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How dark matter conspires to facilitate baryogenesis at the electroweak scale

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The standard model is insufficient to explain two a-priori unrelated problems in modern physics, the nature of the cosmological dark matter (DM) and baryon asymmetry. The latter has long been sought to
be explained by baryogenesis at the electroweak scale, which, however, has been proven to be very difficult for a Higgs boson mass as high as 125 GeV.
In this presentation, we will explore a scenario by which those two problems may be solved at once. We consider a variant of 'hidden sector DM', namely ultralight, bosonic particles which go into a coherent ground state almost
immediately after their birth upon inflaton decay. The DM is supposed to be charged under a U(1)-symmetry, with the charge being the (conserved) DM abundance. The cosmic evolution of this complex scalar field dark matter (SFDM)
has been studied in the past, where it has been found that the expansion history can be in accordance with LCDM, if the fundamental parameters of the model, boson mass and self-interaction, are appropriately constrained by observations.
In particular, SFDM morphes from cold DM to relativistic DM when approaching the early Universe, where its contribution to Neff - the extra relativistic degrees of freedom - has to be properly contrained by Big Bang nucleosynthesis and
the primordial gravitational wave background from inflation. In our model, SFDM is the dominant cosmic component in the Universe after reheating, since its early evolution is driven by its kinetic energy term, rendering its
equation-of-state to be that of 'maximal stiff matter', when w=p/rho ~ 1. The associated expansion rate is many orders of magnitudes higher than in the standard radiation-dominated case, and is a welcome feature to accomplish
a first-order phase transition at the electroweak scale, which is strong enough to facilitate baryogenesis in simple extensions to the standard model Higgs particle. To this end, we will report on the implications of this cosmological
model for a first-order phase transition in the minimal standard model, as well as in the standard model with a low cutoff in which the Higgs potential is augmented by a phi^6-operator.

Oral or Poster Presentation

Oral

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