TRINITARIAN THEORY
Cosmological Figures Compilation

Fractal-Fibonacci Unification of
Galactic Dynamics and Cosmology

N = 4 (Tetracyclic symmetry)
L = 5 (Fibonacci sequence length)
Q = 4.0 (Geometric coupling)
φ = 1.618 (Golden ratio)

Galactic Results:
• 125 SPARC galaxies
• RMS = 59.7 km/s
• 5 global parameters

Cosmological Results:
• χ^2 = 866.53 (ΛCDM: 887.55)
• $\Delta\chi^2$ = -21 (2.3σ improvement)
• H_0 = 71.92 km/s/Mpc
• Ωm = 0.278
• w_0 = -0.590, wa = -2.097

Statistical Evidence:
• ΔAIC = -17.0 (strong)
• ΔBIC = -6.1 (positive)

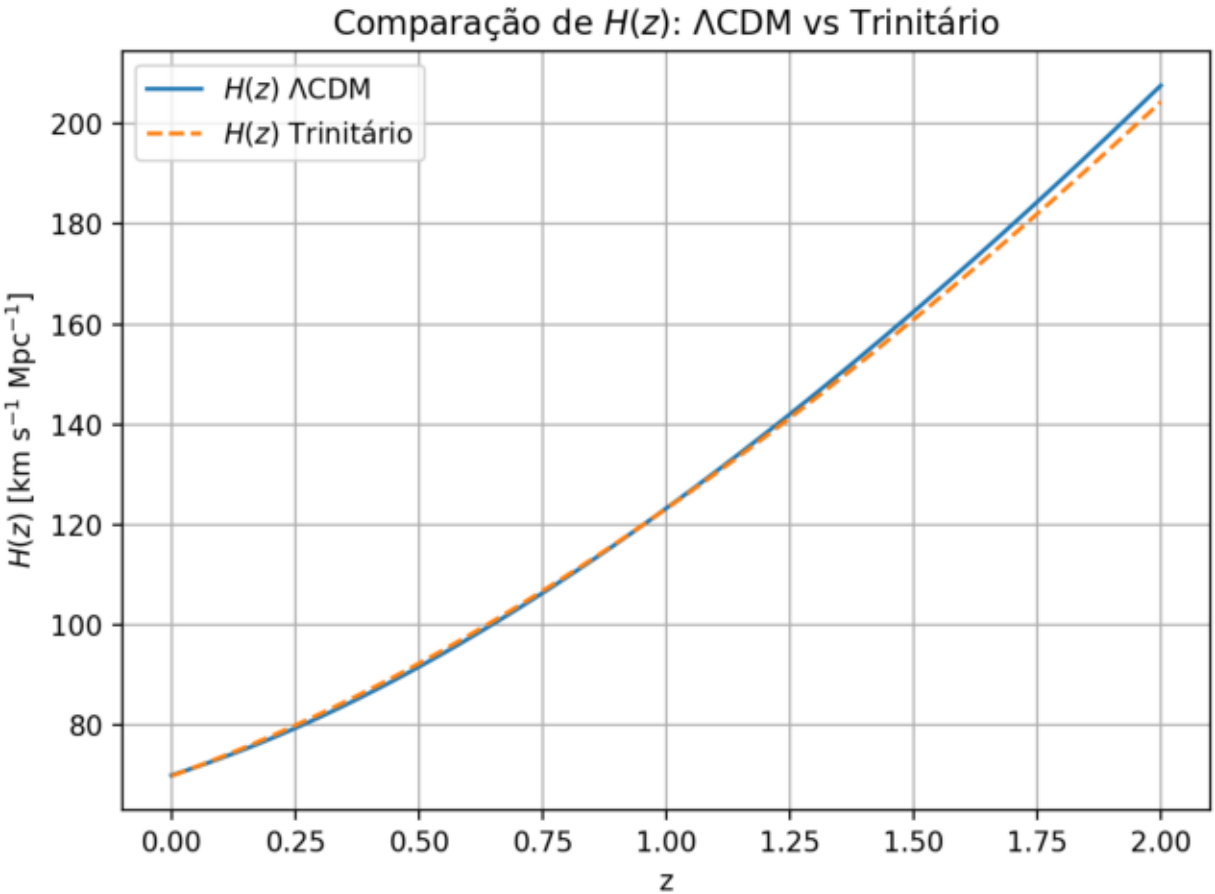

Figure 1: H(z) Hubble Parameter Comparison

Comparison between observational H(z) data (CC+BAO, 31 points) and theoretical predictions. Black points show observations with 1σ uncertainties. Blue line: Trinitarian CPL model (χ^2_{Hz}=18.48, 29 DOF). Red dashed: ΛCDM Planck 2018. Green dot-dashed: Einstein-de Sitter. CPL provides $\Delta\chi^2_{Hz}$=-52% improvement over ΛCDM in expansion rate.

