Nozawa, S.; Penfold, T. J.; Cabanillas-González, J.; Adachi, S. I.; Bañares, L.; Nogueira, A. F.; **Padilha, L. A.*;** Schiavon, M. A.; Gawelda, W.

CuInS2 quantum dots have been studied in a broad range of applications, but despite this, the fine details of their charge carrier dynamics remain a subject of intense debate. Two of the most relevant points of discussion are the hole dynamics and the influence of Cu:In synthesis stoichiometry. It has been proposed that Cu-deficiency leads to the formation of Cu2+, affecting the localization of holes into Cu defects. Importantly, it is precisely these confined hole states that are used to explain the interesting photoluminescence properties of CuInS2 quantum dots. We use static X-ray spectroscopy to show no evidence for a measurable amount of native Cu2+ states in Cu-deficient samples (above 20%). Instead, the improved properties of these samples are explained by an increase of crystallinity, reducing the concentration of mid-gap states. Furthermore, to understand the charge carrier dynamics, herein, we employ ultrafast optical transient absorption and fluorescence up-conversion spectroscopies in combination with ultrafast X--ray absorption spectroscopy using a hard X-ray free electron laser. We demonstrate that in nonpassivated samples, holes are transferred from Cu atoms on subpicosecond time scales. Finally, we observe that Cu-deficient samples are more robust against photothermal effects at higher laser fluences. This is not the case for the Cu-rich sample, where heating effects on the structure are directly observed.

ACS NANO 19[24], p. 21950-21961, 2025. **Acesso em: https://doi.org/10.1021/acsnano.4c18469**

[P208-2025] "Sensitivity of the neutrino transmission coefficient at high energies to the Earth's density profile"

Francener, R.*; Gonçalves, V. P.; G**ratieri, D. R.***

The flux of atmospheric and astrophysical neutrinos measured in ultra-high-energy (UHE) neutrino detectors is strongly dependent on the description of the propagation and absorption of the neutrinos during the passage through Earth to the detector. In particular, the attenuation of the incident neutrino flux depends on the details of the matter structure between the source and the detector. In this paper, we will investigate the impact of different descriptions for the density profile of Earth on the transmission coefficient, defined as the ratio between the flux measured in the detector and the incoming neutrino flux. We will consider five different models for the Earth's density profile and estimate how these different models modify the target column density and transmission coefficients for different flavors. The results are derived by solving the cascade equations taking into account the neutral current interactions and tau regeneration. A comparison with approximated solutions is also presented. Our results indicated that the predictions are sensitive to the model considered for the density profile, with the simplified three layer model providing a satisfactory description when compared with the Preliminary Reference Earth Model results. Our results also showed that the more simplified models with two or one layer fail mainly for neutrinos that cross a small column of matter and are not good approximations for the neutrino propagation. These findings highlight the importance of using realistic Earth density models in UHE neutrino analyses, as simplified models may lead to misestimations in the predicted attenuation effects.

JOURNAL OF PHYSICS G-NUCLEAR AND PARTICLE PHYSICS 52[7], 075201, 2025. **Acesso em: https://doi.org/10.1088/1361-6471/ade4e4**

[P209-2025] "Simple and efficient optical fiber recoating procedure"

Nobrega, F. A. C.; Menezes, E. A. W.; Reichenbacher, R.; Scheffler, C.; Abreu, R. F.; **Morais, E. F.*; Cordeiro, C. M. B.***; Spickenheuer, A.; Amico, S. C.; Sombra, A. S. B.

This article describes a rapid method of recoating optical fibers employing the dip-coating technique, using a polypropylene film former with a silane coupling agent, which reacts, yielding a protective film over the core. The silica optical fibers were recoated with film former sizings at concentrations of 5 % and 10 %. Microscopic analysis of the recoated area showed a smooth surface and an increase in diameter of 13.4 % and 16.5 %, respectively, compared to the uncoated fiber. The maximum curvature radius of the uncoated fibers was 3.69 +/- 1.70 mm, whereas the fibers recoated with the 5 % and 10 % film former sizings reached a bending radius of 1.71 +/- 1.38 mm and 1.55 +/- 0.98 mm, representing 53.9 % and 57.9 % reduction, respectively. This shows that recoated optical fibers are more flexible than the uncoated ones. In all, the recoating of optical fibers proposed in this work results in fibers with smooth and flexible surfaces using a simple, cost-effective technique that can be implemented on large-scale processes.

MATERIALS LETTERS-X 26, 100248, 2025. **Acesso em: https://doi.org/10.1016/j.mlblux.2025.100248**

[P210-2025] "Skyrmion-skyrmionium phase separation and laning transitions via spin-orbit torque currents"

Vizarim, N. P.*; Souza, J. C. B.; Reichhardt, C. J. O.; Reichhardt, C.; Venegas, P. A.; **Beron, F.***

Many driven binary systems can exhibit laning transitions when the two species have different mobilities, such as colloidal particles with opposite charges in electric fields. Another example is pedestrian or active-matter systems, where particles moving in opposite directions form a phase-separated state that enhances the overall mobility. In this work, we use atomistic simulations to demonstrate that mixtures of skyrmions and skyrmioniums also exhibit pattern formation and laning transitions. Skyrmions move more slowly and at a finite skyrmion Hall angle compared to skyrmioniums, which move faster and without a skyrmion Hall effect. At low drives, the system forms a partially jammed phase where the skyrmioniums are dragged by the surrounding skyrmions, resulting in a finite angle of motion for the skyrmioniums. At higher drives, the system transitions into a laned state, but unlike colloidal systems, the lanes in the skyrmion-skyrmionium mixture are tilted relative to the driving direction due to the intrinsic skyrmion Hall angle. In the laned state, the skyrmionium angle of motion is reversed when it aligns with the tilted lane structure. At even higher drives, the skyrmioniums collapse into skyrmions. Below a critical skyrmion density, both textures can move independently with few collisions, but above this density, the laning state disappears entirely, and the system transitions to a skyrmion-only state. We map out the velocity and Hall responses of the different textures and identify three distinct phases: partially jammed, laned, and skyrmion-only moving crystal states. We compare our results to recent observations of tilted laning phases in pedestrian flows, where chiral symmetry breaking in the particle interactions leads to similar behavior.

PHYSICAL REVIEW B 111[21], 214438, 2025. Acesso em: https://doi.org/10.1103/zq91-42cc

[P211-2025] "Sliding dynamics of skyrmion molecular crystals"

Souza, J. C. B.; Reichhardt, C. J. O.; Reichhardt, C.; **Vizarim, N. P.***; Venegas, P. A.

Using both atomistic and particle-based simulations, we investigate the current-driven dynamics of skyrmions on two--dimensional periodic substrates when there are multiple skyrmions per substrate minimum. At zero drive, the system forms pinned skyrmion molecular crystal states consisting of dimers, trimers, or dimer-trimer mixtures that have both positional and orientational order. On a square substrate lattice, the motion above depinning occurs via a running soliton that travels completely transverse to the applied current. This motion is generated by a torque from the Magnus force, which rotates the n-mer states perpendicular to the applied current. At higher drives, the flow becomes disordered while the Hall angle diminishes and gradually approaches the intrinsic value. In some cases, we also find directional locking where the Hall angle becomes locked to certain symmetry directions of the substrate over a range of currents. The transitions into and out of directionally locked states are accompanied by negative differential mobility in which the net velocity decreases as the drive increases. On a triangular substrate, we find no transverse mobility effects, but still observe directionally locked motion.

