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Ultra-long wavelength gravitational waves with pulsar timing array

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A rapidly emerging messenger in astrophysics is gravitational waves (GWs). A new window in the GW spectrum was recently opened when emerging evidence for ultra-long wavelength or nanoHertz frequency GWs was reported by four major pulsar timing array experiments (PTAs). These experiments use a collection of widely separated pulsars in the sky to look for a characteristic spectrum and spatial correlation due to an isotropic stochastic gravitational wave background (SGWB) believed to originate by the superposition of continuous gravitational waves emitted by an ensemble of gravitational radiation dominated in-spiralling super-massive black hole binary systems. A review of these experiments in the context of SGWB will be presented in this talk followed by a discussion of results of joint analysis by Indo-Japanese pulsar timing array (InPTA) and European pulsar timing array (EPTA) collaboration. These results will be examined in the context of similar results from Parkes pulsar timing array (PPTA), North American nanoHertz Observatory for gravitational waves (NANOgrav) and Chinese pulsar timing array (CPTA). Results from a recent comparison of these results jointly by International pulsar timing array (IPTA) will be presented, which suggests a higher significance detection after combining data from all the experiments. Recent efforts in improving the noise models with low frequency data and challenges in IPTA data combination will be described. Finally, the talk concludes with a brief look at possible new astrophysics, where the PTA data as well as multi-messenger astronomy is likely to contribute significantly in developing the field of gravitation and cosmology.

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