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Dynamics of Dark Matter Misalignment Through the Higgs Portal

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A light singlet scalar field feebly coupled through the super-renormalizable Higgs portal provides a minimal and well-motivated realization of ultra-light bosonic dark matter. We study the cosmological production of dark matter in this model by elucidating the dynamics of two sources of scalar field misalignment generated during the radiation era. We compare our relic abundance predictions with constraints and projections from equivalence principle and inverse square law tests, stellar cooling, resonant molecular absorption, and observations of extra-galactic background light and diffuse X-ray backgrounds. New experimental ideas are needed to probe most of the cosmologically motivated regions of parameter space.

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