Cosmic Physics and Dark Energy, Inflation, and Strong-Field Gravity: Summary

Kev Abazajian (UC Irvine)
on behalf of David Kirkby, Neelima Sehgal and Mark Trodden

v10

Cosmic Physics and Dark Energy, Inflation, and Strong-Field Gravity

Inflation Ends, What is Next? - Mustafa Amin (Rice University)

Slides

Using Microhalos to Probe the Universe's First Second - Adrienne Erickcek (University of North Carolina at Chapel Hill)

Slides

Cosmology with a Helical Flavor - Mohamed Anber (Lewis & Clark College)

Slides

Cosmological Probes of Dark Matter Interactions - Vera Gluscevic (Institute for Advanced Study)

Slides

Self-Interacting Dark Matter and Diverse Galactic Rotation Curves - Hai-Bo Yu (University of California, Riverside)

Slides

Searching for Dark Matter at the Cosmic Dawn- Julian Munoz (Harvard University)

Slides

A Particle Physicist's Perspective on the EDGES Anomaly - Samuel McDermott (FNAL)

Slides

Realizing the Promise of 21 cm Cosmology with HERA - Josh Dillon (UC Berkeley)

Slides

21 cm Dark Energy Cosmology with CHIME - Laura Newburgh (Yale University)

Slides

Gravitational-Wave Transient Astronomy on the Rise - Chris Pankow (Northwestern University)

Slides

Did LIGO Detect Dark Matter? - Simeon Bird (UCR)

Slides

The Cosmic Origin of the Heavy Elements: Implications from the Neutron Star Merger GW170817 - Daniel Siegel (Columbia University)

Slides

Recent Results from the Dark Energy Survey - Eric Baxter (University of Pennsylvania)

Slides

The eBOSS Survey: Recent Results and Prospects - Anand Raichoor (EPFL)

Slides

Cosmology with the Atacama Cosmology Telescope - Simone Aiola (Princeton University)

Slides

BICEP/Keck: Constraining the Primordial Gravitational-Wave Signal with CMB Polarization Observations from the South Pole - Lorenzo Moncelsi (California Institute of Technology)

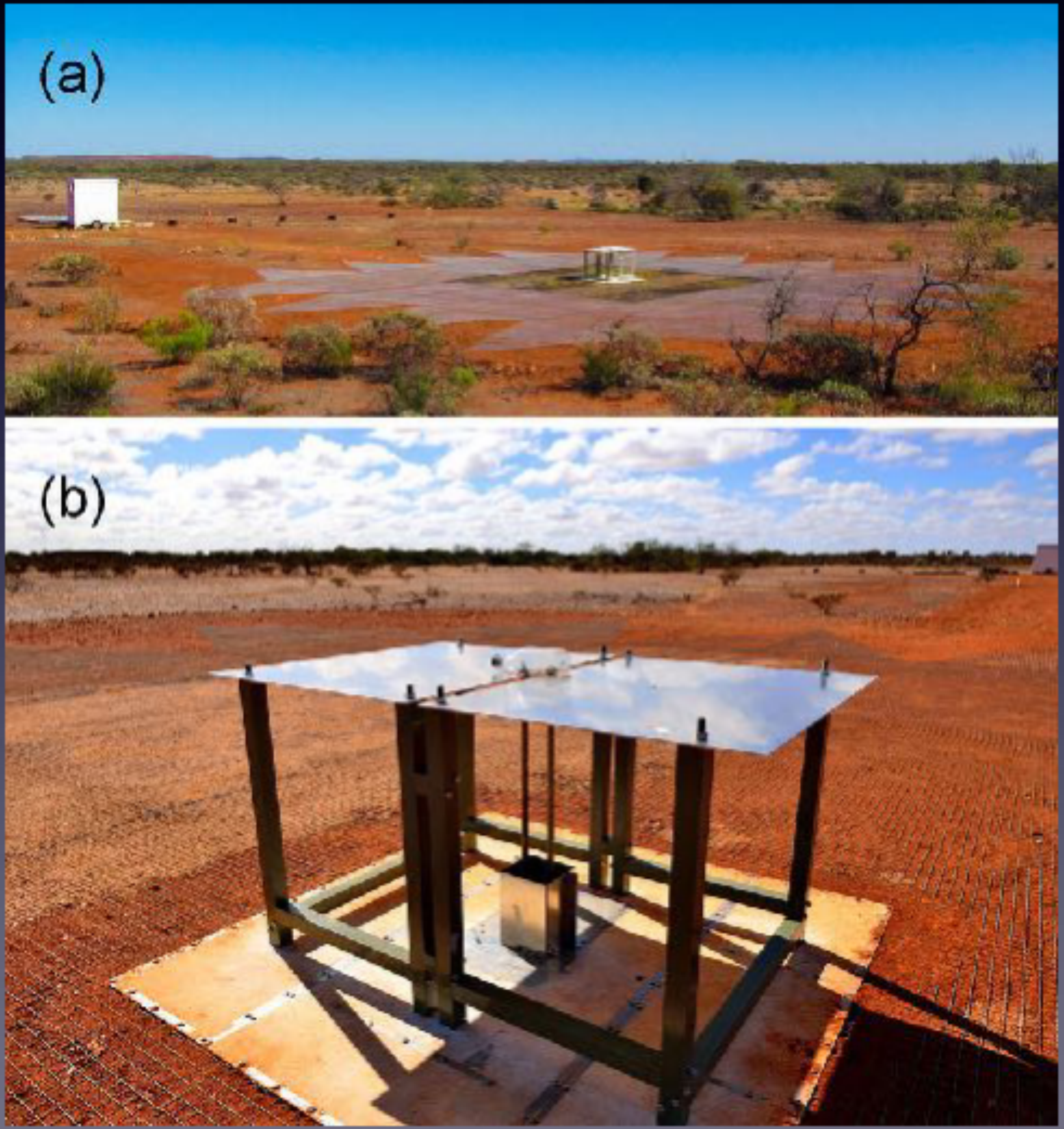
Slides

The Simons Observatory and CMB-Stage IV - Nicholas Galitzki (University of California, San Diego)

[Sam McDermott]

EDGES

Bowman et al, Nature 555 (2018)



Experiment to Detect the Global Epoch of reionization Signature

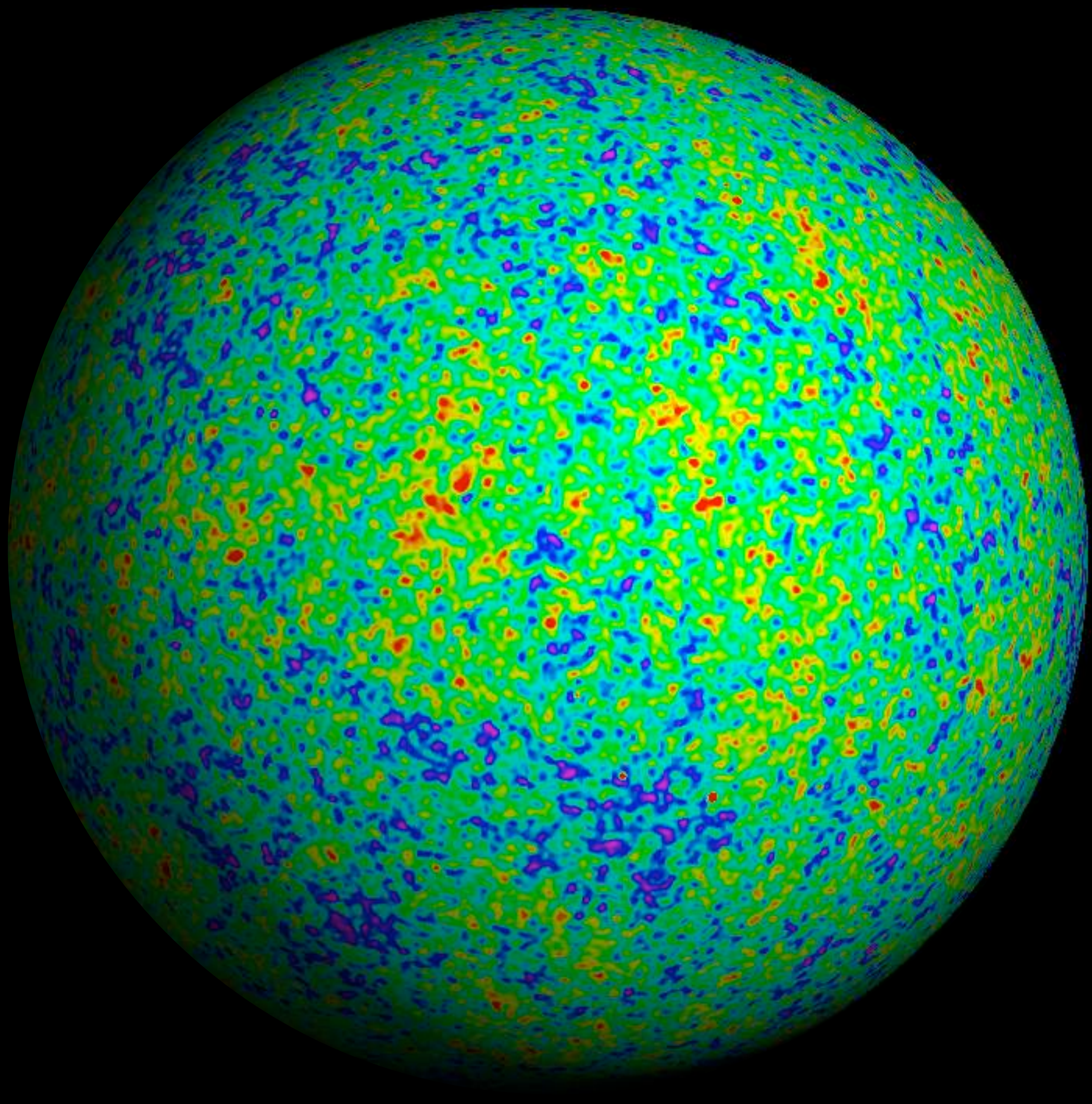
Detects the absorption strength of the spin flip transition of neutral H in the 1s state

$T_{21} \sim (T_S - T_{CMB,0})/(1+z)$

$T_{21,SM} > -200$ mK

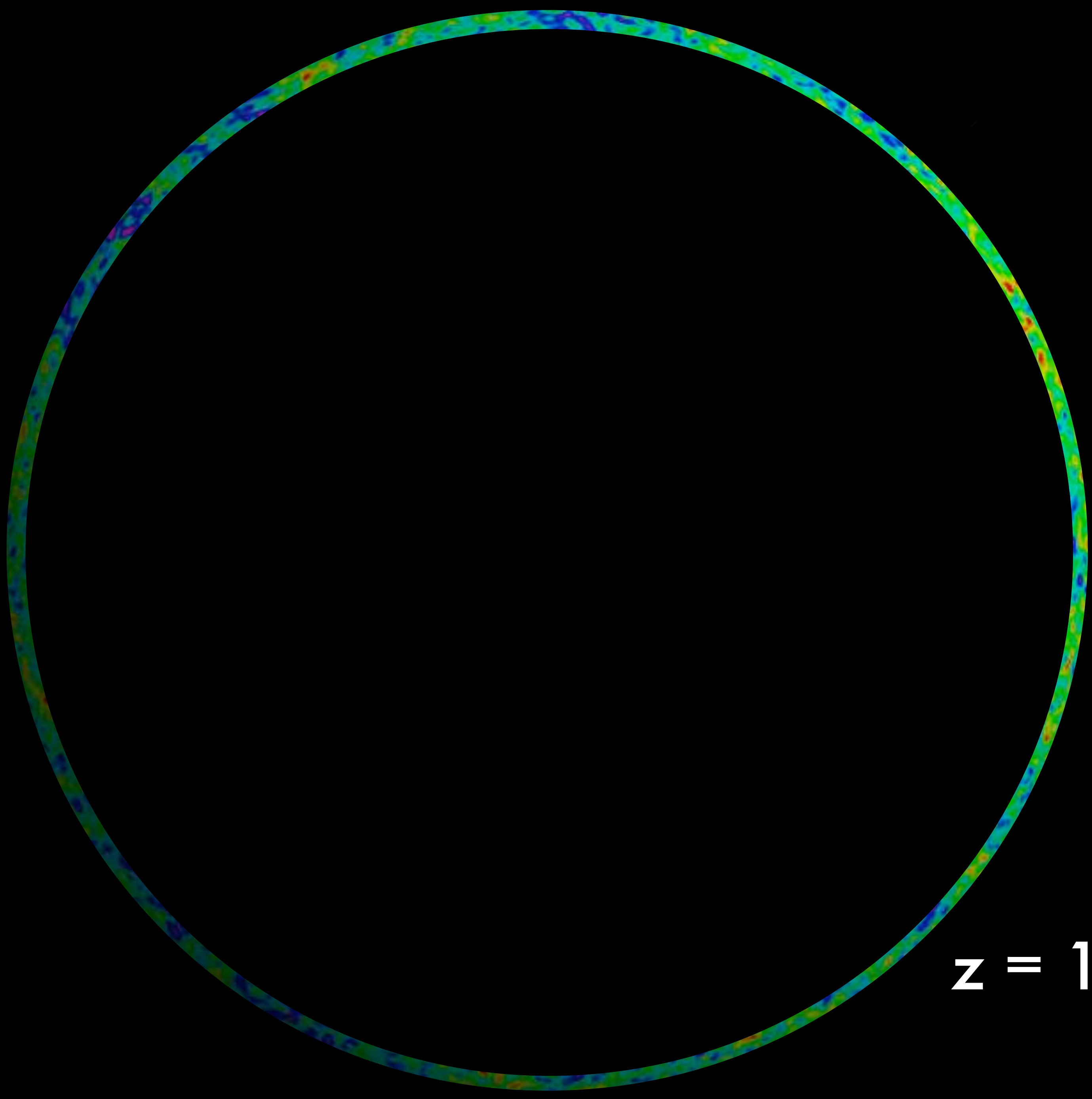
[Josh Dillon]

With the CMB...



