

Career Development Workshop for Women in Physics | (SMR 4312)

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Quantum Algorithm for the Heat Equation: A Rigorous Operator-Theoretic and Spectral Analysis via the Harrow-Hassidim-Lloyd Algorithm

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The heat equation is a prototypical parabolic partial differential equation describing diffusive processes in physics, engineering, and applied mathematics. Classical numerical methods approximate its solution by discretizing the spatial domain, thereby producing large sparse systems of linear equations whose computational cost grows rapidly with the resolution of the discretization. Quantum computing provides an alternative paradigm for solving such systems through quantum linear systems algorithms. In this work we develop a rigorous operator-theoretic framework for the application of the Harrow–Hassidim–Lloyd (HHL) algorithm to the heat equation. The continuous problem is formulated on a Hilbert space using the Laplacian operator and the associated heat semigroup generated by the diffusion operator. We analyze the spectral structure of both the continuous Laplacian and its finite-difference discretization, and prove strong operator convergence of the discrete operators to their continuous counterparts. Using resolvent convergence and spectral functional calculus, we show that the finite-dimensional linear systems solved by the quantum algorithm converge to the continuous heat equation in the continuum limit. Our results establish rigorous convergence and stability guarantees for quantum algorithms applied to parabolic partial differential equations and clarify the spectral mechanism by which the HHL algorithm implements inverse operators on discretized differential operators.

Abstract template for Career Development Workshop for Women in Physics

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This work reports the effect of p – CdTe layers on the opto-electronic behaviour of different solar cell devices fabricated from CdTe – based device architecture. Two sets of device architecture namely n – n Schottky barrier solar cells and homo-heterojunction – based solar cells with n – n – p device structure was investigated. Schottky barrier solar cells were fabricated using glass/FTO/n – CdS/n – CdTe/Au device structure and this serves as the baseline for comparison with the homo-heterojunction solar cells having p – CdTe layers. The multijunction-based homo-heterojunction solar cells with the n – n – p device architecture was fabricated using glass/FTO/n – CdS/n – CdTe/p – CdTe/Au. Non – linear and rectifying responses were observed for homo-heterojunction solar cells and n – n Schottky barrier solar cells respectively, when measured under dark condition. Under illumination condition, the cell parameters of the homo-heterojunction solar cells improved as compared to the Schottky barrier solar cells. Short circuit current density values of 27.0 mAcm^{-2} and 38.0 mAcm^{-2} were obtained for the Schottky barrier and homo-heterojunction – based solar cells respectively. Overall, higher efficiency values of $\sim 4.91\%$ and 7.39% were obtained for the Schottky barrier and homo-heterojunction – based solar cells respectively.

[1] W. Li, L. Feng, J. Zhang, L. Wu, Y. Cai, J. Zheng, W. Cai, B. Li and Z. Lei, Sci. China Technol. Sci. **51**, 33 (2008).

[2] A. Rohatgi, R. Sudharsanan, S. A. Ringel and M. H. MacDougall, Sol Cells, **30**, 1 (1991).

[3] O. K. Echendu and I. M. Dharmadasa, Energies, **8**, 4416, (2015).

Advanced Optical Modeling and Dielectric Function Analysis of Fe_3O_4 -Al Multilayer Thin Film Structures

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Multilayer thin-film structures based on Fe_3O_4 and Al materials have attracted significant attention due to their promising optical, magnetic, and electromagnetic properties for advanced technological applications. In this work, Fe_3O_4 -Al multilayer thin film structures with different dimensional parameters were investigated using optical modeling and dielectric function analysis. The study focuses on the extraction of optical constants and dielectric parameters from experimental spectroscopic data and the investigation of electromagnetic behavior in layered systems.

Optical models of multilayer structures were developed to analyze the interaction of electromagnetic waves with thin-film interfaces and to determine the influence of structural parameters on optical response. The dielectric function behavior of the multilayer systems was evaluated in relation to thickness variation and layer configuration. The obtained results demonstrate that the optical and electromagnetic properties of Fe_3O_4 -Al structures strongly depend on the multilayer architecture and dimensional characteristics of the films.

The combination of theoretical analysis and experimental characterization provides important information for the development of functional multilayer materials with enhanced optical and electromagnetic absorption properties. These materials may have potential applications in optoelectronic devices, electromagnetic shielding systems, and advanced nanostructured technologies.

Correlation Geometry, Magnetic Ordering and Superexchange Interactions in Ni-Zn Ferrites

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Ni_{1-x}Zn_xFe₂O₄ (x=0; 0.25; 0.4; 0.5; 0.6; 0.75; 1) ferrites have attracted considerable attention because of their unique magnetic, electrical, and structural properties, which make them promising materials for microwave devices, magnetic sensors, information storage systems, and spintronic applications. The magnetic behavior of these ferrites is mainly governed by the distribution of cations over tetrahedral (A) and octahedral (B) sites and by the strength of superexchange interactions between magnetic ions. Therefore, understanding the relationship between nanoscale structural organization and magnetic ordering is of great importance.

In the present work, the correlation geometry and magnetic interactions in Ni_{1-x}Zn_xFe₂O₄ ferrites were investigated using small-angle X-ray scattering (SAXS) together with complementary structural and spectroscopic techniques. SAXS measurements were employed to analyze nanoscale structural correlations, characteristic dimensions, and the degree of spatial ordering in the ferrite system. The obtained scattering profiles provided information on the evolution of correlation lengths and structural heterogeneities with increasing Zn concentration.

The results indicate that Zn substitution significantly modifies the correlation geometry of the ferrite lattice, leading to changes in the local arrangement of magnetic ions and affecting the magnetic exchange pathways [1, 2]. The observed variations in correlation length suggest a strong relationship between nanoscale structural organization and magnetic ordering. These effects can be associated with modifications of the A–B superexchange interactions, which play a dominant role in determining the magnetic properties of spinel ferrites.

The study demonstrates that SAXS is a powerful tool for revealing hidden structural correlations that influence magnetic behavior. The obtained results contribute to a deeper understanding of the structure–property relationships in ferrite nanomaterials and provide valuable insights into the mechanisms governing magnetic interactions in spinel systems.

Keywords: Ni-Zn ferrites, SAXS, correlation geometry, magnetic interactions, superexchange interactions, spinel ferrites, magnetic nanomaterials.

[1] S.N. Aliyeva, T.R. Mehdiyev, S.H. Jabarov, K.N. Ahmadova, I.F. Yusibova, *J. Supercond. Magn.* **36**, 367–371 (2023).

[2] T.R. Mehdiyev, A.M. Hashimov, S.H. Jabarov, Sh.N. Aliyeva, S.E. Kichanov, A.V. Rutkauskas, I.F. Yusibova, Kh.N. Ahmadova, *J. Magn. Magn. Mater.* **587**, 171326 (2023).

Women-Led Innovation in Medical Physics: Development and Clinical Validation of the Nabaa Efficiency Index (NEI) for Objective Plan Quality Assessment

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Background: Objective evaluation of radiotherapy and stereotactic radiosurgery treatment plans remains a major challenge in medical physics. Conventional metrics such as conformity, homogeneity, and gradient indices assess individual characteristics of dose distribution but fail to provide a unified measure of geometric and dosimetric efficiency. To address this limitation, we developed the Nabaa Efficiency Index (NEI), a novel dimensionless metric integrating target conformity and dose localization into a single framework.

Methods: The NEI was formulated as: $\eta_{Nabaa} = CI \times DER = \left(\frac{V_{TV}}{V_{PIV_x}} \right) \left(\frac{\bar{D}_{TV}}{\bar{D}_{PIV_x}} \right)$, where V_{TV} is the target volume, V_{PIV} is the prescription isodose volume, $\bar{D}_{TV}$ is the mean target dose, and $\bar{D}_{PIV_x}$ is the mean dose within the prescription isodose envelope. Two prescription-specific variants (NEI₅₀ and NEI₉₀) were developed for stereotactic and conventionally fractionated radiotherapy applications. Clinical validation was performed using 100 stereotactic treatment plans, including 50 Gamma Knife radiosurgery (GK-SRS) and 50 linac-based SRS-VMAT plans. Performance was assessed using correlation analysis, receiver operating characteristic (ROC) analysis, sensitivity, specificity, and comparison with established dosimetric indices.

Results: Gamma Knife plans demonstrated significantly higher efficiency scores than SRS-VMAT plans (NEI₅₀: 0.94 ± 0.06 vs. 0.86 ± 0.12 , $p \leq 0.0001$), indicating superior dose localization efficiency. NEI₉₀ exhibited excellent discriminatory performance, achieving an AUC of 0.902 for GK-SRS and 0.977 for SRS-VMAT, with a pooled AUC of 0.941. The pooled analysis yielded a sensitivity of 86.3% and specificity of 93.1% at the optimal threshold. Strong correlations were observed between NEI and established conformity-based metrics, while NEI demonstrated enhanced sensitivity to dose spill and energy distribution characteristics not captured by traditional indices.

