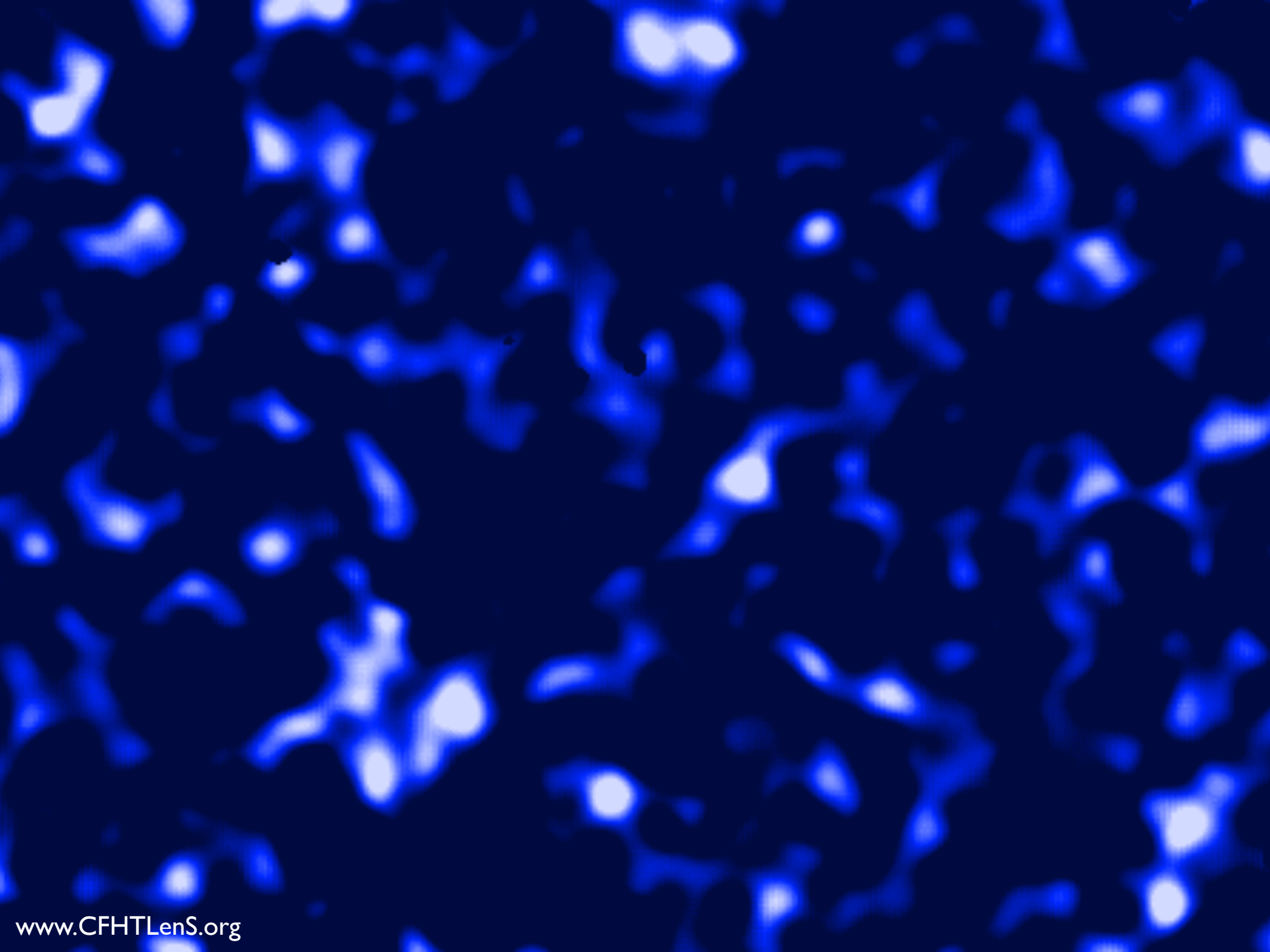
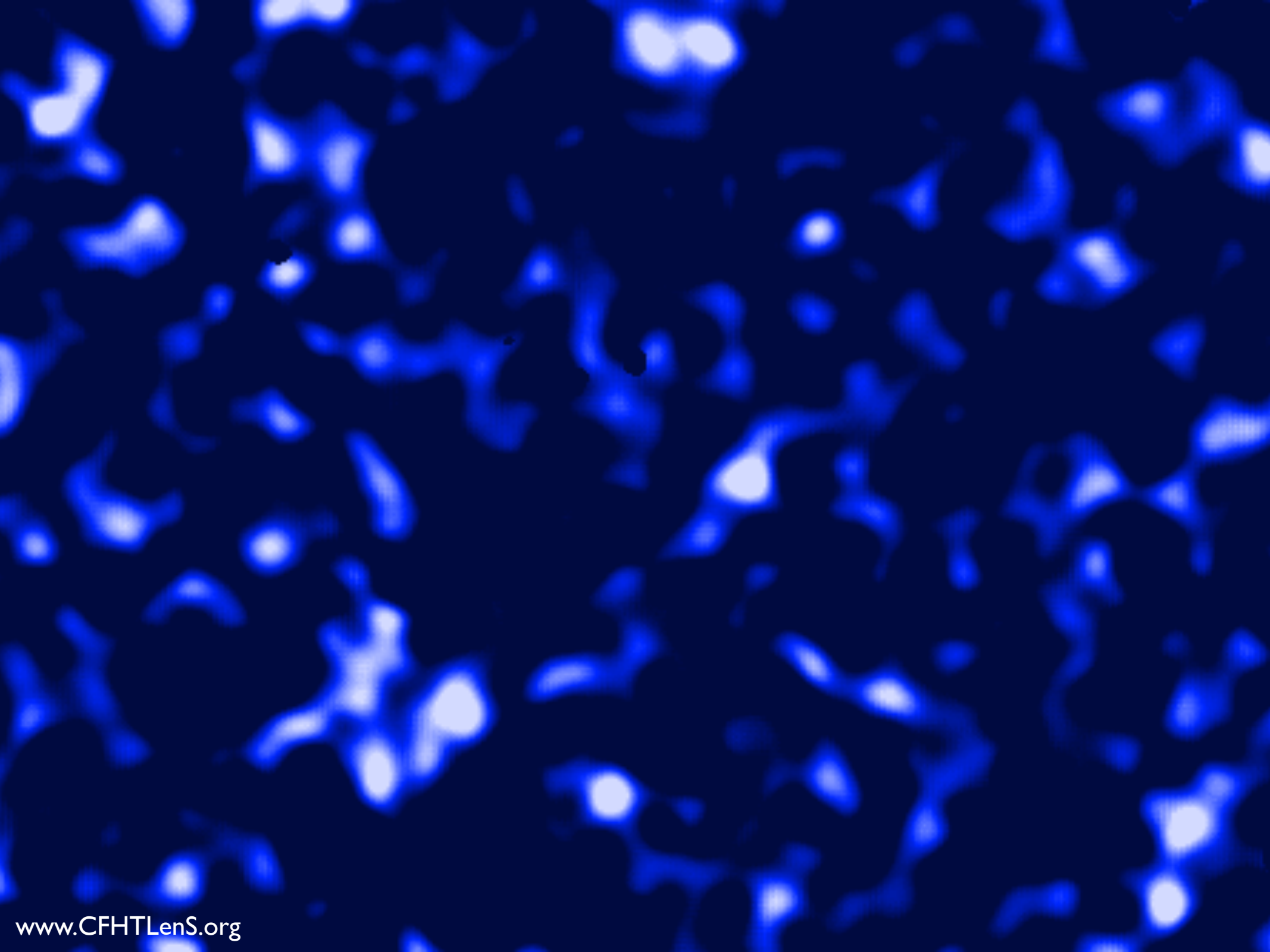


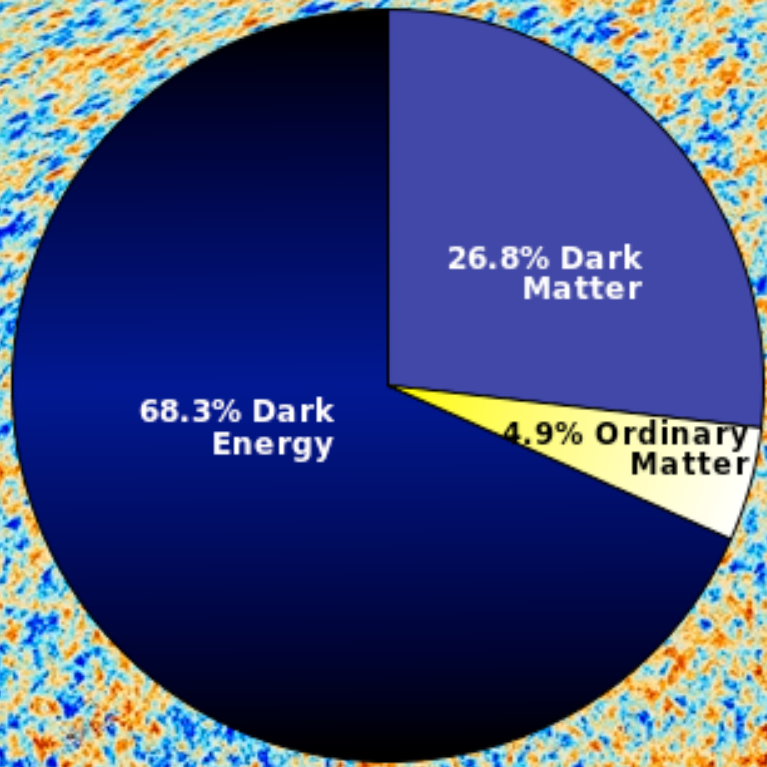
The Dark Side of the Universe, as seen by the Kilo-Degree Survey

Prof. Catherine Heymans
Institute for Astronomy,
University of Edinburgh









Poll:

