# BSM and Primordial Signatures in LSS

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Notes at
https://docs.google.com/document/d/1ibPn5jyphoUBSogw0u5JmSVcH6wYUyfZvuDGbW8H1LY/edit

Most focus in LSS is currently on:

- Physics:
  - Inflation via polyspectra/primordial non-Gaussianity and features
  - Neutrinos/ULAs/WDM/DM-baryon interaction via power spectrum suppression
  - Expansion history/growth as a probe of dark energy/modified gravity
  - Maybe some tailored analyses, as in the CMB (e.g. neutrino self-interactions, DAO, EDE, …)

- Observables:
  - Galaxy clustering
  - Weak lensing
  - CMB secondaries
  - Cross-correlations

Challenge 1: What early-universe (initial conditions) physics can be (much) better constrained by LSS (or combination) than by the CMB alone, even in principle?

- Primordial/oscillatory features (orders of magnitude!)
- Primordial non-Gaussianity? (Factor of 10 for local? Factor of 3 for equilateral?)
- Other examples?
  - If yes: Let's collect them!
  - If no: Why not? What are the properties of the physics and/or the observables for features? Can we find other examples through those properties?
    - Access to 3d field in LSS versus 2d projection in CMB (leading to intrinsic averaging)
    - Oscillatory signal versus smooth background

Challenge 2: What BSM physics (new particles and interactions) can be (much) better constrained by LSS (or combination) than by the CMB alone?
Are there other competing probes of these scenarios?

- Neutrino mass
- Dark sector (matter/radiation) properties & interactions?
- Dark sector interactions with Standard Model matter/radiation?
- Dark energy. . .
- Other examples?
    - If yes: Let's collect them!
    - If no: Why not? What are the properties of the physics and/or the observables for these examples? Can we find other examples through those properties?

Challenge 3: What about other observables?

- Various forms of isocurvature
- Higher-order cross-correlations
- Tracers to map new BSM fields/interactions
- Others?

Challenge 4: Can we build better tools to allow easier interpretation of limits/detections in terms of underlying models, or to categorize models with common (cosmological) phenomenology?

- Example: ETHOS framework for mapping dark matter/dark radiation interactions into properties of the DM fluid relevant to simulations.
- Other examples?
  - If yes: Let’s collect them!
  - If no: Why not? What information is currently missing? Can we find other examples this way?

Challenge 5: How are we supposed to get a precision measurement of e.g. Mnu, which for normal ordering is a ~1.2% suppression in $\sigma_8$, from measurements with few-percent problems (e.g. S8 tension)?