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Coupled Multi-Proca Vector Dark Energy

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We study a new class of vector dark energy models where multi-Proca fields A^a_μ are coupled to cold dark matter by a mass-type term. From here, we derive the general covariant form of the novel interaction term sourcing the field equations. This result is quite general in the sense that encompasses Abelian and non-Abelian vector fields. In particular, we investigate the effects of this type of coupling in a simple dark energy model based on three copies of canonical Maxwell fields to realize isotropic expansion. The cosmological background dynamics of the model is examined by means of a dynamical system analysis to determine the stability of the emergent cosmological solutions. As an interesting result, we find that the coupling function leads to the existence of a novel scaling solution during the dark matter dominance. Furthermore, the critical points show an early contribution of the vector field in the form of dark radiation and a stable de Sitter-type attractor at late times mimicking dark energy. The cosmological evolution of the system as well as the aforementioned features are verified by numerical computations. Observational constraints are also discussed to put the model in a more phenomenological context in the light of future observations.

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