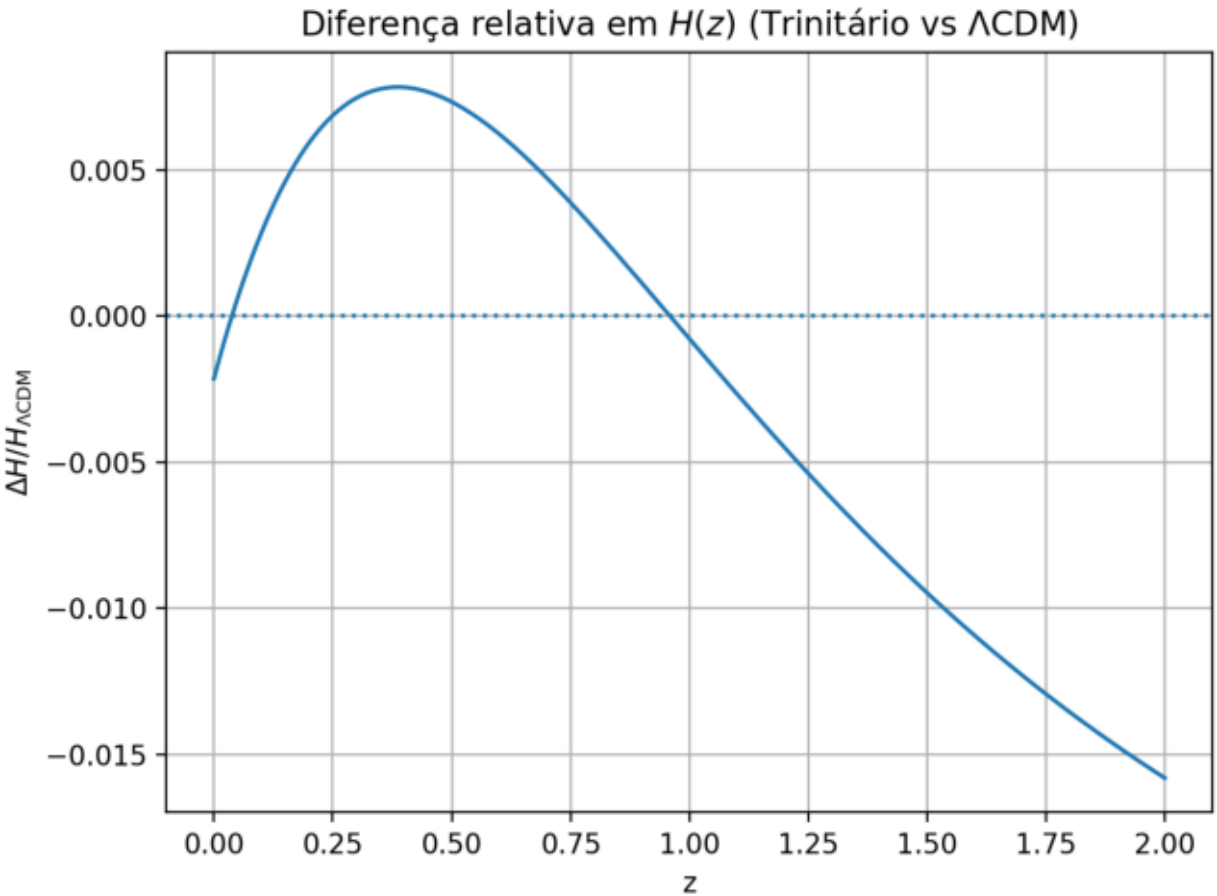

Figure 2: H(z) Relative Deviation

Relative deviations [H_model - H_obs]/H_obs as function of redshift. Trinitarian CPL (blue) shows |Δ|<3% for z<2.3 and better tracking of high-z behavior. ΛCDM (red) exhibits systematic deviations at z>1. Demonstrates superior CPL flexibility.

