University of Puerto Rico
Mayagüez Campus
Department of Physics

Annual Report 2023–2024

Submitted by:

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STATUS REPORT ON ACTIVITIES AND ACHIEVEMENTS

A. Executive Summary

At the Physics Department, our mission is to explore the fundamental principles that govern the universe and advance our understanding of the physical world. We are committed to fostering a vibrant intellectual community and a collaborative academic environment that promotes curiosity, critical thinking, and scientific inquiry. Our dedicated faculty members provide a comprehensive and rigorous education in physics by involving students in hands-on experiences and opportunities to engage them in groundbreaking research. The Department also values interdisciplinary collaborations, encouraging our faculty and students to engage with other fields to address pressing global issues. Ultimately, our goal is to inspire the next generation of physicists, nurturing their passion for discovery and empowering them to make meaningful contributions to society through the pursuit of scientific knowledge.

The mission of the UPRM's Physics Department fits within the triple mission of the University of Puerto Rico:

- ***Teach:*** Educate our students to help them understand and explore physical phenomena, apply critical thinking when presenting, analyzing, and solving problems, maintain a high degree of professional integrity in the practice of their careers.
- ***Research:*** Support and advance knowledge of physics and related fields, and the investigation of physical phenomena.
- ***Service:*** Promote the knowledge of physics and related fields in universities, schools and the community in general.

Accompanying the mission of the Department of Physics, we have the ***Goals and Objectives of the Department:***

1) Provide an effective comprehensive and rigorous education in physics and related disciplines to help students acquire a deep understanding of fundamental physics principles and problem-solving skills.
2) Conduct cutting-edge research in various areas of physics, pushing the boundaries of knowledge and contributing to the scientific community.
3) Develop innovative experimental techniques and computational methods to explore new frontiers in physics research.
4) Stimulate the development of interdisciplinary activities between physics or related fields and other branches of knowledge.
5) Stimulate and facilitate the professional development of the members of the department.
6) Promote interactions of the Department's faculty and students with industry, government agencies, national laboratories, and other academic or research institutions.
7) Prepare our students to compete in the job market.
8) Engage in outreach activities by disseminating and promoting effective science communications, both to the wider public and within the whole department (students, faculties, etc.) to enhance understanding and appreciation for physics education and its

applications.

During the academic year 2023-2024, the Physics Department kept faithful to its Strategic Plan, aligned in turn with the Strategic Plan of the Campus's Faculty of Arts and Sciences 2012-2022.

In the following part of this report, we describe the efforts of the department in teaching, outreach and research of Physics.

During this time, the department's faculties have worked on teaching, outreach and have published a considerable number of scientific articles in conference proceedings and in refereed journals.

In addition, students through their associations continued to carry out various activities to promote their organizations and cooperate in outreach activities to schools and other organizations for the general public.

B. Mission

The Department of Physics, in line with the mission of the Mayagüez Campus, is dedicated to educating students to better understand and explore physics phenomena, to apply critical thinking in the formulation, analysis and solution of physics problems, and to maintain high professional standards in their careers. It is also dedicated to the promotion of research in physics, and other related disciplines as well as to the promotion of physics in the university, local schools, and the community in general.

This year (2023-2024), the Graduation Day for the Faculty of Arts and Sciences was held on Thursday 20th June and our department awarded **twenty-three (23)** degrees to the students who completed their studies. Eleven (11) students received the Bachelor of Science in Physics, five (5) students received the Bachelor of Science in Physical Sciences and seven (7) students a Master of Science in Physics. During the first semester of the 2023-2024 academic year, twenty-two (22) students enrolled in the Physics Department, sixteen (16) of them in the Theoretical Physics program, two (2) in the Physical Sciences program and four (4) students in the Master of Physics graduate program. To better educate these students, our department has several initiatives to add new programs and revise existing ones. Reviews of the baccalaureate in Physical Sciences, Physics, and the master's programs are currently underway.

The possibility of creating an interdisciplinary program with the Department of Marine Sciences in Marine Atmospheric Sciences is also being considered, as well as the possibility of creating a Ph.D. program in Physics.

In terms of research, the work of the Physics Department has been very diverse, including grant proposals submitted to federal agencies, oral and poster presentations at local and

national conferences and scientific publications in peer-reviewed journals in several specialized areas such as high energy physics, meteorology, astronomy and condensed matter. In the area of community service or outreach, the department runs several programs as (i) QuarkNet, a program designed to train high school physics/chemistry teachers on current experimental particle physics experiments, (ii) faculty visits to schools to promote our programs and certification, (iii) NANOGrav, a program design to stimulate the student participation in astronomy, (iv) the Optics outreach program and (v) Software training workshop for high school teachers.

In the Astronomy UPRM's group, a new professor, Dr. Allison Smith, joins the faculty to strengthen the group and area by teaching astronomy courses and doing research at Arecibo Observatory. Dr. Smith's appointment is combined with the College's CARSE NSF grant proposal, she started on July 1, 2023.

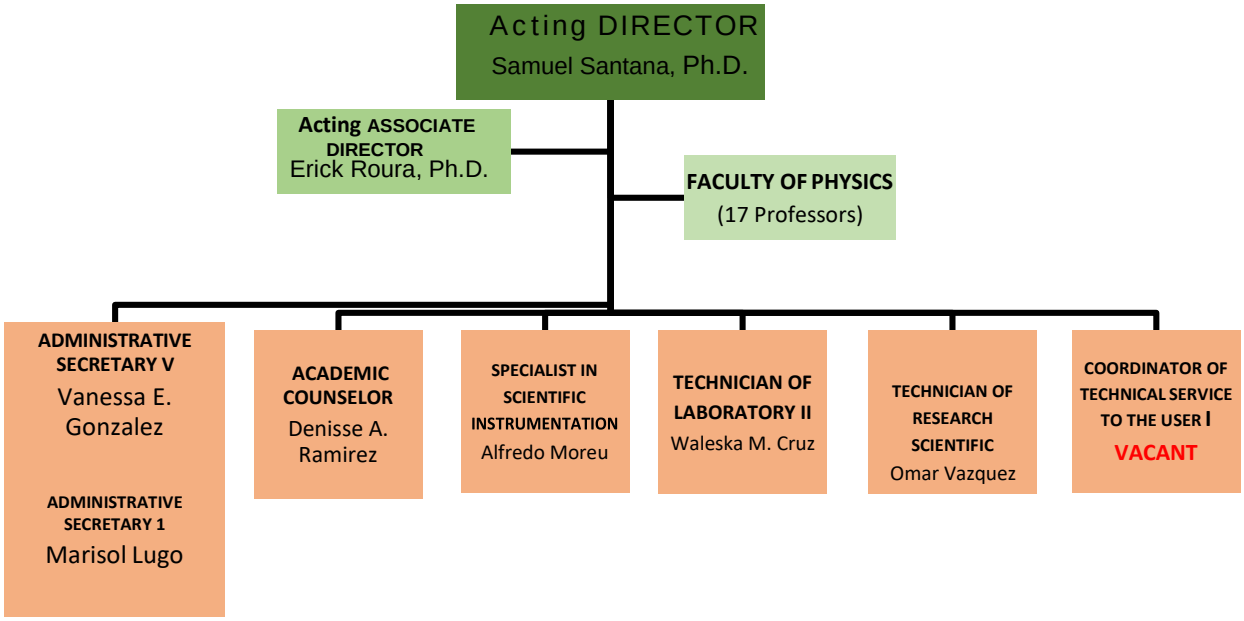
Finally, our student societies also contribute to the promotion of Physics, Atmospheric Sciences, Meteorology and Astronomy as alternatives for professional careers among university and high school students. This document describes the activities carried out by the Physics Department to fulfil the mission of the Mayagüez Campus.

The Department of Physics is composed of non-academic staff (6), tenured faculties (17) and in recent years we have employed six (6) adjunct professors per semester to meet the demand for courses mainly for engineering and biology students.

Organization chart of the Department of Physics

Physics department
University of Puerto Rico
Mayaguez University Campus

ORGANIGRAM
DEPARTMENT OF PHYSICS, UPRM



C. To institutionalize a culture of strategic planning and assessment

The Strategic Plan of the Physics Department can be found on the website of the Mayagüez University Campus at the address **https://www.uprm.edu/arci/planificacion-estrategica/**. During the academic year 2023-24, the Department of Physics continued to review the Strategic Plan, which was last revised during the academic year 2021-22. The Department of Physics has begun to implement part of the new administrative Assessment Plan. The review of the Physics Department Strategic Plan has not yet been completed and we expect to be able to continue its review early next academic year.

The current Strategic Plan of the Department of Physics is aligned with the Strategic Plan of the Faculty of Arts and Sciences 2012-2022 and with the goals of Ten for the Decade: Diary for the Planning in the University of Puerto Rico (2005-2015). We hope that as the

strategic plan changes at the level of the University of Puerto Rico changes, our plan will show the necessary alignment with it.

The Department of Physics continues to send the Exit Survey by e-mail to its graduates from all the programs offered by the Department. The results of the survey are currently being analyzed and we hope that they will help us to update all our strategic plans so that we can adapt our academics offer accordingly.

D. To lead higher education throughout Puerto Rico while guaranteeing the best education for our students

The Department of Physics has made a concerted effort to strengthen and expand its academic programs, in order to provide an academic offering that meets the needs of the student community.

Curricular reviews

The curricular review of the Physics program is being carried out by the Curriculum Committee composed by Dr. Carlos U. Pabon, Dr. Samuel Santana, Dr. Héctor Jiménez, Dr. Raúl Portuondo and Dr. Henri Radovan. The aim of the revision is to reduce the number of credits in the whole program and to increase the possible options within Physics courses. The options currently under consideration are the Bachelor of Physics with a specialization in Physics, Atmospheric Sciences and Meteorology, Computational Physics, and Traditional Physics. Considering the review of the general education courses carried out by the committee appointed by the UPRM Academic Senate, the total number of credits in the three options should be around 127 credits, 14 credits less than the total in the current Physics baccalaureate.

New Academic programs (In Progress)

An ad hoc committee is being formed by the Department to work on the establishment of a Ph.D. program in Physics which, if approved, will offer numerous benefits, including the opportunity to delve deeply into cutting-edge research and make significant contributions to scientific knowledge. Among other things, it provides a platform for intellectual growth and will open doors to a wide range of career options, including academia, research institutions, industry, and entrepreneurship, where advanced expertise is highly valued. The committee is currently working on a draft which will be submitted to the faculty for further consideration and then to the Faculty of Art and Sciences and beyond. The committee is composed of Dr. S. Lysenko, Dr. F. Bezares, Dr. S. Santana, Dr. H. Méndez, Dr. S. Malik and Dr. D. Sánchez.

An interdisciplinary program in Marine Atmospheric Sciences in collaboration with the Department of Marine Sciences is also being considered as a new emerging program in the Department.

Initiatives to strengthen teaching

The Center of Tutorials of Physics has been operating in the room F-449 during the last academic year. Each of the laboratory instructors offered one hour of tutoring/consultation during the week.

Student participation in academic competitions and activities

Students working on **Condensed Matter** with **Dr. Francisco Bezares** were involved in the following activities:

Presentations

• "Surface-enhanced Raman Scattering of Ag-Al Nanoparticles: Pushing the Boundaries of Plasmonic Applications", ***Joshua Chaparro***, *Simposio de Investigación de Estudiantes Subgraduados de Física 2024*, *UPR-Mayagüez*, Mayagüez, Puerto Rico, April 16, 2024.

• "Surface-enhanced Raman Scattering of Ag-Al Nanoparticles: Pushing the Boundaries of Plasmonic Applications", ***Joshua Chaparro***, *ACS PRISM-JTM 2024, UPR-Aguadilla*, Aguadilla, Puerto Rico, April 20, 2024.

Posters

• "Optical Properties of Al-Ag Nanoparticles", ***Cristian Gutierrez*** and ***Jheison Lizcano***, Pacific Northwest National Laboratory visit to UPR-Mayagüez, Mayagüez, PR, April 19, 2024.

• "Formation energy of lithium polysulfides in the presence of ferroelectric phase of polyvinylidene difluoride: A DFT and molecular dynamics simulations", ***José Sánchez***, ACS PRISM-JTM 2024, UPR-Aguadilla, Aguadilla, Puerto Rico, April 20, 2024.

• "Optical Properties of Al-Cu Nanoparticles", ***Cristian Gutiérrez*** and ***Jheison Lizcano***, UPENN-UPR-Humacao NSF PREM Annual Symposium, Humacao, PR, May 10, 2024.

• "Surface-enhanced Raman Scattering of Ag-Al Nanoparticles: Pushing the Boundaries of Plasmonic Applications", ***Joshua Chaparro***, NASA Puerto Rico Space Grant Consortium Symposium, May 22, 2024.

Students working on **High Energy Physics** with **Dr. Sudir Malik** participated in PRLASMP (Aguadilla), 20 April 2024:

- "Primary Vertex Detection in CMS Proton-Proton Collision Open Data using Wasserstein Distance" – ***Diego Vázquez*** (Poster, Masters, ECE)

- Parkinson's Disease Classification using Wasserstein Distance and Graph Convolutional Networks in Resting-State fMRI data" – ***Lesbia Osiris López Limas*** (Poster, PhD, ECE)

- "Deep Neural Network for Track Reconstruction in CMS Open Data" – ***Juvenal Bassa Peñaloza*** (Poster, Masters, Physics)

- "Jet Classification using Optimal Transport" – ***Juan Guadalupe*** (Oral, Undergrad, ECE)

Students working on **Astronomy** with **Dr. Allison Smith** were involved in the following activities:

Presentations

- ***Gerally Medina Rivera***, CH in the Trifid Nebula (poster), American Astronomical Society meeting (international), Madison, Wisconsin, June 9-13, 2024 (accepted)

- ***Marc Thys Charneco***, Observing CH in the Pipe Nebula, American Astronomical Society meeting (international), Madison, Wisconsin, June 9-13, 2024 (accepted)

- ***Gerally Medina Rivera***, CH in the Trifid Nebula, Seminario Interuniversitario de Investigación en Ciencias Matemáticas (international), UPR Humacao, March 1-2, 2024

- ***Marc Thys Charneco***, Observing CH in the Pipe Nebula, Seminario Interuniversitario de Investigación en Ciencias Matemáticas, UPR Humacao (international), March 1-2, 2024

- ***Marc Thys Charneco***, Observing CH in the Pipe Nebula, PRISM Conference UPR Aguadilla, April 20, 2024

- ***Marc Thys Charneco***, Observing CH in the Pipe Nebula, Physics Department Research Symposium, UPRM, April 18, 2024

- ***Marc Thys Charneco***, Observing CH in the Pipe Nebula, NSF review meeting for CARSE (UPRM), NSF Headquarters, Arlington, Virginia, May 16, 2024

- ***Yulian Humaran Humaran***, Observing Neutral Hydrogen with the Green Bank Telescope for a robust Baryonic Tully Fisher Relation (poster), Seminario Interuniversitario de Investigación en Ciencias Matemáticas (international), UPR Humacao, March 1-2, 2024
- ***Yulian Humaran Humaran***, Radio Recombination Lines in SgrB2, Physics Department Research Symposium, UPRM, April 18, 2024

- ***David Reyes Soto*** (co-mentored with Dr. Emmanuel Morales Butler UPR Utuado), Radio Frequency Interference mitigation techniques with Generalized Spectral Kurtosis, PRISM UPR Aguadilla, April 20, 2024

- ***David Reyes Soto*** (co-mentored with Dr. Emmanuel Morales Butler UPR Utuado), Radio Frequency Interference mitigation techniques with Generalized Spectral Kurtosis, Physics Department Research Symposium, UPRM, April 18, 2024

- ***Arianna Rodriguez Ortiz***, Radio Recombination Lines in Star forming region M17, PRISM UPR Aguadilla, April 20, 2024

Student Proposals

- ***Gerally Medina Rivera***, American Astronomical Society, FAMOUS travel grant ($1000) (submitted)

- ***Marc Thys Charneco***, American Astronomical Society, FAMOUS travel grant ($1000) (submitted)

- ***Arianna Rodriguez Ortiz***, PR Space Grant Consortium, Research Fellowship ($8000) (submitted May 17)

Strengthening of facilities for academic use

The Physics Department completed the installation of projectors in all the Physics Department rooms several years ago. At present, the lecturers have the option of teaching their classes with a projector only, with a blackboard only or with a combination of both resources.

