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General Treatment of the Monopole Production Cross Sections by Drell-Yan and Photon Fusion for Three Spin Models

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The existence of magnetic charges remains one of the great questions in high energy physics and their search has gained momentum as recent models predict these may be observable at current colliders. They appear in field theories in two forms: the widely studied but heavily suppressed monopole with structure (soliton), and the not so well covered point like monopole. The latter was first proposed by Dirac as the source of a singular magnetic field, and in effect symmetrises Maxwell's equations. Following this line of research, this study analyses these sources as matter fields in an effective field theory, which carry spins 0, $\frac{1}{2}$ or 1. All three cases are currently under investigation by the MoEDAL collaboration at CERN and the theoretical expressions for kinematic distributions proposed in this work serve as guides to these searches.
The cross section distributions in each case are derived from a U(1) invariant gauge theory. It is not assumed that, like the electron, the monopole's magnetic moment is generated through spin interactions at minimal coupling, as it may be quite large. Instead, the analytical expressions in the spin $\frac{1}{2}$ and 1 cases are kept completely general through the inclusion of a phenomenological parameter κ, related to the gyromagnetic ratio $g_R = 1 + \kappa$. In fact, the inclusion of this parameter gives the effective theory a sense of validity in the high energy limit if the magnetic coupling scales with the particle's velocity $\beta = \frac{v}{c}$.

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