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Two-loop form factors for Dark Matter annihilation to colored Standard Model particles

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A UV complete model where the Dark Matter (DM) particle interacts with gluons via a colored scalar mediator provides a viable phenomenological model that can be tested at hadron colliders. While Mono-jet signatures are relevant for Collider searches, zero-jet processes would mean complete annihilation of Standard Model (SM) particles to DM particles, which contribute to relic-density of DM. We look at the DM annihilation to SM colored particles which, at leading order, is a loop induced process in our model. We compute two-loop amplitudes in QCD which contribute to the process. Decomposing the amplitude in terms of Form factors and making use of the projector technique, scalar Feynman Integrals are obtained. Further, with the help of the IBP identities, an analytical expression for amplitude is obtained in terms of Master Integrals. The amplitude is made UV finite by Counterterm Renormalization. We will discuss preliminary results for the cases of massless and massive mediators. Our results can be used to predict DM pair production at hadron colliders and DM annihilation to SM colored particles at next-to-leading order in QCD.

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