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Correlations between Indirect Detection and Collider Signals in Decaying Dark Matter Scenarios

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Decaying dark matter is an interesting and viable alternative to the common paradigm of stable dark matter. Our purpose is to investigate whether the LHC can probe scenarios of decaying DM. Although the limits on the DM lifetime forbid the direct collider observation of its decays, the couplings responsible for these processes can determine, thanks to crossing symmetries, DM production cross section. In this case a collider analysis outcome can be combined with an eventual dark matter indirect detection in order to get better insight of DM properties. We thus propose a model independent study of operators connecting the dark matter particle with SM model quarks or, possibly, with gauge bosons. Relevant indirect detection limits, namely antiprotons and gamma-rays, already disfavor the simplest configurations of direct coupling of the DM with Standard model states. More promising turn to be instead scenarios in which the interactions of the dark matter are mediated by a scalar state carrying color charge or at least electromagnetic. Its production is not affected by ID limits while at the same time it induces three-body decays of the dark matter. The same couplings also determine decays of the scalar into DM and SM states which can be observed at the collider. In this framework several scenarios can be distinguished, featuring WIMP DM as well as FIMP and superWIMP configurations. For each scenario the relevant constraints from dark matter observables have been investigated. In addition have been identified the current and next future collider searches of new Physics which are relevant for the particle physics framework under consideration.

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