4HS:

THE 4MOST HEMISPHERE SURVEY

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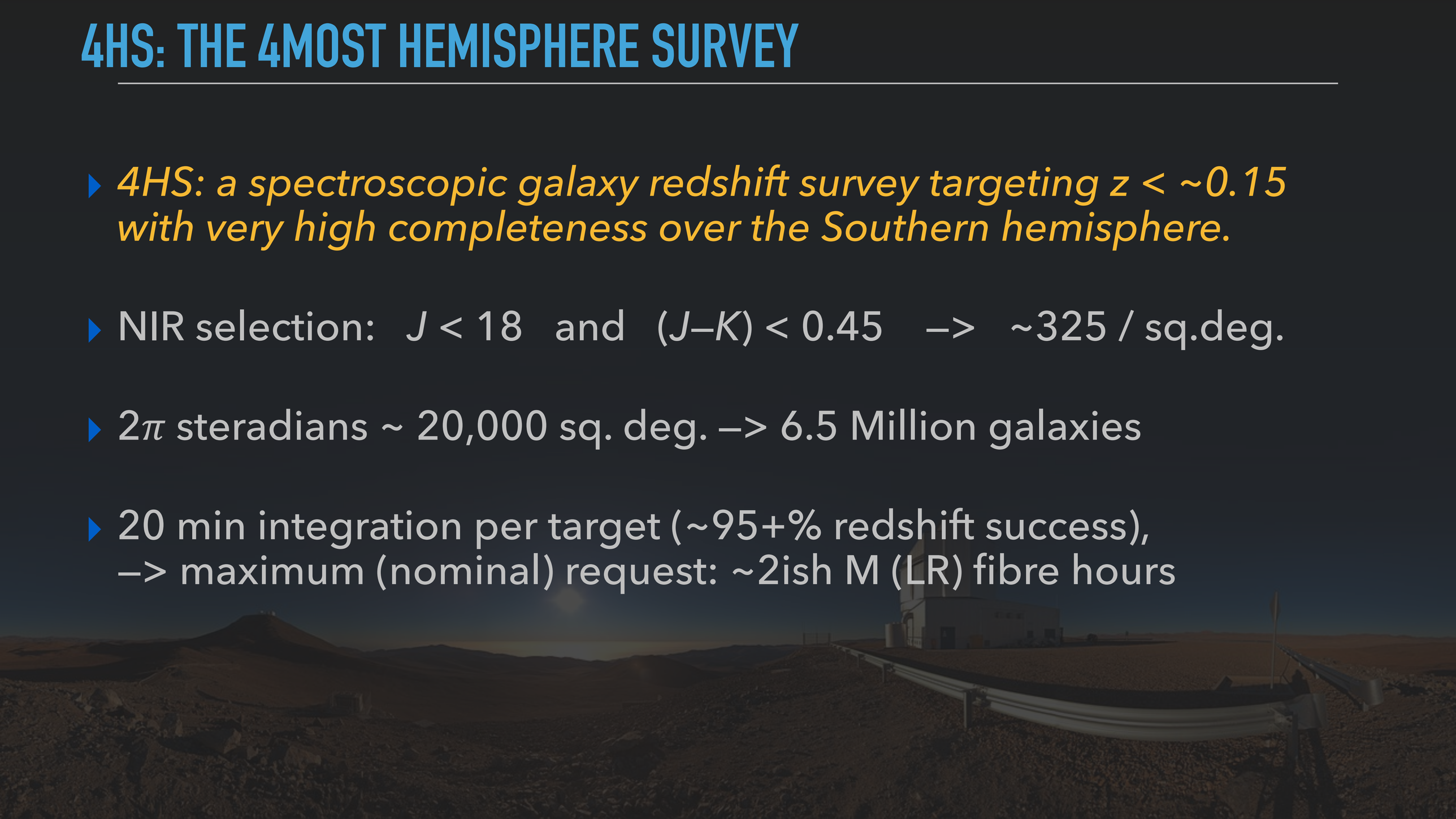
4HS: THE 4MOST HEMISPHERE SURVEY

As a spectroscopic redshift survey targeting $z < 0.15$ galaxies with very high completeness over ~20 000 deg^2, 4HS will:

- establish the local benchmark sample for studies of galaxy demographics in the VRO/Euclid/SKA era.
- establish a transformational laboratory to study the baryon cycle in and around galaxies, as a function of mass and environment.
- map cosmological mass and motion to measure the growth of structure and test gravity over the largest possible scales.

