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Gravitational Waves from Early Universe Turbulent Sources at the QCD Scale

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Gravitational waves (GWs) may be sourced by hydrodynamic and hydromagnetic turbulence generated in cosmological phase transitions such as that at the quantum-chromodynamic (QCD) scale. I will discuss the results of numerical simulations of GWs from the QCD scale induced by various models of primordial turbulence and considering new limits on the turbulent energies which properly account for the decaying nature of the turbulent sources. I will show that the efficiency of GW production and the GW energy spectra depend strongly on the nature of the turbulence and that the new BBN bounds allow for stronger GW signals than previously expected. I will address the prospects for detecting these GW signals from the QCD scale through pulsar timing arrays (particularly in regard to the possible detection of a GW background by the NANOGrav Collaboration) and astrometric missions (such as GAIA).

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