量子物理学・ナノサイエンス第 426 回セミナー

Exact WKB analysis for physics

講師　：　松田　智裕 教授
埼玉工業大学 工学部

日程　：　11 月 17 日（月）13:30－

場所　：　本館 2 階 290 物理学系輪講室

概　要

This seminar will discuss applications of exact WKB analysis in physics and explore how it can differ from conventional calculations. After explaining the Landau–Zener transition, on which our analysis is based, we will expand the model to see how the difference manifests itself in the calculation. In the first part [1], we provide specific examples where the linear approximation at the level crossing, commonly used in Landau-Zener transitions, does not yield a good approximation. We will also mention the possibility that the Stokes lines may differ depending on whether the interacting electric field is a classical electromagnetic field or a photon[1]. As applied examples, we also explain particle creation in the early universe[2], the emergence of asymmetry due to CP violation[3], the Schwinger effect[4], the Unruh effect[4], and Hawking radiation[4]. For CP violation to affect the asymmetry between particles and antiparticles in baryon number generation, it is shown that multiple Stokes phenomena must undergo quantum interference[3]. Particle production in steady states, such as the Schwinger effect and Hawking radiation, can be solved "locally" by examining in detail how degrees of freedom like gauge and Lorentz symmetries are treated in differential geometry[4].

[1] Phys. Rev. A **112** (2025) 3, 032224, e-Print:2505.09240
[2] JHEP **03** (2021) 090, e-Print: 2010. 14835
[3] JHEP **02** (2022) 131, e-Print: 2104. 02312, JHEP **01** (2023) 088, e-Print: 2203.04497
[4] JHEP **05** (2025) 216, e-Print: 2404.19160, Int. J. Mod. Phys. A **40** (2025) 28, 2550130, e-Print: 2501.　09919

連絡教員　　藤井　啓資（内線 2136）