4HS: THE 4MOST HEMISPHERE SURVEY

- *4HS: a spectroscopic galaxy redshift survey targeting z < ~0.15 with very high completeness over the Southern hemisphere.*
- NIR selection: $J < 18$ and $(J–K) < 0.45$ –> ~325 / sq.deg.
- 2π steradians ~ 20,000 sq. deg. –> 6.5 Million galaxies
- 20 min integration per target (~95+% redshift success), –> maximum (nominal) request: ~2ish M (LR) fibre hours



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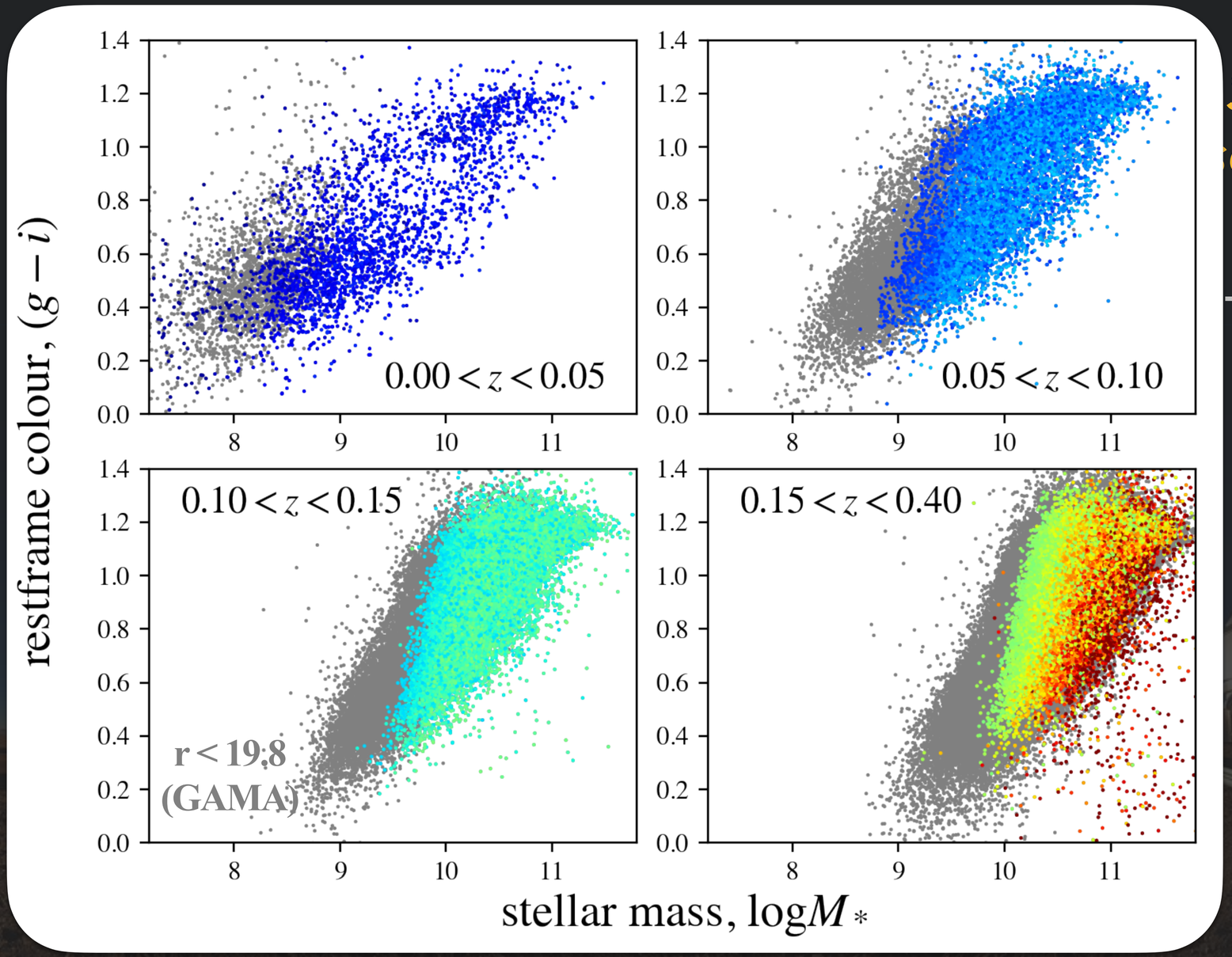
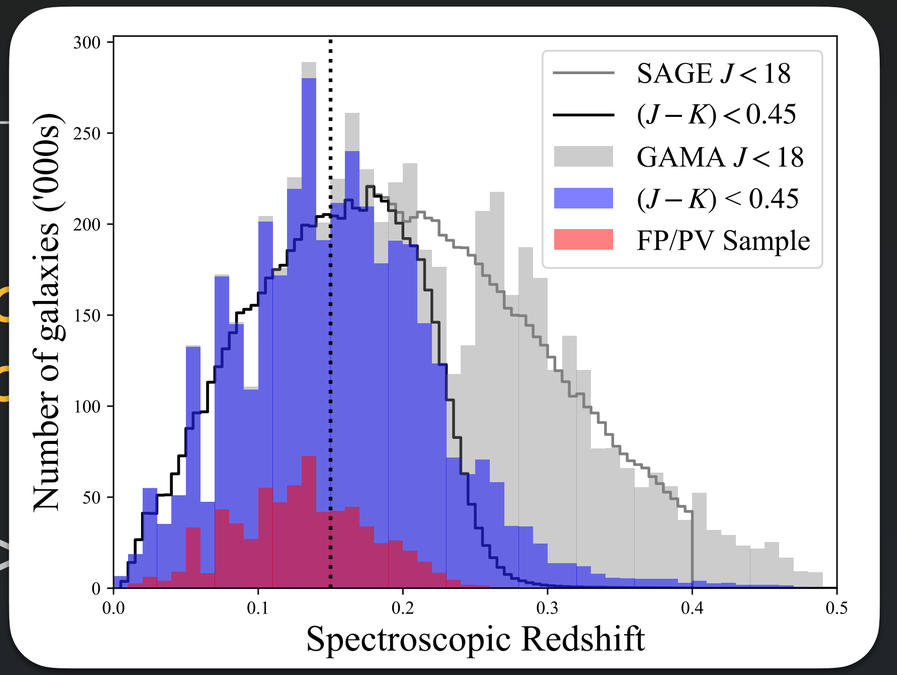
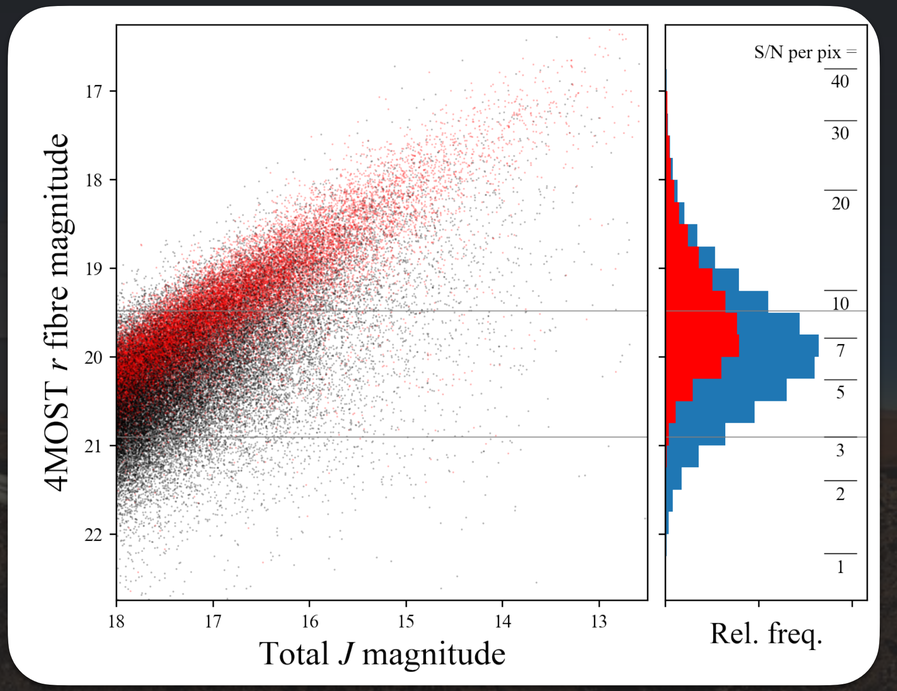
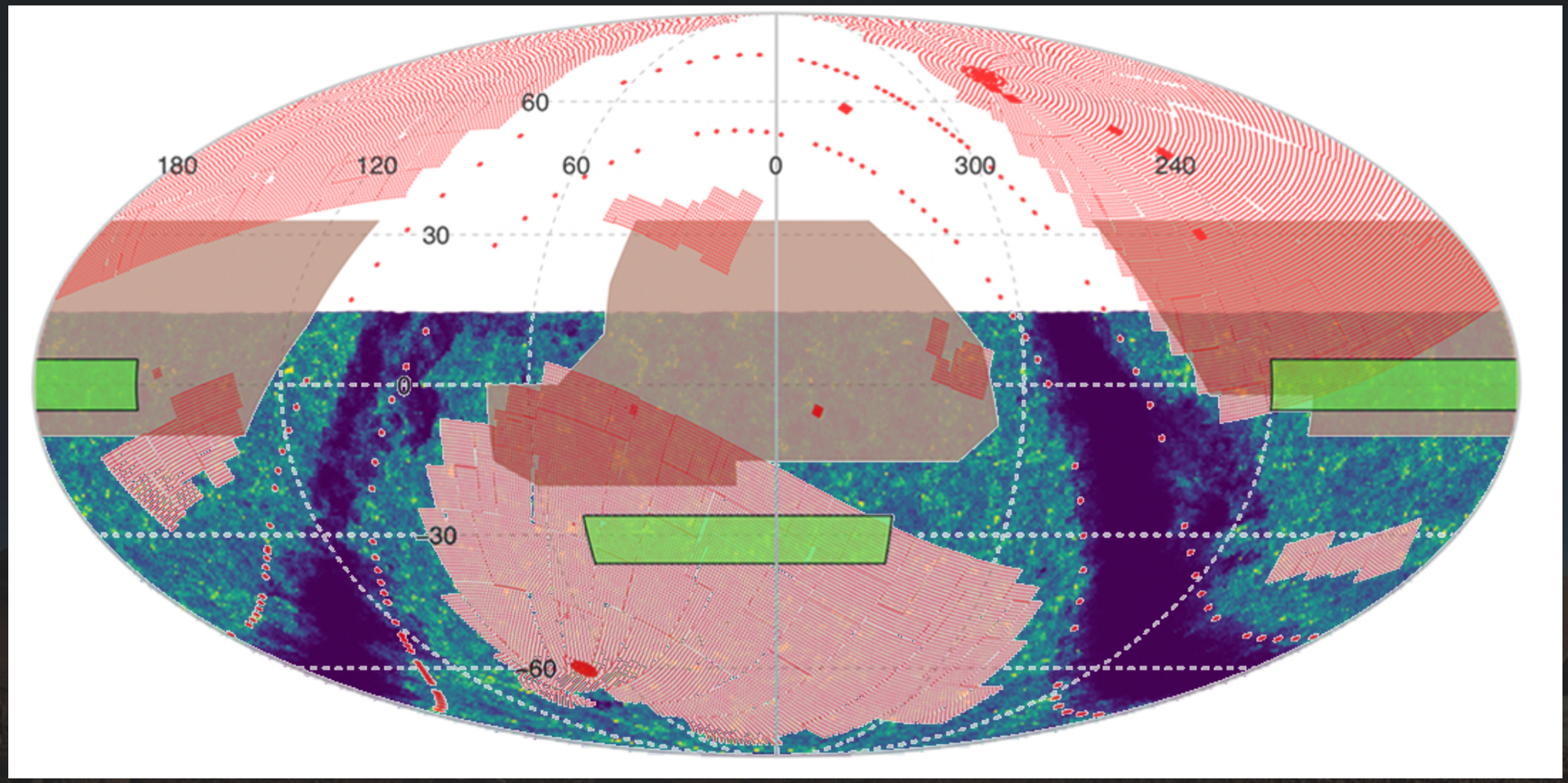