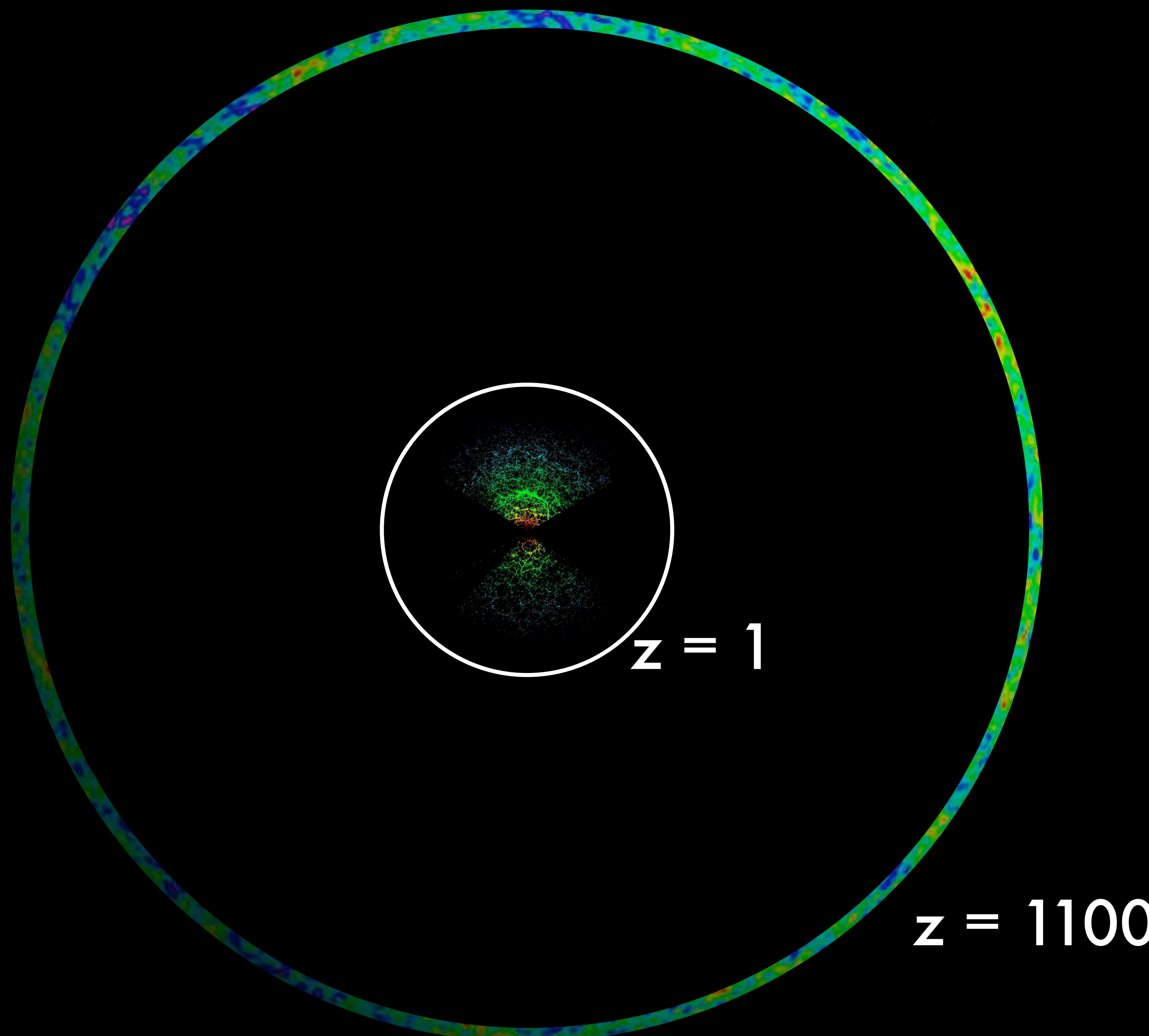
[Josh Dillon]

...we only get a thin shell at high redshift.



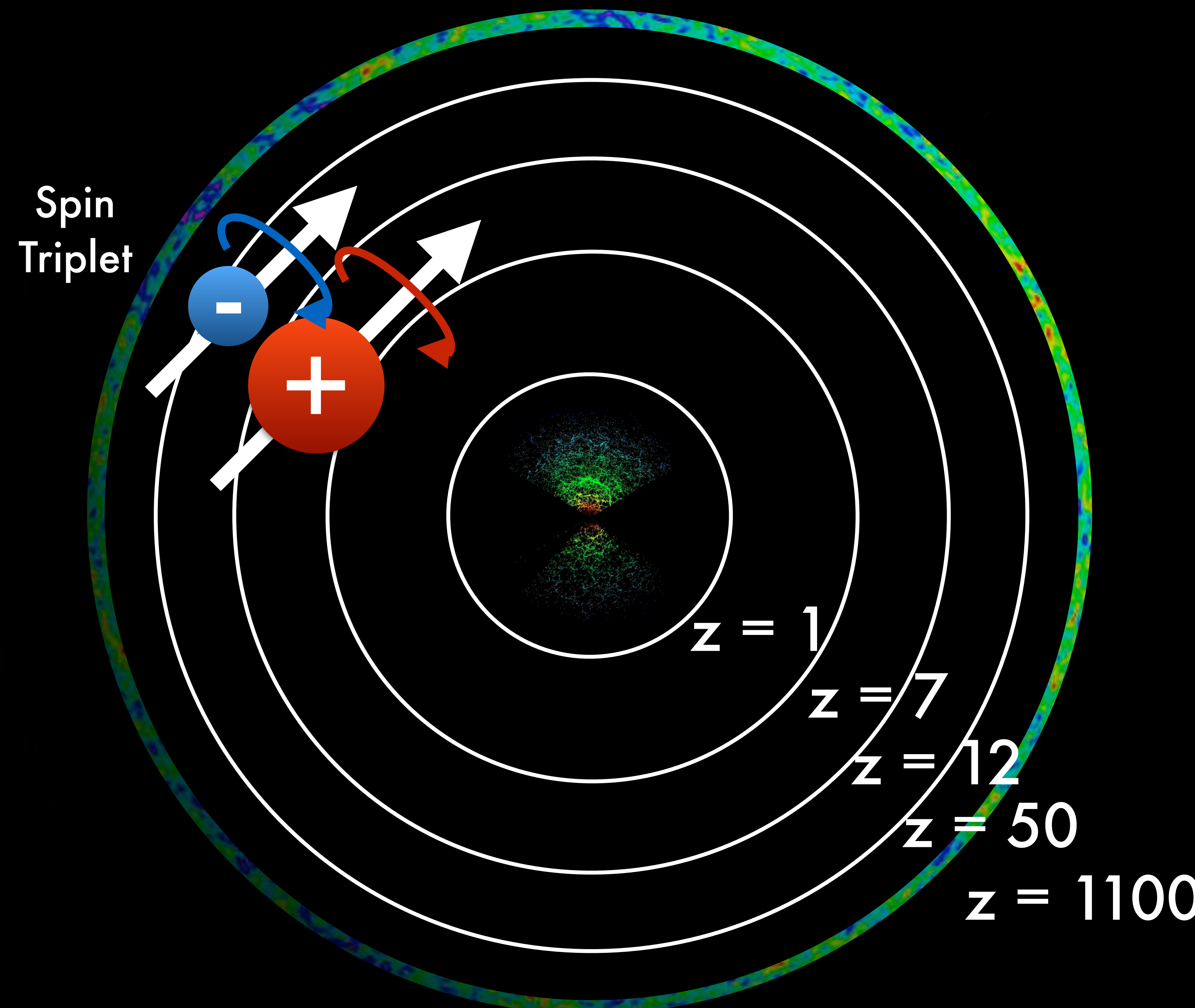
[Josh Dillon]

Galaxy surveys only tell us about the local universe.



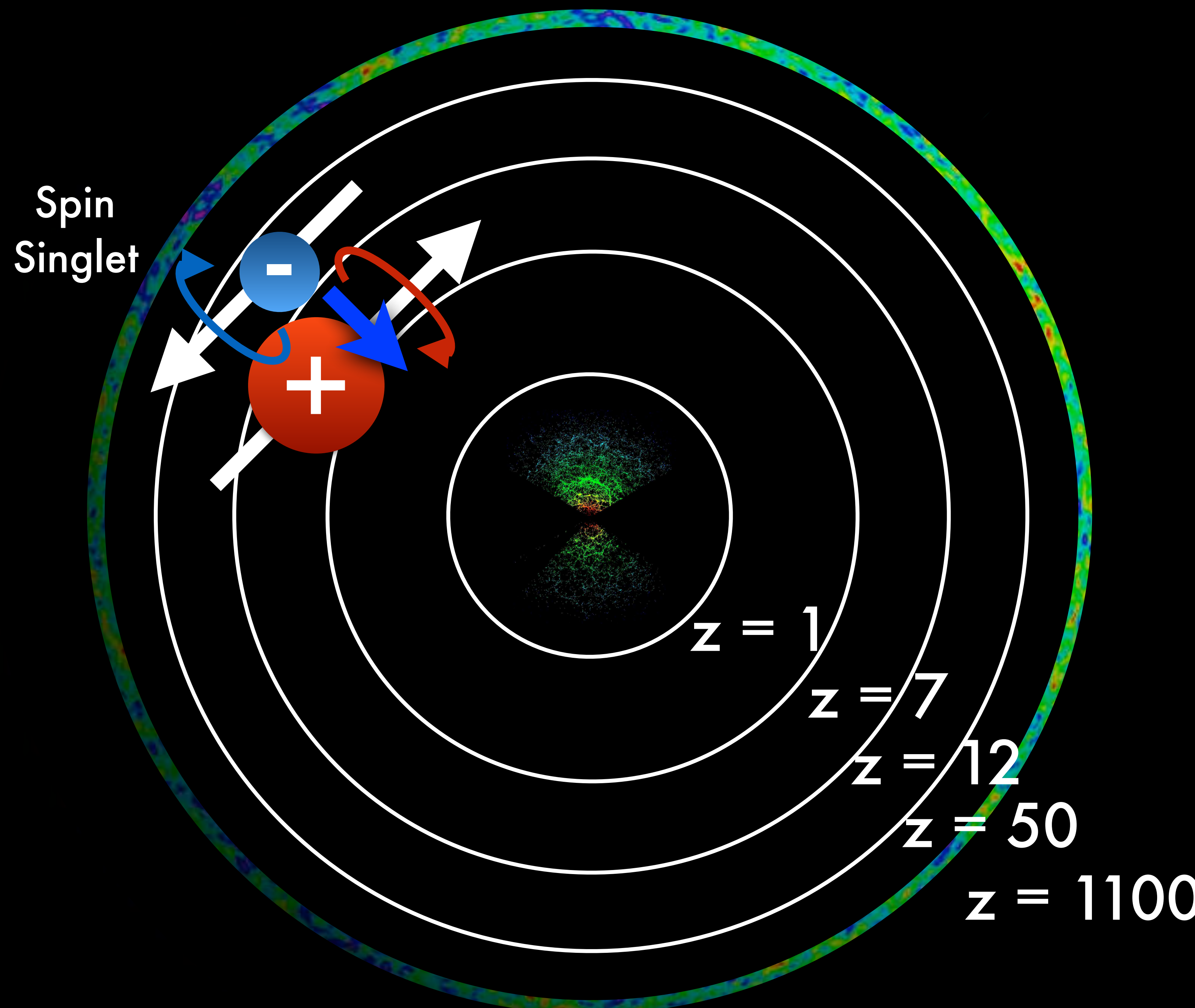
[Josh Dillon]

But with 21 cm tomography...