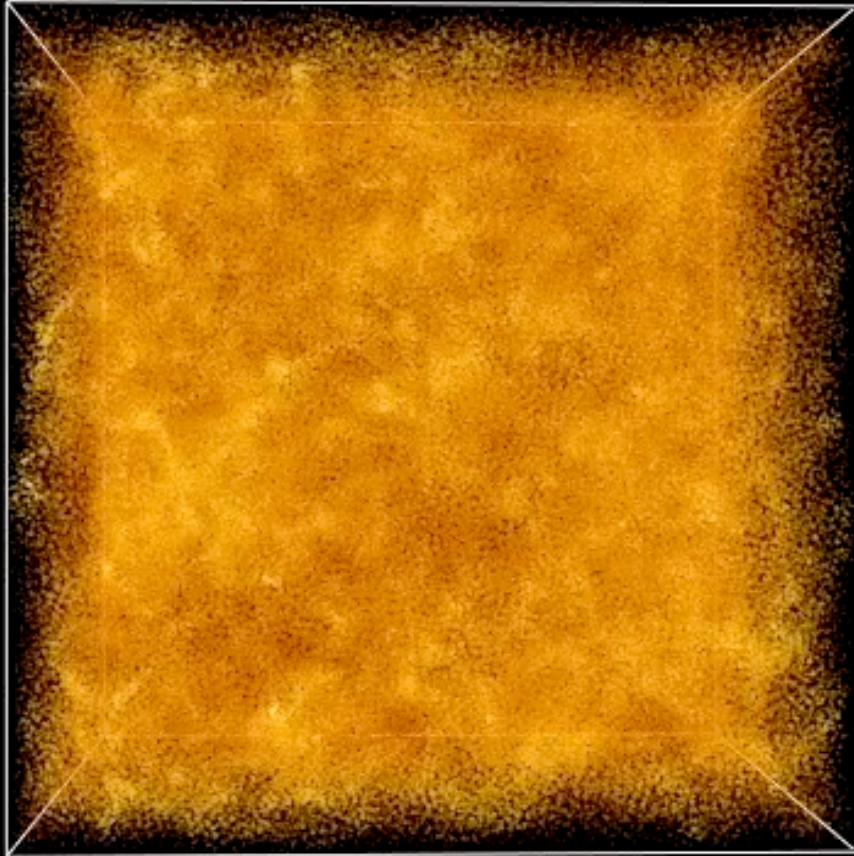
What is causing the accelerated expansion of the Universe?

1. Cosmological constant: a very low but non-zero Vacuum Energy
2. A new scalar field: the Universe is experiencing a new period of inflation
3. Beyond Einstein Gravity: we need to modify Einsteins theory of gravity
4. Multiverse with Vacuum Energy (we're in a weird realisation)

The growth of large-scale structures

Λ CDM

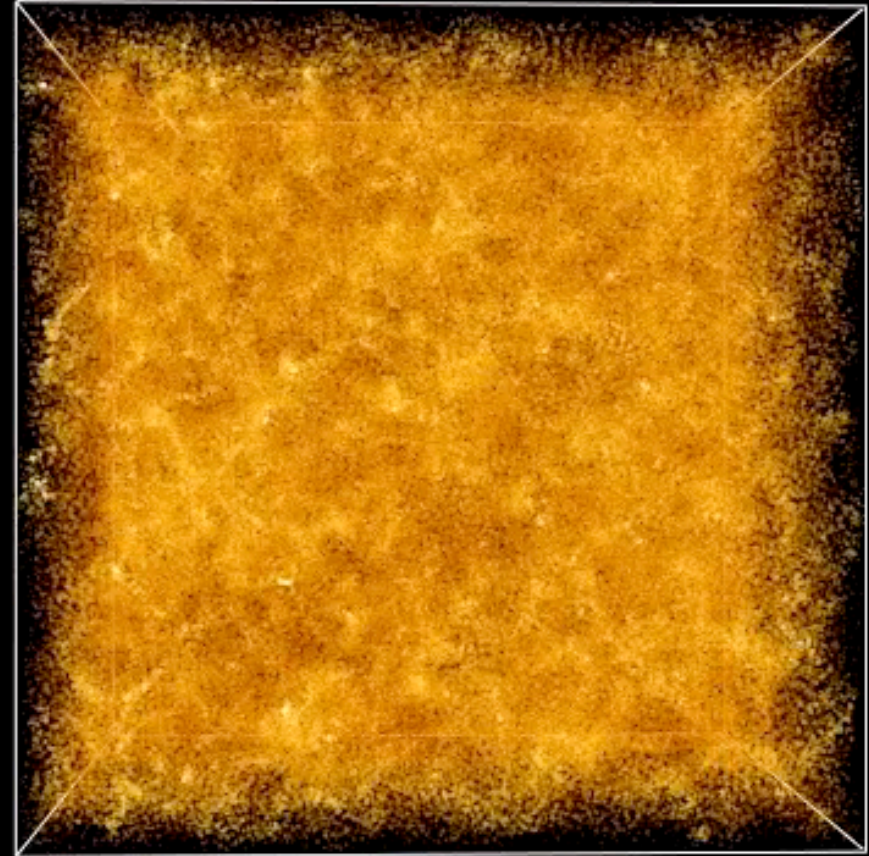
$z = 5.00$



Dark Matter and Dark Energy

SCDM

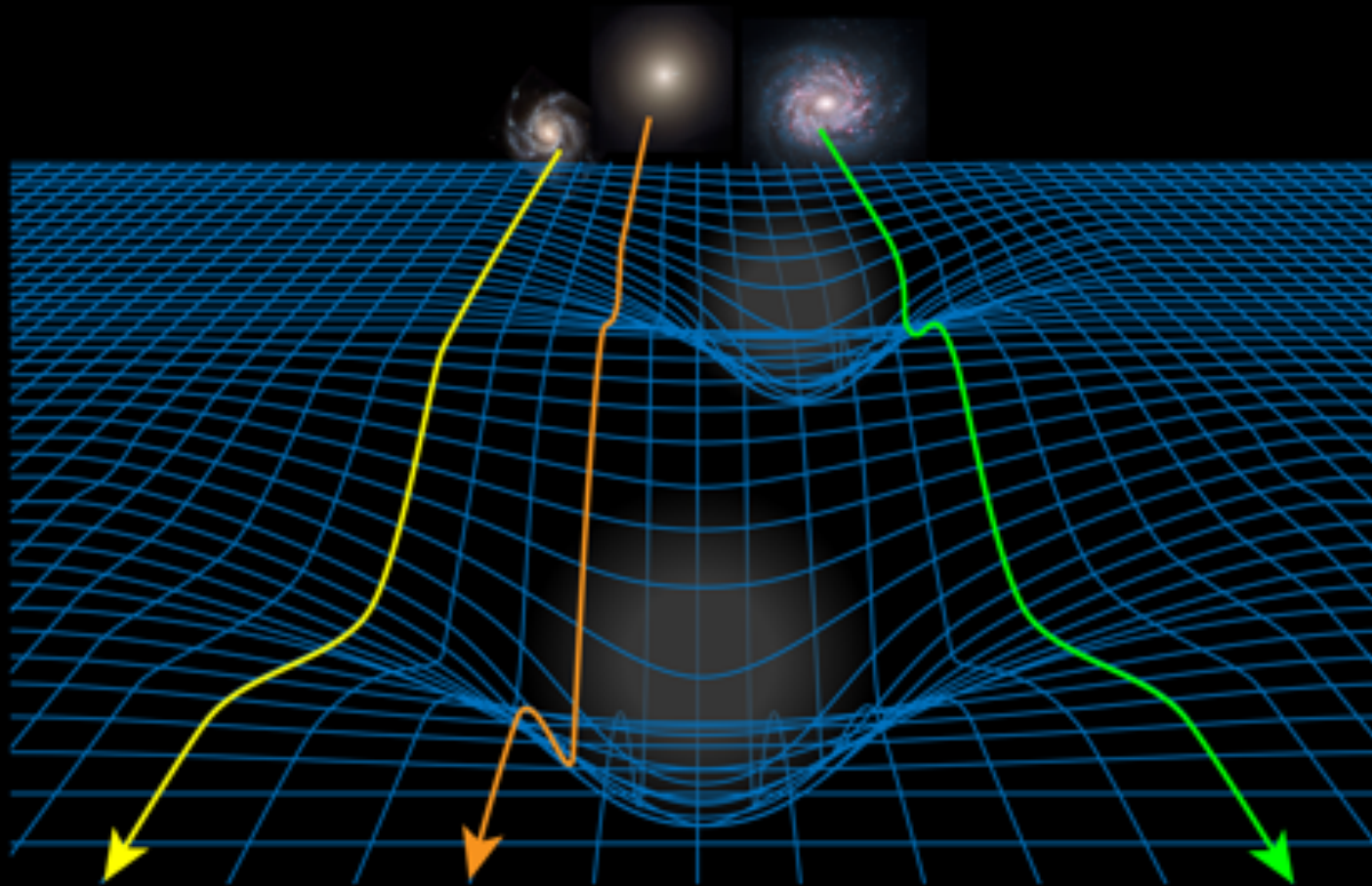
$z = 5.00$



Dark Matter alone

Gravity distorts light





The Oxford–Dartmouth Thirty Degree Survey – I. Observations and calibration of a wide-field multiband survey

Emily C. MacDonald,^{1★} Paul Allen,^{1,2} Gavin Dalton,^{1,3} Leonidas A. Moustakas,^{1,4} Catherine Heymans,^{1,5} Edward Edmondson,¹ Chris Blake,⁶ Lee Clewley,¹ Molly C. Hammell,⁷ Ed Olding,¹ Lance Miller,¹ Steve Rawlings,¹ Jasper Wall,¹ Gary Wegner⁷ and Christian Wolf¹

