

Final report

Internship abroad

Personal data and general information on the internship

Subject of studies: Physics

Bachelor/Master/State exam: Master

Time of internship: 27/08/2024 – 31/10/2024

Place of internship: Palaiseau, France

Internship institution: École Polytechnique, Laboratoire PMC

Planning and preparation

I have long wanted to do a research internship in physics to get more research experience before finishing my master's as I am hoping to do a PhD in physics. Therefore, I wanted more experience besides the required theses in the physics undergrad and master's degrees to be able to decide whether committing myself to three to five years of doing research would be a good choice for me. I found my internship placement in a somewhat unusual way: My brother had done a high school taster internship at the Laboratoire de Physique de la Matière Condensée at the École Polytechnique a few years ago and had really enjoyed it. Having grown up in the Saarland, I have a certain "natural" affinity for France, and since I have spent my undergrad in the UK and had enjoyed the experience of studying abroad enormously, I was very keen on another stay abroad, improving my skills in another language. Thus, I was motivated to see if I could also do an internship where my brother had spent a few informative and enjoyable weeks.

It was easy to contact the researcher who had looked after him at the time. I did so, asking if he was working on any topics where he could use an intern to do some work for him and if he be willing to supervise me for a short research internship. He was willing to grant me an opportunity to work with and learn from him for about two months.

Since I had only recently decided that I wanted to specialize in condensed matter physics, I was not too picky about the exact field, enjoying the opportunity to explore what kind research I could do in the field. As I was entirely open to the topic I would be working on, my supervisor suggested an interdisciplinary project with the solid-state chemistry group: I would be modelling the formation of pores in nano-particles with a computer-based model.

Though the French law requires interns who work for at least two months to be paid for their internship, the rate would not have covered my expenses in the greater Paris region. After I had secured the internship, I applied for Erasmus funding which made it possible to go to live in Palaiseau for two months and a week.

I took long to find accommodation. My supervisor recommended I use “Science Accueil”, a network which helps visiting researchers and visiting students to find their way around in France. Through Science Accueil, I found a room in a “Co-Living” in Palaiseau, about 15 minutes by bike from the École Polytechnique for about 650€ per month. The contract was signed only a month before my internship started. Although I was scared that it might be a scam, because I could not find any reviews online, it turned out to be fine – the house I shared with four other people had just been completed a few months before.

Going to France, I would recommend to take a language class before. Though you can get by with English, but just barely. Moreover, the French consider it rude if you do not at least try to communicate with them in French. Since I had had French in school for overall nine years, but it had become rusty since leaving school, I took a B2 French class at the LMU language centre in the summer term. This turned out to be very useful as I made the experience, that the French really do appreciate if one speaks French with them.

Internship – my responsibilities and use of my previous studies

At the internship I spoke a mixture of three languages. Mostly, I would speak English and German with my supervisor and colleagues – my French not being good enough for scientific discussions. However, toward the end of my stay, I did have a few simple scientific discussions in French. However, at lunch, I tried to speak in French as well as I could.

My workday started between 9 and 10 am and I usually finished at around 6 pm. Since I did my internship in computational physics, I first had to learn a new programming language: C. Furthermore, though I did have a solid background in statistical physics from the master’s in Munich, I had to go into more depth on certain topics. Without a background in field theory, statistical physics, I could not have done the internship. For the first few weeks, my supervisor assigned me various readings which we would afterwards discuss. He also took much time to explain derivations to me on the blackboard. Besides learning new physics, I built on a core program he had written to simulate overly simplified nano-particles. My task was to incorporate increasingly complex features into the program so as to make the simulations increasingly realistic. Much of my time at the beginning was spent debugging

my program extensions. Once the extended programs ran, my tasks also included generating data with various initial parameter settings and developing methods to analyse these. Specifically, I used correlation functions to determine average pore sizes in the simulated nano-particles. To this end, I wrote C-code to efficiently calculate various correlation functions and imported this code into a Python-script which I wrote to handle the data generated by the simulation.

As time passed, my meetings with my supervisor became less frequent (except for lunch, where I would usually eat with him and his colleagues since we had similar lunch times). Nonetheless, he was always available for me to ask if I needed help.

The internship being a research internship, it is perhaps not surprising that I could and needed to use much of what I had learned during my previous studies to perform my duties. Although I needed to learn more physics to be able to proceed with the research internship, the knowledge I had acquired – especially in the “Advanced Statistical Physics” lecture in the master’s at LMU – was instrumental in me being able to start where I did. The concepts of statistical physics, especially of mean field theories and Ginzburg-Landau theory of phase transitions were foundational for the further readings which introduced the specific subject matter: phase separation as modelled by the Cahn-Hilliard equation.

