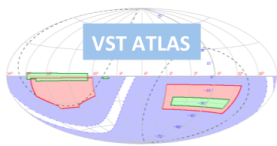




VST ATLAS – Past, Present and Future Highlights

Tom Shanks + ESO + CASU + WFAU +
PUC + Durham + friends



Outline

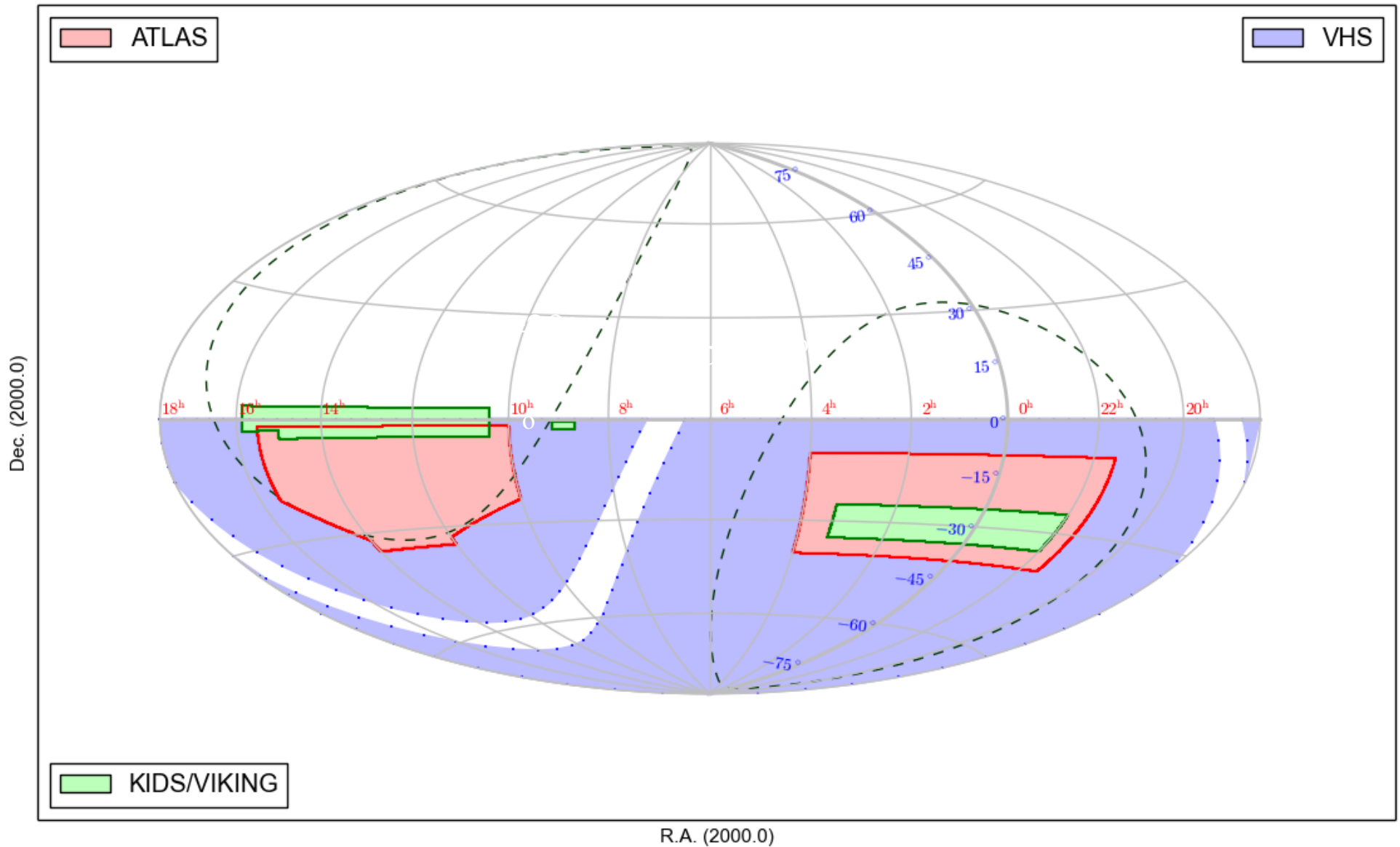
1. VST ATLAS overview
2. ATLAS Cosmology Highlights
 - (a) Dwarf Galaxies
 - (b) ISW+CMB Cold Spot
 - (c) Quasar Surveys
3. Future ATLAS projects
 - (a) 4MOST+eROSITA quasar survey
 - (b) 4MOST+eROSITA galaxy cluster survey
4. Summary

VST ATLAS overview

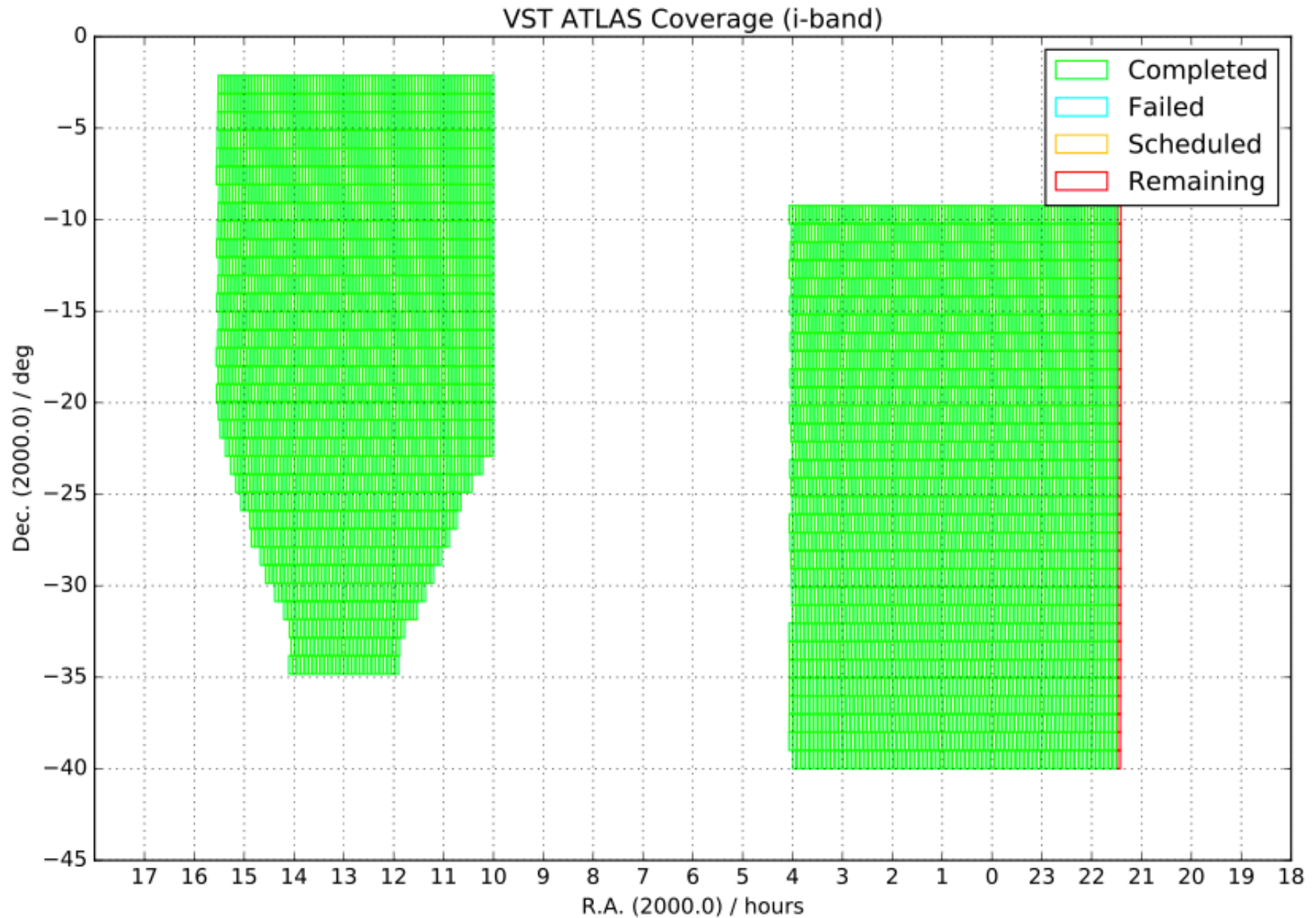


- “Southern Sloan”
- ~5k square degrees
- ugriz bands
- VST camera -256k 0.2”x0.2”pixels
- → 1deg x 1deg field
- Seeing 0.”8 (i)
- Completed June 2017
- Final release – DR4 - July 2018

