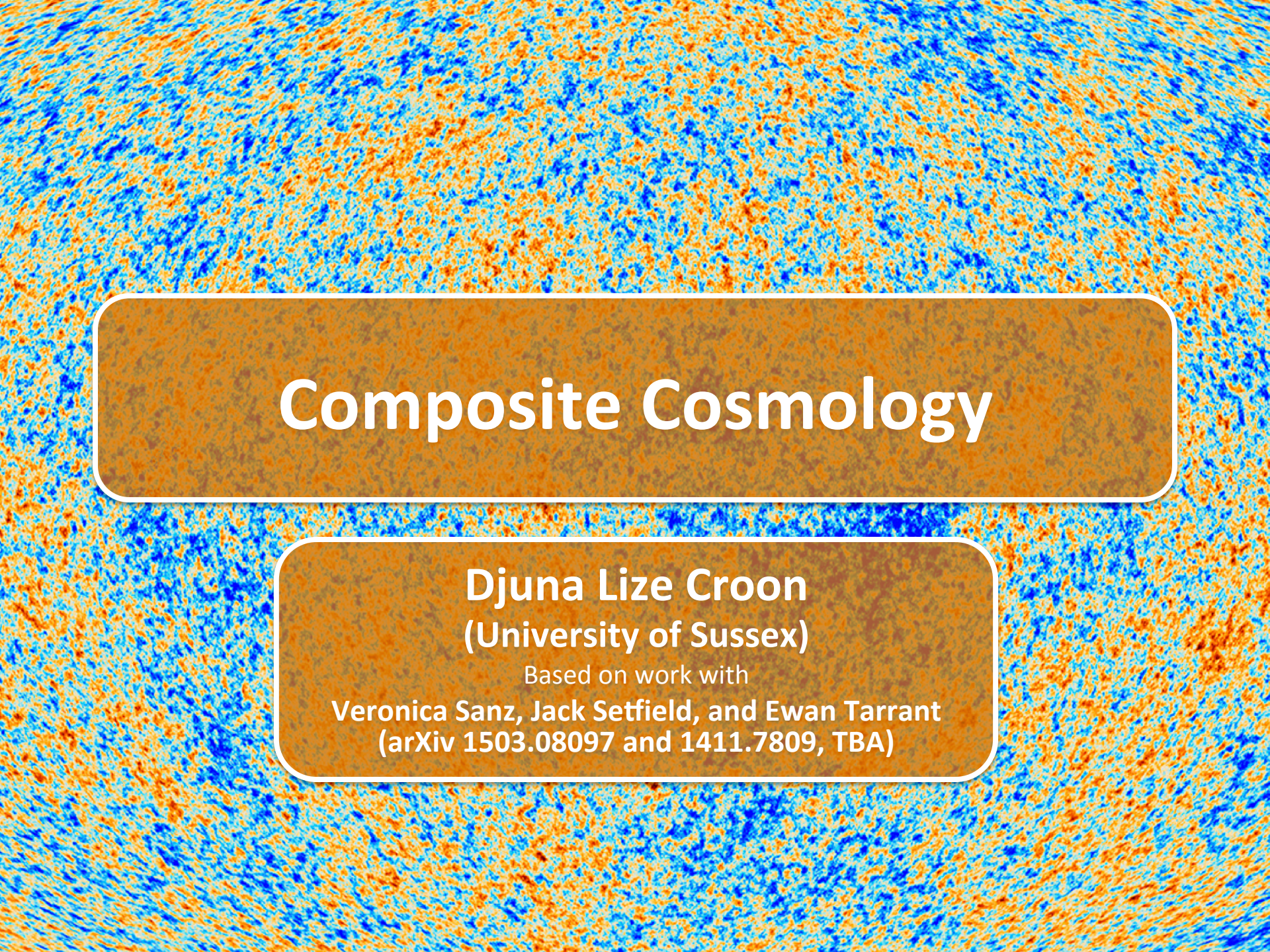

Composite Cosmology

Djuna Lize Croon
(University of Sussex)

Based on work with

Veronica Sanz, Jack Setfield, and Ewan Tarrant
(arXiv 1503.08097 and 1411.7809, TBA)

pGBs solve hierarchy problems!

