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Effective Theory of Freeze-in Dark Matter

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We perform a model independent study of *freeze-in* of massive particle dark matter (DM) by adopting an effective field theory framework. Considering the dark matter to be a gauge singlet Majorana fermion, odd under a stabilising symmetry Z_2 under which all standard model (SM) fields are even, we write down all possible DM-SM operators upto and including mass dimension eight. For simplicity of the numerical analysis we restrict ourselves only to the scalar operators in SM as well as in the dark sector. We calculate the DM abundance for each such dimension of operator considering both *UV and IR freeze-in* contributions which can arise before and after the electroweak symmetry breaking respectively. After constraining the cut-off scale and reheat temperature of the universe from the requirement of correct DM relic abundance, we also study the possibility of connecting the origin of *neutrino mass* to the same cut-off scale by virtue of lepton number violating Weinberg operators. We thus compare the bounds on such cut-off scale and corresponding reheat temperature required for UV freeze-in from the origin of light neutrino mass as well as from the requirement of correct DM relic abundance. We also briefly comment upon the possibilities of realising such DM-SM effective operators in a UV complete model.

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