IDEA League Summer School 2023 @ RWTH Aachen University
“Scalable Quantum Computing – From First Principles to Market”

Overview

IDEA League is a strategic alliance between five leading European universities of science and technology, TU Delf, ETH Zurich, RWTH Aachen, Chalmers University of Technology and Politecnico di Milano. They aim to create valuable connections that inspire innovation and the pursuit of ambitious goals by joining forces together. Summer schools aim to connect and inspire a new generation of European science and technology graduates, champion innovation and entrepreneurship and steer Europe towards a more competitive and compassionate future.

Tokyo Tech is one of the members of ASPIRE League, which is a sister network of IDEA League, so students are invited to participate IDEA League summer schools. This Scalable Quantum Computing Summer Scholl at RWTH Aachen University is aimed at Masters and PhD students in physics who want to gain an overview of quantum computing platforms believed to have the potential for practical applications. The topics covered range from fundamental principles to technological implementations and touch on real-world market considerations. This on-campus summer school took place on RWTH Campus, which is in an area in the historic town of Aachen. Aachen is the westernmost city in Germany, and borders Belgium and the Netherlands to the west. RWTH Aachen University hosts one of the largest technology-oriented research landscapes in Europe and which is also the home to the Institute for Quantum Information and quantum start-up ARQUE Systems.

Campus of RWTH Aachen University

Preparation before departure

I am a citizen of a country that EU waives our Schengen visa, so I am not required to obtain a visa to enter Germany for travel purpose less then 90 days. Therefore, the preparation for me was only to plan my itinerary, book flights and train tickets. The accommodation was provided by the summer school, and I decided to travel to other cities in Germany after summer school, so I only have to find accommodation for my short trip before going back to Tokyo. On the other hand, administrative procedure at Tokyo Tech includes: (1) submit Overseas Travel Notification and Departure Notice through T2Apps (2) purchase overseas travel insurance provided by university designated company (AIG Insurance Company).

Lectures and activities during Summer School

This is the brief schedule of this summer school.

	AM	PM	
11 Sep. (Mon)	Introductory Lecture	(1) Quantum Error Correction (2) Orange Quantum Systems	Visit Digital Church
12 Sep. (Tue)	Rydberg Atoms	(1) Cold Ion Traps (2) Infineon (3) Alpine quantum technologies	Visit Collective Incubator
13 Sep. (Wed)	Superconducting Qubits	(1) Superconducting Quantum Systems (2) IQM	Excursion
14 Sep. (Thu)	(1) Spin Qubits (2) Lab Tours	(1) Spin Qubits (2) Intellectual Property (3) Scientific Integrity (4) ARQUE	Dinner
15 Sep. (Fri)	Cryoelectronics		

The topic this year was Scalable Quantum Computing – From First Principles to Market. Quantum computing is promising to unlock unprecedented computational power to tackle certain complex problems. This summer school was tailored for students to gain overview of quantum computing platforms believed to have a potential to practical applications, ranging from fundamental principles to technological implementations and touching on real-world market considerations. During this summer school, I explored the fundamentals of quantum computing: qubits, entanglement, quantum gates and algorithms. The course also introduced the leading hardware including superconducting and semiconductor qubits, trapped ions, neutral atoms and photonic quantum computing. The applications, error correction, requirements and scalability were also mentioned. Topics about companies and startups and their role in the quantum computing community also triggered my interested.

During lectures

Besides lectures, the summer school also offered us visiting activities and excursion. We visited a digital church in Aachen City, which is a co-working space for start-ups on Day 2. We visited Inden, a small town near Aachen, for excursion to play soccer-golf and had BBQ on Day3. These are valuable time to get to know more about other participating students. They also planned lab tours for us, which we got to see the practical aspects of quantum computing. We visited three labs, one of them are conducting research about

superconducting quantum computing systems and the other one focus more on semiconductor spin qubits. Lunch during summer school was provided by the university, we were handed a card with charged money that can be used at the student cafeteria on campus. The accommodation was provided by the summer school, a double room with one roommate at a hotel in the city, and they also provided us the transportation fee of buses from the hotel to campus, which usually take about 20 minutes. About credits, this summer school did not provide any credits, so I have no plan to transfer credits to Tokyo Tech.

Digital church

Lab tour

Campus cafeteria

Sightseeing before and after summer school

My flight was a round trip between Tokyo Haneda and Frankfurt am Main, so I had some time to look around Frankfurt before arriving to Aachen. I arrived at Aachen one day earlier and walk around and visited the world heritage, Aachen Cathedral. After the summer school was finished, I travelled to Cologne, Koblenz, and Heidelberg before returning to Frankfurt. I used railway (Deutsche Bahn, DB) to travelled between these cities.

Aachen Cathedral

Cologne Cathedral

Heidelberg Old Bridge

Language

All of the lecture during summer school were conducted in English, and all the staffs and students from different countries were able to speak English, so I had no problem communicate with them using English

(my English level was IELTS 7.5/9.0 tested in 2020). Outside campus, most German speaks English, but most menus in café or restaurant are usually in German, so I used Google Translate to order food. I only knew a few German words, and most of the signs in the train station have English so I think there should not be a big problem if you do not know German when travel to Germany.

Expenses

Flight tickets became more expensive after the pandemic and Japanese Yen is very weak to foreign currency, so it cost more to travel overseas compared to pre-pandemic. I arrived at Germany two days before the summer school and spent six more days after, so this is why I had a higher expense.

Scholarship	JPY 80,000
Travel insurance	JPY 8,700
Roundtrip flight tickets	JPY 244,360
Train tickets	around JPY 15,000
Accommodation excluding summer school (8 nights)	around JPY 170,000
Personal expenses (meals, shopping etc.)	around JPY 70,000

Personal growth after summer school

I have spent a lot of time focusing on my own research since I started my doctoral study, and did not have a lot of time to gain knowledge of new fields. My networking was limited in the similar field of my research. This summer school provided me an opportunity to learn new things and able to connect with researchers from other fields. I was also able to know people from different countries and get to learn different cultures. I felt more open-minded towards different research field, networking and different cultures after attending this summer school. I would like to make use of what I learned in this summer school to my future career, connecting my own research field to quantum computing.

Advice and tips

Studying abroad may be a challenge for some people, but I think it is always worth a try because you will definitely be different in some way after coming back. For travelling to Germany, here I have some tips:

(1) For transportation: Download DB Navigator App to buy subway tickets and book seats for intercity express trains. You can also search timetables.

(2) Prepare cash: Most public toilets in Germany required to pay the fee by coins. Very few toilets accept credit card.

(3) For networking: Most people outside Japan use WhatsApp instead of LINE to text each other, and LinkedIn is also very common when it comes to professional networking. The coordinator of this summer school created a LinkedIn group for us to stay in touch.