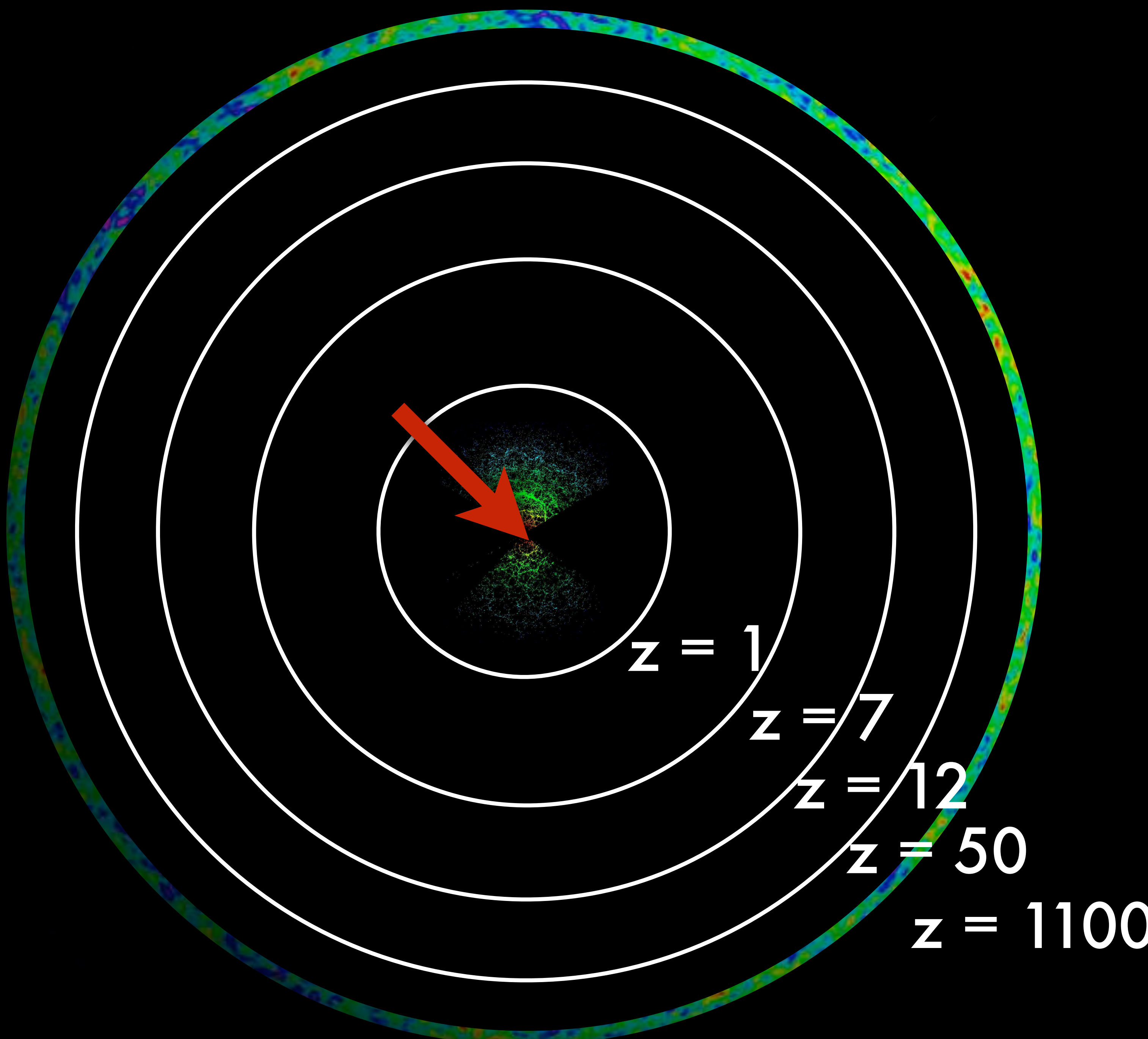
[Josh Dillon]

But with 21 cm tomography...



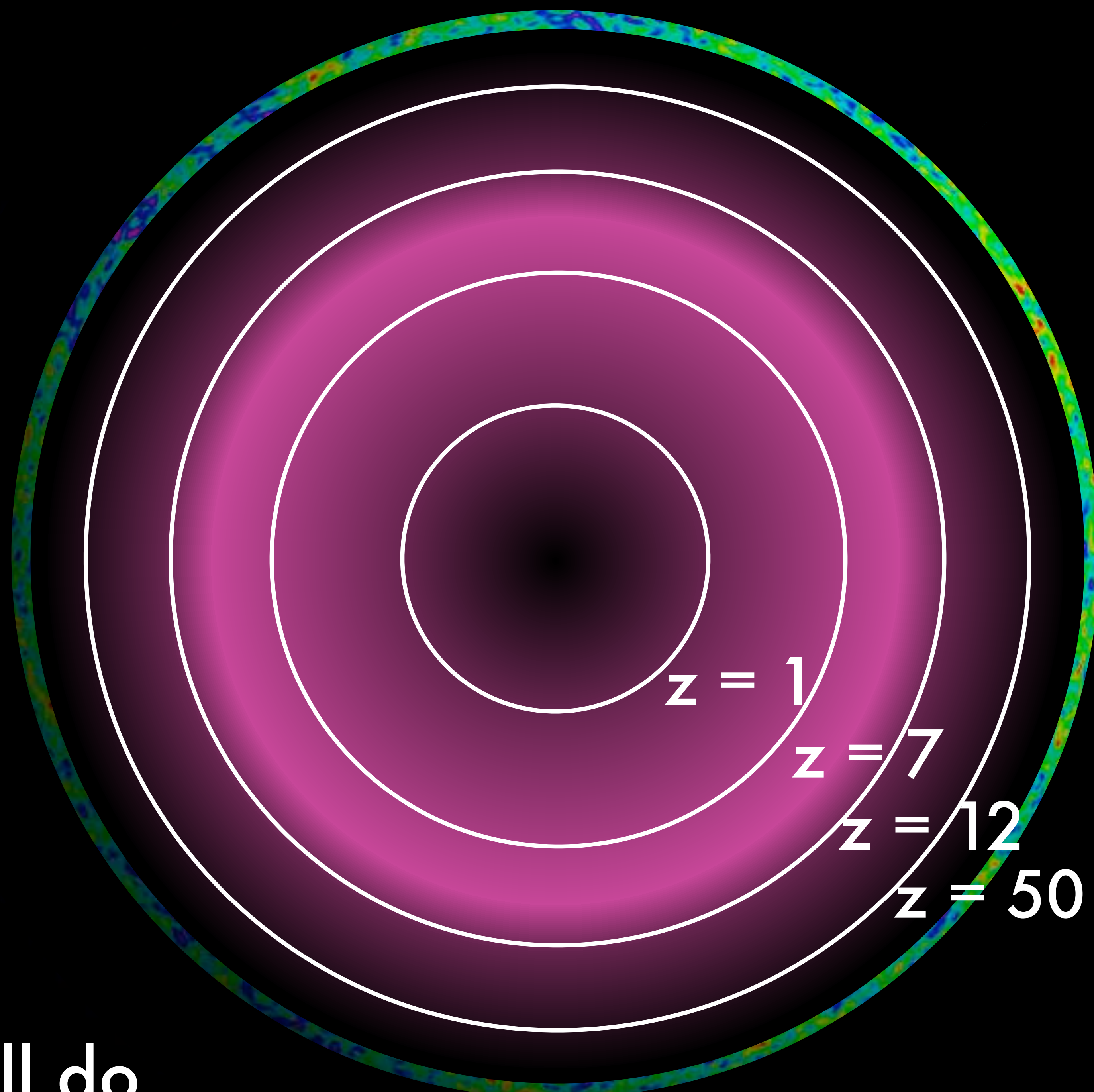
[Josh Dillon]

But with 21 cm tomography...



[Josh Dillon]

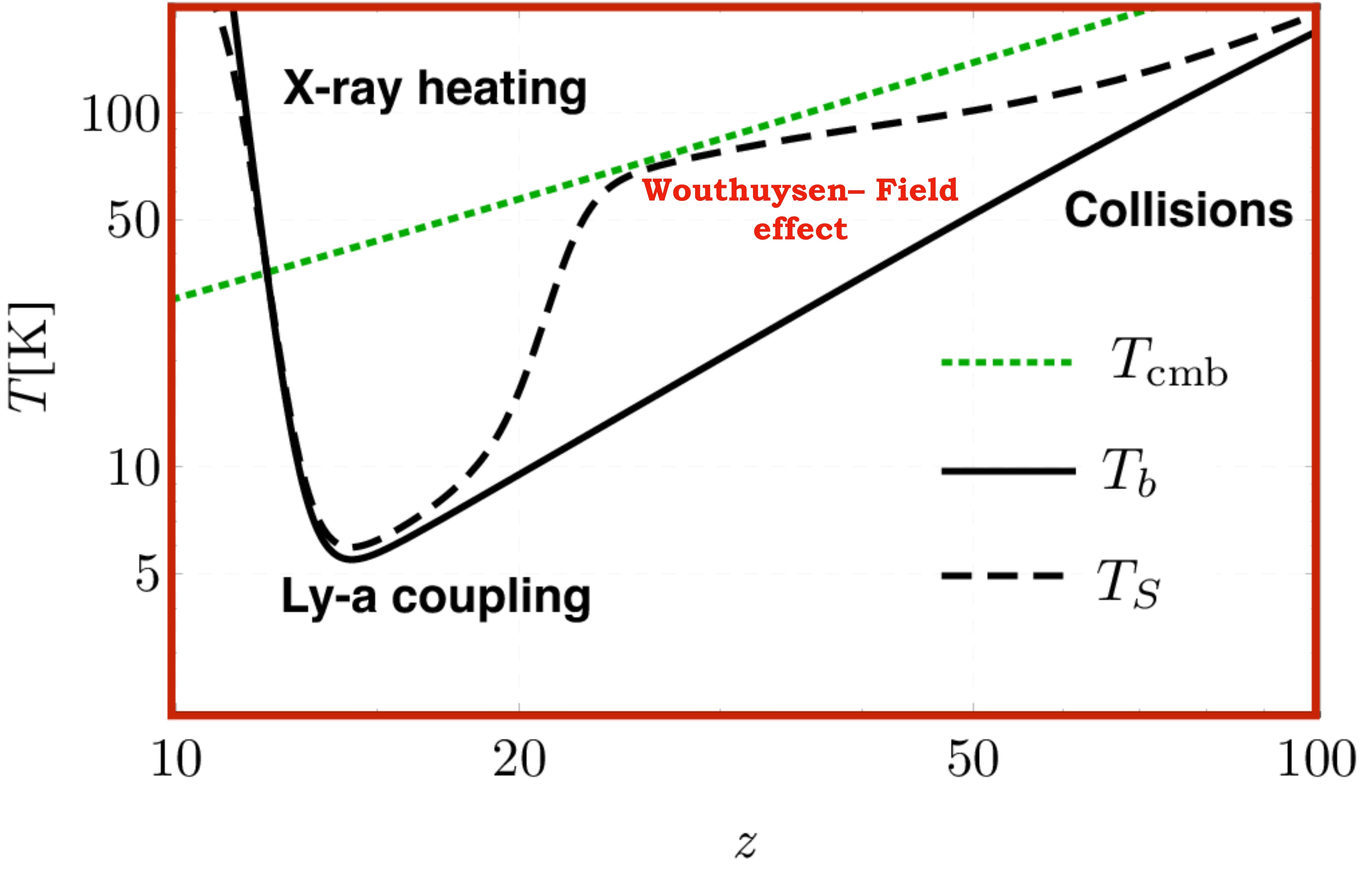
...a huge volume of the universe can be directly probed.



Eventually, we'll do cosmology very precisely.

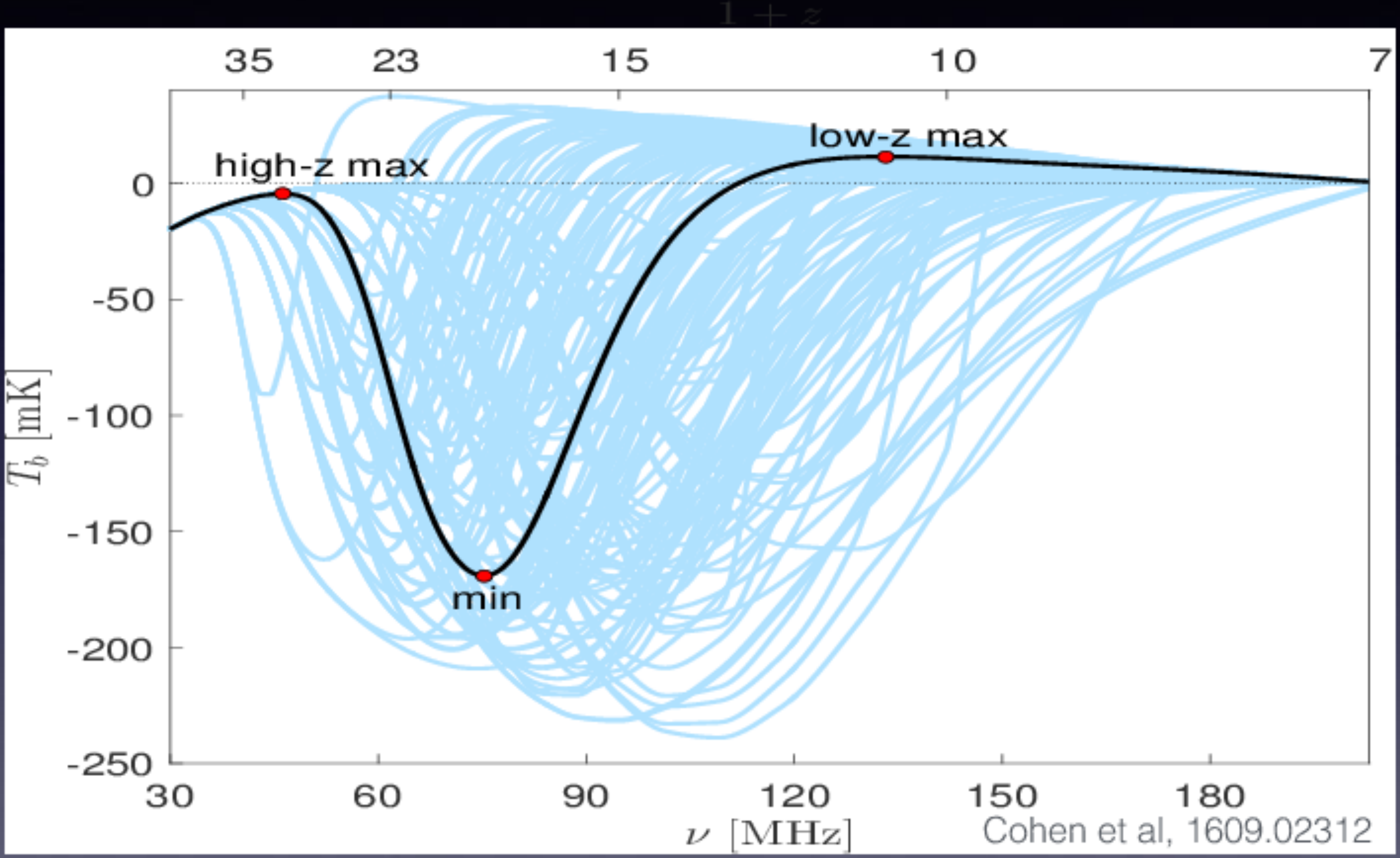
[Julian Munoz]

