El Departamento de Física te invita al

Simposio de investigaciones de Física

Práctica COOP y Verano 2022

Ven y aprende sobre las distintas investigaciones y experiencias en las que estudiantes de nuestro Departamento formaron parte durante el verano y el semestre pasado.

jueves, 16 y martes, 21 de marzo de 2023

Hora: **10:30 am (Hora Universal)**

Salón: **F-229 (Salas Eugene Francis)**

Departamento de física

Universidad de Puerto Rico
Recinto Universitario de Mayagüez

AGENDA

Símposio de Investigaciones en Física

Práctica COOP y Verano 2022

JUEVES, 16 DE MARZO DE 2023

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

PRESENTACIONES:

10:40 A.M. – ***"Search of pair productions of a new heavy quark that decays into a W boson and a light quark in pp collisions at $\sqrt{s}$ = 8 TeV with the ATLAS detector"***
Estudiante: ***Yarelis D. Acevedo Rios***
Internado de verano realizado en: Oklahoma State University
Campo estudiado: Altas Energías

11:00 A.M. – ***"Dee Plaquettes Thermal Studies to Improve Manufacture"***
Estudiante: ***Tiahra Avilés González***
Internado en: Cornell University
Campo estudiado: Altas Energías

11:20 A.M. – ***"Chemical Vapor Deposition Synthesis of WS2 Monolayers and their Optical Characterization"***
Estudiante: ***Joshua Emanuel Chaparro Mata***
Internado de verano realizado en: Binghamton University - Smart Energy Building
Campo estudiado: Materiales

11:40 A.M. – ***"Exploring Diverse Horizons"***
UPRM Post Doc: Richa Sharma, PhD

AGENDA

Simposio de Investigaciones en Física

Práctica COOP y Verano 2022

MARTES, 21 DE MARZO DE 2023

10:30 A.M. – ***Bienvenida***

10:40 A.M. – ***"Comparing Chemistry of Small Molecules in Planet Forming Disks"***

Estudiante: ***Carlos Ortiz Quintana***
Internado de verano realizado en: Space Telescope Science Institute (STScI)
Campo estudiado: Astronomía / Astrofísica

11:00 A.M. – ***"Mitigating the effect of glitches on gravitational-wave parameter estimation using an inpainting filter"***
Estudiante: ***Viviana A. Cáceres Barbosa***
Internado de verano realizado en: California Institute of Technology
Campo estudiado: Astronomía / Astrofísica

11:20 A.M. – ***"Laboratorio de Comunicación de Meteorología de Noticentro por WAPA-TV"***
Estudiante: ***Cherilyn Toro Acosta***
Práctica COOP en: WAPA-TV
Campo estudiado: Ciencias Atmosféricas y Meteorología

11:40 A.M. – ***"Stimulated Raman Scattering for Scanning Technology"***
Estudiante: ***Rebeca Reyes Carrión***
Práctica COOP: MIT Lincoln Laboratory
Campo estudiado: Óptica

"Poster": ***"Insights on the star formation efficiency in the high-redshift Universe"***

Estudiante: ***Rebeca Reyes Carrión***
Internado realizado en: Cosmic Dawn Center, Denmark Technical University

12:00 PM – *"**Investigating the flux asymmetry of double-lobed radio sources"***
Estudiante: ***Caryelis Bayona Figueroa***
Internado de verano realizado en: University of Wisconsin-Madison
Campo estudiado: Astronomía / Astrofísica

12:20 PM – *"**Refinement of the Thermal Interface Material Deposition Routine for CMS's Inner Tracker"***
Estudiante: Reynaldo J. Falcón Torres
Internado realizado en: Cornell University
Campo estudiado: Altas Energías

Estudiante: ***Yarelis D. Acevedo Ríos***
Internado de Verano en: Oklahoma State University
Campo estudiado: Altas Energías

"Search of pair productions of a new heavy quark that decays into a W boson and a light quark in pp collisions at $\sqrt{s}$ = 8 TeV with the ATLAS detector"

The analysis on VLQ Wq + X is searching for pair production of a new heavy quark (Q) that decays into a W boson and a light quark (q) in the final state where one W boson decays leptonically (to an electron or muon plus a neutrino) and the other W boson decays hadronically. Using data collected by ATLAS detector we are looking for new Heavy Quarks (Q) that couple to light SM quarks and Large jets. The particles of interest are Leading Jet pT, Lepton pT, MET, $\Delta\phi$(Q, Q),ΔR(lep, ν), and ST.