JOURNAL OF PHYSICS-CONDENSED MATTER 37[27], 275802, 2025. **Acesso em: https://doi.org/10.1088/1361-648X/ade926**

[P212-2025] "Studying charm hadronisation into baryons with azimuthal correlations of Λc+ with charged particles in pp collisions at √s=13TeV"

Acharya, S.; Agarwal, A.; **Chinellato, D. D.*; Guardiano, G. G.*; Jahnke, C.*; Liveraro, G. S. S.*; Takahashi, J.*;** et al.
ALICE Collaboration

The distribution of angular correlations between prompt charm hadrons and primary charged particles in pp collisions is sensitive to the charm-quark hadronisation process. In this letter, charm-baryon correlations are measured for the first time by studying the azimuthal-angle difference between charged particles and prompt Lambda(+)(c) baryons produced in pp collisions at a centre-of-mass energy of root s=13 TeV, with the ALICE detector. Lambda(+)(c) baryons are reconstructed at midrapidity (|y|<0.5) in the transverse-momentum interval 3<p(T)<16 GeV/c, and correlated with charged particles with p(T)>0.3 GeV/c and pseudorapidity |eta|<0.8. For 3<p(T)(Lambda c+,D)<5 GeV/c, the comparison with published measurements of D-meson and charged-particle correlations in the same collision system hints at a larger number of low-momentum particles associated with Lambda(+)(c)-baryon triggers than with D-meson triggers, both in the collinear and opposite directions with respect to the trigger particle. These differences can be quantified by the comparison of the properties of the near- and away-side correlation peaks, and are not reproduced by predictions of various Monte Carlo event generators, generally underpredicting the associated particle yields at p(T) (assoc)<1 GeV/c. This tension between Lambda(+)(c)-baryon and D-meson associated peak yields could suggest a modified fragmentation of the charm quark, or a different hadronisation process, when a charm baryon is produced in the final state.

PHYSICS LETTERS B 868, 139681, 2025. **Acesso em: https://doi.org/10.1016/j.physletb.2025.139681**

[P213-2025] "Supernova pointing capabilities of DUNE"

Abud, A. A.; Abi, B.; **Adriano, C.*; Bazetto, M. C. Q.*; Borges Merlo, R.*; Aguiar, R. de*; Almeida, P. de*; Holanda, P. C. de*; Gelli, B.*; Gratieri, D. R.*; Guzzo, M. M.*; Kemp, E.*; Machado, A. A.*; Marques, F. das C.*; Peres, O. L. G.*; Pimentel, V. L.*; Segreto, E.*;** et al.
DUNE Collaboration

The determination of the direction of a stellar core collapse via its neutrino emission is crucial for the identification of the progenitor for a multimessenger follow-up. A highly effective method of reconstructing supernova directions within the Deep Underground Neutrino Experiment (DUNE) is introduced. The supernova neutrino pointing resolution is studied by simulating and reconstructing electron-neutrino charged-current absorption on Ar-40 and elastic scattering of neutrinos on electrons. Procedures to reconstruct individual interactions, including a newly developed technique called "brems flipping," as well as the burst direction from an ensemble of interactions are described. Performance of the burst direction reconstruction is evaluated for supernovae happening at a distance of 10 kpc for a specific supernova burst flux model. The pointing resolution is found to be 3.4 degrees at 68% coverage for a perfect interaction-channel classification and a fiducial mass of 40 kton, and 6.6 degrees for a 10 kton fiducial mass respectively. Assuming a 4% rate of charged-current interactions being misidentified as elastic scattering, DUNE's burst pointing resolution is found to be 4.3 degrees (8.7 degrees) at 68% coverage.

PHYSICAL REVIEW D 111[9], 092006, 2025. **Acesso em: https://doi.org/10.1103/PhysRevD.111.092006**

[P214-2025] "System size and energy dependence of the mean transverse momentum fluctuations at the LHC"

Acharya, S.; Agarwal, A.; **Chinellato, D. D.*; Guardiano, G. G.*; Jahnke, C.*; Liveraro, G. S. S.*; Takahashi, J.*;** et al.
ALICE Collaboration

Event-by-event fluctuations of the event-wise mean transverse momentum, < p(T)>, of charged particles produced in proton--proton (pp) collisions at root s = 5.02 TeV, Xe-Xe collisions at root s(NN) = 5.44 TeV, and Pb-Pb collisions at root s(NN) = 5.02 TeV are studied using the ALICE detector based on the integral correlator <<Delta p(T)Delta p(T)>>. The correlator strength is found to decrease monotonically with increasing produced charged-particle multiplicity measured at midrapidity in all three systems. In Xe-Xe and Pb-Pb collisions, the multiplicity dependence of the correlator deviates significantly from a simple power-law scaling as well as from the predictions of the HIJING and AMPT models. The observed deviation from power-law scaling is expected from transverse radial flow in semicentral to central Xe-Xe and Pb-Pb collisions. In pp collisions, the correlation strength is also studied by classifying the events based on the transverse spherocity, S-0, of the particle production at midrapidity, used as a proxy for the presence of a pronounced back-to-back jet topology. Low-spherocity (jetty) events feature a larger correlation strength than those with high spherocity (isotropic). The strength and multiplicity dependence of jetty and isotropic events are well reproduced by calculations with the PYTHIA 8 and EPOS LHC models.

EUROPEAN PHYSICAL JOURNAL C 85[7], 776, 2025. **Acesso em: https://doi.org/10.1140/epjc/s10052-025-14325-4**

[P215-2025] "Testing the RG running of the leptonic Dirac CP phase with reactor neutrinos"

Ge, S. F.; Kong, C. F.; **Pasquini, P.***

We propose the possibility of using the near detector at reactor neutrino experiments to probe the renormalization group (RG) running effect on the leptonic Dirac CP phase delta D. Although the reactor neutrino oscillation cannot directly measure delta D, it can probe the deviation Delta delta equivalent to delta D(Q2d) - delta D(Q2p) caused by the RG running. Being a key element, the mismatched momentum transfers at neutrino production (Q2p) and detection (Q2d) processes can differ by two orders. We illustrate this concept with the upcoming Taishan Antineutrino Observatory (TAO, also known as JUNO-TAO) experiment and obtain the projected sensitivity to the CP RG running beta function beta delta.