Moreover, the knowledge my undergraduate degree gave me of how to deal with differential equations enabled me to follow an interesting side project solving the equation of motion for a simple spherical nano-particle with a spherical concentric pore. This involved attempting to solve the diffusion equation in 2D and 3D for moving boundaries. My foreknowledge made it clear relatively quickly that the 2D problem could not be solved as Bessel functions (which are very difficult to treat analytically) had to be integrated. In the end, I could independently solve the system in 3D under some extra simplifying, but physically motivated assumptions. My supervisor told me at the end of the project, that he considered this bit of this research I did the most promising avenue for further investigation. Since this was the largest piece of independent work I did, this judgement was particularly satisfying. Lastly, my previous studies in physics had taught me how to program in Python. That made it much easier to learn a new programming language. Moreover, having used Python for the handling of data before, it was easy for me to write scripts to analyse the data I had previously generated with my simulation code.

Social contacts

At work, most of my interactions were with my supervisor and a chemistry colleague who had synthesized the particles we attempted to model with our computer program. The culture at the laboratory was to address each other by first name – however, to use the formal pronouns when speaking in French. This may well differ at other institutions, and especially in industry. However, at a research facility, it helped create a sufficiently relaxed atmosphere for me to socialize with co-workers and supervisors alike, and to be creative enough to actively contribute to the research, be the contribution ever so small or my ideas ever so silly.

Naturally, I had social contacts outside work, as well. My housemates were a very international group. For the first month in Palaiseau, I shared the house with an Italian PhD student, Giovanni, who worked on nuclear reactors, a Canadian physics post-doc from Québec, Olivier, an Indian biologist, Shivakshi, who also did a post-doc, and a Scottish chemistry post-doc, Iain. Later on, after Giovanni went back to Italy, Yongmei, a Chinese glaciologist who now worked for the UN, joined and contributed much to the atmosphere in the house.

I believe it was due to the house being advertised on Science Accueil that the group was so science oriented and international. I enjoyed this international flair very much. Already during my undergraduate studies at Oxford, I had been part of a very international group, and benefitted from this cultural blending.

Unsurprisingly, I spoke English a lot. However, I mostly spoke French with my Canadian flatmate and his girlfriend. He, in turn, sometimes spoke German to me in order to practice, having lived in Switzerland for some time and not wanting to lose the ability to speak German.

It is my flatmates I spent most of my free time with – cooking together and talking. Shivakshi taught me some Indian recipes, and Giovanni taught me how to cook a proper Bolognese. I can say that friendship clearly goes through the stomach – especially in France, where it is very easy to buy reasonably cheap high-quality groceries in a supermarket. Palaiseau also has a market twice weekly, which we sometimes visited together to buy produce.

Outside of my flat, I sometimes met up with my friend, Agathe, from Villejuif in Paris whom I had met on a holiday in Brittany a few years before and stayed in touch with. Agathe and I always spoke French with each other when we met up. However, she also speaks German. We have been, and will be using the opportunity to practice each other's respective

languages, when we talk. I believe that, although I had got to know Agathe before my Erasmus stay, this friendship is nonetheless an exemplar of what Erasmus seeks to achieve: Two young people from different nations in Europe meet, become friends, and continue to communicate in each other's languages. This experience teaches to appreciate the diversity of Europe, while also emphasizing that, ultimately, we are all humans with the same rights and basic hopes and dreams. Nationality does not really matter, while cultural identity is still important to who we are.

Everyday life and leisure

With a full-time internship, there is not very much free time. I spent most of my free-time cooking with my flatmates. However, I also made some infrequent forays into Paris. It had long been a desire of mine to go to the Musée d'Orsay to see the paintings by van Gogh – on one trip into Paris, I made this wish true and visited. Admittedly, I was somewhat underwhelmed. But the visit was very enjoyable. In particular, I remember laughing at how roughly and apparently inexpertly von Gogh had portrayed two little children, while his self-portrait was extremely detailed. I could not help make the joke that van Gogh must have been a very selfish person.

I regularly biked to work. Since the École Polytechnique is situated on a plateau and Palaiseau is in the valley below, this was always good exercise. Moreover, at the recommendation of an Australian colleague, I regularly visited the swimming pool at Orsay which has a 50 metre heated outdoor pool.

The student discount there is amazing – I paid around 2,50€ entrance fee per visit, and I can only recommend it to other Erasmus students who might spend their Erasmus time at the École Polytechnique or Paris Saclay (which is just next to the École).

