

Completion Report of the Short-Stay Study Abroad Program

INT Program INT-17-3, Spatial and Momentum Tomography of Hadrons and Nuclei
INT Workshop INT-17-68W, the Flavor Structure of Nucleon Sea
Institute for nuclear theory, Washington University, Seattle
26/09/2017-15/10/2017

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An introduction of INT and the University of Washington at Seattle

The institute for nuclear theory (INT) is a national institute in the United States, which was established by the United States Department of Energy (DOE) in 1990. INT is located at the University of Washington in Seattle, Washington. The research topics of INT include nuclear physics, hadron physics and particle physics, many famous scientists works in INT. One of the main goals of INT is to contribute to scientific education through graduate student research, INT summer schools, and INT workshops. Those workshops and summer schools attract more than 300 visitors each year for an average stay of about one month.

The University of Washington at Seattle was founded in 1861, and it is one of the oldest universities on the West Coast of United States. As a famous top research university, the University of Washington at Seattle ranks 11th in the world according to the US News Rankings of 2017. The university owns a very good research reputation, and about 10 Nobel laureates teach at the university.

Research during my stay

Every year many workshops are held by INT with the financial support from by the United States Department of Energy, in 2017 about 11 workshops are organized. They are listed as follows:

- 1) Toward Predictive Theories of Nuclear Reactions Across the Isotopic Chart (INT-17-1a), February 27 - March 31, 2017.
- 2) Precision Spectroscopy of QGP Properties with Jets and Heavy Quarks (INT-17-1b), May 1-June 8, 2017.
- 3) Neutrinoless Double-beta Decay (INT-17-2a), June 13 - July 14, 2017.
- 4) Electromagnetic Signatures of R-process Nucleosynthesis in Neutron Star Binary Mergers (INT-17-2b), July 24 - August 18, 2017.
- 5) Spatial and Momentum Tomography of Hadrons and Nuclei (INT-17-3), August 28 - September 29, 2017.
- 6) SIGN 2017: International Workshop on the Sign Problem in QCD and Beyond (INT-17-64W), March 20 - 24, 2017.
- 7) Probing QCD in Photon-Nucleus Interactions at RHIC and LHC: the Path to EIC (INT-17-65W), February 13 - 17, 2017.
- 8) Lattice QCD Input for Neutrinoless Double- β Decay (INT-17-67W), July 6 - 7, 2017.
- 9) The Flavor Structure of Nucleon Sea (INT-17-68W), October 2 - 13, 2017.
- 10) Neutron-Antineutron Oscillations: Appearance, Disappearance, and Baryogenesis (INT-17-69W), October 23 - 27, 2017.
- 11) Quantum Computing for Nuclear Physics (INT-17-66W), November 14-15, 2017.

There are two workshops that are closely related to my PhD thesis, they are INT Program INT-17-3 (Spatial and Momentum Tomography of Hadrons and Nuclei, August 28 – September 29, 2017) and INT Workshop INT-17-68W (the Flavor Structure of Nucleon Sea, October 2 - 13, 2017). Therefore, I decided to apply for the Short-Stay Study Abroad Program of Sokendai in the April, and I participated the last week of INT Program INT-17-3 and the whole part of INT Workshop INT-17-68W. My period study is September 26-October 15, in the workshops I was asked to give two presentations. My first presentation is on September 28, and the title is *Analysis of Generalized Distribution Amplitudes*. In this talk I showed how to obtain the Generalized Distribution Amplitudes of pion based the experimental measurements of Belle Collaboration on KEKB, and many questions were asked during my presentation. I learned a lot from discussion with some famous researchers, and this will be helpful to my PhD thesis. Since this presentation contains our unpublished results, my talk is not posed on the website of INT at present. I also gave another presentation on October 12, and the title is *Tensor-Polarized Parton Distribution Functions for Spin-1 Deuteron*. This talk is about tensor structure of the deuteron, which will be measured by proton-deuteron Drell-Yan process at Fermilab. The details of this talk can be found at the website of INT:

http://www.int.washington.edu/talks/WorkShops/int_17_68W/

During the visit all the workshop participants also have an office table to study. In this case, the participants can discuss with each other and exchange ideas.

Language at INT

English is the only language used at INT, so I can communicate with other visitors of INT. However, some American researchers speak English very fast and may have the hometown accent. For example, one professor asked a question about my presentation, and I cannot understand his English because he seems to have a southern accent. This is really embarrassing for me. Therefore, a frequent English is really necessary for research.

Difficulties of this travel

There is only one difficulty of this travel during my stay, and it is the food problem. Because the US food is so different from Asian food, so I did not feel good after I ate the local food so many times. The difficulty can be easily solved if I stayed at the university dormitory, since I can cook my meal in the dormitory kitchen.

Expenses of this travel

The expenses are showed in the Table 1, and the largest amount comes from the hotel fee. Since Seattle is a beautiful coast city, many tourists will come to Seattle for sightseeing from the April to November. Therefore, the hotels are rather expensive at the travel season, and it is impossible to find a cheap hotel. As a student, one possibility is to stay at the university dormitory, unfortunately there is no student dormitory for visitors in October which is exactly the beginning of the autumn semester. In order to save money for the travel, one needs to apply for the university dormitory as the first choice. If there is no university dormitory for the visitors, it is better to book the hotel as soon as possible. I bought the air ticket and the insurance from the Tabbitt Tours Company. I made a reservation for the air ticket before the US visa application, and I paid the money after I got the Visa. The health insurance is very necessary for travel in US, since the medical expenses are rather expensive. The bus transportation fee includes the round ticket from Tsukuba to Tokyo Narita Airport and the round ticket from Seattle–Tacoma International Airport to Washington University. Both the hotel fee and the bus transportation fee transferred to JPY according to the currency exchange rate from USD to JPY.

Category	Amount (JPY)
Hotel fee	218,259
Visa fee	18,400
Air ticket and insurance fee	147,650
Transportation fee (Bus)	5,127
Registration fee	6,714

Table 1: Expenses of the short-stay study at Institute for nuclear theory, Washington University, Seattle.

Photos of the University of Washington at Seattle



Red Square of the University of Washington at Seattle



The fountain of the University of Washington at Seattle