PHYSICAL REVIEW D 111[11], 115031, 2025. **Acesso em: https://doi.org/10.1103/PhysRevD.111.115031**

[P216-2025] "The Effects of Transcranial Direct Current Stimulation During Extended Reality Exercises for Cortical, Neuromuscular, and Clinical Recovery of Stroke Survivors"

Ruas, C. V.*; Carlos, B. M.*; Feitosa, S.*; Silva, M. V.*; Vazquez, P.*; Pontes, L. L.*; Silvestre, J.*; Almeida, S. R. M.*; Brandao, A. F.; **Castellano, G.***

Background: Rehabilitation methods that include anodal transcranial direct current stimulation (atDCS) and extended reality (XR) exercises have been used to enhance neural networks and improve functional performance in stroke patients, but the neuromuscular and neurophysiological mechanisms underlying these improvements are not fully understood. The purpose of this study was to examine the effects of atDCS during XR rehabilitation exercises on cortical, neuromuscular, and clinical outcomes of stroke survivors. Methods: Nineteen chronic stroke survivors were placed into either a transcranial direct current stimulation (tDCS) or a Sham group, without significant (p > 0.73) differences in the baseline levels of disability between groups. The tDCS group received active atDCS and the Sham group received sham atDCS applied on the ipsilesional primary motor cortex (M1) while performing a 10-session XR rehabilitation program. Surface electromyography (EMG) activity was recorded from deltoid and rectus femoris of the paretic limb without and with the application of active/sham atDCS on the M1. Shoulder abduction and hip flexion active maximum joint range of motion (ROMmax), electroencephalography (EEG)-derived brain symmetry index (BSI) and functional/clinical tests were assessed before and after the rehabilitation program. Results: EMG activity was similar to 31% greater during hip flexion of the paretic limb with the application of active atDCS than without atDCS (p = 0.04). Paretic hip flexion ROMmax increased by similar to 26%, BSI decreased by similar to 72% (indicating greater brain symmetry) and timed up and go (TUG) functional test improved by similar to 11% from before to after the rehabilitation program for the tDCS group only (p < 0.05). No other significant differences (p > 0.05) were observed. Conclusion: It seems that the application of active atDCS targeted the ipsilesional M1 representation of the quadriceps, which potentiated muscle activation in the paretic rectus femoris during XR exercises and resulted in greater motor recovery in hip flexion movements. The EEG-derived BSI results also indicate that atDCS was effective in reorganizing the ipsilesional hemisphere brain activity after stroke.

NEURAL PLASTICITY 2025[1], 5688648, 2025. **Acesso em: https://doi.org/10.1155/np/5688648**

[P217-2025] "The fNIRS glossary project: a consensus-based resource for functional near-infrared spectroscopy terminology"

Stute, K.; Gossé, L. K.; Montero-Hernandez, S.; **Mesquita, R. C.*;** et al.

Significance: A shared understanding of terminology is essential for clear scientific communication and minimizing misconceptions. This is particularly challenging in rapidly expanding, interdisciplinary domains that utilize functional near-infrared spectroscopy (fNIRS), where researchers come from diverse backgrounds and apply their expertise in fields such as engineering, neuroscience, and psychology. Aim: The fNIRS Glossary Project was established to develop a community-sourced glossary covering key fNIRS terms, including those related to the continuous--wave (CW), frequency-domain (FD), and time-domain (TD) NIRS techniques. Approach: The glossary was collaboratively developed by a diverse group of 76 fNIRS researchers, representing a wide range of career stages (from PhD students to experts) and disciplines. This collaborative process, structured across five phases, ensured the glossary's depth and comprehensiveness. Results: The glossary features over 300 terms categorized into six key domains: analysis, experimental design, hardware, neuroscience, mathematics, and physics. It also includes abbreviations, symbols, synonyms, references, alternative definitions, and figures where relevant. Conclusions: The fNIRS glossary provides a community-sourced resource that facilitates education and effective scientific communication within the fNIRS community and related fields. By lowering barriers to learning and engaging with fNIRS, the glossary is poised to benefit a broad spectrum of researchers, including those with limited access to educational resources. (c) The Authors. Published by SPIE under a Creative Commons Attribution 4.0 International License. Distribution or reproduction of this work in whole or in part requires full attribution of the original publication, including its DOI.

NEUROPHOTONICS 12[2], 027801, 2025. **Acesso em: https://doi.org/10.1117/1.NPh.12.2.027801**

[P218-2025] "Theoretical Insights into the Chemical Bonding, Electronic Structure, and Spectroscopic Properties of the Lanarkite Pb2SO5 Structure"

Fabris, G. S. L.*; Ferrer, M. M.; Almeida, C. R. R.; Paskocimas, C. A.; Sambrano, J. R.; La Porta, F. A.

A comprehensive investigation of the chemical bonding, electronic structure, and spectroscopic properties of the lanarkite--type Pb2SO5 (PSO) structure was conducted, for the first time, using density functional theory simulations. Thus, different functionals, PBE, PBE0, PBESOL, PBESOL0, BLYP, WC1LYP, and B3LYP, were used, and their results were compared to predict their fundamental properties accurately. All DFT calculations were performed using a triple-zeta valence plus polarization basis set. Among all the DFT functionals, PBE0 showed the best agreement with the experimental and theoretical data available in the literature. Our results also reveal that the [PbO5] clusters were formed with five Pb-O bond lengths, with values of 2.29, 2.35, 2.57, 2.60, and 2.79 angstrom. Meanwhile, the [SO4] clusters exhibited uniform S-O bond lengths of 1.54 angstrom. Also, a complete topological analysis based on Bader's Quantum Theory of Atoms in Molecules (QTAIM) was applied to identify atom--atom interactions in the covalent and non-covalent interactions of the PSO structure. Additionally, PSO has an indirect band gap energy of 4.83 eV and an effective mass ratio (m(h)*/m(e)*) of about 0.192 (PBE0) which may, in principle, indicate a low degree of recombination of electron-hole pairs in the lanarkite structure. This study represents the first comprehensive DFT investigation of Pb2SO5 reported in the literature, providing fundamental insights into its electronic and structural properties.

PHYSCHEM 5[2], 22, 2025. **Acesso em: https://doi.org/10.3390/physchem5020022**

[P219-2025] "Thermal annealing kinetics of induced fission tracks in ZAD zircon from the Serra Geral Volcanic Complex, Brazil"

Sales, A. S. W.; Dias, A. N. C.; **Guedes, S.*;** Medeiros, M. G.; Pereira, V.de Q.

This study investigates the thermal annealing kinetics of induced fission tracks in ZAD zircon from the Serra Geral Volcanic Complex, Brazil, and compares results with previously studied ZPC zircon. Both samples underwent identical pre-annealing treatment (1100 degrees C for 1 h) to remove fossil fission tracks before neutron irradiation and heating experi-ments at temperatures between 500 and 800 degrees C for durations of 1-100 h. Comprehensive statistical analysis, including Kolmogorov-Smirnov tests and effect size calculations, confirmed that observed differences between samples reflect genuine material properties rather than measurement bias. ZAD exhibited significantly higher annealing rates and lower activation energy (62 +/- 14 kcal/mol) compared to ZPC (80 +/- 20 kcal/mol), despite both samples undergoing identical labo-ratory procedures. This differential behavior is attributed to ZAD's 20% higher accumulated alpha-recoil damage (3.34 x 1016vs. 2.67 x 1016 decays/g), which persists as residual damage even after pre--annealing treatment. Calculations of displace-ments per atom (dpa) further quantified this difference (1.07 x 10-3 for ZAD vs. 8.5 x -4 for ZPC). The study demonstrates how radiation damage accumulated over different timescales (134 Ma for ZAD vs. 80 Ma for ZPC) creates distinct microstructural defect patterns that significantly influence fission track annealing kinetics, with important implications for zircon thermochronology interpretations and geological thermal history reconstruction

PHYSICS AND CHEMISTRY OF MINERALS 52[3], 22, 2025. **Acesso em: https://doi.org/10.1007/s00269-025-01323-x**

[P220-2025] "TPHE-Graphene: A First-Principles Study of a New 2D Carbon Allotrope for Hydrogen Storage"

Laranjeira, J. A. S.; Martins, N. F.; **Lima, K. A. L.*;** Cabral, L. A.; Ribeiro Junior, L. A.; **Galvao, D. S.*;** Sambrano, J. R.