The Physics Department also received approval for technology fee money to replace some of the computers in the general physics labs. The refurbishment of several classrooms began. One of them is the electronics lab in F-313 lounge. The Physics Department's computer center was moved to room F-437 a few years ago and is still awaiting improvements to its facilities during the academic year.

Currently, the Department has the goal of changing all the chalk boards, as well as repositioning the projector screens to improve classes that combine projector and blackboard simultaneously, as well as the installation of equipment to teach classes in mixed mode soon.

Academic offerings

In the academic year 2023-24, the academic offer was similar to that of recent years. The distribution of sections by course for graduate and undergraduate physics, physical sciences, astronomy and meteorology is shown below:

Course:	***Sections offered:***		
	summer 2023	***1st sem.***	***2nd sem.***
FISI 3091	**1**	**3**	**3**
FISI 3092	**1**	**3**	**4**
FISI 3151	**2**	**8**	**5**
FISI 3152	**1**	**5**	**8**
FISI 3153	**1**	**12**	**5**
FISI 3154	**1**	**7**	**11**
FISI 3161	**1**	**1**	**1**
FISI 3163		**1**	**1**
FISI 3162		**1**	**1**
FISI 3164		**1**	**1**
FISI 3171	**2**	**17**	**14**
FISI 3172	**1**	**11**	**13**
FISI 3173	**1**	**21**	**15**
FISI 3174	**1**	**15**	**18**
FISI 4001		**1**	
FISI 4002			**1**
FISI 4017		**1**	
FISI 4020			**1**
FISI 4051		**1**	
FISI 4052			**1**
FISI 4057		**1**	
FISI 4063		**1**	

FISI 4071			**1**
FISI 4076		**2**	
FISI 4077			**2**
FISI 4105		**1**	**1**
FISI 4106		**1**	
FISI 4107			**1**
FISI 4118			**1**
FISI 4125			**1**
FISI 4126		**1**	
FISI 4127			**1**
FISI 4997			**1**
FISI 4999	**1**	**5**	**3**
FISI 5037		**1**	
FISI 6090		**1**	
FISI 6190			**1**
FISI 6280			**1**
FISI 6380		**1**	**1**
FISI 6431		**1**	
FISI 6451			**1**
FISI 6510			**1**
FISI 6991	**1**	**8**	**7**
ASTR 4005		**1**	
ASTR 4006			**1**
ASTR 4015		**1**	
ASTR 4017			**1**
ASTR 4999		**1**	**2**
CIFI 3011		**2**	
CIFI 3012			**1**
METE 4006		**1**	
METE 4008			**1**
METE 4057			**1**
METE 4061		**1**	
METE 4075		**1**	
METE 4085			**1**
METE 5065			**1**

E. To increase and diversify the Institution's sources of revenue

Initiatives to obtain funds:

- Proposals by **Dr. Allison Smith** to support her research on **Astrophysics**:

  Submission of a full proposal to Green Bank Observatory, 63 hours

  Submission of a full proposal to American Astronomical Society, FAMOUS travel Grant. Budget: $1,000

- Proposals by **Dr. Francisco Bezares** to support his research on **Condensed Matter**:

  Submission of a full proposal to NSF MRI with UPR Humacao, entitled **"Acquisition of AFM-Confocal Microscope System".** Dr. Bezares' position as Scientific Personnel. Budget: $599,878. Active proposal.

  Submission of a full proposal to NSF CAWT IRG2, entitled **"Exploration of the Photonic Properties of PVDF for Energy Harvesting and Generation on Advanced Wearable Technologies"**. PI: Dr. Bezares
  Budget: $50,000 (not approved)

  Submission of a full proposal to NASA Bridge, entitled **" MOCVD Growth of III-N Materials for Quantum Photonic Technologies"**. PI: Dr. Bezares
  Budget: $300,000 (Pre-proposal active, Proposal pending)

  Submission of a full proposal to NSF EPSCoR E-RISE, entitled **"Incubator Center for Monitoring Air Pollution and Respiratory Diseases in Puerto Rico"**. Dr. Bezares' position as Scientific Personnel. Budget: $7,500,000 (UPRM $2,093,038). Not approved.

  Submission of a full proposal to PRSRT Trust, entitled **"Physical Vapor Deposition of Metal Nanoparticles for the Scalable, Cost-effective Fabrication of Novel Nanophotonic Devices**" PI: Dr. Bezares. Budget: $70,000. Pending.

- Proposal by **Dr. Yong Jhin Kim** to support his research on **Materials**:

  Submission of a full proposal to NSF SBIR, entitled ***"Manufacturing and characterization of Room Temperature Ambient Pressure Superconductor"***.
  PI: Yong-Jihn Kim, subaward: O. Marcelo Suarez, Materials Science and Engineering Department.
  Budget: Phase I, $275,000 + $100,000, cash match from PR Science Trust.

- Proposal by **Dr. Sergiy Lysenko** to support his research on **Materials**:

  Submission of a full proposal to Department of Defense, entitled ***"Transient Dynamics"*** ; PI: SERGIY LYSENKO

External funds received

- Proposal by **Dr. Armando Rúa** to Gordon and Betty Moore Foundation, entitled **"Unraveling the switching mechanism in phase-change materials for brain-inspired computing applications"**
  PI: Armando Rúa
  Funds: $1,246,082.00

- Proposal by **Dr. Henri Radovan** for continuation of his work in the **NANOGrav** collaboration:

  NSF award #2216793
  PI: Henri Radovan
  Title: NANOGrav@UPRM: Growing and characterizing the NANOGrav gravitational-wave detector
  Funds: $520,646
  duration: August 1, 2022 to July 31, 2025

- Proposal by **Dr. Sudhir Malik** for continuation of his work and **CMS:**

  (1) Project Name (submitted, period - 1 September 2023 to 31 August 2028) - "**S2I2: Institute for Research and Innovation in Software for High Energy Physics (IRIS-HEP)"**
  Principal Investigator: **Malik, Sudhir**
  Funding Sponsor – NSF (Proposal Number: 2323298)
  Period of funding - 1 September 2023 to 31 August 2028
  Amount requested - $385,769.00

F. To implement efficient and expedient administrative procedures

The Department of Physics did not implement new administrative procedures during the academic year 2023-2024.

G. To strengthen research and competitive creative endeavors

a) Quantity of external funds received, by source, for research and creative work.

NATIONAL SCIENCE FOUNDATION (NSF)	
Research Project	***2023-2024:***
Student-Driven Internship Opportunities in the Atmospheric Sciences: Breaking Barriers to Diversity, Inclusion, and Equal Access - **(Dr. Héctor J. Jiménez)** Funded amount: $299,927.00 [01/01/2022 – 12/31/2023]	***$72,084.50***
NANOGrav at UPRM: Growing and characterizing the NANOGrav gravitational-wave detector – **(Dr. Henri Radovan)** Funded amount: $520,565.00 [09/01/2022 – 08/31/2025]	***$186,049.00***

Physics Beyond Standard Model with the CMS Pixel Detector **(Dr. Sudhir Malik)** Funded amount: $375,000. [1/Sep/2021-31/Aug/2024]	**$154,601.00**

NATIONAL SCIENCE FOUNDATION (NSF) **(Collaborative Agreements with Princeton University)**	
Institute for Research and Innovation in Software for HighEnergy Physics (IRIS-HEP) - **(Dr. Sudhir Malik**) Funded amount: **$103,475** 09/01/2018 – 08/31/2028 Period of funding – September 1, 2022 through August 31, 2023 (NCE)	**$23,571.00**
NATIONAL SCIENCE FOUNDATION (NSF) **(Collaborative Agreements with Cornell University)**	
High Luminosity (HL) LHC CMS Detector Upgrade Project FPIX:Mechanics & Assembly"- **(Dr. Sudhir Malik)** Period of funding - 1 April 2020 to 31 March 2026 Amount funded: $47,988.	**$10,461.00**
Gordon and Betty Moore Foundation	
Unraveling the switching mechanism in phase-change materials for brain-inspired computing applications Funded amount: **$1,246,082.00** Period of funding: 09/01/2023-08/31/2028 – **(Dr. Armando Rúa)**	**$418,464.00**

b) Total number of proposals submitted and approved by department.

Proposals submitted	**9**
Proposals approved	**1**

c) Number of new research and creative work projects.

One (1)

d) Number of ongoing research and creative work projects.

Five (5)

e) Brief description of new and ongoing projects with significant impact.

Unraveling the switching mechanism in phase-change materials for brain-inspired computing applications

(Dr. Armando Rúa)

In this project, the materials to be grown and characterized, in addition to V6O13, are the vanadium Magnéli phases (V3O5, V4O7, V5O9, V6O11, V6O13, and V8O15). These materials take an intermediate position between V2O3 and VO2 and exist with a mixture of +3 and +4 valence states. As a function of temperature, except for V7O13, which remains metallic, all members of the series exhibit reversible metal insulator transitions as the temperature is lowered, followed by antiferromagnetic ordering at a lower temperature (Figure 1). Although the Magnéli phase vanadium oxides are interesting from both the experimental and theoretical point of view, few studies about them are reported in the literature. Moreover, most of these studies concern bulk crystal samples, which is to be expected because peculiar issues encountered with materials in thin film form and low dimensionality are then avoided. However, these issues become unavoidable as the materials in question are considered for application in novel computing architectures. All samples for the work proposed here will be prepared as thin films by PLD and magnetron sputtering. Some of the properties of the films will be controlled by tuning parameters of the deposition process and by using different single-crystal substrates (which affects residual stress, an important parameter affecting the transitions of interest here). The valence and stoichiometry will be controlled using a post-deposition thermal treatment consistent with equilibrium temperature and oxygen pressure conditions for the desired vanadium oxide compound, an approach that has been successfully applied in the case of V2O3 [8].

With a few exceptions, the characterization techniques mentioned thus far, which will be employed throughout the project to optimize and to monitor the sample fabrication process, can be considered routine. All of these techniques are available either at the PIs lab or at those of close collaborators on campus. However, elucidation of the MIT switching mechanism and, particularly, of the nature and dynamics of Figure 1. Metal-Insulator Transitions of various vanadium oxides [7]. conductive filaments between electrodes will require very advanced techniques for which the required instrumentation is not available even in most research universities. Hence, access to relevant facilities and expertise at BNL is an indispensable component of this proposal.

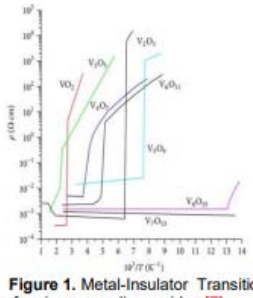


Figure 1. Metal-Insulator Transitions of various vanadium oxides [7].

NANOGrav at UPRM: Growing and characterizing the NANOGrav gravitational-wave detector

(Dr. Henri Radovan)

This proposal partners the Physics Department at the Mayagüez campus of the University of Puerto Rico (UPRM) with the North American Nanohertz Observatory for Gravitational Waves (NANOGrav) Physics Frontiers Center to advance several key NANOGrav science goals and to increase the participation and retention of minorities in the field of physics. NANOGrav's mission is to detect and characterize low frequency gravitational waves from the merger of supermassive black hole binaries using a pulsar timing array as galactic-scale detector. NANOGrav has been engaged in forefront research for the past 15 years in areas including radio astronomy, astrophysics, and cosmology and comprises currently over 200 members at more than 50 mainland universities. Undergraduate students from UPRM will be involved in research projects of relevance to NANOGrav's mission, mentored at UPRM as well as remotely and onsite at several NANOGrav institutions. The research will involve searching for new pulsars, data quality checks, pulsar simulation development, and characterizing pulsar emission properties. The students will also have the opportunity to participate in workshops at UPRM, the Arecibo Observatory, and other NANOGrav sites, as well as to attend general NANOGrav and training meetings on the mainland. Furthermore, they will have a chance to deliver standard NANOGrav talks at local high schools, thereby gaining presentation skills and motivating high schoolers to enroll in physics programs.

Student-Driven Internship Opportunities in the Atmospheric Sciences: Breaking Barriers to Diversity, Inclusion, and Equal Access

(Héctor J. Jiménez, PhD)

This proposal addresses the need for increasing the levels of representation and retention of racial and ethnic minorities in the Atmospheric Sciences. In particular, it focuses on underrepresented minority students at Hispanic Serving Institutions. We are proposing a novel approach to increasing the appeal of Atmospheric Science and Meteorology programs, the retention of students, and the probability of success after graduation, through the implementation of an internship program driven by student needs and input. The outcome of the activities that comprise this model would be a much better understanding and fine tuning of an approach that has the potential to complement and perhaps replace some of the existing ways of providing students with enriching and motivating internship opportunities. We expect that the internships themselves will constitute an important recruitment tool to attract and retain larger numbers of underrepresented minorities into the Geosciences.

Physics Beyond Standard Model with the CMS Pixel Detector

(Sudhir Malik, PhD)

This proposal requests continuation of support for the 3-year period from 9/1/2021 to 8/31/2024 for the ongoing research program in experimental High Energy Physics (HEP) at the University of Puerto Rico Mayaguez (UPRM). The program is centered on the CMS experiment currently running at the proton Large Hadron Collider (LHC), at CERN in Geneva, Switzerland, and it draws on the expertise of the PI gained from the strong and continuous contribution to the CMS experiment. The PI joined University of Puerto Rico Mayaguez (UPRM) as a tenure-track Associate Professor of Physics in July 2014 to establish and secure funding for a High Energy Physics research program. NSF awarded funding for this program in the past from 6/1/2015 to 5/31/2018 and 9/1/2018 to 8/31/2021. UPRM is the only institute pursuing research in High Energy Physics in Puerto Rico and the Caribbean.

f) Impact outcomes of research and creative work projects (e.g., patents, discoveries).

https://www.uprm.edu/portada/2024/03/01/rumeninvestigacionduneneutrinos-2/

UPR
Recinto Universitario de Mayagüez

RUM • ACADEMIA • ESTUDI

67 Shares

Científicos del RUM participan en experimento internacional DUNE sobre neutrinos

Por Mariam Ludim Rosa Vélez (mariam.ludim@upr.edu)
Prensa RUM
viernes, 1 de marzo de 2024

Científicos del Recinto Universitario de Mayagüez (RUM) forman parte del Experimento Subterráneo de Neutrinos (DUNE), investigación internacional en la disciplina de Física de Partículas, cuyo fin es estudiar las propiedades fundamentales de las partículas llamadas neutrinos.

El proyecto coordinado por el Laboratorio Nacional Fermilab del Departamento de Energía de los Estados Unidos, en colaboración con otras agencias que subvencionan el estudio, incluye a más de 1,400 científicos e ingenieros de todo el mundo, de 200 instituciones distribuidas en 36 países. El recinto mayagüezano de la Universidad de Puerto Rico (UPR), forma parte de esta alianza desde su creación en el año 2015. La colaboración ha evaluado la tecnología con el detector *ProtoDune* en el Laboratorio Europeo de Física de Partículas (CERN) en la frontera franco-suiza, cerca de Ginebra, que será utilizada en el primer detector de DUNE que comenzará su toma de datos en 2028.

