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Primordial Black Hole and Gravitational Wave Production from ALP String-Wall Networks

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Recent advances in gravitational wave detection have opened new doors for probing the physics of the early universe, raising the possibility of finding gravitational-wave evidence for the existence of dark matter candidates that have not yet been detected by other methods. In particular, this possibility has motivated the exploration of topological defect formation and decay associated with the existence of scalar fields. We investigate a cosmology that includes a scalar field with a spontaneously broken U(1) symmetry that is also explicitly broken at a lower energy scale, leading to the formation of domain walls that then both annihilate into axion-like particles and could collapse into black holes. In this model, both the axion-like particles and the primordial black holes are viable dark matter candidates. We show the mass ranges where this model could both account for all (or part of) the dark matter and produce gravitational waves observable in the near future.

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