Conclusion: The Nabaa Efficiency Index represents a novel women-led innovation in medical physics, providing a unified and clinically interpretable measure of treatment plan quality. The index demonstrated excellent diagnostic performance across multiple stereotactic platforms and may support automated quality assurance, cross-platform plan comparison, and future integration with artificial intelligence-driven radiotherapy workflows. These findings highlight the potential of NEI as a standardized tool for objective treatment plan evaluation in modern radiation oncology.

[1] M. van't Riet, A. Mak, W. Moerland, L. Elders, W. van der Zee, Int. J. Radiat. Oncol. Biol. Phys. 37, 731 (1997).

[2] I. Paddick, J. Neurosurg. 93, 219 (2000).

[3] B. Feuvret, G. Noel, J. Mazon, P. Bey, Cancer Radiother. 10, 288 (2006).

Women in Medical Physics: Balancing Motherhood, Clinical Responsibility, and Patient-Centered Care in Radiotherapy

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Medical physics is a demanding and rapidly evolving field that requires continuous scientific development, technical competence, and strong clinical responsibility. For women medical physicists, career progression may involve additional challenges, particularly when balancing marriage, motherhood, clinical duties, academic ambition, and lifelong learning.

This poster presents a professional perspective on the journey of women in medical physics, focusing on the experience of balancing family responsibilities with work in radiotherapy practice. The role includes treatment planning, dosimetry, patient-specific quality assurance, radiation-safety awareness, support for research students, and teaching board trainees. These responsibilities require continuous adaptation to advanced radiotherapy technologies such as diagnostic , image-guided radiotherapy, stereotactic techniques, and modern quality assurance methods.

The presence of women medical physicists is particularly valuable in radiotherapy departments, where many female cancer patients may feel more comfortable, respected, and supported when interacting with female healthcare professionals, especially in culturally sensitive environments such as Iraq. Women physicists contribute not only to the technical quality of treatment, but also to patient confidence, communication, privacy, and the overall quality of care.

This poster emphasizes that women with young children can continue to grow scientifically and professionally when supported by mentorship, institutional awareness, radiation-safety guidance, and international networking. Supporting women in medical physics is not only a matter of gender equity; it is also essential for strengthening clinical quality, patient safety, education, and research capacity in developing healthcare systems.

Keywords: Women in Physics; Medical Physics; Radiotherapy; Motherhood; Patient-Centered Care; Radiation Safety; Iraq

Line flux characterization of galaxies in the Green Valley

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Galaxy populations exhibit a well established bimodality in the color-magnitude diagram (CMD), separating into a blue cloud of actively star forming, disk dominated galaxies and a red sequence of quiescent, bulge dominated systems [1]. Between these two populations lies the green valley, a transitional region populated by galaxies undergoing a decline in star formation as they migrate from the blue cloud to the red sequence [2]. Understanding the physical mechanisms driving this transition remains a central challenge in extragalactic astronomy. In this work, we use spectroscopic and photometric data from the Sloan Digital Sky Survey (SDSS) to characterize the spectrophotometric properties of green valley galaxies in the nearby universe through a novel approach based on spectral line ratios. We introduce a new quantity: the *Spectral Line Ratio Space*, defined by the ratios of spectral line fluxes in galaxies, both absorption and emission, aiming to identify distinguishing features across the color-magnitude diagram. Each galaxy is represented as a vector defined by all possible ratios between emission line fluxes and absorption indices, spanning an N-dimensional space (where N is the number of spectral lines used), thus defining two separate parameter spaces.

For emission tracers, a clear decrease in [OIII] 5007 is observed in blue, star forming galaxies, stabilizing at lower values in intermediate and red colors. However, a subset of red galaxies exhibits enhanced emission due to active galactic nuclei (AGN). Combined ratios such as $([OII] + [OII])/[OIII] 5007$ and $([SII] + [SII])/[OIII] 5007$ differentiate two clusters within the red sequence: passive red galaxies and AGN-hosting galaxies with enhanced [OIII] 5007 emission. In this context, we introduce a “robust” criterion to identify objects classified as AGN using spectral line features. Using this criterion, a group of non-AGN-classified galaxies displays AGN behavior along the emission tracers and is an interesting target for future studies. For absorption tracers, H δ A and the MgI index emerge as key indicators, revealing two regions of enhanced absorption activity directly associated with AGN hosts.

We perform a cluster analysis in the n-dimensional space defined by the ratio of spectral lines. This analysis confirms the expected bimodality in the CMD, emphasizing a difference between emission and absorption-line spaces. In the blue-sequence of the color distribution 62% of the galaxies identified through absorption ratios coincide with the emission-based clustering, while an 85.2% agreement is found in the red sequence. A population of transition galaxies emerges from the mixed clustering results in the blue sequence, suggesting an evolutionary link between the blue and red sequences, and allowing green valley galaxies to be identified not only by color, but through their clustering properties and H β (emission)/D4000 < 100 spectral line ratio values.

[1] Baldry et al. (2004). Quantifying the Bimodal Color-Magnitude Distribution of Galaxies. *The Astrophysical Journal*, 600(2), 681–694.

[2] Wyder et al. (2007). The UV-Optical Galaxy Color-Magnitude Diagram. *The Astrophysical Journal Supplement Series*, 173(2), 293–314.

FEMCEN: A Feminist Student Collective Advancing Women in STEM in Colombia

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In 2020 a group of undergraduate students in the Physics Department at the University of Antioquia in Colombia began questioning the persistent underrepresentation of women in STEM fields, particularly in leadership, teaching, and research positions. According to UNESCO, women represent only 30% of researchers worldwide, with participation decreasing from 53% at the bachelor's and master's levels to 44% at the doctoral level [1]. This disparity is even more pronounced at the local level, where women constitute less than 25% of faculty members, and in some departments, such as Physics, only 3 out of 49 professors are women [2]. In this context, FEMCEN emerged as a bottom-up initiative aimed at reclaiming and making visible the contributions of women in science. Through science communication, spaces for reflection, and activism against Gender-Based Violence, FEMCEN seeks to engage both the scientific community and the institution, bringing together students, professors, and administrative staff in its initiatives.

This work presents the experience and trajectory of FEMCEN, focusing on two of its main projects. The first, *Laboratorio de Género* (Gender Lab), awarded in the “Promotores del Bienestar UdeA 2021” call, a fund aimed at preventing gender-based violence and promoting safe and inclusive university environments. Over an eight-month period, FEMCEN organized talks led by experts from different areas of science, as well as hands-on workshops in R, Python, Java, and machine learning, all led exclusively by women. These activities aimed to highlight women's trajectories in STEM and strengthen participants' computational skills. The results showed high participation of women (73%) and members of the LGBTIQ+ community (25.8%).



Figure 1. Some murals of *Legados Invisibles* in the hallway of the Institute of Physics, UdeA.

The second project is *Legados Invisibles*, a series of murals dedicated to women scientists located in a hallway of the Institute of Physics. Developed in collaboration with the artistic collective Biógrafos and the Faculty of Exact and Natural Sciences, this initiative consists of eight murals honoring women whose contributions have been fundamental in different areas of science: Rosalind Franklin, Jeanne Baret, Maryam Mirzakhani, Ana María Rey, Ángela Restrepo, Rebeca Gerschman, Doris Hinestroza, and Katherine Johnson. These murals transform an everyday space in the Faculty into a place of memory and recognition, making female role models visible to the entire community.

Beyond its local initiatives, FEMCEN wants to reach a bigger audience from all around the world, grounded in the conviction that science is a political, ethical, and situated practice.

[1] UNESCO. (2021). *Women in higher education: Has the female advantage put an end to gender inequalities?*

[2] University of Antioquia. (n.d.). *Planta Profesoral: Facultad de Ciencias Exactas y Naturales*. [UdeA].

P08

Exploring Black Hole Physics through Quantum Gravity

Feedback control of cellular noise by intracellular condensates

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Cells must reliably regulate gene expression despite substantial intracellular fluctuations. Stochasticity in transcription and translation generates high variability in protein concentrations, yet cells achieve robust function through mechanisms that buffer these fluctuations. Biomolecular condensates formed by liquid–liquid phase separation provide one such mechanism: by dynamically partitioning molecules between dilute and dense phases, condensates help maintain the free-particle concentration fluctuations within a narrow range even when total molecular copy numbers vary. Experiments and theory have demonstrated noise reduction in single-component condensates under near-equilibrium conditions [1].

However, endogenous condensates are inherently multicomponent and operate far from equilibrium due to molecular turnover, active processes, and compositional regulation. How these features jointly influence noise control remains poorly understood, some attempts have been made in this regard [2] but a framework that simultaneously accounts for multicomponent thermodynamics and non-equilibrium kinetics is still lacking.

A recent experimental study [3] identified a homeostatic feedback mechanism whereby elevated protein concentrations within RNA–protein condensates drive the sequestration of their corresponding mRNAs. Motivated by these findings, we develop a theoretical and computational framework to quantify fluctuations in out-of-equilibrium multicomponent biomolecular condensates and account for this feedback mechanism. Our approach integrates condensate thermodynamics with stochastic reaction kinetics and uses a system-size expansion to determine both steady-state concentrations and their fluctuations. The resulting framework establishes a basis for understanding how compositional complexity and non-equilibrium processes modulate the noise-buffering properties of cellular condensates.

