Contribution ID: **153** Type: **Oral Presentation**

Exploring the Dark Sector extension to the Standard Model via the Higgs Portal

Thursday, 2 July 2015 11:10 (20 minutes)

Abstract content
   (Max 300 words)
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The Standard Model (SM) is known to be incomplete. The introduction of a Dark Sector via an additional U(1)_d gauge symmetry added to the SM Lagrangian provides a mechanism to introduce much needed new physics without perturbing the already excellent agreement between the SM theoretical description and the Electroweak Precision Observables (EWPO) experimental constraints. The model has a dark vector boson Z_d which can mix with the hypercharge gauge boson with the coupling epsilon;. This opens the Hypercharge Portal which can mediate the fluctuation of a Z to a Z_d, or the decay of the Z_d to SM leptons. If a dark Higgs singlet s also exists, this then breaks the U(1)_d, opening the Higgs portal and also allowing for Higgs mass mixing between the SM and dark sectors, described by the Higgs mass mixing parameter, kappa;. Including dark fermionic fields in the Lagrangian allows for long-lived cold Dark Matter candidates. The various connections between the Dark and SM sectors allow descriptions of many key astro-physical phenomena. The Model is therefore a fascinating candidate for new physics beyond the SM. It becomes crucial to search for experimental signatures of this model. A promising avenue is to exploit the production of the dark force boson Z_d via the Higgs Portal and the search for its decay back to SM leptons: H ⟶ h_d⟶ Z_dZ_d ⟶ 4l. The detailed design and results of this search are presented.

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Session Classification: NPRP

Track Classification: Track B - Nuclear, Particle and Radiation Physics