Hunting down the right inflation model ! LiteBird vs. LiteCORE vs. CORE+

Sébastien Clesse

in collab with: C. Ringeval (UCL, Louvain) V. Vennin (ICG, Portsmouth)

delensing products provided by: J. Errard (Inst. Lagrange, Paris) S. Feeney (Imp. College, London)



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Shape of primordial power spectrum Amplitude + scalar spectral index





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Shape of the potential: concave, convex, slope, multi-field Slow-roll (Hubble-flow) parameters: $\epsilon_1, \epsilon_2, \epsilon_3$

Models confronted to data: Bayes factor + ASPIC **Library**





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What's next?





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What's next?

LiteBird, LiteCORE, CORE





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What is the right model? LiteBird, LiteCORE, CORE Reheating?

1. MCMC Bayesian analysis: MontePython & COSMOMC





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1. MCMC Bayesian analysis: MontePython & COSMOMC

2. Experimental specifications: LiteBird, LiteCORE120, LiteCORE150, CORE, optimal-CORE

Channel [GHz]	FWMH [arcmin]	$\Delta T \ [\mu K \ arcmin]$	$\Delta P \ [\mu K \ arcmin]$	
LiteBird, $l_{\text{max}} = 1350, f_{\text{sky}} = 0.7$				
80	55	12.5	17.7	
90	49	10.0	14.1	
100	43 12.0		17.0	
120	36	9.5	13.4	
140	31	7.5	10.6	
166	26	7.0	9.9	
195	22	5.0	7.1	
LiteCORE-120, $l_{\rm max} = 3000, f_{\rm sky} = 0.7$				
80	13.5	8.8	12.5	
90	11.9	7.1	10.0	
100	10.5	8.5	12.0	
120	8.8	6.7	9.5	
140	7.4	5.3	7.5	
166	6.3	5.0	7.0	
195	5.4	3.6	5.0	

LiteCORE-150, $l_{\rm max} = 3000, f_{\rm sky} = 0.7$				
80	10.8	8.8	12.5	
90	9.5	7.1	10.0	
100	8.4	8.5	12.0	
120	7.0	7.0 6.7		
140	5.9	5.3	7.5	
166	5.0	5.0	7.0	
195	4.3	3.6	5.0	
$(opt-)CORE, l_{max} = 3000, f_{sky} = 0.7$				
100	8.4	6.0(4.2)	8.5~(6.0)	
115	7.3	$5.0 \ (3.5)$	$7.0\ (5.0)$	
130	6.5	4.2(3.0)	5.9(4.2)	
145	5.8	3.6~(2.5)	$5.0 \ (3.6)$	
160	5.3	3.8(2.7)	5.4(3.8)	
175	4.8	3.8(2.7)	5.3(3.8)	
195	4.3	3.8(2.7)	5.3(3.8)	
220	3.8	5.8(4.1)	8.1(5.8)	



