（別紙様式５）

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

氏　　名	谷口貴紀
所属部局	理学系　　研究科　　物理学　　専攻
受入先	Academia Sinica Institute of Astronomy and Astrophysics (ASIAA)
日程	西暦　20231　年　12　月　4　日　～　西暦　2023　年　12　月　18　日

I spent two weeks at the Academia Sinica Institute of Astronomy and Astrophysics (ASIAA), located within National Taiwan University. The first four days were dedicated to participating in the Large-scale Parity Violation Workshop, an international cosmology workshop, where I presented my work. The following week, I conducted research activities under the supervision of Professor Teppei Okumura at ASIAA.

The Large-scale Parity Violation Workshop focused on research related to parity violation on a cosmological scale. In current standard cosmology, it is thought that a physical phenomenon and its mirror image are invariant. Therefore, exploring physics that breaks parity symmetry could lead to discover new and interesting physics beyond standard cosmology. Useful observational quantities for investigating parity violation include cosmic birefringence, galaxy spin, the four-point correlation functions of galaxies, and so on. The workshop featured numerous presentations on these and other topics from theoretical, observational, and computational perspectives.

Before talking about my workshop experience, let me explain my own research. My main research topic is cosmic shear, the distortion of distant galaxy images caused by the weak gravitational lensing effect of the large-scale structure of the universe. Cosmic shear is a powerful tool for examining dark matter which cannot be detected by normal light because cosmic shear reflects all mass distributions between the galaxies and us. It is also a spin-2 field that can be decomposed in Fourier space into two modes: parity-even E-mode and parity-odd B-mode, allowing for the investigation of parity violation. At the workshop, I presented on the development of new methods for measuring the cosmic shear power spectrum, which can be extended to cosmic shear bispectrum measurement. Although the existing method called Pseudo-Cl method has been traditionally used for cosmic shear power spectrum measurements, extending this method to the bispectrum is challenging. Hence, we developed a new estimation method for cosmic shear power spectrum that can be extended to the bispectrum by applying the window-free estimation method used in cosmic microwave background observations. In particular, we developed a new method using the plane approximation with a view to applying it to Subaru Hyper Suprime-Cam, to which our research group has access to the data.

Figure 1: Presentation at the workshop

At the workshop, I gained exposure to a variety of topics, including the large-scale structure of the universe, early universe, and gravitational waves, areas I don't usually study. During lunchtime, I had fruitful conversations with local students, postdocs, and American researchers I previously discussed with in Japan, explaining my research in English and hearing about their interesting work. I especially enjoyed the banquet, where I was able to listen to the invited speakers talk meaningful (and more casual, interesting) stories about their attitudes toward their research. My presentation was at the end of the workshop. I was very nervous before my presentation and was encouraged by other researchers. It was the first time for me to give an oral presentation in English at an international conference. Although there were some times during the presentation when I could not

speak well, I did my best to explain what I wanted to say. The audience seemed to be interested in my presentation and asked me some questions. I found areas for improvement in my presentation, and I felt that I would like to put more effort into preparation and practice the next time I give a presentation in English. It was a very good experience that will help me glow as a researcher.

On Friday, the day after the workshop, I started researching and developing a measurement code for cosmic shear bispectrum. I explained my research to my host researcher, Professor Okumura, and set goals for my stay. I could ask him about his research in detail, and we had a very fruitful discussion. Although the actual working period of the research was only about a week, I was able to create a prototype of a code to measure the bispectrum of a scalar field (spin-0 field). Taipei's warm and humid climate, similar to Okinawa, Japan, facilitated focused research. During my stay in Taipei, I was able not only to advance my own research, but also to deepen exchanges with local researchers. In a discussion with a Korean post-doctoral fellow studying cosmology, I was asked some very basic questions about my research, and I realized that even among researchers in the same field of cosmology, the background knowledge can be quite different. I realized the importance of carefully explaining even what I take for granted. I also had a chance to talk with Japanese students and post-doctoral fellows belonging to ASIAA and could hear about their various careers and think my future career.

This was my first overseas stay, filled with fresh and fruitful experiences. Talking with various researchers intensified my motivation for research, realizing the enthusiasm for diverse studies worldwide. It emphasized the need to improve my communication skills, especially in English, for international engagement. The stay was productive, advancing my research significantly.