

# FIVE QUESTIONS WITH M. SC. GABRIEL PALACIOS SERRANO

## Beam source: The first stage in the particle accelerator

The starting point in any particle accelerator is the beam source. The beam source produces the particle beam that is injected into the accelerator. That is why it plays a fundamental role in the beam's parameters such as the emittance (the area of phase space). Electron beams are produced by photocathode and thermionic production in **electron guns**, and ion (protons, H, etc.) beams are usually generated by Electron Cyclotron Resonance (ECR) systems [1].

### Could you introduce yourself?

My name is *Gabriel Gerardo Palacios Serrano*. I got my bachelors in physics engineering at the Metropolitan Autonomous University (Azcapotzalco). I got a masters in physics at Old Dominion University, then, I switched to the engineering department where my health, sanity and GPA (Grade Point Average is the measure used to summaries your academic achievement) improved and I am about to finish my PhD in electrical and computational engineering. I was lucky to participate in the “summer undergraduate internships abroad” [2] organized by the Mexican Physical Society Particles and Fields Division and was selected to go to the Thomas Jefferson National Accelerator Facility (JLab) [3] in 2013, where they offered me the chance to apply for the PhD and become a research assistant with the Injector group in 2015.

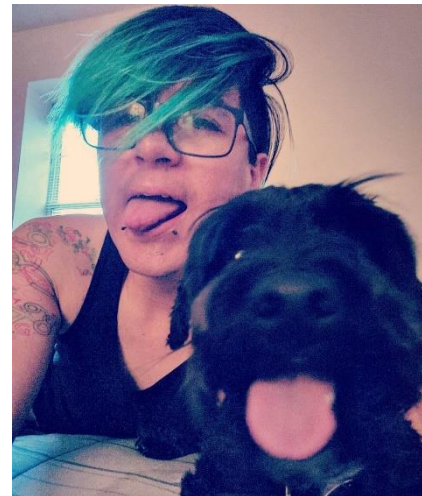


Figure 1. Gabriel and Carlo's dog Chucho. Gabriel painted his hair blue with the Wien ...

### Could you tell me about your institute and research topic?

I work at JLab. This is a particle accelerator facility funded by the department of energy and located in Virginia (USA), where the main efforts are directed to understand the nature of subatomic particles and forces by smashing high-energy

electrons into different types of targets and studying the collision products. The lab has several groups dedicated to specific tasks. I work with the Injector Group under the tutelage of *Dr. Carlos Hernandez Garcia*. The group's main purpose is to design, produce and qualify the initial part of the accelerator, known as an injector or **electron gun**, or photoelectron gun, where a beam of photo emitted electrons is generated by shining a laser on a biased semiconductor in ultra-high vacuum conditions. My research focuses on the design, simulation and testing of a component of the **electron gun**, known as the cathode electrode, to allow the gun to operate at -200 kV, with no field emission, during the production of polarized electron [4]. Additionally, I am doing similar research for another device called the "Wien filter spin rotator" [5] to make it compatible with the updated beam energy. Fun!

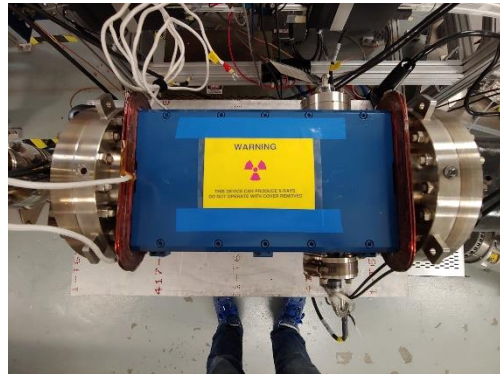


Figure 2. Wien filter for 200 keV testing at Upgrade Injector Test Facility (UITF). The injector group painted it blue because of Gabriel's hair!

### How or why did you choose that topic?

I did not lol. I read somewhere that even at a PhD level, for some people, it is hard to come up with your own scientific questions to solve. That is the final objective, right? Not complaining here, but until now, I found that since I want to do scientific research on accelerator physics, I have the drive, enthusiasm and growing expertise, I have been good at solving problems and questions that more experienced people present to me. Initially I was doing photocathode research but

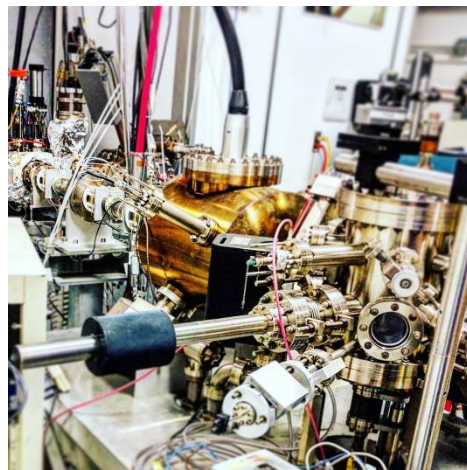


Figure 3. Electron gun at JLAB's UITF.

that did not work as planned so I was offered to work on my current topic and it all pointed to the fact that I was more valuable doing this. I also enjoy it more because it has a good mix of hand labor, computer simulations and data analysis.

### **Right now, what is the biggest challenge of your work?**

This might sound pretentious but, since I am coming to the end of my PhD, the challenges are mostly technical. I think the worst part is to find a hole in the operations schedule for me to be able to take my data. Do not get me wrong, coming to this point was by far the most challenging thing I have ever done. The learning process was riddled with moments where my already-shattered-because-of-the-qualifier confidence was repeatedly put to the test. Nevertheless, the support I received from the people in the team, particularly *Carlos*, has made from every single challenge a very enjoyable experience and it allowed me to renew my confidence and keep going on. If I had to pick, I would say that learning machine learning (pun intended) and dealing with the career prospects are the biggest challenges for me right now.

### **What do you think that will be the future of you research area?**

Machine learning, hands down. We are already experiencing this in JLab, where seminars, funding and projects are set to look at the possibilities of implementing this tool in the field. From my experience, there is so much data analysis, pattern recognition and automatization going on that it just seems natural for the field to at least partially move towards these new technologies, particularly looking at the amazing success that has been applying them to other research and industry. I also think medical applications of accelerators is probably going to be on the spotlight for a while, given the health crisis that we are facing in 2020.

### **References**

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- [4] G. Palacios-Serrano et al, *Review of Scientific Instruments* **89**, 104703 (2018).
- [5] J. M. Grames et al. *Phys. Rev. Accel. Beams*, vol. **7** 042802 (2004).