

Probing Three-Form Dark Energy with a Gaussian Potential

Theoretical Overview and Observational Constraints

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Work in progress in collaboration with *Mariam Bouhmadi-López, Hsu-Wen Chiang and Carlos G. Boiza*

3-form Dark Energy

What is a 3-form?

- Totally antisymmetric covariant tensor
- In 4D: only 1 degree of freedom (like a scalar)

$$A_{\mu\nu\rho} = A_{[\mu\nu\rho]}$$

Action

$$S = \int d^4x \sqrt{-g} \left[\frac{1}{2\kappa^2} R - \frac{1}{48} F_{\mu\nu\rho\sigma} F^{\mu\nu\rho\sigma} - V(A^2) \right]$$

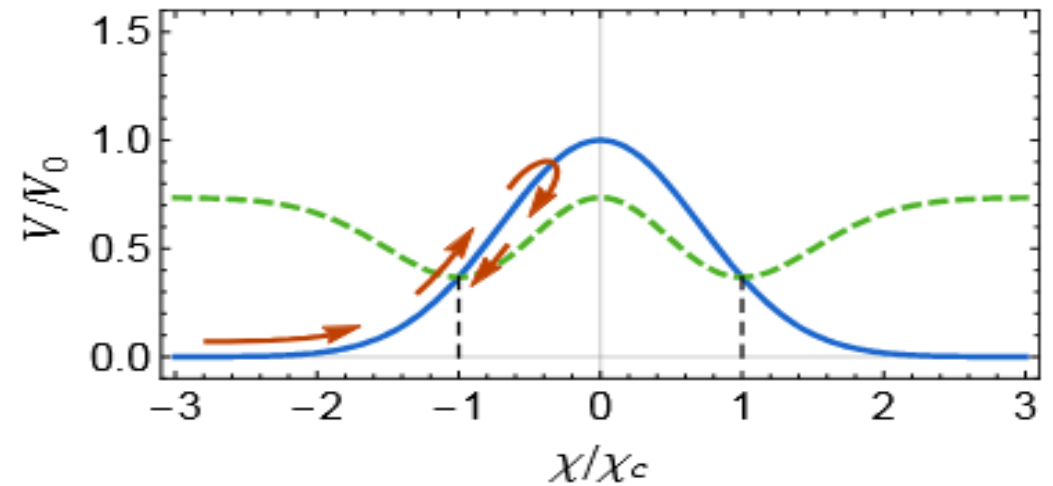
3-form in FLRW

$$A_{0ij} = 0 \quad A_{ijk} = a^3(t) \chi(t) \epsilon_{ijk}$$

$$w_\chi \equiv \frac{p_\chi}{\rho_\chi} = -1 + \frac{V_{,\chi} \chi}{\frac{1}{2} (\dot{\chi} + 3H\chi)^2 + V(\chi)}$$

