

## Research Report (April, 2021- March, 2022)

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. 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)

### **III. Research Results in AY2021**

The time-evolution of a quantum system under a time-dependent Hamiltonian is not generally solvable even for two-level systems. Therefore, we proposed a method to approximate the time-evolution by unitary matrices (generalized adiabatic impulse approximation) for multi-level Hamiltonians that can be regarded as a two-level system in the vicinity of anticrossings. In particular, approximating with unitary matrices not only facilitates numerical calculations, but also enables physical considerations and approximations to bounded Hamiltonians, which were previously unknown.

### **IV. Research Plan for AY2022**

There are known multi-level models for which the transition probability after infinite time under a time-dependent Hamiltonian can be obtained. Still, there is no rigorous proof for this integrability condition. I plan to derive this integrability condition by using the generalized adiabatic impulse approximation. I will also discuss Landau-Zener interference between continuous and discrete spectra by considering a semi-infinite one-dimensional chain as an open Landau-Zener model and analyzing it non-perturbatively.