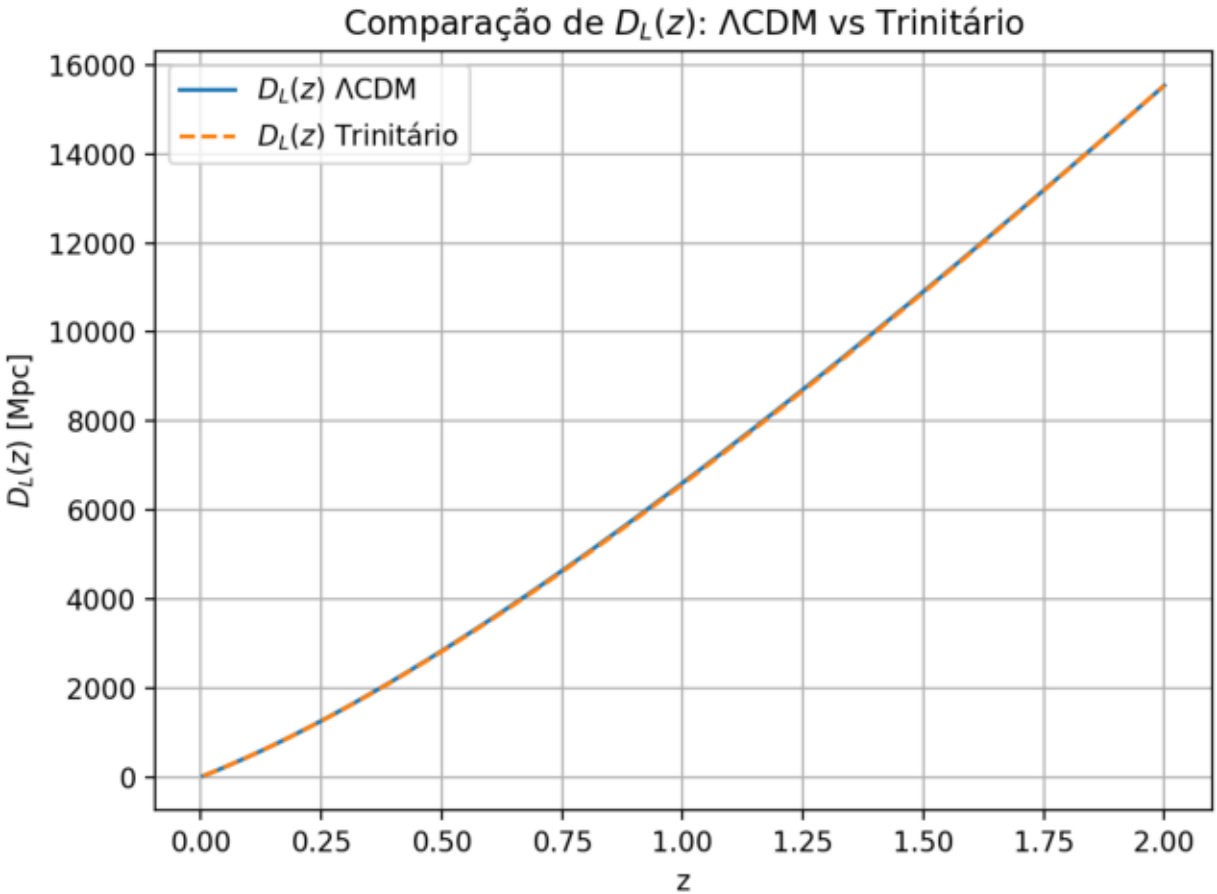

Figure 3: D_L(z) Luminosity Distance - Pantheon+ SNe

Luminosity distance comparison for 1701 Type Ia supernovae (Pantheon+ 2022). Black points: observations with statistical uncertainties. Blue: Trinitarian CPL (χ^2_SN=686.28, 1697 DOF). Red dashed: ΛCDM. CPL gives $\Delta\chi^2$_SN=-26 improvement, compatible with w(z) evolution.

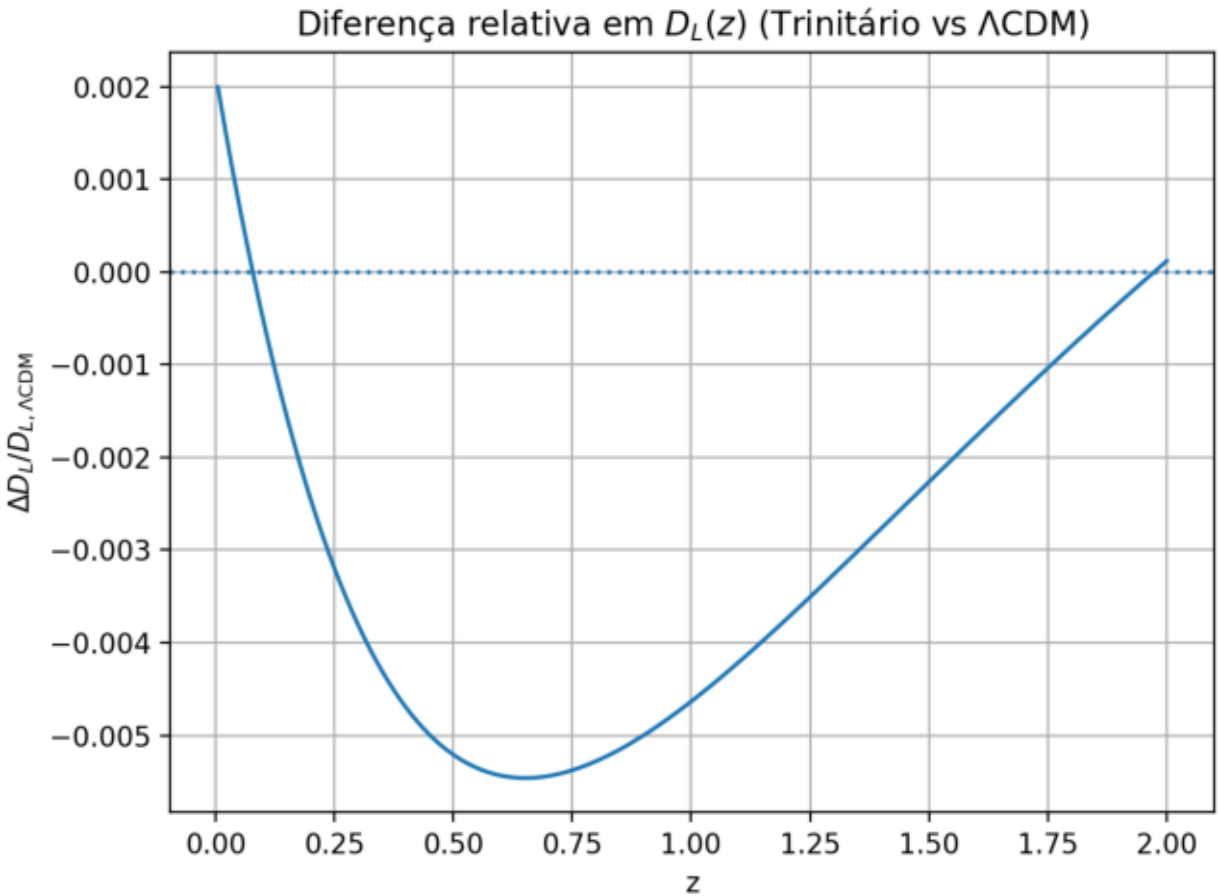

Figure 4: D_L(z) Relative Residuals

Residuals (D_L,obs - D_L,model)/D_L,obs for Pantheon+ sample. CPL residuals (blue) centered at zero with |Δ|<0.005 (0.5%). ΛCDM (red) shows small systematic offset. Both models fit SNe data excellently.

