

2024 UCTS program Experience Report



The promontory point @ Lake Michigan

My name is Bo-Yu, an undergraduate student from the Department of Physics and Computer Science and Information Engineering. Here, I would like to share my experience in Chicago, where I spent a summer to conduct research in 2024. I would say, this grant tour is the best life-changing birthday gift for me, a 19-year-old kiddo!

Life in Chicago

Before leaving Taiwan, in my opinion and bias, Chicago is one of the most dangerous big cities in United States. It is my first adventure in life to explore a foreign continent distant from Taiwan over 10,000 km for a duration over 25% of 2024. When I landed to ORD, everything I saw, listened, experienced is unfamiliar, challenging and unreal. But after living here for three months, the experience is quite different! I feel comfortable everywhere in Chicago, just like my bold advisor Hannes. Following the guideline of my mentor Nikhil, “if you look confident enough, you will not get robbed.” I try to step out of my comfort zone and am open to explore anywhere in the city, even the southern neighborhood of Chicago, where students and residents in Hyde Park would be afraid to visit.

For me, the most fascinating part of Chicago is Lake Michigan, especially the Promontory Point. People and students in Hyde Park usually have a BBQ, bonfire (real activity for Nayana) and picnic here. In my first weekend here, my mentor, Nikhil, invited me to a birthday party around the promontory point. We got many bottles of secret C_2H_5OH liquid from grocery store (to clarify, I did not drink bier oder wein lol). However, after arriving the point, we realized that we forgot to bring the bottle opener. At that time, Nikhil proposed an idea that we can open the bottles by knocking the rocks of Lake Michigan. Here comes a question: *How many knocks do you need to open the bottle?*



Knock knock who's there @ the promontory point

Bernien lab @ UChicago

In the UCTS program, I was fortunate to work on a project about quantum information with my kind mentor Nikhil under the supervision of Hannes. Bernien lab is an energetic and collaborative lab, where talented people from diverse backgrounds work together at the frontier of quantum information and technology. While everyone is dedicated to exciting research during weekdays, we usually hang out with each other during weekends.

There are many activities in our lab, including birthday celebration, farewell party, lab concert, lab Olympics, bonfire (real activity again) etc. In early August, we held a lab concert at Nikhil's house. The song "A Ryan White Christmas" is the most impressive part for me. Ryan White is a dedicated physics graduate student, as he navigates the complexities of quantum mechanics and the quest for the true spirit of Christmas. Will he find the answers he seeks amidst lasers and AODs, or will he discover that the magic of the season lies in unexpected places? With a surprise cameo by Nicolas Cage, this film promises to captivate and inspire audiences of all ages. Prepare to believe in miracles, even in the most unlikely of places.

I'm dreaming of a Ryan White Christmas
 Because my labmates tell me so
 Where the Rabis decay and results delay
 Because M Squared lasers blow

I'm dreaming of a Ryan White Christmas
 Filled with 80 Watts of light
 May your locks not put up a fight
 And may your chambers remain airtight

I'm dreaming of a Ryan White Christmas
 In the great city, Chicago
 Where the restaurants don't suck, unlike in
 But it sounds like

I'm dreaming of a Ryan White Christmas
 With every paper that I write
 May your data analysis be right
 And may



Left: A Ryan White Christmas (some contents are blocked); Right: Concert live

Dragon Boat Race @ Chicago

In the second weekend, I joined 2024 Dragon Boat Race for Literacy @ Ping Tom Park. Taiwanese association registers as a team first time this year. Before I left Taiwan, I noticed this activity on Facebook. Since I think that it would be cool to play dragon boat in U.S. (even I have never watched any race in person in Taiwan), I registered the race. On the racing day, Nikhil and Vikram were so kind that they came to Ping Tom Park to cheer up for us. We had many kinds of Asian snacks together, such as Zongzi, meat floss bread and I-MEI puff. After the race, the Taiwanese association offered us a celebration meal at Imperial Restaurant in Chinatown. I was surprised that Nikhil is the master of chopsticks. :)