¹*University of Oxford, Astrophysics, Keble Road, Oxford OX1 3RH*

²*Research School of Astronomy and Astrophysics, The Australian National University, Mount Stromlo Observatory, Cotter Rd, Weston, ACT 2611, Australia*

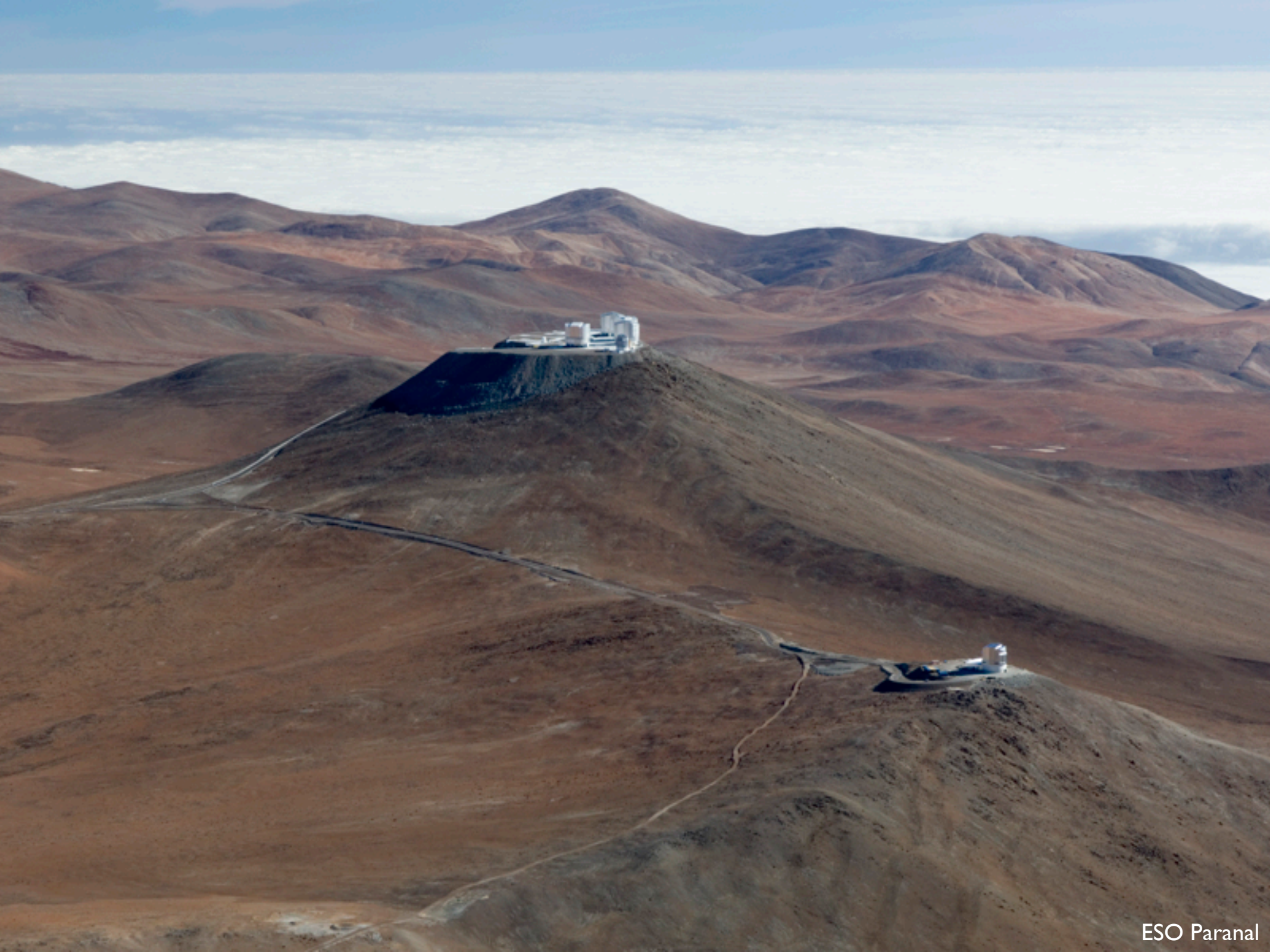
³*Space Science and Technology Division, Rutherford Appleton Laboratory, Didcot OX11 0QX*

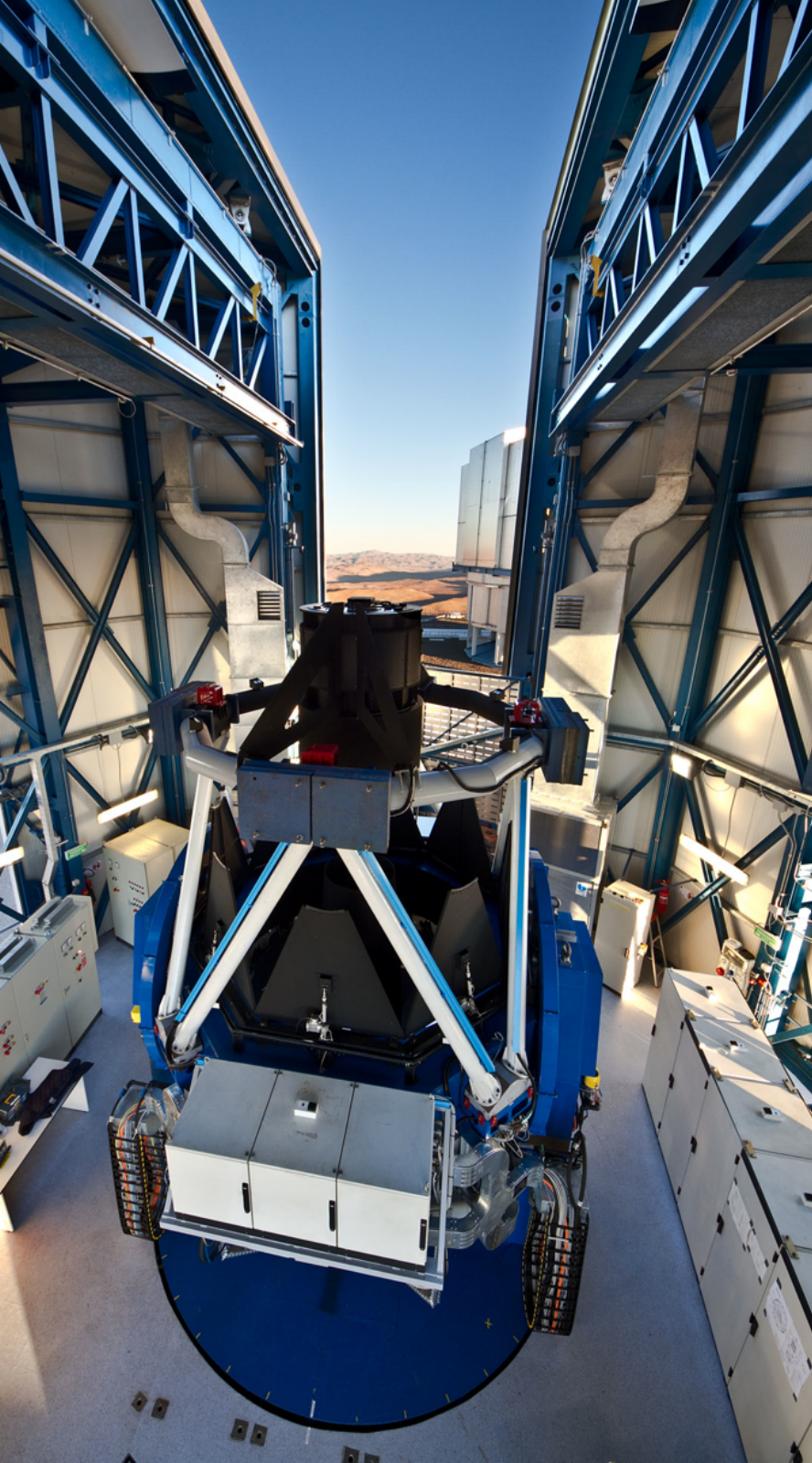
⁴*Space Telescope Science Institute, 3700 San Martin Drive, Baltimore, MD 21218, USA*

⁵*Max-Planck-Institut für Astronomie, Königstuhl, D-69117 Heidelberg, Germany*

⁶*Institute for Astronomy, School of Physics A28, University of New South Wales, New South Wales 2006, Australia*