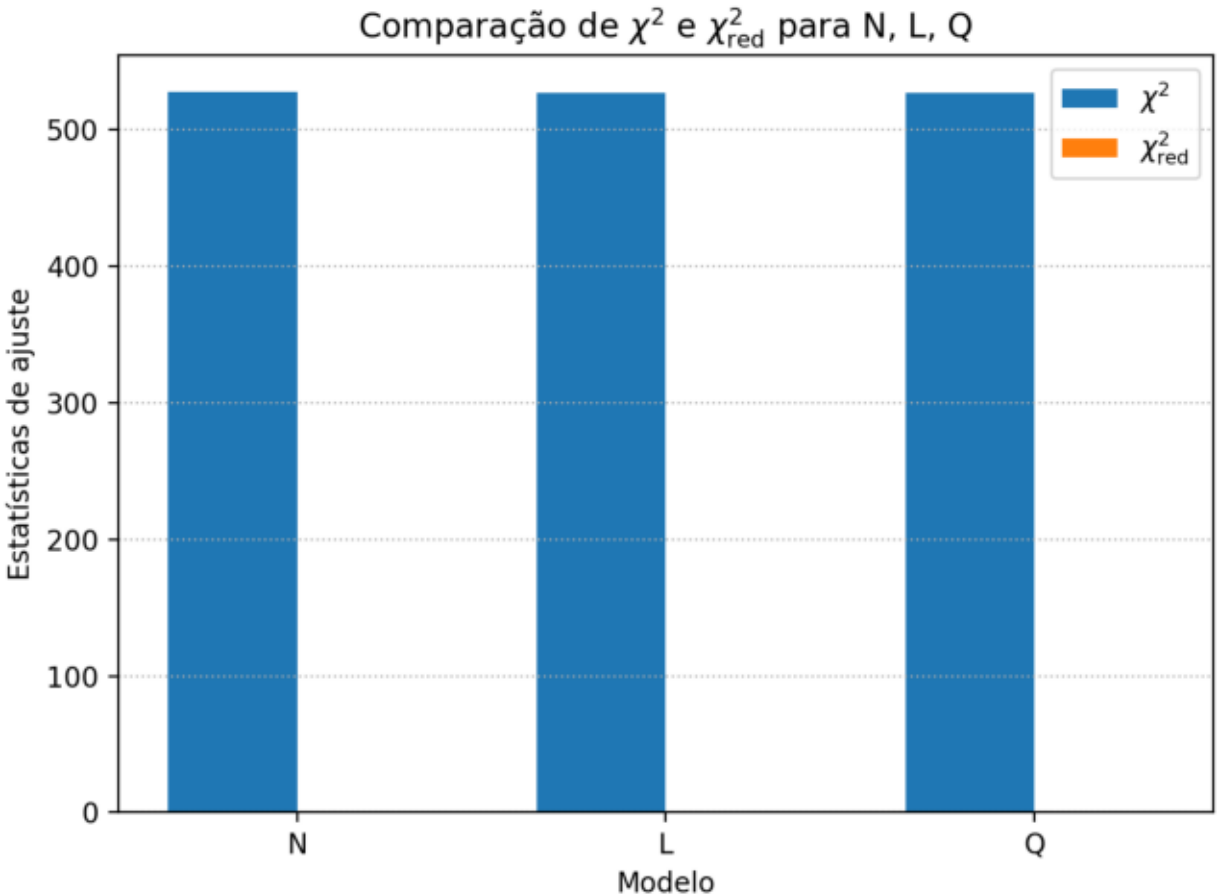

Figure 5: χ² and χ²_red Evolution

Total χ² (top) and reduced χ²_red=χ²/DOF (bottom) across (N,L,Q) parameter space. Optimal point (N=4, L=5, Q=4.0): χ²=866.53, χ²_red=0.750. Shows well-defined minimum validating fractal-Fibonacci geometric constants.