- Flatness of inflation potential and lightness of the Higgs have a common origin
  - Higgs doublet and inflaton η are pGBs
  - Goldstone Inflation[1] and Composite Higgs[2] scenarios
- Reheating: η ➔ 2 h ➔ SM, perturbative

- Minimal realization: SU(4)/Sp(4) (= SO(6)/SO(5))

1) Croon, Sanz, Setford [arXiv: 1411.7809]
2) Gripaios, Pomarol, Riva, Serra [0902.1483]

A model for inflation, reheating, EWSB

- CCWZ in general vacuum of SU(4)/Sp(4) + fermions in 6 of SU(4)

$$\mathcal{L}_{kin} = \frac{f^2}{2}(\partial_\mu h)^2 + \frac{f^2}{2}(\partial_\mu \eta)^2 + \frac{f^2}{2}\frac{(h\partial_\mu h + \eta\partial_\mu \eta)^2}{1-h^2-\eta^2}$$

- Coleman Weinberg mechanism:

$$V(h,\eta) = m_h^2 h^2 + \lambda_h h^4 + m_\eta^2 \eta^2 + c_\eta \eta^3 + \lambda_\eta \eta^4 + c_3 \eta h^2 + c_4 h^2 \eta^2$$

Functions of UV dynamics, fermion rep and choice of vacuum

A model for inflation, reheating, EWSB

- CCWZ + fermions in 6 of SU(4) + Coleman Weinberg mechanism:

$$\mathcal{L}_{kin} = \frac{f^2}{2}(\partial_\mu h)^2 + \frac{f^2}{2}(\partial_\mu \eta)^2 + \frac{f^2}{2}\frac{(h\partial_\mu h + \eta\partial_\mu \eta)^2}{1-h^2-\eta^2}$$

- Need to introduce CP breaking for reheating:

$$V(h,\eta) = m_h^2 h^2 + \lambda_h h^4 + m_\eta^2 \eta^2 + c_\eta \eta^3 + \lambda_\eta \eta^4 + c_3 \eta h^2 + c_4 h^2 \eta^2$$

A model for inflation, reheating, EWSB

- CCWZ + fermions in 6 of SU(4) + Coleman Weinberg mechanism:

$$\mathcal{L}_{kin} = \frac{f^2}{2}(\partial_\mu h)^2 + \frac{f^2}{2}(\partial_\mu \eta)^2 + \frac{f^2}{2}\frac{(h\partial_\mu h + \eta\partial_\mu \eta)^2}{1-h^2-\eta^2}$$

- Inflation:

$$V(h,\eta) = m_h^2 h^2 + \lambda_h h^4 + m_\eta^2 \eta^2 + c_\eta \eta^3 + \lambda_\eta \eta^4 + c_3 \eta h^2 + c_4 h^2 \eta^2$$

Planck 2015:
N=60, n_s=.96, r<.1

A model for inflation, reheating, EWSB

- CCWZ + fermions in 6 of SU(4) + Coleman Weinberg mechanism:

$$\mathcal{L}_{kin} = \frac{f^2}{2}(\partial_\mu h)^2 + \frac{f^2}{2}(\partial_\mu \eta)^2 + \frac{f^2}{2}\frac{(h\partial_\mu h + \eta\partial_\mu \eta)^2}{1-h^2-\eta^2}$$

- Reheating:

$$V(h,\eta) = m_h^2 h^2 + \lambda_h h^4 + m_\eta^2 \eta^2 + c_\eta \eta^3 + \lambda_\eta \eta^4 + c_3 \eta h^2 + c_4 h^2 \eta^2$$

Perturbativity
Complete decay

A model for inflation, reheating, EWSB

- CCWZ + fermions in 6 of SU(4) + Coleman Weinberg mechanism:

$$\mathcal{L}_{kin} = \frac{f^2}{2}(\partial_\mu h)^2 + \frac{f^2}{2}(\partial_\mu \eta)^2 + \frac{f^2}{2}\frac{(h\partial_\mu h + \eta\partial_\mu \eta)^2}{1-h^2-\eta^2}$$

- EWSB:

$$V(h,\eta) = m_h^2 h^2 + \lambda_h h^4 + m_\eta^2 \eta^2 + c_\eta \eta^3 + \lambda_\eta \eta^4 + c_3 \eta h^2 + c_4 h^2 \eta^2$$

EW data

Composite Cosmology

- Addresses in a single model
  - Hierarchy problem of inflation (naturally flat potential)
  - EW hierarchy problem
- Realizes
  - Inflation compatible with Planck 2015 data
  - Perturbative reheating
- Connects to EW data and gives boundary conditions for UV completion