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Multi-Component Dark Matter System with non-standard annihilation processes

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Conversions and semi-annihilations of dark matter (DM) particles in addition to the standard DM annihilations are considered in a three-component DM system. We find that the relic abundance of DM can be very sensitive to these non-standard DM annihilation processes, which has been recently found for two-component DM systems. To consider a concrete model of a three-component DM system, we extend the radiative seesaw model of M_a by adding a Majorana fermion χ and a real scalar boson ϕ , to obtain a $Z_2 \times Z_2'$ DM stabilizing symmetry, where we assume that the DM particles are the inert Higgs boson, χ and ϕ . It is shown how the allowed parameter space, obtained previously in the absence of χ and ϕ , changes. The semi-annihilation process in this model produces monochromatic neutrinos. The observation rate of these monochromatic neutrinos from the Sun at IceCube is estimated. Observations of high energy monochromatic neutrinos from the Sun may indicate a multi-component DM system.

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