4HS: THE 4MOST HEMISPHERE SURVEY

- *4HS: a spectroscopic galaxy redshift survey targeting z < ~0.15 with very high completeness over the Southern hemisphere.*



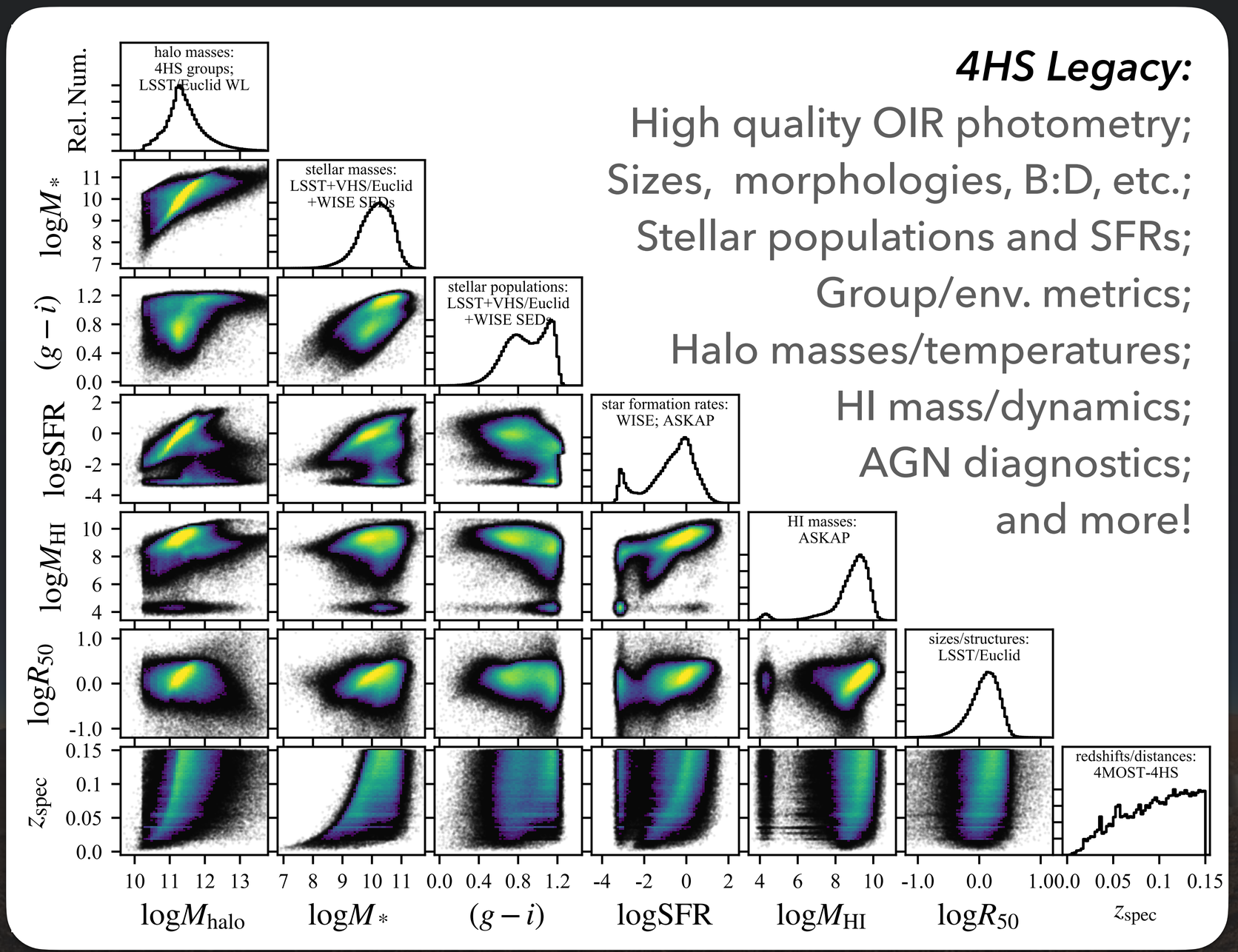
4HS: THE 4MOST HEMISPHERE SURVEY

THE LOCAL BENCHMARK FOR PANCHROMATIC STUDIES OF GALAXY FORMATION AND EVOLUTION IN THE VRO/EUCLID/SKA ERA.

- ***4HS spectra:*** redshifts; group/env. metrics, halo masses
- ***LSST:*** stellar masses and pops, sizes, morphologies, lensing
- ***VHS –> Euclid:*** stellar masses, sizes, morphology, lensing
- ***WISE:*** stellar masses, star formation, AGN diagnostics
- ***ASKAP –> SKA 21cm:*** integrated, resolved, and intragroup HI
- ***ASKAP –> SKA continuum:*** star formation, AGN power
- ***eRosita Xray:*** AGN, intragroup filaments, hot cluster gas

4HS: THE LOCAL BENCHMARK FOR GALAXY DEMOGRAPHICS

- *4HS spectra*
- *LSST*
- *VHS –> Euclid*
- *WISE*
- *SKA 21cm*
- *SKA continuum*
- *eRosita Xray*



4HS Legacy:

High quality OIR photometry;
Sizes, morphologies, B:D, etc.;
Stellar populations and SFRs;
Group/env. metrics;
Halo masses/temperatures;
HI mass/dynamics;
AGN diagnostics;
and more!

