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# Interacting Models of Dark Energy and Dark Matter in Einstein scalar Gauss Bonnet Gravity

We study the dynamics of the interacting models between the Gauss-Bonnet (GB) coupled scalar field and the dark matter fluid in a homogeneous and isotropic background. A key feature of GB coupling models is the varying speed of gravitational waves (GWs). We utilize recent constraints on the GW speed and conduct our analysis in two primary scenarios: model-dependent and model-independent. In the model-dependent scenario, where determining the GW speed requires a specific GB coupling functional form, we choose an exponential GB coupling. We adopt a dynamical system analysis to obtain the necessary constraints on the model parameters that describe different phases of the universe and produce a stable late-time accelerating solution following the GW constraint, and find that to satisfy all these constraints, fine-tuning of the free parameters involved in the models is often needed. In the model-independent scenario, the GW speed is fixed to one, and we construct the autonomous system to identify the late-time stable accelerating critical points. Furthermore, we adopt a Bayesian inference method using late-time observational data sets, including 31 data points from cosmic chronometer data (Hubble data) and 1701 data points from Pantheon+ and find that all the observational constraints can be satisfied without fine-tuning. In addition, we also utilize simulated binned Roman and LSST data to study the evolution of the universe in the model-independent scenario. We find that the model shows significant deviation at higher redshifts from $\Lambda$CDM and fits the current data much better than $\Lambda$CDM within the error bars.

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