A cartoon of the evolution of Ts



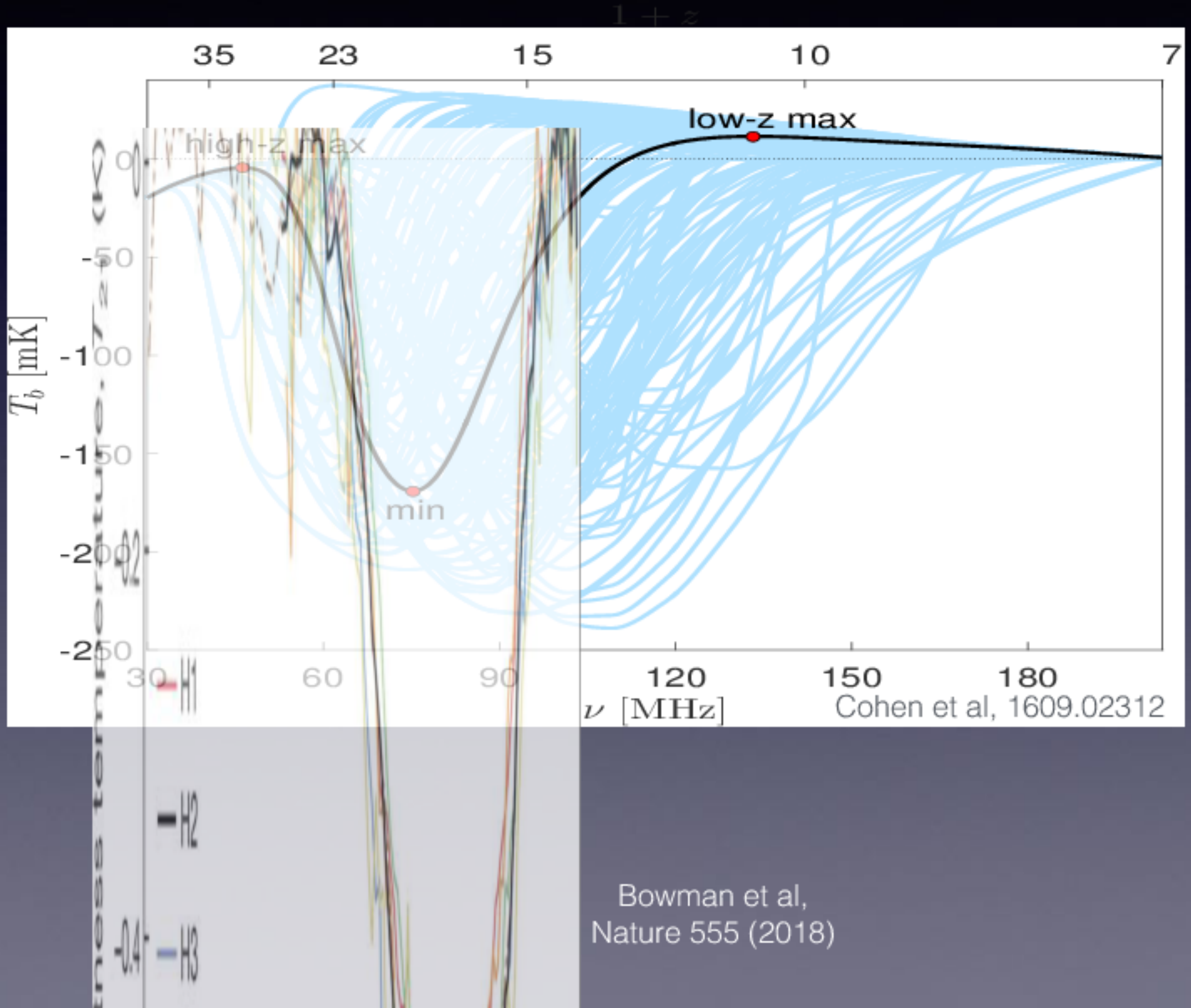
[Sam McDermott]

EDGES



[Sam McDermott]

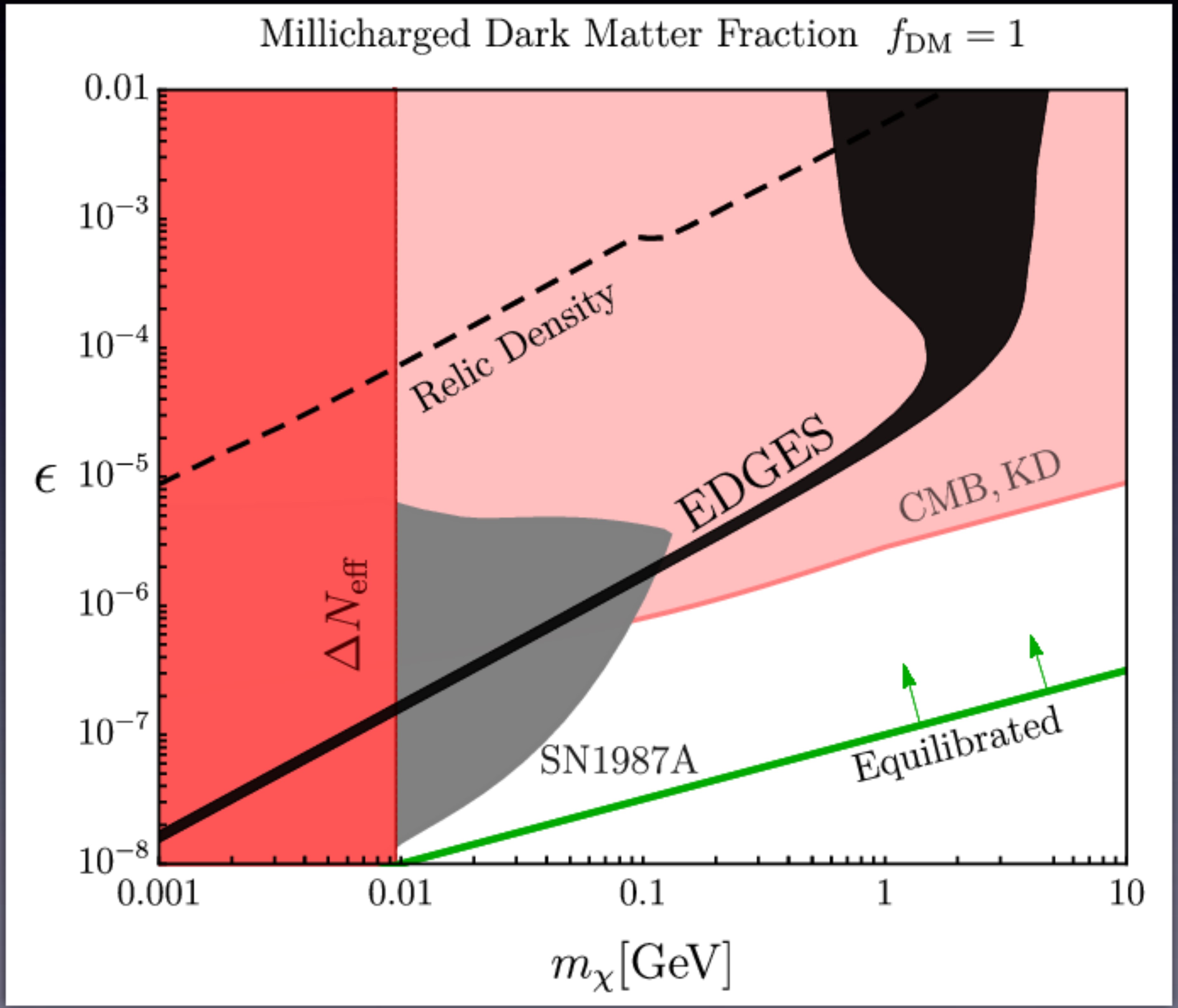
EDGES



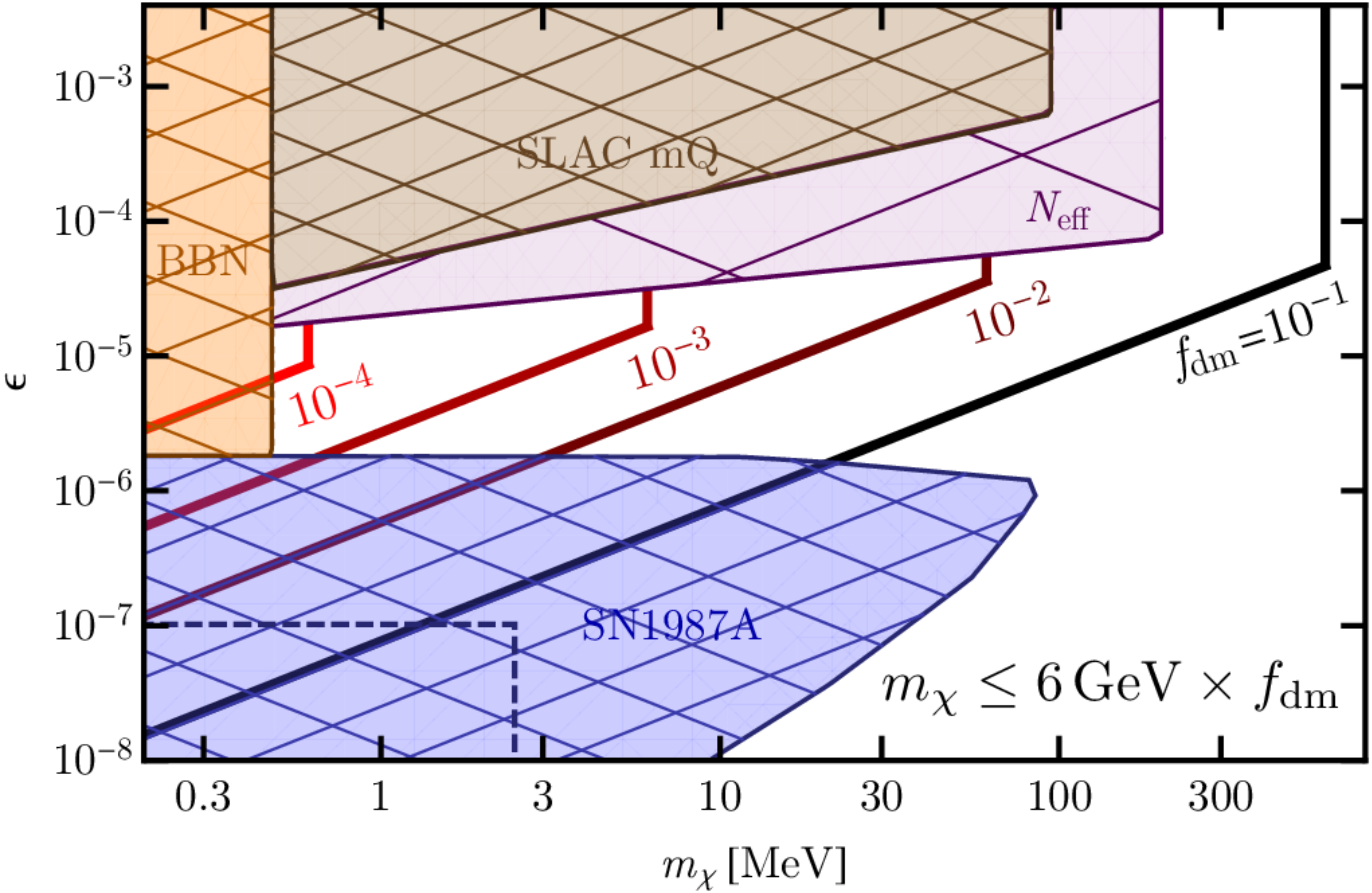
Bowman et al,
Nature 555 (2018)

[Sam McDermott]

EDGES Constraints



[Julian Munoz]