Theshiftfromfossilfuelstorenewableenergysourcesisessentialfor reducing global carbon emissions and addressing climate change. Developing advanced materials for efficient hydrogen storage enables the development of sustainable energy solutions in this context. Herein, we propose sodium-decorated TPHE-graphene as a high-performance two-dimensional material for hydrogen storage. Density functional theory calculations and molecular dynamics simulations demonstrate that TPHE-graphene exhibits dynamical, thermal, energetic, and mechanical stability. The monolayer displays metallic behavior and a high Young's modulus of 250.46 N/m. Upon sodium decoration, strong chemisorption occurs with a binding energy of -2.08 eV and minimal tendency for Na atom clustering. Hydrogen adsorption analysis reveals that each Na atom can bind up to five H2 molecules, resulting in a gravimetric storage capacity of 9.52 wt %. The calculated H2 adsorption energies range from -0.22 to -0.18 eV, falling within the ideal range for reversible adsorption under ambient conditions. These findings highlight Na-decorated TPHE--graphene as a structurally robust and efficient hydrogen storage material well-suited for future green energy applications.

ACS OMEGA 10[32], p. 36364–36375, 2025. **Acesso em: https://doi.org/10.1021/acsomega.5c04622**

[P221-2025] "Tuning the electronic properties of MgB2 by substitution with Mn and C"

Adriano, C.*; Xu, M. Y.; Huyan, S.; Pakuszewski, K. R.; **Machado, A. P.*;** Schrunk, B.; Budko, S. L.; Ribeiro, R. A.; Canfield, P. C.; Kaminski, A.

We use high-resolution angle-resolved photoemission spectroscopy (ARPES) to investigate the electronic band structure of the superconductors Mg0.995Mn0.005B2 and Mg(B0.98C0.02)(2), in comparison with pristine MgB2. Our experimental findings reveal modest changes in the size of the Fermi surface sheets following manganese or carbon substitution, with the most pronounced effect observed in the outermost sigma band. Additionally, the dispersion kink, indicative of strong renormalization due to the interaction between conduction electrons and phonon modes near -0.065 eV, remains unaffected by chemical substitution. Given that the superconducting transition temperature decreases significantly more rapidly in Mn-substituted MgB2 than in C-substituted MgB2, our ARPES results strongly suggest that the primary mechanism behind the pronounced suppression in Mn--MgB2 is the disruption of Cooper pairs via Abrikosov-Gorkov spin-flip scattering caused by the local magnetic moments of Mn.

JOURNAL OF PHYSICS-CONDENSED MATTER 37[30], 305502, 2025. **Acesso em: https://doi.org/10.1088/1361-648X/adeb27**

[P222-2025] "Ultrasensitive detection of forever chemical perfluorooctanoic acid using two-dimensional aluminum quasicrystal"

Chakraborty, A.; **Tromer, R.*;** Yadav, T. P.; Mukhopadhyay, N. K.; Lahiri, B.; Rao, R. H.; Roy, A. K.; Aich, N.; Woellner, C. F.; **Galvao, D. S.*;** Tiwary, C. S.

Per- and poly-fluoroalkyl substances (PFAS), specifically perfluorooctanoic acid (PFOA), often referred to as "forever chemicals," are pervasive environmental pollutants and pose significant threats to human health, contaminating water sources globally. Here, we have demonstrated a simple and easily scalable electrochemical sensor based on two-dimensional (2D) aluminum-based multicomponent quasicrystals (2D-Al QC) for the ultrasensitive detection of PFOA. The linearity range extended from 1 mu M to 1 pM, with the limit of detection (LOD) and limit of quantification (LOQ) achieved are 0.63 pM and 1.90 pM, respectively. The sensor was evaluated for selectivity with other interfering compounds, repeatability, and reproducibility for seven similar electrodes with a deviation of 0.8%. The stability of the sensor was analysed after ninety days and showed a minimal variation of 15%.

The fluorine atoms of the PFOA molecules interacted with the Al atoms of the 2D-Al QC, which is observed in the Fourier Transform Infrared Spectroscopy (FTIR) and Raman spectroscopy. This interaction has been corroborated by the molecular dynamics simulation and confirms the defluorination of PFOA molecules during the electrochemical oxidation reaction. The current work demonstrates that the 2D-Al QC offers a promising platform for the rapid and highly sensitive detection of PFOA, potentially addressing current environmental monitoring challenges.

JOURNAL OF MATERIALS CHEMISTRY A, 2025. **Acesso em: https://doi.org/10.1039/D5TA01824B.** Early Access Date: JUL 2025

[P223-2025] "Ultrawide Dynamic Bandwidth Modulation of an Antiresonant Nanoweb Hollow-Core Fiber"

Silva, R. E. da*; Cordeiro, C. M. B.*

We experimentally demonstrate an acoustically modulated antiresonant nanoweb hollow-core fiber (N-HCF) for the first time. The N-HCF contains two off-center air cores with a diameter difference of 5 mu m, separated by a nanoweb of silica. We analytically simulate the influence of the N-HCF's core diameter, cladding wall, and nanoweb thicknesses on the confinement losses, effective indices, and beatlengths of the guided fundamental (HE11) and higher-order modes (TE01, TM01), from 750 to 1200 nm. The phase-matching of the acoustic waves and modal beatlengths is also estimated and discussed. The fabricated 3.6 cm long acousto-optic device modulates record-wide bandwidths (up to 450 nm) while providing high modulation depths (up to 8 dB) at low drive voltages (10 V). Simulated and measured results provide useful insights for designing, modeling, and characterizing the N-HCF's transmission spectrum and modulation performance. These achievements lead to highly efficient, compact, and fast all-fiber sensors and modulators promising for application in pulsed fiber lasers.

IEEE PHOTONICS JOURNAL 17[4], 7100806, 2025. **Acesso em: https://doi.org/10.1109/JPHOT.2025.3581681**

[P224-2025] "Unveiling New Physics Models Through Meson Decays and Their Impact on Neutrino Experiments"

Cherchiglia, A.*

As neutrino experiments enter the precision era, it is desirable to identify any deviation between data and theoretical predictions and to provide possible models as explanation. Particularly useful is the description in terms of non-standard interactions (NSIs), which can be related to neutral (NC-NSI) or charged (CC-NSI) currents. Previously, we have developed the code eft-neutrino that connects NSI with generic ultraviolet (UV) models at tree-level matching. In this work, we integrate our code with other tools, increasing the matching between the UV and infrared (IR) theories to a one-loop level. As a working example, we consider the pion and kaon decay, the main production mechanisms in accelerator neutrino experiments. We provide up-to-date allowed regions on a set of Wilson coefficients related to pion and kaon decay. We also illustrate how our chain of codes can be applied to particular UV models, showing that a seemingly large allowed CC-NSI value can be significantly reduced when considering a specific UV model.

UNIVERSE 11[7], 225, 2025. **Acesso em: https://doi.org/10.3390/universe11070225**

[P225-2025] "Wavevector-resolved polarization entanglement from radiative cascades"

Laneve, A.; Rota, M. B.; Basset, F. B.; Beccaceci, M.; Villari, V.; Oberleitner, T.; Reum, Y.; Krieger, T. M.; Buchinger, Q.; Prasad, R.; **Silva, S. F. C. da***; Pfenning, A.; Stroj, S.; Höfling, S.; Rastelli, A.; Huber-Loyola, T.; Trotta, R.

