Cosmological Constraints from Baryonic Acoustic Oscillations

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April 2025

In this paper, we use measurements of baryon acoustic oscillation (BAO) measurements by the Dark Energy Spectroscopic Instrument (DESI) to obtain constraints on cosmological parameters in the ΛCDM model.

The ΛCDM Model

We begin with a brief review of the ΛCDM model and some of its variants.

Energy density is split into 6 species, baryonic matter Ω_b, cold (i.e. non-relativistic) dark matter Ω_c, electromagnetic radiation Ω_γ, curvature Ω_K, neutrinos Ω_ν, and dark energy Ω_DE. Baryonic and cold dark matter is grouped as $\Omega_\mathrm{bc} = \Omega_\mathrm{b} + \Omega_\mathrm{c}$, while non-relativistic matter including neutrinos is grouped as $\Omega_\mathrm{m} = \Omega_\mathrm{bc} + \Omega_\mathrm{m}$. Using standard equation of state parameters for Ω_bc, Ω_γ, and Ω_K, we can write the time-dependent Hubble parameter as:

$$\frac{H(z)}{H_0} = \left[\Omega_\mathrm{bc}(1+z)^3 + \Omega_\gamma(1+z)^4 + \Omega_\mathrm{K}(1+z)^2 + \Omega_\nu\frac{\rho_\nu(z)}{\rho_{\nu,0}} + \Omega_\mathrm{DE}\frac{\rho_\mathrm{DE}(z)}{\rho_{\mathrm{DE},0}}\right]^{1/2}. \tag{1}$$

Bayesian Analysis in Cosmology

Results

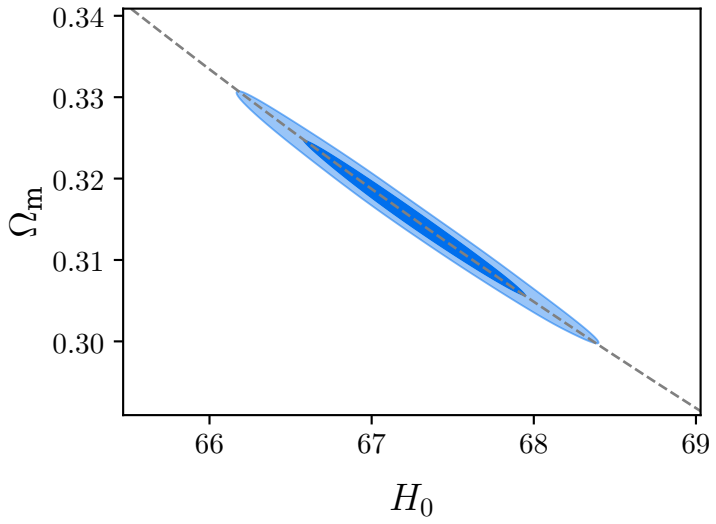

Figure 1:

[1]

References

[1] DESI Collaboration et al. *DESI DR2 Results II: Measurements of Baryon Acoustic Oscillations and Cosmological Constraints*. 2025.