- [1] A. Klosin, F. Oltsch, T. Harmon, A. Honigmann, F. Jülicher, A. A. Hyman, and C. Zechner, *Science* **367**, 464 (2020).
- [2] C. Zechner and F. Jülicher, *Cell Syst.* **16**, 101168 (2025).
- [3] R. Faraway, N. Costello Heaven, H. Digby, K. Kuret Hodnik, J. Rebselj, O. G. Wilkins, A. M. Chakrabarti, I. A. Iosub, N. Vadjnal, R. Dore, L. Knez, S. L. Ameres, C. Plaschka, and J. Ule, *Nature* **647**, 798 (2025).

FEMCEN: A Feminist Student Collective Advancing Women in STEM in Colombia

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Michelson Interferometric Testing of Material-Coated Optical Fiber Tips for Optical Sensor Applications

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Abstract—Michelson interferometry represents a powerful and highly sensitive technique for the characterization of optical components and materials. In this work, a Michelson interferometric setup is employed for the experimental testing of optical fiber tips coated with different functional materials, aiming at their evaluation for optical sensing applications. The investigated fibers are prepared by depositing thin material layers at the distal end of single-mode optical fibers, forming reflective sensing elements whose optical response depends on the coating properties. Variations in the interferometric fringe pattern are analysed as a function of coating material, thickness, and environmental perturbations. The proposed approach enables precise detection of phase shifts and optical path length variations induced by the coated fiber tips. Experimental results demonstrate that the interferometric response is strongly influenced by the refractive index and mechanical properties of the deposited materials, highlighting their suitability for sensor development. The presented method offers a reliable and non-destructive tool for comparing different coating materials and optimizing optical fiber-based sensors for applications such as temperature, strain, and refractive index sensing.

References

- [1]. Hongyun Meng, Wei Shen, Guanbin Zhang, Xiaowei Wu, Wei Wang, Chunhua Tan, Xuguang Huang, Michelson interferometer-based fiber-optic sensing of liquid refractive index, *Sensors and Actuators B: Chemical*, Volume 160, Issue 1, 2011, Pages 720-723.
- [2] Jauregui-Vazquez, D., Marquez-Becerra, H., Rangel-Rojó, R., Tiznado-Vázquez, H. J., Arellano-Gonzalez, L. M., Castro-Toscano, J. D., ... Estudillo-Ayala, J. M. (2025). Compact Visible Range All-Fiber Michelson Interferometer Supported by Nano-TiO₂ Reflective Coating and Analysis of Its Temperature Response. *Fiber and Integrated Optics*, 44(5), 426–444. <https://doi.org/10.1080/01468030.2025.2529139>

Physicochemical Characterization of Massive Young Stellar Objects (MYSOs) Using Regression Models and Machine Learning

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The study of chemical evolution in Massive Young Stellar Objects (MYSOs) allows the molecules CH₃OH, CH₃CN, and CH₃CCH to be used as an evolutionary clock to describe the transition between critical stages of massive star formation. Using a sample of 32 MYSOs observed by ALMA in band 6 (1.24–1.33 mm) and based on the parameters derived by Angarita et al. (2025), Principal Component Analysis (PCA) was applied to reduce the dimensional complexity of the data, successfully capturing 86% of the variance in the spectra across the eight principal components.

Random Forest (RF), Gradient Boosting Machine (GBM), and Convolutional Neural Networks (CNN) regression models were implemented, evaluating their Mean Absolute Error (MAE), Mean Squared Error (MSE), and R metrics for inferring column density and excitation temperature. In addition, data preprocessing was performed using Isolation Forest, which allowed for the identification and filtering of outliers that bias the training, since the prediction made with PCA is sensitive to outliers.

The results show that the integration of Isolation Forest with Gradient Boosting (ISO+GB) achieves high levels of accuracy with very low RMSE values, 0.55 K for the excitation temperature and 0.2 for the column density, as well as an R coefficient of approximately 1 for both characteristics across the three molecules studied. The characteristic spectral signatures were then reconstructed using the regression weights according to their importance for each component, which allowed for the identification of the specific emission lines that the algorithm prioritizes for each chemical species. This surpasses the capabilities of automatic spectral characterization using the established regression model, establishing a robust and accurate inference methodology.

FEMCEN: A Feminist Student Collective Advancing Women in STEM in Colombia

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In 2020 a group of undergraduate students in the Physics Department at the University of Antioquia in Colombia began questioning the persistent underrepresentation of women in STEM fields, particularly in leadership, teaching, and research positions. According to UNESCO, women represent only 30% of researchers worldwide, with participation decreasing from 53% at the bachelor's and master's levels to 44% at the doctoral level [1]. This disparity is even more pronounced at the local level, where women constitute less than 25% of faculty members, and in some departments, such as Physics, only 3 out of 49 professors are women [2]. In this context, FEMCEN emerged as a bottom-up initiative aimed at reclaiming and making visible the contributions of women in science. Through science communication, spaces for reflection, and activism against Gender-Based Violence, FEMCEN seeks

to engage both the scientific community and the institution, bringing together students, professors, and administrative staff in its initiatives.

This work presents the experience and trajectory of FEMCEN, focusing on two of its main projects. The first, *Laboratorio de Género* (Gender Lab), awarded in the “Promotores del Bienestar UdeA 2021” call, a fund aimed at preventing gender-based violence and promoting safe and inclusive university environments. Over an eight-month period, FEMCEN organized talks led by experts from different areas of science, as well as hands-on workshops in R, Python, Java, and machine learning, all led exclusively by women. These activities aimed to highlight women’s trajectories in STEM and strengthen participants’ computational skills. The results showed high participation of women (73%) and members of the LGBTIQ+ community (25.8%).

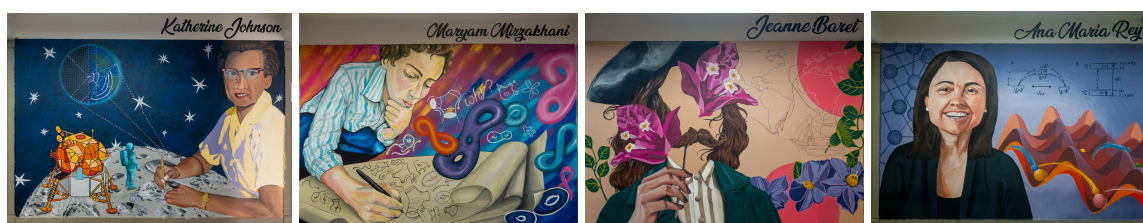


Figure 1. Some murals of *Legados Invisibles* in the hallway of the Institute of Physics, UdeA.

The second project is *Legados Invisibles*, a series of murals dedicated to women scientists located in a hallway of the Institute of Physics. Developed in collaboration with the artistic collective Biógrafos and the Faculty of Exact and Natural Sciences, this initiative consists of eight murals honoring women whose contributions have been fundamental in different areas of science: Rosalind Franklin, Jeanne Baret, Maryam Mirzakhani, Ana María Rey, Ángela Restrepo, Rebeca Gerschman, Doris Hinestroza, and Katherine Johnson. These murals transform an everyday space in the Faculty into a place of memory and recognition, making female role models visible to the entire community.

Beyond its local initiatives, FEMCEN wants to reach a bigger audience from all around the world, grounded in the conviction that science is a political, ethical, and situated practice.

[1] UNESCO. (2021). *Women in higher education: Has the female advantage put an end to gender inequalities?*

[2] University of Antioquia. (n.d.). *Planta Profesor: Facultad de Ciencias Exactas y Naturales*. [[UdeA](#)].

Balancing Radiation Safety and Quality of Life: Optimizing I-131 Isolation for Female Patients

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Introduction: Iodine-131 (I-131) therapy is a standard treatment for differentiated thyroid cancer; however, post-therapy radiation safety precautions often require temporary isolation, which can significantly impact patients' daily lives. This burden is particularly relevant for female patients, who frequently carry primary caregiving and family responsibilities. Balancing radiation safety with quality of life is therefore essential.

Objective: This study aims to determine the optimal duration of home isolation for patients with differentiated thyroid cancer treated with high-dose I-131, based on measured external dose rates and estimated radiation exposure to family members and the public, which supports public radiation safety.

Methods: Conducted at (KHCC), this prospective study involved nine DTC patients who received I-131 doses ranging from 75 to 200 mCi. External dose rates were measured at multiple time points and distances, and dose decay modeling was used to estimate exposure and dose rate decay models were used to estimate the total effective dose equivalent (TEDE) to family members. Patients were stratified based on their administered activity (<100 mCi vs. ≥100 mCi), and internal activity retention was also calculated to determine clearance time below IAEA-recommended limits.

