15th Patras Workshop on Axions, WIMPs and WISPs

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Gravitational Atoms

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Particles in a yet unexplored dark sector with sufficiently large mass and small gauge coupling may form purely gravitational atoms (quantum gravitational bound states) with a rich phenomenology. Near-Planckian atoms decay to gravitons immediately after being produced in the very early universe, creating a nearly monochromatic, isotropic and highly energetic gravitational wave signal. If Einstein gravity is valid all the way up to the Planck scale, and the gravitational waves are redshifted from the earliest moments after inflation until today using the standard Λ CDM scenario, the minimum frequency attainable in this scenario is 10^{13} Hz, three orders of magnitude above the expected cutoff from primordial gravitational waves. Modified Einstein gravity or non-standard cosmological evolution is needed to bring the frequency below that threshold. Gravitational atoms naturally arise in the minimal PIDM scenario consisting of a GUT-scale scalar particle with only gravitational interactions.

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