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Probing Grand Unification through Gravitational Waves, Proton Decay, and Fermion Masses

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Motivated by the direct discovery of gravitational waves (GWs) from black holes and neutron stars, there is a growing interest in investigating GWs from other sources. Among them, GWs from cosmic strings are particularly fascinating since they naturally appear in a large class of grand unified theories (GUTs). Remarkably, a series of pulsar-timing arrays (PTAs) might have already observed GWs in the nHz regime, hinting towards forming a cosmic string network in the early universe, which could originate from phase transition associated with the seesaw scale emerging from GUT. In this talk, I show that if these observations from PTAs are confirmed, GWs from cosmic strings, when combined with fermion masses, gauge coupling unification, and proton decay constraints, the parameter space of the minimal SO(10) GUT becomes exceedingly restrictive. The proposed minimal model is highly predictive and will be fully tested in a number of upcoming gravitational wave observatories.

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