ESO Survey Footprints

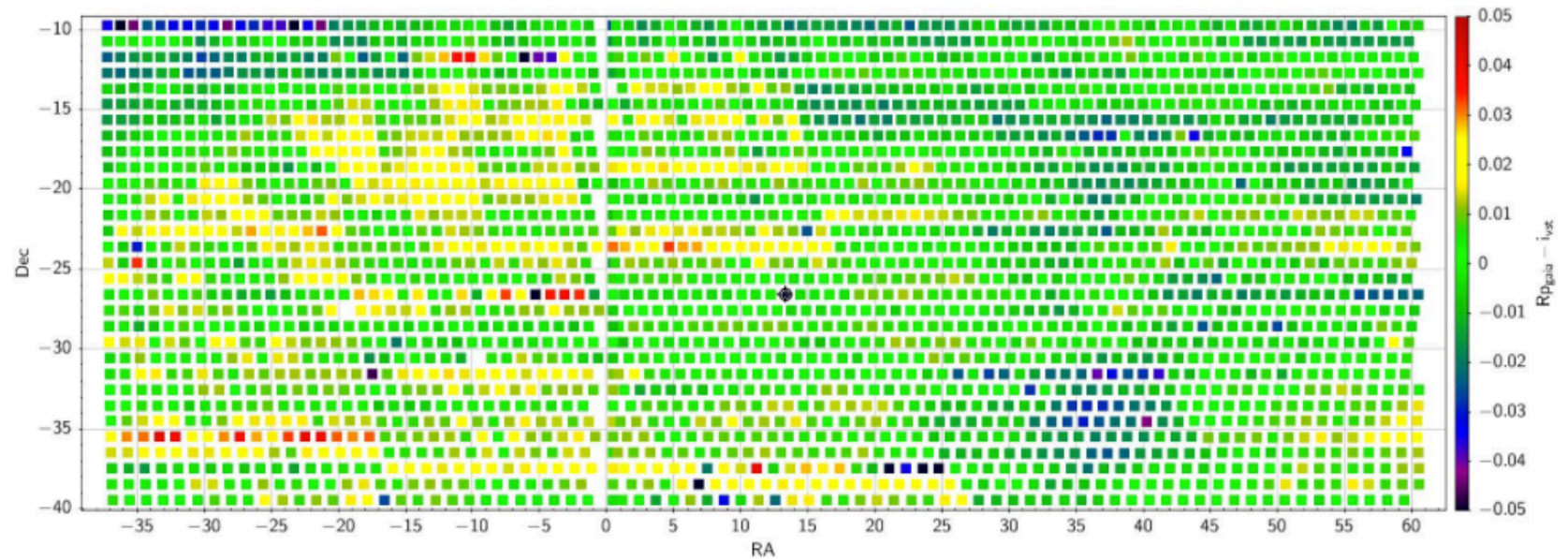
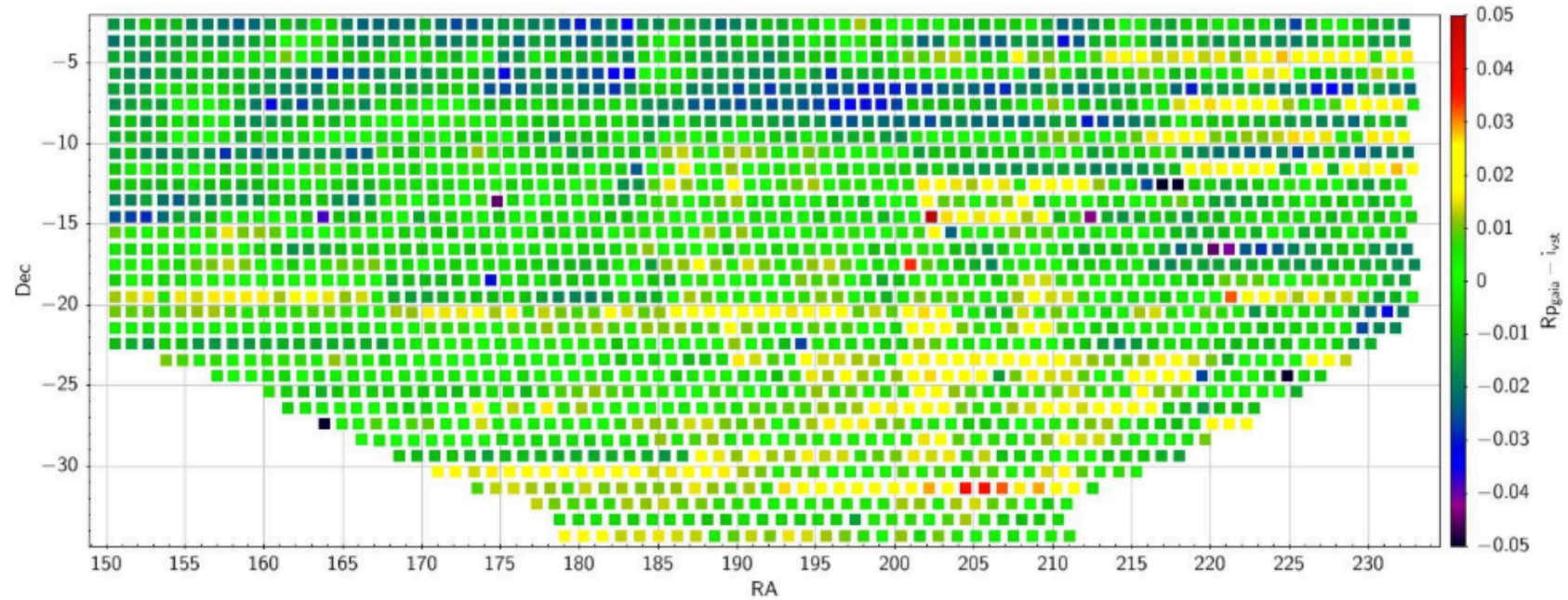


ATLAS completed

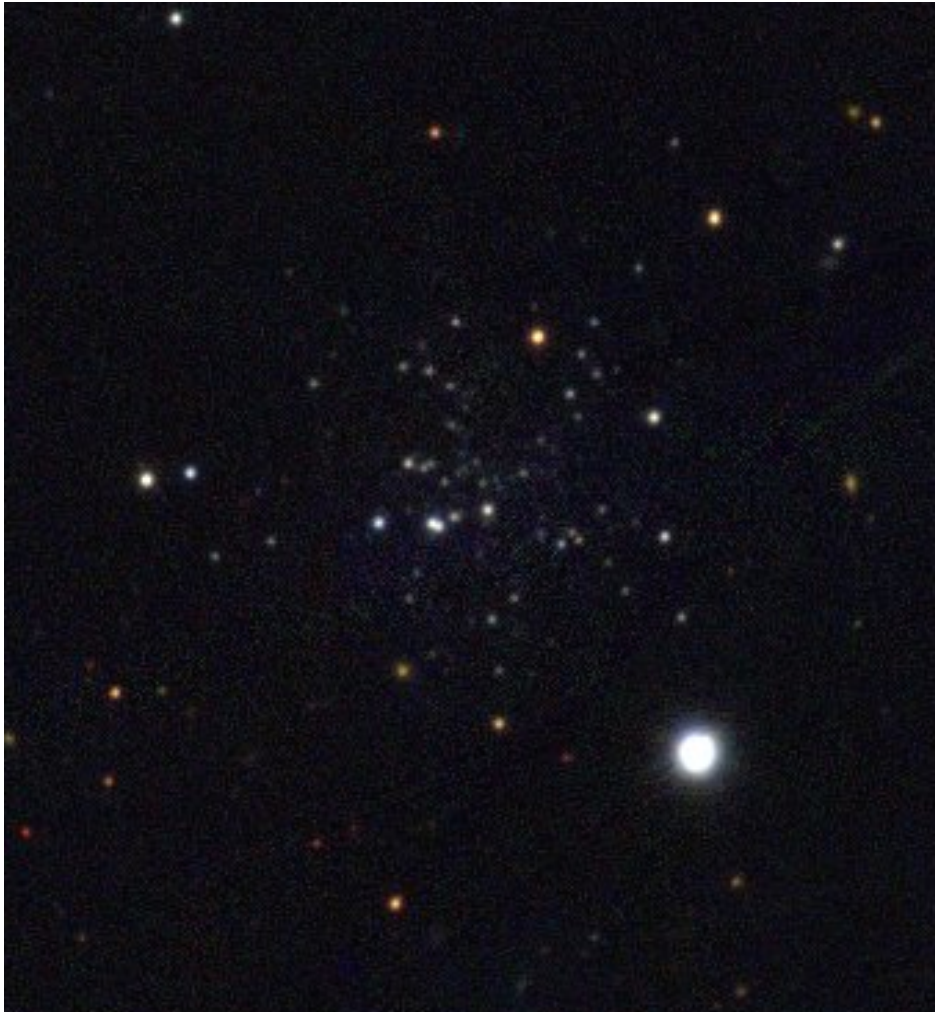


ATLAS calibration via GAIA stars (BGR)

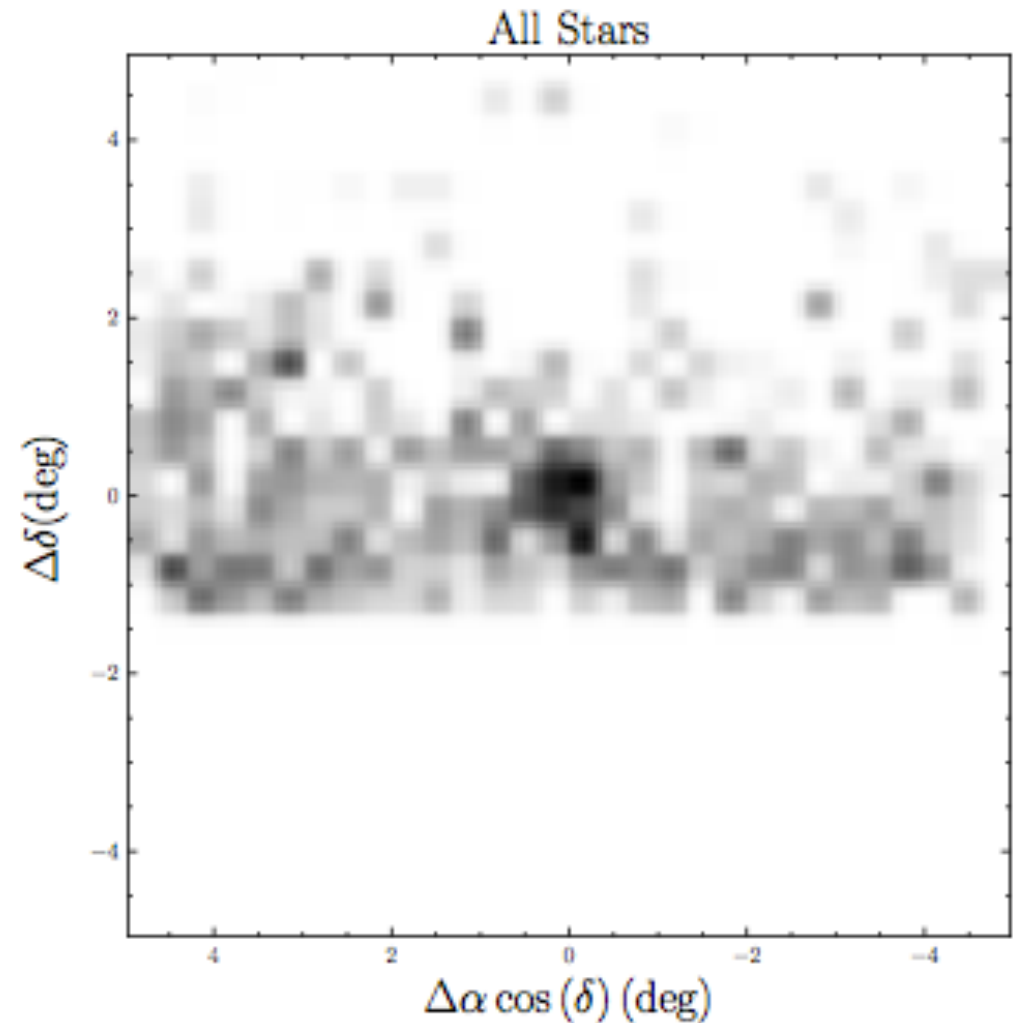
i-band: $(R_{p,gaia} - i_{vst} - 0.03(Bp-Rp)_{gaia} + 0.03(Bp-Rp)_{gaia}^2 + 0.33)$



