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Hidden Monopole Dark Matter via Axion Portal and its Implications for Direct Search and Beam-Dump Experiments

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We study the monopole dark matter (MDM) emerging from a spontaneous breakdown of non-abelian gauge symmetry in the hidden sector. We assume that this hidden MDM was produced as a topological defect during a second-order phase transition in the early universe, and its stability is guaranteed by the topological nature. In particular, we introduce an axion-like particle (ALP), which mediates the interactions between the hidden MDM and nucleus, and the configuration of the ALP field is affected by the Witten effect in the presence of the hidden monopole. We then compute the spin-dependent elastic cross-section of the hidden MDM scattering off a nucleon and compare it to the direct search experiments. To induce the Witten effect, the ALP has to couple to the hidden photons. As a consequence, the bounds coming from the beam-dump experiments and B meson decays for the ALP decay constant are changed. By considering those constraints, we find that the room for the hidden MDM is still large with a benchmark point which can satisfy the relic abundance of dark matter while solving the small-scale problems in galaxy formation.

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