Estudiante: ***Tiahra Avilés González***
Internado de Verano en: Cornell University
Campo estudiado: Altas Energías

"Dee Plaquettes Thermal Studies to Improve Manufacture"

As the Compound Muon Solenoid (CMS) Phase-2 Upgrade approximates, substantial changes need to be made for the utmost performance. A new silicon tracker will be built to attain the increased luminosity from the Large Hadron Collider (LHC). The inner tracker will be exposed to extreme conditions such as elevated levels of radiation and hit rate. Solutions are being built to allow a light design for a pixel detector that can sustain high radiation with proficient operation. This project is focused on the forward part of the tracker (TFPX), especially the Dee, which is composed of four rings of modules. The enhancement of the collision rate will make the silicon modules experience an increase in current leakage caused by radiation damage. In order to prevent the modules from generating an excessive amount of heat, leading to thermal runaway, testing the cooling system is of importance. A convenient way to begin this testing was to construct a sample version of the Dee called plaquettes to reproduce thermal results that the Dee could undertake. It was possible to reproduce the expected outcome of excessive heat generation due to dark currents on the modules leading to thermal runaway and compare different arrangements to optimize cooling and manufacture.

Estudiante: ***Joshua Emanuel Chaparro Mata***
Internado de Verano en: Binghamton University - Smart Energy Building
Campo estudiado: Materiales

"Chemical Vapor Deposition Synthesis of WS2 Monolayers and their Optical Characterization"

During these past decades, two-dimensional materials have been an intensive but essential field of physics research. Specifically, Tungsten disulfide (WS2), a two-dimensional semiconducting transition metal dichalcogenide, possesses superior optoelectronic properties that are advantageous for future devices. For example, it can be used as a photodetector or a hydrogen evolution reduction catalyst in batteries based on electrolysis to reduce the overpotential in acidic electrolytes. Throughout this summer research, we were able to synthesize WS2 monolayers, via chemical vapor deposition, and study their Raman scattering and photoluminescence (PL) spectra using a HORIBA LabRAM HR spectrometer. WS2 monolayers with lateral sizes of 20-150 μm were grown with strong PL peaks. It was observed that PL peak position varies for as-grown and transferred monolayers, and their intensity changed depending on the excitation laser used to make the measurements.

UPRM Post Doc: **Richa Sharma, PhD**

"Exploring Diverse Horizons"

I am new postdoctoral research associate in CMS Experiment group. I did my PhD on the **MINOS** experiment at Fermilab, Illinois and graduated from Panjab University, India. I will discuss my analysis of the 7% muon antineutrino component of the **NuMI** neutrino beam with an exposure of 7×10^{20} protons on target (POT), which tested the oscillation hypothesis for antineutrinos at the atmospheric scale. I will also cover my analysis of muon neutrino and muon antineutrinos in the 10.56×10^{20} POT neutrino-optimized beam, which tested the violation of Lorentz and CPT symmetries using Standard Model Extension (SME). I will also briefly touch upon the light level studies I performed for the MINOS Far Detector to assess its aging over time, setting up the Remote Operation Centre for the **NOvA** experiment at Panjab University and AI project with a hospital that have applications in the medical field. Finally, I will share my interests in the CMS experiment and the work I intend to undertake in this new role.

Estudiante: ***Carlos Ortiz Quintana***
Internado de Verano en: Space Telescope Science Institute (STScI)
Campo estudiado: Astronomía / Astrofísica

"Comparing Chemistry of Small Molecules in Planet Forming Disks"

Planets form in disks of dust and gas around Young Stellar Objects (YSOs), which include key molecules (e.g., CN, HCN, H_2O, CO) necessary for the formation of planetary atmospheres. Far-ultraviolet (FUV) emission from T Tauri stars (i.e., low mass YSOs) is known to play an important role in regulating the gas-phase chemistry of the disks and setting the spatial distributions of C, O, H and S bearing molecules. H I Lyα makes up over 80% of the total FUV emission in T Tauri stars, photodissociating molecules and producing overabundances of other molecules. However, Lyα emission is difficult to observe directly, because hydrogen in the interstellar medium absorbs most of the photons before we can detect them.

