

FIVE QUESTIONS WITH DR. CARLOS HERNANDEZ-GARCIA

Scientific Summers Abroad: Learning Accelerator Physics at the Jefferson Laboratory

Between 1985 and 2020, the Division of Particles and Fields organized the Scientific Summers in a Foreign Laboratory Contest, in which physics and engineering students in their final year of university are invited to participate. In 2022, the CMAP took on the task of organizing the selection of a candidate. Approximately 100 students participate each year in a series of mini-courses. The selection process is very rigorous, resulting in one student from each of the following institutions being selected for summer stays at CERN, DESY, Fermilab, and since 2009 at Jefferson Lab. During their stay at Jefferson Lab, students receive training in beam dynamics simulations, electron beam generation and characterization, and vacuum techniques for accelerators [1].

Can you introduce yourself?

My name is Carlos Hernandez-Garcia . I am originally from Jiquilpan, Michoacán, and am currently a Level IV (Senior) Scientist at the Jefferson Laboratory (abbreviated JLab: Thomas Jefferson National Accelerator Facility, Newport News, VA). I graduated in Industrial Physics Engineering from Tecnológico de Monterrey in 1993. In 2001, I obtained a Ph.D. in Physics from Vanderbilt University with the subject: “Photoelectric Field Emission from Needle cathodes”. Since then, I have worked at JLab, for the first ten years as a leader of the injector group in the Free Electron Laser (FEL) and later as staff scientist at the center for injectors and sources. Since 2009, I have received Mexican students who spend their summer internships at JLab, and I have taken part as an instructor (electron sources and vacuum systems) in the series: Mexican particles Accelerator School (MePAS) since its inception in 2011.



Figure 1. Program participants across several generations in the “Upgrade Injector Test Facility Accelerator” control room, photograph taken on August 2, 2022. C. Hernandez Garcia, Valeria Ramirez (summer 2022), Gabriel Palacios (summer 2013), Max Bruke (JLab staff), and Cristhian Valerio (summer 2009, the first student in the program).

Can you tell us about your institute and your research topic?

The JLab accelerator provides a continuous beam (continuous wave, CW) of electrons at 12 GeV for hadronic experiments in nuclear physics, with a sustained power of up to 1 MW. The accelerator is unique in the World for the brightness of the electron beam, for the high percentage of electrons produced with preferential spin polarization (>85%), and for using superconductivity technology necessary to accelerate the electron beam in a sustained manner (CW).

My research topic is the design, implementation, and operation of very high voltage electron guns for the production of intense and polarized beams of electrons. However, I am going to describe the program that JLab has with Mexican institutions to receive students for summer stays through the Scientific Summers in Foreign Labs Contest.

Why did you choose this research topic?

It is a topic that I am even more passionate about than my technical field of work. The results of the program a decade later are a source of great satisfaction, particularly seeing graduate students in areas related to accelerator physics developing a new discipline for Science and Technology in Mexico.

It could be said that the program began fortuitously. In the summer of 2009, I met Cristhian Valerio in JLab. Cristhian was in the Hampton University summer program Graduate Studies. Once I talked to him about my work with the FEL electron gun, he opted for doing his summer research with me. The following year, Cristhian invited me to give a talk at the XII Congress of the Society of Particles and Fields, where I met Mexican colleagues interested in training a new generation of students in accelerator physics. In this way, it began the fruitful collaboration between JLab and various Mexican institutions that continues solidly. The article in reference [2], written by JG Contreras and M. Napsuciale, offers



Figure 2. CMAP representatives at the “North American Particle Accelerator Conference”, Albuquerque, NM, August 2020. From left to right: Gabriel Palacios, Aurora Araujo, Carlos Hernández, and Salvador Sosa.

a historical overview of the work and achievements to develop the accelerator physics as a new scientific and technological discipline in Mexico.

It is very gratifying to know that of the 16 students who have participated in the program with JLab so far: 6 are enrolled in doctoral programs in various Mexican and foreign institutions. Additionally, 6 students are members of the CMAP: Cristhian Valerio (2009), Alejandro Castilla, Luis Medina and Salvador Sosa (2010), Gabriel Palacios (2013), and Anahi Segovia (2017).

Currently, what is the biggest challenge you have encountered in your work?

Definitely finding funds to offer summer stays to a greater number of students. Thanks to the program sponsored by Jefferson Science Associates Initiatives Fund, each year since 2014, we have received grants for ~\$7,000 to cover room and board for a single student for ten weeks. Traditionally, the university institution of the selected student covered the cost of the round-trip flight Mexico - Newport News. But each year, it has been more difficult for students to find the financial support, which is why the cost to JLab is ~\$8,000 per student each summer. Other labs like Argonne National Lab have offered to host Mexican students for summer stays, but find funding is difficult for students who are not US citizens.

What do you think is the future of your area of research?

Without a doubt: the training of Mexican talents participating in the design, construction, and operation of the first accelerator in Mexico for educational, research, and development purposes. The formation and training of personnel in the multiple disciplines of accelerator physics and engineering require time, dedication, resources, and support from various national and foreign educational institutions, government institutions, as well as private industry.

Despite these challenges, the past decade has seen the formation of a strong pool of accelerator science and technology resources, thanks to collaborations with CERN (through the invaluable support of Frank Zimmerman) and JLab. Reliable proof of this is the members that constitute the CMAP and the accelerator physics programs of the University of Guanajuato and the Autonomous University of Sinaloa.

The presence of Mexican engineers who are members of CMAP in the accelerator industry in the United States has great potential for training talent at the technical

level, which is essential for the construction of the first accelerator in Mexico for educational purposes, fundamental research, and exploration of industrial applications.

References

[1] <https://www.jlab.org/news/stories/education-outreach-accelerator-physics>

[2] JG Contreras and M. Napsuciale, "Creation of a group on particle science and technology in Mexico", 2016 J. Phys.: Conf. Ser. 761 012002, IOP Publishing. doi:10.1088/1742-6596/761/1/012002