"Participar en el experimento DUNE es crucial, pues además de comprender las propiedades de los neutrinos y avanzar en la física de partículas elementales, implica el desarrollo y la aplicación de tecnologías de vanguardia, desde detectores altamente sensibles hasta técnicas avanzadas de generación de haces de neutrinos. Estas innovaciones no solo benefician al experimento, sino que también pueden tener aplicaciones prácticas en otras áreas de la ciencia y la tecnología", sostuvo el doctor Héctor Méndez Mella, catedrático de Física, quien junto a sus estudiantes se integra en varias fases de la investigación.

"Contribuir a DUNE significa ser parte de un esfuerzo global para expandir nuestro conocimiento sobre la naturaleza fundamental del universo. Los resultados obtenidos pueden tener un impacto significativo en la física de partículas y, por ende, en nuestra comprensión más profunda de la realidad que nos rodea", puntualizó.

Méndez Mella destacó la importancia de la participación de alumnos del Recinto en este proyecto internacional.

"Durante esta fase de preparación del experimento, dos de nuestros estudiantes graduados, Marvin Santos y Norman Martínez, han completado sus maestrías en Física con proyectos relacionados con la simulación del decaimiento del protón. En la actualidad, ambos se encuentran trabajando en sus programas doctorales; Santos en Ingeniería Eléctrica en el RUM, y Martínez en Física de Neutrinos en *Kansas University*", explicó.

"Además, Daniel Gutiérrez, quien completó su bachillerato en Física en nuestro Recinto y, actualmente, está cursando su doctorado en Educación Científica en Física en el Recinto de Río Piedras de la UPR, colabora en el experimento a través de los proyectos de divulgación (*outreach*) del experimento DUNE, mediante el programa nacional de *QuarkNet*. Dentro de esa plataforma, se desarrollan actividades destinadas a promover la física de neutrinos con los maestros de Física y Química de Puerto Rico, siendo nuestro centro el único en Puerto Rico y en el Caribe que participa en esta iniciativa", agregó.

DUNE busca tres objetivos científicos principales: descubrir si los neutrinos, que son partículas elementales subatómicas sin carga eléctrica, podrían ser la razón por la que el universo está hecho solo de materia; buscar fenómenos subatómicos que puedan ayudar a hacer realidad el sueño de Einstein de la unificación de fuerzas ; y observar los neutrinos que emergen de una estrella en explosión, tal vez presenciando el nacimiento de una estrella de neutrones o un agujero negro.

"DUNE utilizará un potente haz de neutrinos generado en el Laboratorio Nacional Acelerador de Partículas Fermilab ubicado en Batavia, Illinois. Estos neutrinos *hand made* viajarán 800 millas a través de la tierra, no requiriendo una línea especial, pues cruzan la materia con mínima interacción, hacia el *Sanford Underground Research Facility* en Dakota del Sur, donde se ubica el experimento DUNE. En ese lugar, a una profundidad de una milla, se encuentra el recién completado *hall experimental*, que tiene aproximadamente el tamaño de ocho campos de fútbol. En este espacio, el experimento DUNE instalará cuatro enormes detectores compuestos de argón líquido, cada uno capaz de registrar las interacciones de neutrinos cuando estas ocurran", señaló.

De hecho, el doctor Méndez Mella colaboró en el proyecto del descubrimiento del bosón de Higgs en el año 2012, a través del experimento *Compact Muon Solenoid* (CMS), un enorme detector de partículas compuesto de varios subdetectores en el CERN.

"Con el interés en explorar áreas diversas de la física de partículas y contribuir a proyectos que aborden preguntas fundamentales en diferentes aspectos del universo, decidí trasladarme al experimento DUNE, uno de vanguardia en el campo de la física de neutrinos", sostuvo.

Destacó que existen tres tipos de neutrinos distintos en la naturaleza, que oscilan y son extremamente esquivos para detectarlos, pues interactúan débilmente con la materia.

"Debido a esto, son complejos de estudiar a pesar de que son las segundas partículas más abundantes en el universo después de las partículas de la luz (fotones). Cerca de 100 trillones de neutrinos provenientes del sol atraviesan nuestro cuerpo cada segundo sin que lo notemos, y otros 30 millones de neutrinos fósiles provenientes del *Big Bang* también nos atraviesan continuamente. Por cada electrón, protón y neutrón, el universo contiene billones de otras partículas, como los neutrinos, que no interactúan con la radiación electromagnética (luz). La abundancia de neutrinos en el universo da importancia a la necesidad de comprender plenamente su naturaleza para obtener una visión completa de nuestro cosmos", concluyó.

Fotos

Universidad de Puerto Rico Recinto de Mayaguez
1 de marzo ·

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Científicos del RUM participan en experimento internacional DUNE sobre neutrinos
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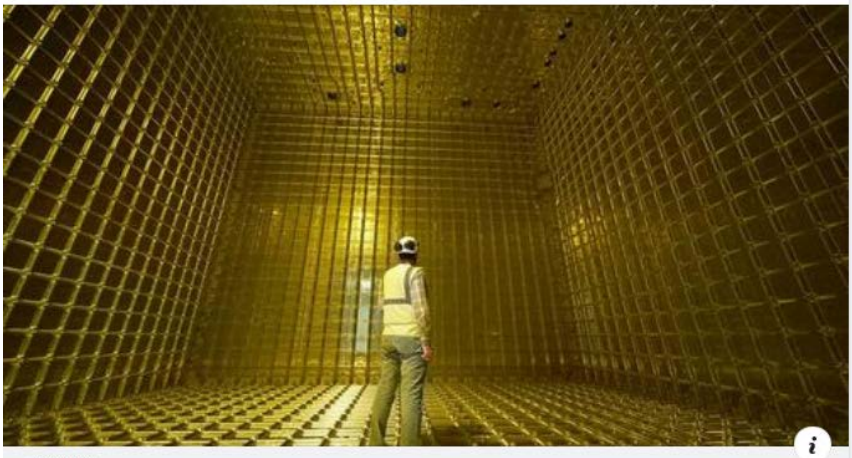

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Científicos del RUM participan en experimento internacional DUNE sobre neutrinos

Agustín Rullán y 22 personas más — 7 veces compartido

https://islanewspr.com/2024/03/27/cientificos-del-rum-participan-en-experimento-internacional-dune-sobre-neutrinos/?fbclid=IwZXh0bgNhZW0CMTEAAR0hZKOvp6OznVLG_9ymI6lTteaBvxfkWSAUVzy6lgV13-BHaY2OOk8IehI_aem_b3vKh3e2nJGxCYvJhMpo4A

March 27, 2024

Científicos Del RUM Participan En Experimento Internacional DUNE Sobre Neutrinos

Posted By: Manuel Santiago / 0 Comment

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https://www.uprm.edu/portada/2023/08/25/catedratico-de-fisica-del-rum-recibe-subvencion-millonaria-de-la-fundacion-gordon-and-betty-moore/

Catedrático de Física del RUM recibe subvención millonaria de la Fundación Gordon and Betty Moore

Por Idem Osorio De Jesús (idem.osorio@upr.edu)
Prensa RUM
miércoles, 23 de agosto de 2023

El doctor Armando Rúa de la Asunción, catedrático del Departamento de Física del Recinto Universitario de Mayagüez (RUM), de la Universidad de Puerto Rico (UPR) recibió una subvención de $1, 250,000 de la Fundación Gordon and Betty Moore, que le permitirá ampliar su investigación en la física experimental por los próximos cinco años.

El doctor Rúa de la Asunción, quien es el primer científico en ganar esta subvención en Puerto Rico, fue seleccionado junto a otros 20 investigadores del primer cohorte de 2023, quienes contarán con estos fondos para abordar sus ideas innovadoras de forma más creativa, así como propiciar avances en su campo.

Así lo anunció hoy la Fundación Moore, establecida en el año 2000 con un fondo inicial de $5 mil millones por Gordon Moore, cofundador de la compañía Intel y su esposa Betty Moore. Entre sus objetivos, la Fundación apoya la investigación científica, particularmente en campos emergentes. La iniciativa de investigadores en física experimental es una de las más recientes de la entidad, cuyo norte es otorgar subvenciones considerables que logren impactos significativos.

De acuerdo con el doctor Rúa de la Asunción; "esta distinción reconoce el trabajo realizado hasta ahora, y facilitará significativamente su continuación y extensión durante los próximos años. Es un gran logro estar entre los seleccionados por la Fundación Moore para esta iniciativa, ya que sus programas son altamente competitivos. El proyecto se gana esencialmente por el mérito de la propuesta y su base en el trabajo previo. Lo anterior valida nuestro esfuerzo de años y, por supuesto, repercute de manera positiva en nuestros estudiantes y en nuestro entorno universitario. Con estos fondos podremos adquirir equipos necesarios, así como financiar a estudiantes subgraduados y graduados de manera que continúen viajando, como ya hacemos mis alumnos y yo, al Laboratorio Nacional de Brookhaven, en New York, para realizar parte de la investigación con equipos avanzados que no están disponibles en Puerto Rico".

Según explicó el catedrático, la subvención viabilizará profundizar en el estudio de materiales, tales como algunos vanadatos, que cambian bruscamente sus propiedades eléctricas, ópticas y mecánicas al ser estimulados mediante cambios en temperatura, campos eléctricos intensos, altas presiones o pulsos fuertes de luz.

"La física detrás de estos cambios ha sido estudiada desde hace muchas décadas, pero los mecanismos responsables son complejos y todavía no los entendemos bien. Este proyecto nos permitirá contribuir en la explicación de estos fenómenos. A la vez, exploraremos aplicaciones de estos materiales para nuevos dispositivos electrónicos y opto-electrónicos. En particular, nos interesa la posibilidad de crear dispositivos neuromórficos. Estos representan un acercamiento a la computación inspirado en la manera en la que funciona el cerebro. Esperamos que tengan importantes ventajas con respecto a la tecnología actual, incluyendo mayor capacidad para computación en paralelo y mucho menor consumo de energía", abundó.

El doctor Rúa de la Asunción posee un bachillerato en Matemáticas y Física de la Universidad del Atlántico en Colombia. Realizó una maestría en Física del Recinto Universitario de Mayagüez de la UPR, con la asesoría del doctor Félix Fernández y completó su doctorado en Física en el Centro graduado de la Universidad de la Ciudad de New York (CUNY), bajo la dirección del doctor Steve Greenbaum. Hace ocho años se desempeña como profesor en el Departamento de Física del RUM y también se ha destacado como coautor de dos patentes y más de 60 artículos revisados por pares.

En su trayectoria docente, su trabajo ha sido patrocinado dos veces por el Departamento de Defensa de Estados Unidos y, actualmente, trabaja en dos proyectos subvencionados por la Fundación Nacional para la Ciencia (NSF), uno de ellos en colaboración con el también catedrático en Física, doctor Sergiy Lysenko. El profesor Rúa de la Asunción tiene colaboraciones con varios investigadores en el Recinto, en el Centro Funcional de Nanomateriales en el Laboratorio Nacional de Brookhaven y con colegas en la Universidad Nacional de Australia en Canberra.

Por su parte, el rector del RUM, doctor Agustín Rullán Toro, felicitó al catedrático por esta prestigiosa subvención que le permitirá aportar a su campo científico y realzar el trabajo competitivo que realiza con impacto en el país y mundialmente.

"Enhorabuena al doctor Armando Rúa de la Asunción por ser el primer científico en Puerto Rico en recibir esta prestigiosa subvención que, sin duda, hará posible que, junto a sus estudiantes, amplíe sus investigaciones, obtenga mayores fondos y continúe aportando a la ciencia como embajador de la excelencia de nuestra Universidad", reiteró el Rector.

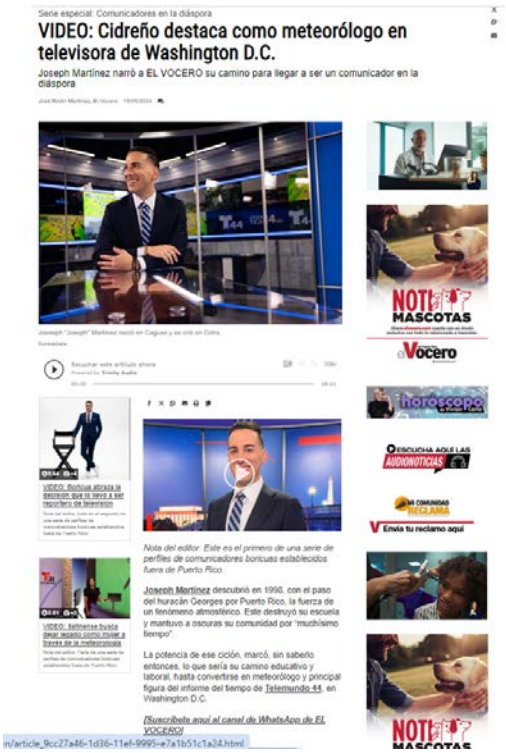
Según amplió la Fundación Moore, esta iniciativa selecciona y apoya a investigadores que están avanzando en la investigación en física experimental que mejore la comprensión científica del mundo natural. En el proceso de selección, en el que solamente se evalúan los proyectos presentados, sin identificar los proponentes o la Universidad que representan, se presta especial atención a la cultura de los grupos de investigación para desarrollar y reforzar prácticas que promuevan la inclusión, el acceso equitativo a la educación y el desarrollo profesional dentro de la comunidad de física experimental.

Para más información de la próxima ronda de financiación para investigadores, que se abrirá el 5 de septiembre de 2023, favor de visitar la página de la Fundación Gordon and Betty Moore.

Fotos

Joeseph Martínez, who graduated of the Meteorology curricular sequence, was hired by the Telemundo 44 television station in Washington, DC. He is the first meteorologist in Telemundo 44.

https://www.elvocero.com/actualidad/otros/video-cidre-o-destaca-como-meteor-logo-en-televisora-de-washington-d-c/article_bff0b8bc-0d86-11ef-aba7-1faa36ce02f3.html?fbclid=IwZXh0bgNhZW0CMTEAAR2noNQJPKfUK6vlUTorjFQWLbd9ESlSFXeJ6PTsJKDyoP0xRAdaH0Wk2yI_aem_AbKKTF-hSjy-r1nm7MN6FvQTT07BipcxFO9IBqjmfoeifOFUpHxoUQB0J5bAVP9u2nYnriBKZn7vudBb785WRHnJ


Serie especial: Comunicadores en la diáspora

VIDEO: Cidreño destaca como meteorólogo en televisora de Washington D.C.

Joseph Martínez narró a EL VOCERO su camino para llegar a ser un comunicador en la diáspora

Nota del editor: Este es el primero de una serie de perfiles de comunicadores boricuas establecidos fuera de Puerto Rico.

Joseph Martínez descubrió en 1998, con el paso del huracán Georges por Puerto Rico, la fuerza de un fenómeno atmosférico. Este destruyó su escuela y mantuvo a oscuras su comunidad por "muchísimo tiempo".

La potencia de ese ción, marcó, sin saberlo entonces, lo que sería su camino educativo y laboral, hasta convertirse en meteorólogo y principal figura del informe del tiempo de Telemundo 44, en Washington D.C.

