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Conformally and Disformally Coupled Vector field Models of Dark Energy

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Scalar fields coupled to dark matter by conformal or disformal transformation gives rise to a general class of scalar-tensor theories which leads to a rich phenomenology in a cosmological setting. While this possibility has been studied comprehensively in the literature for scalar fields, the vector case has been hardly treated. We build models of vector fields coupled conformally and disformallyto dark matter and study their cosmological implications by dynamical system analysis. In doing so, we derive explicitly the general covariant form of the coupling term that can be applied for general vector-tensor theories. For concreteness, the standard Proca theory with a vector potential is taken to describe dark energy. Despite this minimal realization for the vector-tensor theory, the parameter space is considerably enriched compared to the uncoupled case to provide new emerging scaling solutions, and renewed stable attractor points to drive the late-time accelerated expansion of the universe. Numerical calculations are performed to see the impact of the conformal and disformal couplings in the cosmological background evolution.

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