

Research Report (April, 2020 - March, 2023)

In the SGU course of Mathematical Physical Science: April 2020-March 2023

Conferring university	Degree name (by completing a course)	Date of conferment
Waseda University	Science	3 15, 2023

Enrollment from
April 2020

Department of Physics and Applied Physics

Takayuki Suzuki

I. List of Papers

T. Suzuki, H. Nakazato, "Generalized Adiabatic Impulse Approximation", Phys. Rev. A 105, 022211 (2022)

II. Record of Awards

III. List of Talks

"Exact WKB analysis of Landau-Zener grid model" The 44th Quantum Information Technology Symposium (2021/5/24-25 online)

"Exact WKB analysis of Landau-Zener grid model and its application" 78th Autumn Meeting, The Physical Society of Japan (2021/09/20-23 online)

"Relationship between Adiabatic/Non-adiabatic Processes and Phase in the Multi-level Parabolic Model" Aspects of Quantum Information and Quantum Foundations (2023/2/9-10 the university of Tokyo)

IV. Research Results in AY 2022

The generalized adiabatic approximation proposed in the previous year is an approximation method applicable to a class of time-dependent multi-level models. This year, non-perturbative analysis was conducted for a multi-level parabolic model that cannot be analyzed using this method. The analysis revealed that the roles of relative phase and transition probability derived from the generalized adiabatic approximation are reversed in this model. This reversal phenomenon is a novel phenomenon in quantum physics that has not been known before. In the future, I will discuss how common this phenomenon is and consider its potential application to control in quantum computers.

V. Summary (From April 2020 to May 2023)

Through the generalized adiabatic approximation proposed last year and the analysis of the multi-level parabolic model, a deeper understanding of the dynamics under time-dependent Hamiltonians in quantum mechanics has been achieved. This research was also a collaboration with Prof. Messina, who graciously accepted my study abroad in Italy, and was a very meaningful experience. In addition, despite the COVID-19 pandemic, the annual international workshop continued, and I was able to have discussions with various researchers. I deeply appreciate all those involved for giving me such a valuable opportunity.