[Suscríbete aquí al canal de WhatsApp de EL VOCERO]


"Para el huracán George era un niño que estaba, me parece en tercer grado y todavía no entendía mucho sobre la meteorología, pero me llamó la atención, sobre todo, que primero fue un sistema atmosférico que logró destruir mi escuela, así que fue algo bien poderoso. Y segundo, que estuvimos muchísimo tiempo sin electricidad", recordó Martínez en entrevista con EL VOCERO.

En su mente tiene vivas todavía, las imágenes de las pérdidas de propiedad y cultivos, así como servicios esenciales colapsados.

"Siempre veía los meteorólogos, los mapas y yo siento que es como una pasión con la que uno nace, porque sin que nadie me dijera nada, yo sentí como que esa pasión de que me gustaba ver el segmento del tiempo cada vez que veía las noticias desde bien pequeño", rememoró.

Martínez es egresado de la Universidad de Puerto Rico (UPR) de Cayey, donde tomó cursos básicos de su bachillerato y luego se movió a la UPR de Mayagüez (RUM), donde completó sus cursos en meteorología.

Posteriormente, realizó un internado en WIPR-TV Canal 6 con Suheily López Belén —quien trabaja actualmente en WAPA TV— que lo llevó a estar frente a las cámaras de televisión por primera vez.

Tras graduarse del RUM en 2016, una amiga le comentó sobre plazas disponibles en Estados Unidos en la cadena NBCUniversal, empresa matriz de Telemundo. Aunque su deseo era trabajar en Puerto Rico, en ese momento reconoció que el mercado de la televisión comercial local estaba "establecido".

"Realmente cuando yo me gradué, los medios en Puerto Rico estaban básicamente establecidos y no vi que hubiera ninguna vacante o ninguna posibilidad para alguien como tal nuevo, sin experiencia como era yo en ese entonces. Así que realmente nunca logré aplicar a ninguna plaza en Puerto Rico", lamentó.

"Las cosas se entrelazan"

El cidreño explicó a EL VOCERO que, tras la meteoróloga Yara Lasanta mudarse de la estación de Telemundo Puerto Rico a la de Los Ángeles, California, quedó una vacante en la estación local de la Isla, que más adelante cubrió Elizabeth Robaina, quien laboraba entonces en el espacio de la misma cadena en McAllen, Texas.


Primer meteorólogo de Telemundo 44

En el último trimestre de 2017, nuevamente a través de un amigo, logró conquistar una nueva oportunidad en la televisión norteamericana y convertirse en el primer meteorólogo de Telemundo 44.

Y es que, uno de los mejores amigos de Martínez, que también labora para una de las estaciones de Telemundo, le hizo saber que en Washington D.C., NBCUniversal establecería una nueva estación.

Su actitud de estar abierto al cambio y de probar algo "distinto", una vez más lo llevó a tomar la decisión de lanzarse y solicitar unirse a ese nuevo proyecto.

"En el noreste del país pasan condiciones meteorológicas bien diferentes. Obviamente, aquí tenemos las cuatro estaciones del año, entonces como meteorólogo iba a ser una experiencia más enriquecedora para mí, por lo que decidí aplicar a esta plaza de Telemundo 44", sostuvo quien poco después se mudó a Washington D.C.

"Soy el primer meteorólogo que ha tenido la estación que se lanzó en enero del 2018", remarcó con orgullo.

Recientemente, fue nominado a un premio Emmy como "mejor meteorólogo" en la capital estadounidense. Mientras que, en 2018, 2019 y en 2020, fue galardonado en su región en la

The newspaper, El Nuevo Día, interviewed *Yaireska Collado,* who received her BS in Physics (2004) and Master in Physics (2007) and currently, is the director of NASA's Moon to Mars (M2M) Space Weather Analysis Office and the former lead of the experimental Space Weather Forecasting Team at the Community Coordinated Modeling Center (CCMC) and *Marangelly Fuentes,* who received her BS in Physics (2004) and, currently, is a Chief Scientist Officer in ADNET Systems Inc, NASA Goddard Space Flight Center - Greenbelt, MD.

https://www.elnuevodia.com/corresponsalias/washington-dc/notas/en-la-tierra-en-la-luna-o-en-el-espacio-estos-boricuas-llevan-con-orgullo-nuestra-bandera-en-la-nasa/

En la Tierra, en la Luna o en el espacio, estos boricuas llevan con orgullo nuestra bandera en la NASA

Son parte del nutrido grupo de puertorriqueños que aportan su conocimiento y experiencia en el Centro Espacial de Vuelo Goddard de la NASA en Maryland

3 de diciembre de 2023 - 11:40 PM COMPARTIR 30

NOTA DE ARCHIVO
Esta historia fue publicada hace más de 6 meses.

Se adhiere a los criterios de The Trust Project

Parte del grupo de científicos, ingenieros y expertos puertorriqueños en diversas materias que trabajan en el Centro Espacial de Vuelo Goddard de la NASA en Greenbelt, Maryland. (TIMOTHY M YANTZ)


Por José A. Delgado
Corresponsal de El Nuevo Día en Washington D. C.
jose.delgado@gfrmedia.com

Greenbelt, Maryland.- Desde los seis años, **Yaireska "Yari" Collado Vega** quería ser astronauta.

RELACIONADAS

CORRESPONSALÍAS
Algo está cambiando en Washington D. C.: cada vez más puertorriqueños se insertan en esferas de influencia en la capital federal
Por José A. Delgado

CORRESPONSALÍAS
Así se fragua la identidad de la diáspora boricua: "Hay un fuerte sentido de la nacionalidad, independiente de la ciudadanía"
Por José A. Delgado

CORRESPONSALÍAS
GFR Media presenta el proyecto del Junte Boricua en la capital estadounidense
Por José A. Delgado

Y aunque el universo le desvió un poco esa ruta, la mantuvo conectada al espacio sideral.

Como directora de la Oficina de Meteorología Espacial de la **NASA** (siglas en inglés de la Administración Nacional de Aeronáutica y el Espacio) se encarga de hacer los análisis para informar a los astronautas de las consecuencias que pueden causar las tormentas solares sobre sus misiones y el nivel de radiación a la que se exponen, entre otras cosas.

"El espacio no está vacío. Tenemos el viento solar, que es la expansión de la corona solar, y el sol también tiene tormentas solares. Esas tormentas cuando llegan a la Tierra pueden causar problemas en comunicaciones, en las señales de GPS, las redes eléctricas y pueden provocar cambios en las órbitas de los satélites", explicó Collado Vega.

La científica es una de las decenas de boricuas que trabajan en el **Centro Espacial de Vuelo Goddard de la NASA** en Greenbelt, Maryland, a media hora de la capital estadounidense y uno de los principales laboratorios de investigación de la NASA. **El centro Goddard reúne el mayor número de científicos e ingenieros en Estados Unidos dedicados a estudiar la Tierra, el Sistema Solar y el Universo.**

El Nuevo Día entrevistó a seis de estos boricuas que trabajan para la NASA -una agencia que cuenta con un astronauta boricua, Joseph Acabá Herrero, y otro en camino, Marcos Gabriel Berríos-, en la estación Goddard y se encontró con otra media docena que también labora en estas instalaciones, que reúnen a muchos alumnos de ingeniería de la Universidad de Puerto Rico en Mayagüez (**UPRM**).

Graduada de la UPRM, Collado Vega tuvo su primer encuentro presencial con la NASA en un viaje familiar. Para el quinceañero de su hermana, sus padres hicieron el esfuerzo económico de llevarlos a Florida, donde fueron a ver el **centro espacial Kennedy**.

"Me enamoré completamente de lo que tenía que ver con la NASA", indicó Collado Vega, quien en 2017 fue una de las presentadoras principales de la transmisión del canal de televisión de la NASA sobre el eclipse solar total de ese año, evento para el cual –con la idea de afirmar que es puertorriqueña-, se vistió con una camiseta del "Colegio de Mayagüez".

Aunque pensó en un momento estudiar Leyes, una maestra le llamó la atención: 'Muchacha si a ti lo que te gusta es la física'.

"No soy astronauta, pero mi oficina hace los pronósticos para asesorar el nivel de radiación para proteger a los astronautas de las misiones Artemis (que llevará a la primera mujer y la primera persona negra con la encomienda de explorar más superficie lunar que nunca). Me siento muy orgullosa porque la oficina la establecí yo", señaló Collado Vega.

Trabajando en la NASA, a **Marangelly "Mara" Fuentes**, directora científica especialista en Ciclones Tropicales, el devastador impacto del **huracán María** sobre Puerto Rico le hizo repensar el entusiasmo profesional que experimentaba con el desarrollo de un fenómeno atmosférico.

"Jamás he vuelto a decir, 'ay que bueno un huracán'", dijo Fuentes, natural de Naranjito, al aludir al impacto que tuvo ese ciclón no solo en su familia en Puerto Rico, sino en ella como científica. Alertó a toda su familia en Puerto Rico que el impacto sería significativo, aunque nadie proyectaba que se desarrollaría en unas horas en un huracán categoría 5.

"Cuando María entró a Puerto Rico estaba hablando con mi mamá... Supe de mis papás 24 horas después de la entrada del huracán, porque mi papá cogió un machete, se fue cortando y brincando árboles hasta que subió a una montaña, tuvo un poquito de señal en el teléfono y me llamó. Era la mañana del otro día y me dice, 'estamos vivos', y fue lo único que escuchaba", afirmó.

Pero Fuentes, quien trabaja como contratista en la NASA y entró a la agencia como becaria en 2005, tuvo desde pequeña un interés particular en la meteorología. "Después de pasar por la experiencia del **huracán Hugo** (1989) me fascinó saber de los huracanes. Estudié Física en el Colegio de Mayagüez y cuando me gradué me mudé a Washington D.C.", dijo.

g) Initiatives to involve students in research and creative work projects. <u>Three</u>

1. Student-Driven Internship Opportunities in the Atmospheric Sciences: Breaking Barriers to Diversity, Inclusion, and Equal Access – **Dr. Héctor Jiménez**

2. NANOGrav at UPRM: Growing and characterizing the NANOGrav gravitational-wave detector – **Henri Radovan, PhD**

3. **"Laboratorio de Comunicación Científica" between NotiCentro -WAPA TV and Meteorology Program"** – Jomar López Molina, an Atmospheric Sciences and Meteorology's Curricular Sequence student participated as intern in WAPA TV during Spring Semester 2023-2024.

h) Number of research collaboration agreements and brief description (purpose, validity period, and agency name). **FOUR (4)**

- **"Laboratorio de Comunicación Científica" between NotiCentro -WAPA TV and Meteorology Program" since August 2021.**

  This collaboration allows that our Meteorology and Atmospheric Sciences students can have the experience of being TV communicators and can help to strengthen the UPRM Meteorology program.

- **"High Luminosity (HL) LHC CMS Detector Upgrade Project FPIX: Mechanics & Assembly**" (approved, continuing award - 1 September 2018 to 31 August 2023)
  Principal Investigator: **Sudhir Malik** Funding Sponsor – NSF
  (Subaward via Cornell University Award Number: NSF PHY-1946735)
  Period of funding – 1 April 2020 to 31 March 2026

- **NANOGrav** collaboration between Physics Department with the North American Nanohertz Observatory for Gravitational Waves (NANOGrav) Physics Frontiers Center.

  This partnership looks to advance several key NANOGrav science goals and to increase the participation and retention of minorities in the field of physics. Undergraduate students from UPRM will be involved in research projects of relevance to NANOGrav's mission, mentored at UPRM as well as remotely and onsite at several NANOGrav institutions.

- **Institute for Research and Innovation in Software for High Energy Physics** (IRIS-HEP) - **(Dr. Sudhir Malik**)
  Collaborative Agreements with Princeton University
  09/01/2018 – 08/31/2023

i) Most relevant publications and presentations.

SCIENTIFIC PUBLICATIONS:

As an active member of the **NANOGrav** collaboration, **Dr. Henri Radovan** has published the following articles in the field of astronomy:

- Agazie, J. Antoniadis, A. Anumarlapudi et al., **"Comparing Recent Pulsar Timing Array Results on the Nanohertz Stochastic Gravitational-wave Background"**, The Astrophysical Journal 966, 105 (May 2024).

- Agazie, A. Anumarlapudi, A.M. Archibald et al., "**The NANOGrav 15 yr Data Set: Search for Transverse Polarization Modes in the Gravitational-wave Background"**, The Astrophysical Journal Letters 964, L14 (March 2024).

- Agazie, Z. Arzoumanian, P.T. Baker et al., **"The NANOGrav 12.5 yr Data Set: A Computationally Efficient Eccentric Binary Search Pipeline and Constraints on an Eccentric Supermassive Binary Candidate in 3C 66B"**, The Astrophysical Journal 963, 144 (March 2024).

- B. Bécsy, N.J. Cornish, P.M. Meyers et al., **"How to Detect an Astrophysical Nanohertz Gravitational Wave Background"**, The Astrophysical Journal 959, 9 (December 2023).

- G. Agazie, A. Anumarlapudi, A.M. Archibald et al., **"The NANOGrav 15 yr Data Set: Search for Anisotropy in the Gravitational-wave Background"**, The Astrophysical Journal Letters 956, L3 (October 2023).

- G. Agazie, A. Anumarlapudi, A.M. Archibald et al., **"The NANOGrav 15yr Data Set: Constraints on Supermassive Black Hole Binaries from the Gravitational-wave Background"**, The Astrophysical Journal Letters 952, L37 (August 2023).

Dr. Mark Jury has published and has under review the following scientific articles in the field of **Meteorology**:

- Jury, M.R. 2024, **"Environmental sensitivity of Caribbean economic growth rate"**, Advances Statistical Climatology Meteorology Ocean, (in review).

- Jury, M.R. 2024, "**Rising dewpoint temperature and mosquito-borne virus transmission in the Caribbean"**, Weather Climate Society AMS, (in review).

- Jury, M.R. 2024, "**A survey of African weather and climate extremes"**, Climate MDPI, (accepted)

- Jury, M.R., 2024, "**Environmental conditions affecting air pollution dispersion over Richards Bay South Africa"**, Clean Air J., (accepted)

- Jury, M.R. 2024 "**Inter-America Hadley circulation and boreal summer Climate"**, Theor. Applied Climatol., (in review)

- Jury, M.R. 2024 "**Structure, modulation and impacts of southeastern Africa's diurnal convection"**, Theor. Applied Climatol., doi.org/10.1007/s00704-024-04885-y

- Jury, M.R. 2024 "**Regional controls on climate and weather variability on the southwest coast of Peru"**, Coasts MDPI, 4, 49-62; doi.org/10.3390/coasts4010004

- Jury, M.R. "**Subsidence and evaporation in South African dry spells"**, SA Geogr. J., (in review)

- Jury, M.R. "**Wind vorticity and upwelling on the coast of South Africa"**, Coasts MDPI (in review)

- Jury, M.R. & Alfaro-Garcia, L. 2024 "**Peru north coast climate variability and regional ocean-atmosphere forcing"**, Coasts MDPI (in review)

- Govender, Y & Jury, M.R. 2024 "**Environmental controls on bioluminescent dinoflagellate density in Laguna Grande"**, Fajardo Puerto Rico, (in review)

- Jury, M.R., 2024. "**Topographically channeled ocean-atmosphere coupling in the southern Caribbean and summer climate variability"**, Climate Research, doi.org/10.3354/cr01733

- Jury, M.R., 2024. "**Meteorology of 'ridging high' rainfall over the KwaZulu-Natal coastal plains**, Intl J. Climatol., doi.org/10.1002/joc.8277.