⁷*Dartmouth College, 6127 Wilder Laboratory, Hanover, NH 03755-3528, USA*

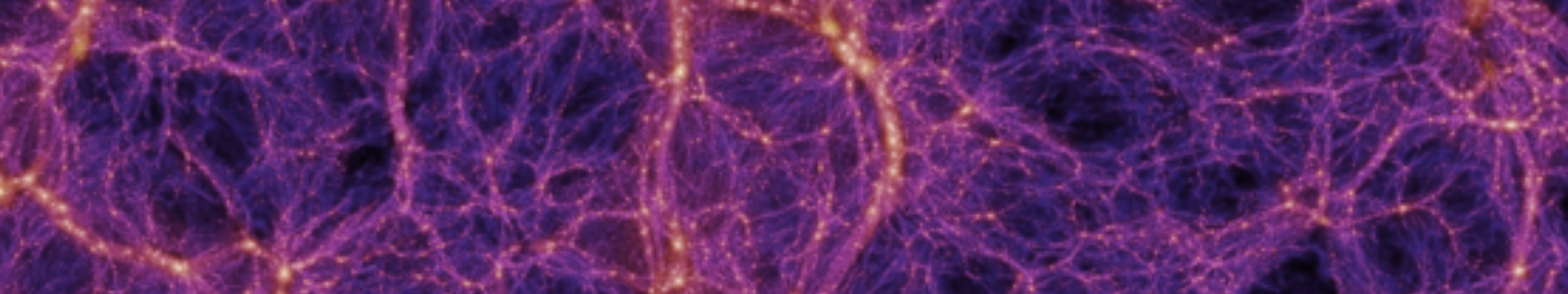




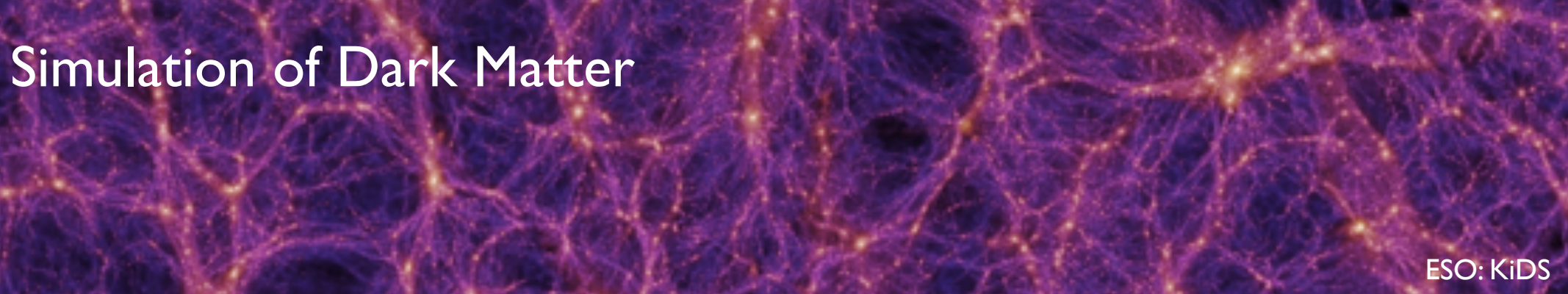
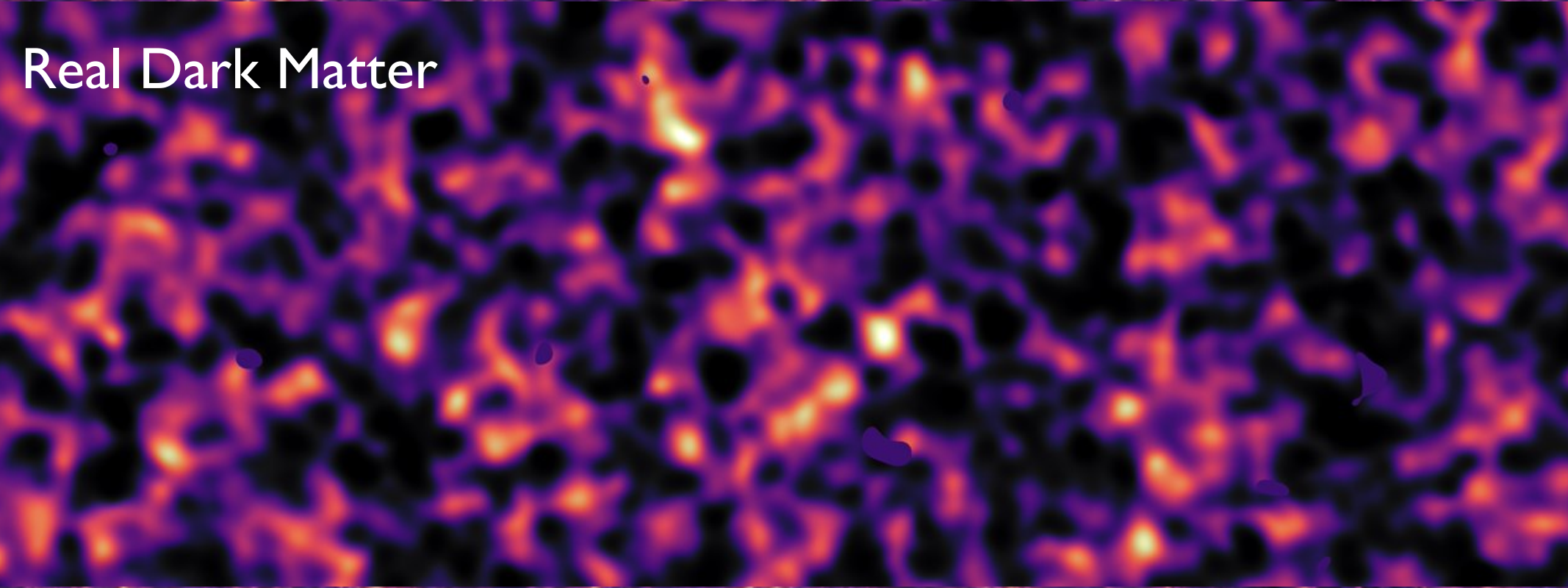
OmegaCAM at VST





