## Phenomenology 2022 Symposium: From Virtual to Real



Contribution ID: 24

Type: not specified

## Gravitational Waves from Early Universe Turbulent Sources at the QCD Scale

Monday 9 May 2022 14:45 (15 minutes)

Gravitational waves (GWs) may be sourced by hydrodynamic and hydromagnetic turbulent sources in the early universe at epochs such as the cosmological quantum-chromodynamic (QCD) transition. I will discuss the results of numerical simulations of GWs from the QCD scale induced by various models of primordial turbulence: purely hydrodynamical turbulence induced by fluid motions and magnetohydrodynamic (MHD) turbulence dominated either by kinetic or magnetic energy, both with and without helicity. I will show that the efficiency of GW production and the GW energy spectra depend strongly on the nature of the turbulence. Prospects for detecting these GW signals from the QCD scale through pulsar timing arrays and astrometric missions will be addressed. In particular, I will discuss the potential of explaining the possible detection of a stochastic GW background by the NANOGrav collaboration with turbulence at the QCD scale and the constraints this observation could place on the properties of such turbulence.

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