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Single Top and Dark Matter: Two is not always better than one

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To date, only two modes of production at hadron colliders of dark matter through new scalar or pseudoscalar mediators have been considered in the existing literature: pairs of dark matter particles produced through top quark loops with an associated hadronic jet in the event (monojet), and production of dark matter with pairs of heavy flavoured top or bottom quarks.

We present a third, previously overlooked channel, which consists of dark matter production in association with a single top quark.

In spite of a generally lower production cross section at LHC when compared to the associated top-pair channel, non-flavour violating single top quark processes are kinematically favored and can greatly increase the sensitivity to these models. We will show that including dark matter production in association with a single top quark through scalar or pseudoscalar mediators significantly improves the current searches. In particular, the exclusion limit with the available data set by the LHC searches for dark matter and heavy flavours can be substantially improved from 30% to up to a factor 2 depending on the mass assumed for the mediator particle. We expect that, with a dedicated event selection, the single top and dark matter production mode would demonstrate its full potential, and become the leading channel in Run II and future LHC searches.

Experimental Collaboration

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