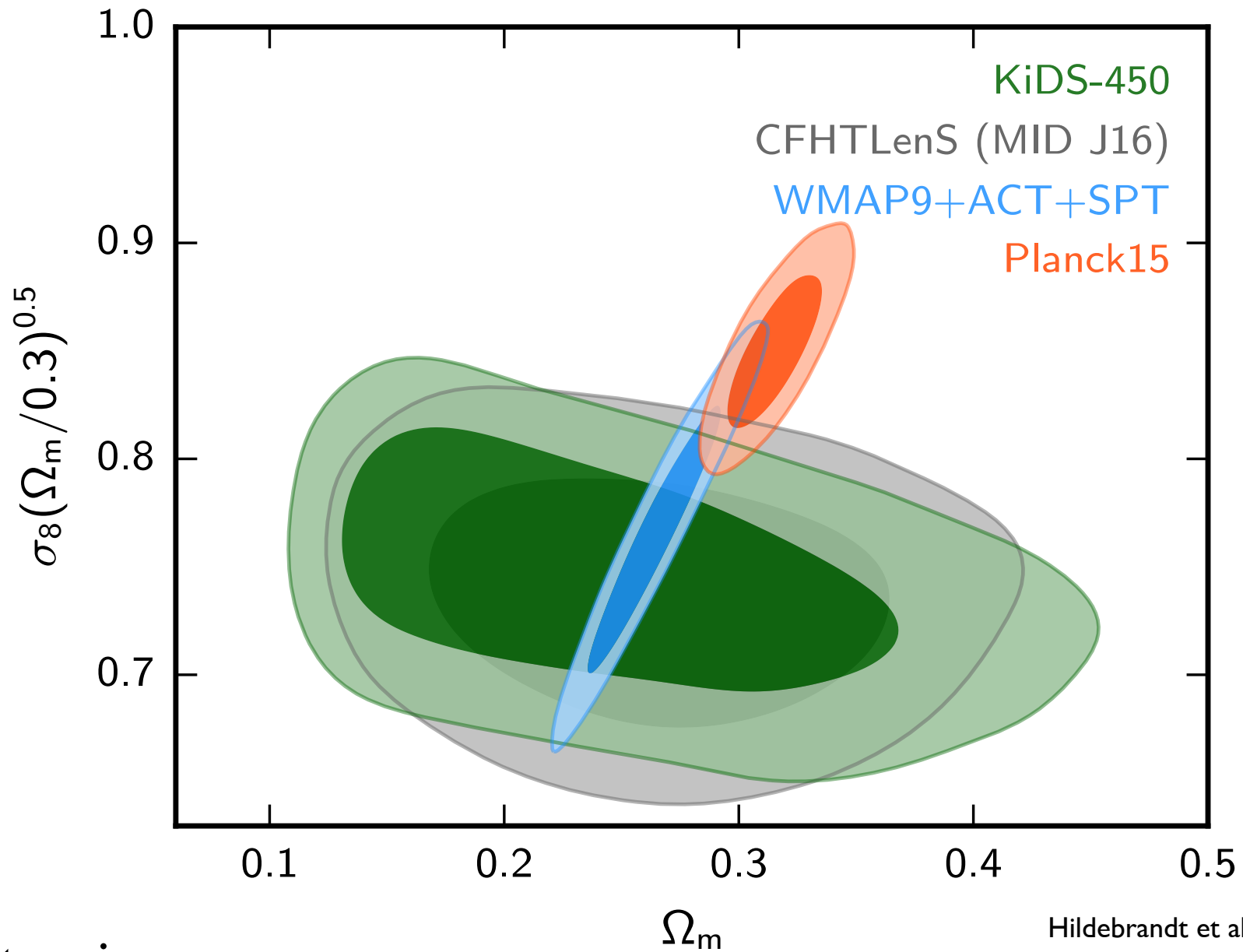


Real Dark Matter



Simulation of Dark Matter

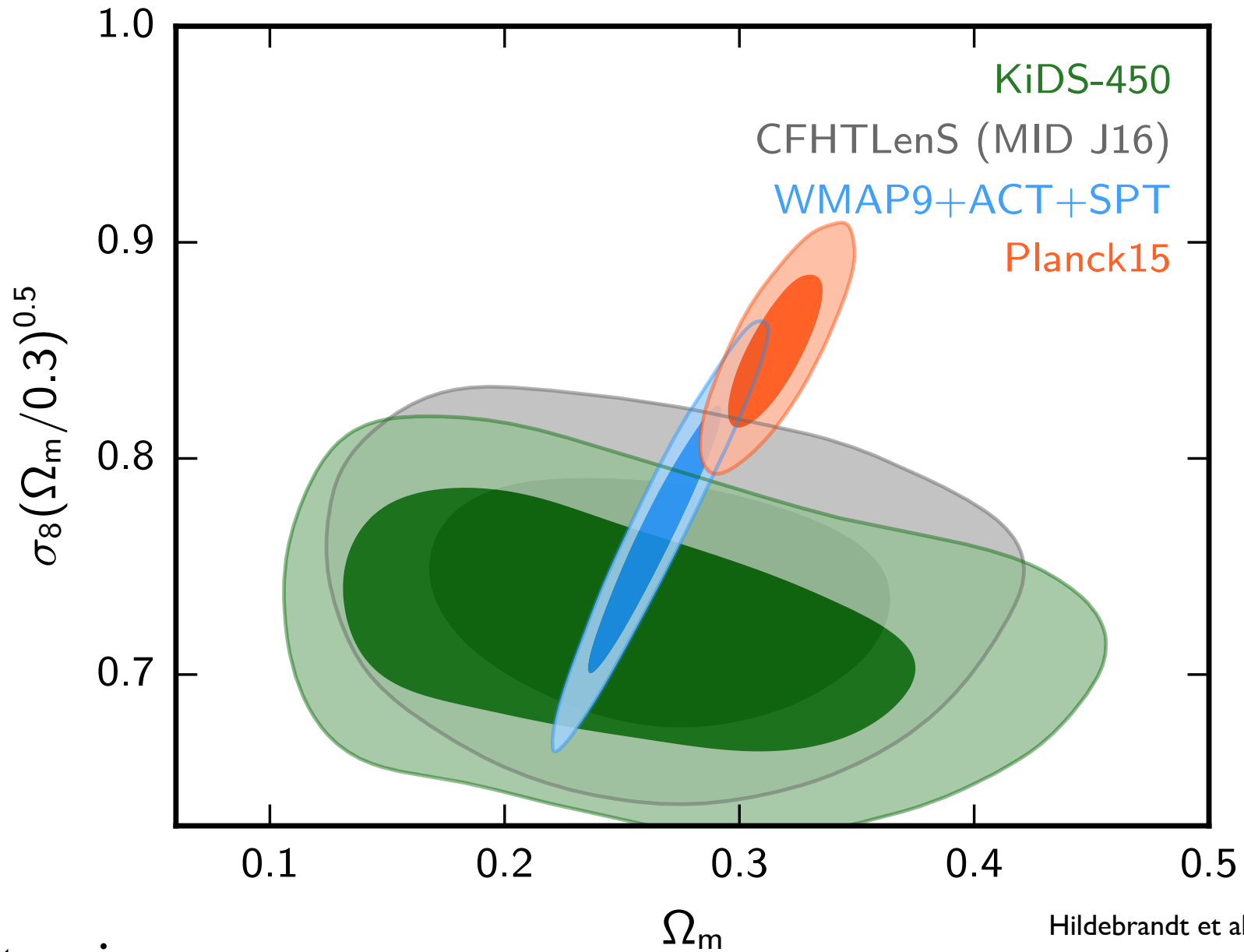
Blind I



2.3 σ tension

Hildebrandt et al 2017

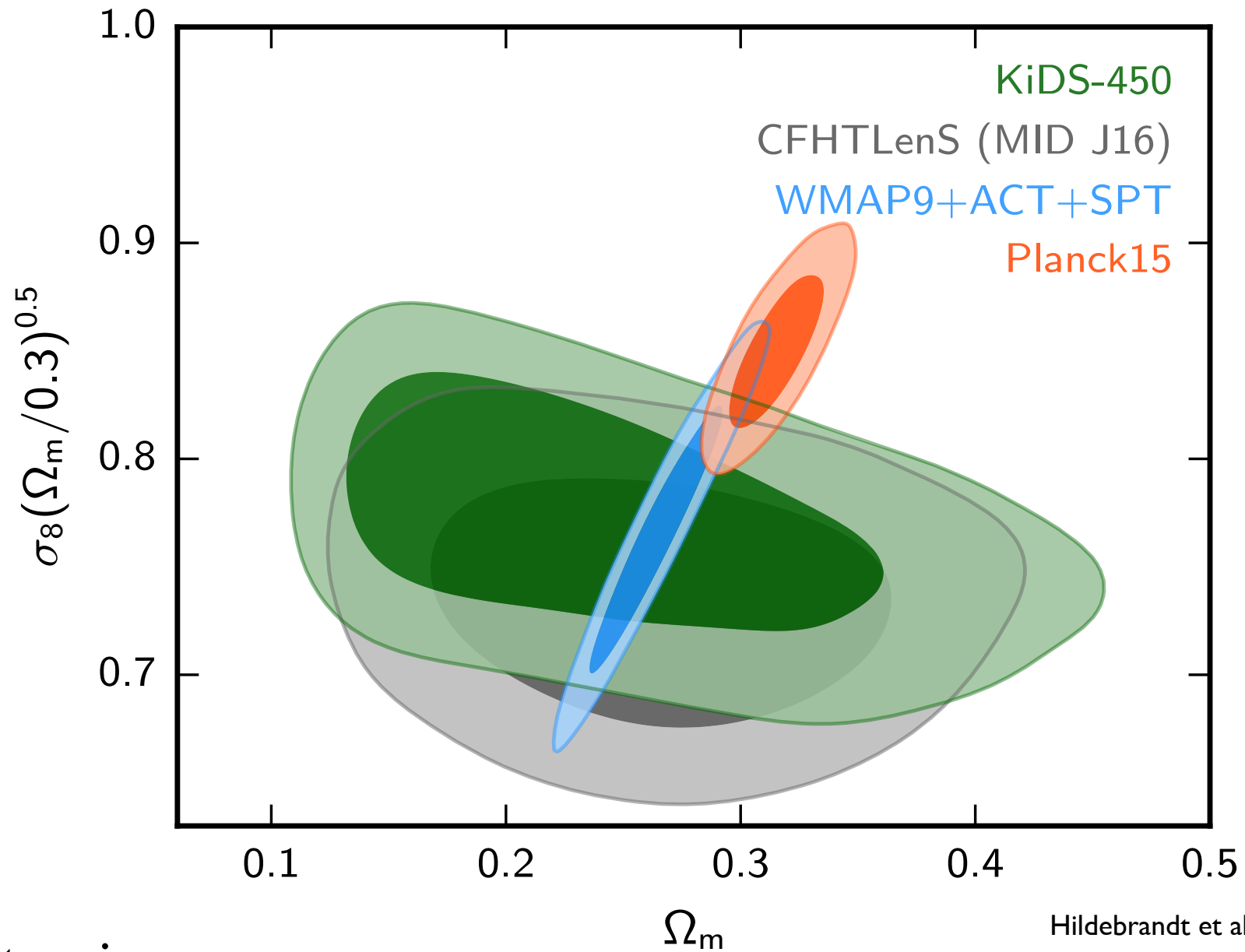
Blind 2



3.0 σ tension

Hildebrandt et al 2017

