Contribution ID: **3** Type: **Oral**

Non-Abelian Vector Boson Dark Matter, its Unified Route and signatures at the LHC

Monday, 20 May 2019 16:20 (20 minutes)

Non-abelian vector boson dark matter (DM), although not widely studied, offers very important phenomenological outcome. In this talk, we highlight some possibilities that can be accommodated in an $SU(2)$ extension of the the Standard Model (SM). One important feature of DM of such kind is realized via t-channel annihilation for relic abundance and s-channel direct search interaction, that helps the DM survive severe direct search guillotine, which has otherwise excluded many simple DM realizations. In another scenario, we explore a multipartite DM framework, where, in addition to the non-abelian vector boson DM, a scalar DM may exist and the DM-DM interaction alters the viable parameter space quite significantly. We also elaborate signatures of these DM scenarios at the Large Hadron Collider (LHC) and show that multi-lepton final states offer as a good probe over direct searches. In addition, generation of correct neutrino masses, unification of such extensions in a high scale $E(6)$ framework via consistent intermediate symmetries and *freeze-in* production of DM are also discussed.

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Session Classification: Dark Matter, Astroparticle Physics

Track Classification: Dark Matter, Astroparticle Physics