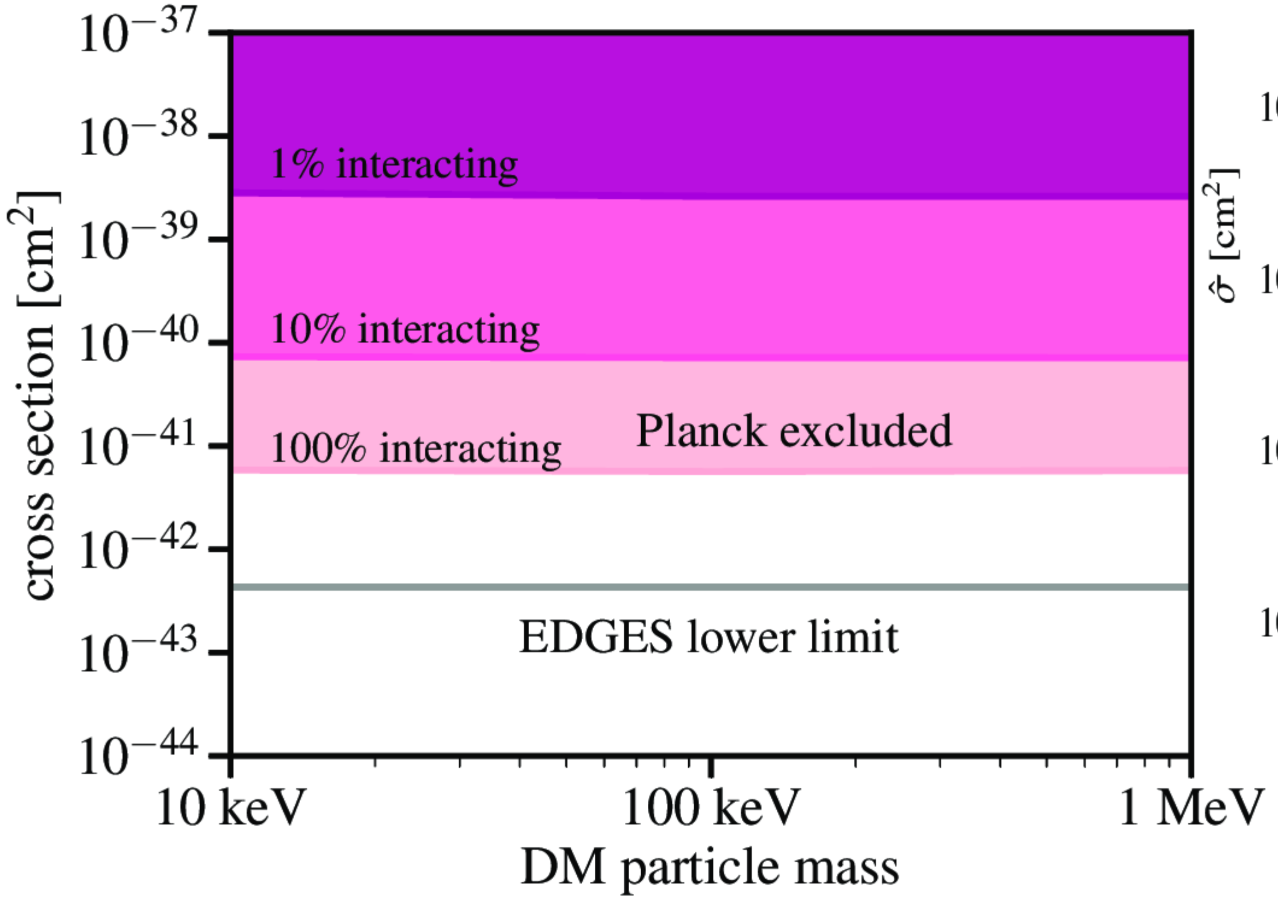


JBM and Loeb Nature 2018

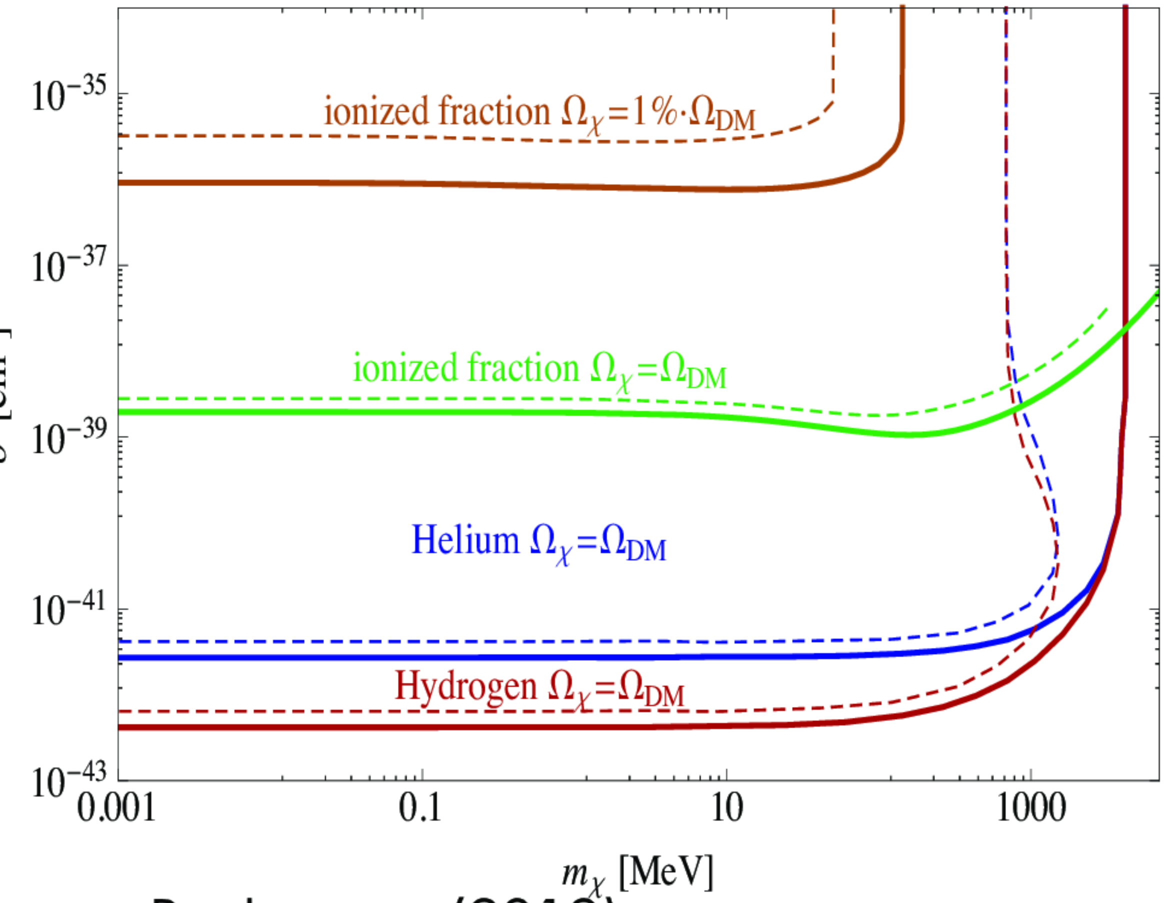
[Vera Gluscevic]

EDGES: v^{-4} and millicharge

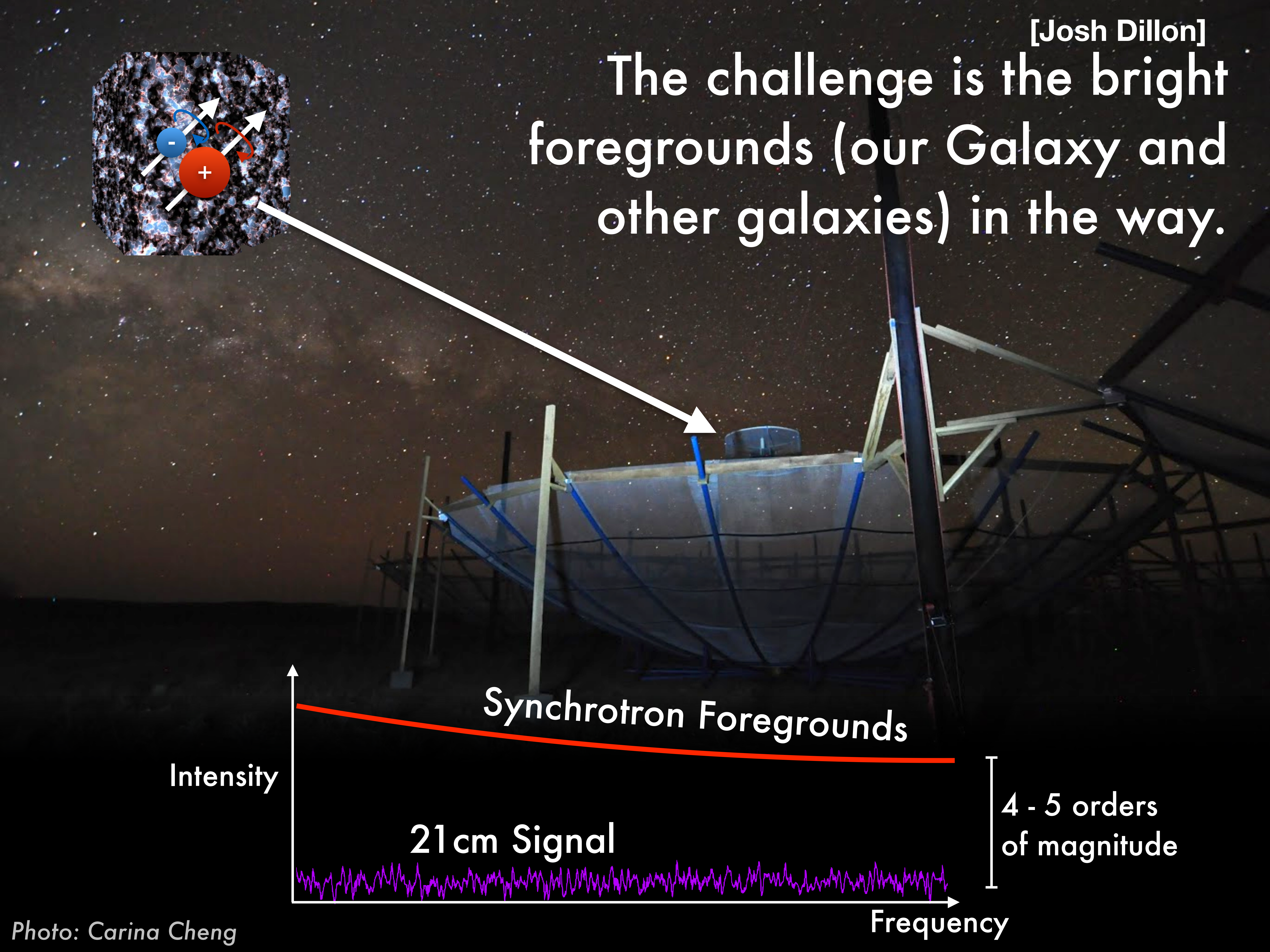
From CMB limits on momentum-transfer: EDGES cannot be 1% of millicharged DM, but could be 100% with some other v^{-4} interaction.



Boddy, VG, Poulin, + (coming up)



Barkana+ (2018)

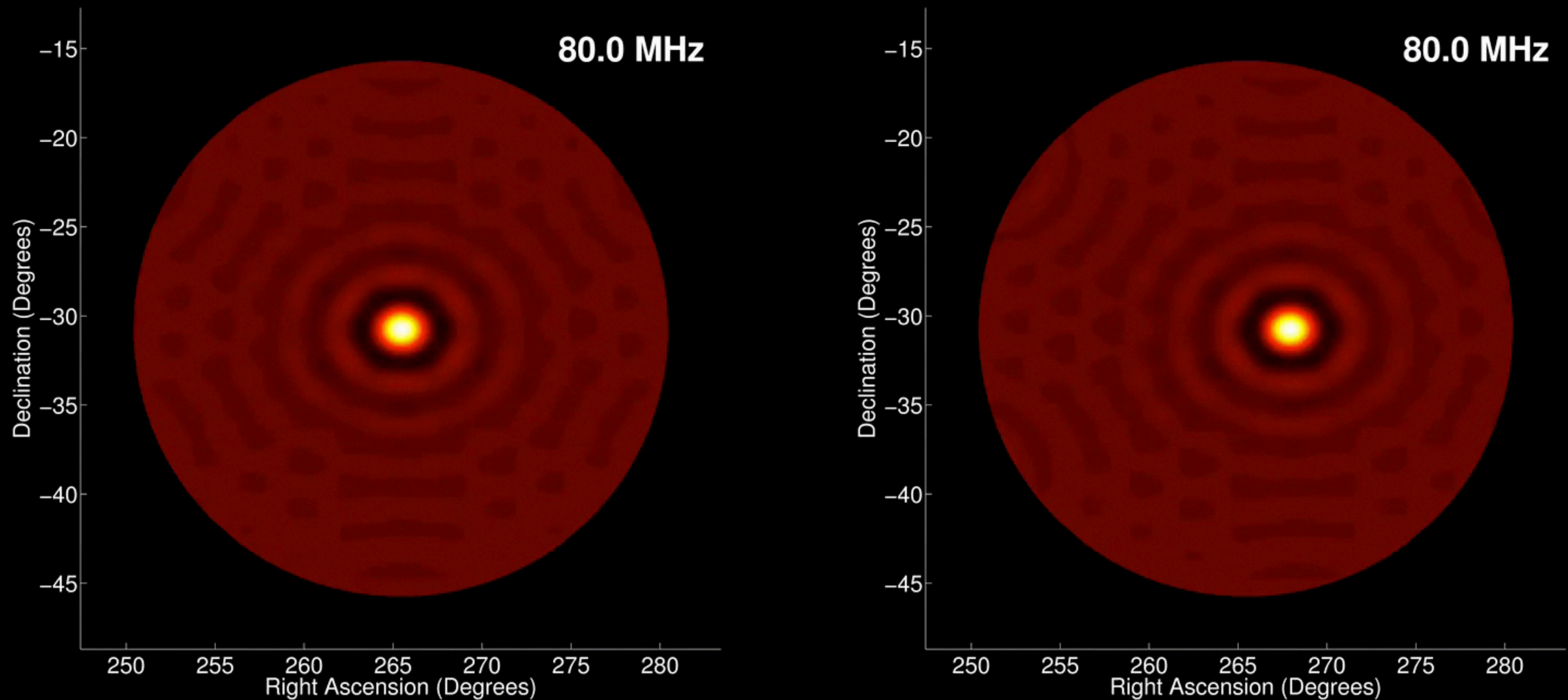

[Josh Dillon]
The challenge is the bright foregrounds (our Galaxy and other galaxies) in the way.
+
-
Synchrotron Foregrounds
Intensity
4 - 5 orders of magnitude
21cm Signal
Frequency
Photo: Carina Cheng

[Josh Dillon]

Spectral smoothness is the key to separating foregrounds from 21cm signal.

