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Reheating and Post-inflationary Production of Dark Matter

In the first stages of inflationary reheating, the mean energy of the radiation produced by inflaton decay is higher than the commonly defined reheating temperature. In thermal equilibrium, particle production can then be significantly enhanced relative to the subsequent radiation dominated era. Furthermore, in the earliest stages of reheating, before thermalization takes place, scattering of the inflaton decay products with momenta comparable to the inflaton mass can further enhance the particle production rate relative to the thermal one.

In this talk I will present a landscape of scenarios for freeze-in dark matter production during reheating. I will discuss the role played in the determination of the dark matter relic abundance by the shape of the inflationary potential (which in general is not quadratic near the minimum), the energy dependence of the dark matter production cross section, the perturbative or non-perturbative nature of the inflaton decay, and the thermalization time-scale for the decay products of the inflaton. In many scenarios, the thermal and non-thermal enhancement dominate over the dilution by the later generation of entropy near the end of reheating, leading to a relic abundance that is sensitive to the maximum temperature of the Universe. This makes dark matter a potential probe of the dynamics during the earliest stages of reheating, just after the end of inflation.

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