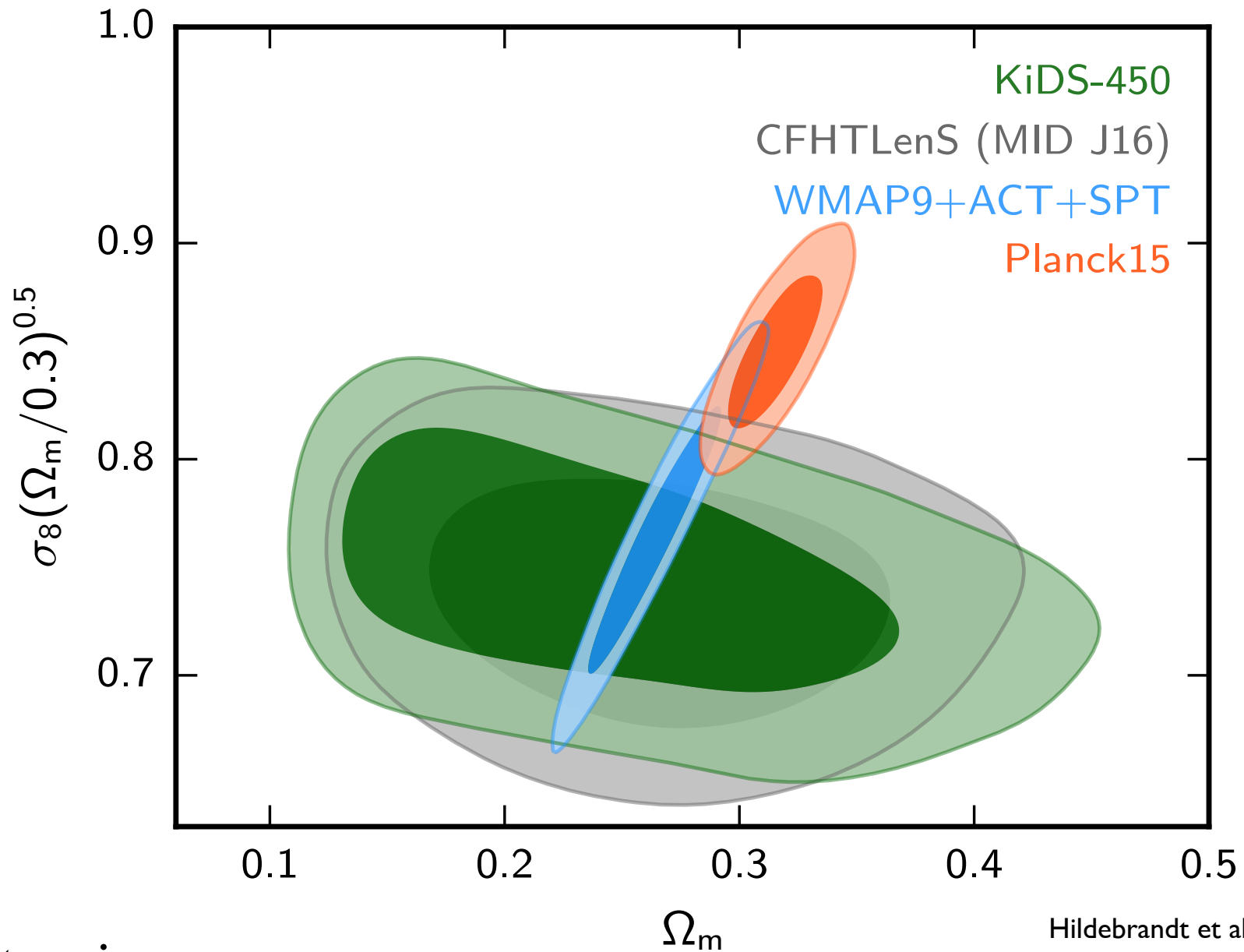
Blind 3



1.5 σ tension

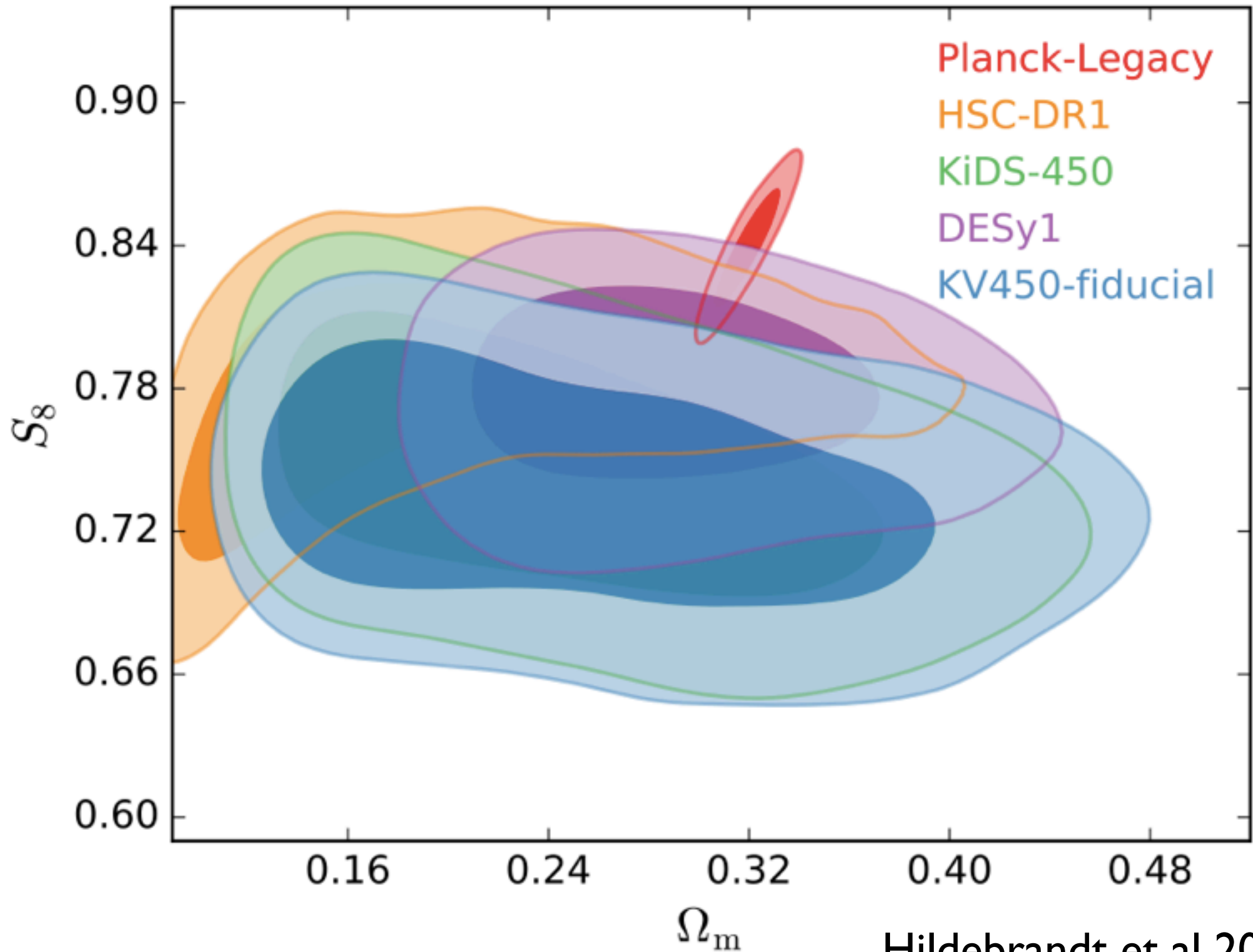
Hildebrandt et al 2017

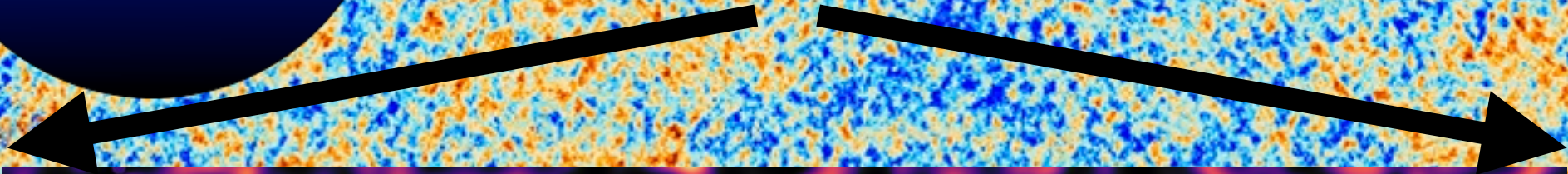
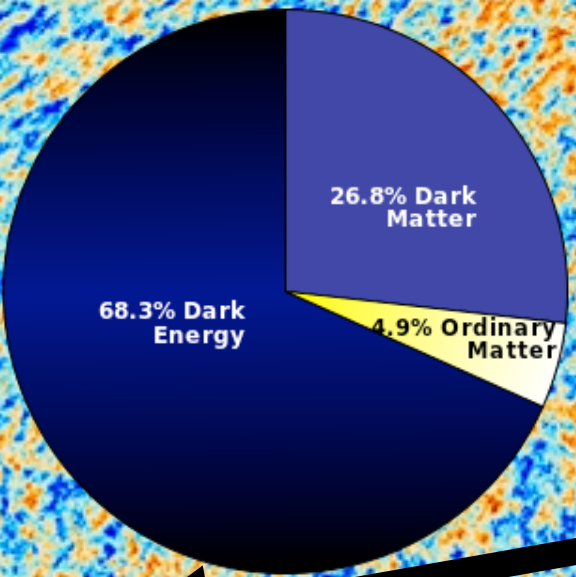
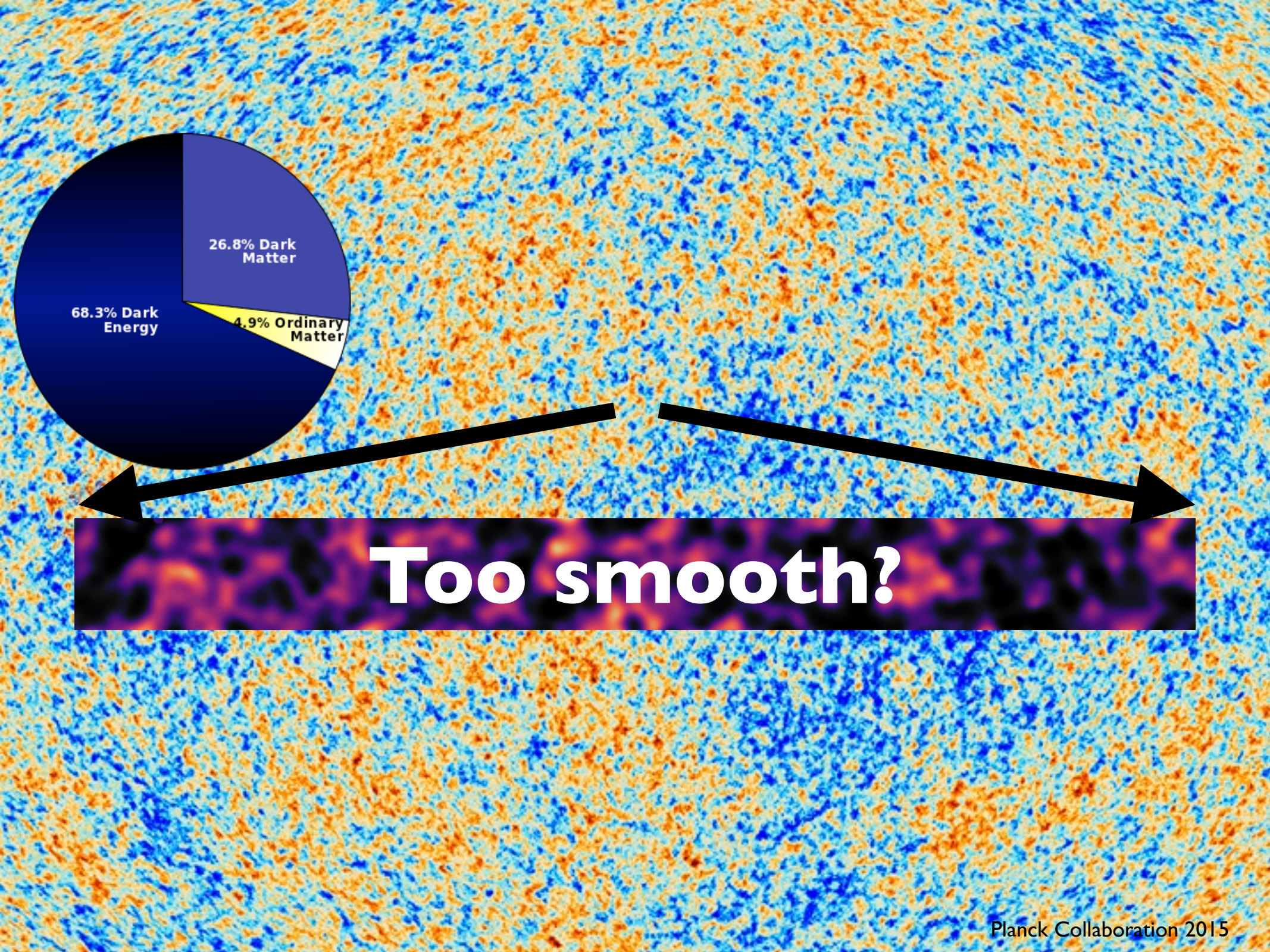
The truth....