4HS: THE 4MOST HEMISPHERE SURVEY

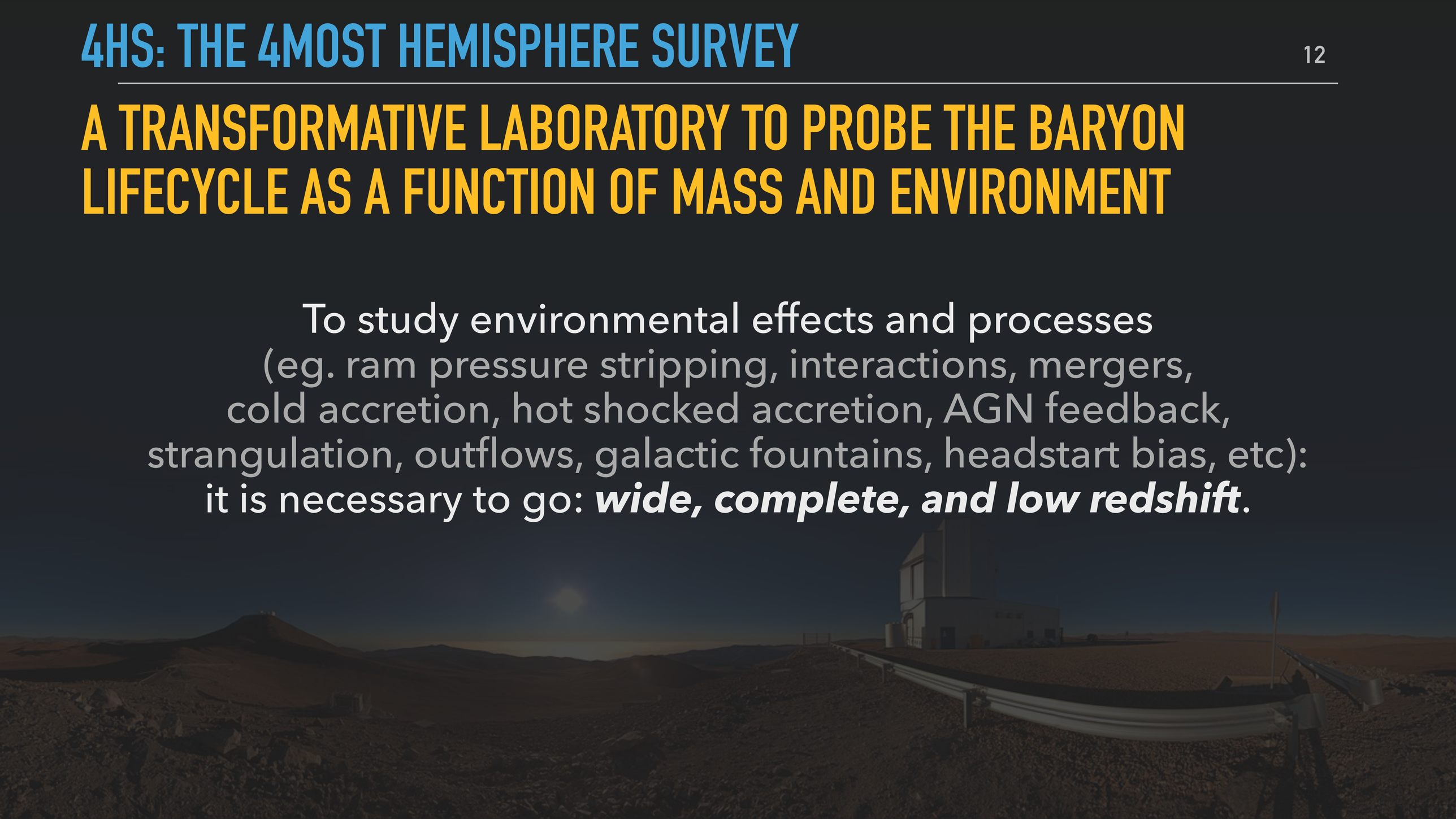
A CRUCIAL COMPLEMENT TO SKA SURVEY SCIENCE

- HI surveys need redshifts, too! Group finding and halo masses …
- … and stacking, obviously; but at least as valuable is …
- … targeted HI mass measurements of marginal detections: loads and loads of 1–10σ measurements (cf. 10+ σ detections).
- Resolved galaxy and intragroup HI science with ASKAP –> SKA is the next frontier (after SAMI, Hector, MaNGa, SDSS-V, etc).
- ***This is all best done at z < 0.15, where RFI is not so horrendous.***

