

Collective properties of gravitational waves in a radiation-dominated universe

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Speaker

Prof. Atsuhisa Ota (太田敦久)

School of Physics, Chongqing University

重庆大学



Abstract

The properties of waves are modified by the medium through which they propagate. For example, electromagnetic waves in a thermal plasma exhibit collective effects, such as a plasmon gap and Landau damping. Motivated by these phenomena, in this talk I discuss the collective properties of gravitational waves in a cosmological medium, such as the thermal radiation bath of the early universe.

An adiabatic dispersion relation consistent with diffeomorphism invariance reveals a plasmon gap of order the cosmological curvature scale. Although the frequencies of superhorizon gravitational waves lie below this gap, the dispersion relation cannot be interpreted naively. The appropriate cosmological boundary conditions ensure the existence of a conserved superhorizon mode.

The interpretation of Landau damping is also subtle. Cosmic expansion gives rise to a pole on the first Riemann sheet, in contrast to the second-sheet pole associated with conventional Landau damping. However, within the accuracy of the adiabatic approximation, this pole cannot be resolved separately from the branch point. By imposing the appropriate boundary conditions in a real-time formulation, we recover Weinberg's kinetic-theory result for the damping of tensor modes.

Biography

Associate Professor Atsuhisa Ota received his Ph.D. from Tokyo Institute of Technology in 2017. He was awarded with a JSPS doctoral fellowship (2017-2018) and joined the University of Cambridge as a JSPS overseas fellow (2019-2020). After postdoctoral position at Ohio University (2020-2021), IAS Postdoctoral Fellow in HKUST (2021-2023), he has been working at Chongqing University.