The CMB bispectrum from vector-mode perturbations induced by primordial magnetic fields

▸MS + (2010) : 1009.3632, submitted to PRL
▸MS + in prep. of full paper
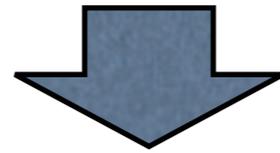
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Abstract

one of the studies to probe the nature of the early universe :
constraint on Primordial Magnetic field (PMF) by the analysis of
CMB bispectrum

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PMF can become a source of CMB bispectra generated from
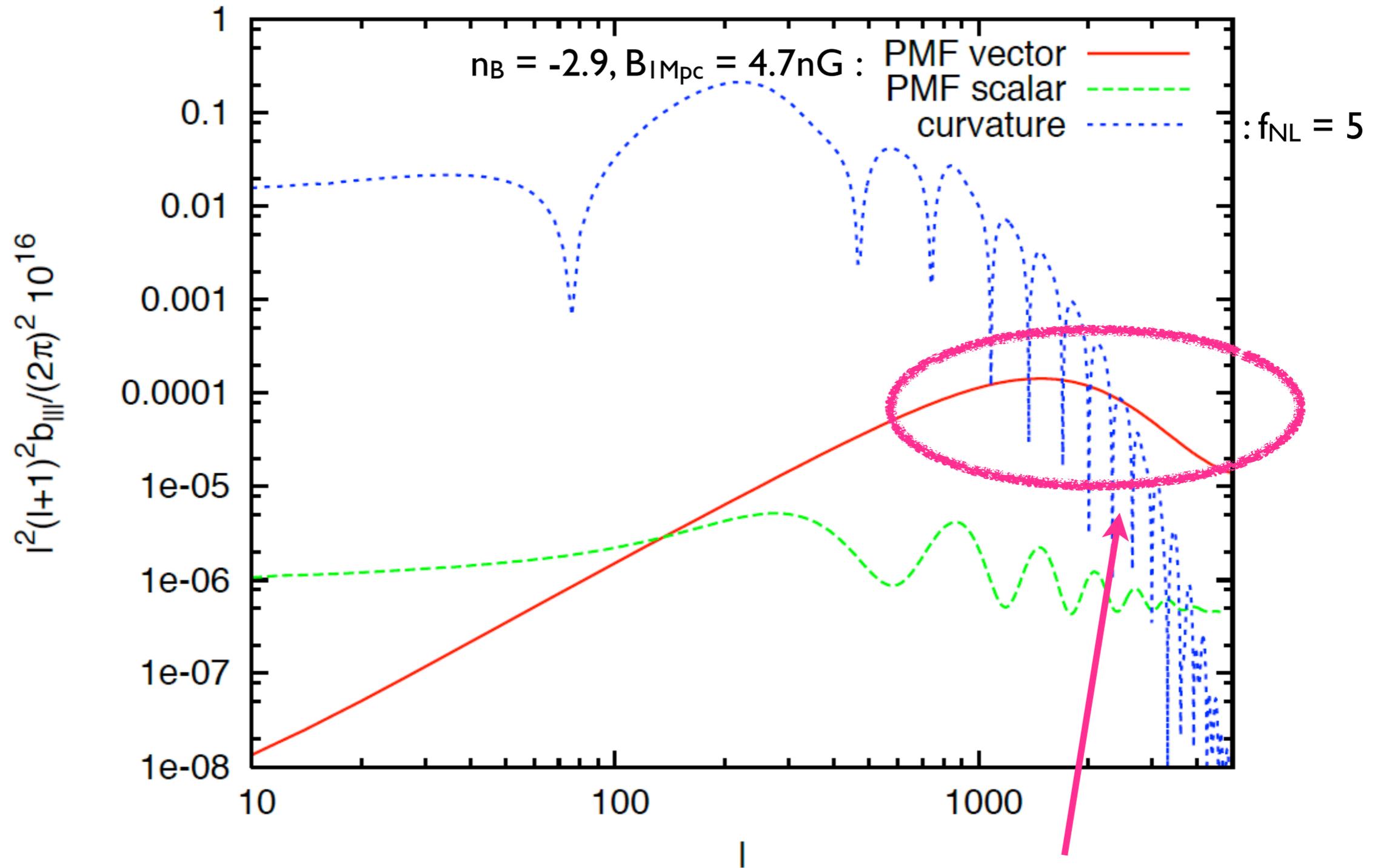scalar, vector and tensor-mode perturbations