Results: demonstrated that patients receiving lower activities (<100 mCi) had mean dose rates of 14.87 μSv/h at 1 m and typically required only 24 hours of hospital stay, followed by (1–3) days of home precautions, while Patients receiving ≥100 mCi showed mean dose rates of 36.7 μSv/h at 1 m and required longer isolation (up to 5 days), especially to protect children and pregnant women. Calculated TEDE values remain below ICRP and IAEA limits*, validating the discharge and isolation recommendations.

Conclusion: The study provides evidence-based recommendations for tailoring home isolation duration based on administered activity and dose measurements; this work highlights the critical role of the Radiation Protection Officer in translating technical data into practical, patient-centred policies that support both safety and quality of life. As a female professional in radiation protection, this perspective also reflects the importance of understanding and addressing gender-specific challenges in clinical practice. By enabling earlier and safe reintegration into family and social life, this approach contributes to more compassionate, efficient, and inclusive radiation protection practices.

*(1 mSv/year for the public and 5 mSv/year for caregivers)

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Advanced Physics-Based Approaches for Brain Tumor Detection: From Laboratory Research to Spin off Enterprise

INVESTIGATION OF THE CONDUCTIVE PROPERTIES OF $\text{Ag}_8\text{Ge}_{1-x}\text{Mn}_x\text{Te}_6$ SOLID SOLUTIONS

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Samples of $\text{Ag}_8\text{Ge}_{1-x}\text{Mn}_x\text{Te}_6$ solid solutions with varying manganese content ($x = 0, 0.05, 0.1, 0.2$) were synthesized by fusing and subsequently pressing the powdered precursors under a pressure of 0.6 GPa. X-ray diffraction analysis revealed that the introduction of manganese atoms led to a compression of the Ag_8GeTe_6 crystal lattice. All p-type samples exhibited high resistance below the transition region, with resistivity values measured in the temperature range of 180–220 K. The electrical conductivity of all compositions in the temperature range of 220–300 K increased via a hopping conduction mechanism, and for temperatures above 320 K, semiconductor-like behavior was observed. Impedance spectroscopy analysis showed that at 80 K, the solid solutions exhibited behavior characteristic of a homogeneous dielectric material. At elevated temperatures and under high-frequency external electric fields, the role of grain boundaries in electrical conductivity became significant. Additionally, the dielectric anomaly observed at low frequencies was attributed to the influence of grain boundary effect.

Keywords: Solid solutions, X-ray diffraction, DSC analysis, electrical conductivity, impedance spectra.

Synergistic Effect of 2D Self-Assembled Monolayer and ZnO Nanoparticles on the Passivation of Sol-gel ZnO Electron Transport Layer to Enhance the Performance and Stability of Non-Fullerene Organic Solar Cells.

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Organic solar cells (OSCs) have emerged as a promising next generation source of green energy due to the promising properties such as low-cost fabrication, mechanical flexibility, and tunable opto-electronic properties [1,2]. Although ZnO exhibits excellent optoelectronic properties as an electron transport layer (ETL) in the multi-stack organic solar cells (OSCs), the typical intrinsic defect induces interfacial instability, leading to a reduction in power conversion efficiency (PCE) and lifetime [3,4]. In this work, a synergistic passivation strategy has been implemented by ZnO nanoparticle and self-assembled monolayer (SAMs) to effectively passivate the structural and chemical defects of sol-gel ZnO simultaneously. Devices were characterized using XRD, current-voltage measurements, surface photovoltage and impedance spectroscopy. Stability tests were measured after one-week of dark storage without encapsulation under ambient condition. Optical and electrical characterization revealed that the synergistic incorporation of ZnO nanoparticles and SAMs-based surface passivation enhanced the crystallinity and electrical conductivity of the ZnO layer, while effectively suppressing trap-assisted recombination losses. Consequently, the device exhibited a 17% improvement in power conversion efficiency compared to the pristine ZnO ETL-based organic solar cells. More importantly, devices with modified ZnO ETLs retained over 80% of their initial efficiency whereas the pristine ZnO ETLs based device were degraded significantly. These results provide a practical knowledge into interfacial engineering approaches to enhance performance and stabilizing nonfullerene-based OSCs, paves towards OSC large-scale application.

Keywords: Organic solar cells, electron transporting layer, Sol-gel ZnO, Synergistic surface passivation, Impedance spectroscopy

References

- [1] S. Li, Z. Li, X. Wan, and Y. Chen, *eScience* **3**, 100085 (2023).
- [2] P. Ding, D. Yang, S. Yang, and Z. Ge, *Chem. Soc. Rev.* **53**, 2350 (2024).
- [3] C. Li, J. Song, H. Lai, H. Zhang, R. Zhou, J. Xu *et al.*, *Nat. Mater.* **24**, 433 (2025)
- [4] B. Zhang, Z. Pan, W. Li, Y. Zhao, X. Qin, A. Li *et al.*, *Adv. Energy Mater.* 2404297 (2025).

Women in Physics in Algeria: Between Scientific Research and Professional Challenge

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This contribution presents both a scientific overview of my research and a personal reflection on the experience of being a woman physicist in Algeria.

From a scientific perspective, I study plasma spectroscopy for all atoms and ions and my present research is on the Paschen series. Using the **PPP code** based on the Frequency Fluctuation Model (FFM), I perform systematic calculations of line profiles under different plasma conditions, comparing static and dynamic ion treatments with and without fine structure effects. These calculations have direct implications for plasma diagnostics in fusion devices and astrophysical plasmas.

From a personal and professional perspective, pursuing a research career in physics as a woman in Algeria presents specific challenges, including **limited access to international collaborations and funding, institutional barriers, work-life balance difficulties, and a lack of visible role models**. Despite these obstacles, I have been able to develop an active research program, supervise Master's PhD's students, and establish international collaborations.

Through this contribution, I wish to share my experience, highlight the specific challenges faced by women physicists in Algeria, and discuss concrete strategies that could help address them, both at the institutional and individual level.

From Cairo to CERN: A Woman's Journey Toward Knowledge Sustainability and Scientific Empowerment

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This poster presents a reflective case study of a female physicist's journey from Egypt to the frontier of particle physics, and the deliberate efforts made to transform personal scientific mobility into collective empowerment for the next generation of women in physics.

In 2013, supported by an Erasmus Mundus scholarship, I left Egypt to pursue a PhD in Particle Physics in Brussels — navigating cultural displacement, academic pressure, and social isolation while maintaining strong ties to my home university. Despite these challenges, I completed my doctoral studies on time within a competitive European research environment.

Upon returning to Egypt in 2018 as a faculty member at Ain Shams University, I joined the council of the Egyptian Network of High Energy Physics (ENHEP) — the main national umbrella for Egyptian participation in CERN and the CMS collaboration — and committed to building scientific capacity for the next generation. In this role, I organized a High Energy Physics school for young undergraduate and recently graduated students across Egypt, the Middle East, and North Africa, while continuing my own frontier research within CMS.

A subsequent fellowship from INFN Pavia (Italy) enabled me to deepen my engagement with frontier research, leading to significant career milestones: an L2/L3 leadership role in the CMS GEM muon detector system, contributions to over 650 peer-reviewed publications, membership on the CMS Diversity Monitoring and Oversight Committee as the first Egyptian and Arab physicist in this role, and recognition through the 2025 Breakthrough Prize in Fundamental Physics.

This poster highlights how transnational scientific mobility can serve as both a survival strategy and a mechanism for empowerment for women from underrepresented regions. By maintaining active collaboration with my home institution, I continue to mentor young researchers — particularly women — across Egypt and Africa, bridging global research systems and demonstrating that individual scientific opportunity can be transformed into lasting regional impact.

Researcher Profiles

[1] ORCID: <https://orcid.org/0000-0002-0820-0483>

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A Woman Physicist's Journey in Establishing a Radiotherapy Service in Indonesia

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Introduction

Access to radiotherapy remains a significant challenge in many low- and middle-income countries, despite its essential role in comprehensive cancer care. Establishing a radiotherapy service requires not only advanced technology but also the coordinated efforts of multidisciplinary professionals to ensure safe and effective treatment delivery. Medical physicists play a critical role throughout this process, contributing expertise in radiation safety, quality assurance, commissioning, and clinical implementation.

Experience and Professional Journey

This poster presents my experience as a woman medical physicist contributing to the establishment of a new radiation oncology center in Indonesia. The project involved multiple stages, including regulatory preparation, facility readiness, equipment installation, commissioning, quality assurance implementation, and the initiation of clinical services.

Working within a multidisciplinary environment required close collaboration with radiation oncologists, radiotherapy technologists, engineers, hospital management, vendors, and regulatory authorities. Beyond technical responsibilities, I became involved in project coordination, stakeholder communication, and problem-solving throughout different phases of implementation. These experiences provided valuable opportunities to understand the broader challenges associated with developing healthcare infrastructure and expanding access to cancer treatment.

Key Lessons Learned

While technical competencies were fundamental to the project, the experience highlighted the importance of leadership, communication, adaptability, and teamwork. Navigating regulatory requirements, coordinating with diverse stakeholders, and balancing safety with operational needs strengthened my confidence and broadened my perspective on the role of physicists in healthcare development.