Gaussian potential

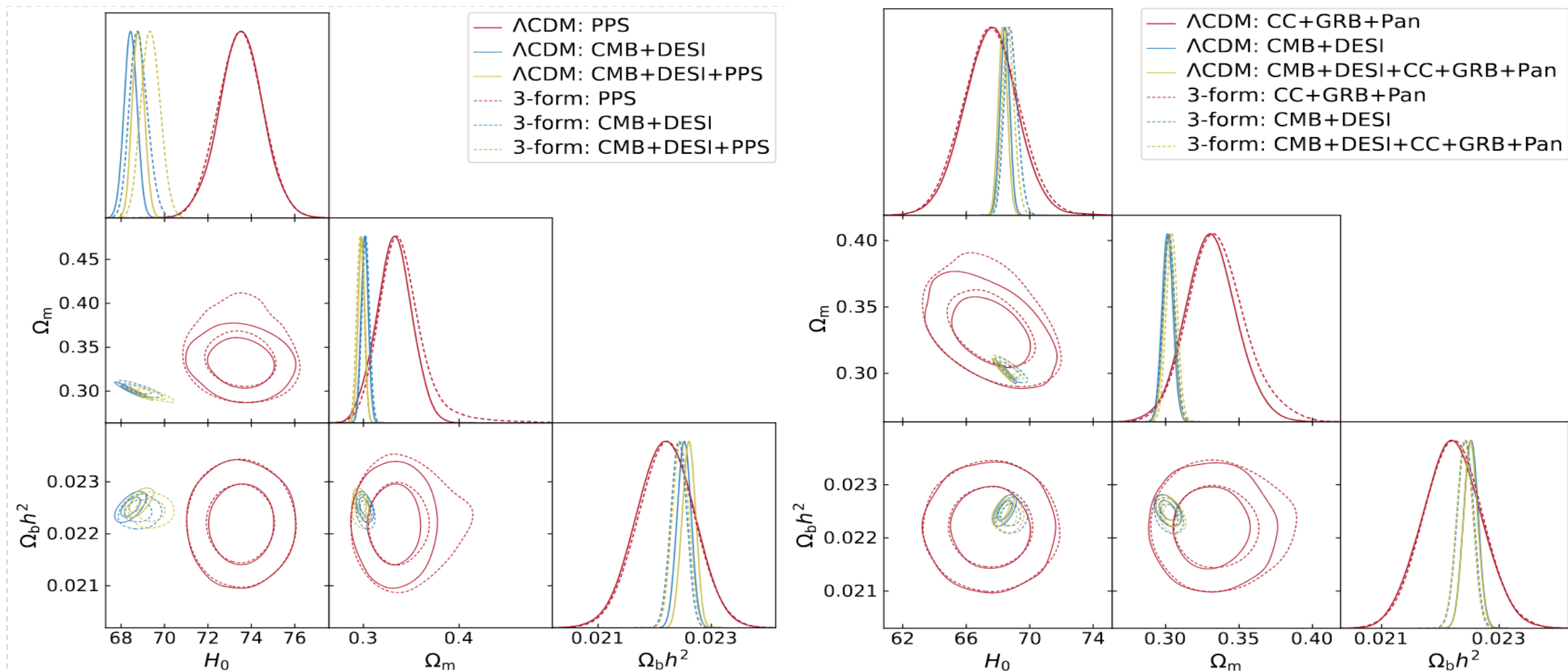
$$V(\chi) = V_* \exp\left(-\frac{\xi \kappa^2}{6} \chi^2\right), \quad V_*, \xi > 0$$



Tomi S. Koivisto, Nelson J. Nunes, arXiv: 0907.3883, Physics Letters B, 685 (2010)

João Morais, Mariam Bouhmadi-LópezK. Sravan Kumar, João Marto, Yaser Tavakoli, arXiv: 1608.01679, Phys. the Dark Universe 15 (2017)

Results



Mariam Bouhmadi-López, Hsu-Wen Chiang, Carlos .G. Boiza, Javier Ortega del Río (work in progress)

Results

	DESIBAO2	CMB+DESIBAO2	PPS	CMB+DESIBAO2+PPS	CC+GRB+Pan	CMB+BAO+CC+GRB+Pan
ΔAIC_C	15.46 ± 0.25	7.93 ± 0.84	5.5918 ± 0.0089	-4.45 ± 0.35	5.857 ± 0.016	-0.353 ± 0.020
ΔBIC	5.82 ± 0.25	2.92 ± 0.84	21.8733 ± 0.0089	11.86 ± 0.35	22.332 ± 0.016	16.148 ± 0.020
ΔDIC	3.7 ± 1.5	1.0 ± 1.3	2.55 ± 0.16	-1.50 ± 0.22	2.28 ± 0.47	-0.51 ± 0.42
$\Delta WAIC$	2.2 ± 1.5	0.2 ± 1.4	2.33 ± 0.19	-1.52 ± 0.25	2.1 ± 1.0	-1.4 ± 1.0
$\Delta(-\ln B)$	3.4 ± 2.0	-0.1 ± 2.4	3.71 ± 0.73	-0.5 ± 1.0	1.2 ± 1.9	-2.6 ± 3.5

Probe		CMB+DESIBAO2 PPS	CMB+DESIBAO2 CC+GRB+Pan
$n_\sigma(\text{GoF})$	ΛCDM	5.126 ± 0.074	1.41 ± 0.19
	three-form	4.872 ± 0.038	1.043 ± 0.063
	Δ	-0.255 ± 0.083	-0.36 ± 0.20
$n_\sigma(S)$	ΛCDM	4.922 ± 0.095	0.58 ± 0.36
	three-form	4.627 ± 0.050	-0.38 ± 0.23
	Δ	-0.29 ± 0.11	-0.96 ± 0.43