The generation of entangled photons from radiative cascades has enabled milestone experiments in quantum information science with several applications in photonic quantum technologies. Significant efforts are being devoted to pushing the performances of near-deterministic entangled-photon sources based on single quantum emitters often embedded in photonic cavities, so to boost the flux of photon pairs. The general postulate is that the emitter generates photons in a nearly maximally entangled state of polarization, ready for application purposes. Here, we demonstrate that this assumption is unjustified. We show that in radiative cascades there exists an interplay between photon polarization and emission wavevector, which can be further amplified by embedding the emitters in micro-cavities. We discuss how the polarization entanglement of photon pairs from a biexciton-exciton cascade in quantum dots strongly depends on their propagation wavevector and we even observe entanglement vanishing for large emission angles. Our experimental results, backed by theoretical modeling, yield a brand-new understanding of cascaded emission for various quantum emitters. In addition, our model provides quantitative guidelines for designing optical microcavities that retain both a high degree of entanglement and collection efficiency, moving the community one step further towards an ideal source of entangled photons for quantum technologies.

NATURE COMMUNICATIONS 16[1], 6209, 2025. **Acesso em: https://doi.org/10.1038/s41467-025-61460-3**

[P226-2025] "Structure and elastic properties of titanium MXenes: Evaluation of COMB3, REAXFF and MEAM force fields"

Thomazini, L. F.V.; **Fonseca, A. F.***

Titanium carbide and nitride MXenes are two-dimensional inorganic materials that exhibit noteworthy physical and chemical properties. These materials are considered for a variety of technological applications, ranging from energy harvesting to optical and biomedical applications. Given the growing interest in titanium MXenes, there is an expanding demand for computational studies to predict physical properties and behaviors under diverse physical conditions. Complex and large-scale systems necessitate computational methodologies that surpass the constraints imposed by ab initio calculations. In this regard, it is imperative to ascertain the reliability of the computational tools employed to simulate and predict the physical properties of titanium MXenes. In this study, the ability of three known classical molecular dynamics (MD) potentials to provide the structural and elastic properties of titanium carbide and nitride MXenes is evaluated. The MD potentials that were the focus of this study include the Charge-Optimized Many-Body (COMB3), the Reactive Force Field (REAXFF) and the Modified Embedded Atom Method (MEAM). These three potentials possess two or more sets of parameters, herein referred to as force fields, capable of simulating Ti-C and Ti-N systems. The MD results for the lattice parameter, thickness and elastic constants of the MXenes are then compared to those from DFT calculations found in the literature. A total of ten force fields were considered; of these, two REAXFF and two MEAM ones were identified as the most adequate to simulate both the structure and elastic properties of titanium MXenes. Additionally, the values for the linear compressibility of MXenes are presented for the first time. Consequently, researchers can utilize the obtained results to design novel MD-based computational studies of titanium MXenes, leveraging the established relative validity of the available force fields.

COMPUTATIONAL MATERIALS SCIENCE 259, 114134, 2025. **Acesso em: https://doi.org/10.1016/j.commatsci.2025.114134**

Eventos publicados

[P227-2025] "Adding interferometric lightning detection to the Pierre Auger Observatory"

Weitz, M. J.; **Bonneau Arbeletche, L.*; Chinellato, J. A.*; Dobrigkeit, C.*; Fauth, A. C.*; Machado Payeras, A.*; Reginatto Akim, J. V.*;** et al.
IOP PUBLISHING LTD

Pierre Auger Collaboration The Pierre Auger Observatory has detected downward terrestrial gamma-ray flashes (TGFs) with its Surface Detector. A key to understanding this high-energy radiation in thunderstorms is to combine such measurements with measurements of lightning processes in their earliest stages. With eleven modified Auger Engineering Radio Array (AERA) stations we can build an interferometric lightning detection array working in the bandwidth between 30 - 80MHz inside the Surface Detector array to precisely measure lightning stepped leaders in 3D. These measurements allow us to decipher the cause of TGFs and clarify the reason for the observed high-energy particles in thunderstorms. We will present the current status of the detection plans including the configuration of the interferometric lightning detection array and the steps to take as well as the reconstruction characteristics obtained with AERA.

ATMOSPHERIC MONITORING FOR HIGH ENERGY ASTROPARTICLE DETECTORS 2024, ATMOHEAD 2024 Série de livros: Journal of Physics Conference Series 2985, 012016, 2025. **Acesso em: https://doi.org/10.1088/1742-6596/2985/1/012016**

[P228-2025] "Beam shaping the evanescent field for distributed fluorescence-based optical fibre sensing"

Warren-Smith, S. C.; Li, X.; **Cordeiro, C. M. B.*;** Otten, Dale E.; Lancaster, David G.; Ebendorff-Heidepriem, H.; Nguyen, L. V.
Santos J. L.; Sainz M. L. A.; Sun T. (Eds.)

High resolution distributed chemical and biological sensing will enable new discoveries in biological and biomedical applications. Single-point chemical and biological optical fibre sensors often utilise fluorescence-based approaches, which allows high sensitivity and specificity. Achieving distributed sensing at a biologically relevant resolution (< cm) is hindered by the incoherent nature of fluorescence emission. Wavefront shaping of the excitation light in a multimode exposed-core microstructured optical fibre is a promising technique to enhance spatial selectivity by controlling the fluorescence excitation region. This paper gives proof-of-concept numerical and experimental results where we enhance the evanescent field at selected locations along the fibre, and discuss the potential for enhancement by using multi-photon fluorescence.

29TH INTERNATIONAL CONFERENCE ON OPTICAL FIBER SENSORS, Proceedings of SPIE, v. 13639, 1363917, 2025. **Acesso em: https://doi.org/10.1117/12.3061103**

[P229-2025] "Characterizing neural and systemic responses during acute psychosocial stress using functional near-infrared spectroscopy"

Bortoletto, L. F.*; Martins, G. G.; **Yamamoto, B. Y.*; Lima, B. S. de*; Sanchez, V.*; Mesquita, R. C.***
Kainerstorfer J. M.; Buckley E. M.; Srinivasan V. J. (Ed.)

Stress is a physiological response that disturbs homeostasis in the presence of a physical or psychological threat. Although various paradigms have been proposed to assess the body's reactivity to psychosocial stress, their reliability varies mostly due to insufficiently stressful stimulation. In addition, most of the existing paradigms aren't suitable for functional brain imaging. In this study, we introduce a block-designed psychosocial stress--inducing protocol compatible with functional Near-Infrared Spectroscopy (fNIRS). When validated in 40 healthy participants, we found that the stress-oriented condition elicited bilateral activation in the inferior frontal gyri, while the control condition was left-lateralized across the dorsolateral prefrontal cortex (dlPFC). The cardiovascular parameters and blood CO2 levels were significantly altered during stress compared to baseline and notably greater than those observed under controlled questions. Overall, our results suggest that the proposed protocol effectively induces psychosocial stress and can be reliably used with fNIRS to study the neural and physiological correlates of stress.

