Testing cosmic parity violation with CMB 2, 3, 4-point correlators

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$$\mathcal{L} = \underbrace{-\frac{1}{2}(\partial\phi)^2 - V(\phi)}_{\text{inflaton = axion}} - \frac{1}{4}F^2 - \frac{\alpha}{4f}\phi F\tilde{F}$$

e.g., Sorbo: 1101.1525, Barnaby +: 1210.3257

$$A_\lambda'' + k^2 A_\lambda = 0$$

unpolarized,
i.e., $A_+ = A_-$

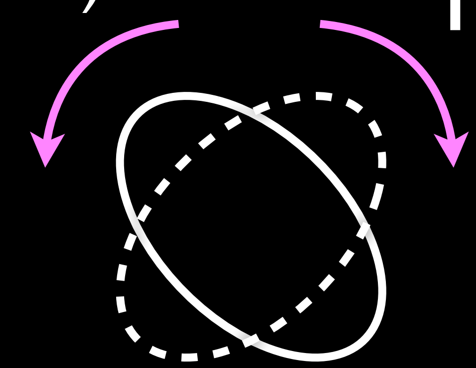
$$+2\lambda\xi\frac{k}{\tau}A_\lambda$$

A_+ enhanced exponentially, so $A_+ >> A_-$

$A + A \rightarrow h$

★ parity violation

$h^{(+2)}$ >> $h^{(-2)}$



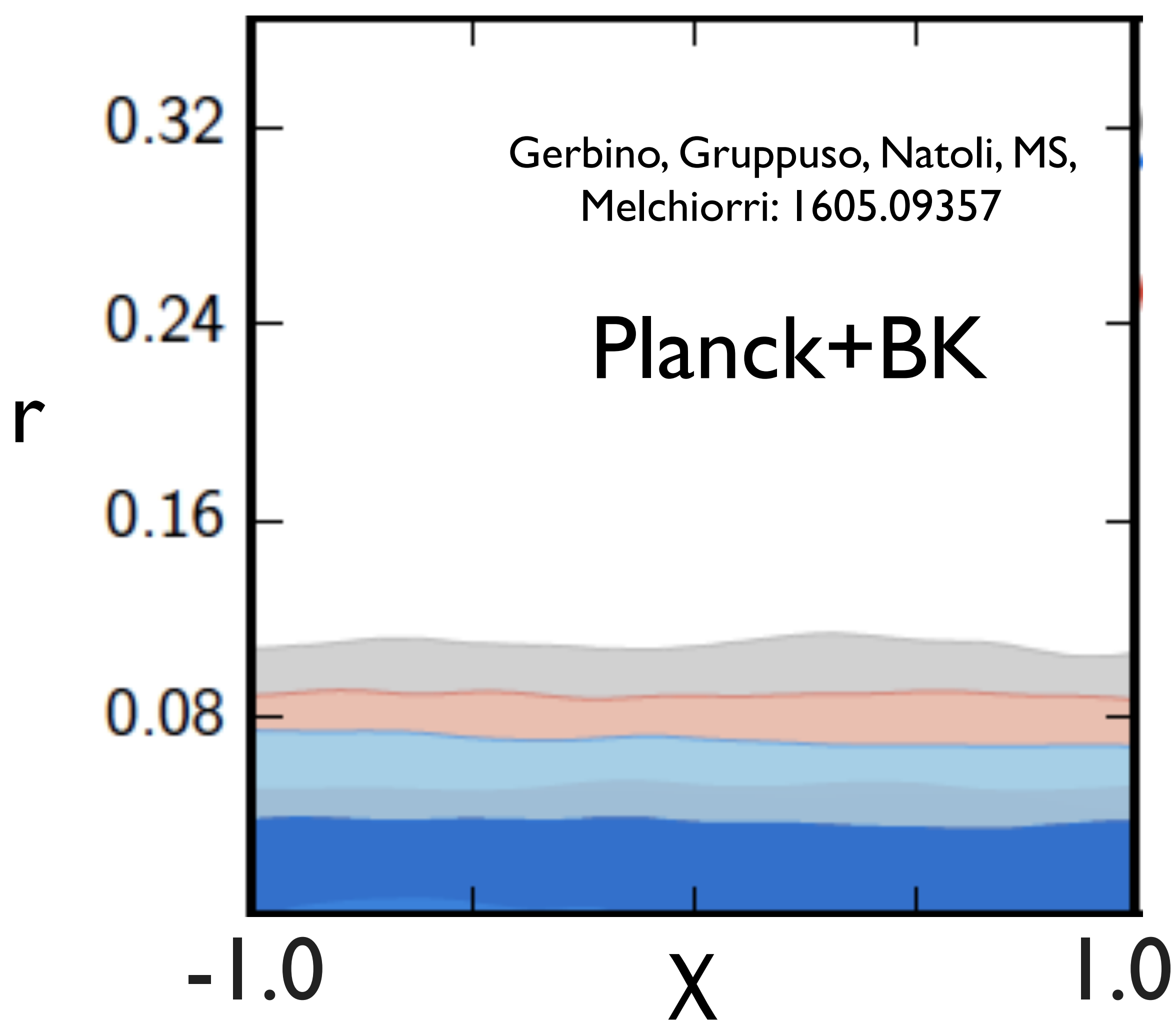
⭐ TB in $\ell_1 = \ell_2$

$C_\ell^{BB} \sim P_h^{(+)} + P_h^{(-)} \sim r\, P_\zeta$

$C_\ell^{TB} \sim P_h^{(+)} - P_h^{(-)} \sim r\, \chi\, P_\zeta$

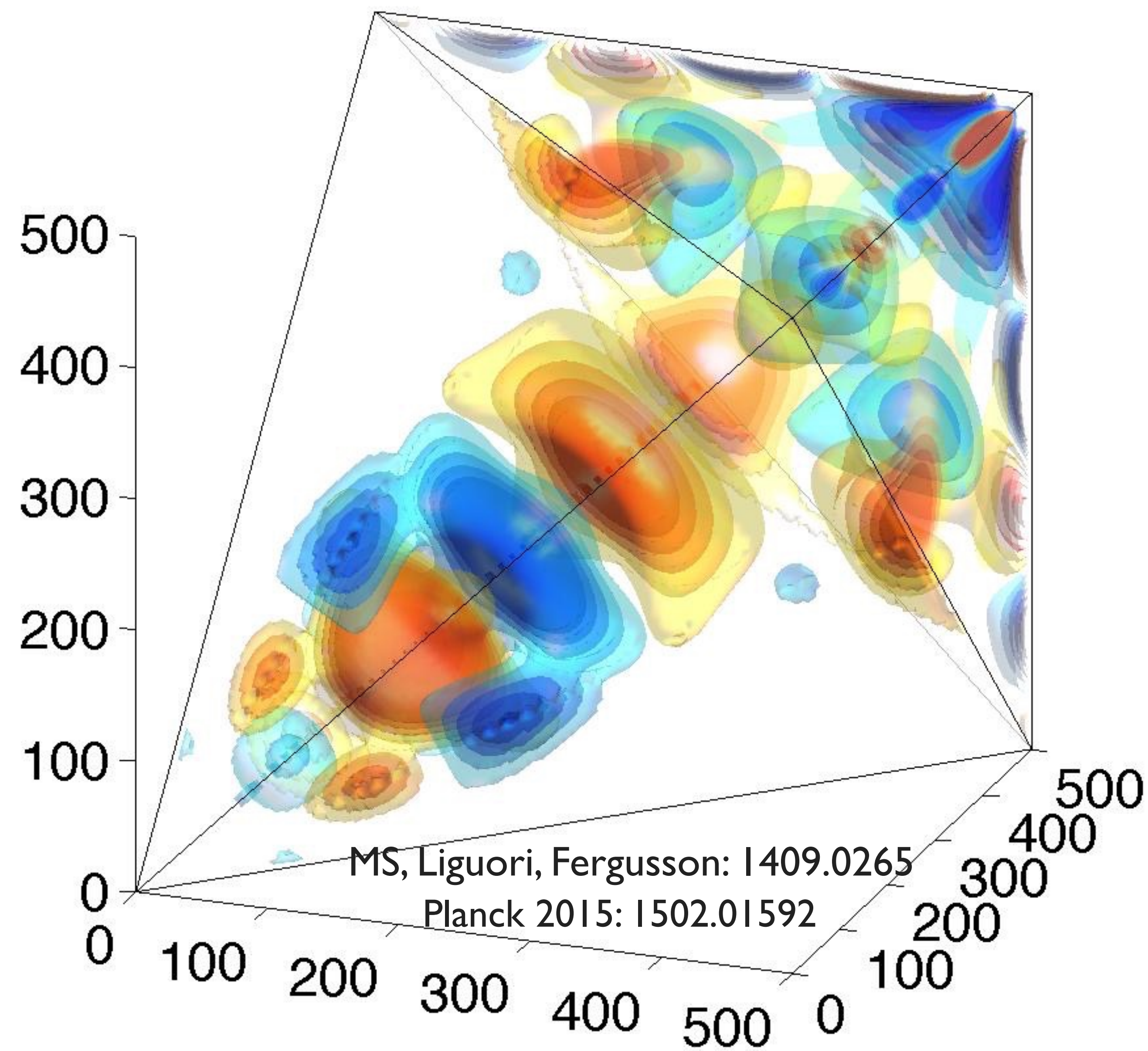
$$\left(\frac{S}{N}\right)^2_{TB} = \sum_\ell (2\ell+1)\frac{(C_\ell^{TB})^2}{C_\ell^{TT} C_\ell^{BB}}$$

