Report about the visit of Bergen of Professor Alexander Solynin

My short visit, from May 24 to May 31 in 2023, to the University of Bergen was a sequel to the visit of Dr. Markina to the Department of Mathematics and Statistics at Texas Tech University, Lubbock, USA, in November-December 2022. During her stay in Lubbock, Dr. Markina introduced me to a topic for a joint research project to study properties of solutions to the Rabi problem in Theoretical Physics. I found this project to be rather fascinated, learned a lot of background on Rabi problem, and was pleased to find that my own results on extremal metrics and quadratic differentials may have an important impact to understanding the qualitative behavior of solutions to this problem. Dr. Markina invited me to visit the University of Bergen in May 2023 to continue the discussion on the research project.

During my stay in Bergen, on May 30, I presented a lecture on *"Problems on the loss of heat: Herd instinct versus individual feelings"* at the Analysis Seminar at the University of Bergen. Also, I had daily meetings with Dr. Markina and her PhD student René Langøen. Three of us worked on the research project "Quadratic differential to study the Rabi problem". The goal of this project is to study the geometry of the Stokes graphs associated with the problem, which was introduced by Isidor Rabi in 1937 to model reactions of atoms to the harmonic electric field with frequency closed to the natural frequency of the atoms. The differential equation governing solutions to the Rabi problem depends on three physical parameters: the level of separation of the fermion mode, the boson-fermion coupling, and the Hamiltonian relevant to the Rabi model. Thus a better understanding of the behavior of solutions to the Rabi problem would be useful for studying of the physical phenomenon behind this model.

The qualitative behavior of solutions to this type of problem is often described in terms of the Stokes graphs of associated quadratic differentials, which is exactly my area of expertise. Thus, during our daily meetings with Dr. Markina and student Mr. Langøen, we discussed a possible complete classification of topological types of domain configurations and Stokes graphs of the related quadratic differential and then we discussed how to identify domain configurations corresponding to choices of the physical parameters of the Rabi model.

We obtained good results, which include complete classification of Stokes graphs for the symmetric case of the Rabi model. Now, we are finalizing our work on a joint paper of three of us on "Quadratic differential to study the Rabi problem", which will be submitted soon. To emphasize the importance of any progress toward understanding solutions to the Rabi problem, I want to mention that a team of mathematicians from MIT work on similar problems and, in a very recent paper "Bootstrapping closed string field theory" by Atakar Hilmi Firat, the author applied some of my results on quadratic differentials to study problems in the closed string field theory. Thus, this area of mathematical research is rather hot and competitive.

I want to mention that this was not my first visit to Norway. In May 2007, I was invited to the international conference "New trends in harmonic and complex analysis", held in Voss, where

I gave a plenary lecture on "Quadratic Differentials and Weighted Graphs on Compact Surfaces". That conference hosted by the University of Bergen and the Norwegian University of Science and Technology in Trondheim attracted many outstanding mathematicians and was perfectly organized.

My recent stay in Bergen also exceeded all my expectations. Besides very fruitful work on a research project, Dr. Markina drove me and my wife to many scenery locations near Bergen. The whole time we stayed in Bergen, the weather was warm and sunny, almost no rain! Also, our hotel was nice, clean, and quiet. I want to thank Dr. Markina for inviting me to work on a joint project and I want to thank the TMS foundation for paying for my stay in that hotel.