TDLI Astro Plasma Seminar

李政道研究所 TSUNG-DAO LEE INSTITUTE

Hui-Chun Wu 武慧春

(Zhejiang University)

Title: Circular-polarization mechanism of giant pulses and fast radio bursts

Time: 14:00-15:00, 9 January (Thursday), Shanghai time

Host: Longqing Yi

Location: N600

Join Tencent Meeting： https://meeting.tencent.com/dm/zqePkiLtwXeA

Meeting ID: 988905057 (no password）

Abstract：

The remnant of the supernova SN1054 is the Crab Nebula, which contains the neutron star at its center. Giant radio pulses from the Crab neutron star were first detected in 1968. High-resolution observations in 2003 revealed that these giant pulses consist of sub-pulses with durations shorter than 1 nanosecond, and these sub-pulses exhibit strong circular polarization. Recently, I discovered that a giant pulse is composed of pairs of equally-spaced sub-pulses, with one sub-pulse being left-circularly polarized and the other right-circularly polarized [Wu, ApJL 974, L21 (2024)]. To explain this phenomenon, I propose that the electron-positron plasma in the neutron star's magnetosphere is highly asymmetric, for instance, not fully neutralized. In such an asymmetric plasma, the nonlinear Faraday effect can split a linearly polarized wave into two circularly polarized modes, each with different propagation speeds. This model also naturally accounts for the anomalous dispersion and random polarization angles observed in Crab giant pulses. Furthermore, the same mechanism can explain the high-degree circular polarization observed in some fast radio bursts from magnetars. A reliable understanding of the circular polarization in both giant pulses and fast radio bursts is crucial for unraveling their radiation mechanisms, which remain an open question.

Biography:

H.-C. Wu graduated from Department of Physics at Shanxi University in 2001 and received his PhD from Institute of Physics, Chinese Academy of Sciences, in 2006. After postdoctoral work at Max-Planck Institute of Quantum Optics and Los Alamos National Laboratory, he joined School of Physics at Zhejiang University as a professor in 2013. His research interests include relativistic laser-plasma physics, high-energy lightning phenomena, and fast radio bursts. His contributions include laser compression using plasma gratings, generation of half-cycle attosecond pulses, coherent Thomson scattering theory, and microwave-bubble model of ball lightning.

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