

## 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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Contents, ExperiencesAnalysis work on the CMB experiment (Simons Array) at UC Berkeley

I stayed at the University of California Berkeley for a month and worked on the analysis development of the ground-based CMB experiment, Simons Array. Since the CMB laboratory at UC Berkeley is also working on Simons Array analysis, I worked on the development, discussing it with them in person. I was nervous when I arrived at the lab, but a professor and their students welcomed me warmly. I liked their positive attitude toward the research and thought it would be good for me to work on the research in such an environment.



Fig.1. the building of UC Berkeley I stayed at for a month.

There are mainly two tasks I worked on;

- Development of the overall pipeline to evaluate the cosmological results from the real data of Simons Array.  
I used the real data of Simons Array taken in 2021 to evaluate the 2D maps needed to lead to the cosmological results. I investigated the maps coadded by about thousands of detector maps and the power spectrum of the coadded maps. I also worked on the evaluation of the noise of the maps. Because the UC Berkeley team developed the analysis code which converts the detector time-ordered data to the maps, discussion with them helped me understand the output maps. I attended the weekly Simons Array analysis meeting in the meeting room together and discussed our analysis status. It was very efficient for me to receive much advice and to explain what I thought directly. What impressed me was that when I reported my status, the students asked me about it after the meeting and told me that it was good. That was a good point for staying in the same room in person.
- Development of the calibration analysis, especially related to the detector sensitivity and telescope pointing.  
I have ever worked on the calibration analysis of the telescope pointing using the data of Simons Array taken in 2021, and I'm working on the further development of the calibration. What I worked on this time was the calibration analysis of the detector sensitivity using the information of the detector operation. I discussed the analysis status with a collaborator, who is an expert in calibration for the CMB experiments.

I attended the weekly local meeting of the lab and reported my status. It was a good time to practice explaining my status in English and to catch up on the status of the other people and groups in the lab.

I found that it was a good experience to discuss with the collaborators in person because discussing got easier for me than if I hadn't seen their faces directly. It inspired me a lot to work on the analysis besides the collaborators who were also working on it for the same science goal.

#### Face-to-face meeting of the next-generation CMB experiment (Simons Observatory) at UC San Diego

Since I have also worked on the detector evaluation of the test chips for the next-generation CMB experiment, Simons Observatory, I attended the face-to-face meeting of the Simons Observatory at the University of California San Diego (UCSD) for a week. It was an annual meeting all collaborators of Simons Observatory (about 200-300 people in total) gathered in but was held online in 2020 and 2021 due to COVID-19. I got the hardware and analysis status and the plan for the next 12 months. I communicated in person with the collaborators not only who are relevant to my research but also who I have met for the first time.

Since this was a good chance, I also attended the analysis hackathon of Simons Array and discussed it with the students of UCSD after the face-to-face meeting.



Fig.2. the group photo of the face-to-face meeting at UC San Diego.

I visited the CMB laboratory in UCSD a few days before the meeting. The professor introduced me to the testbed for the readout and the parts of the telescope of Simons Observatory and I discussed the analysis matter of Simons Array. It was a good time for me to get the knowledge the other institution has. At a lunch time, the students of the lab invited me and talked about our background, research, and so on with each other, which was a good experience.

#### Status

Through the direct discussion with the collaborators at UC Berkeley, I was able to gain a better understanding of the analysis methods for CMB experiments and contribute to the development of the analysis pipeline for Simons Array experiment. The analysis of the data acquired in Simons Array previously and the evaluation of the data quality will be useful for future observation strategies and analysis developments in Simons Array. I also gained a better understanding of the calibration methods of the detector sensitivity, which will lead to establishing the precise calibration method for Simons Array. I improved my skills to express my ideas and understand the opinion of others through the interactions with the collaborators of Simons Array and Simons Observatory, which is necessary for working on international research.