APCTP 2025 JRG SYMPOSIUM

Probing the fundamentals and applications of magnetized plasma physics in the Universe

Dr. Young Dae Yoon

APCTP

July 2nd (Wed.) 10:00

#512, Online via ZOOM

Because most of the baryonic matter in the Universe is in the plasma state, a deep investigation of plasma physics is necessary for both fundamental understanding and state-of-the-art applications. In this talk, I present examples of both instances, namely the problem of magnetogenesis in the plasma, and magnetic topology change in tokamaks via plasma turbulence. For the first part, I introduce a theoretical framework in which a quantity called "canonical vorticity" is examined. This framework tells us that only the term that contains the plasma pressure tensor is responsible for the spontaneous generation of magnetic fields. This term is shown to generalize popular magnetogenesis mechanisms and predict new ones. For the second part, I introduce how turbulence can be used to change magnetic topology in a nuclear fusion device so that a technique called local helicity injection becomes possible. A combination of simulations and experiments shows that this is indeed possible.
I conclude by flashing a variety of other topics that plasma physics can address both fundamentally and in the applied sense.

■ **ZOOM Webinar**
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■ **Contact information**
- Office: Research Support Team (rs@apctp.org)

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APCTP 2025 JRG SYMPOSIUM

Recent Progress in Statistical Physics: Nonequilibrium Thermodynamics and Complex Systems

Dr. Jong-Min Park

APCTP

July 2nd (Wed.) 10:40

#512, Online via ZOOM

In this seminar, I will present recent progress and ongoing research directions of our Junior Research Group, focusing on key topics in nonequilibrium thermodynamics and complex systems. The first topic concerns thermodynamics in microscopic systems, also known as stochastic thermodynamics. A central challenge in this field is to extend the conventional formalism beyond the Langevin description. I will introduce our theoretical contributions toward this goal, including generalized thermodynamic relations and frameworks applicable to systems with quantum effects, strong system-bath coupling, or interactions with nonequilibrium environments. The second topic focuses on time-series analysis. Our research aims to infer entropy production directly from observed time series without prior knowledge of the underlying dynamics and to utilize entropy-based measures to extract meaningful information hidden behind time series in complex systems. The third topic addresses synchronization in oscillator networks, where we investigate how synchronization can be enhanced as system size or network connectivity increases. I will introduce our approach to identifying optimal conditions for synchronization in such growing systems. Finally, I will outline promising directions for future research across these topics.

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