[Josh Dillon]

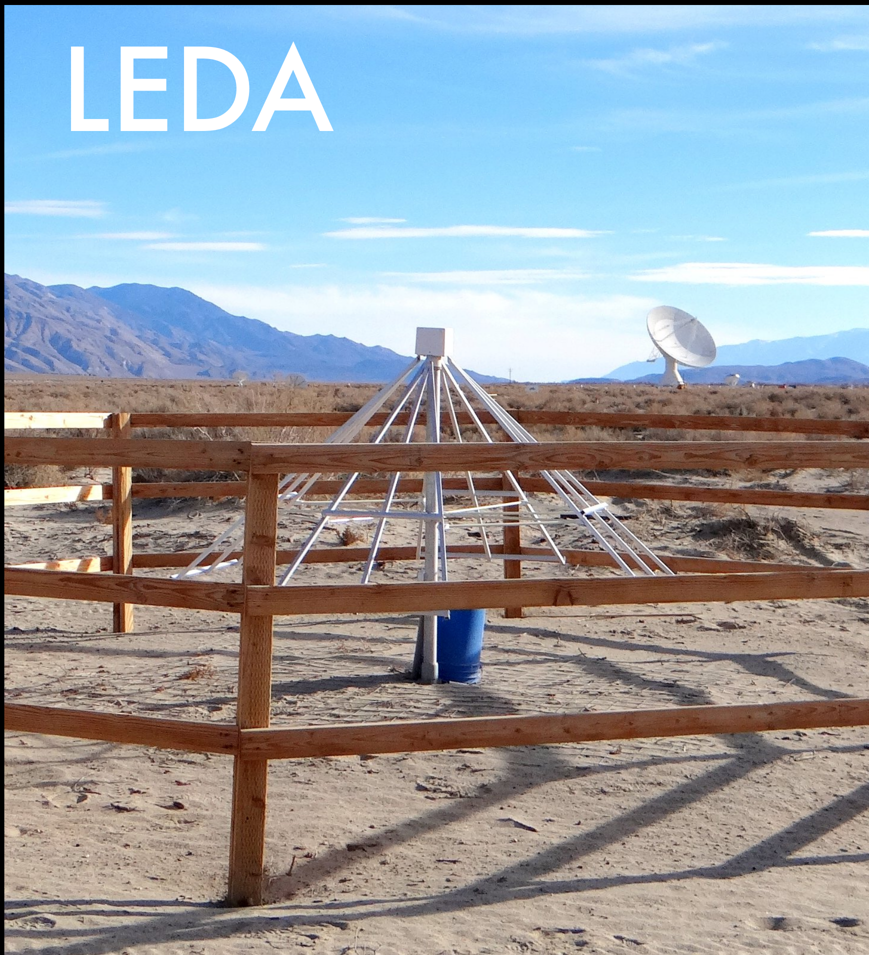
However, a frequency-dependent PSF creates spectral structure in smooth foregrounds.



Dillon et al. (2015)

Following Up EDGES...

[Josh Dillon]

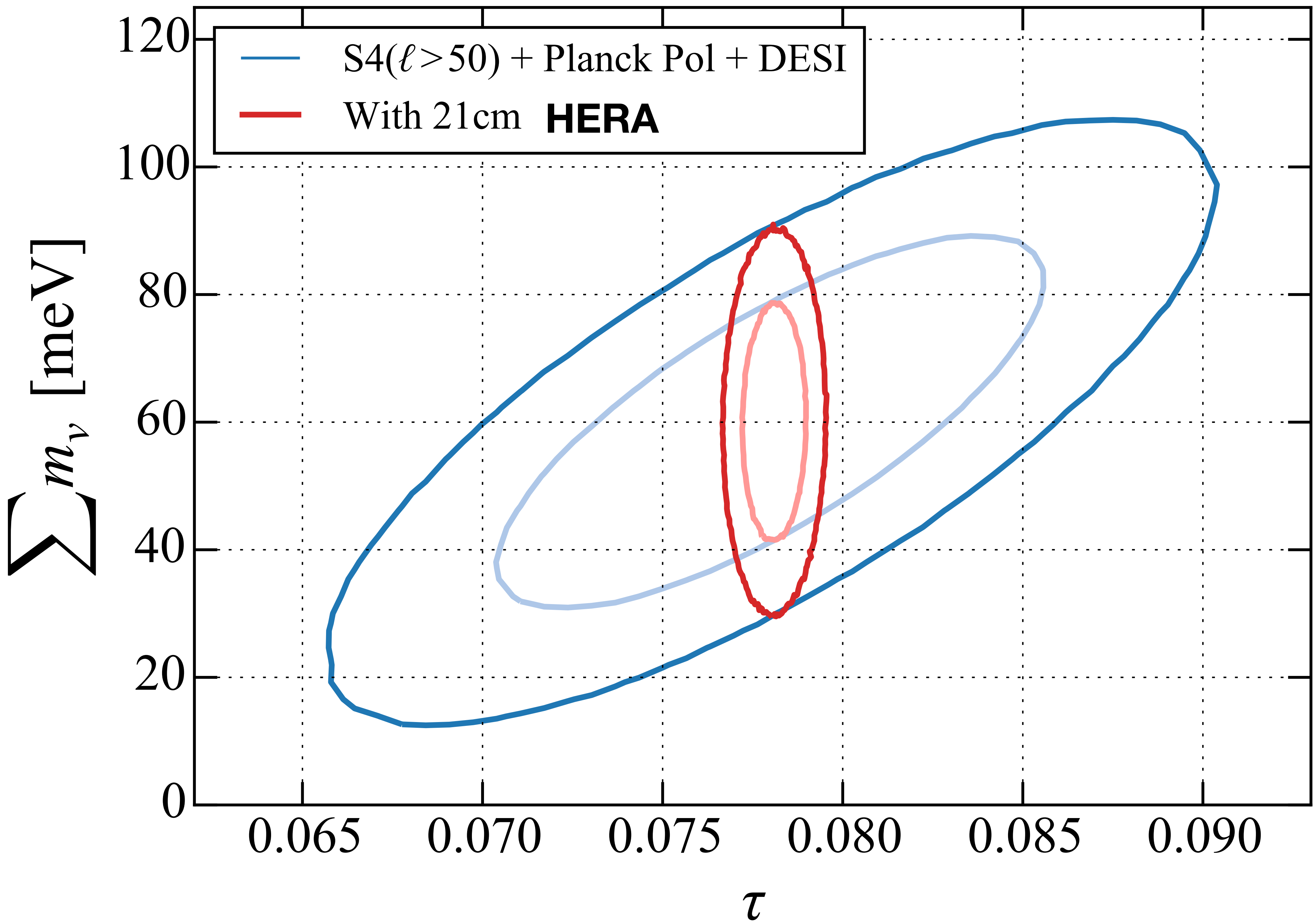


...and HERA.

We're upgrading right with wide-band Vivaldi feeds that let us go from 50 – 250 MHz and will be back on the sky this fall.

[Josh Dillon]

And, perhaps increase the significance of a detection of non-zero Σm_ν with CMB-S4.



Liu et al. (2016)

Cosmological Tension

σ_8 **problem**

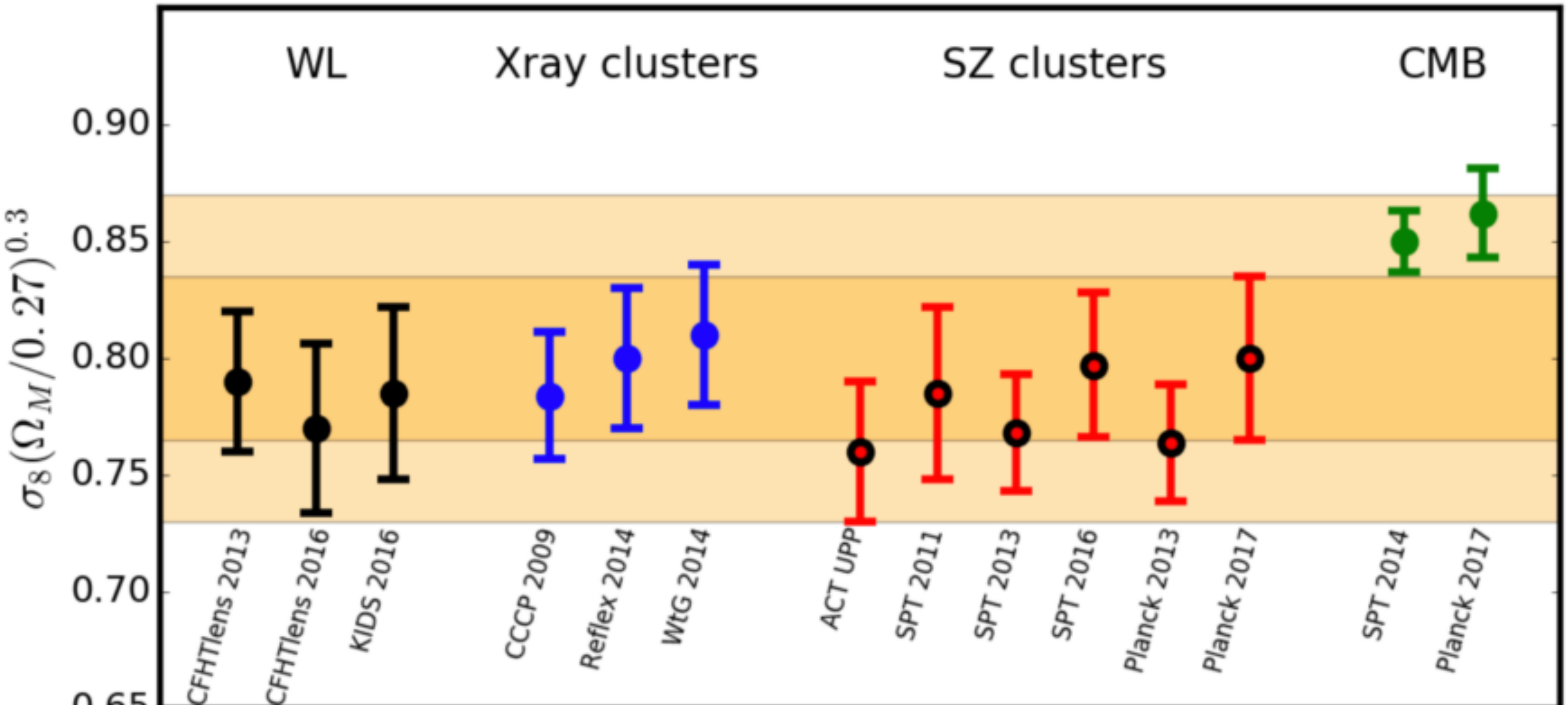
H_0 **problem**

[Eric Baxter]

The beginning of tension?