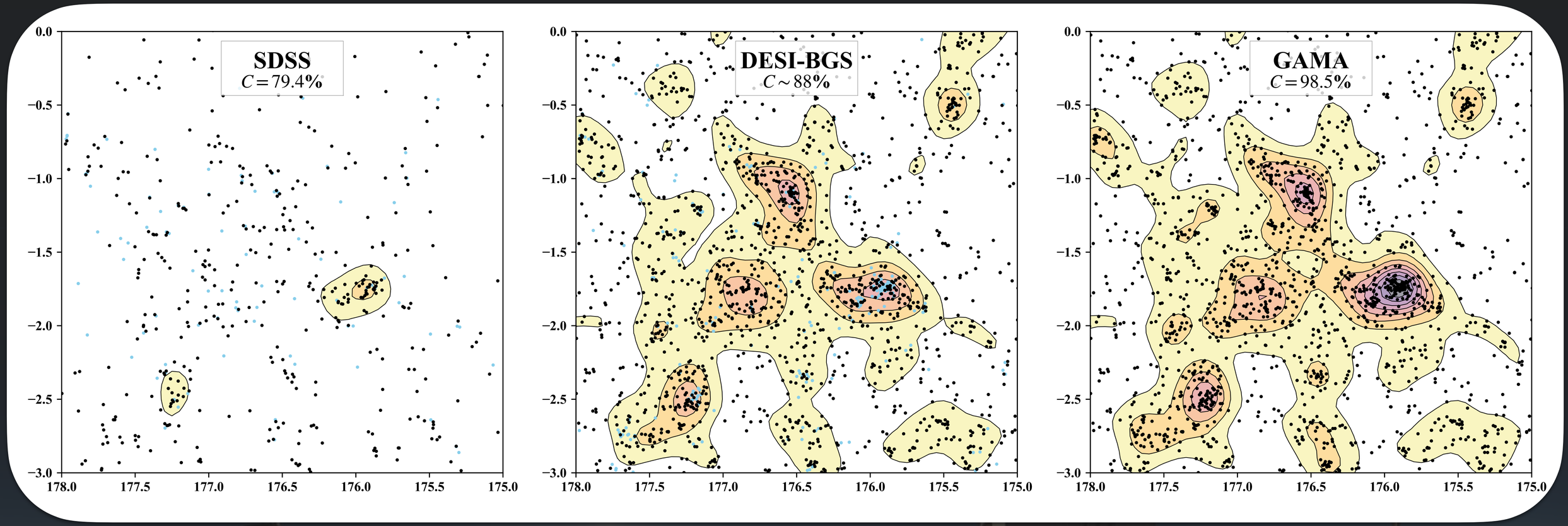
4HS: THE 4MOST HEMISPHERE SURVEY

A TRANSFORMATIVE LABORATORY TO PROBE THE BARYON LIFECYCLE AS A FUNCTION OF MASS AND ENVIRONMENT

To study environmental effects and processes
(eg. ram pressure stripping, interactions, mergers,
cold accretion, hot shocked accretion, AGN feedback,
strangulation, outflows, galactic fountains, headstart bias, etc):
it is necessary to go: ***wide, complete, and low redshift***.



THE VALUE OF HIGH AND UNBIASED REDSHIFT COMPLETENESS

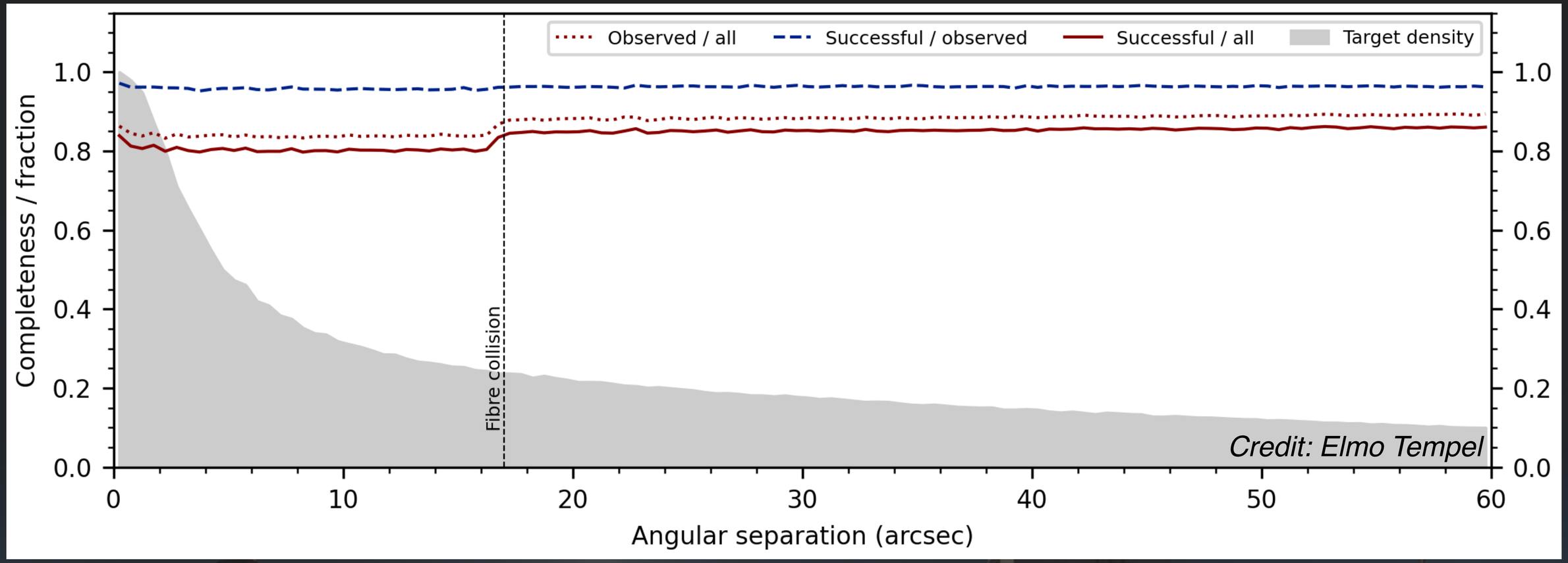


Can (mostly?) distinguish satellites vs. centrals.

