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Freeze-out and freeze-in relic density for a light vector mediator (12'+3')

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In collider experiments, such as the Large Hadron Collider (LHC), an unknown particle could be produced from a pair of quarks in proton-proton collisions. In simplified dark matter (DM) models, this particle could then decay either into WIMP (Weakly-Interacting Massive Particles) dark matter or into Standard Model (SM) particles, acting as a mediator between ordinary matter and dark matter. From such a simplified model, we consider a light mediator Z' (m_Z' < 300 GeV) and test different scenarios of the couplings to dark matter and Standard Model matter of this mediator to see the impact these changes have on the relic density of dark matter, using MadDM and micrOMEGAs for the calculations. The today observable abundance of dark matter can be achieved through different mechanisms, such as freeze-out and freeze-in. In the freeze-out scenario, the initial dark matter abundance is high and decreases due to annihilation and decay processes as the universe cools down. Conversely, in the freeze-in case, there is only a small amount of dark matter initially, and more dark matter is produced as the universe evolves. Additionally to investigating the relic density from the freeze-out production of dark matter, we use the freeze-in module in micrOMEGAs to calculate the relic density for even smaller couplings to dark matter and Standard Model matter.

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