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Beyond $w_0 - w_a$ and Phantom Crossing: Testing Models of Coupled Dark Sector

The combination of cosmic microwave background (CMB) measurements with distance measurements from baryon acoustic oscillations (BAO) and type Ia supernovae (SNIa) suggests that dark energy is dynamical, with an equation of state crossing the phantom divide at low redshifts. This feature can not be described within canonically normalized, minimally coupled, self-interacting scalar field models. We investigate the possibility of achieving phantom crossing by introducing an interaction in the dark sector such that the dark matter particle mass is dependent on the dark energy field ϕ as $m \propto \phi$. We consider a self-interacting potential of the inverse power-law form $V \propto \phi^{-n}$. We implement this model both at the background and perturbative levels in a Boltzmann solver and use a bayesian framework to constrain its parameters using CMB, BAO and SNIa data. We find best-fits that have similar goodness-of-fits as the commonly used phenomenological $w_0 - w_a$ parameterization, providing a more fundamental understanding of the dark sector

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