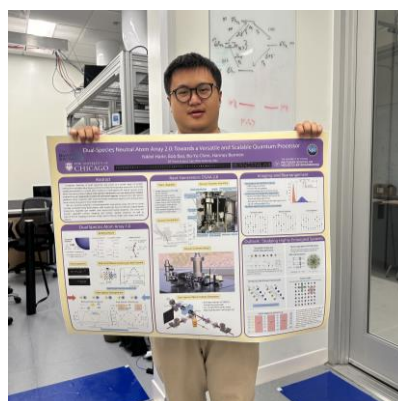
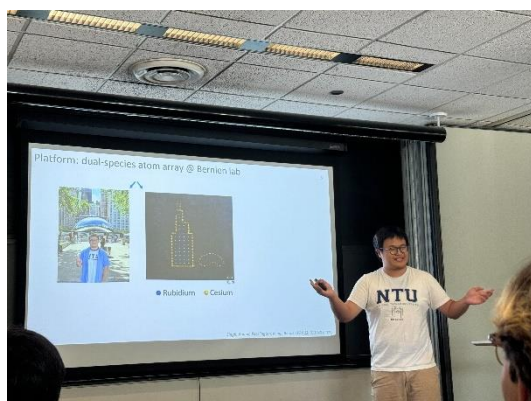
2024 Dragon Boat Race for Literacy @ Ping Tom Park

Rearrangement project @ Bernien lab

During this summer, I enjoy my summer research project, atom rearrangement project a lot. The goal of my project is to explore an efficient strategy to construct large-scale 2D dual-species neutral atom array. This project not only integrates my passion in physics and computer science but also is a completely new project. In our lab, we build up quantum computer composed of Rb and Cs atoms just like playing Lego building blocks. Similarly, we started this project from building up our own atom rearrangement simulator package from zero.

At the starting point of this project, Hannes only sent me a paper from Lukin's group and asked me try to play something by myself. Since I did not have any experience in building up a simulation package from zero, what I could do is to learn from ChatGPT and write some sloppy code. To create our own algorithms, first we try to reproduce state-of-the-art rearrangement algorithms from existing reference. However, this process is more challenging as I imagined because the papers never provide source code and merely leave a line "data and source code available upon reasonable request." Though some papers provide illustration of their algorithm, honestly, the algorithm instructions and descriptions from physicists are handwaving and hard to reproduce. By our dedicated work, now the package is versatile in simulating various state-of-the-art algorithms with a variety of customized physical parameters. By this simulation package, we learn important insights for an efficient rearrangement algorithm and use it to craft our own new algorithms for both single-species and dual-species atom arrays.

I am happy to learn many things from this project and proud of it. I wholeheartedly look forward to trigger the community's interest in the rearrangement algorithm after publishing the works. :)



Left: Final Presentation; Right: poster presented on SIF Fermi School

Reflections

Beyond the research, the most important lesson I learned during the trip is treasuring my time with family and friends. In our lab, we divide people into three subgroups, red lab, blue lab and purple lab. Purple lab consists of Bob, Nikhil, Jinyue and me. For me, they are my closest friends in Chicago and it's been so much fun getting to hang out with them every day. Bob and Nikhil are so nice that they picked me up after arriving the ORD airport (no other UCTS fellows have such privilege!). On the way to Chicago, I was supposed to be sent to airport by them at the end of my internship. However, one day Bob and Nikhil announced that they are leaving UChicago and going to transfer to another PhD program due to some secret reasons. Jinyue is going to be the last survivor and boss of purple lab! XD After knowing the information, I treasured everyday to get along with them and try to learn as many things as I could from them. In the last two weekends, we had a Hello Jasmine dinner, Switch party and Karaoke together. I remembered, on the way to Hello Jasmine, we played the famous song "Cheers (乾杯 in Mandarin)" by Mayday, which is a famous band from my alma mater, HSNU. I felt very sad because "Cheers" is a song about goodbye. Many Taiwanese schools choose this song as their graduation songs. But I don't feel sad now, I did my best to treasure the time to get along with them until the last moment!