unconstrained since C_ℓ^{TT} is huge



⭐ TTT in $\ell_1 + \ell_2 + \ell_3$ = odd

bisp from obs data



$f_{NL}^{tens} = B_h^{+++} / B_\zeta(f_{NL}^{scal} = 1)$

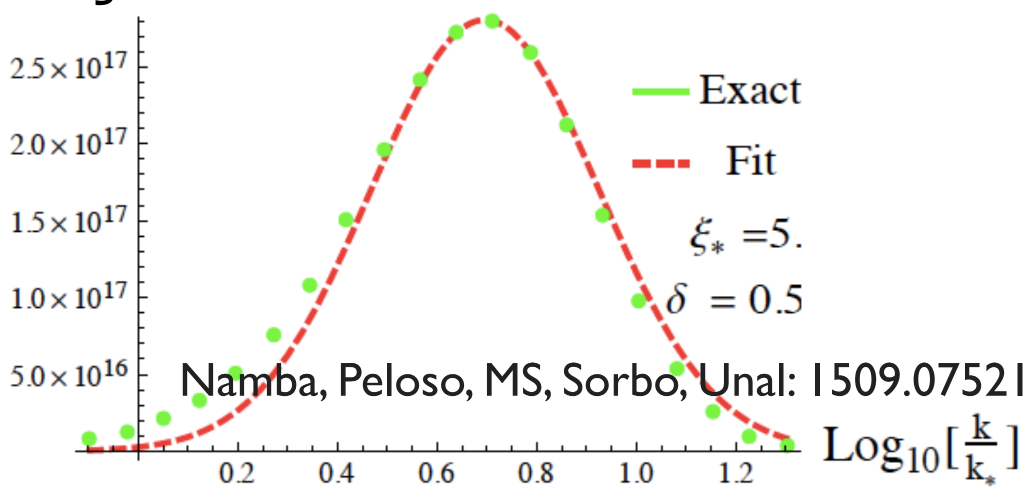
= 8000 ± 11000 (WMAP)
= 12000 ± 11000 (Planck)

