

Open quantum system dynamics of non-relativistic dark matter pairs

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For a quantitative investigation on the real-time evolution of heavy dark matter in the early universe, not only close-to-threshold effects but also key aspects such as decoherence and dissipation due to interactions with the thermal environment need to be taken into account. We employ the formalism of open quantum systems and determine the out-of-equilibrium evolution equations for non-relativistic dark matter pairs from first principles within the framework of potential non-relativistic effective field theories at finite temperature. For the considered hierarchy of energy scales, we eventually derive the coupled semiclassical Boltzmann equations from the quantum master equations and highlight their range of validity and consistency.

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