

## Constraining UV freeze-in of light relics with current and next-generation CMB observations

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The Cosmic Microwave Background (CMB) provides a powerful tool for testing the existence of light particle species beyond the Standard Model (BSM). In particular, light relics produced via freeze-in are a common feature of models where new light degrees of freedom interact too weakly with the Standard Model (SM) plasma to achieve full thermalization in the early Universe. This talk focuses on ultraviolet (UV) freeze-in scenarios, where the new light species is produced through non-renormalizable interactions typical of BSM models. Several benchmark BSM models are explored, including axion-like particles from Primakoff production, massless dark photons, and light right-handed neutrinos. We discuss the impact on the effective number of neutrino species and demonstrate that next-generation CMB observations will be able to complement—and in some cases surpass—current astrophysical, laboratory, and collider constraints on the couplings of the SM to the light relic.

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