Crater 1 and 2 dwarf galaxies

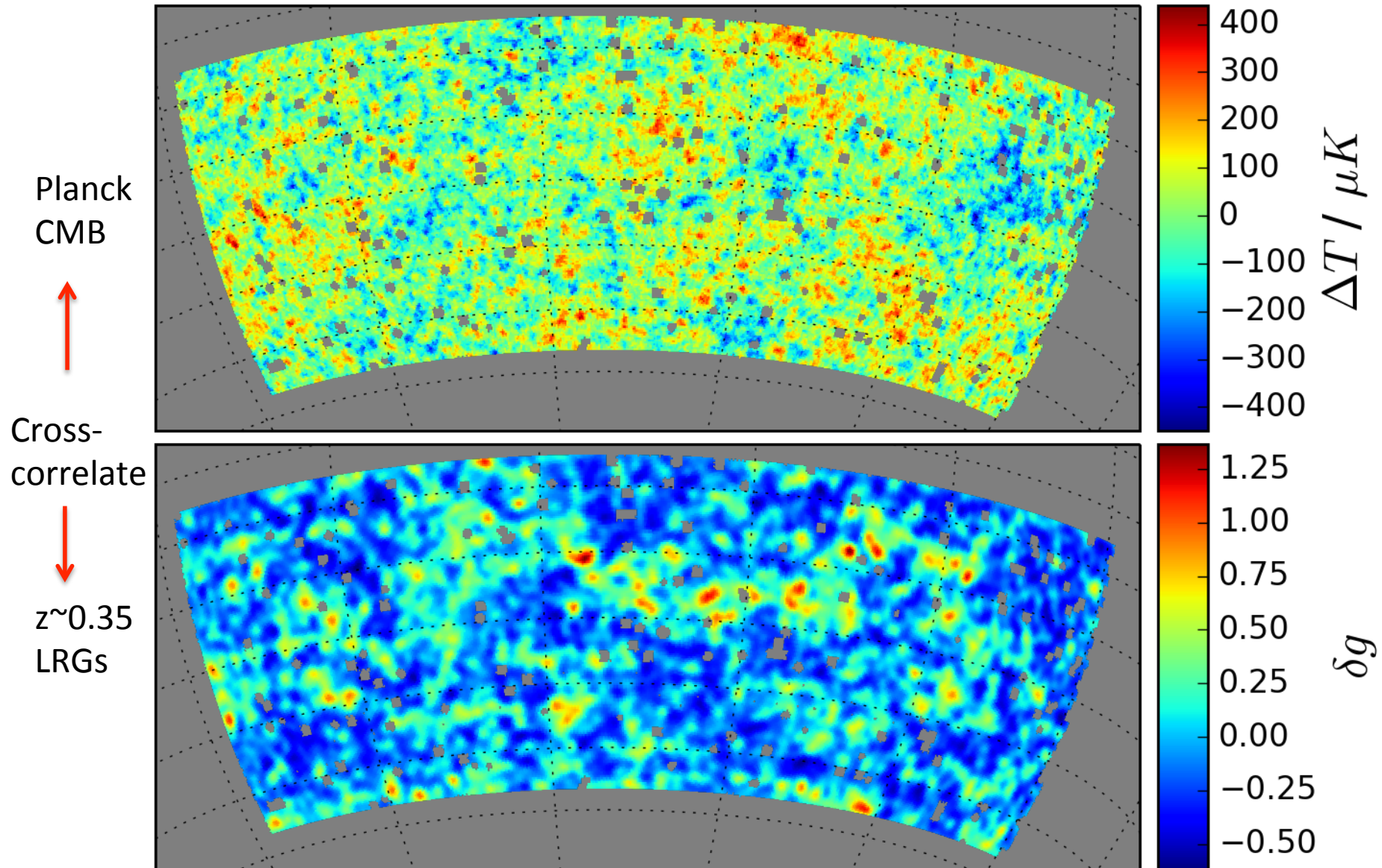


ATLAS gri Crater 1 dwarf (Belokurov et al 2014)

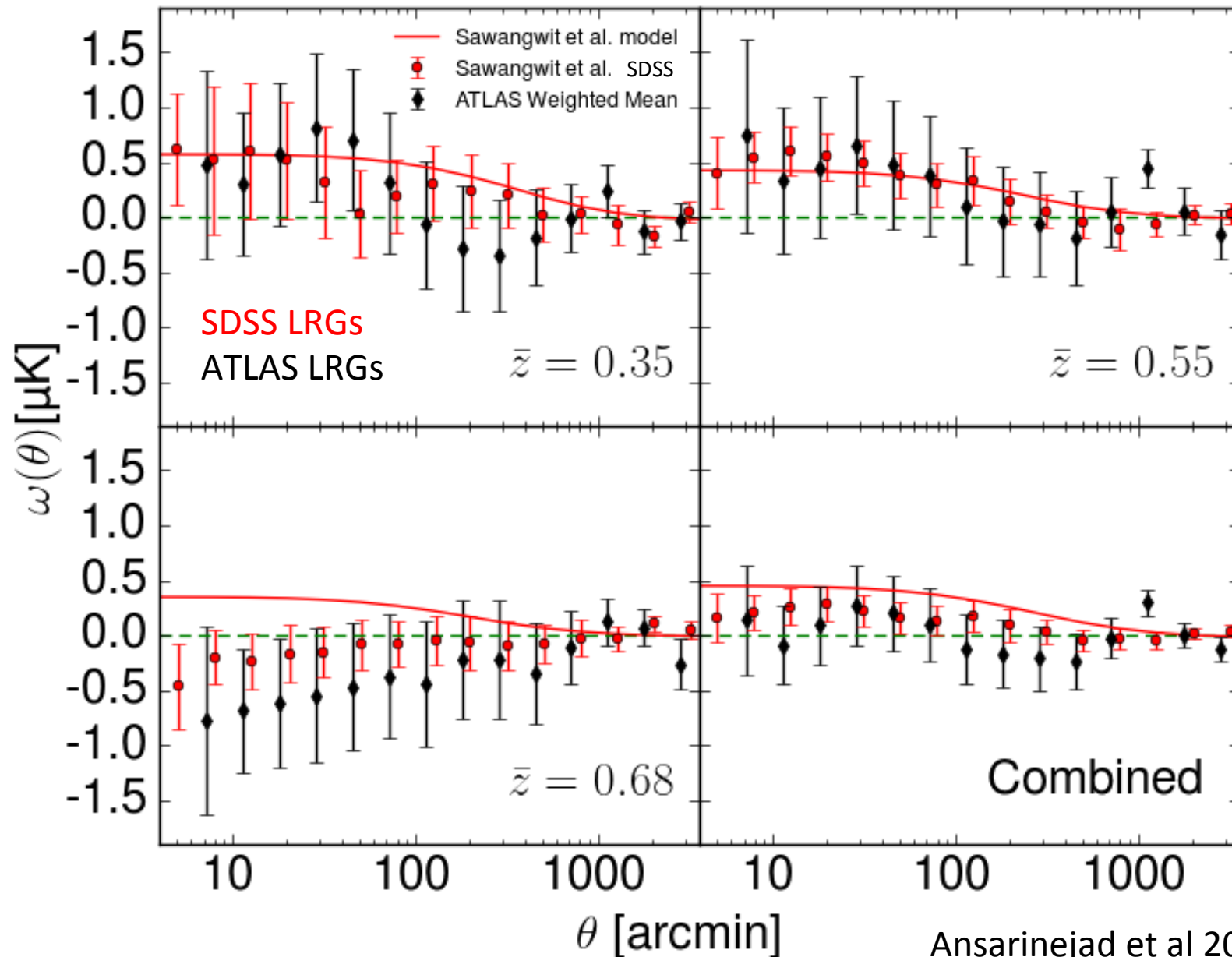


ATLAS Crater 2 (Torrealba et al 2016)