The journey also demonstrated that women physicists can contribute beyond traditional technical roles by participating in service development, interdisciplinary collaboration, and healthcare innovation.

Conclusion

The establishment of a radiotherapy service was not only a technical achievement but also a transformative professional experience. It reinforced the value of combining scientific expertise with leadership and collaboration to create meaningful impact. Through sharing this journey, I hope to encourage other early-career women physicists to embrace opportunities for growth, seek leadership experiences, and recognize the diverse ways in which physics can contribute to improving healthcare systems and society.

Structural, electrocatalytic, dielectric and optical studies to unveil the synergistic effect of B-site cations diversity in $\text{La}_{0.6}\text{Sr}_{0.4}\text{Co}_{1-x}\text{B}_x\text{O}_3$ ($0 \leq x \leq 0.8$) (B= Ni, Fe, Cu, Cr) Oxide Materials

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The outstanding properties of perovskites have attained significant attention for energy generation. A series of polycrystalline $\text{La}_{0.6}\text{Sr}_{0.4}\text{Co}_{1-x}\text{B}_x\text{O}_3$ ($0 \leq x \leq 0.8$) (B= Ni, Fe, Cu, Cr) perovskite oxide materials have been fabricated by Sol-Gel method at 750 °C with gradual doping of different cations on B-site. A detailed examination of the compositional impacts on the structure, optical, dielectric and electrical properties that characterize the fundamental physics is done. The lattice parameters are observed to rise with the decrease in Co-content due to the difference in ionic radii of the substituted B-site cations. With the moderate Tafel slope and low overpotential of 290mV and 305mV at 10 mAcm^{-2} , the respective perovskites $\text{La}_{0.6}\text{Sr}_{0.4}\text{Co}_{0.6}\text{Ni}_{0.2}\text{Fe}_{0.2}\text{O}_3$ and $\text{La}_{0.6}\text{Sr}_{0.4}\text{Co}_{0.2}\text{Ni}_{0.2}\text{Fe}_{0.2}\text{Cu}_{0.2}\text{Cr}_{0.2}\text{O}_3$ have demonstrated exceptional oxygen evolution reaction (OER) activity making them suitable for energy storage devices. Dielectric constant (ϵ' , ϵ'') and tangent loss decreases as the applied frequency increases. The impedance Z' ranges from minimum of 537 Ω to the maximum of 10022 Ω leads to the applications in sensor technology, supercapacitors, electrochemical devices and dielectric filters. Grain boundary conduction was evaluated using Nyquist and Cole-Cole plots, along with Randles circuit study. The higher values of optical bandgaps (3.21-3.71 eV) and (2.89-3.28 eV) finds applications in photocatalysis, optoelectronic devices and UV photodetectors. Urbach energy ranges from 564-1163 meV with transition of B-site cations. Moreover, I-V measurement at room temperature indicates the semi-conducting behavior of high entropy perovskites.

Quasi-Periodic Coherence Revival by Complex Fractal Phase Masks

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This abstract presents a numerical study of coherence dynamics induced by continuous phase modulation via complex Julia fractal masks in a normalized 4f Fourier-optical framework. While traditional random or smooth deterministic phase masks characteristically cause a monotonic decay in spatial correlation as modulation strength scales up [1], specific structural configurations of Julia sets exhibit distinct, non-monotonic correlation behavior. This phenomenon is characterized by unique structural variations in the output field profiles depending on the geometry of the mask, as illustrated in Fig. 1. The resulting correlation dynamics feature pronounced, alternating regions of decorrelation and partial coherence revival at specific, recurring phase modulation strengths (β), as quantitatively mapped in Fig. 2.

To systematically uncover the physical mechanisms driving these revivals, we executed an array of computational diagnostic tests on the applied fields, including pixel-wise phase randomization, block shuffling, and power-spectrum-preserving randomization via Fourier-phase scrambling. Total phase randomization and power-spectrum-preserving scrambling completely eliminated the coherence revivals. This indicates that the non-monotonic dynamics cannot be explained by phase variance or second-order spectral magnitude statistics alone. [2] Conversely, block-shuffled masks successfully retained a significant portion of the revival behavior, demonstrating that localized, multiscale spatial organization within the phase topology dictates the overall interference dynamics.

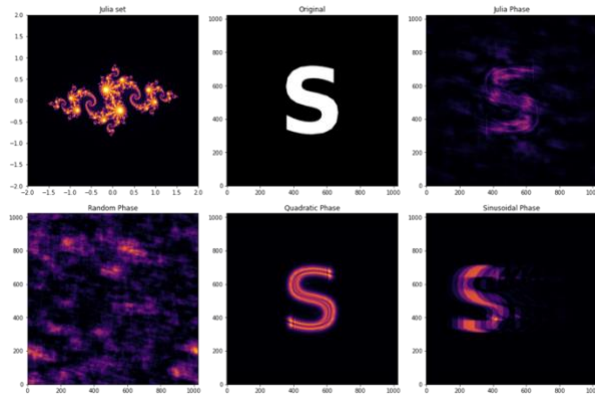


Fig. 1. Julia phase template and representative 4f outputs.

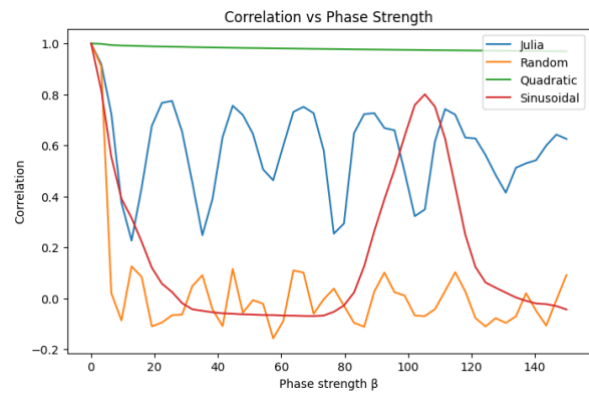


Fig. 2. Representative reconstructed intensity distributions for selected phase strengths β using Fourier-plane phase masks.

At local correlation minima, the field outputs suffer intense spatial scrambling and structural degradation. Yet, at adjacent correlation peaks, the target patterns emerge cleanly out of the background noise, revealing a structured re-alignment of phase differences between interacting spatial-frequency subsets. These findings offer promising avenues for complex wavefront engineering, optical encryption, and coherence control using programmable spatial light modulators. [3]

[1] X. Liu, C. Liang, Y. Cai, and S. A. Ponomarenko, Phys. Rev. Appl. 20, L021004 (2023).

[2] Y. Chen, F. Wang, Y. Liu, C. Liang, and Y. Cai, Light: Sci. Appl. 10, 205 (2021).

[3] L. Ackermann, Appl. Phys. A 128, 3 (2022).

Numerical investigation of enhanced high-intensity laser–matter interactions using micro and nanostructured conical targets

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Micro and nanostructured targets are increasingly used in high-power laser-matter interaction experiments to enhance the laser absorption, increase ion/electron generation or to boost the secondary radiation (THz, Xray, etc.) in accordance to the actual scientific requirements in ultra-intense regime. Their tailored surface features influence the way the energy is deposited in the material, conducting to significantly enhanced interaction effect compared to the flat conventional targets [1-3]. In this direction, we have numerically investigated the laser beam intensification in an ultra-intense laser beam – micro and nanostructured cone target interaction system under particular conditions. In order to provide a complex spatio-temporal description of the laser intensity evolution in the interaction area, we developed a 2D finite-difference time-domain model in accordance to the relative spatial extension of the pulse. The laser field intensification is numerically investigated in the vicinity of the laser matter interaction point considering different micro-structured profiles and distinct materials of the micro and nanopatterned conical targets and variable laser beam parameters in order to determine the optimum conditions to streamline the laser field enrichment in the laser solid targets interaction area (Figure 1). The numerical data provides an extension of the results regarding the S-T disparity of focused ultra-short laser pulses in predefined conditions. The obtained results show that the designed micro and nanostructured profile of the internal cone target walls under imposed particular conditions induces a highly controllable increase in laser intensity and it may bring significant contributions to the laser field intensity enrichment overly required in a wide variety of ultra-intense laser applications.

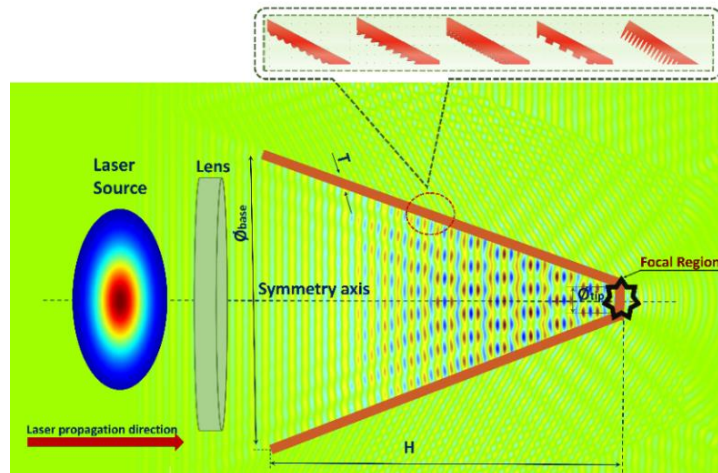


Fig. 1. Schematic representation of an ultra-short and ultra-intense laser beam – micro and nanostructured top-flat conical target interaction system.

