Contribution ID: **279** Type: **talk**

Asymmetric Reheating by Primordial Black Holes

Wednesday 14 July 2021 16:30 (15 minutes)

We investigate Hawking evaporation of a population of primordial black holes (PBHs) as a novel mechanism to populate a dark sector which consists of self-interacting scalar dark matter with pure gravitational coupling to the visible sector. We demonstrate that depending on initial abundance of PBHs and the dark matter mass, the dark sector can reach chemical equilibrium with a temperature above, below, or equal to the temperature of the visible sector at the same time. Due to the absence of non-gravitational mediators between two sectors, any temperature asymmetry between two sectors will persist and evolve to keep the entropy of each sector conserved during the expansion of the Universe. We show that an equilibrated dark sector populated by Hawking evaporation of PBHs can explain the dark matter relic abundance today for dark matter in the MeV-TeV mass range.

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Session Classification: Dark Matter

Track Classification: Dark Matter