- Alaminie, A.A., Giriraj, A., Padhee, S.-K., Ghosh, S., Tilahun, S., Mekonnen, M., Assefa, G., Seid, A., Atanaw, F., Jury, M.R. 2023. "**Nested hydrological modeling for flood prediction using CMIP6 inputs around Lake Tana, Ethiopia"**, J. Hydrology Reg. S. 46, 101343 doi.org/10.1016/j.ejrh.2023.101343

- Jury, M.R. 2023. "**Identifying the drivers of Caribbean severe weather Impacts"**, Remote Sensing MDPI, 15, 5282, doi.org/10.3390/rs15225282

- Jury, M.R., 2023. "**A statistical analysis of tropical salinity and its relationship to SST, highlighting two contrasting areas"**, Dynam. Atmos. Oceans, 103, 101384, doi.org/10.1016/j.dynatmoce.2023.101384

- Jury, M.R., 2023. "**Winter climate of the northeastern Dominican Republic and cash crop production"**, Climate MDPI, 11, 161; doi.org/10.3390/cli11080161

- Jury, M.R., 2023. "**Modulation of the marine environment in the Natal Bight"**, MDPI Remote Sensing, 15, 1434, doi.org/10.3390/rs15051434

- Jury, M.R., 2023. "**Atmosphere-ocean processes governing inflow to the northern Caribbean Sea"**, J. Marine Science Eng., 11, 718, doi org/10.3390/jmse11040718.

- Jury, M.R., 2023. "**Spring-time SW cloud bands in the central Caribbean"**, J. Applied Meteorol. Climatol., 62, 251-262, doi.org/10.1175/JAMC-D-22-0126.1

- Jury, M.R. 2023. "**Turkana low-level jet influence on southwest Ethiopia Climate"**, J. Hydro-Meteorol., 24, 585-599, doi.org/10.1175/JHM-D-22-0134.1

Dr. Silvana Urcia has contributed on the following publications on her work on **Material Science**:

- **"Skyrmionium dynamics on a racetrack in the presence of a magnetic defect"**
  Journal of Applied Physics 2024-04-28 | Journal article
  DOI:10.1063/5.0207827
  CONTRIBUTORS: H. Vigo-Cotrina; S. Navarro-Vilca; S. Urcia-Romero

- **"Magnetic interactions in vortex-state nanodisk arrays characterized by gradient magnetic vortex echo"**
  Journal of Applied Physics 2024-02-28 | Journal article
  DOI:10.1063/5.0194332
  CONTRIBUTORS: H. Vigo-Cotrina; S. Urcia-Romero; A. P. Guimarães

- **"Influence of dimension and magnetic interaction on annihilation and nucleation fields of permalloy nanodisks using micromagnetic simulations"**
  Momento Revista de Física
  No. 68, Ene - Jun 2024 DOI: https://doi.org/10.15446/mo.n68.110938
  CONTRIBUTORS: S. Urcia-Romero; H. Vigo-Cotrina; S. Jauregui-Rosa

Dr. Sudhir Malik has contributed on the following publications on his work on **High Energy Physics**:

- **Search for new physics in high-mass diphoton events from proton-proton collisions at Search for new physics in high-mass diphoton events from proton-proton collisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al. e-Print: 2405.09320 [hep-ex]

- **Search for production of a single vector-like quark decaying to tH or tZ in the all-hadronic final state in pp collisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al. e-Print: 2405.05071 [hep-ex]

- **Girth and groomed radius of jets recoiling against isolated photons in lead-lead and proton-proton collisions at $\sqrt{s_{NN}}$ = 5.02 TeV** CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al. e-Print: 2405.02737 [nucl-ex]

- **Search for new resonances decaying to pairs of merged diphotons in proton-proton collisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al. e-Print: 2405.00834 [hep-ex]

- **Search for the Z boson decay to $\tau\tau\mu\mu$ in proton-proton collisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al. e-Print: 2404.18298 [hep-ex]

- **Performance of CMS muon reconstruction from proton-proton to heavy ion collisions**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al. e-Print: 2404.17377 [hep-ex]

- **Measurement of multijet azimuthal correlations and determination of the strong coupling in proton-proton collisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al. e-Print: 2404.16082 [hep-ex]

- **Search for Higgs Boson Pair Production with One Associated Vector Boson in Proton-Proton Collisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al. e-Print: 2404.08462 [hep-ex]

- **Beam Test Performance Studies of CMS Phase-2 Outer Tracker Module Prototypes** CMS Tracker Group • W. Adam (Vienna, OAW) et al. e-Print: 2404.08794 [physics.ins-det]

- **The CMS Statistical Analysis and Combination Tool: COMBINE**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al.e-Print: 2404.06614 [physics.data-an]

- **Measurement of Differential ZZ+Jets Production Cross Sections in pp Collisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al. e-Print: 2404.02711 [hep-ex]

- **Searches for Pair-Produced Multijet Resonances using Data Scouting in Proton-Proton Collisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al. e-Print: 2404.02992 [hep-ex]

- **Search for ZZ and ZH Production in the $\mathrm{b\bar{b}b\bar{b}}$ Final State using Proton-Proton Collisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al. e-Print: 2403.20241 [hep-ex]

- **Measurement of the Production Cross Section of a Higgs Boson with Large Transverse Momentum in Its Decays to a Pair of τ Leptons in Proton-Proton Collisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al. e-Print: 2403.20201 [hep-ex]

- **Searches for Higgs Boson Production through Decays of Heavy Resonances**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al.e-Print: 2403.16926 [hep-ex]

- **Enriching the Physics Program of the CMS Experiment via Data Scouting and Data Parking**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al. e-Print: 2403.16134 [hep-ex]

- **Performance of the CMS electromagnetic calorimeter in pp collisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al. e-Print: 2403.15518 [physics.ins-det]

- **Observation of the $J/\psi \to \mu^+\mu^-\mu^+\mu^-$ decay in proton-proton collisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al. e-Print: 2403.11352 [hep-ex]

- **Search for the decay of the Higgs boson to a pair of light pseudoscalar bosons in the final state with four bottom quarks in proton-proton collisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al. e-Print: 2403.10341 [hep-ex]

- **Search for Higgs boson pair production in the bbWW decay mode in proton-protoncollisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al.e-Print: 2403.09430 [hep-ex]

- **Search for soft unclustered energy patterns in proton-proton collisions at 13 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al.e-Print: 2403.05311 [hep-ex]

- **Search for long-lived heavy neutrinos in the decays of B mesons produced in proton-proton collisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al.e-Print: 2403.04584 [hep-ex]

- **Search for new physics with emerging jets in proton-proton collisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al.e-Print: 2403.01556 [hep-ex]

- **Review of top quark mass measurements in CMS**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al.e-Print: 2403.01313 [hep-ex]

- **Constraints on anomalous Higgs boson couplings from its production and decay usingthe WW channel in proton-proton collisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al.e-Print: 2403.00657 [hep-ex]

- **Search for heavy neutral leptons in final states with electrons, muons, and hadronically decaying tau leptons in proton-proton collisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration •Aram Hayrapetyan (Yerevan Phys. Inst.) et al. e-Print: 2403.00100 [hep-ex]

- **Search for baryon number violation in top quark production and decay using proton-proton collisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al.e-Print: 2402.18461 [hep-ex]

- **Search for long-lived heavy neutral leptons decaying in the CMS muon detectors in proton-proton collisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al. e-Print: 2402.18658 [hep-ex]

- **Observation of the $\Xi_b^- \to \psi(2S)\Xi^-$ decay and studies of the $\Xi_\mathrm{b}^{\ast{}0}$ baryon in proton-proton collisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al. e-Print: 2402.17738 [hep-ex]

- **Search for long-lived particles using displaced vertices and missing transverse momentum in proton-proton collisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al.e-Print: 2402.15804 [hep-ex]

- **Portable acceleration of CMS computing workflows with coprocessors as a service**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al. e-Print: 2402.15366 [physics.ins-det]

- **Search for long-lived particles decaying to final states with a pair of muons in proton-proton collisions at $\sqrt{s}$ = 13.6 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al.e-Print: 2402.14491 [hep-ex]

- **Measurement of energy correlators inside jets and determination of the strong coupling $\alpha_S(m_Z)$**. CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al.e-Print: 2402.13864 [hep-ex]

- **A search for bottom-type vector-like quark pair production in dileptonic and fully hadronic final states in proton-proton collisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al.e-Print: 2402.13808 [hep-ex]

- **Search for exotic decays of the Higgs boson to a pair of pseudoscalars in the $\mu\mu$bb and $\tau\tau$ final states,** CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al. e-Print: 2402.13358 [hep-ex], DOI: 10.1140/epjc/s10052-024-12727-4, Published in: Eur.Phys.J.C 84 (2024) 5, 493, Eur.Phys.J.C 84 (2024), 493

- **Search for a scalar or pseudoscalar dilepton resonance produced in association with a massive vector boson or top quark-antiquark pair in multilepton events at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Armen Tumasyan (Yerevan Phys. Inst.) et al.e-Print: 2402.11098 [hep-ex]

- **Search for fractionally charged particles in proton-proton collisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al.e-Print: 2402.09932 [hep-ex]

- **Search for pair production of scalar and vector leptoquarks decaying to muons andbottom quarks in proton-proton collisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Aram Hayrapetyan (YerevanPhys. Inst.) et al.e-Print: 2402.08668 [hep-ex]

- **Combined search for electroweak production of winos, binos, higgsinos, and sleptons in proton-proton collisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al.e-Print: 2402.01888 [hep-ex]

- **Search for long-lived particles decaying in the CMS muon detectors in proton-protoncollisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al.e-Print: 2402.01898 [hep-ex]

- **Observation of the $\Lambda_b^0 \to J/\psi \Xi^- K^+$ decay**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al.e-Print: 2401.16303 [hep-ex]

- **Nonresonant central exclusive production of charged-hadron pairs in proton-protoncollisions at $\sqrt{s}$ = 13 TeV**, TOTEM and CMS Collaborations • Aram Hayrapetyan (Yerevan Phys. Inst.) et al.e-Print: 2401.14494 [hep-ex]

- **Measurement of the double-differential inclusive jet cross section in proton-proton collisions at $\sqrt{s}$ = 5.02 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al.e-Print: 2401.11355 [hep-ex]

- **Train to Sustain**, Sudhir Malik (Puerto Rico U., Mayaguez), Kilian Lieret (Princeton U.), Peter Elmer (Princeton U.),Michel Hernandez Villanueva (DESY), Stefan Roiser (CERN), DOI: 10.1051/epjconf/202429505023, Published in: EPJ Web Conf. 295 (2024), 05023

- **Software Training Outreach In HEP**, Sudhir Malik, Danelix Cordero, Peter Elmer, Adam LaMee, Ken CecireDOI: 10.1051/epjconf/202429508018, Published in: EPJ Web Conf. 295 (2024), 08018

- **Search for Long-Lived Heavy Neutral Leptons with Lepton Flavour Conserving or Violating Decays to a Jet and a Charged Lepton**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al.e-Print: 2312.07484 [hep-ex], DOI: 10.1007/JHEP03(2024)105, Published in: JHEP 03 (2024), 10

- **Search for flavor changing neutral current interactions of the top quark in final states with a photon and additional jets in proton-proton collisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al.e-Print: 2312.08229 [hep-ex], DOI: 10.1103/PhysRevD.109.072004 (publication)Published in: Phys.Rev.D 109 (2024) 7, 072004

- **Search for the Lepton Flavor Violating $\tau \to 3\mu$ Decay in Proton-Proton Collisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al. e-Print: 2312.02371 [hep-ex], DOI: 10.1016/j.physletb.2024.138633 (publication) Published in: Phys.Lett.B 853 (2024), 138633

- **Higher-order moments of the elliptic flow distribution in PbPb collisions at $\sqrt{s_{NN}}$ = 5.02 TeV**, CMS Collaboration • Armen Tumasyan (Yerevan Phys. Inst.) et al.e-Print: 2311.11370 [nucl-ex], DOI: 10.1007/JHEP02(2024)106, Published in: JHEP 2024 (2024) 02, 106

- **Search for new Higgs bosons via same-sign top quark pair production in association with a jet in proton-proton collisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al.e-Print: 2311.03261 [hep-ex], DOI: 10.1016/j.physletb.2024.138478 (publication) Published in: Phys.Lett.B 850 (2024), 138478

- **Search for an exotic decay of the Higgs boson into a Z boson and a pseudoscalar particle in proton-proton collisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al.e-Print: 2311.00130 [hep-ex], DOI: 10.1016/j.physletb.2024.138582 (publication) Published in: Phys.Lett.B 852 (2024), 138582

- **Observation of WWγ production and search for Hγ production in proton-proton collisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al. e-Print: 2310.05164 [hep-ex], DOI: 10.1103/PhysRevLett.132.121901 (publication)Published in: Phys.Rev.Lett. 132 (2024) 12, 121901

- **Muon identification using multivariate techniques in the CMS experiment in proton-proton collisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al.e-Print: 2310.03844 [hep-ex], DOI: 10.1088/1748-0221/19/02/P02031 Published in: JINST 19 (2024) 02, P02031

- **Study of azimuthal anisotropy of $\Upsilon(1S)$ mesons in pPb collisions at $\sqrt{s_{NN}}$ = 8.16 TeV**, CMS Collaboration • Armen Tumasyan (Yerevan Phys. Inst.) et al.e-Print: 2310.03233 [hep-ex], DOI: 10.1016/j.physletb.2024.138518 (publication) Published in: Phys.Lett.B 850 (2024), 138518

- **Search for supersymmetry in final states with disappearing tracks in proton-proton collisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al. e-Print: 2309.16823 [hep-ex], DOI: 10.1103/PhysRevD.109.072007 (publication) Published in: Phys.Rev.D 109 (2024) 7, 072007

- **Measurement of the τ lepton polarization in Z boson decays in proton-proton collisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al.e-Print: 2309.12408 [hep-ex], DOI: 10.1007/JHEP01(2024)101, Published in: JHEP 01 (2024), 101

- Evidence for the Higgs Boson Decay to a Z Boson and a Photon at the LHC, ATLAS and CMS Collaborations • Georges Aad (Marseille, CPPM) et al.e-Print: 2309.03501 [hep-ex], DOI: 10.1103/PhysRevLett.132.021803 (publication) Published in: Phys.Rev.Lett. 132 (2024) 2, 021803

- Luminosity determination using Z boson production at the CMS experiment, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al. e-Print: 2309.01008 [hep-ex], DOI: 10.1140/epjc/s10052-023-12268-2, Published in: Eur.Phys.J.C 84 (2024) 1, 26

- **Search for Scalar Leptoquarks Produced via τ-Lepton–Quark Scattering in pp Collisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al. e-Print: 2308.06143 [hep-ex], DOI: 10.1103/PhysRevLett.132.061801 (publication)Published in: Phys.Rev.Lett. 132 (2024) 6, 061801

- **Measurement of the production cross section for a W boson in association with a charm quark in proton–proton collisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Armen Tumasyan (Yerevan Phys. Inst.) et al.e-Print: 2308.02285 [hep-ex], DOI: 10.1140/epjc/s10052-023-12258-4 (publication) Published in: Eur.Phys.J.C 84 (2024), 27

- **Measurement of the Higgs boson production via vector boson fusion and its decay into bottom quarks in proton-proton collisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al. e-Print: 2308.01253 [hep-ex], DOI: 10.1007/JHEP01(2024)173 (publication)Published in: JHEP 01 (2024), 173

- **Study of charm hadronization with prompt Λ_c^+ baryons in proton-proton and lead-lead collisions at $\sqrt{s_{NN}}$ = 5.02 TeV**, CMS Collaboration • Armen Tumasyan (Yerevan Phys. Inst.) et al. e-Print: 2307.11186 [nucl-ex], DOI: 10.1007/JHEP01(2024)128 (publication)Published in: JHEP 01 (2024), 128