σ_8 problem

σ_8: lensing (+clusters) vs. CMB



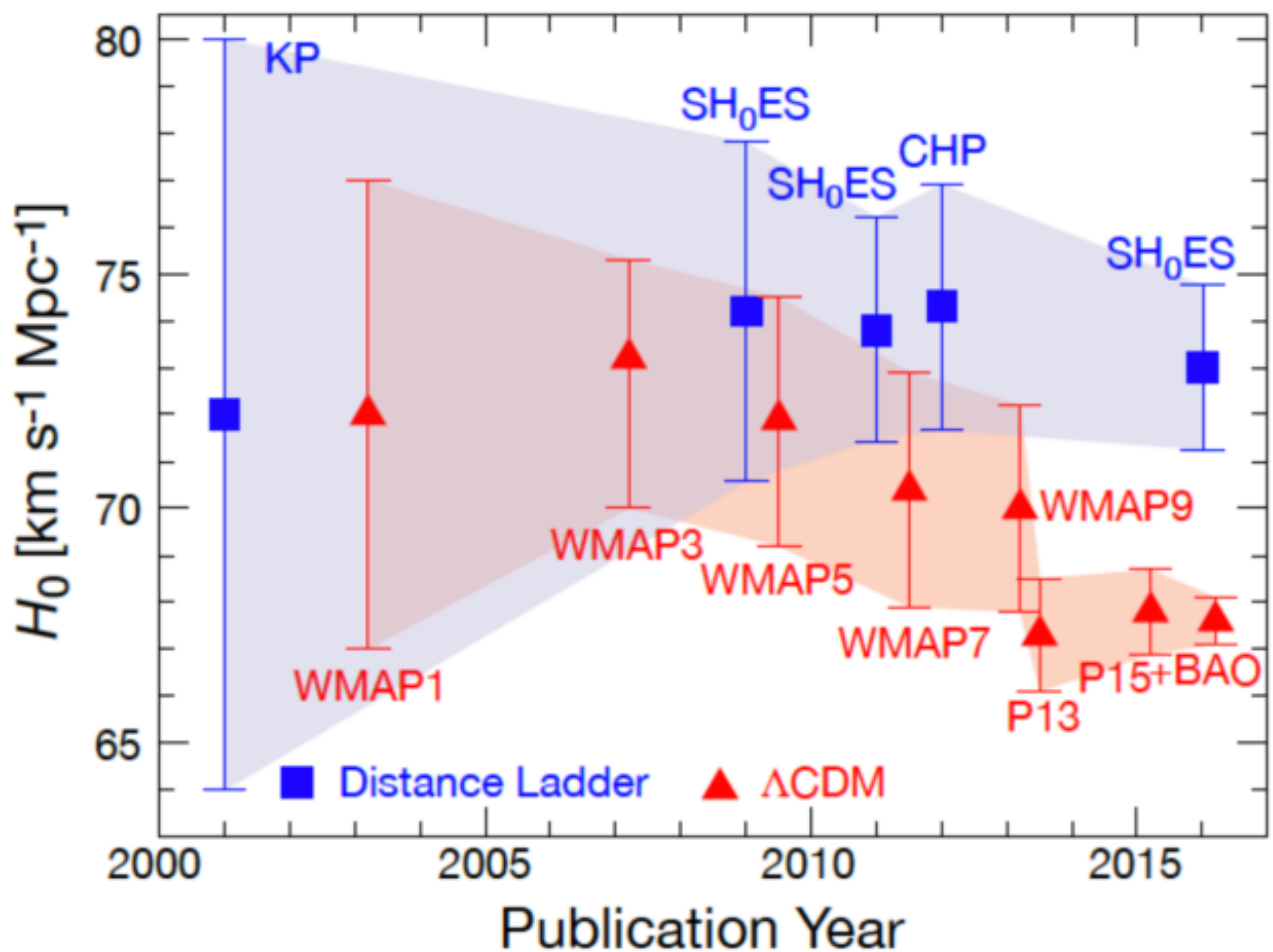
Douspis et al.

[Eric Baxter]

The beginning of tension?

H_0 problem

H_0: local vs. CMB (+BAO)



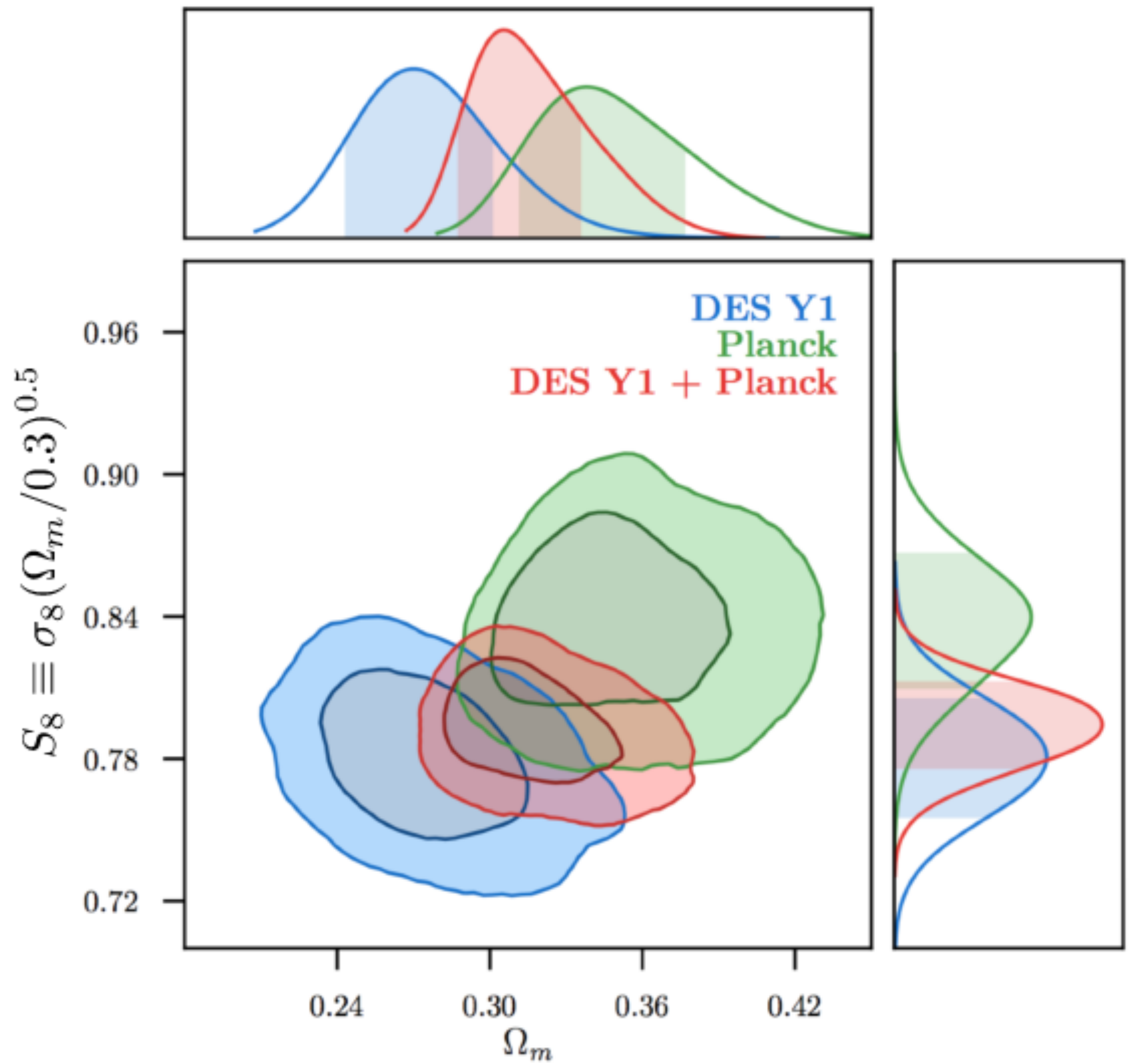
Freedman, 2017

[Eric Baxter]

3x2pt results vs. Planck

DES 3x2 prefers low S_8 and matter density relative to Planck (similar to other previous weak lensing measurements)

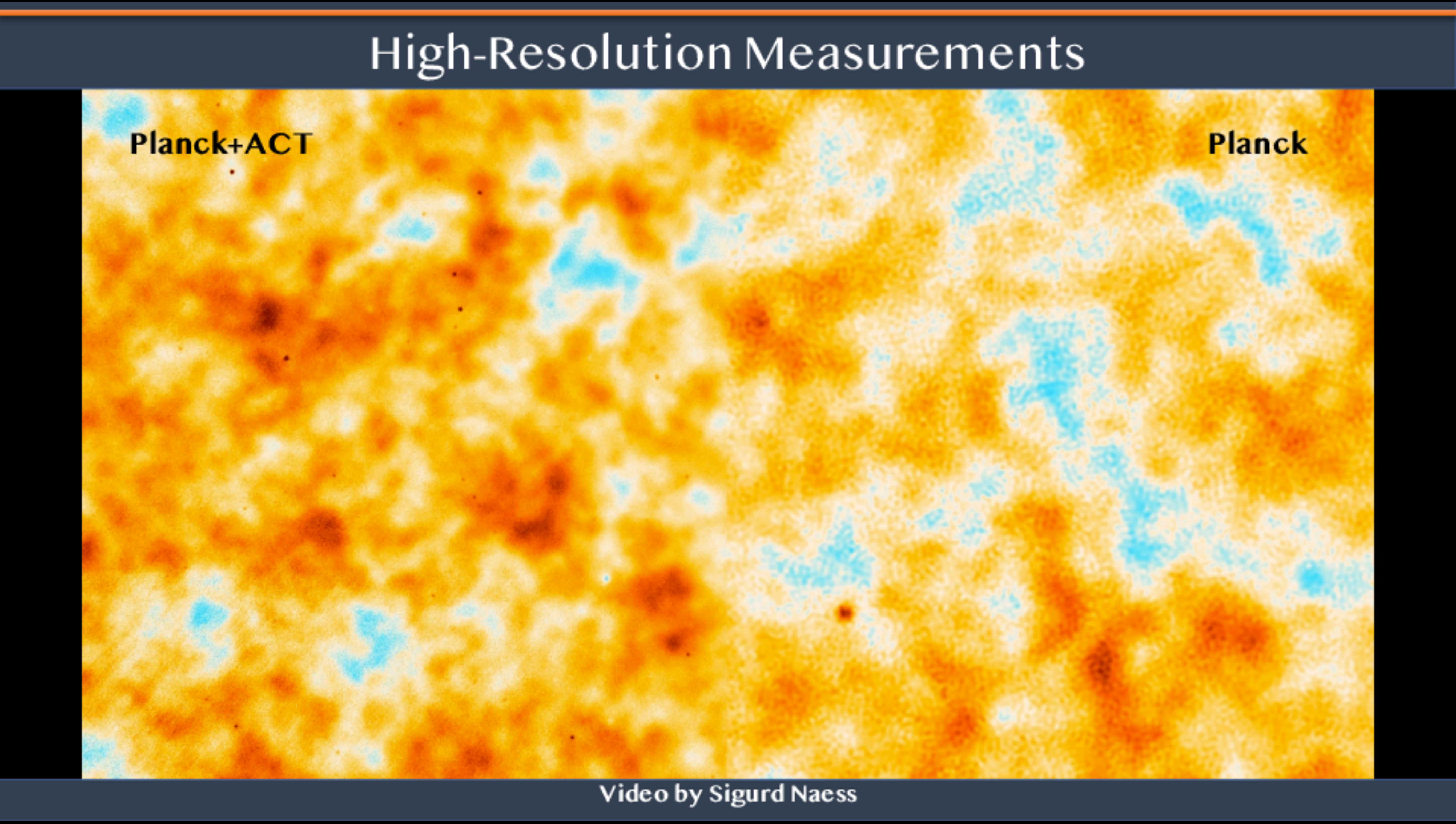
Statistically consistent with Planck



DES Y1, Abbot et al. 2017

[Simone Aiola]

Atacama Cosmology Telescope (ACT+ACTPol)

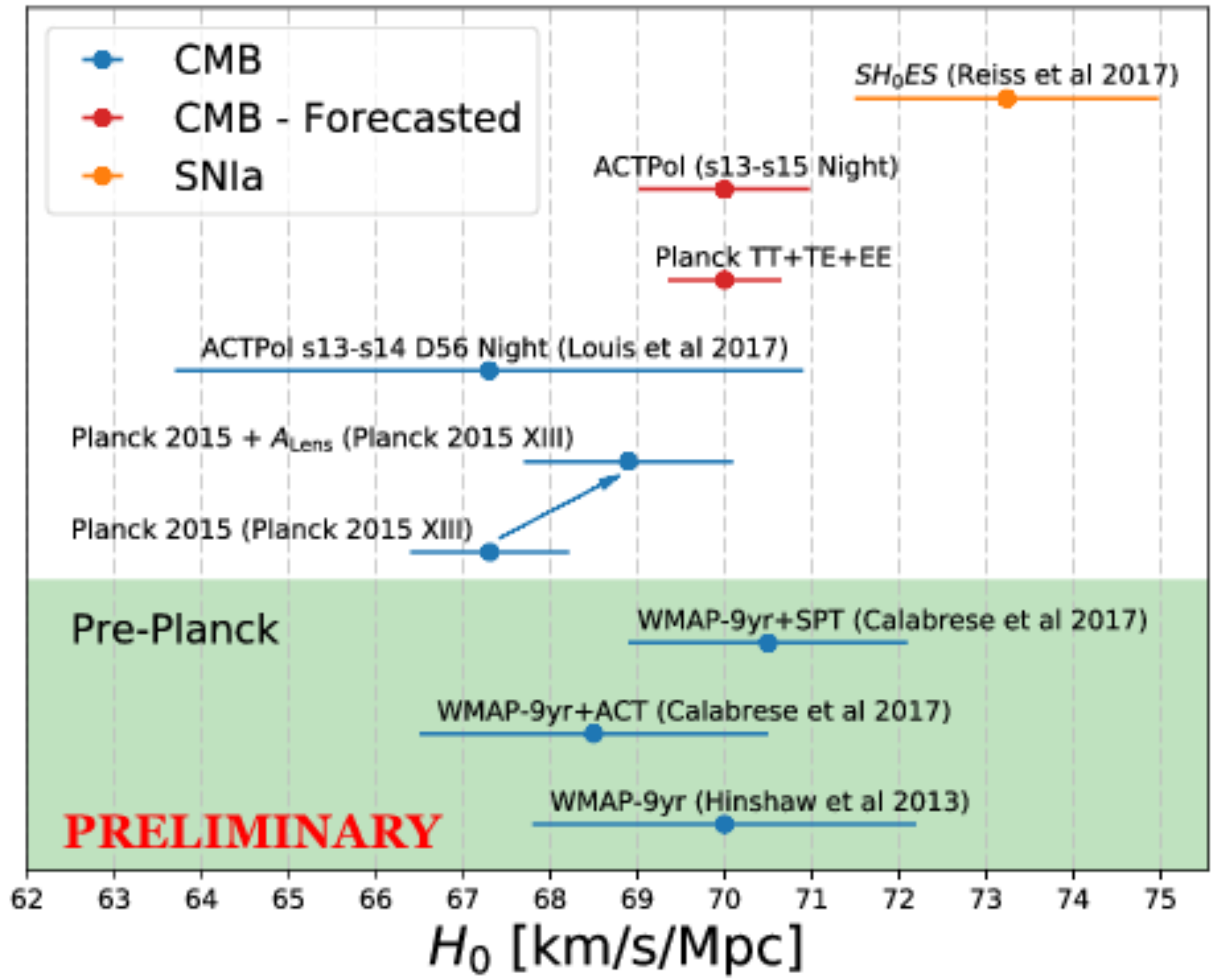


[Simone Aiola]

