

Beyond $j=1$: Observational Constraints on Almost- Λ CDM Cosmologies

jueves, 17 de septiembre de 2026 14:50 (25)

The cosmographic condition $j(z) = 1$ provides the kinematical signature of the spatially flat Λ CDM model independently of any specific dark-energy or modified-gravity theory. We investigate the extent to which current observations permit departures from this condition by considering three phenomenological “almost- Λ CDM” cosmographic closures in which the cosmic jerk differs slightly from unity through a small deformation parameter ϵ . The models are constrained using Markov Chain Monte Carlo analyses of recent DESI baryon acoustic oscillation measurements together with compressed Planck cosmic microwave background likelihoods and the Union3, Pantheon+, and DESY5 Type Ia supernova compilations.

Unlike conventional analyses that infer the expansion history after imposing an explicit parameterization of the dark-energy equation of state, our cosmographic framework reconstructs the expansion history directly from observations, with the effective dark-energy equation of state emerging as a derived quantity rather than an assumed one. We find that all three cosmographic closures are confined by current observations to a remarkably small neighbourhood of the Λ CDM cosmographic fixed point, with the inclusion of Planck data driving the preferred evolution toward $j_0 \simeq 1$ and $w_{\text{DE},0} \simeq -1$. Despite their distinct kinematical constructions, the reconstructed dark-energy evolution consistently exhibits a smooth freezing behaviour that remains close to $w = -1$ without crossing the phantom divide.

Model comparison using the Akaike and Bayesian information criteria shows that the almost- Λ CDM cosmographic models remain statistically competitive with standard dark-energy parameterizations while relying on fewer assumptions regarding the functional form of $w(z)$. Our analysis demonstrates that current observations constrain the cosmic expansion history more robustly than the detailed evolution of the dark-energy equation of state, which remains sensitive to the reconstruction methodology employed. These results highlight the importance of model-independent cosmographic approaches for interpreting current evidence for dynamical dark energy and provide a natural framework for future studies of cosmological perturbations and structure formation.

Primary author(s) : Sra. WORSLEY, Jess (1Department of Mathematics and Applied Mathematics, University of Cape Town, 7 University Ave N, 7700, South Africa.)

Presenter(s) : Sra. WORSLEY, Jess (1Department of Mathematics and Applied Mathematics, University of Cape Town, 7 University Ave N, 7700, South Africa.)

Clasificación de la sesión : Afternoon Session (Thursday)