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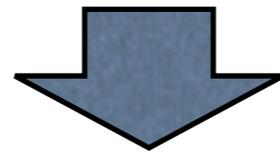
So far, for simplicity, only the dependence on scalar magnetic
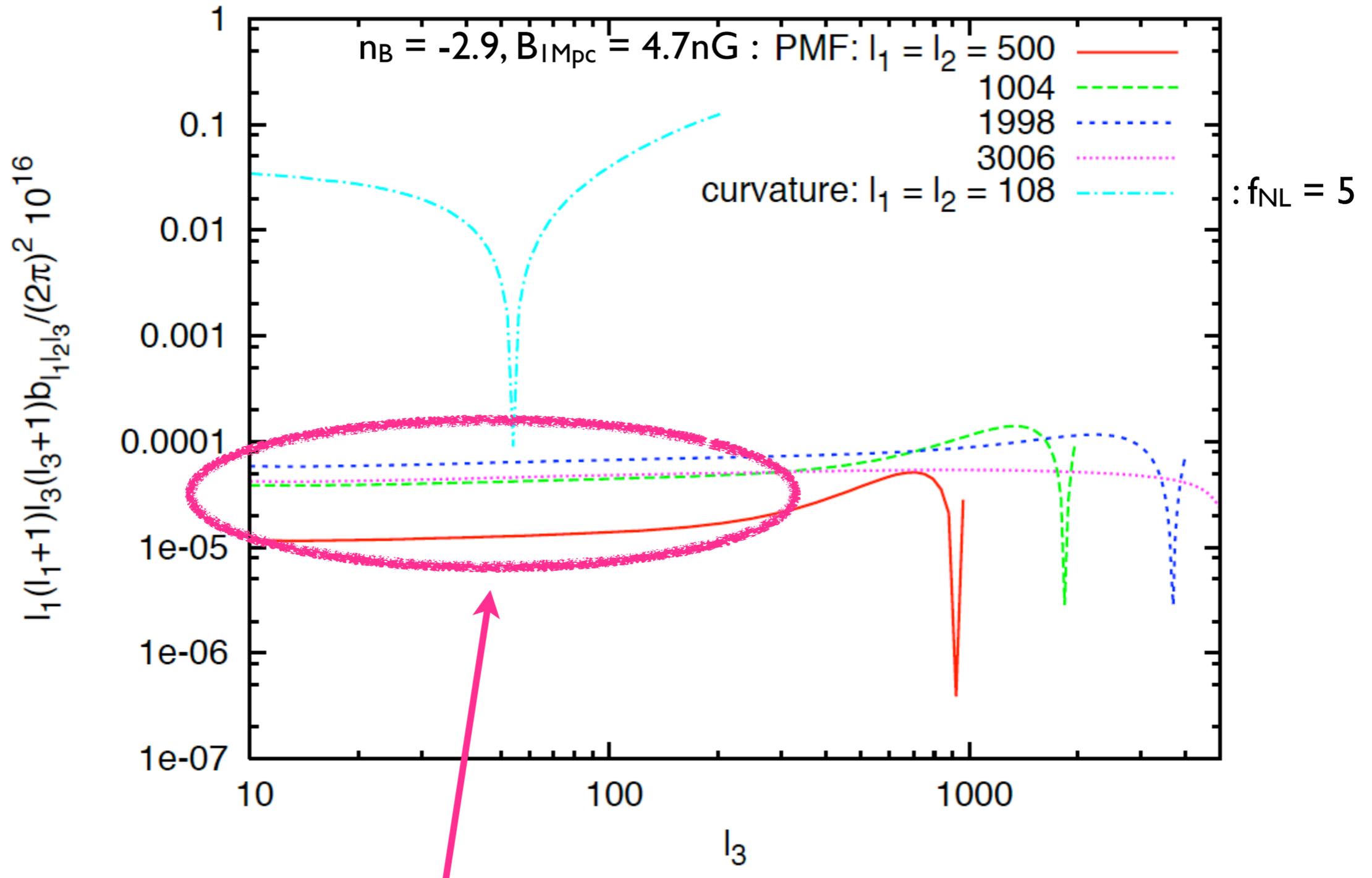mode has been considered, despite greater effect of vector one

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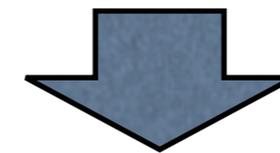
We compute the contribution of vector mode
and update bound on the magnitude of PMF

CMB reduced bispectrum $b_{\ell_1 \ell_2 \ell_3} \equiv \sqrt{\frac{(4\pi)}{(2\ell_1+1)(2\ell_1+2)(2\ell_1+3)}} \begin{pmatrix} \ell_1 & \ell_2 & \ell_3 \\ 0 & 0 & 0 \end{pmatrix}^{-1} B_{\ell_1 \ell_2 \ell_3}$
of intensity mode for $l_1 = l_2 = l_3$

vector component of b_{lll} dominates at small scale

CMB reduced bispectrum of intensity mode for $l_1 = l_2 \neq l_3$

the shape of vector bispectrum for $n_B = -2.9$ is close to the local-type configuration due to $b_{lll} \propto l_3^{-2}$
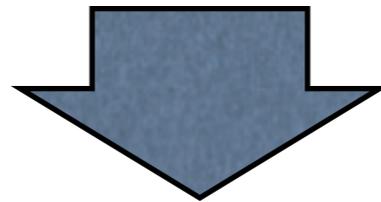
Constraints

◉ our bispectrum of magnetic vector mode ($n_B = -2.9$)

$$\ell_1(\ell_1 + 1)\ell_3(\ell_3 + 1)b_{\ell_1\ell_2\ell_3} \sim -2 \times 10^{-19} \left(\frac{B_{1\mathrm{Mpc}}}{4.7\mathrm{nG}}\right)^6$$
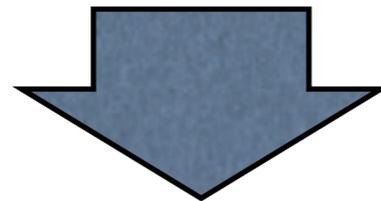
VS

◉ bispectrum from PNG in the curvature perturbations

$$\ell_1(\ell_1 + 1)\ell_3(\ell_3 + 1)b_{\ell_1\ell_2\ell_3} \sim 4 \times 10^{-18} f_{\mathrm{NL}}^{\mathrm{local}}$$

$$\left(\frac{B_{1\mathrm{Mpc}}}{1\mathrm{nG}}\right) \sim 7.74 \, |f_{\mathrm{NL}}^{\mathrm{local}}|^{1/6} \quad (\text{for } n_B = -2.9)$$

tighter by factor of two than Seshadri + (2009)!!

▸ WMAP : $|f_{NL}| < 100$ ☞ $B_{1Mpc} < 17nG$

▸ PLANCK : $|f_{NL}| < 5$ ☞ $B_{1Mpc} < 10nG$