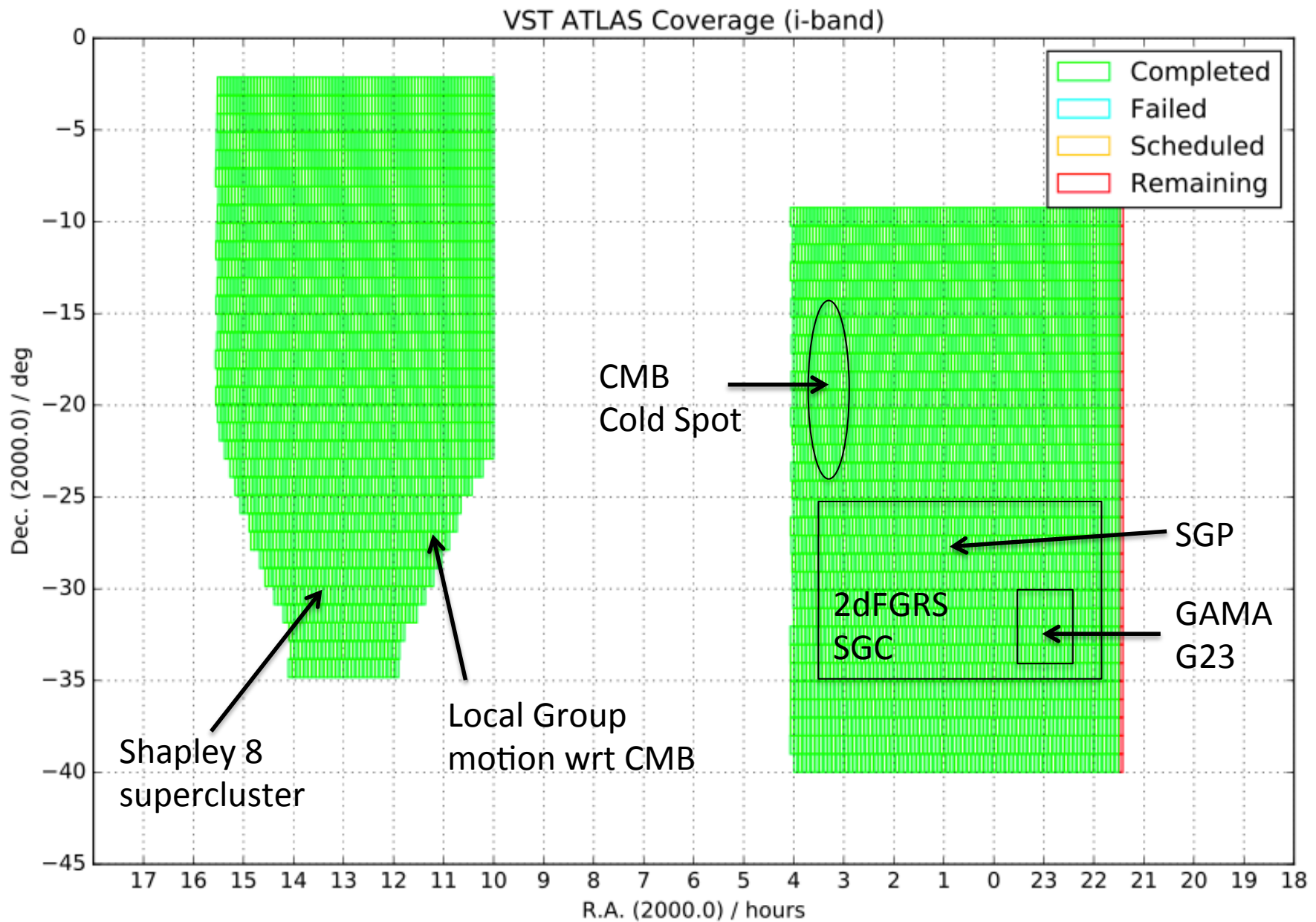
ATLAS detection of ISW effect



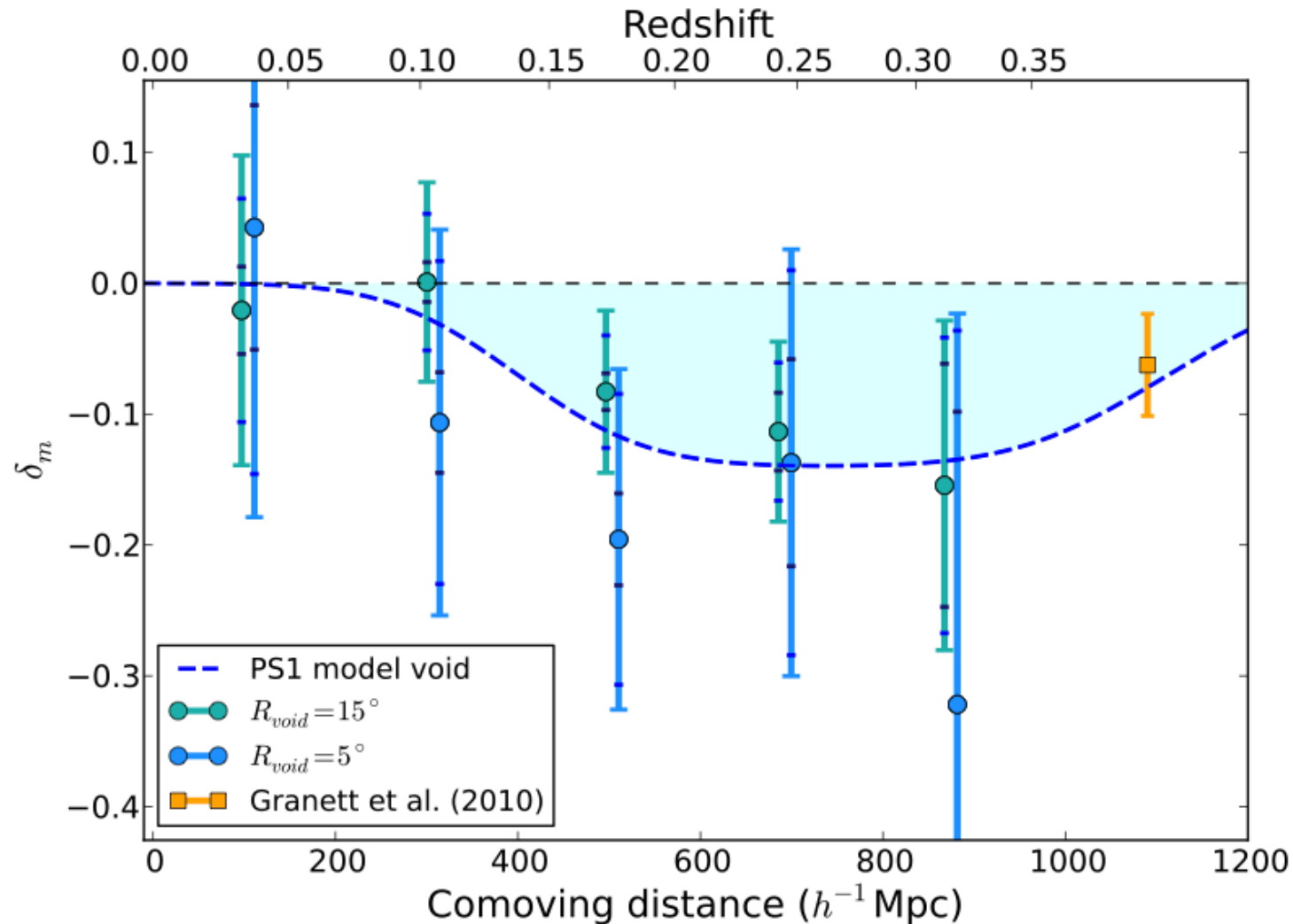
ATLAS vs SDSS ISW effect



ISW+Cold Spot

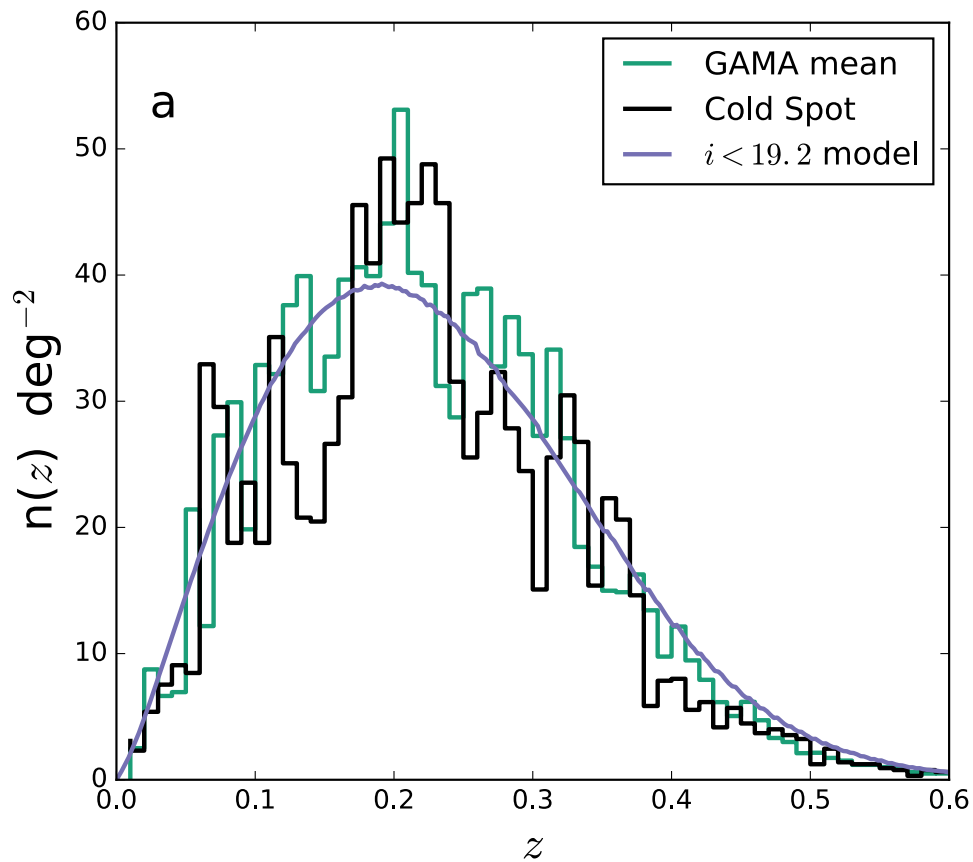


Szapudi+ (2015) PanSTARRS CS “supervoid”

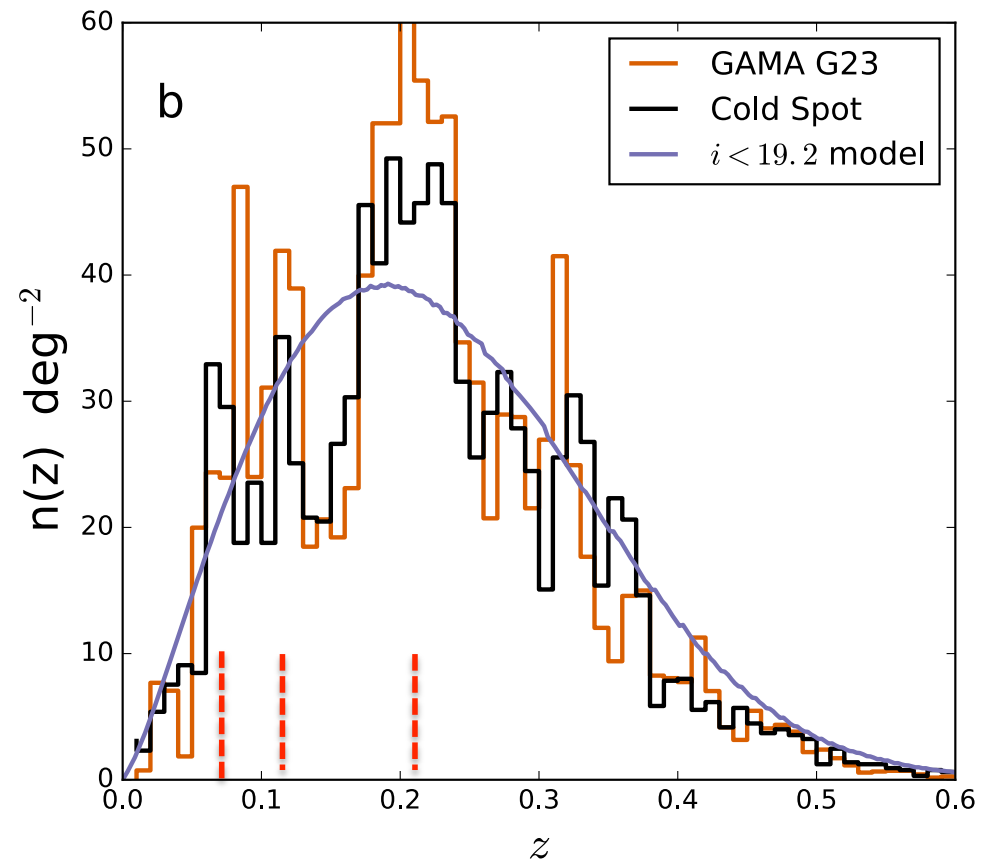


⇒ Significant contribution to Cold Spot from Integrated Sachs-Wolfe (ISW) Effect?

Cold Spot v GAMA G23 $n(z)$



Mackenzie et al (2017) - ATLAS + 2dF CS
~7000 galaxy redshift survey - peak at
 $z \sim 0.2$ - no supervoid!



Striking similarity of galaxy $n(z)$ in Cold Spot
and G23 "control" field! Since no CS in G23
implies voids+ISW may not cause Cold Spot.

Science

Across the universe

Multiverse: have astronomers found evidence of parallel universes?

