A modal approach to the numerical calculation of primordial non-Gaussianities

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- Key-observation: **the tree-level bispectrum calculation in the Keldysh-Schwinger formalism is intrinsically separable!** Example:

$$S_{\dot\zeta(\partial\zeta)^2}(k_1,k_2,k_3) = \mathbf{k_2}\cdot\mathbf{k_3}\int_{-\infty(1+i\epsilon)}^{0} \mathrm{d}\tau g(\tau)\left(k_1^2\zeta_{k_1}(0)\zeta_{k_1}^{*'}(\tau)\right)\left(k_2^2\zeta_{k_2}(0)\zeta_{k_2}^{*}(\tau)\right)\left(k_3^2\zeta_{k_3}(0)\zeta_{k_3}^{*}(\tau)\right) + \text{c.c.} + 2\,\text{perms.}$$

- Efficient numerical calculation of the bispectrum through a modal decomposition.

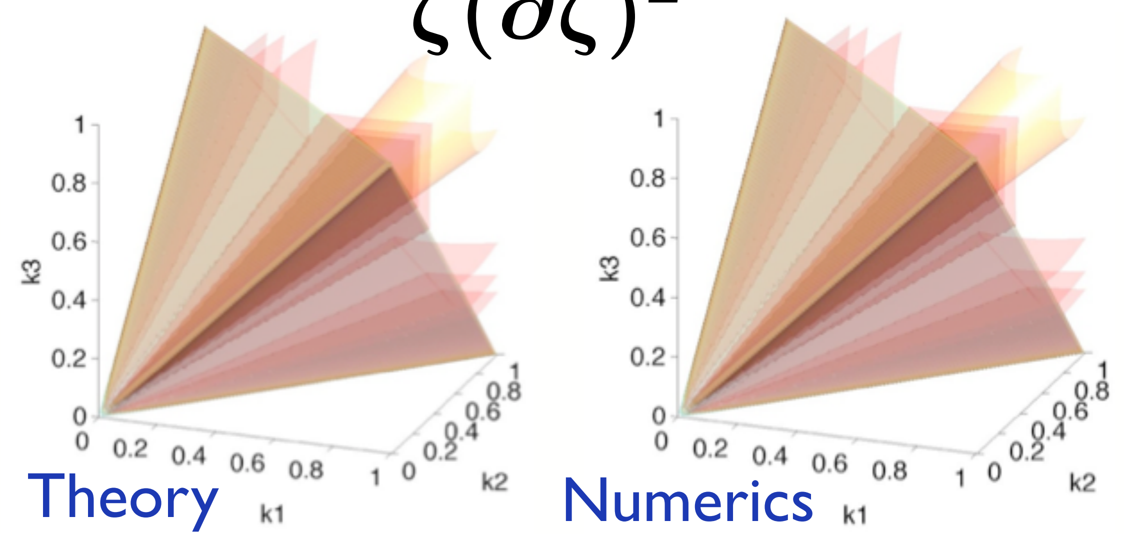
$$S(k_1,k_2,k_3) = \sum_n \alpha_n \mathcal{Q}_n$$ where $\mathcal{Q}_n$: orthonormalized over the cube $[k_{\min}, k_{\max}]^3$, built out of products of Legendre polynomials.

- We calculate: $$\alpha_n = \int_{\text{cube}} \mathrm{d}V_k\, \mathcal{Q}_n(k_1,k_2,k_3)S(k_1,k_2,k_3)$$

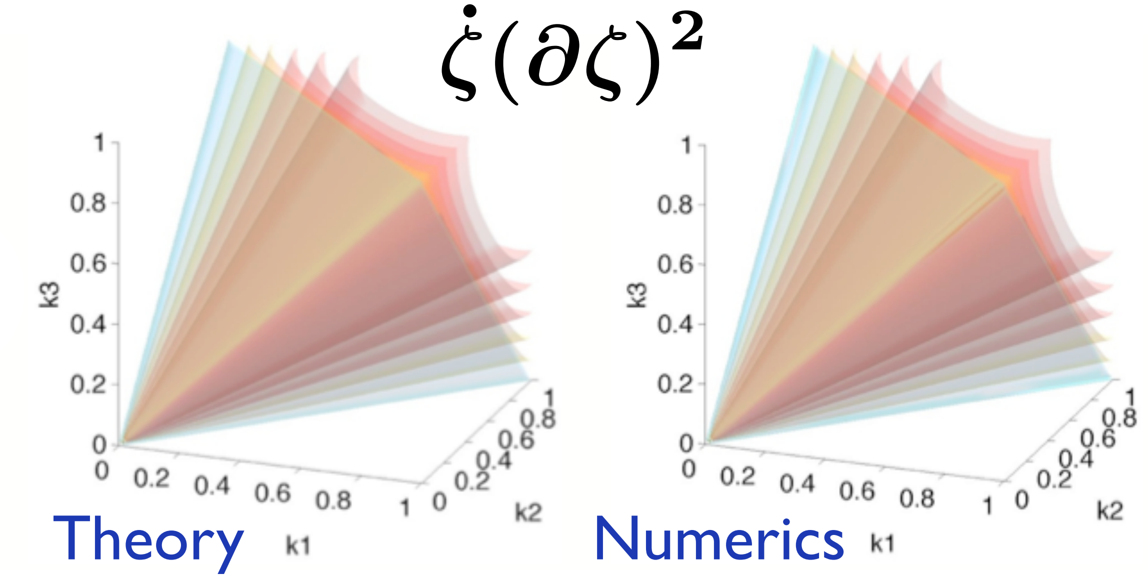
- No $i\epsilon$ prescription is needed!

- More than 99% correlations between theoretical and numerically calculated bispectra on slowly-varying backgrounds:

$\zeta(\partial\zeta)^2$



$\dot\zeta(\partial\zeta)^2$



- Several non-trivial checks, including the test of the single field consistency relation.