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## Freeze-in Dark Matter from Secret Neutrino Interactions

We investigate a simplified freeze-in dark-matter model in which the dark matter only interacts with the standard-model neutrinos via a light scalar. The extremely small coupling for the freeze-in mechanism is naturally realized in several neutrino-portal scenarios with the secret neutrino interactions. We study possible evolution history of the hidden sector: the dark sector would undergo pure freeze-in production if the interaction between the dark-sector particles are negligible, while thermal equilibrium within the dark sector could occur if the re-annihilation of the dark matter and the scalar mediator is rapid enough. We investigate the relic abundance in the freeze-in and dark freeze-out regimes, calculate evolution of the dark temperature, and study its phenomenological aspects on BBN and CMB constraints, the indirect-detection signature, as well as the potential to solve the small scale structure problem.

### Mini-abstract

Dark Matter interactions via a weak scalar and its implications on freeze-in.

### Experiment/Collaboration

**Primary author:** DU, Yong (University of Massachusetts-Amherst)

**Co-authors:** HUANG, Fei (Chinese Academy of Sciences, Beijing); LI, Hao-Lin ( University of California, Irvine); YU, Jing-Hao (Chinese Academy of Sciences, Beijing)

**Presenter:** DU, Yong (University of Massachusetts-Amherst)

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