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Conversions in multi-component dark sectors: a phase space level analysis

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We study the thermal freeze-out of two-component dark matter (DM). The freeze-out in a multicomponent dark sector can be more complex and richer than the canonical single-component WIMP DM. This is owing to the relevance of processes of conversions, co-annihilations, co-scatterings, decays and self-scatterings in addition to those of annihilations and elastic scatterings, which can affect the momentum distributions of the dark sector particles and thereby the DM relic abundance. Models with suppressed elastic scatterings are known to have DM freeze-out outside of kinetic equilibrium so that a precise calculation of relic abundance needs to take into account the effect of non-thermal phase space distributions. The pseudoscalar mediated (Coy) DM model is an example of such a model. We develop a numerical tool to calculate the DM abundance in such models with a multi-component dark sector, from a solution of the full momenutum-dependent Boltzmann equations and use it to study a pseudoscalar mediated two-component DM model.

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