- **Two-particle Bose-Einstein correlations and their Lévy parameters in PbPb collisions at $\sqrt{s_{NN}}$ = 5.02 TeV**, CMS Collaboration • Armen Tumasyan (Yerevan Phys. Inst.) et al. e-Print: 2306.11574 [nucl-ex], DOI: 10.1103/PhysRevC.109.024914 (publication)Published in: Phys.Rev.C 109 (2024) 2, 024914

- **New Structures in the J/ψJ/ψ Mass Spectrum in Proton-Proton Collisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al.e-Print: 2306.07164 [hep-ex], DOI: 10.1103/PhysRevLett.132.111901 (publication)Published in: Phys.Rev.Lett. 132 (2024) 11, 111901

- **Search for Inelastic Dark Matter in Events with Two Displaced Muons and MissingTransverse Momentum in Proton-Proton Collisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al. e-Print: 2305.11649 [hep-ex],DOI: 10.1103/PhysRevLett.132.041802 (publication) Published in: Phys.Rev.Lett. 132 (2024) 4, 041802

- **Search for dark matter particles in W^+W^- events with transverse momentum imbalance in proton-proton collisions at $\sqrt{s}$ = 13 TeV**, CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al.e-Print: 2310.12229 [hep-ex], DOI: 10.1007/JHEP03(2024)134, Published in: JHEP 03 (2024), 134, JHEP 03 (2024), 134

- **Measurements of azimuthal anisotropy of nonprompt D^0 mesons in PbPb collisions at $\sqrt{s_{NN}}$ = 5.02 TeV**, CMS Collaboration • Armen Tumasyan (Yerevan Phys. Inst.) et al. e-Print: 2212.01636 [nucl-ex], DOI: 10.1016/j.physletb.2023.138389 (publication)Published in: Phys.Lett.B 850 (2024), 138389

Dr. Armando Rua has contributed on the following publications on his work on **Solid State Physics**:

- Shimul Kanti Nath, Sujan Kumar Das, Sanjoy Kumar Nandi, Chen Xi, Camilo Verbel Marquez, Armando Rúa, Mutsunori Uenuma, Zhongrui Wang, Songqing Zhang, Rui-Jie Zhu, Jason Eshraghian, Xiao Sun, Teng Lu, Yue Bian, Nitu Syed, Wenwu Pan, Han Wang, Wen Lei, Lan Fu, Lorezo Faraone, Yun Liu, and Robert Glen Elliman. ***Optically Tunable Electrical Oscillation in Oxide-based Memristors for Neuromorphic Computing***, Advanced Materials (2024) doi.org/10.1002/adma.202400904

- Akhil Bonagiri, Sujan Kumar Das, Camilo Verbel Marquez, Armando Rúa, Etienne Puyoo, Shimul Kanti Nath, David Albertini, Nicolas Baboux, Mutsunori Uenuma, Robert Glen Elliman, and Sanjoy Kumar Nandi. ***Biorealistic Neuronal Temperature-Sensitive Dynamics within Threshold Switching Memristors: Toward Neuromorphic Thermosensation*****,** ACS Applied Materials and Interfaces, (2024) https://pubs.acs.org/doi/10.1021/acsami.4c03803

- **Dynamics of Leaky Integrate-and-Fire Neurons Based on Oxyvanite Memristors for Spiking Neural Networks.**
  Sujan Kumar Das, Sanjoy Kumar Nandi, Camilo Verbel Marquez, Armando Rúa, Mutsunori Uenuma, Shimul Kanti Nath, Shuo Zhang, Chun-Ho Lin, Dewei Chu, Tom Ratcliff, Robert Glen Elliman Advanced Intelligent Systems, (2024) doi.org/10.1002/aisy.202400191

Talks and Poster Presentations by faculty members

- Intermag 2024- IEEE International Magnetic Conference
  May 5 - 10, 2024 Rio de Janeiro, Brazil
  Skyrmionium dynamics on a racetrack in the presence of a magnetic defect
  Vigo-Cotrina; S. Navarro-Vilca; **S. Urcia-Romero**

- Invited talk at the 5th International Conference on Materials Science and Engineering, San Francisco, CA, June 10 – 12, 2024. **Yong-Jihn Kim**

- **"Physical Vapor Deposition of Random Arrays of Ag Nanoparticles: Sensing Applications and Beyond"**, **Francisco Bezares**, UPR-Cayey Physics Symposium, Cayey, PR, March 8, 2024.

- **"Software Training as an enabler of community engagement and broader impacts"**, DPF-Pheno Conference (12-17 May 2024), **Sudhir Malik**

- **"Panel discussion: Snowmass recommendations on community",** DPF-Pheno Conference (12-17 May 2024), **Sudhir Malik**

- **"A Pilot Study of Methylidyne in the Galactic Center Region using the Arecibo 12-m Telescope"**, Seminario Interuniversitario de Investigación en Ciencias Matemáticas, UPR Humacao, March 1-2, 2024, **Allison Smith**

- **"CH 3.3 GHz observations of Rho Ophiuchus with the Arecibo 12-m Antenna"**, American Astronomical Society meeting (international), Madison, Wisconsin, June 9-13, 2024 (accepted), **Allison Smith**

- CARSE (UPRM) colloquium during "Radio Week", public lecture, **"A Pilot Study of Methylidyne in the Galactic Center Region using the Arecibo 12-m Radio Telescope"**, March 5, 2024, **Allison Smith**

j) Graduate assistantships for research and teaching (quantity and amount awarded).

Graduate teaching assistantships total $84,649.59 during the first semester of the academic year 2023-2024, and $88,100.03 during the second semester of the academic year 2023-2024.

k) Origin of graduate students (OPIMI).

During academic year 2023-2024, the Department of Physics had **23** graduate students on both semesters.

Physics	**Total**			**Year of study 1**			**2**		
	Total	**Femenine**	**Masculine**	**Total**	**Femenine**	**Masculine**	**Total**	**Femenine**	**Masculine**
1st semester	**23**	2	21	**4**	0	4	19	2	17
2nd semester	**23**	2	21	**4**	0	4	19	2	17

On average, the program of master's in physics had **8** students from Puerto Rico, **12** students from Colombia, **2** students from Ukraine, and **1** student from Perú.

G. To impact our Puerto Rican society

a. Participation in community initiatives (students, non-teaching staff, teaching staff)

On **October 14th 2023**, the Department of Physics with PR NASA Space Grant Program, organized the activity ***"Eclipse Solar Parcial 2023 – En familia"***. The Physics' student organizations': "Society of Physics Students" (SPS), "Sociedad Meteorológica de Puerto Rico" (SMPR) and "Students for the Exploration and Development of Space" (SEDS) and various projects from Engineering participated in the activity. As part of the activity, we had various talks, including one by Dr. Juan G. González Lagoa, UPRM Emeritus Professor and the "Sociedad de Astronomía del Caribe" brought some telescopes to watch the eclipse. We received students and persons from general community.


UNIVERSIDAD DE PUERTO RICO
RECINTO UNIVERSITARIO DE MAYAGÜEZ
VEN Y DISFRUTA DEL
ECLIPSE SOLAR PARCIAL
EN FAMILIA
¡CHARLAS, TELESCOPIOS, DEMOSTRACIONES, VENTAS Y MÁS!
SE REGALARÁN GAFAS, CANTIDADES LIMITADAS
SÁBADO 14/OCT/23
10:00AM-4:00PM
DEPARTAMENTO DE FÍSICA, UPRM
PERSONA CONTACTO:
DOLORES BALZAC
Outreach Specialist NASA PRSGC
dolores.balzac@upr.edu
787-832-4040 Ext. 3763, 37

On **December 7th, 2023**, our Physics' students participated in **"UPR EXPO 2023" in Ponce, PR.** SPS and SMPR students offered a "Show of Physics and Meteorology" as UPRM representation in the activity.


ortugués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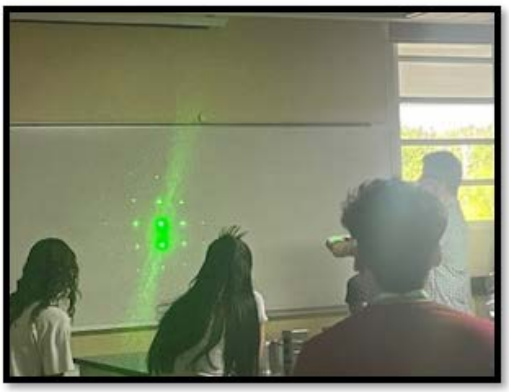
de Puer

e) Activities aimed at students and young people of school age

Arts & Sciences Summer Camp
June 25, 2024

For third consecutive year, the Department of Physics participated in Arts & Sciences Summer Camp: ***"Explora tu Vocación en las Artes y las Ciencias"*** that was held during June 24-28, 2024 in our Campus. Ninety-four (94) students participated in it. Prof. Samuel Santana participated in the panel with other professors from Biology, Industrial Biotechnology and Geology. Also, Professors, Dr. José R. López and Dr. Pablo Marrero offered some Physics demonstrations.




Física



I. **To strengthen school spirit, pride, and identity**

a. **Improvement in services offered to students**

The Department of Physics continues to offer free tutoring services for Physics courses by graduate students from the Department.

b. **Activities of student organizations**

Society of Physics Students UPRM Chapter

The UPRM SPS chapter had most of its activities on campus. We held general assemblies, game nights, study nights, special topics meetings, fundraising activities, and more. During this academic year our chapter was also working alongside the UPRM Women in Physics (WiP) student association. We united due to lack of people for board positions in both organizations. This allowed for members of SPS and WiP to attend all meetings organized by both groups. Most of the activities did not require the use of funds, however, for the Induction ceremony and the Physics Awards, we organized multiple fundraising events throughout the year.

The UPRM SPS chapter always tries to encourage their members to participate in all activities, especially those that are organized as social activities to help members fraternize among themselves. We also have an office space where members can go to study, individually or in groups, and also, lay back and socialize with other members. Our office space has 5 to 6 desks and chairs, 1 whiteboard, a varied selection of textbooks of physics, math, and other subjects, as well as a comfy couch and a snack bar.

Game nights are always a fun activity to do at the start of each semester as an icebreaker and catch up with members; "*trivias*" has become quite popular amongst our members this year! Members were also very interested in activities where they learnt how to prepare for REUs, grad school, and that sort of process; we held different activities on that topic. To know what our members were interested in this year, it helped using a *Google form* at the end of our first General Assembly where we asked them to suggest or request activities they would love to be involved in during the academic year.

Social Activities:

- **Game nights:** members were invited to participate and bring games, sing, dance, eat pizza and socialize with us
- **Study nights:** during exam weeks we did various nights of study sessions using the Pomodoro technique, during the breaks we would socialize or play games with each other's
- **Movie nights**: members were invited to bring friends, their own blankets and join us with some fresh popcorn to watch movies
- **Presentations night:** this activity was organized by our leader of the Inclusivity and Diversity committee, we created a safe space where members could talk or give brief 5-minutes presentations of their topic of interest
- **Planksgiving:** a Thanksgiving dinner organized by our board members to celebrate along with the faculty members of the Physics department as well as other physics department student organizations
- **Induction Ceremony & "*Parranda Navideña*":** we had our Induction Ceremony for new members on a Saturday night in December, along with a dinner; once the dinner was over we visited faculty member's houses with a *Parranda Navideña* (*Puertorrican* tradition to surprise visit people's houses during the Christmas time and sing Christmas songs together)
- **Physics Awards:** social activity at the end of the academic year to celebrate the end of a school year and our members achievements; it consisted of a ceremony, dinner, trivia, dancing, and singing.

Outreach Activities:

- UPRM Open House: physics demonstrations, info-session table about our SPS chapter
- School visits: performed physics demonstrations as requested by science teachers for high school students of various schools in the Mayagüez area

- Weather Fest: provided physics demonstrations with application to meteorology for an activity organized by the Physics Department AMS chapter where students from schools all over the country and general community visited to learn about careers, topics and more related to meteorology

Fundraising Activities:

- Pizza sales every two weeks at the Physics Department Lobby
- Brownies sales in collaboration with "The Brownie Alchemist" small local brownie and baked goods business
- Valentine's Day flowers and love letter sale
- Nacho sale
- T-shirt and stickers sale

WOMEN IN PHYSICS UPRM
ACADEMIC ACTIVITIES 2023-2024

Professional Activities:

1. On **Thursday, September 7, 2023**, Dr. Allison Smith offered the workshop: **"Graduate School"** in room F-329 to members of WiP-UPRM and the Physics Department.

2. On **Thursday, October 12, 2023**, Dr. Angela González-Mederos offered the **"Resume and Curriculum Vitae Workshop"** in room F-325 through the Zoom platform to WiP-UPRM members.

3. On **Thursday, November 16, 2023**, we organized the talk **"Male Toxicity"** with the student associations HERCampus and SiempreVivas UPRM. The talk was held in room F-329 and F-330. A discussion began on the causes of male toxicity and its impact on social and academic culture.

4. On **Thursday, March 14, 2024**, the "Women in Physics: Research & Discussion Panel" event was held at the F-C Amphitheater. It had the participation of two professional panelists: Adriana Córdova Ayuso, specialist in Medical Physics, and Dr. Yaireska Collado Vega, dedicated to the area of Astronomy and Astrophysics. In addition, two undergraduate students from the Physics Department participated: Andrea P. Hernández Díaz, focused on Plasma Physics, and Arianna B. Ginés Ocasio, student of Meteorology. During the event, each panelist had the opportunity to share their achievements and research throughout their careers.

Outreach activities:

1. On **Saturday, October 1, 2023**, WiP-UPRM participated as an exhibitor in the "Solar Eclipse" activity, carried out in the Physics Department. During the activity, physics demonstrations were performed and information sessions were offered to the public about the mission and vision of the association.

2. On **Friday, November 10, 2023**, WiP-UPRM participated as an exhibitor at the Open House 2023 of the University of Puerto Rico in Mayagüez. This event provide high school students with the opportunity to explore the academic offerings and research opportunities of each department. During the activity, WiP-UPRM held physics-related demonstrations and invited students to join WiP once they were accepted into the university.

3. On **Monday, February 5, 2024**, we visited the Carmen Vignals Rosario School in Cabo Rojo to carry out demonstrations aimed at students between 10 and 14 years old. The activity consisted of groups of students participating in a circuit of demonstrations, going through each one in a certain time. The topics addressed were: angular momentum, pressure and surface area, planetary sciences, and surface tension.

Recognitions and Competencies:

Women in Physics had the opportunity to participate in the ***APS Conference for Undergraduate Women in Physics (CUWiP)***, which consisted in three-day regional conferences for undergraduate students, generally focusing on research and opportunities in different areas within physics such as astronomy, meteorology, and medical physics. This year, the conference was held from **January 19 to 21, 2024** in South Carolina, specifically in Clemson. During the event, two of our members, Astrid Reyes and Caryelis Bayona, took first and second place respectively in the poster presentations. This achievement highlights the talent and dedication of our members, as well as the commitment of our student association to fostering academic and professional excellence.

Participation in Academic Activities:

1. On **Tuesday, March 5, 2024**, WiP participated in the Associations Fair. During the event, demonstrations and a lemonade sale were held, offering university students the opportunity to join our student association.