- [1] L. Ionel, Photonics **11**, 689 (2024)
- [2] L. Ionel, Opt. Comm. **498**, 127234 (2021)
- [3] L. Ionel, Phys. Scr. **95**, 105501 (2020)

The Unequal Pace of Brain Aging: From Physical and Machine Learning Models to Social Realities

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Brain age is a biomarker estimated from brain data, such as electrical signals (EEG) or MRI scans [1-2], and obtained using machine learning models [3]. The difference between this estimated age and chronological age is called the "brain age gap": a positive gap indicates accelerated ageing and may reflect a higher risk of cognitive decline or neurodegenerative diseases. In this work, we explore what brain age is, how it's calculated using physics and machine learning models, and why it matters as a health tool. I will also share my journey from physics training to developing brain age models. We'll see how the physical and social environment we live in (from pollution to inequality) can accelerate brain aging, with evidence from studies in 34 countries, including Argentina and other Latin American countries [4]. I'll also explain how, in Argentina, in international collaboration with other institutions, we're researching computational methods to improve brain age estimation from EEG, an accessible and non-invasive technology. I will discuss also the career lessons I gained while building international collaborations and offer concrete, practical advice for other early-career women in physics who want to apply their skills to socially impactful problems.

[1] Li, M., Y. Wang, C. Lopez-Naranjo, et al. 2022. "Harmonized-Multinational qEEG Norms (HarMNqEEG)." *NeuroImage* 256: 119190 <https://doi.org/10.1016/j.neuroimage.2022.119190>

[2] Moguilner, S., et al. (2024). Brain clocks capture diversity and disparities in aging and dementia across geographically diverse populations. *Nature Medicine*, 30, 3646–3657
<https://doi.org/10.1038/s41591-024-03294-y>

[3] Jarne, C., Griffin, B. and Vidaurre, D. (2024), Predicting Subject Traits From Brain Spectral Signatures: An Application to Brain Ageing. *Hum Brain Mapp*, 45: e70096.
<https://doi.org/10.1002/hbm.70096>

[4] Legaz, A., Moguilner, S., ..., Jarne, C., et al. The exposome of brain aging across 34 countries. *Nature Medicine*. <https://doi.org/10.1038/s41591-026-04302-z>

Enhanced spontaneous Ferroelectric polarization in Sm-doped BaFe_{0.2}Ti_{0.8}O₃ ceramics

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Abstract: We investigate the origin of progressive spontaneous polarization enhancement at room temperature (RT) in Ba_{1-x}Sm_xTi_{0.8}Fe_{0.2}O₃ (BTO) solid solution ($x = 0, 0.10, 0.15, 0.20$) with increasing Sm doping. X-ray diffraction and Raman spectroscopic results confirm A (Sm_{Ba}) and B (Fe_{Ti}) site cationic substitution and increase in the tetragonality. The cooperative off-centering phenomena promote interpolar clustering via nucleation causing an enhancement in remnant polarization and coercive field with increasing Sm doping. Microscopic observation has indicated the presence of multivariant ferroelectric domain fringes along with more compact and larger grain distribution at the highest Sm concentration. The continuous reduction in oxygen vacancy density observed from X-ray photoelectron spectroscopy results in domain wall depinning and easier domain switching.

The X-ray absorption spectra for Ti $L_{3,2}$ shows the increase of $\frac{t_{2g}}{e_g}$ ratio indicating enhanced Ti

3d– O 2p orbital hybridization. The first-principles density functional theory calculation also indicates that doping induced increment in Ti 3d/Sm 4d–O 2p orbital hybridization which weakens the short-range repulsion between core orbitals and facilitates the ferroelectricity enhancement. Such in-depth understanding permits us to tune the controlling parameters in optimizing the ferroelectric ordering at RT with appropriately co-doped BTO-based ceramics.

Anomalous phenomena in DC–ULF geomagnetic daily variation registered three days before the 12 May 2008 Wenchuan M_S 8.0 earthquake

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The hourly data of the vertical Z and the horizontal H components of 37 ground-based DC–ULF geomagnetic stations are examined during 20 April–12 May 2008. On 9 May 2008, three days before the Wenchuan M_S 8.0 shock, anomalies—a double low-point and a decreased amplitude—are registered on the curves of the Z component at 25 stations in a large-scale area surrounding the Wenchuan epicentral area (See Figure 1a,b). The H component shows none of the double low-point phenomenon but does exhibit a reduced magnitude at the same time. The geomagnetic index K_p is also examined and indicates that the anomalies appear at a solar quiet period. The appearing time shift (Tzs) between the first low-point on May 9 and the minimum point occurring time of May 1–5, 2008 is also checked. The results show that Tzs is on the order of 1–2 hours earlier or later than usual and there is a 2–6 hours' gap between these two lowpoints. However, there is still a transition area which includes the epicenter where $Tzs = 0$. Variation amplitude examined on vertical Z increases as the distance from the epicenter decreases. An Earth-air-ionosphere model has been employed to investigate a possible mechanism of this phenomenon and positive results have been unexpectedly attained. All these above-related results tend to prove that the variations of the Z and H on May 9, 2008 during the solar quiet period are probably associated with the forthcoming Wenchuan M_S 8.0 earthquake.

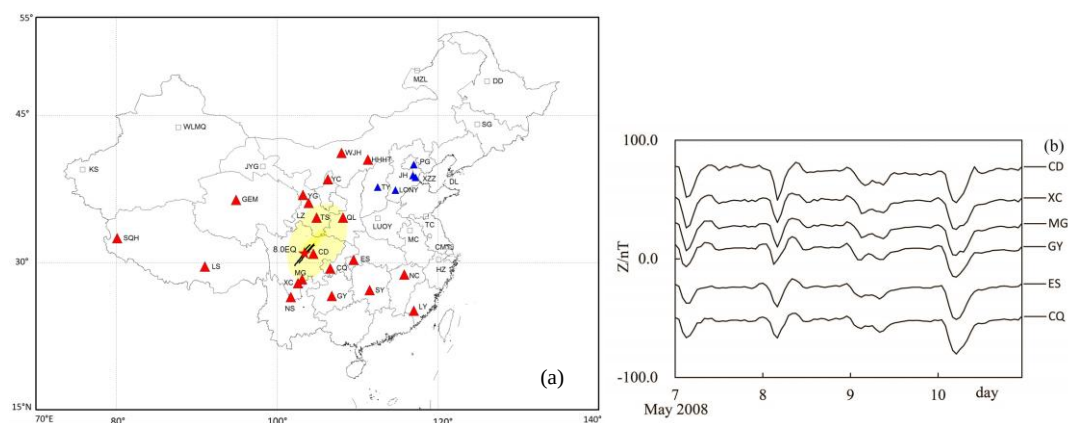


Figure 1 (a) Location of the geomagnetic observing stations in China during the Wenchuan M_S 8.0 EQ. Red triangles stand for geomagnetic stations registering the ‘double low-point’ anomalous phenomenon in the vertical Z on 9 May, 2008; blue triangles indicate stations recording this phenomenon on 8 and 9 May, 2008. Black empty squares are stations that do not record this kind of anomaly during 20 April–12 May 2008. The location of the Wenchuan M_S 8.0 EQ is indicated by a red star. (b) Daily variations of geomagnetic component Z at some stations.

Barriers and Balance: Women's Pathways in Physics and research

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Over the past decade, the representation of women in STEM-related fields has increased from approximately 21% in 2016 to nearly 26% in 2023, reflecting important progress toward gender diversity in science and research. Although this growth highlights increasing opportunities for women in physics, challenges related to representation, mentorship, and career advancement still remain. Women With No Limits in Research is a career development workshop designed to empower and inspire women pursuing careers in physics and related scientific fields.

Despite progress in science and research, women continue to face inequality in access, recognition, and career advancement, particularly in environments where social and cultural expectations place additional burdens on them. In addition to academic and professional challenges, many women must also balance the responsibilities traditionally assigned to them in family and daily life, making it harder to fully pursue careers in physics and research.

As a result, entering the scientific world often requires overcoming both institutional barriers and societal expectations, including limited representation, fewer mentorship opportunities, and unequal career support. Despite these challenges, women continue to contribute significantly to science, demonstrating resilience, capability, and a growing presence in research communities worldwide.

Small Modular Reactors and Open-Source Modelling for Advanced Nuclear System Assessmen

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Nuclear energy is regaining strategic importance in the context of global decarbonization targets and long-term energy security considerations. Within this evolving landscape, Small Modular Reactors (SMRs) have emerged as a promising technology due to their modular architecture, inherent safety characteristics, and adaptability to a wide range of electrical grid conditions.