Instead, we used the Cosmic Origins Spectrograph (COS) on board the *Hubble Space Telescope* (HST) to observe spectrally resolved H_2 emission lines from the inner gas disks and reconstructed the intrinsic Lyα intensity profiles from those features. We reconstructed the intrinsic Lyα profiles from a sample of transitional disks with large dust cavities, using the method described in Schindhelm et al. (2012). We found a range of two orders of magnitude in photodissociative Lyα flux emitted from the accretion shocks surrounding T Tauri stars with large dust cavities in their disks. We also found similar photodissociative Lyα flux between a less evolved disk and the brightest transitional disks in our sample. These results represent the initial steps in using photodissociative fluxes as input in models of disk chemistry to explore the impact of Lyα photons on molecular gas that can be observed with ALMA and JWST.

Estudiante: ***Viviana A. Cáceres Barbosa***
Internado de Verano en: California Institute of Technology
Campo estudiado: Astronomía / Astrofísica
Mentor: Derek Davis

"Mitigating the effect of glitches on gravitational-wave parameter estimation using an inpainting filter"

Correctly recovering the source parameters of gravitational-wave signals is essential to confirm current general relativity models and understand the universe's astrophysical properties. However, glitches in gravitational-wave data may cause inaccurate recovery of source parameters. We use data "inpainting" methods to prevent glitches from contributing to parameter estimation analyses. Using the parameter estimation software Bilby, we study how inpainting increases analysis time. We inject a gravitational-wave signal of a binary black hole merger into Gaussian data and examine how inpainting affects Bilby's ability to recover its parameters. We show that our implementation exhibits the expected behavior of increasing the uncertainty of the recovered parameters without introducing a bias and can now undergo more rigorous testing. This tool will allow us to determine the properties of gravitational-wave signals even if the data contains glitches.

Estudiante: ***Cherilyn Toro Acosta***
Práctica COOP en: WAPA-TV
Campo estudiado: Ciencias Atmosféricas y Meteorología

"Laboratorio de Comunicación de Meteorología de Noticentro por WAPA-TV"

During the semester of spring 2022 and fall 2022 I was able to participate from the Laboratory of Scientific Communication at Noticentro from WAPA-TV, where I was able to learn from the broadcast meteorology field from professional meteorologists Ada Monzón and Suheily López Belén. The internship consisted mainly of visiting the channel and making meteorological graphs for the meteorologists while also preparing my own weather segment to practice as a broadcast meteorologist once the live tv news section was done. Through those practices I was able to gain an experience similar to what a broadcast meteorologist does daily, as I was assigned to interpret the weather for the day and develop the graphs to communicate the information acquired to the public. As a result, other challenges started to pop up as I had to know how to communicate difficult meteorology concepts to the general public in a simple way for them to understand me entirely. I also had to be very careful with not only what I said or did in front of the cameras, but what I showed on my graphs. In addition, I was also assigned a project of a scientific interview, where I had to make a short video of the interview and add elements like music, banners, graphs, voice over, and a "bridge", where I transfer the video from one scene of the interview or the voice over, to a scene

where I am present at the studio and showing other information that works as a “bridge” for the interview to be better understood or developed. This assignment was made with the purpose of understanding and acquiring the experience of making my own “scientific story” or report as if I was going to show it on live tv just like professional meteorologists do. Consequently, my project was based on how landslides and land collapses are managed by the different emergency management organizations in Puerto Rico after atmospheric events like hurricanes, especially after the hit of Hurricanes Maria and Fiona. As a result, I interviewed a surveyor that was working at the time with the localization and identification of these phenomena around communities of southern Puerto Rico under a project from the Federal Emergency Management Administration (FEMA). Finally, after several months of training and learning from the professionals, the final assignment of the internship was to give the weather in live television. This happened on December 28th, 2022, in the afternoon news section (Noticentro al Atardecer).

Estudiante: ***Rebeca Reyes Carrión***
Práctica COOP en: MIT Lincoln Laboratory
Campo estudiado: Óptica

“Stimulated Raman Scattering for Scanning Technology”

Stimulated Raman Spectroscopy is an advanced technique within Raman Spectroscopy and Coherent Raman Spectroscopy. In Stimulated Raman Spectroscopy the molecule is radiated with two different beams, the Pump beam and the Stokes beam. The goal of the Stimulated Raman Scanning (SRS) project is to minimize the current footprint of a Stimulated Raman Spectroscopy experimental setup into a a compact field-deployable system, capable of performing a faster analysis in a much smaller form. An SRS testbed was developed and installed for initial scanning experiments. For initial scanning, the sample used was oil suspended in water to discriminate between the water molecules and the oil. Initial results were single point measurements, followed by a 2D scanning of the sample.

