Contribution ID: **82** Type: **parallel**

Less-simplified models of dark matter for direct detection and the LHC

Thursday, 15 September 2016 16:40 (30 minutes)

We construct models of dark matter with suppressed spin-independent scattering cross section utilizing the existing simplified model framework. Even simple combinations of simplified models can exhibit interference effects that cause the tree level contribution to the scattering cross section to vanish, thus demonstrating that direct detection limits on simplified models are not robust when embedded in a more complicated and realistic framework. In general for fermionic WIMP masses > 10 GeV direct detection limits on the spin-independent scattering cross section are much stronger than those coming from the LHC. However these model combinations, which we call less-simplified models, represent situations where LHC searches become more competitive than direct detection experiments even for moderate dark matter mass. We show that a complementary use of several searches at the LHC can strongly constrain the direct detection blind spots by setting limits on the coupling constants and mediators' mass. We derive the strongest limits for combinations of vector + scalar, vector + "squark", and "squark" + scalar mediator, and present the corresponding projections for the LHC 14 TeV for a number of searches: mono-jet, jets + missing energy, and searches for heavy vector resonances.

Summary

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Session Classification: [INF/DM] Inflation, early universe and dark matter