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Unlocking the Inelastic Dark Matter Window with Vector Mediators

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Despite robust cosmological and astrophysical evidence for the existence of non-baryonic Dark Matter (DM), its microscopic nature remains a mystery. Among the several possible scenarios, light DM candidates thermally produced in the early Universe are especially interesting, as they are both theoretically motivated and experimentally accessible. In this context, inelastic dark matter (iDM) models offer a compelling framework, since they can avoid cosmological bounds as well as indirect and direct detection searches. While most literature assume a secluded dark photon mediator, in this work we investigate the broader case of general vector mediators that can couple directly to baryon and lepton numbers. We explore the consequences of such a choice in the relic density computation, as well as for the cosmological and experimental bounds, showing that, especially for anomaly-free gauge groups with non-universal couplings to leptons, we can unlock new windows of the parameter space yet unexplored by experiments. This work is accompanied by the numerical Python package ReD-DeLiVeR, developed for computing decay widths (including several hadronic channels), relic abundances, process rates, and thermal targets for user-defined gauge charges and dark matter candidates.

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