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Gauge Invariance and Simplified Models with Scalar Mediators

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Up to a few years ago the standard paradigm for Dark Matter search at LHC was the use of Effective Field Theories. It was pointed out, however, that the validity of the EFT approach might be questionable at LHC. Because of this, recently the both theory and experimental communities switched to the use of “Simplified Models”, that are models that contain only renormalizable interactions. To keep them “simple”, they make some assumptions, such as that DM interacts with SM particles only through one mediator, or that, in case there are more than one, that one is much lighter than all others and consequently is a good approximation to consider only the lightest one. In this talk, we explore the consequences of gauge invariance concerning the Simplified Models with a Scalar mediator exchanged in the S-channel. We will see that gauge invariance requires necessarily 2 or more mediators to be the portal to DM, and one of them may be the Higgs. We will try to explore and discuss all possible options, taking into account Direct Detection, Collider and Flavor constraints.

Summary

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