Testing ΛCDM

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We can quantify the improvement on constraining the cosmological parameters of PICO with respect to Planck 2018 (or previous experiments), by considering the ratio of the Figure of Merit (FoM) for an extended parameter space:

$$FoM_{ext} = (\det[\mathrm{cov}\{\Omega_\mathrm{b}h^2,\, \Omega_\mathrm{c}h^2,\, \theta,\, \tau,\, A_\mathrm{s},\, n_\mathrm{s},\, p_i\}])^{-1/2}$$

where p_i are the extra parameters we considered.

- The FoM is discussed in more detail in Di Valentino et al. (2018) JCAP Vol. 4 pg. 17

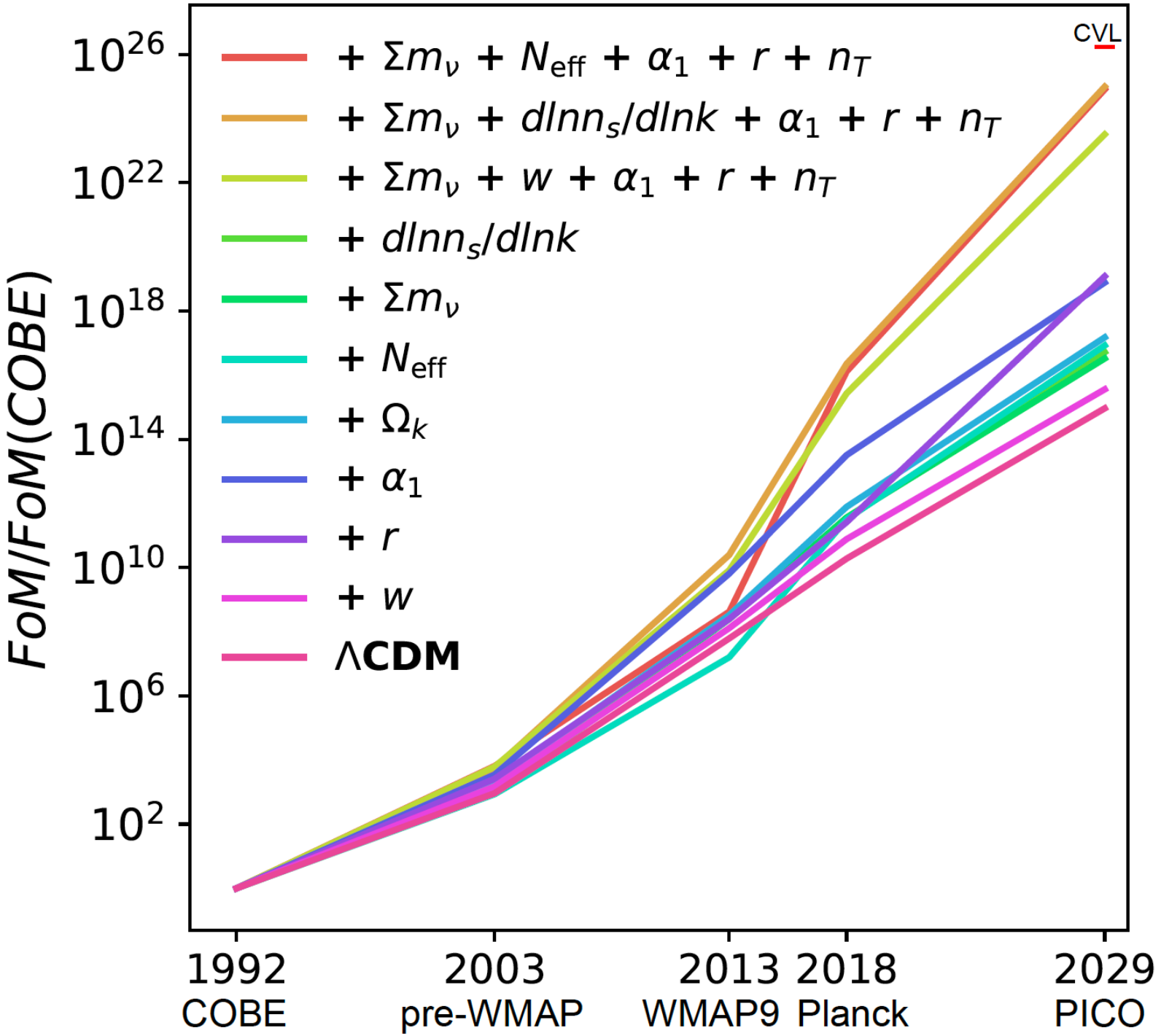
The FoMs in the next pages have been obtained with:

- TT,TE,EE,BB
- fiducial m_ν=0.06 eV, r=0 and cosmological parameters fixed to Planck 2018
- multichannel approach using the 70-220 GHz specs for v4.1 and v4.0.
- delensing 85% for PICO v4.0 and 81% for PICO v4.1, no delensing for Planck.
- α_1 is the amplitude of correlated CDM isocurvature perturbations (see equation 43 in astro-ph/1502.01589)

Model	COBE (τ is fixed)	pre-WMAP	WMAP9	Planck	PICO v4.1 del	CVL
ΛCDM	1	9.2×10^2	6.2×10^7	1.9×10^{10}	9.2×10^{14}	
ΛCDM + Σm_ν	1	9.8×10^2	2.5×10^8	3.6×10^{11}	3.3×10^{16}	
ΛCDM + w	1	1.5×10^3	1.3×10^8	7.7×10^{10}	3.6×10^{15}	
ΛCDM + $N_{\rm eff}$	1	8.6×10^2	1.6×10^7	3.2×10^{11}	8.4×10^{16}	
ΛCDM + Ω_k	1	2.2×10^3	3.3×10^8	7.8×10^{11}	1.5×10^{17}	
ΛCDM + $dlnn_s/dlnk$	1	1.5×10^3	2.5×10^8	3.6×10^{11}	5.2×10^{16}	
ΛCDM + α_1	1	3.5×10^3	6.5×10^9	3.2×10^{13}	7.7×10^{18}	
ΛCDM + r	1	2.6×10^3	2.5×10^8	2.6×10^{11}	1.2×10^{19}	
ΛCDM + Σm_ν + $N_{\rm eff}$ + α_1 + r + n_T	1	6.5×10^3	4.2×10^8	1.3×10^{16}	8.1×10^{24}	1.7×10^{26}
ΛCDM + Σm_ν + $dlnn_s/dlnk$ + α_1 + r + n_T	1	5.7×10^3	2.5×10^{10}	2.25×10^{16}	9.8×10^{24}	
ΛCDM + Σm_ν + w + α_1 + r + n_T	1	6.2×10^3	8.3×10^9	2.7×10^{15}	3.2×10^{23}	

Here the FOMs for COBE, pre-WMAP, WMAP9 and Planck are obtained with the real data. COBE has one less parameter because tau is fixed.

We also calculated the cosmic variance limit (CVL) for one set of parameters (see last column in Table). The experimental configuration has a resolution that is twice PICO (representing a 2.8 m effective aperture) and the noise x9 lower per each frequency band compared to PICO, which should give 0.1 uK*arcmin across the sky, fsky=0.75, and lmax=10000.


CVL
10^{26}
10^{22}
10^{18}
10^{14}
10^{10}
10^{6}
10^{2}
FoM/FoM(COBE)
+ Σm_ν + $N_{\rm eff}$ + α_1 + r + n_T
+ Σm_ν + $dlnn_s/dlnk$ + α_1 + r + n_T
+ Σm_ν + w + α_1 + r + n_T
+ $dlnn_s/dlnk$
+ Σm_ν
+ $N_{\rm eff}$
+ Ω_k
+ α_1
+ r
+ w
ΛCDM
1992
COBE
2003
pre-WMAP
2013
WMAP9
2018
Planck
2029
PICO

We also ran a comparison between PICO and Planck. In the Table below values are normalized to Planck 2018. Instead of using the Planck data, mission performance is simulated because the Planck2018 likelihood is not available for running extra extensions of the LCDM model.

Model	PICO v4.0	PICO v4.1	Planck18
$\Lambda\mathrm{CDM} + \Omega_k + N_{\mathrm{eff}} + \alpha_1 + w_0 + w_a + \Sigma m_\nu$	1.5×10^7	1.0×10^7	1
$\Lambda\mathrm{CDM} + N_{\mathrm{eff}} + \alpha_1 + w_0 + w_a + \Sigma m_\nu$	9.1×10^6	6.6×10^6	1
$\Lambda\mathrm{CDM} + N_{\mathrm{eff}} + \alpha_1 + w_0 + w_a + r + \Sigma m_\nu$	2.7×10^{10}	9.5×10^9	1

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where p_i are the extra parameters we considered.

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The FoMs (given in the next pages) are normalized to the Planck value and has been obtained with:

- TT,TE,EE,BB
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