

# 粒子物理与原子核物理学科学学术报告

## Quantum Field Theory on the Worldline: Applications to the Schwinger Effect, Chirality Generation, and N-photon Scattering

**会议地址：**物质楼C1204

**会议时间：**2024年09月11日 16:00 – 17:30

**报告人：**Dr. Patrick Copinger (University of Plymouth)

**摘要：**Quantum field theories may be defined not only in the textbook second-quantized picture, but also in a first-quantized one with proper time replacing what would be time in a similar quantum mechanical-like setting. Such a formulation possesses many merits; one of which lies in the study of background fields, in that all orders of the coupling to the background field may be included without recourse to perturbation theory. I discuss several highlights made possible in the non-perturbative background picture including the Schwinger Effect (or the vacuum instability in strong electric fields leading to particle anti-particle pair production) and how the Schwinger effect facilitates the chiral anomaly [1]. The extension to non-Abelian fields as well as exotic backgrounds are also further discussed [2]. Another merit of the worldline formalism is that large swaths (for higher-order processes) of Feynman diagrams are naturally incorporated into the proper time construction. I illustrate this simplification through tree-level scattering in a plane-wave or shock-wave background [3]. Last, extensions to higher-order loops are briefly reviewed.

[1] PC, K. Fukushima, S. Pu, Phys. Rev. Lett. 121, 261602 (2018), [1807.04416]; PC, S. Pu, Int. J. Mod. Phys. A, 35, 28, 2030015 (2020), [2008.03635].

[2] PC, K. Hattori, D.L. Yang Phys. Rev.D 107, 5, 056016 (2023), [2208.12913].

[3] PC, J.P. Edwards, A. Ilderton, K. Rajeev, Phys.Rev.D 109, 6, 065003 (2024), [2311.14638]; (2024) [2405.07385].

**报告人简介：**Patrick Copinger research interests lie in the worldline representation of quantum field theories, strong field physics such as strong field quantum electrodynamics, and the chiral anomaly. He is a postdoctoral researcher at University of Plymouth in the U.K. Before that he has held appointments at Academia Sinica in Taiwan, and YITP Kyoto University in Japan, and has earned his PhD at the University of Tokyo in 2020.