Forecasted ACTPol H_0 Constraints

Baseline is:

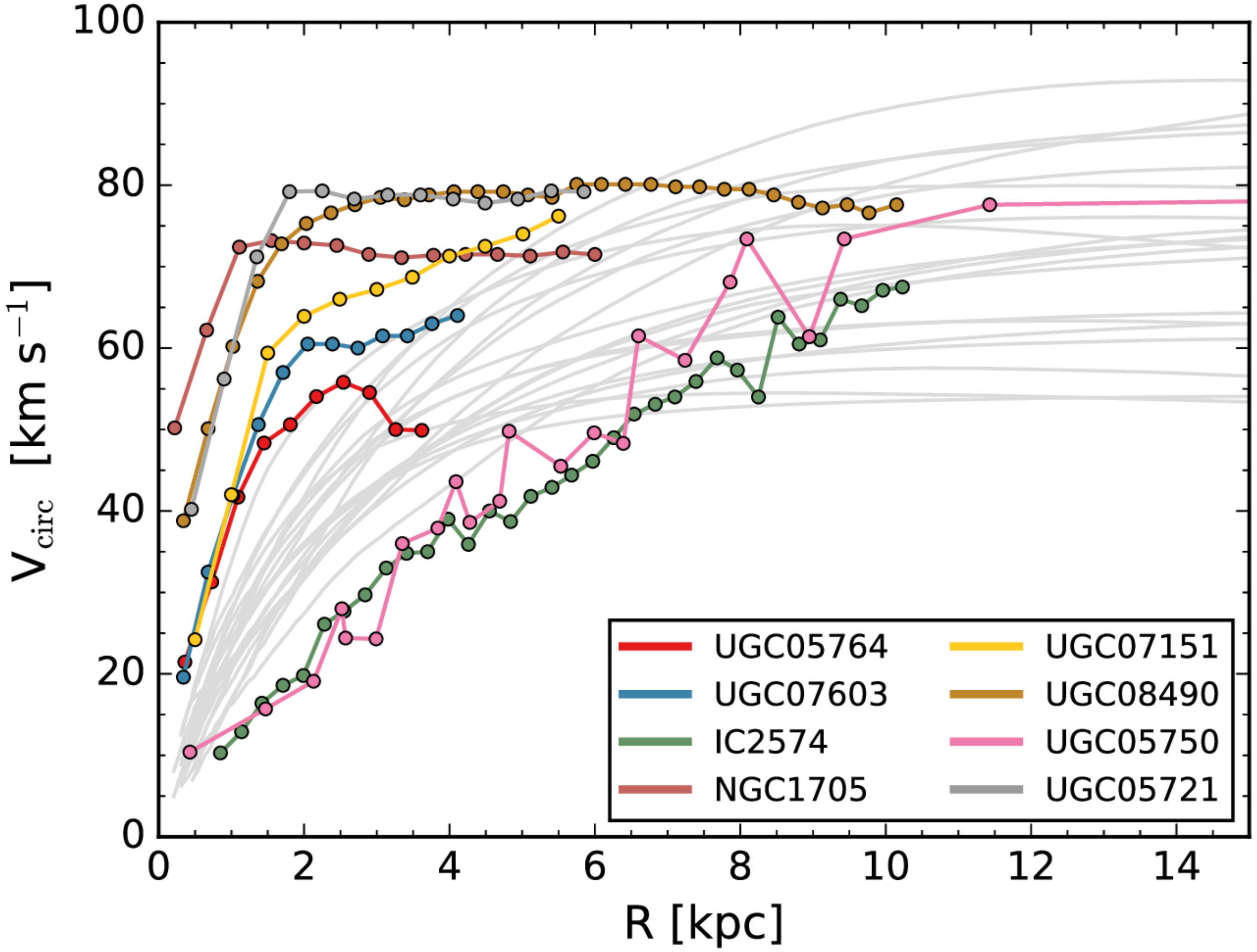
1. ACTPol TT, TE, EE spectra
2. WMAP low-ell TT
3. Planck tau-prior
4. Use ACT (MBAC) for high-ell FG-cleaning



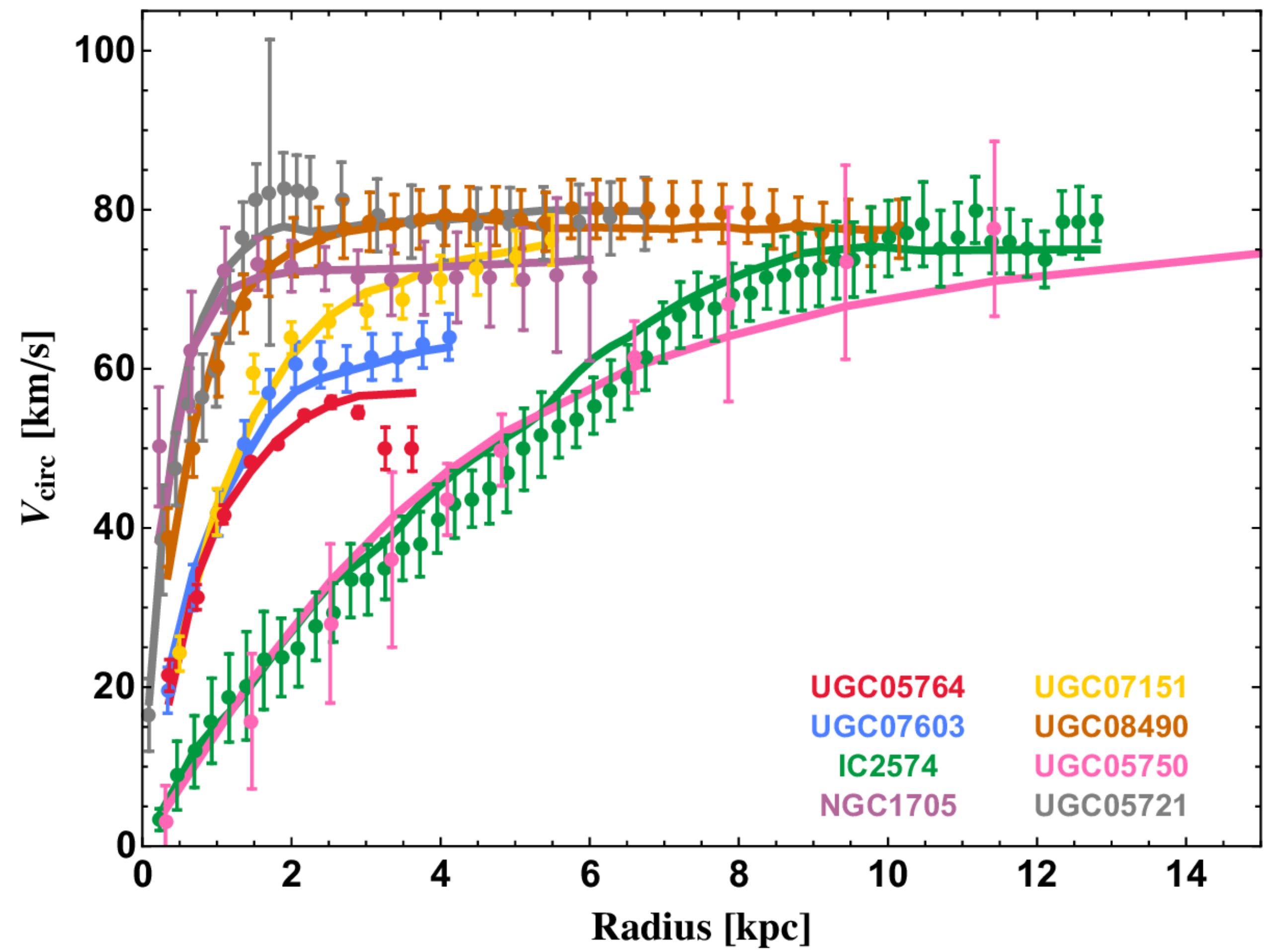
Galaxy Signal of Dark Matter Self-Interaction?

[Hai Bo Yu]

Strong Feedback vs SIDM



Santos-Santos et al. (2017)



with Kamada, Kaplinghat, Pace (PRL 2016)

Gray: NIHAO CDM simulations

"strong/violent" feedback

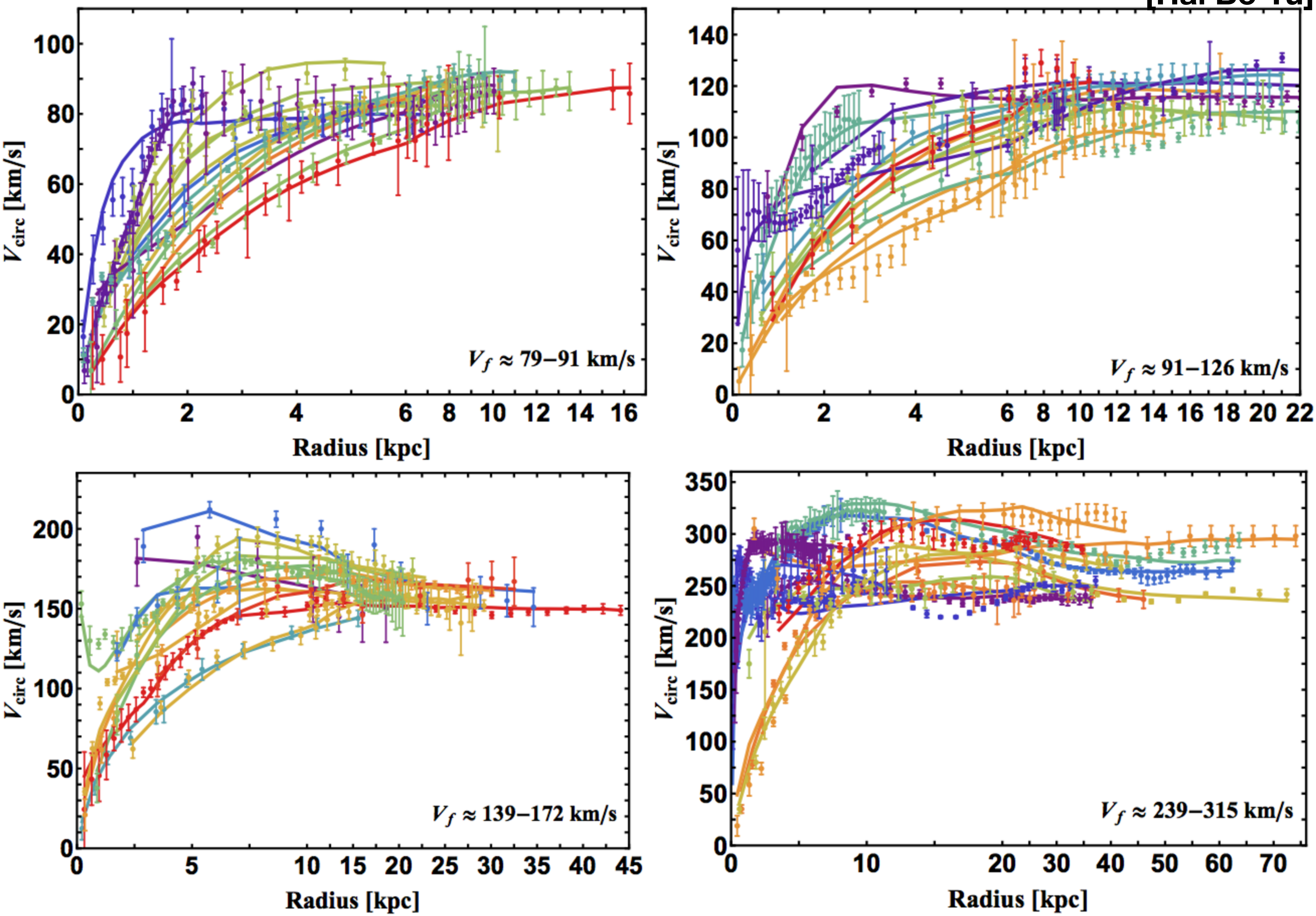
Observed scatter: ~4 (3σ away)

Simulations: ~2

Solid lines: SIDM fits

(~2σ in the c_{200}-M_{200} relation)

[Hai Bo Yu]



We have fitted to 135 galaxies

with Kaplinghat, Kwa, Ren (in prep)