FIVE QUESTIONS WITH

M. C. ANAHÍ SEGOVIA MIRANDA

Resonant Ionization Laser: Selective Ion Production

The Resonant Ionization Laser Ion Source (**RILIS**) is an elementally selective ionization process, based on stepwise resonant photoexcitation. A free atom can be excited and ionized with a high probability through a resonant interaction with the radiation from a series of pulsed lasers tuned to match the energy of consecutive transitions between atomic states. The atoms are ionized via stepwise atomic resonant excitation, which is followed by ionization in the last transition. Optical excitation occurs when the laser radiation frequency matches the atomic transition frequency. Since the atoms of each element have their own specific energy level structure, the ionization process has a higher selectivity compared to other non-specific ion source generation techniques. Basically, what we research in **RILIS** is stepwise selectivity using an array of multiple lasers to select an element and efficiently choose the resonant path with higher probability. In the absence of isobaric contamination, this results in the production of isobarically pure radioactive ion beams.

Could you introduce yourself?

My name is Anahí Segovia Miranda, I am from Valparaiso, a small town in Zacatecas. I have a bachelor's degree in physics and a Master of Science in Physics from the Autonomous University of Zacatecas (UAZ). During my Masters, I worked in the Center of Injector and Sources at Jefferson Lab, developing a vacuum system to reach extreme high vacuum (XHV). After finishing my Master, I was an intern at CERN in the Hadron Sources and Linacs section. In this project, I was carrying out simulations and measurements of the beam matching in the low energy part of the new CERN Linear accelerator Linac4. I am currently a PhD student at Paris-Saclay (Paris-Sud) University, working at the Irène-Joliot Curie Physics of Two Infinities Lab

Figure 1. Anahi Segovia Miranda.

(IJCLab) at the resonance ionization laser ion source of ALTO (RIALTO).

Could you tell me about your institute and research topic?

The IJCLab [1] is the fruit of the collaboration between five physics labs based on the Orsay campus: The Centre for Nuclear and Matter Sciences (CSNSM), the Neurobiology and Oncology Imaging and Modelling Laboratory (IMNC), the Orsay Nuclear Physics Institute (IPNO), the Linear Accelerator Laboratory (LAL), and the Theoretical Physics Laboratory (LPT).

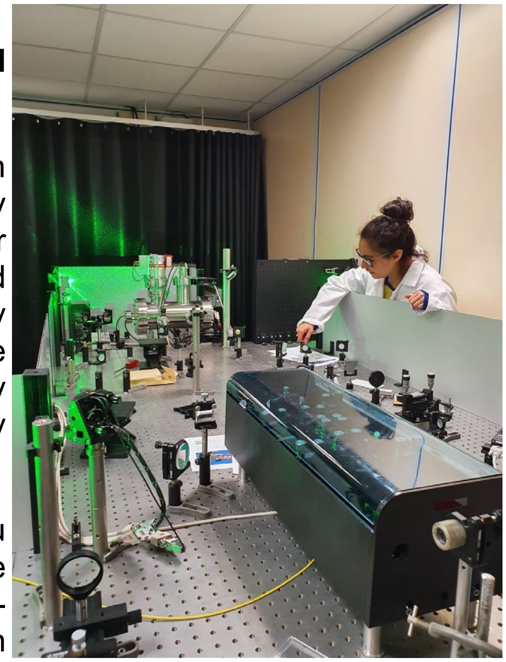

Figure 2. Anahi in the laboratory.

ALTO (Accélérateur Linéaire auprès du Tandem d'Orsay) is an on-line isotope separator (ISOL) facility that produces neutron-rich radioactive ion beams from the interaction of a gamma flux created by a 50 MeV electron beam in a uranium carbide target (photofission). A magnetic dipole mass separator and a resonance ionization laser ion source allow to select the ions of interest [2].

RIALTO aims to produce pure ion beams using the resonance ionization technique, an efficient and highly selective way to ionize exotic isotopes using a multi-step laser excitation process [3].

How or why did you choose that topic?

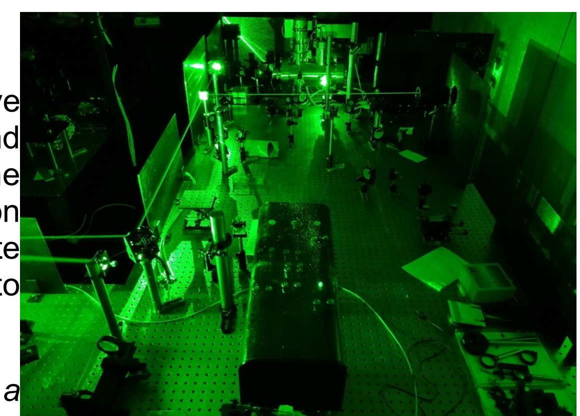

Figure 3. Rialto set up.

In the field of particle accelerators, I've always been more attracted to injectors and particle sources, because it is there where the magic begins. Getting involved in the creation and optimization of beams is my ultimate dream goal and where I would most prefer to contribute and become an expert.

As many others, I'm here by chance. After *a series of unfortunate events*, I met my supervisor (in his words: "I threw a bottle to the sea and he found it"), discovered another side of accelerators and the creation of beams. This time at low energy, with radioactive beams, and from a nuclear physics perspective.

What I love is that my work allows me to have a complete vision of a nuclear physics experiment, starting with the creation of the beam, the transport to the experiments, taking measurements and studying fundamental properties of nuclei.

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

Certainly, dealing with the sanitary crisis adds an extra challenge to every work and we are not an exception. We've been dealing with a lot of delays on being able to test our source on-line, as we recently made an upgrade of our lab and we are ready to produce silver and gallium beams.

The next step is to produce antimony, this scheme is a little bit more difficult, as tripling the frequency is required for the first excitation step, and this has never been done before at ALTO.

What did you think that will be the future of you research area?

The study of rare phenomena in nuclear structure is fundamental to understand the behavior of hadronic matter at low excitation energy. The discovery of new nuclei, the study of nuclear shapes and nuclear magnetism allows us to understand the interactions of the three fundamental forces occurring in an atomic nucleus. For this, one studies exotic nuclei (i.e., very far from stability) that are produced by particle accelerators, these beams need to be very pure in A and in Z, which can be achieved with laser ion sources.

The **RILIS** method has a long history of success in the ISOL facilities worldwide but still requires further development to produce new challenging and more complex beams.

References

[1] "IJCLab site", *https://www.ijclab.in2p3.fr*

[2] S. Essabaa and et al. Nuc. In. Meth. B, vol. 317, pp. 218 – 222, 2013.

[3] R. Li, Franchoo, and et al. International Symposium on Exotic Nuclei EXON-2014, pp. 635–644.