Local-type non-gaussianities in single-field inflation from a non-vacuum initial state

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I. CONCLUSIONS

Single-field inflation, canonical Lagrangian,

Non-vacuum initial state for scalar perturbations → **Enhancement of primordial non-Gaussianities in the squeezed limit**

$$f_{NL} \approx \mathcal{O}(100) f_{NL}^{\rm vac}$$

II. ANALYSIS

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Quantum Mechanics:

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3) Bispectrum in the squeezed limit $k_1 \approx k_2 \gg k_3$ **with** $k_i \gg H(t_{on})a(t_{on})$

$$B_{\mathcal{R}}(\vec{k}_1, \vec{k}_2, \vec{k}_3) = P_{\mathcal{R}}(k_1) P_{\mathcal{R}}(k_3) \frac{12}{5} f_{NL}$$

An explicit computation shows

$$f_{NL} \approx \frac{5}{3}\epsilon \frac{k_1}{k_3} \left(\frac{2\langle N_{\vec{k}_1} N_{\vec{k}_2} \rangle + \langle N_{\vec{k}_1} \rangle + \langle N_{\vec{k}_2} \rangle}{(2\langle N_{\vec{k}_1} \rangle + 1)(2\langle N_{\vec{k}_2} \rangle + 1)} \right) \overset{\langle N_{\vec{k}} \rangle \gtrsim 1}{\approx} \frac{5}{3}\epsilon \frac{k_1}{k_3}$$

Comparing with the vacuum prediction

$$\frac{f_{NL}}{f_{NL}^{\rm vac}} \approx \frac{k_1}{k_3} \frac{2\epsilon}{4\epsilon + 2\delta} \approx \mathcal{O}(\frac{k_1}{k_3}) \approx \mathcal{O}(100)$$

III. REMARKS

1) **Single-field inflation may produce local-type primordial non-gaussianities**

2) **The explicit form of our prediction may offer a observational signature for identifying the effects of a non-vacuum initial state**

$$f_{NL} \approx \frac{5}{3}\epsilon\frac{k_1}{k_3}$$

3) **Observations can provide information about the state of the Universe at the onset of inflation ⟶ information about the history of our Universe before inflation**