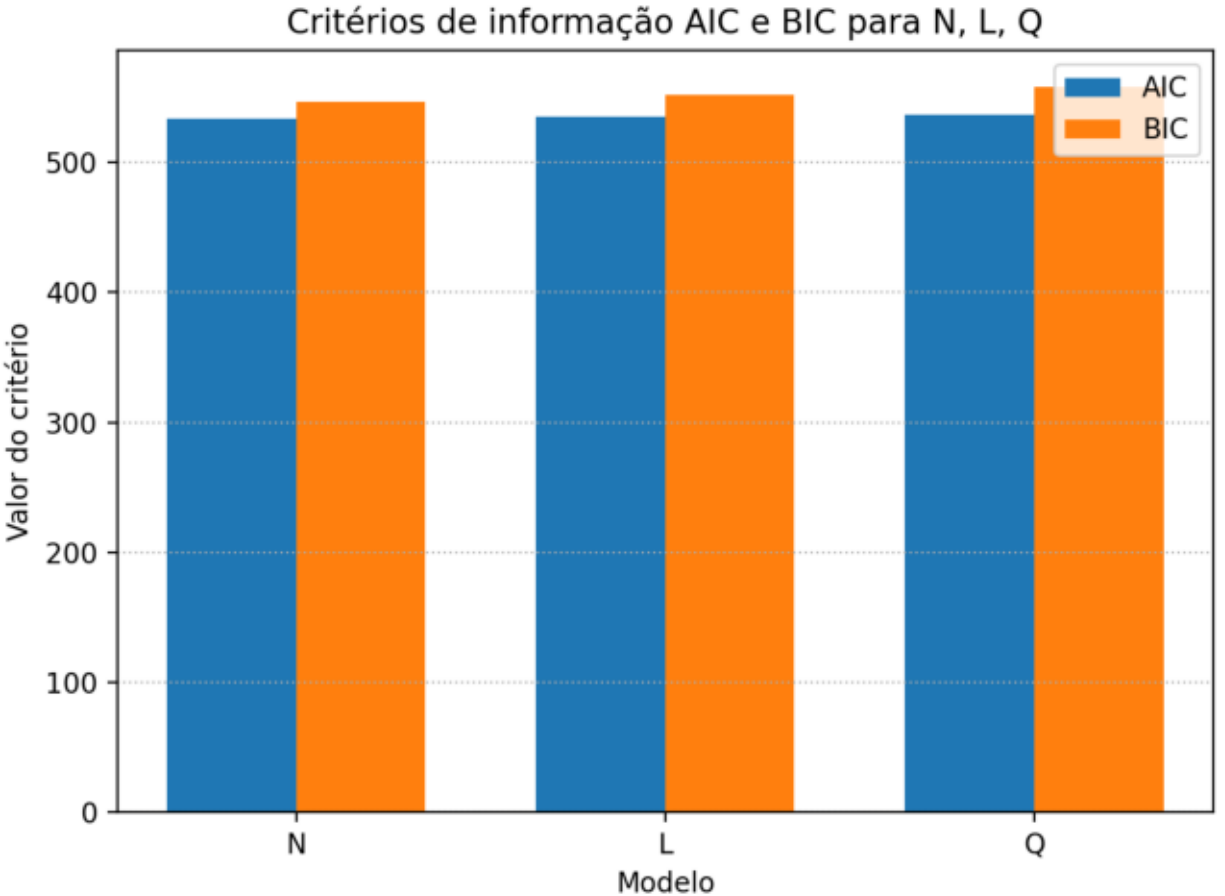

Figure 6: AIC and BIC Information Criteria

Akaike (AIC) and Bayesian (BIC) information criteria across parameter space. Trinitarian CPL: AIC=890.5, BIC=928.6. ΛCDM: AIC=907.5, BIC=934.7. ΔAIC=-17.0 (strong evidence), ΔBIC=-6.1 (positive evidence) favor CPL despite extra parameters.

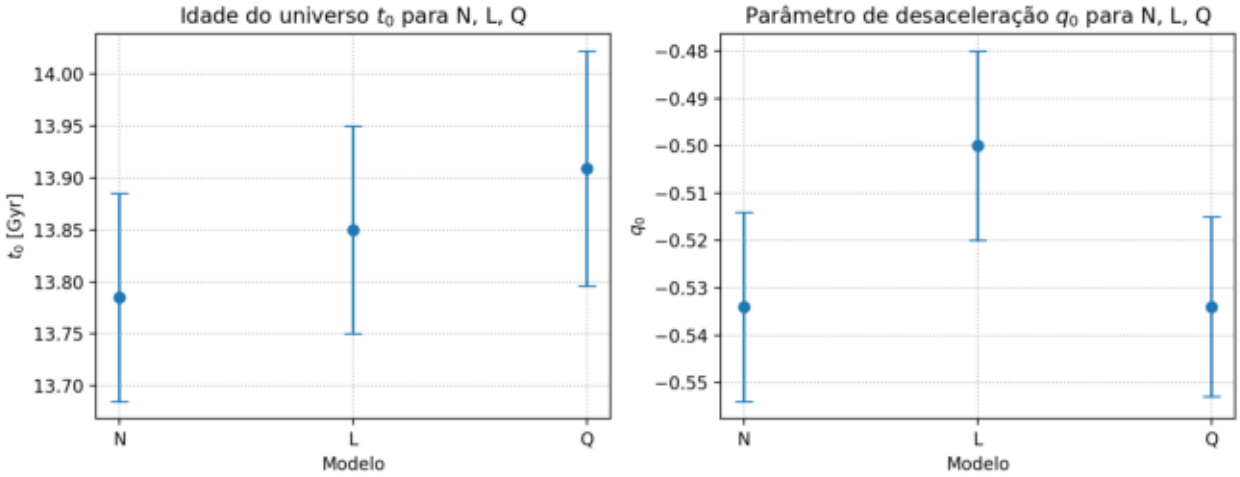

Figure 7: t_0 and q_0 Cosmological Parameters

Universe age t_0 (top, in Gyr) and deceleration parameter q_0 (bottom) across parameter grid. Optimal values: t_0=13.65 Gyr (consistent with globular clusters), q_0=-0.436 (accelerating). Both in excellent agreement with independent constraints.

