2025 APCTP Symposium

Date: June 4, 2025

Place: #512, APCTP & Common Room

Program:

Time	Program	Presenter
10:00-10:30	Thermodynamics and stability analysis of magnetized plasma via partition function approach	Suresh Basnet (YST)
10:30-11:00	Detection prospects of solitary black holes in the Milky Way galaxy by next-generation GW detectors	Susmita Jana (YST)
11:00-11:30	Solving Einstein equation using recursions	Kanghoon Lee (JRG Leader)
11:30-14:00	Lunch with President Misao Sasaki	-

Talk 1 by Suresh Basnet (10:00~10:30)

Title: Thermodynamics and stability analysis of magnetized plasma via partition function approach

Abstract: In this work, we have used the classical Hamiltonian to construct the partition function for a cylindrical collisionless magnetized plasma column which is frequently encountered in fusion devices, astrophysical plasma jets, pinch jet thrusters, etc. The fact that plasma is confined within a column limits the allowed momenta that the constituent particles can have, imposing integration limits in the partition function. The volume, temperature, and magnetic perturbation applied to the system configures the microstates over the phase-space which allows us to study the various macroscopic properties of magnetized plasma such as Helmholtz free energy, pressure, entropy, and energy fluctuation of the system. Moreover, we have retained the Chew-Goldberger-Low (CGL) theory by using canonical free energy and expressing the CGL constants in terms of the physical variables of the system. The recovery of CGL equations along with macroscopic thermodynamic proprieties provides a solid foundation that connects the statistical physics to the kinetic and fluid models of magnetized plasma. The effect of a magnetic field on entropy production and energy fluctuation on the stability of a magnetized plasma system has been discussed.

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References:
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[2] X.-P. Huang, J. Bollinger, T. Mitchell, and W. M. Itano, Physical Review Letters, 80, 73 (1998).
[3] M. Capitelli, D. Bruno, G. Colonna, C. Catalfamo, and A. Laricchiuta, Journal of Physics D: Applied Physics, 42, 194005 (2009).

Talk 2 by Susmita Jana (10:30~11:00)

Title: Detection prospects of solitary black holes in the Milky Way galaxy by next-generation GW detectors

Abstract: The Milky Way galaxy is estimated to host up to a billion stellar-mass solitary black holes (BHs). The number and distribution of BH masses can provide crucial information about the processes involved in BH formation, the existence of primordial BHs, and the interpretation of gravitational wave (GW) signals detected in LIGO-VIRGO-KAGRA. Sahu et al. recently confirmed one solitary stellar-mass BH in our galaxy using astrometric microlensing. This work proposes a novel mechanism to identify such a BH by analyzing the frequency and damping of the quasi-normal modes of GW generated from the interaction of the BH and EM wave originating from a transient electromagnetic (TEM) source. The incoming EM waves distort the curvature of a BH, releasing GWs as it returns to its steady state. Using the covariant semi-tetrad formalism, we quantify the generated GWs via the Regge-Wheeler tensor and relate the GW amplitude to the energy of the TEM. We demonstrate that isolated BHs at a distance of 50 pc from Earth can be detected by the next-generation detectors such as LIGO A+ and Einstein Telescope. Additionally, we discuss the observational implications for orphan afterglows associated with GRBs, highlighting the potential for further discoveries.

Talk 3 by Kanghoon Lee (11:00~11:30)

Title: Solving Einstein equation using recursions

Abstract: I'll discuss solving the perturbative Einstein equation using recursions and the iterative structure of the loop integrals. Using this method, I'll show how to derive the Schwarzschild metric to all orders in Newton's constant. It is a first all-order perturbative computation in Einstein gravity with a matter source. I'll also discuss the generalization to the binary black holes.