To many these past 12 months seem as if we have already slipped into a parallel universe but Brexit and Trump are nothing compared to the alternate universes some astronomers are contemplating



8,338 | 721

Stuart Clark

Stuart Clark writes Across the Universe for The Guardian. He is author of The Unknown Universe (Head of Zeus).

@DrStuClark

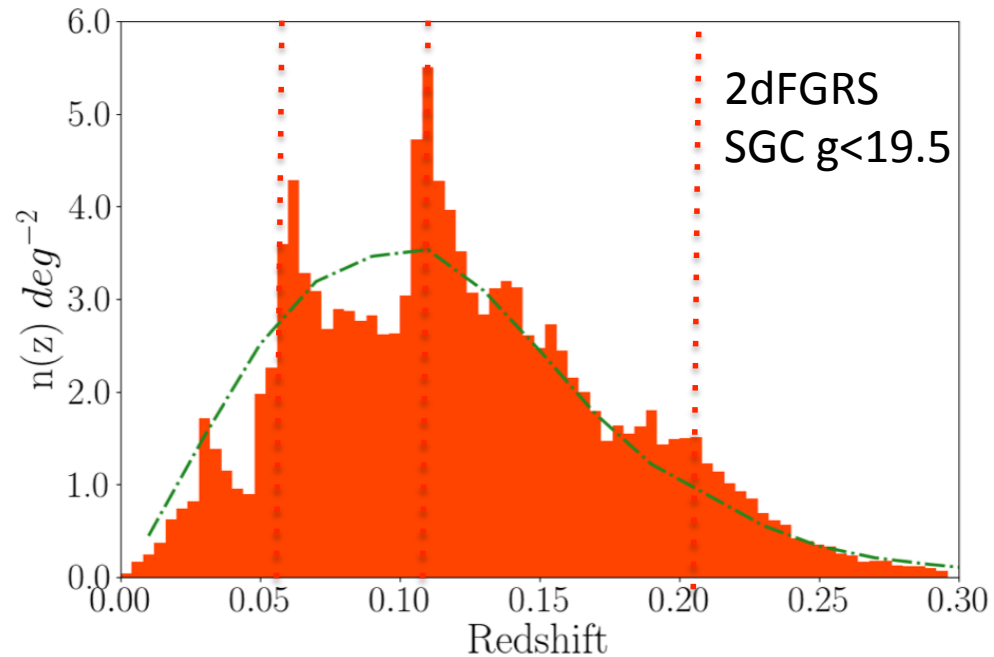
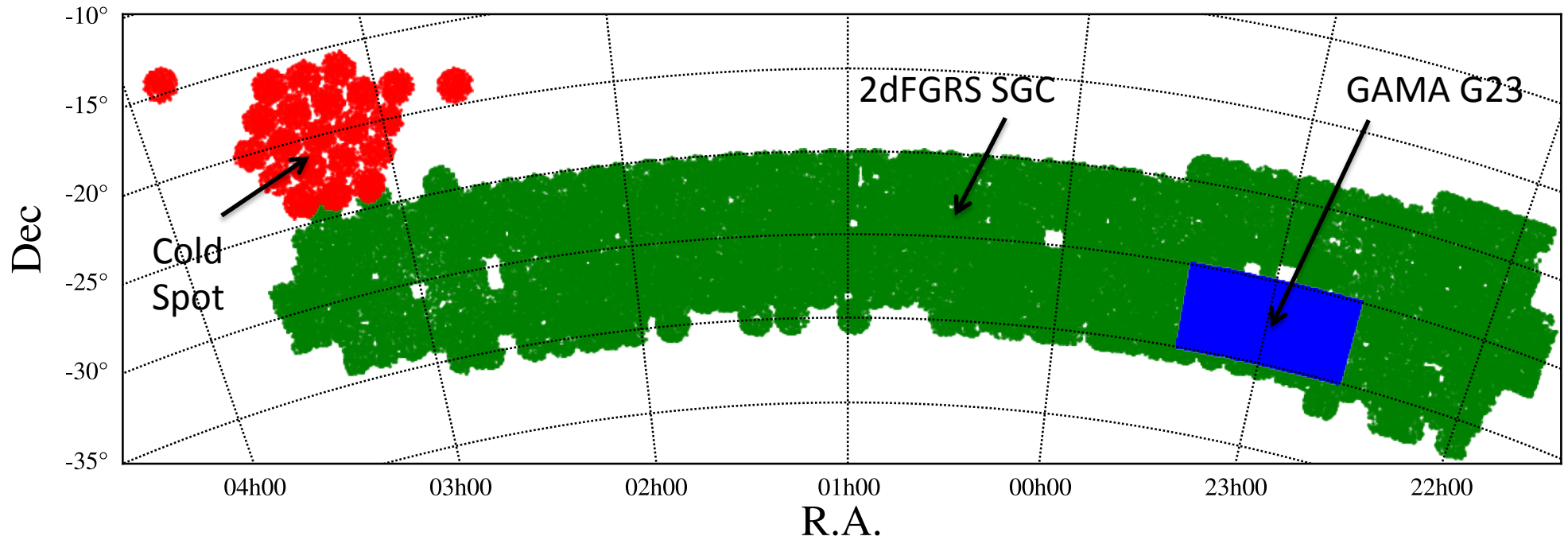
Wednesday 17 May 2017 06.30 BST



Is our Universe just one of many? Photograph: NASA/Alamy Stock Photo

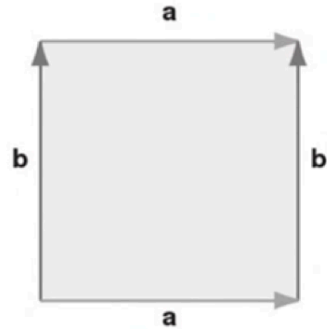
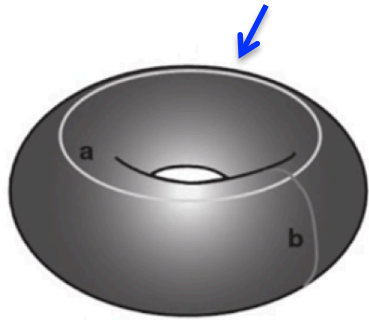
They call it the multiverse. It's a cosmos in which there are multiple universes. And by multiple, I mean an infinite number. These uncountable realms sit side by side in higher dimensions that our senses are incapable of perceiving directly.

LSS coherence across $600h^{-1}$ Mpc of S sky?



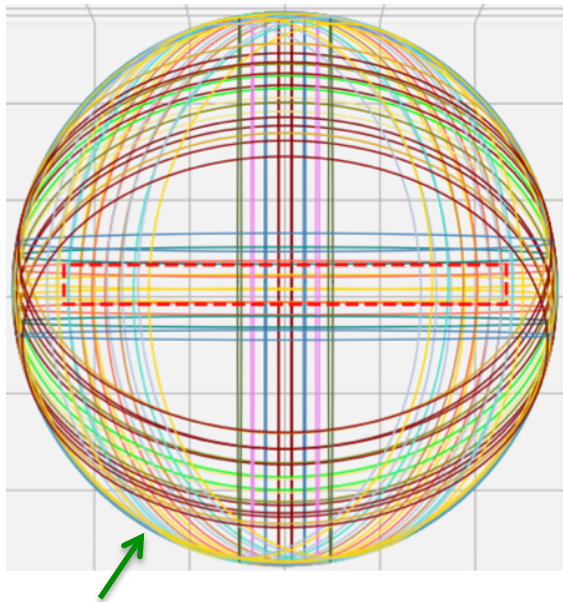
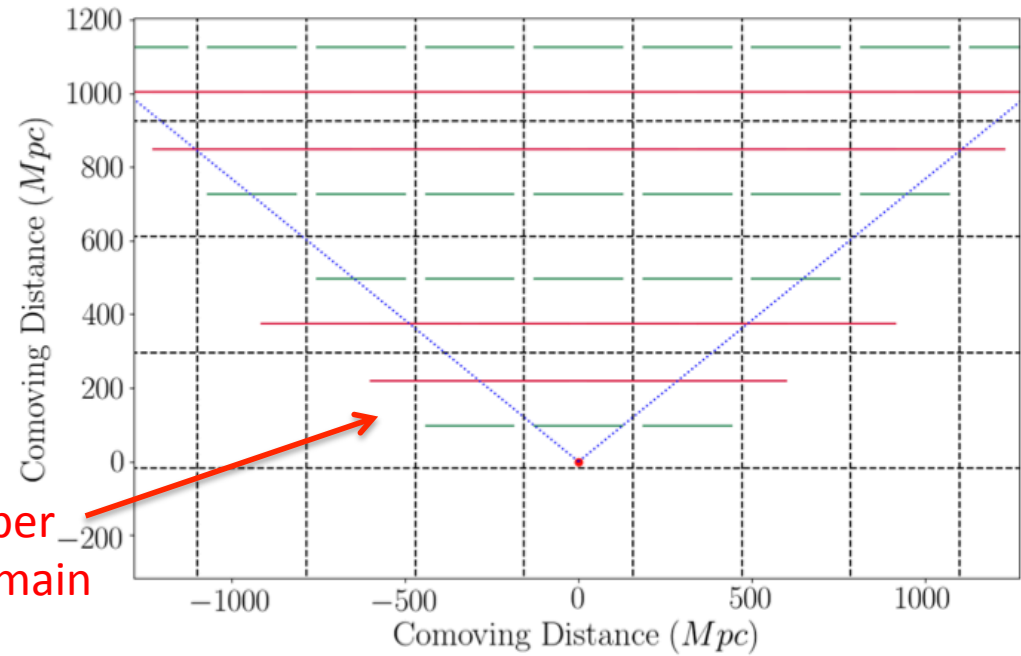
Wraparound Universe vs Multiverse?