This study presents a simplified neutronic modelling framework for SMRs developed with OpenMC, an open-source Monte Carlo neutron transport code. The objective is not detailed core optimization, but rather the development of a transparent, reproducible, and computationally accessible modelling approach suitable for system-level investigations.

The proposed model enables the analysis of fundamental neutronic behavior and key design sensitivities associated with SMR configurations. It provides a physically consistent yet simplified representation of reactor physics phenomena, with an emphasis on interpretability and reproducibility through open-source tools.

Within this framework, the model is also intended to serve as a baseline for advanced computational extensions, including optimization strategies based on quantum algorithms for fuel reloading and core configuration studies. This perspective highlights the potential of combining classical Monte Carlo neutronic simulations with emerging quantum computing approaches for next-generation reactor design and optimization.

In the context of the INPRO methodology, this work demonstrates how simplified reactor physics models can support broader nuclear energy system assessments, particularly for strategic planning and decision-making in sustainable energy transitions at national and regional scales.

Keywords: Small Modular Reactors (SMRs), OpenMC Monte Carlo neutron transport, open-source modelling, quantum algorithms, fuel reload optimization, nuclear energy systems analysis, INPRO framework, reactor physics, sustainable energy transition.

- [1] J. Lee, S. Hong, H. Cho, B. Lyu, M. Kim, J. Kim, I. Moon, *Energy Conversion and Management* **244**, 114438 (2021).
- [2] R. S. El-Emam, M. H. Subki, *Int. J. Energy Res.* **45**, 16995 (2021).
- [3] J. de Troullioud de Lanversin, M. Kütt, A. Glaser, *Ann. Nucl. Energy* **151**, 107903 (2021).
- [4] M. Ellis, D. Gaston, B. Forget, K. Smith, *Nucl. Sci. Eng.* **185**, 184–193 (2017).
- [5] A. Novak et al., *Proc. PHYSOR* (2018).

BRIDGING THE GAP IN MECHANICS: INTERACTIVE VISUALIZATION OF NEWTON'S LAWS IN THE CLASSROOM

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ABSTRACT

Understanding Newton's Laws of Motion is fundamental to physics education, yet students commonly struggle to connect abstract mathematical equations with real world physical behavior. Traditional textbook problems often fail to address persistent misconceptions about force, inertia, and acceleration.

This presentation introduces a practical framework used in a Rwandan physics classroom to make mechanics more concrete and understandable By integrating simple computational tools, such as Python and Matplotlib. For instance, modifying variables like mass or applied force allows students to instantly see the impact on acceleration, reinforcing Newton's Second Law ($F = ma$) dynamically rather than through passive memorization.

The results show that combining numerical plots with conceptual discussions significantly improves student engagement and helps clear up common misunderstandings about forces. This poster outlines the teaching methodology, shares sample visualization models, and discusses the challenges and successes of introducing basic digital tools into introductory physics courses to foster a deeper, more lasting understanding of mechanics.

Empowering Women in STEM through Local Chapter Initiatives: The ISMWS Chapter at the University of Barisal, Bangladesh

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Women remain underrepresented in physics and STEM, especially in developing countries like Bangladesh, where female scientists face social isolation, limited mentorship, and systemic career barriers [1]. This poster presents a grassroots solution: the founding of the International Society of Muslim Women in Science (ISMWS) Chapter at the University of Barisal [2], where I serve as Founding President and Faculty Advisor. The Chapter creates a supportive space for female undergraduate and graduate students in STEM. Its key objectives are: (1) promoting research and higher education; (2) offering career development workshops [3]; (3) facilitating mentorship between senior female faculty and junior students; and (4) building a local network connected to global communities (e.g., OWSD, APS). Since its launch, the Chapter has held regular meetings, invited talks by successful women scientists, and guidance sessions on research grants and graduate programs. Furthermore, through this organization the Academic Excellence Award was given to the female STEM students, based on merit and financial condition. Preliminary outcomes include increased student research participation and growing STEM career awareness among first-generation female students from rural backgrounds. This localized, faculty-led model effectively bridges the gender gap at the institutional level and is replicable in other resource-limited universities. At the workshop, I seek to share this experience, learn from global efforts, and build international collaborations to scale such initiatives.

References

- [1] UNESCO, UNESCO Science Report, Paris: UNESCO Publishing (2021).
- [2] ISMWS, International Society of Muslim Women in Science Mission Statement. www.ismws.org. (2025).
- [3] ICTP Career Development Workshop for Women in Physics: <https://indico.ictp.it/event/11308/> (2024).

Integrating Diffuse Optics and Laser-Induced Spectrochemical Techniques for Reliable Biological Tissue Screening, Classification, and Characterization

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Optical diagnosis methods are gaining high impact because they are safe, minimally invasive, and non-destructive. Diffuse optical techniques are employed to estimate the absorption and scattering properties of biological tissues using light in the red and near-infrared range (~600–900 nm). Photons could travel deep in tissue in that spectral window due to the relatively small absorption of water and hemoglobin [1]. Light is recorded after passing through thick tissue and the optical properties are spatially reconstructed using mathematical models [2]. The transmitted and/or reflected signal can be reasonably modeled as a diffusive process. Diffuse reflectance and transmittance values are the key data in the tissue's optical parameters estimation process [3]. Tissue optical properties are wavelength dependent and are considered important indicators for tissue health as they are related to tissue's histopathology, hence, they can be utilized in cancer screening and diagnostic tools [4]. The absorption of light in tissues provides quantitative identification of the present molecules, their concentration, and their local environment, while the scattering of light provides information about micrometric-size objects (e.g., molecular weight) that cause light scattering [5]. Moreover, laser-induced fluorescence and laser-induced breakdown spectroscopy are promising spectrochemical techniques that are widely utilized for tissue classification via molecular and elemental analysis of the examined samples [6]. In this work, diffuse optics and spectrochemical techniques combined with different statistical evaluation methods are proposed for non-invasive tissue screening, characterization, and classification.

- [1] S. Mahdy, O. Hamdy, M. A. Hassan, and M. A. A. Eldosoky, *Lasers Med. Sci.* **37**(3), 1855–1864 (2022).
- [2] V. V. Tuchin, *J. Biomed. Photonics Eng.* **1**(2), 98–134 (2015).
- [3] T. Durduran, R. Choe, W. . Baker, and A. G. Yodh, *Rep Prog Phys.* **73**(7), (2010).
- [4] Y. Hoshi, Y. Tanikawa, E. Okada, H. Kawaguchi, and M. Nemoto, *Sci. Rep.* **9**(9165), 1–7 (2019).
- [5] M. Eisel, S. Ströbl, T. Pongratz, H. Stepp, A. Rühm, and R. Sroka, *J. Biomed. Opt.* **23**(9), 091418–1–9 (2018).
- [6] R. Gaudiuso, N. Melikechi, Z. A. Abdel-Salam, M. A. Harith, V. Palleschi, V. Motto-Ros, and B. Busser, *Spectrochim. Acta - Part B At. Spectrosc.* **152**, 123–148 (2019).

Spectral Properties of a Quasiparticle Interacting with Polarization Phonons at Low Temperature

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Interest in multilevel nanostructures remains consistently high due to their application in modern optoelectronic devices, such as quantum cascade detectors and lasers [1, 2], whose operation is driven by quantum transitions between electron states with absorption or emission of photons. The phonon subsystem in such devices plays a crucial role as an energy relaxation channel. At the same time, phonons, by interacting with electrons and renormalizing their spectral characteristics, can significantly affect the operating parameters of these devices.

A consistent theoretical description of quasiparticle-phonon interaction requires the consideration of multiphonon processes, which are often neglected within the standard single-phonon approximation or perturbation theory. In practical calculations using the Feynman-Pines diagrammatic technique, this problem also encounters well-known mathematical difficulties and is therefore solvable only under certain approximations.

We consider a quasiparticle interacting with dispersionless polarization phonons at a low temperature ($T \approx 0$ K). Such a two- or three-level system can serve as a model for the active element of a quantum cascade laser or detector.

The quasiparticle-phonon system is described by a Fröhlich-type Hamiltonian. Within this approach, the analytical calculation of the mass operator of the Fourier transform of the quasiparticle Green's function is performed using a modified Feynman-Pines diagrammatic technique by exact partial summation of infinite series of all diagrams of the same type [3, 4]. The obtained mass operator allows for the numerical calculation of the quasiparticle-phonon system's energy spectrum.

It is established that interaction with phonons leads to a low-energy shift of all main quasiparticle levels and the emergence of split-level complexes, in contrast to the simplified single-phonon approximation or the single-level quasiparticle model [5]. In the region of the main (or satellite) levels' anticrossing, a complex spectral rearrangement is observed, where levels can pairwise collapse or experience repulsion.

An analysis of the average phonon numbers revealed the distinct nature of the system's main and satellite states depending on the distance between the bare (unrenormalized) levels. The first main state is always characterized by purely quasiparticle properties. The properties of the excited main state depend significantly on the energy gap to the first one: it can be quasiparticle-like, hybrid (with a substantial mixing of quasiparticle and phonon state properties), or phonon-like. All satellite states are exclusively hybrid or phonon-like complexes.

