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Dark Forces in the Sky: Signals from Z' and the Dark Higgs

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We consider the indirect detection signals for models containing a fermionic DM candidate, a dark gauge boson, and a dark Higgs field. Compared with a model containing only a dark matter candidate and vector mediator, the addition of the scalar provides a mass generation mechanism for the dark sector particles which, in some cases, is required in order to avoid unitarity violation at high energies. We demonstrate that the dark matter interaction types, and hence the annihilation processes relevant for relic density and indirect detection, are strongly dictated by the mass generation mechanism chosen for the dark sector particles, and the requirement of gauge invariance. We outline important phenomenology of such two-mediator models, which is missed in the usual single-mediator simplified model approach. In particular, the inclusion of the two mediators opens up a new, dominant, s-wave annihilation channel that does not arise when a single mediator is considered in isolation.

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