Contribution ID : **2** Type : **In person**

Gravitational Wave Birefringence in Fuzzy Dark Matter and Symmetron Cosmology

Monday, 28 July 2025 11:30 (30)

Gravitational wave (GW) birefringence is a remarkable phenomenon which provides a window to test partiy violation in gravity. In this talk, I would discuss our recent studies on the GW birefringence in the FDM and symmetron models. In particular, inspired by the complicated distributions of the Fuzzy dark matter (FDM) and the symmetron field in our Galaxy, we are led to considering the GW propagation over the light scalar profile of general spacetime dependence. We apply the well-known eikonal approximation to solve this technical problem. In the FDM case, it is shown that GWs exhibit the amplitude birefringence with the dominant contribution only depending on the GW frequency. More importantly, the birefringence factor shows a periodic time modulation with its period reflecting the FDM mass, which is the smoking gun to test this FDM-induced mechanism. In the symmetron model, we introduce a new Z_2-symmetric Chern-Simons-like coupling, which can also generate the amplitude birefringence. However, unlike the FDM case, the birefringence induced by the galactic symmetron field is suppressed due to its screening mechanism. Thus, the GW birefringence is dominantly generated by the extra-galactic symmetron distribution, which can be further used to place a reasonable constraint on this parity-violating coupling in the symmetron model.

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Session Classification : Morning Session