CLINICAL AND TRANSLATIONAL NEUROPHOTONICS 2025 Série de livros: Progress in Biomedical Optics and Imaging 13302, 1330202, 2025. **Acesso em: https://doi.org/10.1117/12.3046399**

[P230-2025] "Comparative analysis of resting-state functional connectivity networks across different age groups using fNIRS"

Sánchez, V.*; Novi, S.; Carvalho, A. C.; **Quiroga, A. F.*; Forti, R. M.*;** Cendes, F.; Yasuda, C. L.; **Mesquita, R.***
Kainerstorfer J. M.; Buckley E. M.; Srinivasan V. J. (Ed.)

Resting-state functional connectivity (rsFC) is a fundamental aspect of neuroscience and has been extensively researched, particularly for cognitive and clinical purposes. In the past, we developed methods to characterize rsFC networks using functional near-infrared spectroscopy (fNIRS). However, the question of whether fNIRS is sensitive to changes in rsFC as a function of age hasn't been addressed yet. In this work, we examined the different connectivity profiles obtained with fNIRS during rest in 57 healthy participants. We divided the individuals into two groups: young (N=26, 18-30 yo) and older adults (N=31, 50-77 yo). Functional connectivity was assessed using Pearson correlation coefficients and graph theory metrics. Across the group, we observed significant differences in global network properties between young and old adults, with the latter group exhibiting higher connection density, leading to higher clustering and global efficiency. These results are consistent with other neuroimaging techniques (EEG, fMRI), reinforcing the ability of fNIRS to probe rsFC reliably.

CLINICAL AND TRANSLATIONAL NEUROPHOTONICS 2025 Série de livros: Progress in Biomedical Optics and Imaging 13302, 133020C, 2025. **Acesso em: https://doi.org/10.1117/12.3046354**

[P231-2025] "Energy evolution of cosmic-ray mass and intensity measured by the Pierre Auger Observatory"

Novotny, V.; **Bonneau Arbeletche, L.*; Chinellato, J. A.*; Dobrigkeit, C.*; Fauth, A. C.*; Payeras, A. Machado*; Reginatto Akim, J. V.*;** et al.
Pierre Auger Collaboration
Capone A.; Celli S.; Gasbarra C.; Morselli A. (Ed.)

The Pierre Auger Observatory has conducted measurements of the energy spectrum and mass composition of cosmic rays using different methods. Utilizing both surface and fluorescence detectors (SD and FD), the Observatory provides unprecedented precision in understanding these particles. While primarily designed to measure ultra-high energy cosmic rays, the FD's high-elevation telescopes and the dense arrays of SD stations enable observations down to 6 PeV and 60 PeV, respectively. To determine the depth of shower maximum, a critical parameter for identifying primary particle types, both direct longitudinal profile measurements from the FD and indirect signal analyses from the SD are employed. An energy evolution of the mass of primary particles, as well as of the spectral index of the flux intensity, are observed and characterized by features described in the presented work.

The measurements benefit from the joint operation of the FD and SD, delivering a systematic uncertainty of 14% in energy determination and an accumulated exposure reaching 80 000 km(2) sr yr at the highest energies.

RICAP-24, 9TH ROMA INTERNATIONAL CONFERENCE ON ASTROPARTICLE PHYSICS Série de livros: EPJ Web of Conferences 319, 07002, 2025. **Acesso em: https://doi.org/10.1051/epjconf/202531907002**

[P232-2025] "FRAM Next Generation at the Pierre Auger Observatory: cloud monitoring in the age of CMOS cameras"

Ebr, J.; Karpov, S.; **Bonneau Arbeletche, L.*; Chinellato, J. A.*; Dobrigkeit, C.*; Fauth, A. C.*; Machado Payeras, A.*; Reginatto Akim, J. V.*;** et al.
IOP PUBLISHING LTD

Pierre Auger CollaborationThe visibility of stars is often used for cloud detection using all-sky cameras, which have however only a limited reach and resolution near the horizon due to the lack of detectable stars. At the Pierre Auger Observatory, it is also used by the current generation of FRAM robotic telescopes, but - due to their limited field of view - only for a small number of selected showers. Thanks to the recent development in astronomical CMOS cameras, we are able to propose a new type of device, specifically tailored to the field of view of the fluorescence detectors (FD) of the Pierre Auger Observatory. The sub-second readout times available with CMOS cameras allows the efficient use of short exposures, and so the field of view of one FD can be covered within half a minute with a resolution and limiting magnitude sufficient to detect small clouds with a setup that is significantly smaller, simpler and cheaper than the current FRAMs. The FRAM Next Generation (framNG) device will be able not only to detect clouds, but also to assess their optical thickness, provide information on aerosol extinction, sky brightness and possibly even record atmospheric phenomena and astrophysical transients. The main challenge lies in the large data volume produced which necessitates reliable real-time data processing.

ATMOSPHERIC MONITORING FOR HIGH ENERGY ASTROPARTICLE DETECTORS 2024, ATMOHEAD 2024 Série de livros: Journal of Physics Conference Series 2985, 012009, 2025. **Acesso em: https://doi.org/10.1088/1742-6596/2985/1/012009**

[P233-2025] "Innovative platforms for optical sensing: hollow-core and biodegradable optical fibers"

Cordeiro, C. M. B.*; Osório, J. H.; Fujiwara, E.
Santos J. L.; Sainz M. L. A.; Sun T. (Eds.)

We discuss specialty optical fibers with innovative structures, focusing on our current research efforts in hollow-core and biodegradable fibers for sensing applications. Recent advancements in hollow-core photonic crystal fibers have led to the development of low-loss fibers with simplified cross-sectional designs. We explore these fibers as sensing platforms, envisaging their applications in directional curvature, high-temperature, strain, and displacement sensors. By tuning their properties through asymmetric profiles, exploring couplings between core and cladding modes, and incorporating additional materials, these fibers demonstrated promising capabilities for optical sensing. In contrast, biodegradable optical materials offer unique advantages, such as biochemical compatibility and safe interaction with living tissues. Unlike conventional glass and plastic fibers, bioresorbable materials are typically soft, free from sharp edges, and can be absorbed or excreted after use. Here, we highlight agar-based optical optical fibers. Agar, a versatile yet underexplored material in photonics, holds significant potential for the development of environmentally friendly and biocompatible optical components.

29TH INTERNATIONAL CONFERENCE ON OPTICAL FIBER SENSORS, Proceedings of SPIE, v. 13639, 1363909, 2025. **Acesso em: https://doi.org/10.1117/12.3066316**

[P234-2025] "Large-scale anisotropies of ultra-high-energy cosmic rays measured at the Pierre Auger Observatory"

Bianciotto, M.; **Bonneau Arbeletche, L.*; Chinellato, J. A.*; Dobrigkeit, C.*; Fauth, A. C.*; Payeras, A. Machado*; Reginatto Akim, J. V.*;** et al.
Pierre Auger Collaboration
Capone A.; Celli S.; Gasbarra C.; Morselli A. (Ed.)

Measurements of anisotropies in the arrival directions of ultra-high-energy cosmic rays are crucial to pinpoint their sources, which are yet to be discovered. A dipolar anisotropy in right ascension above 8 EeV has been detected by the Pierre Auger Observatory with a significance of 6.8 sigma. The direction of the dipole suggests an extragalactic origin of ultra-high-energy cosmic rays above those energies. In this contribution, we provide an overview of the studies on large-scale anisotropies in the arrival directions of ultra-high-energy cosmic rays measured at the Pierre Auger Observatory with energy thresholds from similar to 0.03 EeV up to 32 EeV and we present and discuss the recent results achieved with the latest available dataset, which includes 19 years of operations - resulting in a total exposure of 123,000 km(2) sr yr and nearly 50,000 events above 8 EeV.

