Contribution ID: **36** Type: **not specified**

Freezing-in into a thermalized hidden sector.

Thursday 10 June 2021 08:25 (25 minutes)

The standard freeze-in paradigm has a hidden UV sensitivity in that the initial DM population is assumed to be exactly zero. We explore how a pre-existing population of DM, either alone or as part of a thermalized dark sector, affects the dynamics of freeze-in. The UV sensitivity of this more general scenario, which we dub "glaciation", is manifested in the dependence of the late-time relic abundance on the size of the initial population. We dispense rather quickly with the case of a stand-alone initial DM abundance, which simply leads to an offset in the relic abundance compared to the standard scenario, but we find rich and interesting dynamics in the case of a pre-existing thermalized dark sector. Our results have important consequences for direct detection experiments searching for freeze-in dark matter.

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Session Classification: MOCa