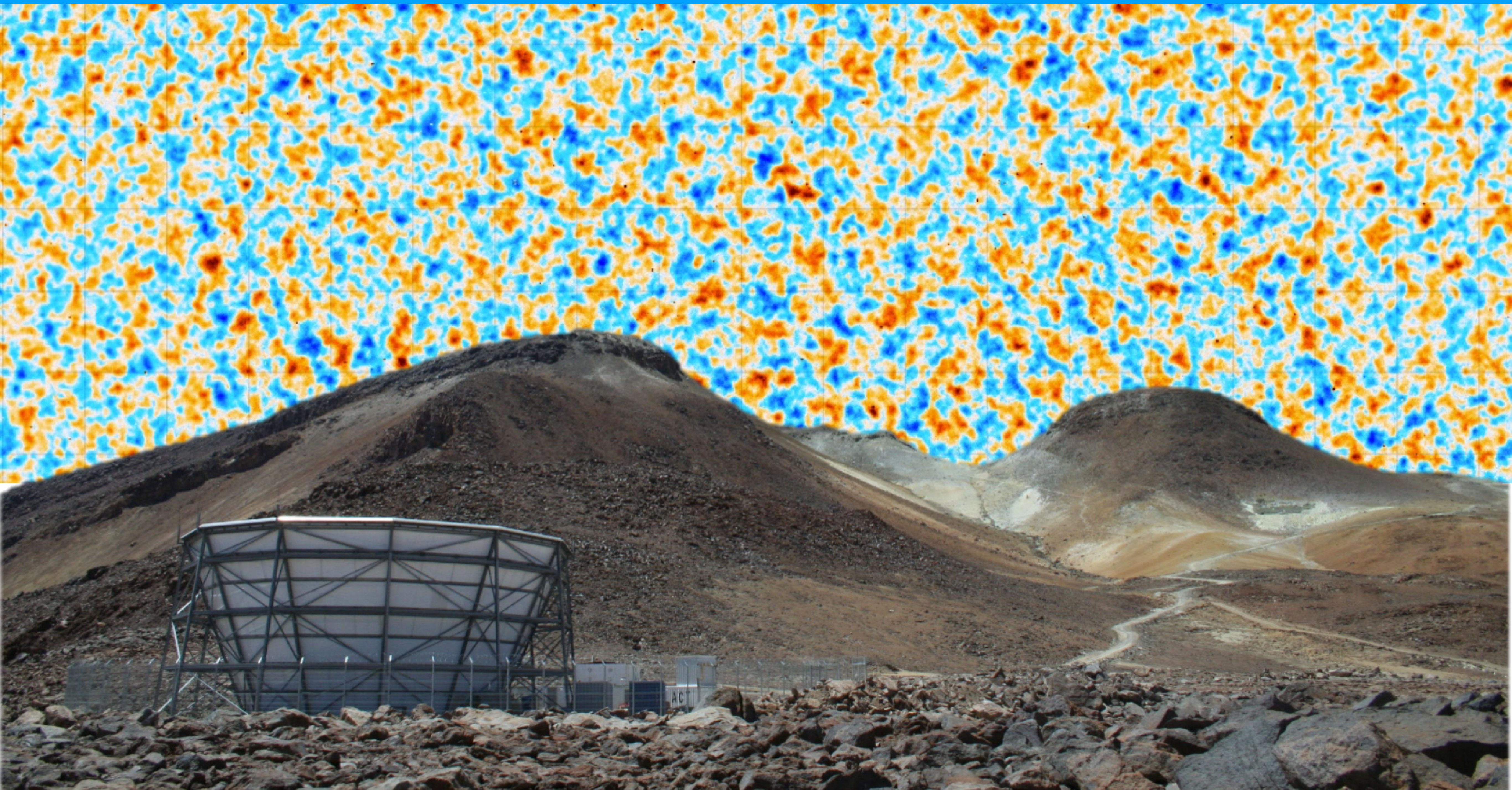
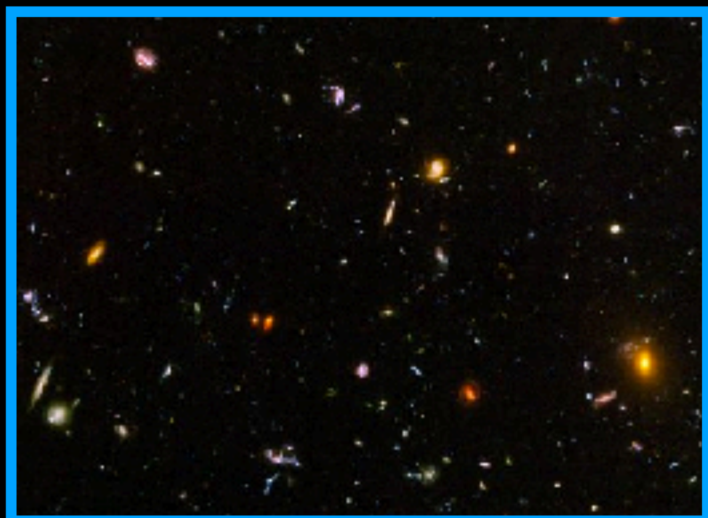
Non-Gaussianity from CMB secondary anisotropies



