

Multiscale Analysis, Modeling and Simulation

-Top Global University Project, Waseda University-

REPORT ON STUDY ABROAD

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1. Study Abroad Destination: Instituto de Matemática Pura e Aplicada (IMPA), Brazil

2. Dates of Stay: August 22, 2017 - December 4, 2017 (105days)

3. Purpose:

To study derivative nonlinear Schrödinger equations.

4. Host Professor: Felipe Linares (IMPA)

5. Education and Research Activity in the Destination

I) Presentations:

Global existence of solutions for the derivative nonlinear Schrödinger equation, Third Workshop on Nonlinear Dispersive Equations, IMECC-UNICAMP, Campinas, Brazil, November 8, 2017.

II) Research Results:

I mainly studied the derivative nonlinear Schrödinger equation (DNLS) which was derived in plasma physics as a model for the propagation of Alfvén waves in magnetized plasma. Recently, I constructed exact periodic traveling waves for (DNLS) which yield the classical solitary waves on the whole line in the long-period limit. During my stay at IMPA, I investigated further properties of periodic traveling waves and connection between them and classical solitary waves from the viewpoint of the long-period limit. From November 8th to November 10th, the workshop on nonlinear dispersive equations was held at Campinas. I attended this conference and gave a presentation about my recent study. At Campinas, I discussed problems of orbital stability and instability with Professor Masahito Ohta who was one of the main speakers at that conference. The discussion with him helped me to clarify the problems and set a direction of my future research.

In September, the new project started with Professor Felipe Linares and Alex Hernandez Ardila who was a postdoctoral researcher of Prof. Linares. Alex was studying nonlinear Schrödinger equations with delta potential or on star graphs. He gave me several questions about problems on star graphs and we started to consider these problems. This project is still going on, and the discussion with them was fruitful.

I was also studying nonlinear Schrödinger equations on general domains during my visit. This work had been going on since my first year in PhD course. I was mainly studying the Cauchy problem for logarithmic Schrödinger equations at IMPA. To construct solutions of this equation is a delicate problem due to singularity of the origin. I could find the simple proof which is independent of classical compactness arguments. I finished writing the paper very recently which contain this work, and have already submitted it to a mathematical journal (you can see the manuscript at [arXiv:1712.10239](https://arxiv.org/abs/1712.10239)).

6. Other Comments:

My first visit at IMPA became an invaluable experience. I would like to express my gratitude

Professor Felipe Linares to his warm hospitality. I am also grateful to my friends at IMPA. Thanks to their help, I had a really great time at Rio de Janeiro. I was also happy to be invited to the workshop at Campinas, where many experts at dispersive equations from all over the world gathered at one place and it was very good learning. Especially, I was so glad to communicate with Professors Gustavo Ponce and Luis Vega who are great mathematicians at my research area. Having such a great experience is completely thanks to "Top Global University Project," Waseda University. I am grateful to Professors Yoshihiro Shibata, Tohru Ozawa and all the staff who are related to this project. Especially, I would like to thank Prof. Ozawa for recommending me to Prof. Linares as a good student and giving me a precious opportunity to visit IMPA. Furthermore, he kindly visited IMPA for only three days in November during my stay, even though it takes more than 24 hours to go from Japan to Brazil. Thanks to that, I could talk with him in Japanese for the first time after I arrived at Rio de Janeiro. I was only one Japanese student at IMPA. When I was talking with a staff at library at IMPA, he said to me, "I have been working here for a long time, however you are a first Japanese who registered this library system since I came here." I think such an experience is invaluable and it could give me an opportunity to broaden my network of contacts.



Figure 1: At a pizza restaurant with my friends studying at IMPA



Figure 2: Group picture of Third Workshop on Nonlinear Dispersive Equations at Campinas