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Data–Driven Dark Energy: Probing w(a) with Flexknots

Recent cosmological surveys have opened a new window onto the nature of dark energy. In our work we reconstruct the dark energy equation of state using a "flexknot"parameterisation that represents $w(a)$ as a linear spline with free–moving nodes. By combining the latest DESI Baryonic Acoustic Oscillation measurements with Pantheon+ supernovae data—and cross–checking our results with an independent Cobaya–based pipeline—we obtain posterior distributions for $w(a)$ that reveal an unexpected W–shaped structure. Although the Bayesian evidence does not ultimately favour dynamical dark energy over the standard ΛCDM model, our analysis shows that even non–CMB datasets can indicate deviations from a constant $w = -1$.

We also generalise dataset tension statistics to marginalise over multiple models, ensuring our unexpected results are not driven by inter-dataset disagreement.

We finish with a brief discussion of the pedagogical advantages and computational benefits of developing an analysis pipeline in-house, which, in addition to increasing efficiency, allows us to analytically marginalise nuisance parameters and provides confidence that these features are genuinely driven by the data.

AI keywords

Bayesian inference; dataset tension; model selection

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Track Classification: Inference & Uncertainty