Fundraising Activities

The Women in Physics association also held a variety of sales in order to raise funds for the association. These were carried out during notable activities, among these are:

- Popcorn Sale at the Solar Eclipse Activity
- Sale of Brownies at the First Semester General Student Assembly
- Lemonade sale at the association fair in the second semester
- Sale of Flowers for Valentine's Day
- Pizza Sale at Weather Fest

Activities on social media accounts:

During the last academic year, the Women in Physics association has carried out a series of activities on its social media accounts with the aim of promoting various initiatives and recognizing the achievements of its members. Among the notable publications was the promotion of different social events and food sales, which allowed members and the student community to actively participate and support the cause. In addition, the individual successes of some members were mentioned, highlighting those who obtained summer internships and the winner of the WiP scholarship.

"Sociedad Meteorológica de Puerto Rico"
Student Chapter affiliated to American Meteorological Society (AMS)
UPR- Recinto Universitario de Mayagüez

Annual report
Academic Year 2023-2024

During this year, "Sociedad Meteorológica de Puerto Rico (SMPR) focused on expanding opportunities for professional growth and interaction with the university community and the general public. In September 2023 we participated with the "EcoExploratorio: Puerto Rico Science Museum" in its Hurricane Awareness Tour, where we had the opportunity to offer a talk to the community about the formation of tropical cyclones and warning products that they should have clear at the time of a cyclonic threat. In addition, we share demonstrations related to the topic with the public. In addition, in October we were collaborating with the SEDS, SPS, WiP associations and the NASA Space Grant PR group to carry out an observation activity of the Solar Eclipse, which took place on October 14, 2023. In this activity we had the opportunity to present atmospheric sciences to the general public through demonstrations. More specifically, as far as the university community is concerned, we were participating in the Open House of our institution in November 2023, where we had the opportunity to take our science to high school students. Continuing these efforts, on April 5, 2024, we were part of the Associations Fair of the Dean of Arts and Sciences, and in this we similarly had the opportunity to share information about our association and offer demonstrations to the university community.

Additionally, we received the Hurricane Hunter plane at the Aguadilla Airport at the invitation of meteorologist Ada Monzón, which allowed us to share with the public the importance of hurricanes through demonstrations. Our commitment to the community and the environment led us to carry out a cleanup on the Crash Boat beach in Aguadilla. Finally, in May, we held our summit activity, the Weather Fest, where more than 200 high school students received information about meteorology and other branches of science and engineering, as well as had the opportunity to participate in a Weather Briefing Challenge. In this activity we achieved the collaboration of associations from the Department of Physics as well as Geology and Engineering, the Office of Climatology, and entities such as Hurricane Info, “EcoExploratorio”, the Puerto Rico Seismic Network, among others.

With great enthusiasm and pride, we participated in the **Annual Meteorology Conference (AMS Annual Conference) in Baltimore, Maryland** in **January 2024**, in which, thanks to the sponsorship of the NASA Space Grant program in collaboration with meteorologist Ada Monzón and fundraising activities, we achieved the participation of 17 members. In this national activity, several of our members presented the research carried out in their past internships. We all had the opportunity to explore and learn about the diversity of careers in atmospheric sciences, as well as create valuable connections for our future. In addition, we received an honorary mention from the student chapters.

Our members’ dedication to the meteorology was key to their selection to participate in internship opportunities at entities such as:

● Stephanie M. Ortiz: “NOAA Geophysical Fluid Dynamics Laboratory” at Princeton University.
● Juan L. Colón Pérez: “National Hurricane Center” in Miami, Florida.
● Andrea N. Belvis Aquino: “Lamont-Doherty Summer Intern Program” at Columbia University in New York.
● Arianna B. Ginés Ocasio: “NCAR Earth System Science Internship” (NESSI) at the National Center for Atmospheric Research (NCAR) in Boulder, Colorado.
● Katiria Colón Rivera: “Student Training in Oceanography, Remote Sensing and Meteorology program” at the University of Wisconsin in Madison.
● Astrid K. Vera Torres: “Research Experience for Undergraduate Students in Climate and Society” from the University of South Florida.
● Jomar López: “International Research Experiences (IRES) program “Manifestations of Climate Change in Extreme Event, Social and Biological Systems” of Penn State University to be carried out in Peru.
● Other students are part of the “NSF Student Driven Opportunities”, opportunity led by Prof. Héctor Jiménez, who was in charge of guiding our members on the requirements to apply at the beginning of the academic year.

In addition, it is important to highlight that 4 of our members graduated this May 2024 from the Departments of Physics, Geology and Electrical Engineering and they are: Kevin Martinez Lopez (Geology), Juan L. Colón Pérez (Physics), Cherilyn Toro (Geology) and Maria C. Novoa (graduate student, Electrical Engineering).

Thanks

We would like to extend our gratitude to Prof. Hector Jiménez, the meteorologist Ada Monzón in collaboration with the NASA Space Grant program and the Ecoexploratorio: Museum of Sciences of Puerto Rico, Department of Physics and associations attached to the department for their collaboration with the Meteorological Society of Puerto Rich to make this academic year one full of opportunities and achievements for our organization.

c. Activities to promote links with alumni – N/A

d. Donations received from alumni – N/A

e. Collaboration agreements with government agencies, the private sector, and various entities (purpose, validity, and name of the agency)

- "Laboratorio de Comunicación Científica" between NotiCentro -WAPA TV and Meteorology Program" Since August 2021.

  This collaboration allows that our Meteorology and Atmospheric Sciences students can have the experience of being TV communicators and can help to strengthen the UPRM Meteorology program.

f. Activities aimed at the community in general

The department runs several community service programs, including those aimed at: Physics/Chemistry teachers (QuarkNet), visiting middle and high schools, outreach on optics, software for teachers and other related activities.

a) QuarkNet.

The mentors of the QuarkNet program at UPRM are **Dr. Héctor Méndez** and **Prof. Daniel Gutiérrez. M.S.**

QuarkNet is a national education program involving various national and international physics laboratories, and more than 60 universities across the United States, including the University of Puerto Rico in Mayaguez. The QuarkNet Center for PR was established in 2003 to provide training and academic support to high school physics/chemistry teachers, who in turn bring their educational experience into the classroom. During these 20 years of uninterrupted operation working with teachers and their students, we have found indescribable talent in the schools of Puerto Rico, many of whom have gone on to higher studies in physics, including masters and doctoral degrees.

The primary goal of the program is to provide teachers with a basic knowledge of particle physics and its interactions, with the main aim of integrating the study of high-energy physics into the high school curriculum and motivating their students to pursue careers in STEM subjects.

Laboratories participating in the program include the particle accelerators at Fermilab in Batavia, Ill. CERN in Geneva, Switzerland, BNL (Brookhaven National Lab) in uptown, New York, among others. Several of the teachers participating in the program have attended national workshops in Puerto Rico, as well as workshops and international schools in Switzerland, Greece, USA, etc. These experiences are not only extremely motivating, but also improve the quality of teaching in the classroom.

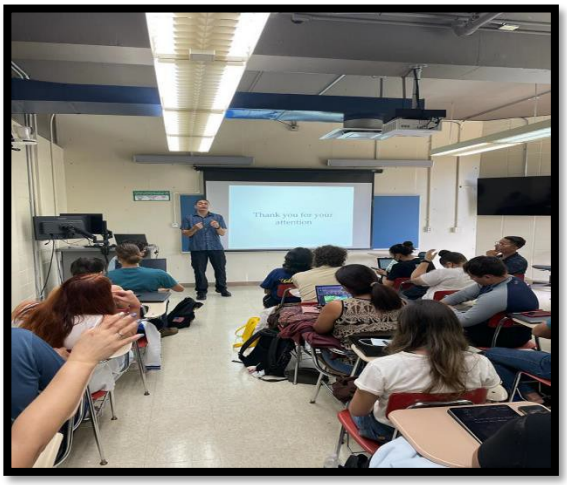
During the past 2023-2024 school year, QuarkNet engaged with teachers and students in the following activities:

- **Taller para Maestros de Física/Química** (D. Gutiérrez M.S.- H. Méndez Ph.D.)
  November 11, 2023 at Dept. of Physics (UPRM)
  https://quarknet.org/content/taller-de-f%C3%ADsica-de-neutrinos
  Presentaciones:
  1. **"Physics Overture"** (Héctor Méndez)
  2. **"QuarkNet Program"** (Héctor Méndez)
  3. **"Modelo Estándar de las Partículas Elementales"** (Daniel Gutiérrez)

Videoconference with scientists from Fermi National Laboratory Accelerator (Fermilab) and students from the University of Minnesota Duluth and UPRM were held to analyze and discuss the results of the MasterClass.

b) Visiting middle and high schools.

On **Monday, February 5, 2024**, the student association, Women in Physics (WiP) visited the Carmen Vignals Rosario School in Cabo Rojo to carry out demonstrations aimed at students between 10 and 14 years old. The activity consisted of groups of students participating in a circuit of demonstrations, going through each one in a certain time. The topics addressed were: angular momentum, pressure and surface area, planetary sciences, and surface tension.



- The TRIO Talent Search Program of ASPIRA of Puerto Rico with 30 students visited the campus on the 24th of March to get more information about some university programs like Physics. Dr. Héctor Méndez gave the presentation "El Departamento de Física de UPRM" where he explained the different possibilities to pursue a career in Physics at UPRM.

c) Outreach

Francisco Bezares, PhD - Outreach Activities

• Joshua Chaparro, school visit, March 2024, Añasco, Puerto Rico.

• Joshua Chaparro, school visit, April 2024 Cupey, Puerto Rico.

Other

• Undergraduate Student Joshua Chaparro accepted to the Applied Physics Graduate Program at Yale University, New Heaven, CT.

• Graduate Student Germán Vázquez successfully defended and published his thesis under the MS in Physics Program.

Software Training Workshops

- Software Training Outreach In HEP – Sudhir Malik et al - https://www.epjconferences.org/articles/epjconf/abs/2024/05/epjconf_chep2024_08018/epjconf_chep2 024_08018.html - EPJ Web of Conf., 295 (2024) 05023

- Train to Sustain – Sudhir Malik et al - https://www.epjconferences.org/articles/epjconf/abs/2024/05/epjconf_chep2024_05023/epjconf_chep2 024_05023.html - EPJ Web of Conf., 295 (2024) 05023

- A novel internship program in HEP – Sudhir Malik et al - https://doi.org/10.48550/arXiv.2401.16217

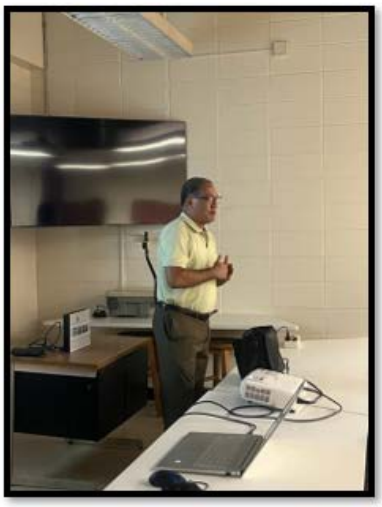
- Workshops Training on Analysis Pipelines - https://indico.cern.ch/event/1375507/

d. Activities aimed at the university community

"Cuadro de Honor (2022-2023) and 2024 Physics' Graduates Activity"
May 2, 2024 in Eugene Francis Room

2024 candidates for graduation

On August 4th, 2023, the Dept. of Physics received 18 freshmen students: 2 to Physical Sciences Program and 16 to the Physics Program. As part of the activities, SPS, WiP and SMPR offered demonstrations. Dr. Rafael Ramos and Dr. Héctor Méndez welcomed the new students. Dr. Erick Roura offered the talk: "*¿Cuánto vale estudiar Física?*"



Universidad de Puerto Rico
Recinto Universitario de Mayagüez
Facultad de Artes y Ciencias
Departamento de Física

Bienvenidos a
mc física
Colegio Mayagüez

AGENDA

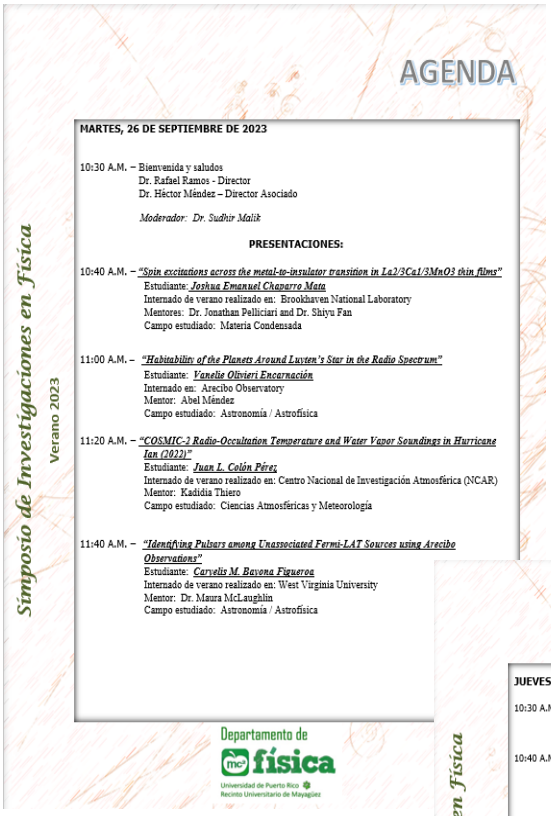
4 de agosto de 2023
Edificio de Física
F-317 B

Orientación Estudiantes de Nuevo Ingreso 2023

viernes, 4 de agosto de 2023	
Período:	Actividad:
8:30am – 8:40am	Bienvenida: Director – Rafael A. Ramos, Ph.D. Director Asociado – Héctor Méndez, Ph.D.
8:40am – 9:40am	Presentaciones: o *¿Cuánto vale estudiar Física?* – Erick Roura, Ph.D. o Programas del Departamento de Física: o *Ciencias Físicas (1207)* o *Física Teórica (1208)* o *Secuencia Curricular en Astronomía y Astrofísica (3222)* o *Secuencia Curricular en Ciencias Atmosféricas y Meteorología (3204)*
9:40am – 10:00am	Demostración "Tesla Coil" por Sr. Omar Vázquez, Técnico de Investigaciones Científicas del Depto. Física (*Lobby 2do piso - frente a oficina del Departamento de Física*) Receso
10:00 am – 11:00am	Asociaciones estudiantiles del Departamento de Física: • *Sociedad de Estudiantes de Física (SPS)* • *Sociedad Meteorológica de Puerto Rico (SMPR)* • *Students for the Exploration and Development of Space (SEDS)*
11:00am – 11:45am	Matrícula *Denisse A. Ramírez – Oficial de Orientación*
11:45am – 1:00pm	**Almuerzo**
1:00 pm – 4:30 pm	Ajustes de Matrícula Plataforma: **ajustes.uprm.edu / F-214**

Summer Research Symposium
September 24 and 26, 2023

Nine Physics' students offered a brief presentation about their research projects during Summer 2023.