The obtained results demonstrate that even with weak coupling, multiphonon processes can influence the spectral characteristics of nanostructures by forming additional energy relaxation channels.

- [1] A. Delga, Woodhead Publishing Series in Electronic and Optical Materials. Mid-Infrared Optoelectronics, 337 (2020).
- [2] M. A. Belkin, F. Capasso, Phys. Scr. **90**, 118002 (2015).
- [3] M. Tkach, J. Seti, O. Pytiuk, O. Voitsekhivska, J. Low Temp. Phys. **195**, 26 (2019).
- [4] J. Seti, I. Boyko, Phys. Lett. A **548**, 130556 (2025).
- [5] M. Tkach, Ju. Seti, O. Voitsekhivska, V. Hutiv, Int. J. Theor. Phys. **61**, 29 (2022).

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Using quantum physics in meteorology

Identification of structures in the Universe through quasar clustering

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Matter in the Universe organizes into a cosmic web of filaments and nodes, whose mapping at high redshift requires luminous tracers. In this work, we study the large-scale structure using quasars from the *Quiaia* catalog, in its two magnitude-limited samples, $G < 20.5$ and $G < 20.0$, as the main tracers. We implement a reproducible methodological chain that begins with sample cleaning through sigma-clipping in the $(z, z_{\text{error}}/z)$ plane. After this filtering, we retain approximately 67.2% of the original $G < 20.0$ sample and 61.3% of the $G < 20.5$ sample. From this selection, we define the *SubQuiaia* catalog and construct nine volume-limited samples for each magnitude cut.

Using these samples, we estimate the luminosity function, compute the two-point correlation function with the Landy-Szalay estimator, and assign masses to the dark matter halos hosting the quasars. With this information, we reconstruct the density field through a halo-based method and extract the filamentary skeleton using DisPerSE.

We analyze the impact of spatial smoothing on the reconstructed skeleton, finding that larger smoothing scales systematically increase filament lengths, as expected when smoothing sets the effective resolution scale. We also identify anomalies in the distances between vertices caused by boundary effects. To mitigate these artifacts, we apply a geometric filtering procedure that removes segments with separations larger than 30 Mpc and generates subfilaments, stabilizing the local geometry. We then compute filament occupation, defined as the number of quasars for which a given filament is the closest one, and discard low-occupation filaments according to magnitude-dependent thresholds.

With the resulting catalog, we characterize the filamentary skeleton separately in the Galactic North and South through vertex-separation distributions, length distributions, occupation statistics, cumulative distribution functions, and filament number densities. These measurements reveal indications of hemispheric asymmetries. We therefore perform a targeted overdensity analysis using radial filament counts, angular sweeps on the sky, quasar-filament cross-correlation measurements, and visual inspection of quasar concentrations around the reconstructed skeleton.

Independently, these analyses show consistent signals of simultaneous overdensities in quasars and filaments. These signals are not primarily associated with the position of the Magellanic Clouds, suggesting the possible presence of an underlying large-scale structure. Finally, this work shows that quasars as tracers, halo-based density reconstruction, and skeleton extraction with DisPerSE constitute a viable and reproducible route to map the cosmic web across large cosmological volumes, laying the groundwork for future refined studies of its morphology.

FEMCEN: A Feminist Student Collective Advancing Women in STEM in Colombia

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In 2020 a group of undergraduate students in the Physics Department at the University of Antioquia in Colombia began questioning the persistent underrepresentation of women in STEM fields, particularly in leadership, teaching, and research positions. According to UNESCO, women represent only 30% of researchers worldwide, with participation decreasing from 53% at the bachelor's and master's levels to 44% at the doctoral level [1]. This disparity is even more pronounced at the local level, where women constitute less than 25% of faculty members, and in some departments, such as Physics, only 3 out of 49 professors are women [2]. In this context, FEMCEN emerged as a bottom-up initiative aimed at reclaiming and making visible the contributions of women in science. Through science communication, spaces for reflection, and activism against Gender-Based Violence, FEMCEN seeks to engage both the scientific community and the institution, bringing together students, professors, and administrative staff in its initiatives.

This work presents the experience and trajectory of FEMCEN, focusing on two of its main projects. The first, *Laboratorio de Género* (Gender Lab), awarded in the “Promotores del Bienestar UdeA 2021” call, a fund aimed at preventing gender-based violence and promoting safe and inclusive university environments. Over an eight-month period, FEMCEN organized talks led by experts from different areas of science, as well as hands-on workshops in R, Python, Java, and machine learning, all led exclusively by women. These activities aimed to highlight women's trajectories in STEM and strengthen participants' computational skills. The results showed high participation of women (73%) and members of the LGBTIQ+ community (25.8%).



Figure 1. Some murals of *Legados Invisibles* in the hallway of the Institute of Physics, UdeA.

The second project is *Legados Invisibles*, a series of murals dedicated to women scientists located in a hallway of the Institute of Physics. Developed in collaboration with the artistic collective Biógrafos and the Faculty of Exact and Natural Sciences, this initiative consists of eight murals honoring women whose contributions have been fundamental in different areas of science: Rosalind Franklin, Jeanne Baret, Maryam Mirzakhani, Ana María Rey, Ángela Restrepo, Rebeca Gerschman, Doris Hinestroza, and Katherine Johnson. These murals transform an everyday space in the Faculty into a place of memory and recognition, making female role models visible to the entire community.

Beyond its local initiatives, FEMCEN wants to reach a bigger audience from all around the world, grounded in the conviction that science is a political, ethical, and situated practice.

[1] UNESCO. (2021). *Women in higher education: Has the female advantage put an end to gender inequalities?*

[2] University of Antioquia. (n.d.). *Planta Profesoral: Facultad de Ciencias Exactas y Naturales*. [[UdeA](#)].

Static Electric Field effect on the Superconductor: a microscopic approach

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Although a static electric field is generally expected to be expelled from the bulk of a conductor, an interesting case concerns superconducting films under strong external electric fields. Recent experiments [2] suggest that ultra-thin films may allow partial field penetration and thus a suppression of superconductivity known as Superconductive Field Effect (SFE). This challenges the conventional screening picture of [1] and points toward a (local) phase transition toward the metallic state, as shown by the phenomenological study of [3]. In such regimes, where the system is close to a phase transition towards metal, even locally, as shown by the phenomenological study of [3]. In this work, we tackle the problem microscopically by examining a thin, homogeneous superconductor and solving the Eliashberg equations in the presence of a static electric field. Our goal is to establish a theoretical framework that supports the experimental observations and offers an explanation for the SFE.

[1] J. Bardeen, L.N. Cooper, J.R. Schrieffer, Phys. Rev. 108, 1175 (1957).

[2] G. De Simoni et al., Nat. Nanotechnol. 13, 802 (2018).

[3] A. Amoretti, J. Phys.: Conf. Ser. 2531, 012001 (2023).

Multiple tipping phenomena in a system with a time-dependent parameter excited by colored noise

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Tipping can describe various dynamical transitions in real-world systems, such as climate change and thermoacoustic instability. However, previous studies have focused on systems with monocritical transitions that switch between only two stable states. In this study, as an example of multistable complex systems, we analyse multiple tipping in a system with a time-dependent parameter and three stable limit cycles under colored noise excitation. By stochastically averaging the system and performing numerical simulations, multiple tipping-delay phenomena are identified, with the first tipping exhibiting a larger delay. Joint influences of the rate of parameter change and the noise parameters on the tipping behaviours are also discussed. It is revealed that both high rate of change and high noise intensity can turn multiple tipping into single tipping, where the former causes skipping of an intermediate amplitude state and results in direct jumps from a low-amplitude state to a high-amplitude state, while the latter changes the tipping from abrupt to smooth. These findings provide a new perspective for understanding tipping phenomenon in multistable systems.

Bridging Theory and Experiment in Next-Generation Functional Material Discovery via IM²ODE

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Material discovery can be significantly accelerated through inverse design. Here, we present IM²ODE (Inverse Design of Materials by Multi-Objective Differential Evolution), a methodology developed over the past ten years that couples advanced evolutionary algorithms with first-principles calculations. IM²ODE successfully identifies atomic configurations with targeted optical, electronic, and mechanical properties across bulk materials, interfaces, clusters, and complex defects. Through continuous methodology development and tight integration with experimental validation, IM²ODE effectively bridges the gap between theoretical prediction and experimental realization of next-generation functional materials.

- [1] Y.-Y. Zhang, W. Gao, S. Chen, H. Xiang, and X.-G. Gong, *Comput. Mater. Sci.* 98, 51 (2015).
- [2] L. Chen, B. Liu, Z. Guo, X. Duan, G. Fang, Y.-F. Zheng, H. Fang, and Y.-Y. Zhang, *J. Chem. Theory Comput.* 21, 5346 (2025).
- [3] J. Jia, S.-Y. Gao, L. Chen, Y. Qiang, S.-Q. He, J. Zhang, Y.-F. Zheng, F. Zhu, H. Fang, and Y.-Y. Zhang, *Nano Lett.* 25, 14051 (2025).