Are GWs from vacuum fluctuation in spacetime, or from sources?

E. Komatsu (MPA)

$$\Box h_{ij} = -16\pi G \pi_{ij}$$

- **Homogeneous solution**: "GWs from vacuum fluctuation"
  This is what everyone has been talking about so far
- **Inhomogeneous solution**: "GWs from sources"
  New paradigm!
  - *Working example: GWs from SU(2) fields during inflation*
- We must **not** assume that detection of gravitational waves (GWs) from inflation immediately implies that GWs are from the vacuum fluctuation in tensor metric perturbation
  - Key tests: scale invariance; **non-Gaussianity**; parity violation → Profound implications for physics of inflation and fundamental physics

B. Thorne's talk

Agrawal, Fujita & EK, arXiv:1707.03023

Large bispectrum in GW from SU(2) fields

Aniket Agrawal
(MPA)

$$\frac{B_h^{RRR}(k,k,k)}{P_h^2(k)} \approx \frac{25}{\Omega_A}$$

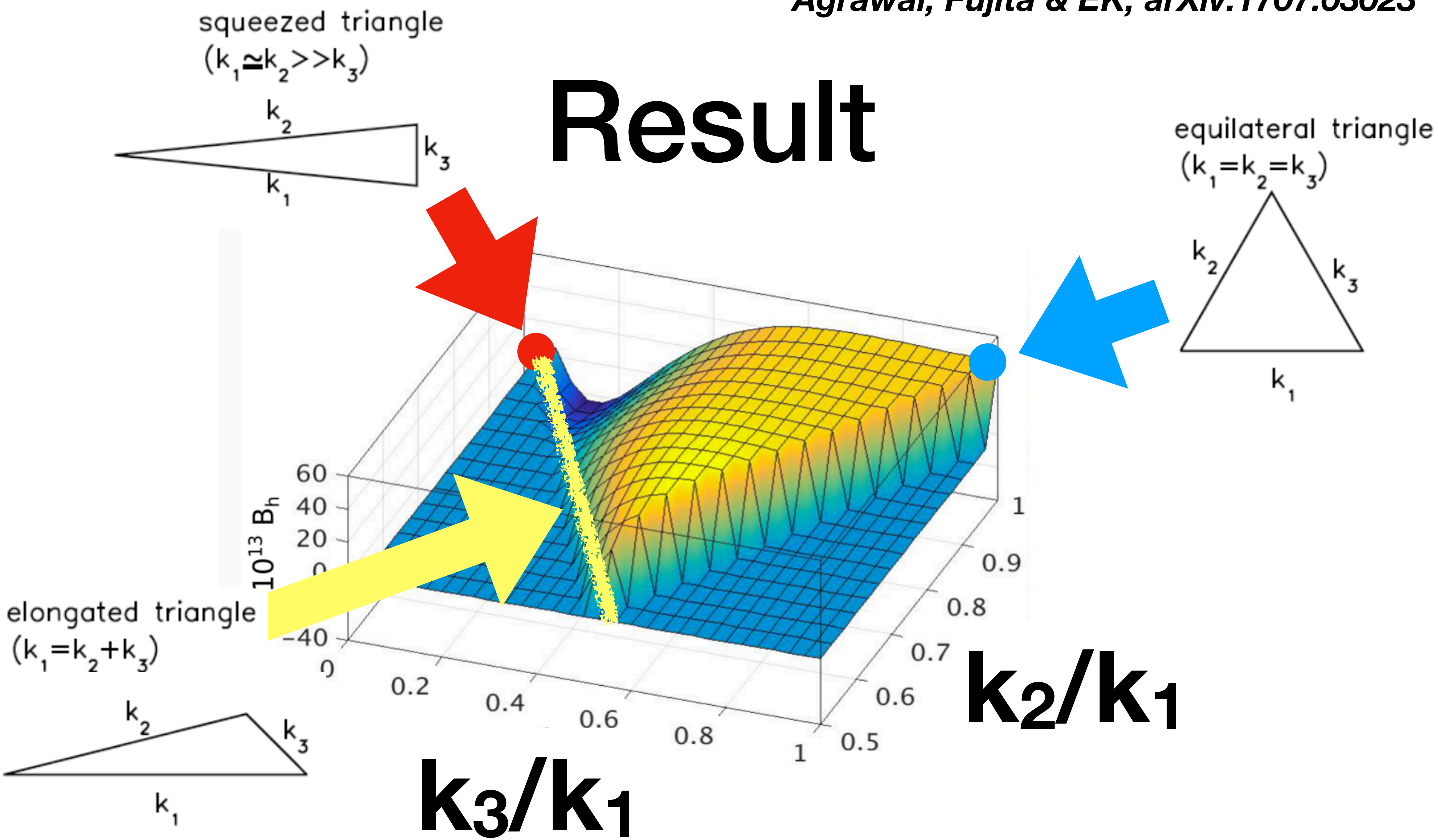
Tomo Fujita
(Stanford->Kyoto)

$$\langle \hat{h}_R(\boldsymbol{k}_1)\hat{h}_R(\boldsymbol{k}_2)\hat{h}_R(\boldsymbol{k}_3)\rangle = (2\pi)^3\delta\left(\sum_{i=1}^{3}\boldsymbol{k}_i\right) B_h^{RRR}(k_1,k_2,k_3)$$

- Ω_A << 1 is the energy density fraction of the gauge field
- **B_h/P_h^2 is of order unity for the vacuum contribution**
  [Maldacena (2003); Maldacena & Pimentel (2011)]
- ***Gaussianity offers a powerful test of whether the detected GW comes from the vacuum or sources***

Agrawal, Fujita & EK, arXiv:1707.03023

Result



- This shape is similar to, but not exactly the same as, what was used by the Planck team to look for tensor bispectrum

Agrawal, Fujita & EK, arXiv:1707.03023

SU(2), confronted

- The Planck data constrain tensor non-Gaussianity using

$$f_{\rm NL}^{\rm tens} \approx 0.1 r^2 \frac{B_h}{P_h^2}$$

- The vacuum contribution gives

$$f_{\rm NL}^{\rm tens}({\rm vacuum}) \approx 0.1 r^2$$

- **The SU(2) model predicts:**

$$f_{\rm NL}^{\rm tens} \approx r^2 \frac{2.5}{\Omega_A}$$

- The current 68%CL constraint from Planck is $f_{\rm NL}^{\rm tens} = 400 \pm 1500$

- **LiteBIRD would reach $f_{\rm NL}^{\rm tens}$ ~ 1!** (by M. Shiraishi)