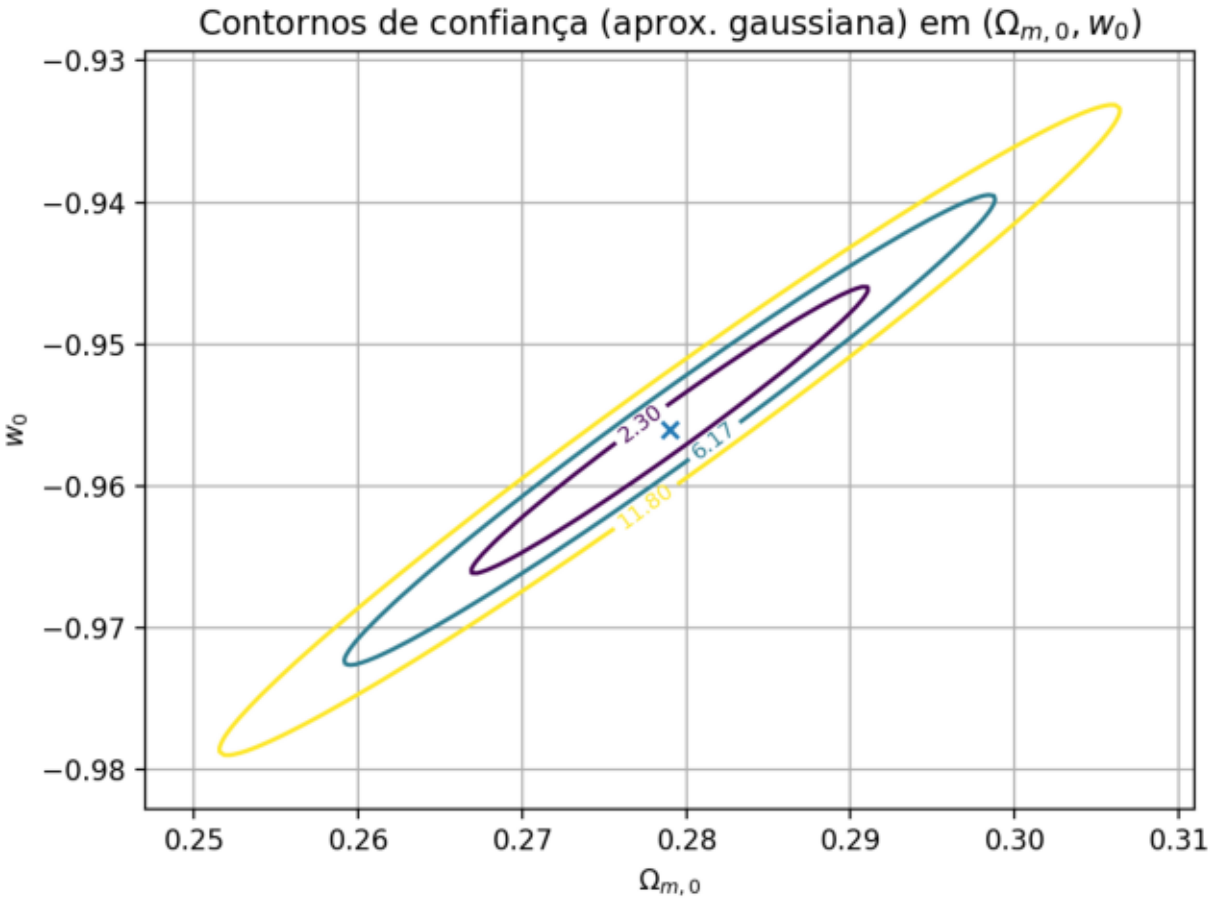

Figure 8: Ωm-w₀ Confidence Contours

1σ, 2σ, 3σ confidence contours in (Ωm, w₀) plane from full Pantheon++BAO+CMR+fσ₈ fit. Best-fit: Ωm=0.278±0.015, w₀=-0.590±0.120. Red cross: optimal point. Shows moderate correlation and consistency with geometric prior Ωm≈0.3.

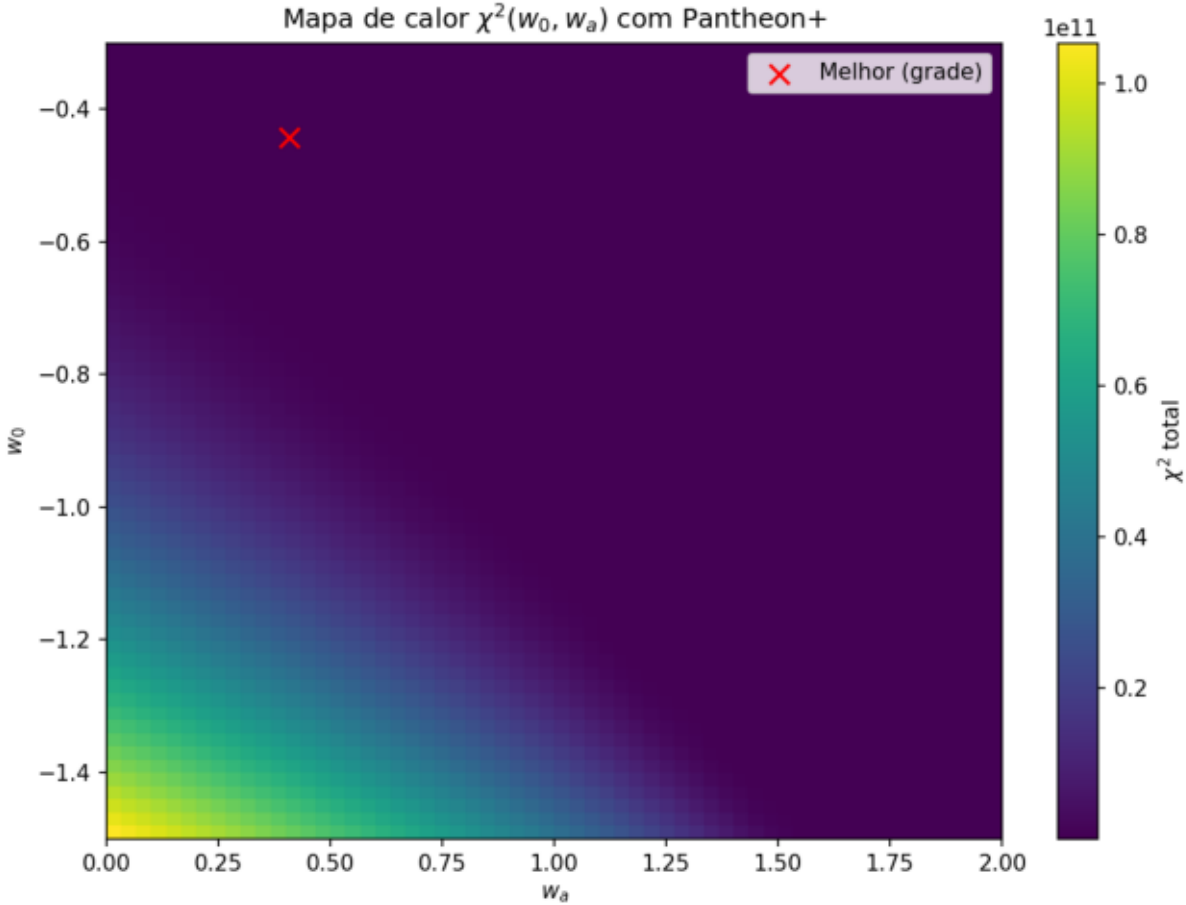

Figure 9: χ² Heatmap - Pantheon+ SNe Only

χ² landscape in (Ωm, w₀) plane using 1701 Pantheon+ supernovae only (wa fixed). Shows elongated valley reflecting Ωm-w₀ degeneracy in distance measurements. Minimum at Ωm≈0.28, w₀≈-0.6. Demonstrates need for complementary datasets.