William Coulton and the ACTPol Collaboration

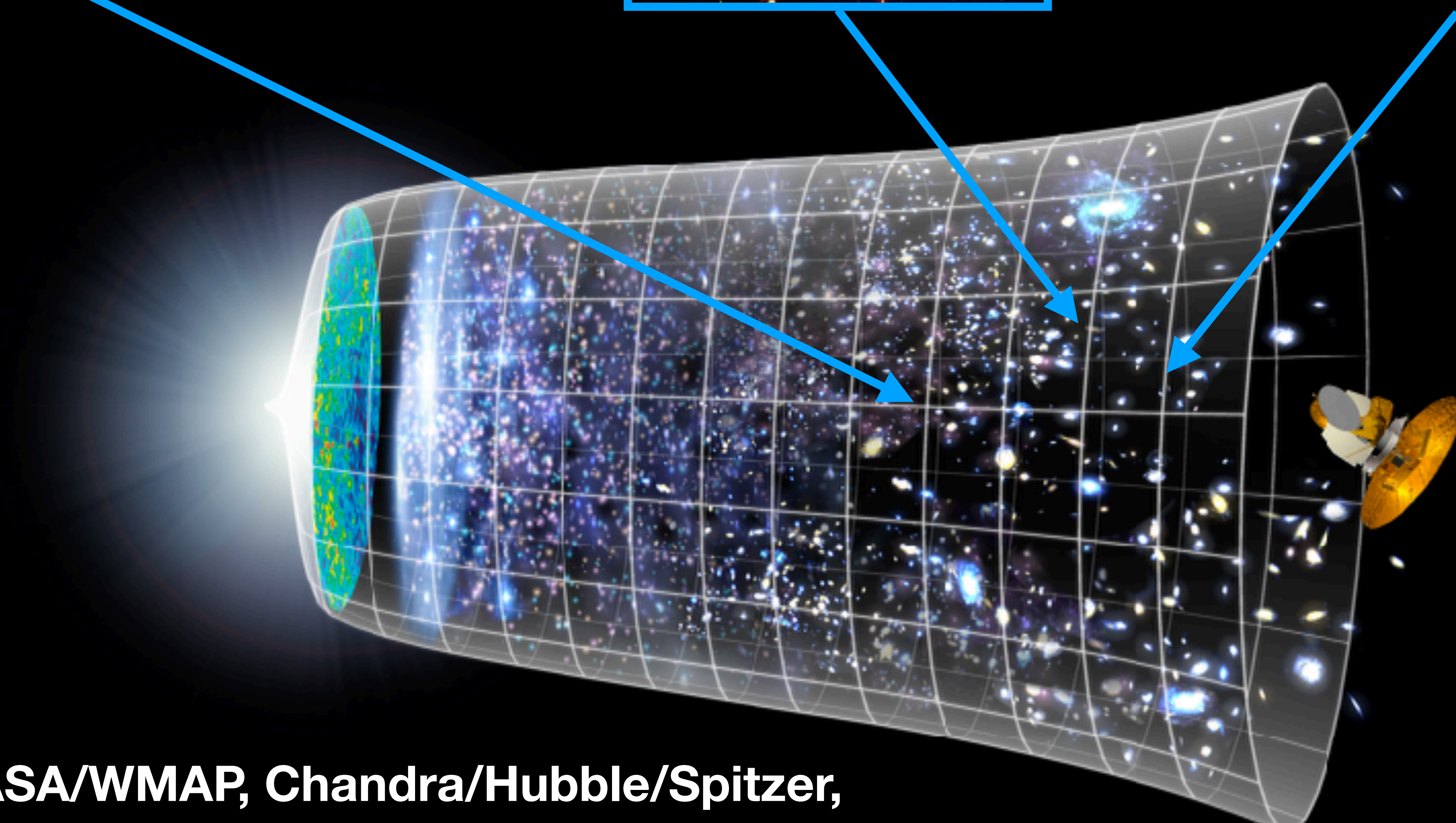
What are secondary anisotropies?

Dusty star forming Galaxies



Galaxy Clusters

Radio Galaxies



Sources: NASA/WMAP, Chandra/Hubble/Spitzer, NRAO/AUI/NSF

What is the bispectrum?

$$I(\vec{n}) = \sum a_{\ell,m} Y_{\ell,m}(\vec{n})$$

- Harmonic equivalent of the three point function

$$B^{m_1,m_2,m_3}_{\ell_1,\ell_2,\ell_3} = \langle a_{\ell_1,m_1} a_{\ell_2,m_2} a_{\ell_3,m_3} \rangle$$

- Vanishes for purely Gaussian fluctuations

- Under the assumption of rotational invariance

$$\langle a_{\ell_1,m_1} a_{\ell_2,m_2} a_{\ell_3,m_3} \rangle = \mathcal{G}^{m_1,m_2,m_3}_{\ell_1,\ell_2,\ell_3} b_{\ell_1,\ell_2,\ell_3}$$

How do we measure the bispectrum?

- Ideally measure all different configurations $\langle a_{\ell_1,m_1} a_{\ell_2,m_2} a_{\ell_3,m_3} \rangle$
    - Computationally very challenging
    - Any individual triplet is likely noise dominated
- Compress the data:
    - Binned estimator

Bucher et al (2015)

- Compress the information:
    - Modal estimator: project data onto orthogonal basis set

Fergusson et al (2010)

- **KSW estimator: project data onto physical templates**

Komatsu, Spergel and Wandelt (2005)

Latest Results

Type	Measured A_i
lensing x Radio	-0.31 ± 6.37
lensing x tSZ	1.74 ± 1.60
lensing x DSFG	0.43 ± 0.45
lensing x ISW	47.86 ± 28.81
tSZ-tSZ-tSZ	0.80 ± 0.65
tSZ-tSZ-DSFG	1.20 ± 0.80
tSZ-DSFG-DSFG	-0.96 ± 0.78
radio-DSFG-tSZ	6.03 ± 1.83
DSFG Only	1.65 ± 0.45
radio-tSZ	1.20 ± 1.05
radio-DSFG	-0.45 ± 1.65
Radio Gal Only	0.99 ± 0.13

Constraints on non-Gaussianity different sources of CMB secondary anisotropy using data from the Atacama Cosmology Telescope and the Planck Satellite