PPC 2021: XIV International Workshop on Interconnections between Particle Physics and Cosmology

Contribution ID: **267** Type: **Dark Matter**

Gravitational Decoherence with Applications to Dark Matter Phenomenology

Thursday 20 May 2021 17:15 (15 minutes)

Nontrivial quantum arrangements of matter, such as Schrodinger cat-like states, are sensitive to decoherence from their environment. However, matter that interacts only gravitationally is weakly coupled to its environment, and thus may exhibit slower rates of decoherence. Since dark matter (DM) may only interact via gravity, we explore the decoherence rate of a dark-matter-Schrodinger-cat-state (DMSCS). In the nonrelativistic approximation of gravity, we find that a superposition of distinct DM density profiles can undergo decoherence from the scattering of nearby standard model (SM) particles on observable timescales. In addition, when considering light bosonic DM like an axion, one can conceive of a superposition of the phase of oscillation of the scalar (axion) field, requiring a truly relativistic formalism of gravitational scattering. We derive such a formalism and find that for typical DM populations in the Milky Way, a DMSCS of the axion phase can maintain quantum coherence for exponentially long times, while exotic configurations including DM near a black hole and dense boson stars can experience rapid decoherence. This can have potential observable consequences for direct detection experiments that are sensitive to the axion's phase, such as haloscopes which rely on resonant cavities to detect axions. This talk will be based on the work in Refs. 2005.12287, 2012.12903, and 2103.15892.

Authors: ALLALI, Itamar; HERTZBERG, Mark (Tufts University)

Presenter: ALLALI, Itamar

Session Classification: BSM with Compact Objects 2