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Electroweak phase transition with scalar portal to Majorana fermion dark matter

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Beyond the Standard Model physics is required to explain both the baryon asymmetry of the universe and the the dark matter relic density. In this talk we discuss a setup wherein both problems could possibly be solved within an unified framework. In particular we consider a new scalar particle, that shares interaction with the Higgs boson and admits charges under the SM gauge groups, that can trigger a first order phase transition, as required for electroweak baryogenesis, and couples to a dark state consisting of a Majorana fermion.

We link state-of-art perturbative assessments of phase transition thermodynamics with the extraction of the dark matter energy density. On the one hand, resummation at two-loop order are needed, on the other hand the inclusion of the Sommerfeld enhancement and bound-state formation for the co-annihilating scalar particle is considered in the context of freeze-out dark matter. We discuss also the alternative production mechanism via freeze-in for the dark matter Majorana fermion.

We compare the model parameter space that reproduces the observed dark matter energy density with the one triggering a first order phase transition, and find that there is a substantial overlap for some regions of the parameter space. We explore the impact of the various couplings on the electroweak phase transitions and highlight the trends of the strength of the transition. Finally, we comment on the relation between the strong phase transition with the production of gravitational waves, and we determine the regions of the parameter space that are likely to produce a gravitational wave background under the reach of the LISA interferometer sensitivity.

In-person participation

No

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