Furthermore, I too several train and bike trips to and into the vallée de l'Yvette. Specifically, I took the RER-B train to Saint-Rémy-lès-Chevreuse. Except at rush hour, one can simply take one's bike in the train for free. At Sain-Rémy, I visited the ruined castle (château de la Madeleine) and enjoyed the forest and landscape.

Financing

As the rent for the room suggests, housing cost in the region pf greater Paris is as high, if not higher than in Munich. I was in Palaiseau which is in the “banlieue” and, unlike in Munich, the banlieue is cheaper than the city itself. An additional factor in France are the food prices:

Trying not to eat much meat and going for discounted deals, I was aiming at a balanced diet. Not eating meat too much certainly is a great factor in saving money. As such, I spent around 100€ per week on food. This was without going out for dinners. Moreover, since I do not drink alcohol, I managed to save some more money. The wine aisles in the supermarkets are very large, but also more expensive than in Germany. In general, I would judge the food quality in supermarkets like “Carrefour” or “Intermarché” or “Leclercq” to be higher than in German discounters, but similarly, the prices are also higher. As my supervisor explained to me, the French are generally willing to spend more money on food than the Germans. To the extent that my experiences covered the French food shopping habits, they corroborated this claim. The supermarkets in France are larger than in Germany, and one can easily find “luxury” food products including pâté, expensive cheeses, game and seafood, which are regularly bought by French customers. If one wants to immerse oneself in French food culture, one must be prepared to spend more than 100€ per week, at least in the greater Paris region.

I sometimes, but very rarely, did go out for dinner. The restaurants in greater Paris are more expensive than in Munich. A single course meal, without any starters, dessert, or drinks, can quickly amount to 17€ or more. At least, tap water is available for free in French restaurants by law. This can help save some money. As I have many food allergies, I preferred to cook my own food, which certainly helped me save money.

Another financial burden I did not have to shoulder was transportation cost since I could bike to work. However, living in zone 4 of the Paris public transport system, if I did want to go to the city centre, I had to pay 4.15€ for a single ticket, or 14.35€ for a day pass if I anticipated making more than three trips in the day.

Conclusion

At last, and very importantly for a research internship, I learnt more physics and I was to apply the physics I already knew or had just learned in a creative way, always thinking critically and questioning the results. I benefitted enormously from the tutelage of my supervisor, and my academic aspirations were rekindled, when before I had been unsure if I wanted to pursue a career in research. But, of course, an internship abroad is much more than just an internship.

On the downside, a stay in the greater Paris region never cheap. However, if the internship is paid, the gratification from the internship and the Erasmus funding combine to cover the cost of the stay if one does not insist on eating out very often and does not buy the most expensive food. Supermarkets usually have high quality food at acceptable prices. An extra piece of advice, if you'd like to go to any of the many museums in Paris, is that the first Sunday in the month, entry is free in all museums. Note, however, that these tickets need to be booked in advance and sell out rapidly.

When living in France, speaking French never hurts, and certainly will make things easier – and it helps endear you to the French people you interact with. I have been favourably compared with people who, despite living in France for several years, did not make the effort to learn the language. One older colleague commended me for making an effort to speak French and improve my language skills, even though I stayed for only a bit more than two months – in front of a colleague who had not bothered to learn French yet.

However, to speak French is not essential anymore. Besides the French taking kinder to people who make an effort to speak French, I can only say that I personally benefitted from being able to speak and practice my French during my stay. Not only did I learn more, but I also managed to interact more intimately with French culture than I otherwise could have. Greater Paris is much more than just a place in France. You can interact mainly with French people if you want to. But Paris is international and intercultural. I experienced much more than just French culture and French food. Near the Gare du Nord, there is a large South Asian community with the according shops and restaurants. I also got to go to an Uzbeki restaurant and experience Central Asian cuisine.

The people I got to know, both by sharing a flat, and also in the lab, were from many different countries (predominantly European, but also from Asia and North America) and the sense of an openminded intercultural community was palpable and enjoyable. It was a sense of a community of fellow humans where race, colour or nationality don't matter. I can only recommend to any student planning to spend some time in or near Paris to make the most of interacting with the international community in Paris besides immersing themselves in French culture.

I have only one regret: The duration of the stay was too short to improve my French to the level I would have liked, I had just become comfortable speaking French when I had to leave again. Moreover, friendships had just started to form or intensify, and I would have really

enjoyed and wanted to spend more time with these wonderful people. So: If you are interested in a stay abroad, make it six months or longer, you will not regret it!