Estudiante: ***Rebeca Reyes Carrión***
Internado realizado en: Cosmic Dawn Center, Denmark Technical University

“Afiche”: *“Insights on the star formation efficiency in the high-redshift Universe”*

The advent of new telescopes like Euclid, Webb and Roman Space Telescope will provide us access to a large number of galaxies in the Epoch of Reionisation (EoR), giving us insight into the properties of the galaxies and their dark matter halo environments. To understand this galaxy-halo connection, one need to use simulations such as hydrodynamical simulations that self-consistently evolve dark matter and baryons. However, currently available periodic boxes like EAGLE or Illustris are ill suited to do this, due to their small volumes and thus relative lack of bright rare galaxies required to probe the full galaxy population. To overcome this problem, we have carried out a suite of hydrodynamical zoom simulations targeting a range of overdensities in the EoR, called the First Light and Reionisation Epoch Simulations (FLARES). The overdensities are selected from a 3.2 cGpc per side volume Dark Matter only simulation giving us access to large structures which will be observed by the next generation telescopes. This strategy yields more than an order of magnitude more massive galaxies than EAGLE, with composite distribution functions like the stellar mass function and luminosity functions, representative of the full parent volume, derived using a novel weighting scheme. The work is the first time a hydrodynamical simulation, well tested in the local Universe, is statistically examined to study the high-redshift dependence. The obtained stellar mass

function, star formation rate function, and UV-luminosity function are in good agreement with the current observational results. Using this dataset, we explore the dependency of the efficiency of star formation on various properties like the halo mass, stellar mass, and UV luminosity. For the first time, we are able to study the dependence of the star formation efficiency on overdensities at extreme environments in the high-redshift Universe.

Estudiante: ***Caryelis Bayona Figueroa***
Internado de Verano en: University of Wisconsin-Madison
Campo estudiado: Astronomía / Astrofísica

"Investigating the flux asymmetry of double-lobed radio sources"

A catalog of approximately **15,000** double radio sources from the **Very Large Array Sky Survey** have been used to analyze **high lobe-flux-ratio** sources and compare them to **normal lobe-flux-ratio** sources. The data selection was based on the percentiles of the normal-like distribution of the lobe flux ratio and for sources with fluxes lower than **200 mJy**. Two subsets were created, the experimental subset containing the high flux sources from the outer percentiles of the distribution, and the control subset, containing the normal flux sources from the inner percentiles of the distribution. Classifications of real and non-real double sources were made using the Zooniverse platform, with a total of **230 sources** analyzed. A total of **67 real sources** were found in the experimental subset, comprising **77%** of the total subset, with an uncertainty of **+5%/-4%**. For the control subset, a total of **133 real sources** were found, corresponding to **93%** of the whole subset, with an uncertainty of **+3%/-2%**. This shows that there is a significant population of extreme lobe-flux-ratio double sources that can be the object of future research.

Estudiante: Reynaldo J. Falcón Torres
Internado realizado en: Cornell University
Campo estudiado: Altas Energías

"***Refinement of the Thermal Interface Material Deposition Routine for CMS's Inner Tracker"***

Cern's Compact Muon Solenoid (CMS), one of four particle detectors found inside the Large Hadron Collider (LHC), is soon to undergo its Phase 2 upgrade. With this in mind, Cornell University's CMS group focuses on replacing parts of the particle detector's inner tracker; whose data allows for the observation of trajectories from resulting particles during collisions. The tracker itself is composed of multiple plaques called Dees that host and fix individual silicon trackers, and these will always heat up exponentially in the presence of radiation from nearby particle collisions. To avoid irreversible damage due to overheating, Thermal Interface Material (TIM) is applied on top of the silicon trackers. TIM being a paste-like substance, similar in function to thermal paste, that allows for efficient heat transfer away from individual silicon pixel trackers. The process of applying the material requires a high level of precision. Studies conducted within Cornell University's CMS group indicate that the material's performance can suffer when applied in different configurations and at thicknesses exceeding the magnitude of 100 microns. To look after these intricacies, the Thermal Interface Material Deposition Routine was created and during the period of June 5, 2022 to August 10, 2022, the routine underwent change to define and simplify it as a whole under my supervision. The deposition aims to dispense TIM on both faces of a Dee with a guaranteed level of precision and consistency. With an end goal of producing a total of 80 TIM-deposited Dees, 64 of which will be installed inside CMS's Inner Tracker during the aforementioned Phase 2 upgrade.