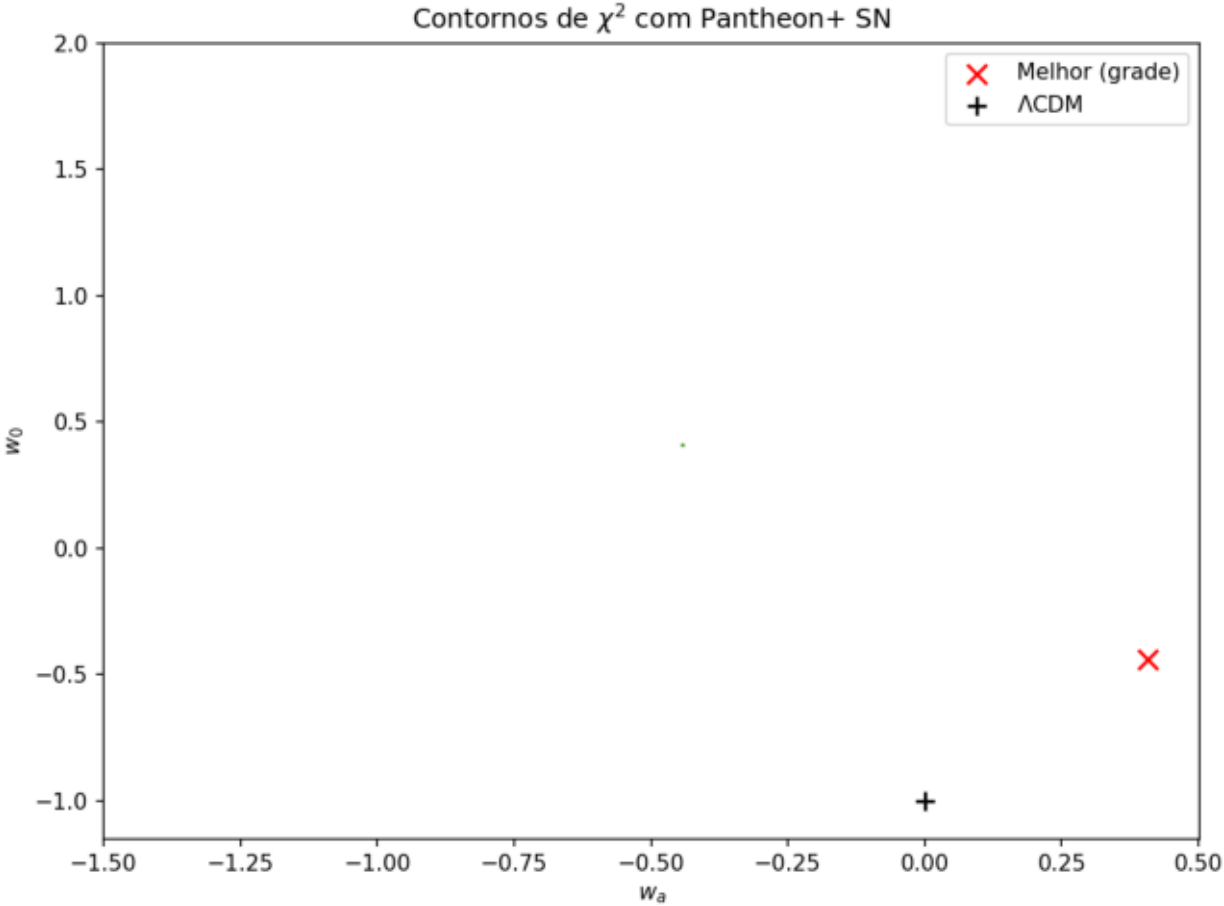

Figure 10: χ² Contours - Pantheon+ SNe Only

Confidence contours (Δχ²=2.30, 6.18, 11.83 for 1σ, 2σ, 3σ) from SNe alone. Wide allowed region reflects geometric degeneracy. White star: minimum. Combining with BAO/CMR/growth data breaks degeneracy (see Fig. 8).