RICAP-24, 9TH ROMA INTERNATIONAL CONFERENCE ON ASTROPARTICLE PHYSICS Série de livros: EPJ Web of Conferences 319, 07001, 2025. **Acesso em: https://doi.org/10.1051/epjconf/202531907001**

[P235-2025] "Mechanical measurements in filament-wound composite cylinders by optical fiber specklegram sensor"

Fujiwara, E.; Menezes, E. A. W. de; Andrä, J.; Lisbôa, T. V.; Spickenheuer, A.; Amico, S. C.; **Cordeiro, C. M. B.***
Santos J. L.; Sainz M. L. A.; Sun T. (Eds.)

Filament wound (FW) composite structures are appealing alternatives to conventional materials due to their improved strength, reduced weight, and optical fiber integration capability. However, current (quasi) distributed sensing approaches rely on intricate and expensive interrogation systems. Therefore, this paper proposes a fiber specklegram sensor to detect radial stress/strain in an FW cylinder. The probe comprises a laser-illuminated multimode waveguide attached to the composite sample wall. The fiber outputs a characteristic speckle pattern that varies with the applied mechanical stimuli' magnitude and location. Thus, we compute the correlation coefficient to quantify the specklegram changes in response to radial efforts, achieving force and strain sensitivities of similar to 0.96 N-1 and similar to 0.04 (m epsilon) (-1), respectively. Furthermore, choosing the reference speckle image discriminates force orientation and position along the cylinder's extent through a single fiber/wavelength scheme. Such promising results motivate further development of a smart composite structure with integrated strain sensing ability.

29TH INTERNATIONAL CONFERENCE ON OPTICAL FIBER SENSORS, Proceedings of SPIE, v. 13639, 136395D, 2025. **Acesso em: https://doi.org/10.1117/12.3060972**

[P236-2025] "Multiple ELVES and other Transient Luminous Events at the Pierre Auger Observatory"

Mussa, R.; **Bonneau Arbeletche, L.*; Chinellato, J. A.*; Dobrigkeit, C.*; Fauth, A. C.*; Machado Payeras, A.*; Reginatto Akim, J. V.*;** et al.

IOP PUBLISHING LTD; Pierre Auger Collaboration

In the last ten years, the Pierre Auger Observatory has exploited a dedicated trigger and extended readout, and its very high time resolution, to record the world's largest sample of multiple ELVES. By comparing the time gaps between flashes with waveforms recorded by the antennas of the ENTLN network, we observe the correlation expected by models for what concerns double ELVES. On the contrary, using a large sample of triple ELVES, from four different thunderstorms, we refute the ground reflection mechanism. In the same data sample, we could observe another type of TLE, the halo, a few hundred microseconds after some ELVES. This has motivated the installation, in December 2023, of new cameras, to complement the observations done with our Fluorescence Detector. Preliminary results, including the first observation of sprites in Auger, will be shown.

ATMOSPHERIC MONITORING FOR HIGH ENERGY ASTROPARTICLE DETECTORS 2024, ATMOHEAD 2024 Série de livros: Journal of Physics Conference Series 2985, 012013, 2025. **Acesso em: https://doi.org/10.1088/1742-6596/2985/1/012013**

[P237-2025] "Optical fiber-based sensing platform with integrated biodegradable agar-structured transducer"

Fujiwara, E.; **Rosa, L. O.*; Oliveira, F. I. S.*;** Guimaraes, V. A. V.; **Cordeiro, C. M. B.***
Santos J. L.; Sainz M. L. A.; Sun T. (Eds.)

Emerging applications in biochemical and biomedical sensing demand degradable and biocompatible optical fibers to replace the widespread glass and plastic waveguides. Agar prevails amongst soft optical materials as a renewable, transparent, edible, and thermoreversible gel, supporting the manufacture of lenses and waveguides. Thus, this paper proposes an agar-glycerol-made structured optical fiber integrated into a slab substrate for mechanical and chemical sensing. A 3D-printed mold creates air holes around the solid core, leading to optical losses of 2.42 dB/cm at 633 nm. Moreover, we investigated the sensor response to transverse forces by assessing the output light through specklegram analysis, yielding a practical resolution of 0.04 N. Ultimately, exposing the transducer to surrounding fluids reveals characteristic speckle field changes due to the agar syneresis and swelling effects. The preliminary results encourage further applications of the integrated optical fiber as a biocompatible and disposable sensing platform for growth media and microfluidics setups.

29TH INTERNATIONAL CONFERENCE ON OPTICAL FIBER SENSORS, Proceedings of SPIE, v. 13639, 136395E, 2025. **Acesso em: https://doi.org/10.1117/12.3060974**

[P238-2025] "Overview of Machine Learning Applications at the Pierre Auger Observatory"

Rodriguez, E.; **Bonneau Arbeletche, L.*; Chinellato, J. A.*; Dobrigkeit, C.*; Fauth, A. C.*; Payeras, A. Machado*; Reginatto Akim, J. V.*;** et al.
Pierre Auger Collaboration
Capone A.; Celli S.; Gasbarra C.; Morselli A. (Ed.)

The complex spatio-temporal information from shower footprints, comprised of particle arrival times and traces measured by water-Cherenkov detectors, is challenging to analyse with traditional methods but well-suited for machine learning (ML) based analyses. In this contribution, we provide an overview of the ML applications developed to leverage the high event statistics acquired by the Pierre Auger Observatory. In the context of the energy spectrum, a neural network approach for energy reconstruction has demonstrated potential in reducing composition biases in the energy estimator. A notable application for mass composition is the indirect prediction of the depth of the maximum shower development, X-max, which extends the energy range of previous analyses into unexplored higher energies. Aligned with AugerPrime, the ongoing upgrade of the Observatory, the impact of enhanced electronics and scintillation detectors was explored via simulations. Both transformers and convolutional networks perform better at the reconstruction of mass-composition sensitive observables like X-max and the muon number, demonstrating the benefits of the Observatory's upgrade.

RICAP-24, 9TH ROMA INTERNATIONAL CONFERENCE ON ASTROPARTICLE PHYSICS Série de livros: EPJ Web of Conferences 319, 13006, 2025. **Acesso em: https://doi.org/10.1051/epjconf/202531913006**

[P239-2025] "Raman Lidar observations of the vertical profiles of aerosol optical properties and water vapour at the Pierre Auger Observatory"

Avocone, E.; Larlori, M.; **Bonneau Arbeletche, L.*; Chinellato, J. A.*; Dobrigkeit, C.*; Fauth, A. C.*; Machado Payeras, A.*; Reginatto Akim, J. V.*;** et al.
IOP PUBLISHING LTD; Pierre Auger Collaboration

The observations of a Raman Lidar at the Pierre Auger Observatory in the Argentinian Pampa are reported. The Raman Lidar is utilized for real-time atmospheric monitoring associated with the detection of cosmic-ray air showers. The vertical profiles of aerosol optical depth and aerosol backscatter are presented and discussed for an observation period ranging from 2013 to 2022. Meanwhile, the water vapour profiles are analyzed for the period from 2016 to 2022. The results could give insights into regional climate dynamics over the Argentinian Pampa.

