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GW from Metastable Cosmic String in Delayed Scaling Scenario ——A Cosmological Prospective of View

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Recent observations from pulsar timing arrays (PTAs) suggest the existence of a stochastic gravitational wave background (GWB) in the nanohertz frequency range. One of the most promising explanations is a GWB generated by metastable cosmic strings.

However, the standard formation scenario for (meta)stable cosmic strings—based on the Kibble-Zurek mechanism triggered by a thermal phase transition—faces several challenges. Notably, the GWB spectrum predicted by a cosmic string network with a relatively large string tension, as required to explain the PTA results, is in tension with the null detections by ground-based interferometers such as LIGO-Virgo-KAGRA (LVK) at higher frequencies. Moreover, in conventional setups, a monopole-forming phase transition preceding the cosmic string-forming symmetry breaking often disrupts the subsequent formation of the string network.

These issues can be avoided in the delayed scaling scenario, in which cosmic strings are generated during inflation and their network is diluted away, beginning to evolve and emit gravitational waves only at a later time. In this framework, a cosmic string network with large tension can naturally evade LVK constraints while still accounting for the PTA signal.

In this talk, I will present predictions for the stochastic GWB spectrum from metastable cosmic strings in the delayed scaling scenario and identify in which case it is consistent with current observations. I will also discuss implications for inflationary dynamics and possible ultraviolet completions such as grand unified theories.

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