AGENDA

Simposio de Investigaciones en Física
Verano 2023

MARTES, 26 DE SEPTIEMBRE DE 2023

10:30 A.M. – Bienvenida y saludos
Dr. Rafael Ramos - Director
Dr. Héctor Méndez – Director Asociado

Moderador: Dr. Sudhir Malik

PRESENTACIONES:

10:40 A.M. – *"Spin excitations across the metal-to-insulator transition in La2/3Ca1/3MnO3 thin films"*
Estudiante: *Joshua Emanuel Chaparro Mata*
Internado de verano realizado en: Brookhaven National Laboratory
Mentores: Dr. Jonathan Pelliciari and Dr. Shiyu Fan
Campo estudiado: Materia Condensada

11:00 A.M. – *"Habitability of the Planets Around Luyten's Star in the Radio Spectrum"*
Estudiante: *Vanelie Olivieri Encarnación*
Internado en: Arecibo Observatory
Mentor: Abel Méndez
Campo estudiado: Astronomía / Astrofísica

11:20 A.M. – *"COSMIC-2 Radio-Occultation Temperature and Water Vapor Soundings in Hurricane Ian (2022)"*
Estudiante: *Juan L. Colón Pérez*
Internado de verano realizado en: Centro Nacional de Investigación Atmosférica (NCAR)
Mentor: Kadidia Thiero
Campo estudiado: Ciencias Atmosféricas y Meteorología

11:40 A.M. – *"Identifying Pulsars among Unassociated Fermi-LAT Sources using Arecibo Observations"*
Estudiante: *Caryelis M. Bayona Figueroa*
Internado de verano realizado en: West Virginia University
Mentor: Dr. Maura McLaughlin
Campo estudiado: Astronomía / Astrofísica

Departamento de física
Universidad de Puerto Rico
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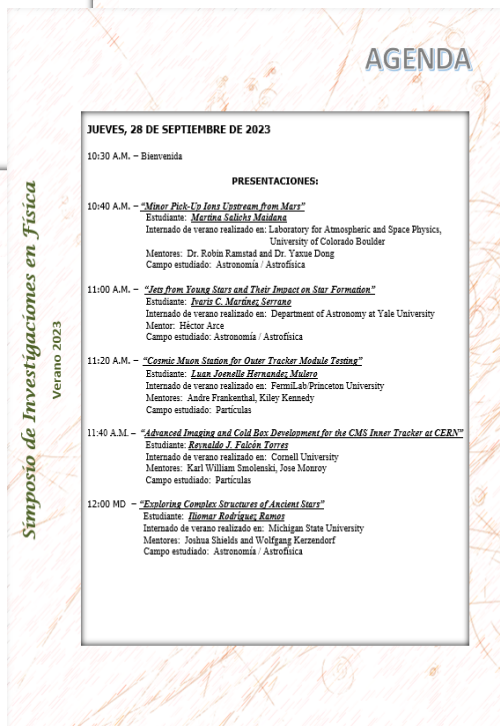


AGENDA

Simposio de Investigaciones en Física
Verano 2023

JUEVES, 28 DE SEPTIEMBRE DE 2023

10:30 A.M. – Bienvenida

PRESENTACIONES:

10:40 A.M. – *"Minor Pick-Up Ions Upstream from Mars"*
Estudiante: *Martina Salichy Maidana*
Internado de verano realizado en: Laboratory for Atmospheric and Space Physics, University of Colorado Boulder
Mentores: Dr. Robin Ramstad and Dr. Yaxue Dong
Campo estudiado: Astronomía / Astrofísica

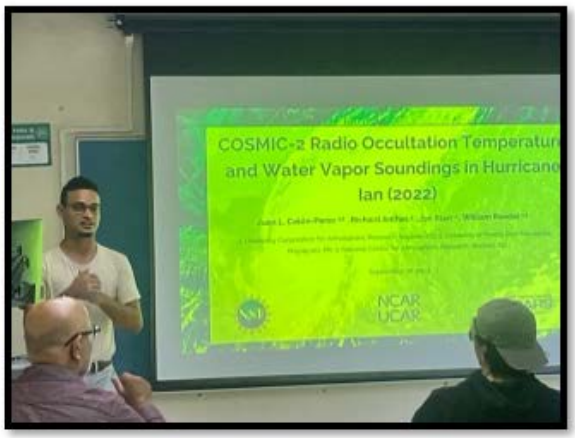
11:00 A.M. – *"Jets from Young Stars and Their Impact on Star Formation"*
Estudiante: *Ivaris C. Martínez Serrano*
Internado de verano realizado en: Department of Astronomy at Yale University
Mentor: Héctor Arce
Campo estudiado: Astronomía / Astrofísica

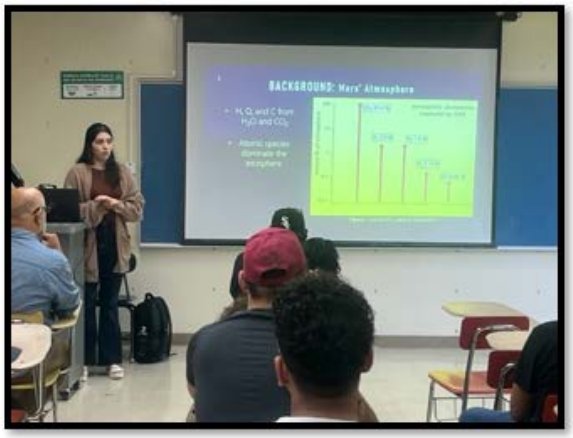
11:20 A.M. – *"Cosmic Muon Station for Outer Tracker Module Testing"*
Estudiante: *Luan Joenelle Hernandez Mulero*
Internado de verano realizado en: FermiLab/Princeton University
Mentores: Andre Frankenthal, Kiley Kennedy
Campo estudiado: Particulas

11:40 A.M. – *"Advanced Imaging and Cold Box Development for the CMS Inner Tracker at CERN"*
Estudiante: *Reynaldo J. Falcón Torres*
Internado de verano realizado en: Cornell University
Mentores: Karl William Smolenski, Jose Monroy
Campo estudiado: Particulas

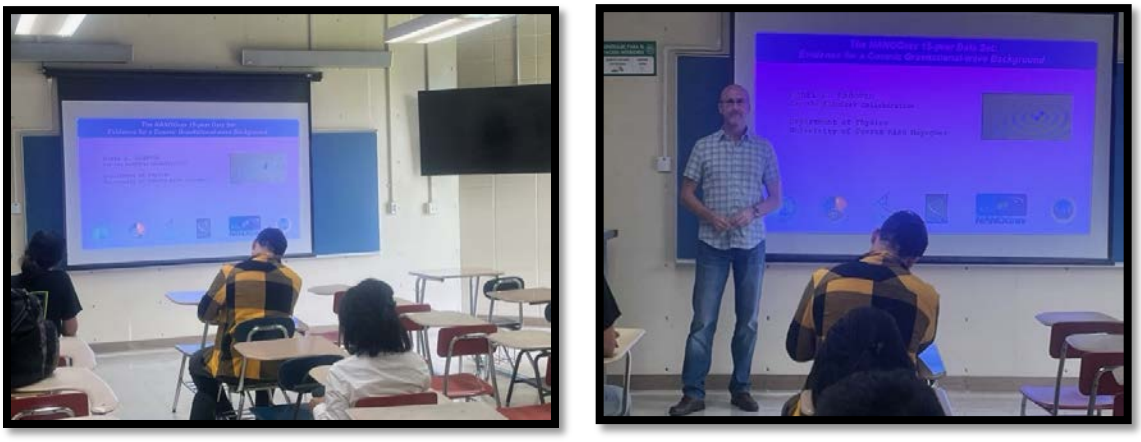
12:00 MD – *"Exploring Complex Structures of Ancient Stars"*
Estudiante: *Illomar Rodriguez Ramos*
Internado de verano realizado en: Michigan State University
Mentores: Joshua Shields and Wolfgang Kerzendorf
Campo estudiado: Astronomía / Astrofísica

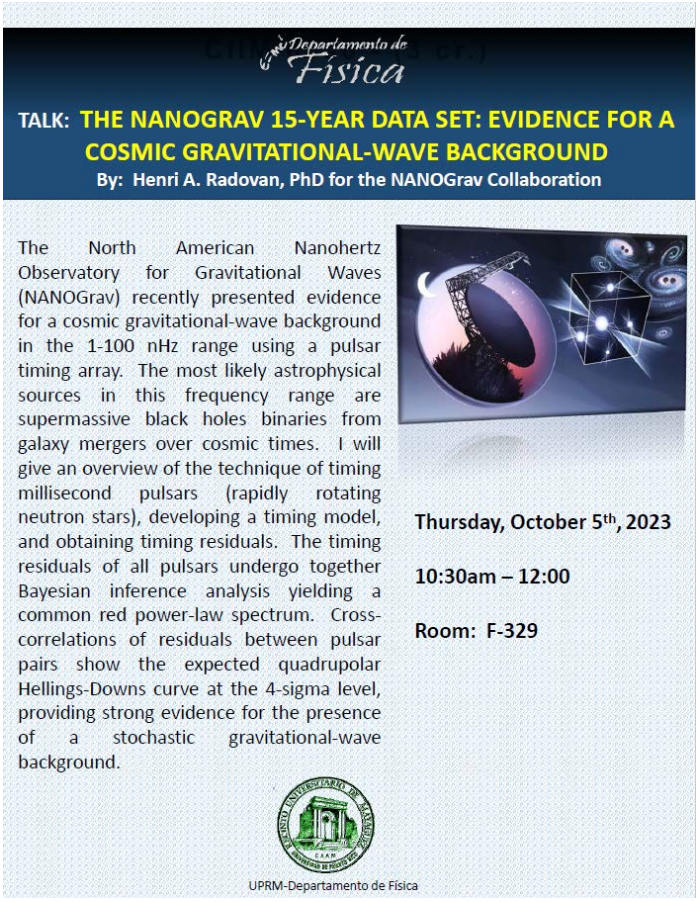

Spin excitations across the metal-to-insulator transition in


COSMIC-2 Radio Occultation Temperatur
and Water Vapor Soundings in Hurricane
Ian (2022)
NCAR
UCAR

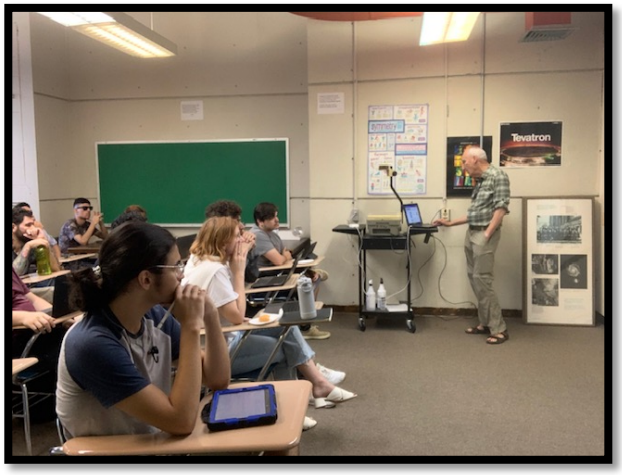

BACKGROUND: Mars' Atmosphere

On October 5th 2023, Dr. Henri Radovan offered the talk: **"The NanoGrav 15-year data set: Evidence for a Cosmic Gravitational-Wave Background"** in Room F-329.





On November 7, 2024, Dr. Michael Solkoloff, Professor of Physics at University of Cincinnati offered the talk: **"Machine Learning: Advances in developing deep neural networks for finding primary vertices in proton-proton collisions at the LHC"**. Also, Dr. Solkoloff gave two workshops to Physics and Engineering graduate students on Monday, November 6th and Wednesday, November 8th, 2023



2023 UPRM Open House – On November 10th, 2023, we had a promotional table with Department's information and Physics' demonstrations.

I. Improvements to infrastructure and buildings – N/A

J. Internacional activity

The Department has a large international component among its graduates, students and faculties. It also has three active and very productive international collaborations:

1) NANOGrav (North American Nanohertz Observatory for Gravitational Waves) is an international collaboration of astronomers and physicists dedicated to detecting and studying low-frequency gravitational waves using pulsar timing arrays,

2) DUNE (Deep Underground Neutrino Experiment) is a major international collaboration to study neutrinos (subatomic particles with very little mass and no electric charge). The experiment involves building a massive neutrino detector deep underground to reduce interference from other particles. DUNE will use a beam of neutrinos produced at Fermilab in Illinois, USA, and detect them 800 miles away at the Sanford Underground Research Facility in South Dakota, USA. The primary goals of the experiment are to study the properties of neutrinos, such as their oscillation behavior, and to potentially uncover new physics beyond the current understanding of particle physics.

3) CMS (Compact Muon Solenoid Detector) is a high energy proton-proton collisions experiment located at the LHC (Large Hadron Collider) at CERN (European Organization for Nuclear Research) in Switzerland. The primary goal of the CMS experiment is to explore the fundamental building blocks of matter and the forces that govern them, to study the properties of particles, to search for new particles, and to test theories such as the Standard Model of particle physics and beyond.

a) Number of international students in the department/faculty:

International	
Students:	**15**
Colombia	12
Ukraine	2
Perú	1

b) Number of international faculty in department/faculty

Faculty:	International
Tenure Track	8
Adjunct	3
Total	**11**

c) Publications with international co-authors

All the Department's publications from the international collaborations NANOgrav, DUNE and CMS have been included in point G (To strengthen research and competitive creative endeavors) above.

d) Projects and initiatives with international collaboration

- CMS collaboration
- Collaborations resulting in internships or exchanges

in other countries CMS collaboration.

Participation in international conferences, symposiums, forums, or seminars

Presentations by Sudhir Malik, PhD

- "Software Training as an enabler of community engagement and broader impacts", DPF-Pheno Conference (12-17 May 2024)
- Sudhir Malik – "Panel discussion: Snowmass recommendations on community," DPF-Pheno Conference (12-17 May 2024)

Link to both the above contributions is here with keyword "Malik": https://indico.cern.ch/event/1358339/timetable/?view=standard

Presentations by Francisco Bezares, PhD group

• "Physical Vapor Deposition of Random Arrays of Ag Nanoparticles: Sensing Applications and Beyond", Francisco Bezares, UPR-Cayey Physics Symposium, Cayey, PR, March 8, 2024.

• "Surface-enhanced Raman Scattering of Ag-Al Nanoparticles: Pushing the Boundaries of Plasmonic Applications", Joshua Chaparro, Simposio de Investigación de Estudiantes Subgraduados de Física 2024, UPR-Mayagüez, Mayagüez, Puerto Rico, April 16, 2024.

• "Surface-enhanced Raman Scattering of Ag-Al Nanoparticles: Pushing the Boundaries of Plasmonic Applications", Joshua Chaparro, ACS PRISM-JTM 2024, UPR-Aguadilla, Aguadilla, Puerto Rico, April 20, 2024.

Poster presentation by Silvana Urcia Romero, PhD

Intermag 2024- IEEE International Magnetic Conference
May 5 - 10, 2024 Rio de Janeiro, Brazil
Skyrmionium dynamics on a racetrack in the presence of a magnetic defect
H. Vigo-Cotrina; S. Navarro-Vilca; S. Urcia-Romero

Henri Radovan, PhD

- Organized NANOGrav student workshop on December 12-13, 2023 at UPRM with speaker from Florida Space Institute (FSI/UCF).

- Promoted to Full Member of the North American Nanohertz Observatory for Gravitational Waves (NANOGrav) Collaboration (September 2023).

Allison Smith, PhD

- Allison Smith, "A Pilot Study of Methylidyne in the Galactic Center Region using the Arecibo 12-m Telescope", Seminario Interuniversitario de Investigación en Ciencias Matemáticas, UPR Humacao, March 1-2, 2024

- Allison Smith, "CH 3.3 GHz observations of Rho Ophiuchus with the Arecibo 12-m Antenna", American Astronomical Society meeting (international), Madison, Wisconsin, June 9-13, 2024 (accepted)

- Allison Smith, CARSE (UPRM) colloquium during “Radio Week”, public lecture, “A Pilot Study of Methylidyne in the Galactic Center Region using the Arecibo 12-m Radio Telescope”, March 5, 2024

Yong Jhin Kim, PhD

- Invited talk at the 5th International Conference on Materials Science and Engineering, San Francisco, CA, June 10 – 12, 2024. Yong-Jihn Kim Microsoft Word - MAT PROGRAM (materials-meetings.com)

Study trips to other countries organized by the department/faculty - N/A

Courses with international collaborators – N/A