2.3 σ tension

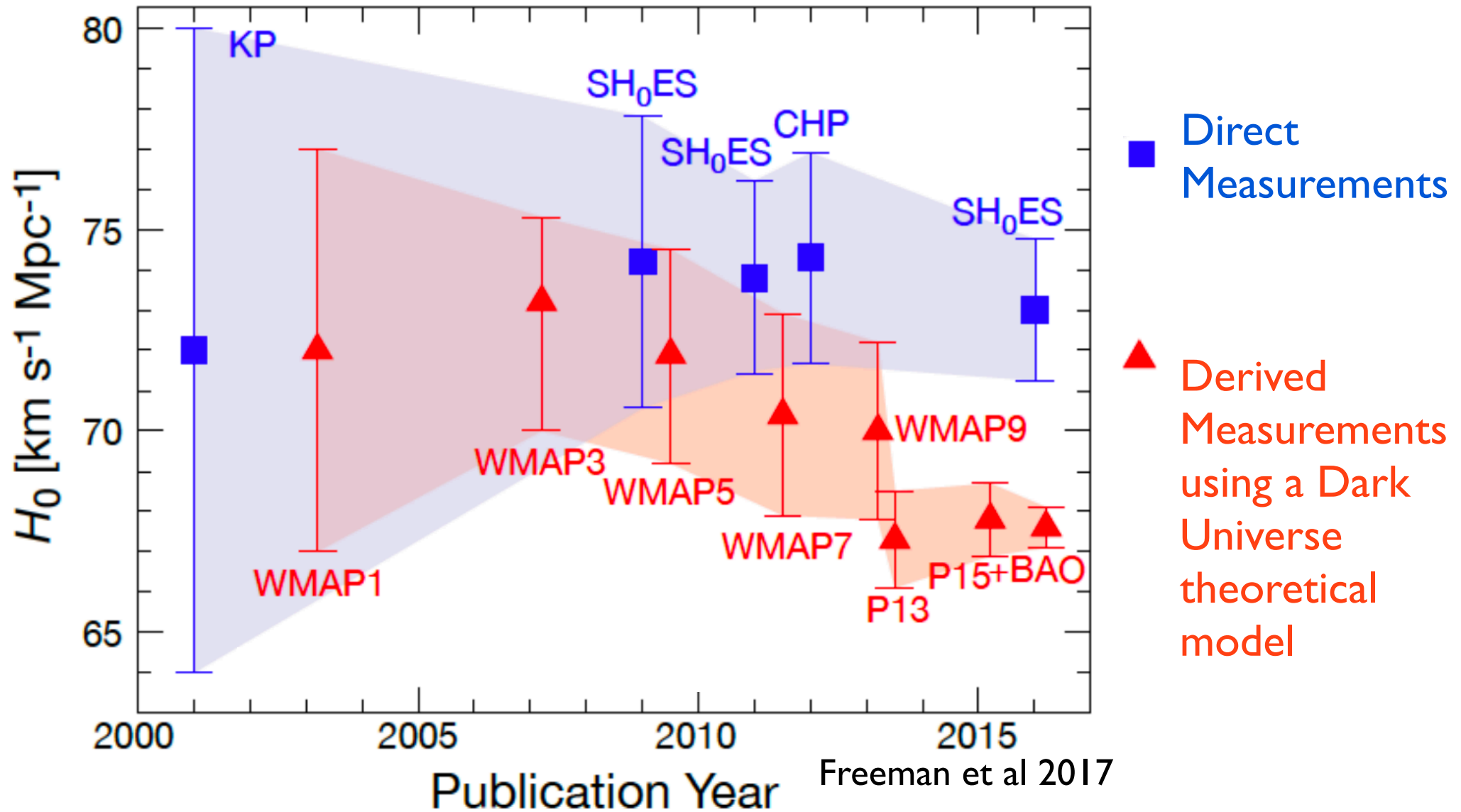
Hildebrandt et al 2017





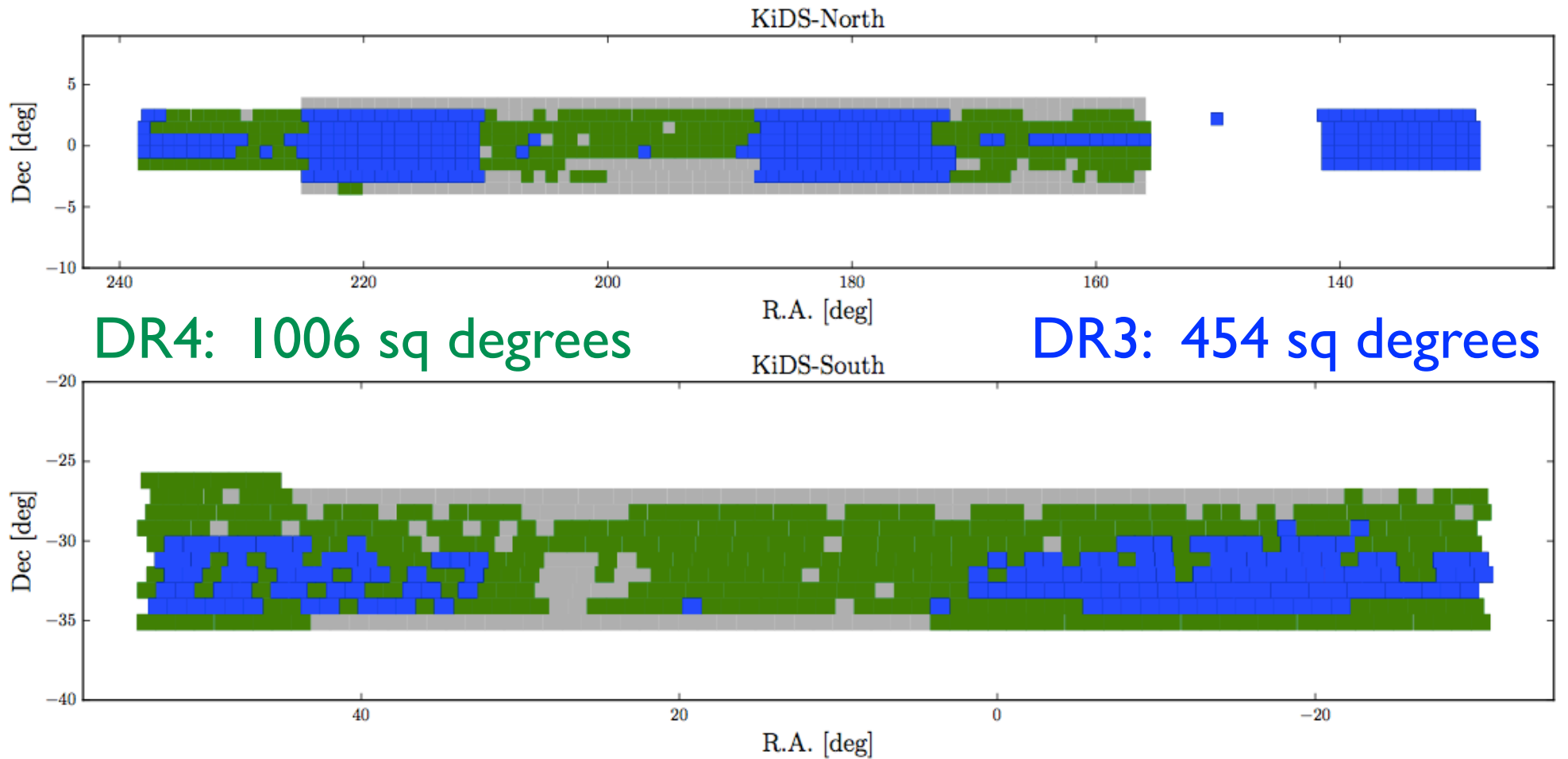
Too smooth?

Hubble Constant



Two points separated by the same distance between the MW to Andromeda (2.5 million light years) are moving apart at a rate of 125,000 miles per hour

