MERIT Overseas Dispatch Report

Department of Advanced Materials Science, 2nd Year Doctoral Student
Kumpei Imamura

Overview

From November 10, 2024 to February 16, 2025, I stayed at Los Alamos National Laboratory (LANL) in the United States and conducted a series of property measurements under uniaxial pressure on strongly correlated electron systems. These included AC heat capacity, electrical resistivity, and Seebeck coefficient measurements. In addition to these, I performed various experiments on topological and superconducting materials, and through this stay, I not only acquired new experimental techniques but also gained valuable experiences in English-based research discussions and international collaborations. This report summarizes the details of these activities.

Research Activities

My main experiments were conducted with the SCES team at the Institute for Materials Science, LANL, under the guidance of Dr. Filip Ronning (Director) and Dr. Sean M. Thomas.

LANL main gate

Originally, I planned to measure the AC heat capacity of the Kitaev quantum spin liquid candidate α-$RuCl_3$ under uniaxial pressure. However, due to the material's fragility and instrumental limitations, I shifted the focus to heavy-fermion systems. The main subject of study became $CeCoIn_5$, where I investigated the first-order superconducting transition near 5 T under uniaxial pressure using electrical resistivity and AC calorimetry. Additionally, I conducted Seebeck coefficient measurements under uniaxial pressure on $HfTe_5$, and resistivity measurements on the kagome compound ScV_6Sb_6, thereby acquiring the fundamental techniques required for uniaxial pressure measurements.

I was also fortunate to receive tremendous support from Professor Yuji Matsuda of Kyoto University, who were visiting LANL during the same period and Dr. Suguru Hosoi. With Dr. Hosoi, I conducted low-temperature thermal conductivity measurements on the spin-triplet superconductor UTe_2. Utilizing a crystal elongated along the b-axis, our results suggested a

fully gapped superconducting state. Moreover, I carried out Kerr rotation measurements to examine time-reversal symmetry breaking in Fe(Se,S) and in-plane Hall effect measurements in CsV_3Sb_5, engaging in multifaceted research activities.

Through these discussions and presentations in English, I significantly improved my language and international communication skills. I now feel more confident in my future research activities. The professional network that I built locally will be a valuable asset for future collaborations, and I hope to continue developing these connections.

Landscape of Los Alamos

Life in Los Alamos and Research Environment

Los Alamos is a uniquely situated town in the mountainous region of northern New Mexico, USA. At an elevation of about 2,200 meters, the area features large temperature swings between day and night, and the air is very dry. Despite these challenges, the surrounding natural beauty was stunning. As shown in the accompanying photo, the landscape is characterized by mesas and scenic overlooks, with hiking trails everywhere.

White Sands national Park

The town itself is small, with only a few supermarkets and restaurants and virtually no entertainment facilities. As such, I spent my weekends hiking and enjoying nature. Fortunately, with a car, it was easy to access nearby cities like Santa Fe and Albuquerque. One of the highlights of my stay was visiting White Sands National Park, about six hours away by car. The pure white sand dunes stretching out in every direction left a lasting impression.

In terms of food, while not comparable to Japan, I enjoyed Mexican cuisine such as tacos, which suited my taste and made daily life quite comfortable.

Acknowledgments

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the SCES team, who provided both research guidance and assistance with administrative procedures. Dr. Sean M. Thomas offered exceptional support in all aspects of the experimental work.

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