

NEW PERSPECTIVES IN CONFORMAL FIELD THEORY AND GRAVITY

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Assessing the Role of Finite Temperature Corrections in Dark Matter Freeze-In

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Models of feebly-interacting Dark Matter (DM) have gained popularity due to the non-observation of DM in direct detection experiments. Unlike DM freeze-out, which occurs when the dark sector particles are non-relativistic, feebly-interacting DM is primarily produced at temperatures corresponding to the heaviest mass scale involved in the production process. As a result, quantum and finite temperature corrections can significantly alter the predictions for the DM production rate and hence for its relic abundance. However, current calculations often rely on the conventional Boltzmann equation approach performed at either zero temperature or with thermal masses to regulate infrared divergences in scattering amplitudes throughout all temperature regimes. In this talk, I will discuss some recent advancements of an ongoing effort to consistently calculate the DM production rate from first principles, combining the real-time approach of thermal quantum field theory with Schwinger–Dyson equations derived from a two-particle irreducible (2PI) effective action. We compare our results with the Boltzmann approach, both in vacuum and by using thermal masses, and with different approximations for the in-medium propagators. Moreover, we discuss the applicability and accuracy of these various approaches for phenomenological studies.

Summary

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