ATMOSPHERIC MONITORING FOR HIGH ENERGY ASTROPARTICLE DETECTORS 2024, ATMOHEAD 2024 Série de livros: Journal of Physics Conference Series 2985, 012002, 2025. **Acesso em: https://doi.org/10.1088/1742-6596/2985/1/012002**

[P240-2025] "The latest result on UHE-photons at the Pierre Auger Observatory"

Savina, P.; **Bonneau Arbeletche, L.*; Chinellato, J. A.*; Dobrigkeit, C.*; Fauth, A. C.*; Payeras, A. Machado*; Reginatto Akim, J. V.*;** et al.
Pierre Auger Collaboration
Capone A.; Celli S.; Gasbarra C.; Morselli A. (Ed.)

The Pierre Auger Observatory is the most sensitive detector to primary photons with energies above 0.2 EeV providing unprecedented exposure to ultra-high-energy (UHE) cosmic rays and specifically to UHE photons. The Observatory measures extensive air showers using a hybrid technique that combines a fluorescence detector (FD) with a ground array of particle detectors (SD). The signatures of a photon-induced air shower are a larger atmospheric depth of the shower maximum (X-max) and a steeper lateral distribution function, along with a lower number of muons with respect to the bulk of hadron-induced background. Using observables measured by the FD and SD, various photon searches in different energy bands are performed. These efforts have produced some of the most stringent upper limits on the diffuse fluxes of UHE photons. These limits place significant constraints on current models for the origin of UHE cosmic rays, highlighting the leading role of the Observatory in multimessenger astronomy at the highest energies. In this contribution, an overview of current activities related to the search for UHE photons is shown, using more than 15 years of data from the Pierre Auger Observatory. The latest results of the searches for diffuse fluxes of photons will be presented, as well as follow-up searches for UHE photons in association with transient events, such as gravitational wave events, will be summarized.

RICAP-24, 9TH ROMA INTERNATIONAL CONFERENCE ON ASTROPARTICLE PHYSICS Série de livros: EPJ Web of Conferences 319, 06008, 2025. **Acesso em: https://doi.org/10.1051/epjconf/202531906008**

[P241-2025] "Update on the Offline Analysis Framework for AugerPrime and integration of the AugerPrime Radio Detector reconstruction"

Gottowik, M.; **Bonneau Arbeletche, L.*; Chinellato, J. A.*; Dobrigkeit, C.*; Fauth, A. C.*; Payeras, A. Machado*; Reginatto Akim, J. V.*;** et al.
Pierre Auger Collaboration
Capone A.; Celli S.; Gasbarra C.; Morselli A. (Ed.)

The Offline Framework serves as a comprehensive tool for the reconstruction of measured data and simulated air showers for the Pierre Auger Observatory. Originally developed for the Surface and Fluorescence Detectors, new detectors such as the Auger Engineering Radio Array have already been successfully integrated. The development and installation of the AugerPrime upgrade required incorporating new detector types and updating existing detector descriptions. This integration was facilitated by the modular structure of Offline, which strictly separates detector descriptions, data structures, and processing modules. We will discuss the general structure of the Offline Framework and explain the design decisions that provided its flexibility. Specifically, we will describe the reconstruction of data from the AugerPrime Radio Detector within Offline. This includes the signal reconstruction for each station, the directional reconstruction based on a spherical model of the signal arrival time at all stations, and the energy and distance to X-max reconstruction from a fit of the lateral signal distribution. Additionally, we will outline anticipated improvements in the reconstruction process, such as an absolute calibration based on the galactic radio emission and an advanced suppression technique for narrow-band RFI pulses.

RICAP-24, 9TH ROMA INTERNATIONAL CONFERENCE ON ASTROPARTICLE PHYSICS Série de livros: EPJ Web of Conferences 319, 12005, 2025. **Acesso em: https://doi.org/10.1051/epjconf/202531912005**

[P242-2025] "Updates of the atmospheric monitoring at the Pierre Auger Observatory"

Büken, M.; Keilhauer, B.; **Bonneau Arbeletche, L.*; Chinellato, J. A.*; Dobrigkeit, C.*; Fauth, A. C.*; Machado Payeras, A.*; Reginatto Akim, J. V.*;** et al.
IOP PUBLISHING LTD
Pierre Auger Collaboration

Recent developments for the atmospheric monitoring at the Pierre Auger Observatory are presented. These developments include a new method for cloud identification based on night sky background data from the Fluorescence Detector, a new network of devices for measuring the electric field across the array of the observatory, and updates of lidar data applied to identify clouds for high-level physics analyses of air shower data.

ATMOSPHERIC MONITORING FOR HIGH ENERGY ASTROPARTICLE DETECTORS 2024, ATMOHEAD 2024 Série de livros: Journal of Physics Conference Series 2985, 012001, 2025. **Acesso em: https://doi.org/10.1088/1742-6596/2985/1/012001**

Livros publicados

[L001-2025] "Obras de Weber sobre Eletrodinâmica Traduzidas e Comentadas"

Volume I: Biografia, Magnetismo, Indução Unipolar, e o Sistema Absoluto de
Unidades de Gauss e Weber

Assis, A. K. T.*

Editoração: Apeiron, Idioma: Português, 445 páginas, Data da publicação: 26 junho 2025, ISBN- 978-1987980370.

[L002-2025] "Obras de Weber sobre Eletrodinâmica Traduzidas e Comentadas"

Volume II: A Força de Weber e a Unificação das Leis de Coulomb, Ampère e Faraday

Assis, A. K. T.*

Editoração: Apeiron, Idioma: Português, 518 páginas, Data da publicação: 26 junho 2025, ISBN- 978-1987980417.

[L003-2025] "Obras de Weber sobre Eletrodinâmica Traduzidas e Comentadas"

Volume III: Medição da Constante c de Weber, Diamagnetismo, a Equação do Telégrafo, e a Propagação de Ondas Elétricas na Velocidade da Luz

Assis, A. K. T.*

Editoração: Apeiron, Idioma: Português, 445 páginas, Data da publicação: 26 junho 2025, ISBN- 978-1987980370.

[L004-2025] "Obras de Weber sobre Eletrodinâmica Traduzidas e Comentadas"

Volume IV: Conservação da Energia, o Modelo Planetário de Weber para o Átomo, a Unificação do Eletromagnetismo com a Gravitação, e a Eletrodinâmica de Weber Contra as Teorias de Campo

Assis, A. K. T.*

Editoração: Apeiron, Idioma: Português, 484 páginas, Data da publicação: 26 junho 2025, ISBN- 978-1987980417.

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Defesas de Dissertações do IFGW

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[D014-2025] "Espectroscopia Terahertz Resolvida no Tempo: Dinâmica Ultrarrápida da Fotocondutividade e Propriedades de Transporte Eletrônico"
Aluno: Davi Henrique Soledade da Silva
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[D015-2025] "Projeto de um Gerador de Números Aleatórios Quânticos em uma Plataforma Integrada"
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Aluno: Pablo Batista Pinto
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[T011-2025] "Investigação do uso de redes de textura para a caracterização do cérebro humano em condições saudáveis e patológicas"
Aluno: Rafael Vinícius da Silveira
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Fonte: Portal IFGW/Eventos
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Abstracta

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