Λ CDM Universe may have non-trivial topology eg Flat Torus

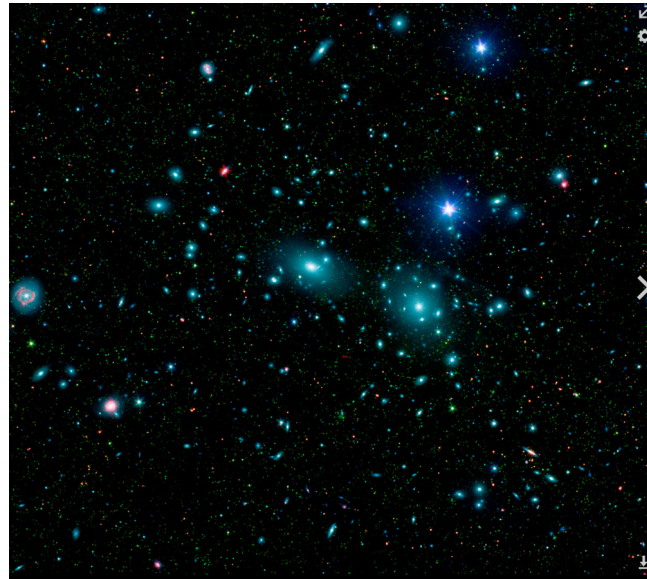


Hogarth et al 2018 in prep

2 filaments per
360 Mpc domain

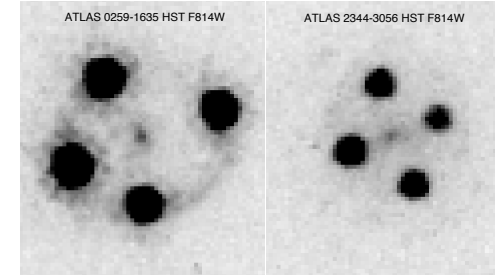
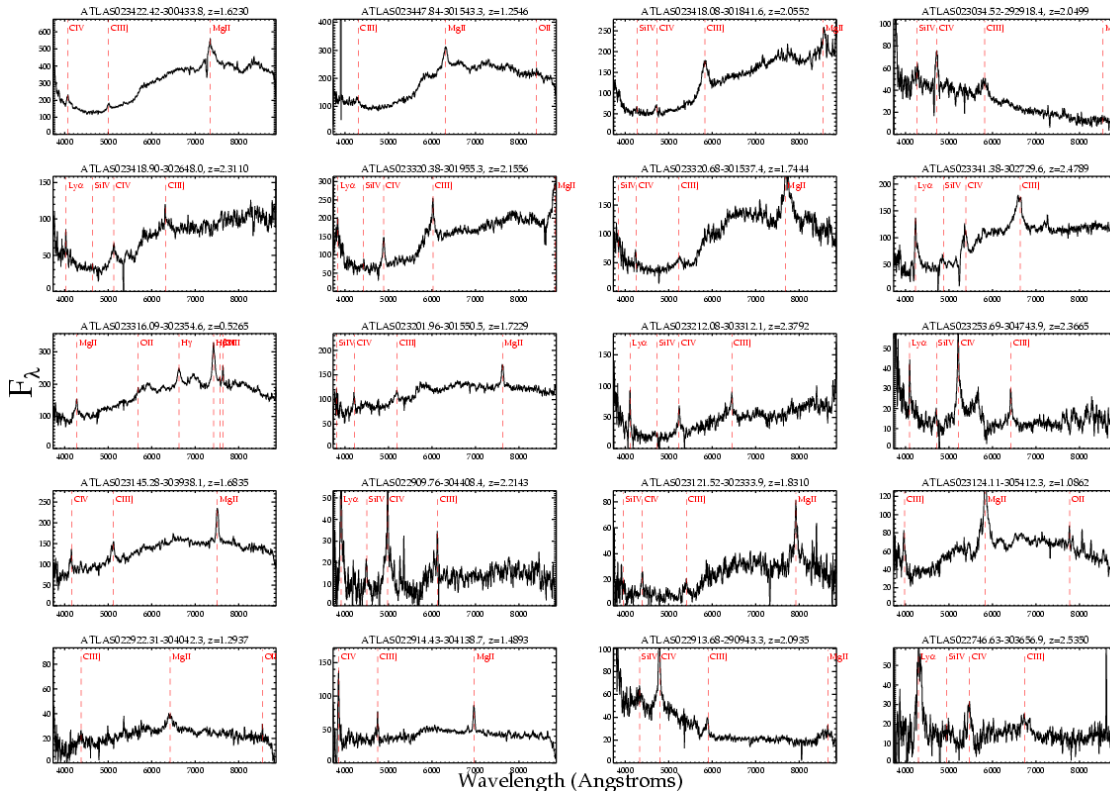


Predicts "Matched Circles"
in CMB - plus Cold Spot?



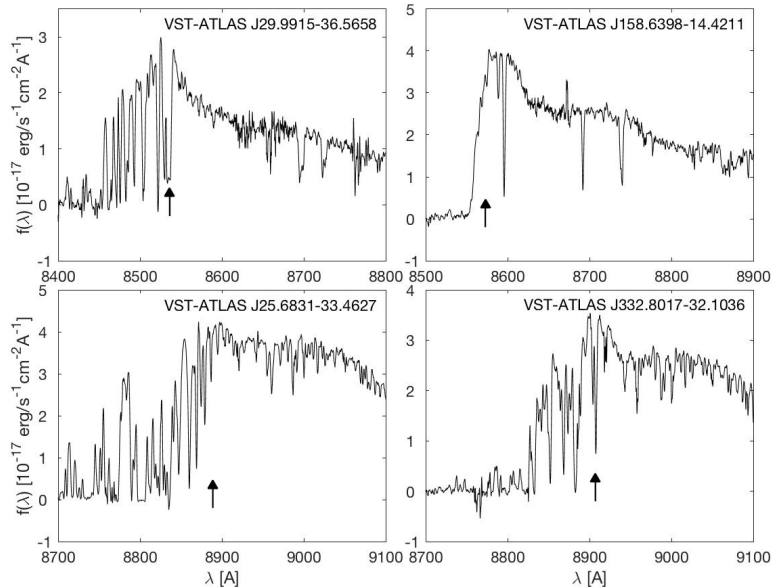
Is Klemola 44 cluster an image of the Coma Cluster?

ATLAS QSO Highlights

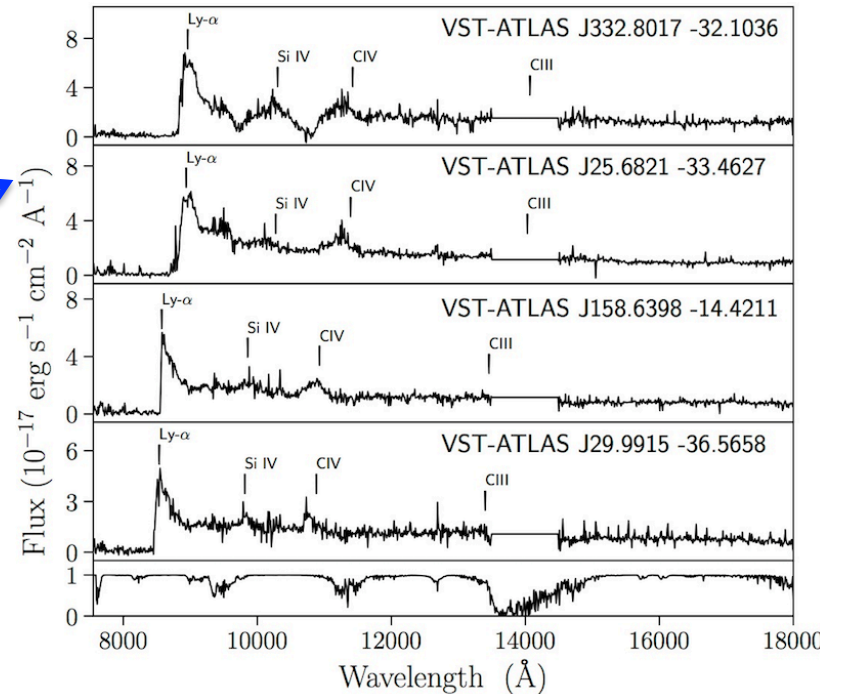


HST WFC3 images of 2 ATLAS quad lenses (Schechter et al 2018)

2QDESp – 2dF z survey of ~10000 $g < 22.5$ ATLAS QSOs



X-shooter spectra of ATLAS $z > 6$ QSOs





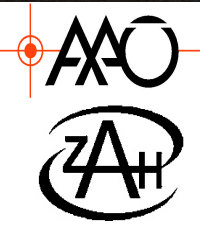
4MOST – 4m Multi-Object Spectroscopic Telescope



eROSITA AGN Report

Andrea Merloni (MPE)

www.4MOST.eu

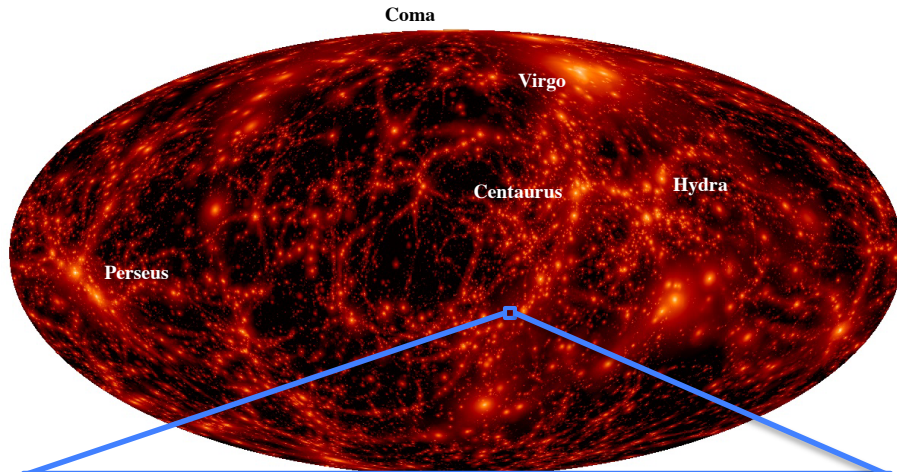




eROSITA: Mapping the hot cosmic web

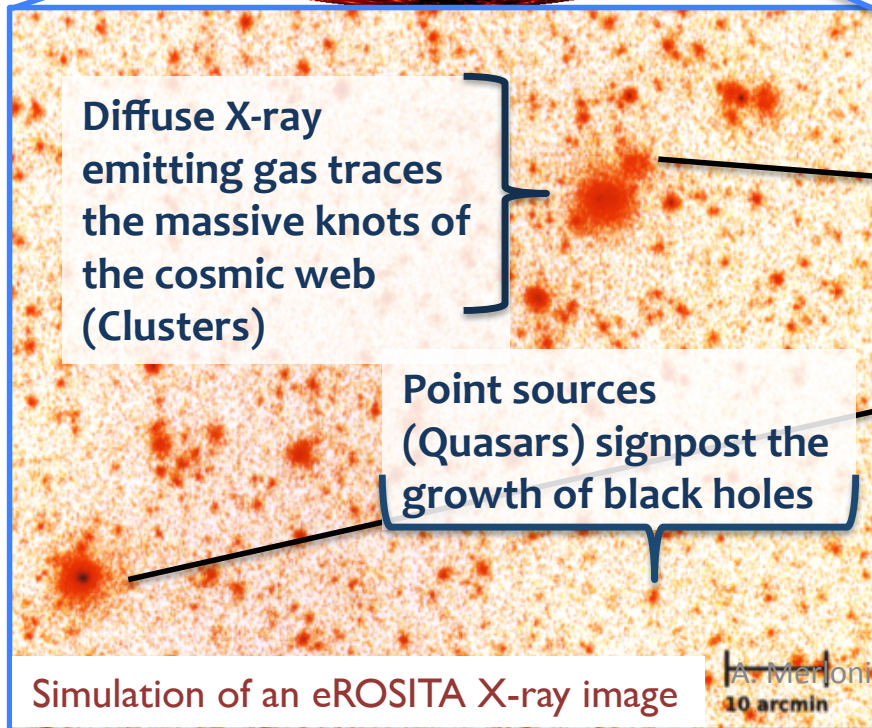


All-sky X-ray survey (ROSAT, eROSITA)



eROSITA (*) will study Dark Energy by detecting diffuse emission from the hot gas in the largest structures of the Universe (Clusters). Further, eROSITA will yield a full census of millions of growing black holes (Quasars).

