

BSM² - Beyond the Standard Model BrainStorming Meeting: Particle Physics and Cosmology interface



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Freeze-in Complements Freeze-out

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There are many extensions of the Standard Model with a dark matter (DM) candidate obtained via the freeze-out mechanism. It can happen that after all experimental and theoretical constraints are taken into account, all parameter points have a relic density below the experimentally measured value. This means that the models solve only partially the DM problem, and at least one more candidate is needed. In this work we show that it is possible to further extend the model with a DM candidate obtained via the freeze-in mechanism to be in agreement with the relic density experimental measurement. Once the relic density problem is solved with this addition, new questions are raised. This new model with at least two DM candidates could have a freeze-out undetectable DM particle both in direct and indirect detection. This could happen if the freeze-out DM particle would have a very low density. Hence, a collider DM hint via excess in the missing energy with no correspondence in direct and indirect detection experiments, could signal the existence of a Feebly Interacting Massive Particle (FIMP). Conversely, if a DM particle is found and a particular model can explain all observables except the correct relic density, an extension with an extra FIMP would solve the problem. The freeze-in DM candidate, due to the small portal couplings, will evade most experimental constraints.

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