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Lattice NRQCD study of thermal Sommerfeld factor

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The thermal Sommerfeld factor, concerning the co-annihilation rate of heavy quarks in thermal equilibrium, is shown that it can be defined in terms of two-point correlator ratios. Then, we calculate non-perturbatively the co-annihilation rate of heavy quarks close to thermal equilibrium using lattice NRQCD framework. Lattice measurements indicate a modest suppression in the octet channel, in reasonable agreement with perturbation theory, and a large enhancement in the singlet channel, much above the perturbative prediction. The additional enhancement is suggested to originate from bound state formation and subsequent decay, omitted in previous estimates of thermal Sommerfeld factors, which were meant for use in Boltzmann equations governing single-particle phase space distributions. We show how bound state effects can be included in perturbative computations. The latter formalism may find applications also in specific dark matter models.

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