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Thermal field theory of dark matter and thermal corrections to dark matter annihilation cross sections

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Models incorporating moderately heavy dark matter (DM) typically need charged (scalar) fields to establish admissible relic densities. Since the DM freezes out at an early epoch, thermal corrections to the cross sections can be important. Here, we study the IR behaviour at finite temperatures, of dark matter annihilation cross sections, which potentially contains both both linear and sub-leading logarithmic divergences. We prove that the theory is IR-finite to all orders with the divergences cancelling when both absorption and emission of photons from and into the heat bath are taken into account. While 4-point interaction terms are known to be IR finite, their inclusion leads to a neat exponentiation. The finite remainder has then been calculated to NLO in the theory; these corrections can affect the collision term in the Boltzmann equation and in principle alter the dark matter relic density.

Designation

Faculty

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Institution

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