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Dark Sector Production via Proton Bremsstrahlung

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Experiments using proton beams at high luminosity colliders and fixed-target facilities provide impressive sensitivity to new light weakly coupled degrees of freedom. With these experiments in mind, we revisit the production of dark vectors and scalars via proton bremsstrahlung, making use of a model that describes the underlying nucleon scattering cross-section in the forward direction due to pomeron exchange. We compare the resulting distributions and rates with those obtained via variants of the Fermi-Weizsacker-Williams approximation and provide production rate distributions for a range of beam energies, including those relevant for the proposed Forward Physics Facility at the High Luminosity-LHC. In addition, we extend the application of proton bremsstrahlung to other long-lived dark sectors such as axion-like particles (ALPs) with gluon coupling and millicharged particles.

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