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11.9	1.1	10.0	130	6.5	<u>12(30</u>)	5.9(4.2)
10.5	8.5	12.0	1.15	5.8	3.6~(2.5)	5.0(3.6)
8.8	6.7	9.5	160	5.3	3.8(2.7)	5.4(3.8)
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	$\begin{array}{r} \text{MH} [\operatorname{arcmin}] \\ \hline \text{eBird, } l_{\max} = \\ 55 \\ 49 \\ 43 \\ 36 \\ 31 \\ 26 \\ 22 \\ \hline \text{ORE-120, } l_{\max} \\ 13.5 \\ 11.9 \\ 10.5 \\ 8.8 \\ 7.4 \\ 6.3 \\ 5.4 \\ \end{array}$	MH [arcmin] ΔT [μ K arcmin] eBird, $l_{max} = 1350, f_{sky} = 0.7$ 55 12.5 49 10.0 43 12.0 36 9.5 31 7.5 26 7.0 22 5.0 ORE-120, $l_{max} = 3000, f_{sky} =$ 13.5 8.8 11.9 7.1 10.5 8.5 8.8 6.7 7.4 5.3 6.3 5.0 5.4 3.6	MH [arcmin] ΔT [μ K arcmin] ΔP [μ K arcmin] eBird, $l_{max} = 1350, f_{sky} = 0.7$ 55 12.5 17.7 49 10.0 14.1 43 12.0 17.0 36 9.5 13.4 31 7.5 10.6 26 7.0 9.9 22 5.0 7.1 ORE-120, $l_{max} = 3000, f_{sky} = 0.7$ 13.5 8.8 12.5 11.9 7.1 10.0 10.5 8.5 12.0 8.8 6.7 9.5 7.4 5.3 7.5 6.3 5.0 7.0 5.0 5.0 7.0	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	MH [arcmin] $\Delta T \ [\mu K \ arcmin]$ $\Delta P \ [\mu K \ arcmin]$ eBird, $l_{max} = 1350, f_{sky} = 0.7$ 5512.517.74910.014.18010.84312.017.0909.5369.513.41207.0317.510.61405.9267.09.91665.0225.07.11008.4DRE-120, $l_{max} = 3000, f_{sky} = 0.7$ 1008.411.97.110.01457.310.58.512.01157.38.86.79.51605.37.45.37.51605.35.43.65.02203.8	MH [arcmin] ΔT [μ K arcmin] ΔP [μ K arcmin] eBird, $l_{max} = 1350, f_{sky} = 0.7$ 55 12.5 17.7 55 12.5 17.7 80 10.8 8.8 49 10.0 14.1 90 9.5 7.1 43 12.0 17.0 100 8.4 8.5 36 9.5 13.4 120 7.0 6.7 31 7.5 10.6 120 7.0 6.7 26 7.0 9.9 105 4.3 3.6 22 5.0 7.1 100 8.4 6.0 6.7 11.9 7.1 10.0 105 8.5 12.0 115 7.3 5.0 (3.5) 130 6.5 4.2 (3.0) 145 5.8 3.6 (2.5) 160 5.3 3.8 (2.7) 175 4.8 3.8 (2.7) 175 4.8 3.8 (2.7) 125 143 3.8 (2.7) 125 143 3.8 (2.7) 125 143 3.8 (2.7) 125 143 3.8 (2.7) 125 4.3 3.8 (2.7) 125



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- 1. MCMC Bayesian analysis: MontePython & COSMOMC
- 2. Experimental specifications: LiteBird, LiteCORE120, LiteCORE150, CORE, optimal-CORE
- 3. Fiducial models: Higgs inflation (HI) & Mutated Hybrid Inflation (MHI)



Most favored after Planck zero-parameter model no tensors,
in the middle of Planck
confidence region for ns



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- **5. Model comparison: Bayes factor for ~200 models in ASPIC library**



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Bayes Factor: $B_{\text{Ref}}^{i} \equiv \frac{\mathscr{E}(\mathscr{M}_{\text{Ref}}|D)}{\mathscr{E}(\mathscr{M}_{i}|D)} = \frac{p(\mathscr{M}_{i}|D)}{p(\mathscr{M}_{\text{Ref}}|D)}$ $p(\mathscr{M}_{i}|D) = \frac{\pi(\mathscr{M}_{i})\mathscr{E}(D|\mathscr{M}_{i})}{\sum_{i}\pi(\mathscr{M}_{i})\mathscr{E}(D|\mathscr{M}_{i})}$ $\mathscr{E}(D|M_{i}) = \int d\theta_{ij}\mathscr{L}(\theta_{ij})\pi(\theta_{ij}|\mathscr{M}_{i})$ Jeffrey's scale: $\ln B < -5 < -2.5 < -1 = 0$ **Strong Moderate Weak Inconclusive**



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- **5. Model comparison: Bayes factor for ~200 models in ASPIC library**
- 6. Information gain on the reheating (see V. Vennin's talk)
 - ~ between 10⁵ and 10⁶ CPU hours
 - > 2000 model comparisons



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3. ...to compute forecasts on $\epsilon_1, \epsilon_2, \epsilon_3$



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4. ...and on $n_{\rm s}, r, \alpha_{\rm s}$

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. then hunt down the right model!



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5....and constraints on reheating



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Conclusion

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- 1. Size does not matter, sensitivity does!
- 2. If tensors, isolating a few models is possible ...
- 3. ... and reheating temperature can be measured
- 4. If no tensors: ~25-30 viable models



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My preferred experiment: LiteCORE120, 2x longer mission







Thank you!



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