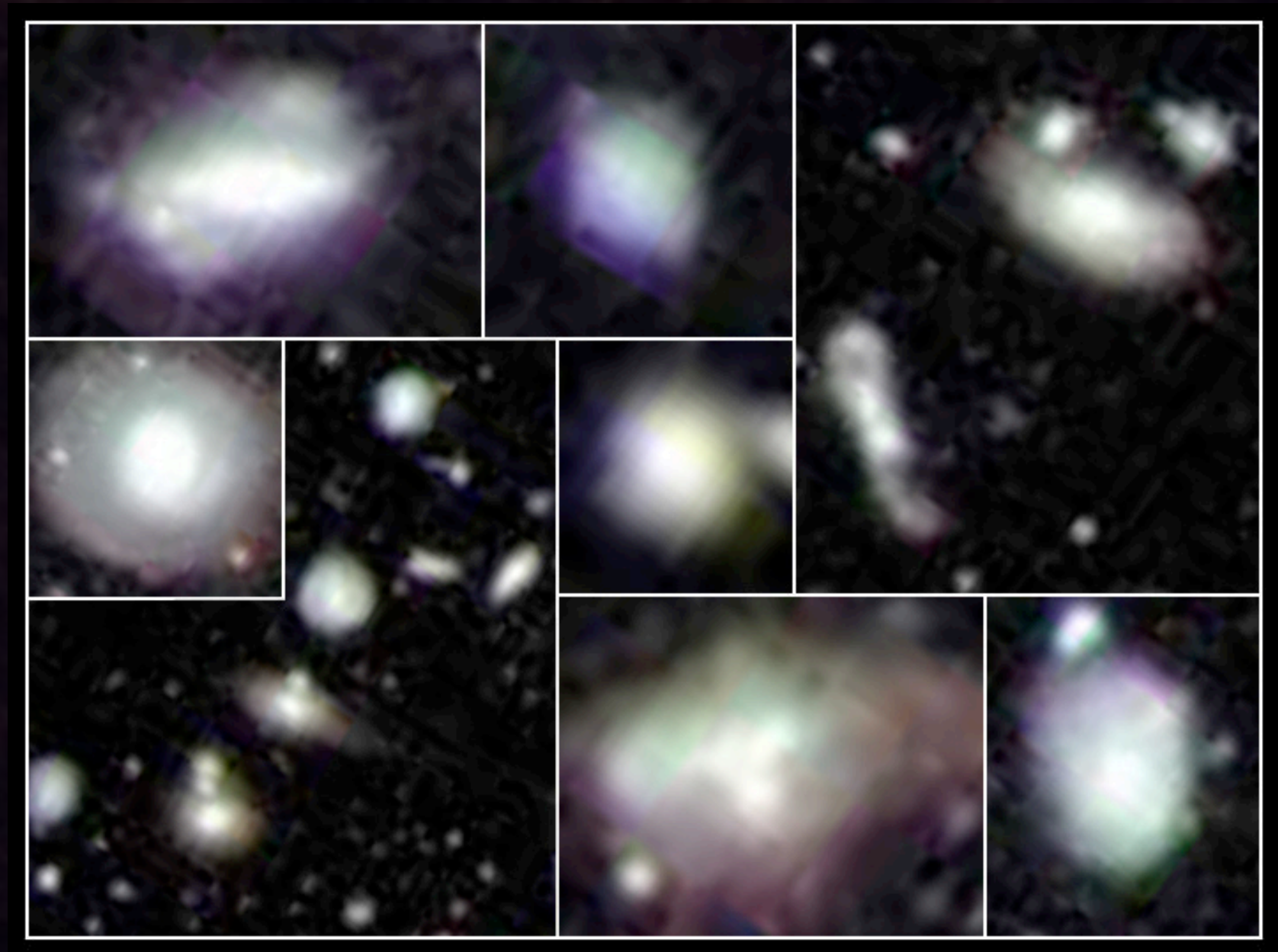
KiDS: Kilo-Degree Survey



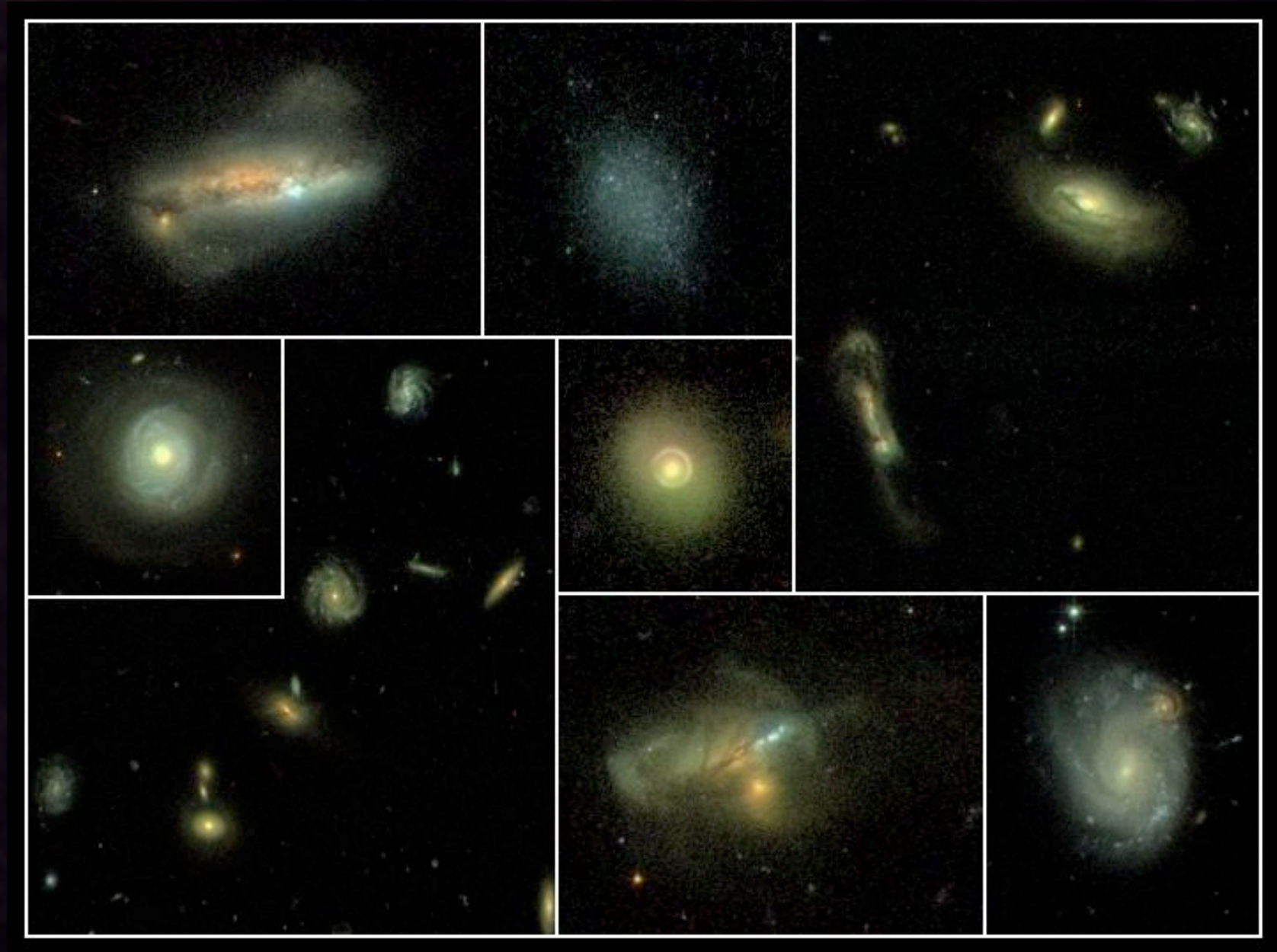
The Large Synoptic Survey Telescope LSST



Ground-based imaging



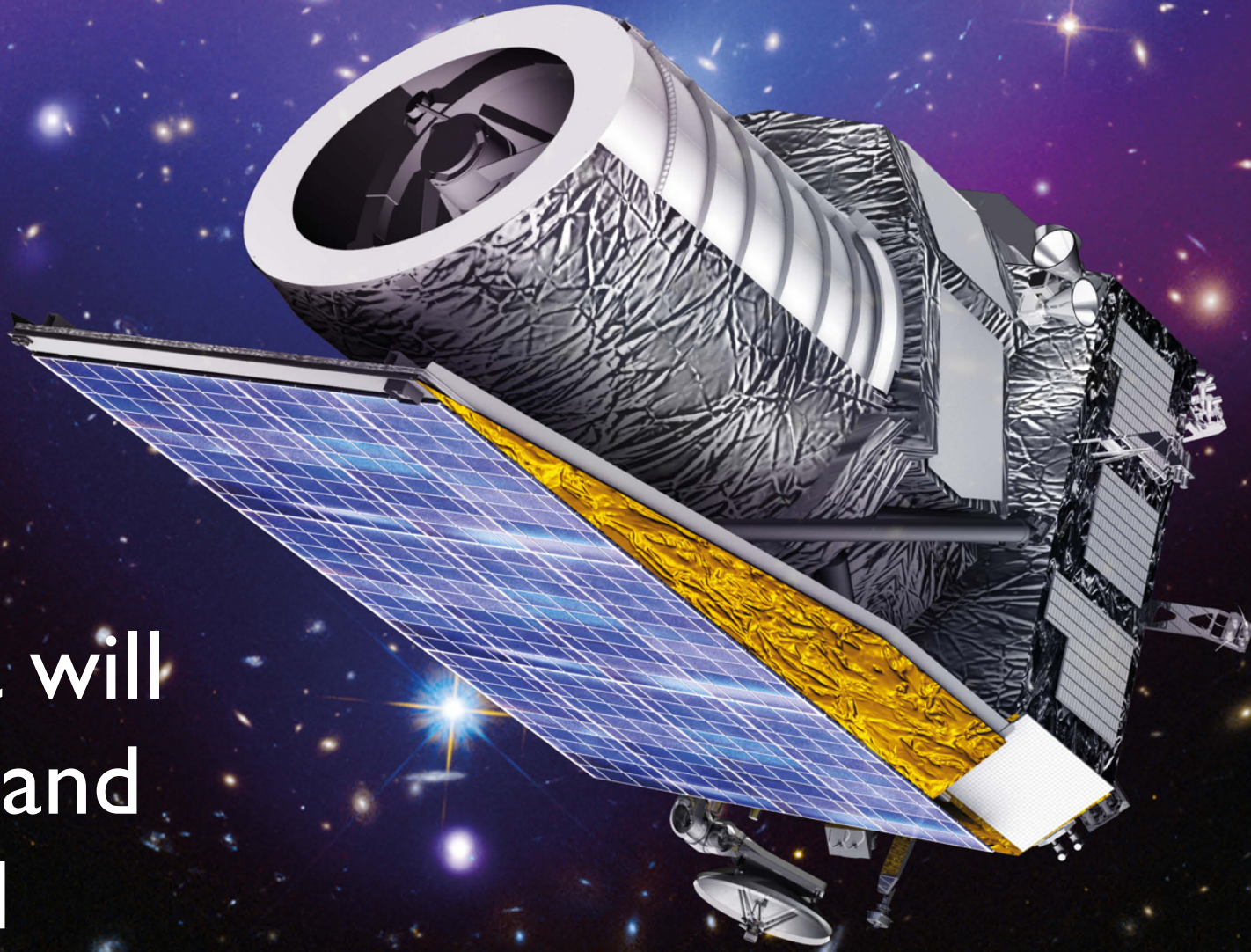
Space-based imaging



STAGES: Gray et al 2009

Slide courtesy of Meghan Gray

Euclid



What will
LSST and
Euclid
discover?