



The search for the mysterious "Dark Matter": Jing tells us about his experience between China, Japan (Okayama) and France (SU)



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(LPNHE: Laboratoire de Physique Nucléaire et de Hautes Energies ---- <https://lpnhe.in2p3.fr/>)
- 4 months internship, from September to December, 2022



My Education Experience

I have been studying in China from primary school to university. My primary school to high school years were spent in a small city called Zhangjiakou in northern China. It is close to Beijing which just hosted the 2022 Winter Olympics.

I graduated (bachelor) in Lanzhou University, which is in northwest China and is one of the well-known universities in China. I received a good education there.

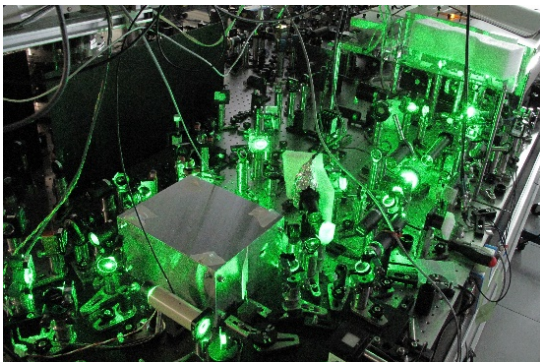
During my junior year, I participated in the Sakura Exchange Program between China and Japan and came to Okayama University. That was a memorable exchange program. Over the course of a week, under the guidance of a Japanese professor, we completed an experimental project that involved everything from soldering circuits to setting up laboratory equipment, and finally collecting data. I gained a lot from this project. So, after graduating with my bachelor's degree, I was motivated to come to Japan to pursue my master's and doctoral degrees.

My Research Area : detection of 'dark matter'

My research direction has been dark matter since my master's degree but, unlike some large collaborative groups, we focus on exploring dark matter using the energy level transitions of cold atoms, rather than using giant experimental devices.

Detecting the presence of dark matter is one of the most difficult challenges facing physicists today. Indeed, dark matter is theorized to be a major component of the known universe and also a key ingredient of the structure of galaxies.

My master's degree was dedicated to simulating the dynamic states of cold atoms. After entering the doctoral stage, I started to build our experimental setup and conduct some preliminary experiments.



Motivations for joining Sorbonne University

One of the important purposes of my stay in Sorbonne University (SU) was to work under the guidance of the researcher in charge of the XENON collaboration group at LPNHE, Dr. L. Scotto Lavina. In the field of dark matter exploration, the XENON Experiment is undoubtedly the world leader. They use liquid xenon as the target to search for dark matter, and their experimental devices have very high sensitivity. At the LPNHE I was trained about their research progress and particular experimental methods, which were also very helpful for my experiments in Okayama. Apart those research similarities, I am also drawn to the culture and history of Europe. It is well-known that many major historical events that have shaped the world have taken place in Europe over the centuries. In

particular in France, the French Revolution marked a radical change in the society's laws and government. In modern times, the Industrial Revolution in France was instigated by many engineers and innovations. Also, this region has given birth to numerous great works of art and historical figures. Being able to visit France and experience European culture firsthand was extremely attractive to me.

I would like here to give special thanks to Dr. A. L. Poquet (SU), Prof. W. Sacks (SU), and Dr. B. Chenevier (Okayama). Without their help, I might not have been able to go to SU. During my master's program, I took a course within the I-Ma-C program in Oka-Dai on superconducting materials physics taught by Pr. Sacks. **I-Ma-C** stands for **I**nternational **Ma**ster **C**ourse - Okayama (https://www.gnst.okayama-u.ac.jp/en/international/imac_okayama/). After the course ended, we remained in contact and it happened he proposed me to participate in a visiting scholar program in Paris. I happily applied. He trained me together with B. Chenevier to prepare my oral presentation for the final selection done on line by a SU committee and I succeeded. I could then join the group of the 6 Oka-Dai merit grant winners of a program called "2022 SFRI", offered by Sorbonne Univ. to institutional partners recognized as "privileged" ones by the Faculty of Sciences. It is very important to mention that in addition to the SU grant I got some additional grant from LPNHE, a mandatory French social system to help precarious workers. Dr. Poquet and the team of the

international mobility office, set-up all details of my stay in the Pierre et Marie Curie Science campus (student admission, internship agreement, financial support, housing in CROUS).

Research in Paris

I arrived in Paris at the end of August 2022. During the first weeks, I did a lab tour of LPNHE and discussed with my supervisor in Sorbonne University about the details of XENON project and the plan of the future experiment. I also started my work on the data analysis of the calibration experiment in the XENON project. I wrote several programs to help estimate the electron lifetime in the detector, which is important for the background subtraction of the raw data. The result of the estimation had a good agreement with the theoretical calculation and will be used for the data correction in the future. I contributed the development of the slow control system in the Xelab project (XeLab: a joint project - ANR et DIM-ACAV+ and Subatech) aiming at building a TPC (Time Projection Chamber) where backgrounds resulting from single electrons and characteristic of light dark matter, can be modelled. I performed the preliminary tests for the Revolution Pi and the temperature sensor.

In November, I participated in the XENON-France conference held in Nantes, where I gave a talk about my research in Okayama University and listened to many other reports. I also had meetings and discussions with the researchers in the Subatech lab (<http://www-subatech.in2p3.fr/en/>) in Nantes about their projects.

Daily Life in Paris

Paris is a vibrant city where interesting street performances are often seen. It is also a city with a long history. During my four-month stay in Paris, I tried to visit as many famous museums and art galleries as possible, but there are still many excellent art venues waiting for me to explore.

Moreover, because transportation in Europe is very convenient, I had the opportunity to travel to other countries. Hiking is one of my favorite sports, so in late September 2022, my friend and I walked from Belgium to Maastricht in the Netherlands and then went on to Luxembourg. In the winter, I went to Switzerland and took a train through mountains and canyons, with magnificent cedars and beautiful Lake Geneva next to me. It was an unforgettable travel experience.



Summary

As an overall conclusion, I wish to mention that my experience in SU and Paris was incredibly enriching and fulfilling. In addition to completing my research tasks, I had the opportunity to make many friends from all over the world and to experience different cultures and cuisines while traveling throughout Europe. These experiences not only broadened my horizons but also strengthened my interpersonal and adaptability skills. I am very grateful to those who provided me with support and assistance, allowing me to have such a memorable time in Paris.

I highly encourage other students of various cultural backgrounds to have such an experience if they have the chance.