

変革を駆動する先端物理・数学プログラム (FoPM)

国外連携機関長期研修 報告書

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Why I wanted to visit this group

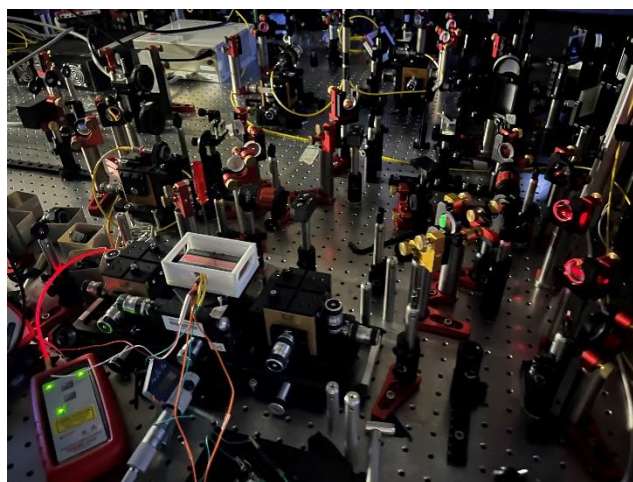
I worked in Prof. Christine Silberhorn's group at Paderborn University in Germany. I had some reasons why I wanted to visit there. At the University of Tokyo, I have been working in quantum optics and quantum information processing since my master's course. Prof. Silberhorn's group is also doing in the same field. However, there are big differences in the experimental approach. Therefore, through this international research experience, I wanted to broaden my knowledge and strengthen my experimental techniques. And now I feel that this purpose has been achieved.

Excited by different viewpoints and techniques

As I expected, between Prof. Silberhorn's group and our group, there were a lot of differences in the interpretation of quantum optics and experimental techniques. In the beginning, these differences always confused me. If I had deeply understood physics, I could interpret one thing from various perspectives. My understanding was very fragile, and I could not easily change the different viewpoints back and forth. However, thanks to many kind people, I could ask questions without hesitating until I could comprehend precisely what they wanted to achieve. I gradually developed the skill of thinking from the different viewpoints that I did not have, and finally, their research topic has become more and more fascinating to me. Also, from this experience, I noticed that learning other fields is not only exciting but also useful for a better understanding of my own research topic.

Here I will briefly mention two differences that are complicated but interesting to me. The first example is the time scale. Our group usually uses optical wave packets with ~ 10 ns time width, while they use pulses with ~ 100 fs. Thus, their time scale is much faster than ours and they discuss these pulses in the frequency domain. Although the time and frequency are just related by the Fourier transform, I was not familiar with the interpretation using the frequency domain. However, when I began to be used to thinking about optical phenomena from the frequency domain, I found that this way of thinking would be helpful also for my future research, which is related to optical temporal mode. This was a new and meaningful find for me.

The second example is *alignment*. Here the *alignment* means aligning mirrors in the optics experiment. In our group, the main purpose of alignment is to interfere with two lights with the same frequency. On the other hand, their alignment purpose is to interact with two lights with different frequencies in the waveguide of a non-linear optical crystal. Such different purposes require different alignment steps and I struggled to acquire them. Actually, our group also uses the waveguides, but they are convenient fiber-coupled modules. We do not have to couple the light to the waveguide by ourselves and I did not know the difficulties of this alignment. So, my experience here was very precious and I was very happy to know the mechanisms hidden behind the experimental devices that we daily use. This is exactly one of the reasons why I chose this group for my training.



Experimental setup. The waveguide is placed in the white box in front.

Feeling diversity

This was my first time doing research in English. In my daily research in Japan, I have no opportunities to discuss physics or work on experiments speaking English. Actually, at the beginning of my stay, I truly felt the difficulty of my English conversation. It is also due to English with some accents of non-native English speakers. However, as my hearing got used to their English, I came to catch up with them a bit better than before. Then I found that they are always enjoying their different backgrounds. This research group has a lot of people from other countries such as Italy, India, Spain, and Australia. When they talk about everyday life including cultures and politics at lunchtime, they often ask each other “How about your country?”. This kind of talk was never special for them, but it was fresh for me because I had few chances to learn about other cultures in Japan. This environment, where they can easily experience the crossroads of diverse cultures, was really exciting to me and I felt like I wanted to be in such an environment again in the future.

Enjoying research life overseas

I fully enjoyed not only the research but also my daily life in Germany for two and a half months. For example, I joined the Halloween party of the Department of Physics with some friends. At the party, we had fun with quizzes, *karaoke*, and funny costume contests. Another day, we enjoyed a waffle party at my friend’s house. Through such events, I could know the habits, food, music, and so on in various countries.

Also, at the Halloween party, one of my friends let me know that Japanese researchers would meet together at Dusseldorf the next weekend, so I decided to go there. About 15 Japanese from master’s students to postdocs working in Germany attended this meeting. Before this meeting, I thought there would be a low possibility of research abroad after my PhD course. However, I met these researchers challenging out of Japan and I started to want to try like them. This meeting was a valuable opportunity for me to think about my academic career path.

From the end of November, I enjoyed some Christmas markets. Although Paderborn, where I stayed, is not a big city, there are many beautiful historical buildings like Paderborner Dom and City Council Paderborn, and they are lightened nicely during the Christmas season. I loved walking around the city center, shopping at cute stands, and eating German food. Other than the Christmas market, I went to famous cities such as Köln and Berlin on some weekends and enjoyed sightseeing.



Group photo of Japanese researchers. This photo was taken after the meeting in Dusseldorf.



Christmas market in Paderborn. The building seen on the right is City Council Paderborn. We can see an advent calendar on the windows of this building.

Summary

Before I visited, I already believed that this training would be a precious experience for my future, but now I feel it was more meaningful than I expected. During this stay, I realized that my knowledge regarding the research field was very limited, and I noticed my ignorance about the cultural differences as well. In the future, I would like to challenge myself abroad for a longer time. Now I am sure that research overseas will definitely make me grow. Thanks to many people, I had a wonderful time. At last, I appreciate all the people supporting this international research experience.