4MOST will measure redshift of up to 1M X-ray selected AGN and ~50k Clusters from eROSITA.

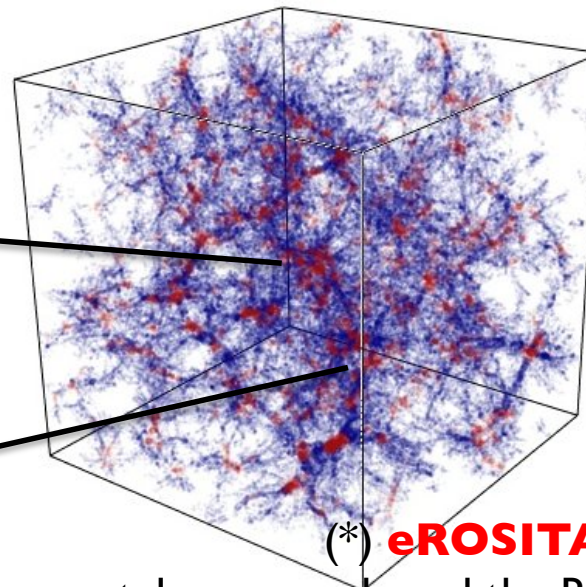


Diffuse X-ray emitting gas traces the massive knots of the cosmic web (Clusters)

Point sources (Quasars) signpost the growth of black holes

Simulation of an eROSITA X-ray image

A. Merloni - eROSITA - AHM 9/2017
10 arcmin



Optical surveys (SDSS-IV&V 4MOST)

(*) **eROSITA** is a German X-ray telescope onboard the Russian SRG satellite. It will perform a revolutionary all-sky survey in X-rays, starting in 2019

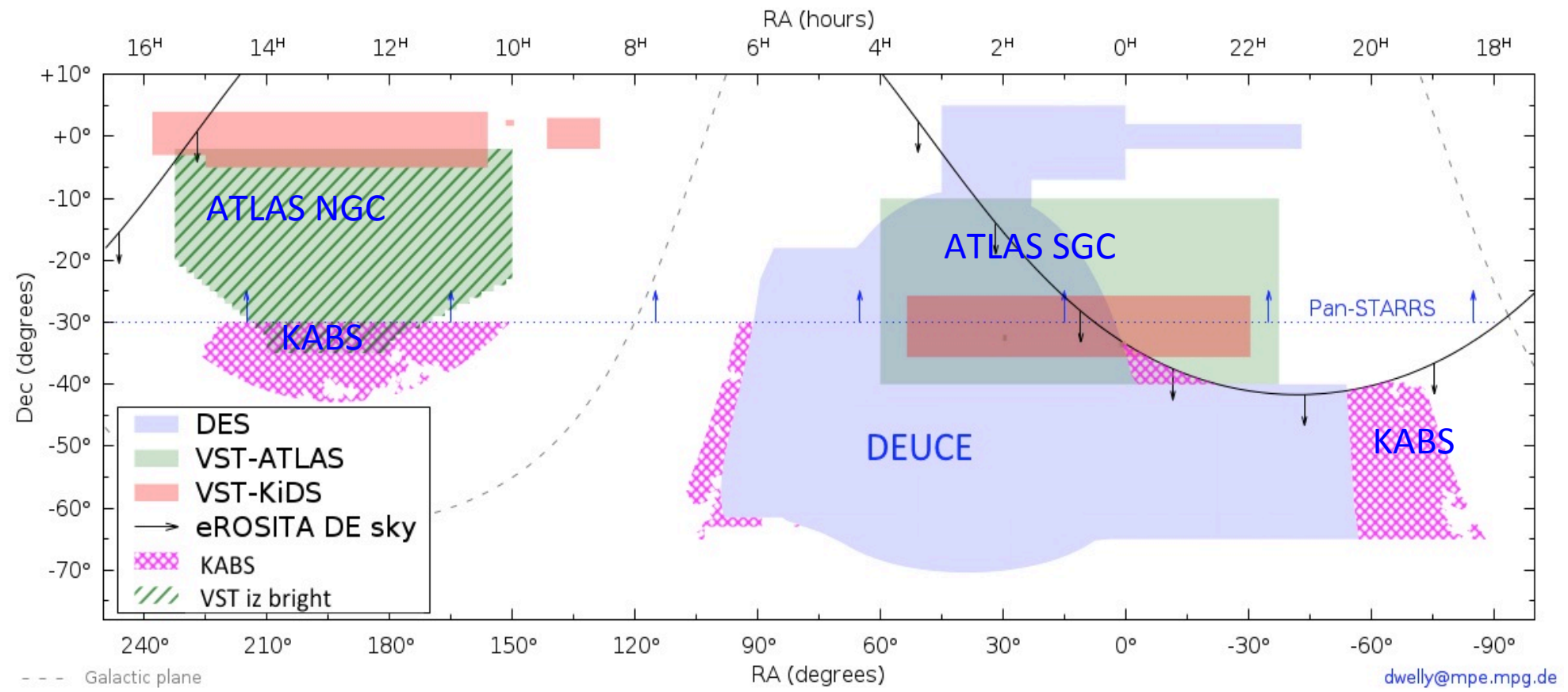
eROSITA+ATLAS UVX 4MOST QSO survey

- QSO correln fn error $\Delta\xi \propto 1/\text{sky density}$
- So increase eROSITA $\sim 60 \text{ deg}^{-2}$ X-ray QSO sky density to 130 deg^{-2} by UVX selection via ATLAS + Chilean u extension
- eBOSS 2% BAO error from 7500 deg^2 @ 65 deg^{-2}

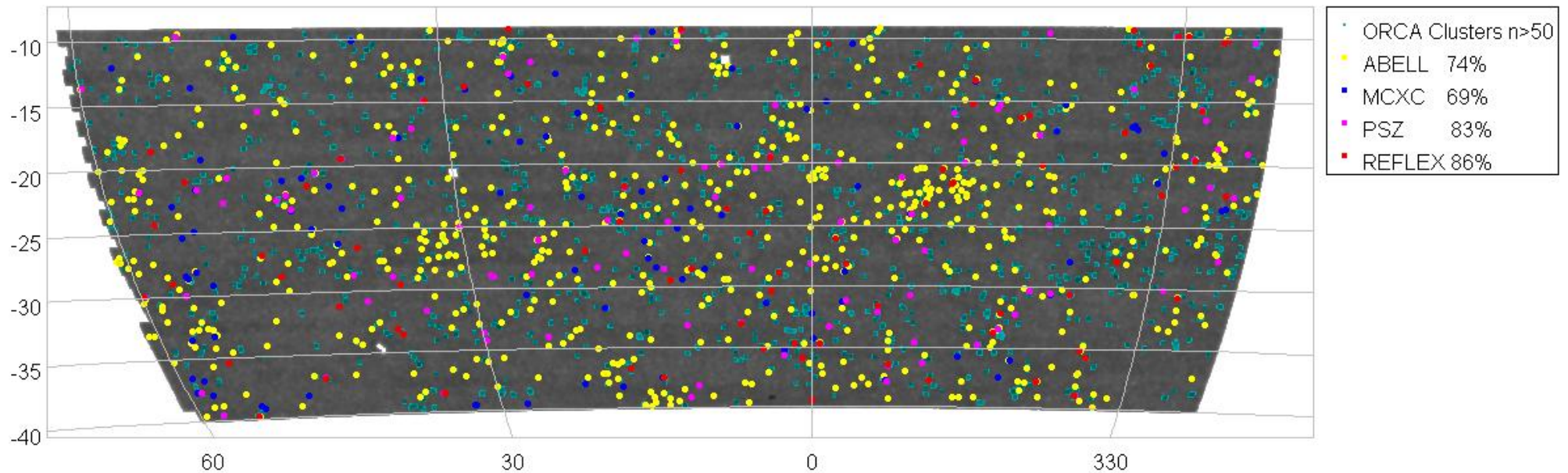
Quasar sky density is $\sim 130 \text{ deg}^{-2}$ at $g < 22.5$

