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Quantum tunneling in the early universe: Stable magnetic monopoles from metastable cosmic strings

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We discuss a novel mechanism for producing topologically stable monopoles (TSMs) from the quantum mechanical decay of metastable cosmic strings in the early universe. For a dimensionless string tension parameter $G\mu \approx 10^{-9} - 10^{-5}$, the monopoles are superheavy with masses of order $10^{15} - 10^{17}$ GeV. The stochastic gravitational wave emission arises from metastable strings with $G\mu \sim 10^{-9} - 10^{-5}$ and should be accessible at HLVK and future detectors, including the Einstein Telescope and Cosmic Explorer. Monopoles with masses of order $10^{8} - 10^{14}$ GeV arise from metastable strings for $G\mu$ values from $\sim 10^{-22}$ to 10^{-10}. We discuss the parameter space for producing these monopoles at an observable level with detectors such as IceCube, KM3NeT, Pierre Auger, and ANITA. This mechanism yields TSMs that carry two units $(4\pi/e)$ of Dirac magnetic charge and some screened color magnetic charge in an $SO(10)$ model.

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