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The SGWB produced by MHD turbulence in the early universe

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The stochastic gravitational wave background (SGWB) produced at the electroweak phase transition is expected to be peaking within LISA's sensitivity frequency range, being a promising test of high energy physics and beyond Standard Model extensions. The contribution of magnetohydrodynamic (MHD) turbulence to the cosmological SGWB is one of the least understood sources due to the necessity, in general, to perform large-scale numerical simulations solving MHD equations. In this talk, I will review recent numerical simulations that have addressed this issue and studied the potential detectability of the resulting SGWB and its polarization by space-based GW detectors like LISA. I will focus on magnetically dominated MHD turbulence and compare to astrophysical constraints that can provide a multi-messenger study of primordial magnetic fields. In particular, I will present the SGWB produced by decaying MHD turbulence, which has been validated by numerical simulations for a particular range of parameters. This model has been recently used to constrain the characteristics of a primordial magnetic field produced at the QCD phase transition with the common-spectrum process reported by the different pulsar timing array collaborations in the last few years.

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