eROSITA+ATLAS+WISE+4MOST \rightarrow
1% BAO error from 7500 deg^2 @ 130 deg^{-2}

ATLAS extensions - see F Barrientos' talk



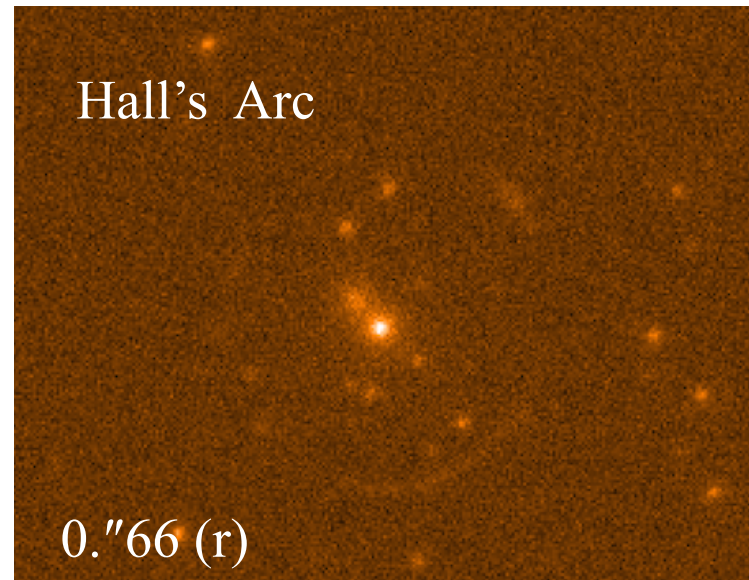
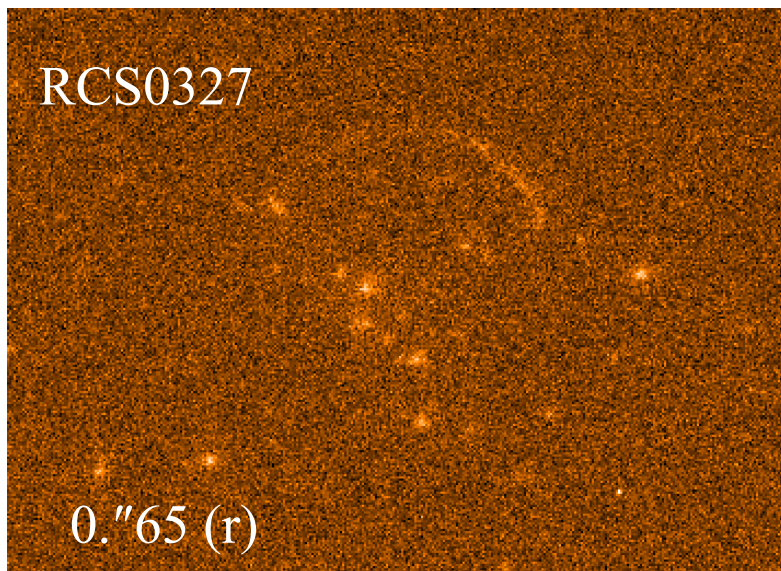
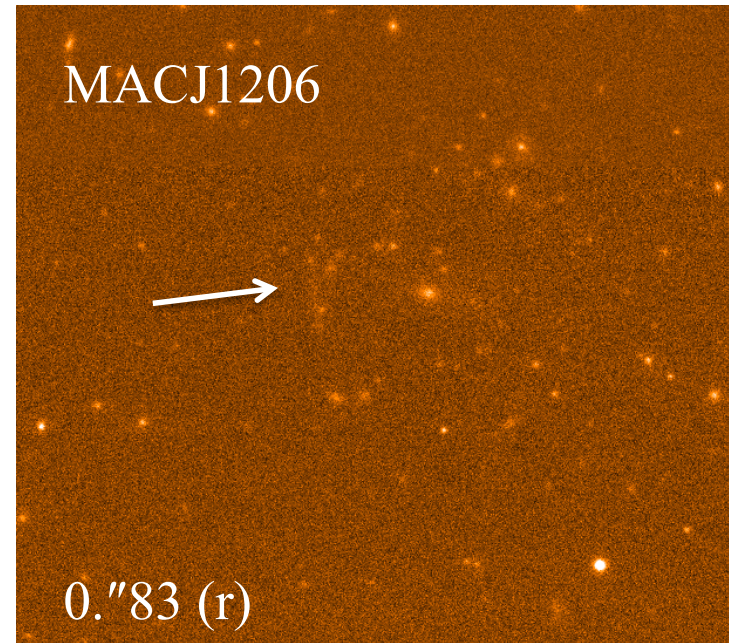
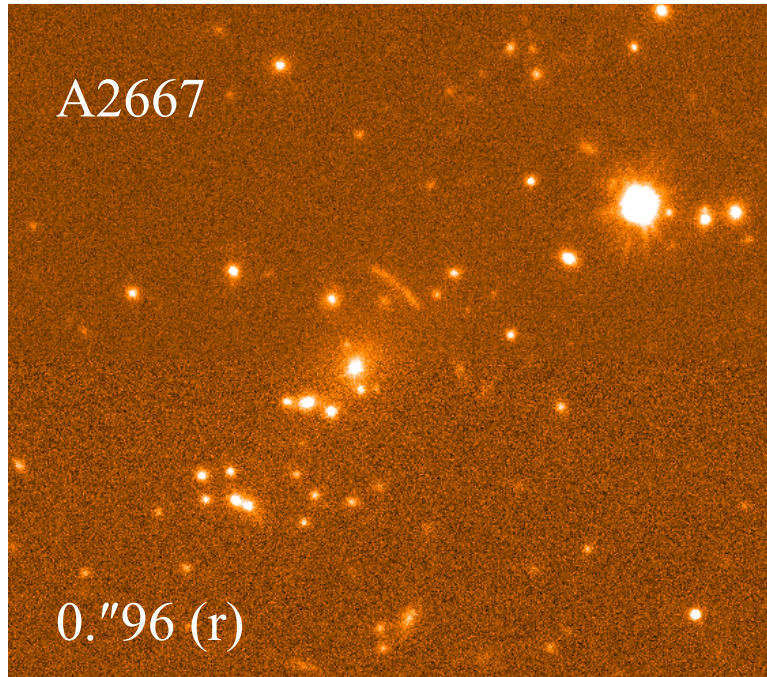
VST ATLAS+VHS+WISE Galaxy Clusters



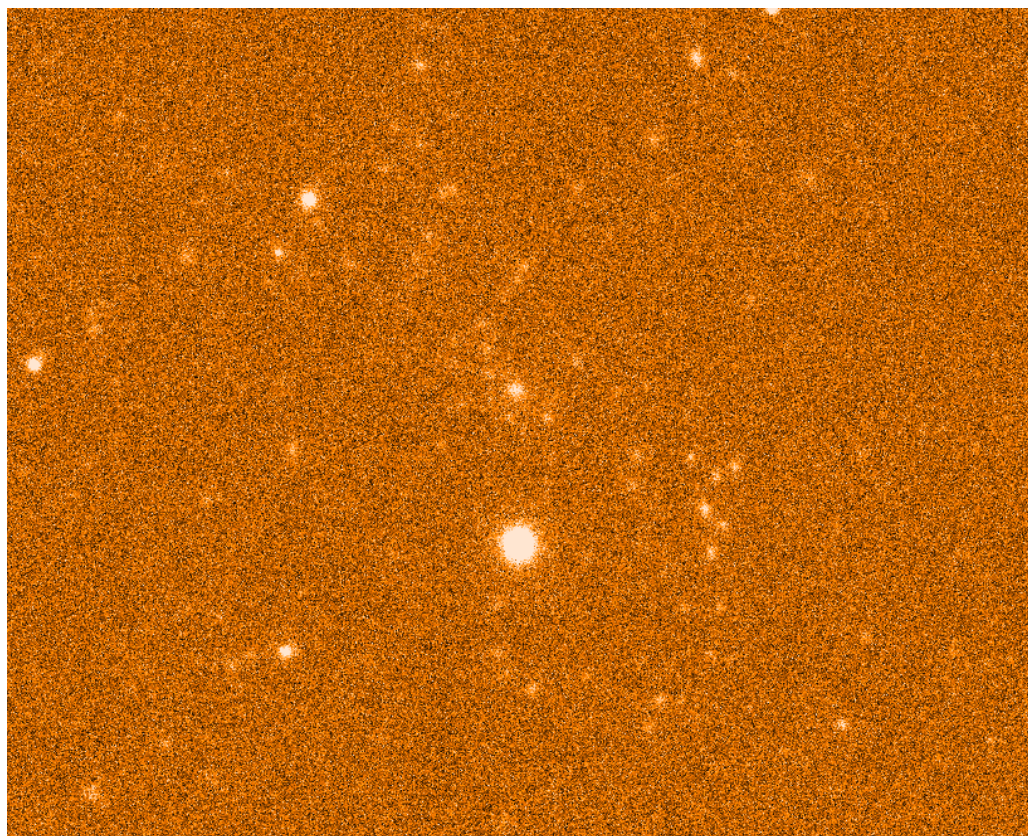
VST ATLAS SGC Clusters ($r<21.5$) with $n>50$ members (detects 74% of Abell Clusters)

- VST ATLAS coverage of 4700deg^2 in $ugriz + VISTA YJK + WISE W1, W2$
- Overdense Red-sequence Cluster Algorithm (ORCA: Murphy, Geach + Bower (2011))
- RedSeq + Voronoi tessellation + FoF \rightarrow ATLAS Galaxy Clusters Catalogue
- + QSO survey \rightarrow weak lensing via magnification bias
- $\sim 0.9''$ seeing also allows strong lensing surveys
- + Follow-up of **eROSITA X-ray clusters** to $z \sim 0.7$

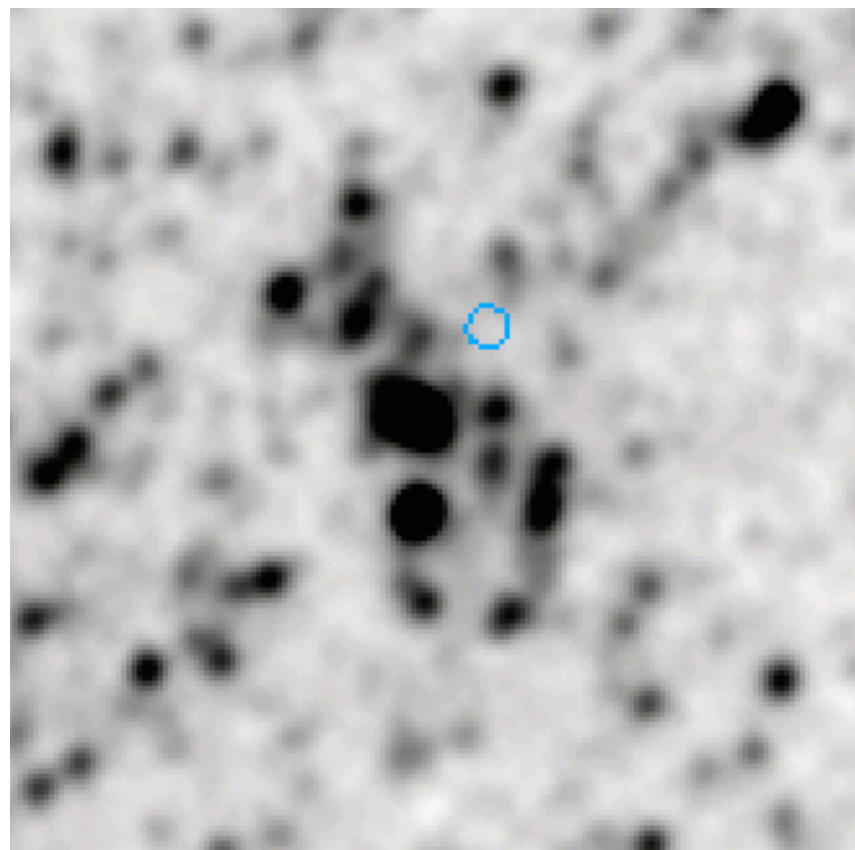
ATLAS Arc Gallery



Planck SZ cluster at $z=0.72$



ATLAS i band



WISE W1

Summary: ATLAS highlights+future projects

1) ATLAS highlights

- Dwarf Galaxies
- ISW + Cold Spot \Rightarrow Multiverse?
- LSS coherence across SGP? \Rightarrow Wraparound Universe?
- Quasar survey
 - QSO clustering
 - High-z qsos + quad lensing

2) ATLAS Future Projects

- 4MOST/eROSITA quasar cosmology
- 4MOST/eROSITA galaxy cluster cosmology