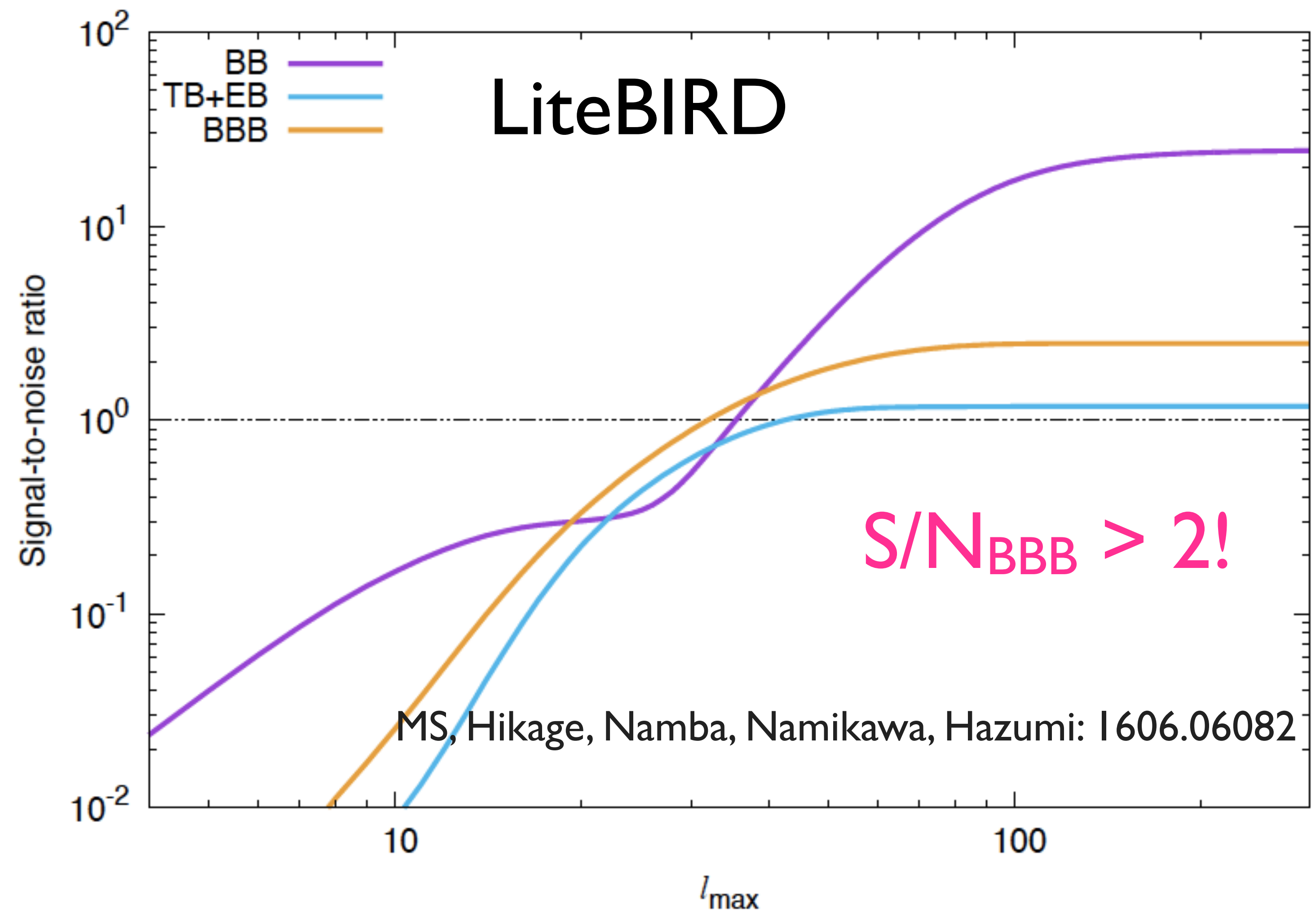
⭐BBB in $\ell_1 + \ell_2 + \ell_3$ = even

inflaton ≠ axion

→ bumped feature

P_ζ, P_h





⭐TTTT in $\ell_1 + \ell_2 + \ell_3 + \ell_4$ =odd

restriction of rotational invariance

$\langle\zeta^2\rangle, \langle\zeta^3\rangle \in \mathbf{R}$ → $\Sigma\, \ell_n$ = even

$\langle\zeta^4\rangle \in \mathbf{C}$ → $\Sigma\, \ell_n$ = even + odd

trisp is required for measuring parity violation in scalar sector!