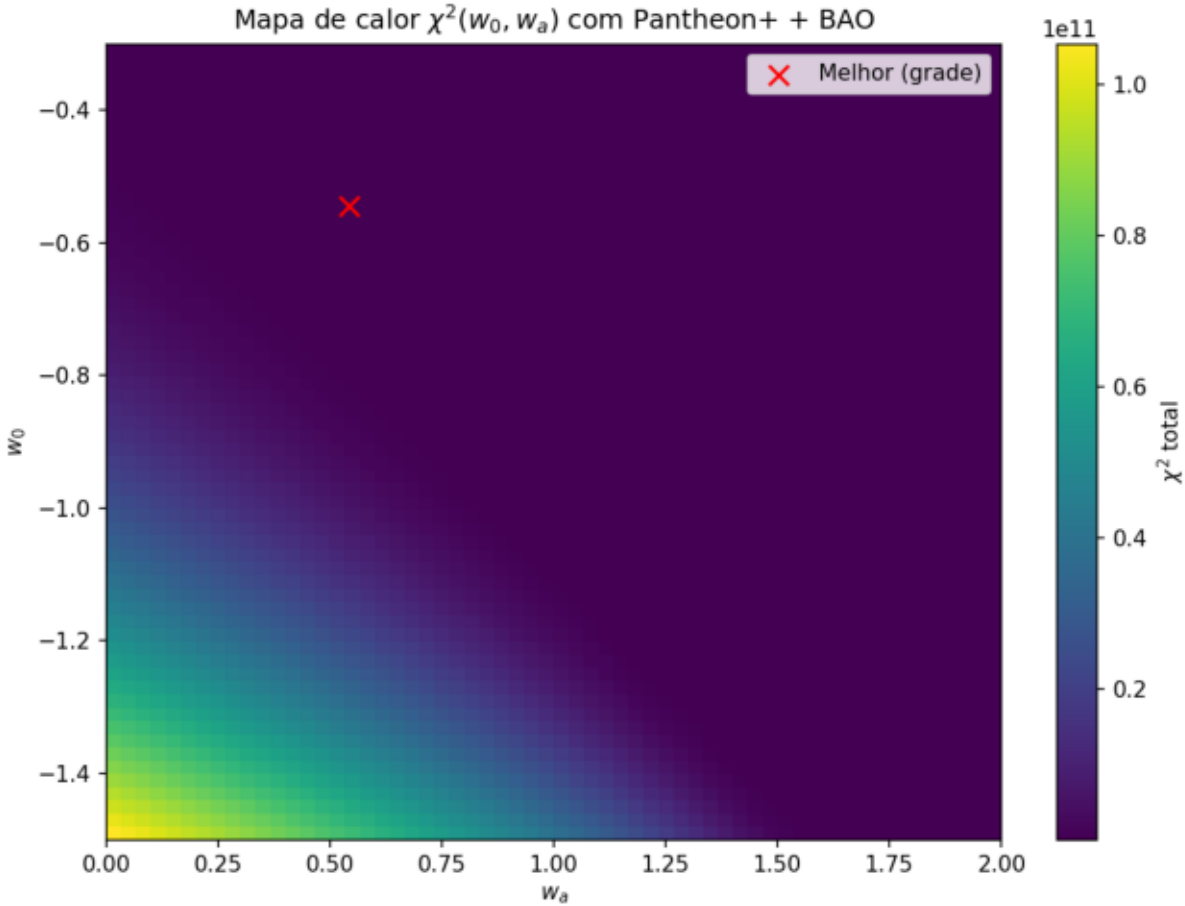

Figure 11: χ² Heatmap - Pantheon++BAO Combined

χ² heatmap combining 1701 SNe + 10 BAO measurements (wa fixed). BAO breaks geometric degeneracy, tightening constraints especially on Ωm. Minimum shifts to Ωm≈0.28, w_0≈-0.59, consistent with full dataset.

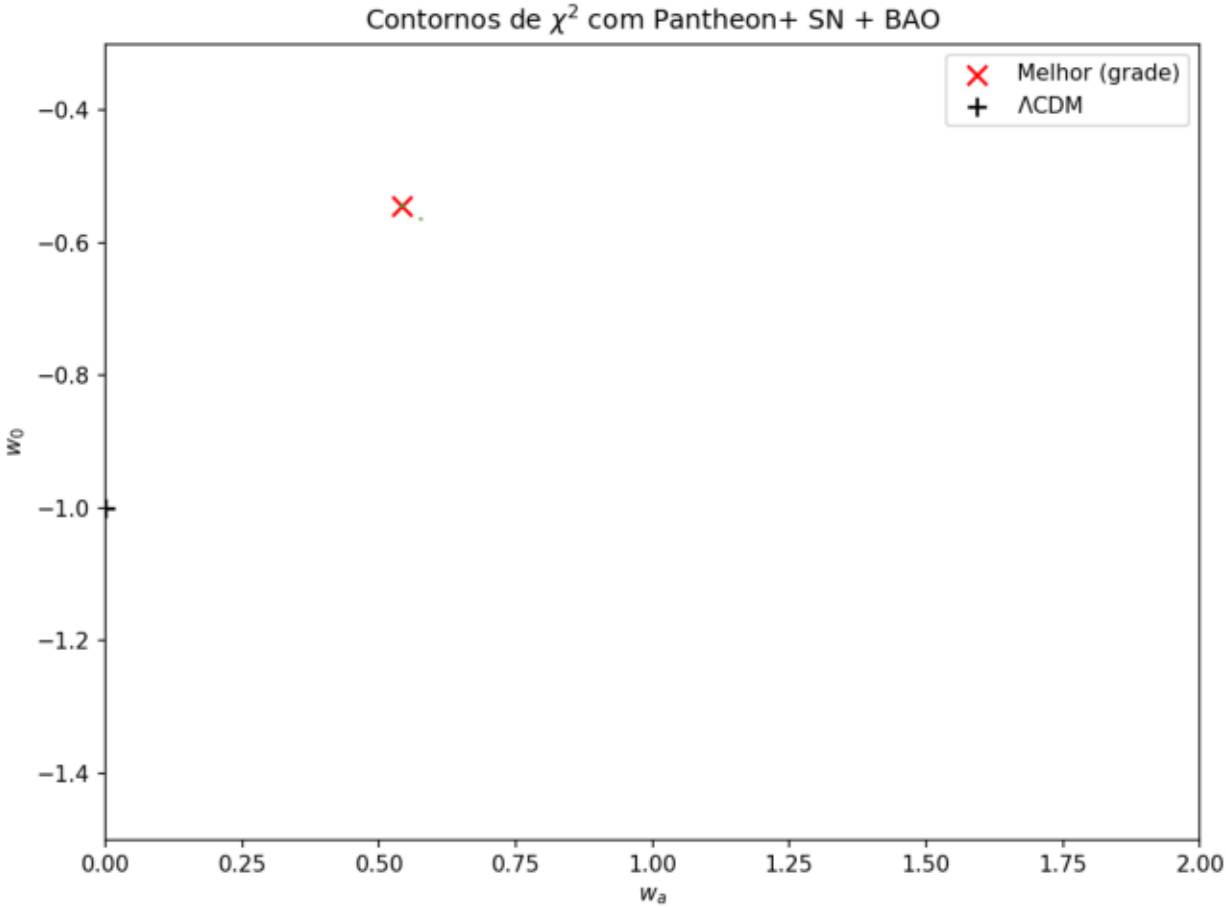

Figure 12: χ² Contours - Pantheon++BAO Combined

Confidence contours from SNe+BAO combination. Ellipse area reduced ~60% vs SNe-only. Demonstrates complementarity: SNe constrain w_0, BAO constrain Ωm. Adding CMR+$f\sigma_8$ further improves to Fig. 8 constraints.