As the aspect about my family, I felt sad while I had a lunar year reunion in my grandma house. As my grandma is approaching 90 years old, I was thinking about how many times I could sit in front of this dining table if I decide to study abroad for graduate school in the future. Despite the fact that the answer is probably less than 10, I decide to focus on the present and stop thinking too much. I exchanged many ideas regarding this topic with senior international students in our group, Jeff and Shankar. Thanks to their experience, now I have a more comfortable perspective to treat relationships with my family and friends.

GM XYZ: Con te partirò



Purple lab's last group meeting: Con te partirò



Bernien lab photo (Hannes is not here)



Purple lab family photo

Acknowledgement

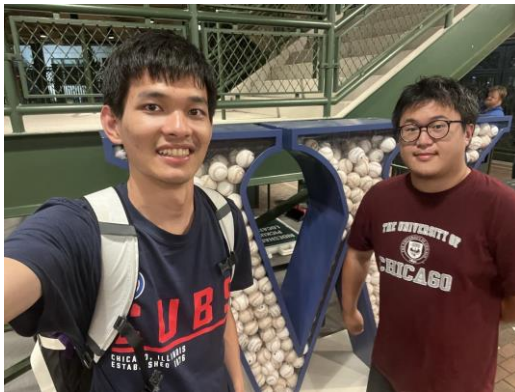
I would like to especially thank my advisor Hannes Bernien! Hannes, you are a great team leader and have created a dynamic and collaborative environment that any students would be happy to stay (include baby scientist Zoe). I am looking forward to keep learning countless things from you, ranging from research vision to bass and German such as hast du die brot.

Purple lab is a small group of very kind and talented people that are willing to spend their time in vacuum chamber ~~and make an incredible song for it~~. It's been so much fun being a part of this inspiring group, no matter inside or outside the lab (for example the first lab concert, Switch party, Navy Pier). I would like to thank everyone from the purple lab for that. Nikhil, thanks for your consistent and supportive mentorship during this summer! All of my gratitude is written in the card! Bob, a discussion with you always gave me new insights and ideas regarding experiments. Thanks for introducing Shanya Salon and curry rice ball of Quantum Cafe to me and I hope that Jinyue likes Shanya's style! My fellow-intern Jinyue, we went through most of our internship in the Bernien lab together. This included many funny times in the lab, doing experiments and coding till late and also much fun outside the lab, with many dinners in Chinatown with Shu Shi. In addition, I especially thanks for your wholehearted help once I was locked outside the lab. I wish you a super start and a successful PhD career in Innsbruck or U.S.! Ryan and Jeff, it is great to have the last dinner with you in Medici! Let's have a floating root beer again in the social ice cream session and revisit Navy Pier in the future! Vikram, thank you so much for your efforts to my final presentation! You are very careful and points out many flaws I did not notice! Looking forward to watch Kung Fu show and have a dragon boat race again! Nayana, thanks for your insightful discussion regarding the rearrangement project and bringing laugh for the lab. Noah, great to drink Malört with you and thanks for your explanation of Fahrenheit, which represents the percentage of hot! Dahlia, thanks for visiting purple lab frequently! Hope Jinyue will not feel too lonely in purple lab after I leave. Shankar and Kevin, it was fun to have a nothannes week and have a flammable liquid together in July. Wish you have a super start in the next career stage! YuZhou, thank you for introducing many delicious foods in Trader Joe's! The dumplings there are amazing! Outside the lab, I would like to thank my roommate Austin! I enjoy playing iPad games and watching Cubs baseball game with you very much. Good luck to your medical school internship!

I am fortunate to participate in the first UCTS program. I would like to thank the ones that are indispensable for UCTS program, including but not limit to Prof. Cheng Chin, Dr. Bo Lu, Prof. Pao-Ti Chang and everyone in NTU Office of International Affair, especially Mr. Jeffrey! Thanks for your efforts to initiate, organize and support this program. Looking forward to visit the greenest Chicago quantum park many years later! Finally, I would like to thank my parents who always let me explore anything I want to try and are always there for me.



Navy Pier Centennial Wheel w/ Jinyue, Jeff, Shu



Left: Chicago Cubs vs. Minnesota Twins; Right: Quantum Park adventure



Prof. Chen is talking about "what's up big dawg" (taught by Nikhil)