Can identify structures as clusters/groups/filaments.

Can quantify structures, and situate galaxies within them.

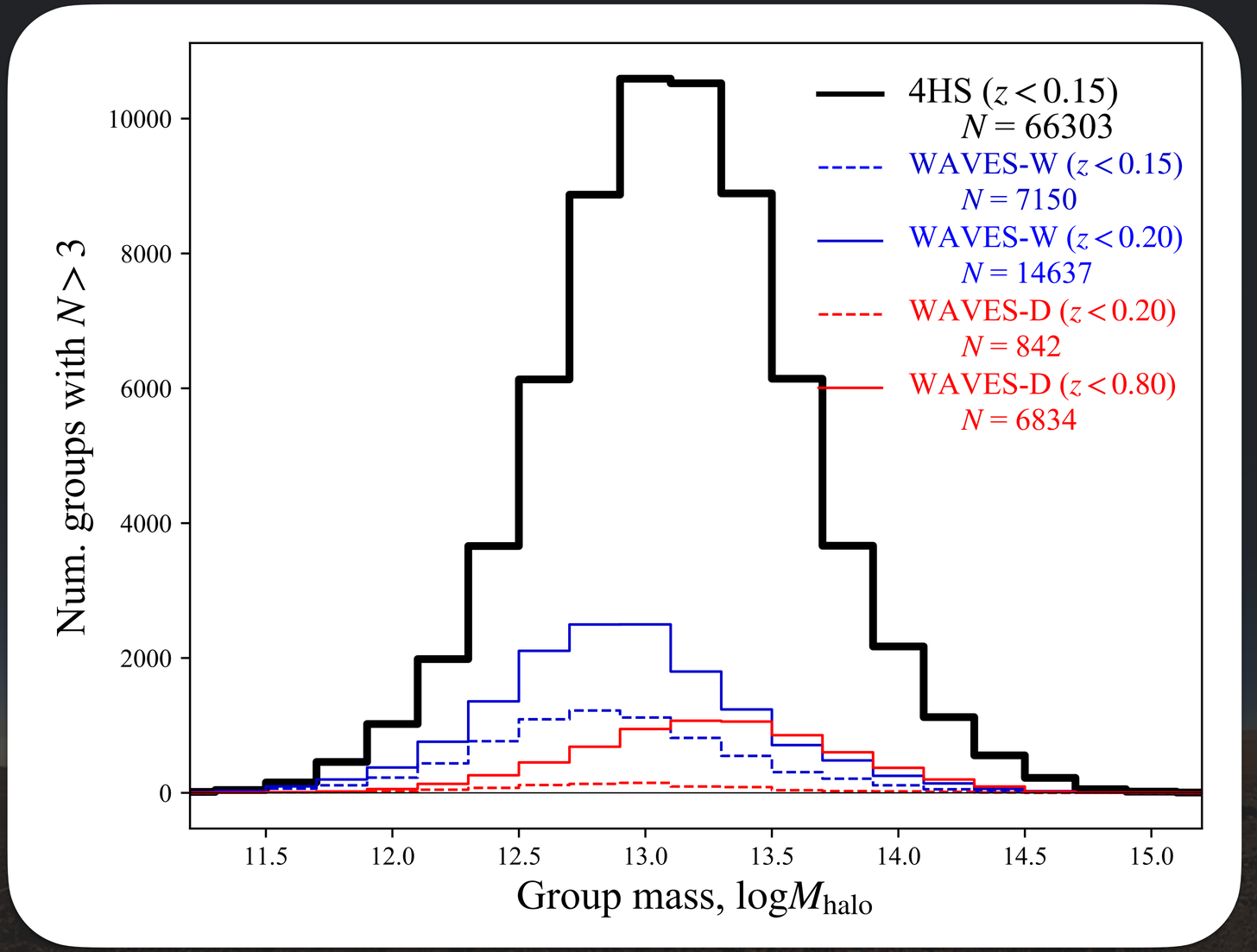
HIGH AND UNBIASED REDSHIFT COMPLETENESS IS ACHEIVABLE



- > ~90 % comp. with minimal bias as a function of pair separation; small dip (to 85%) for separations < 20'' – *DESI cannot do this.*

ENVIRONMENTAL EFFECTS THROUGH OVERWHELMING STATISTICS

- A powerful complement to WAVES-Wide/Deep.
- Can probe environment as a function of: centrals vs satellites (meh), local density, halo mass, group/cluster radius, void vs filament vs node, new ideas?
- x5 numbers means able to probe an extra dimension vs WAVES.



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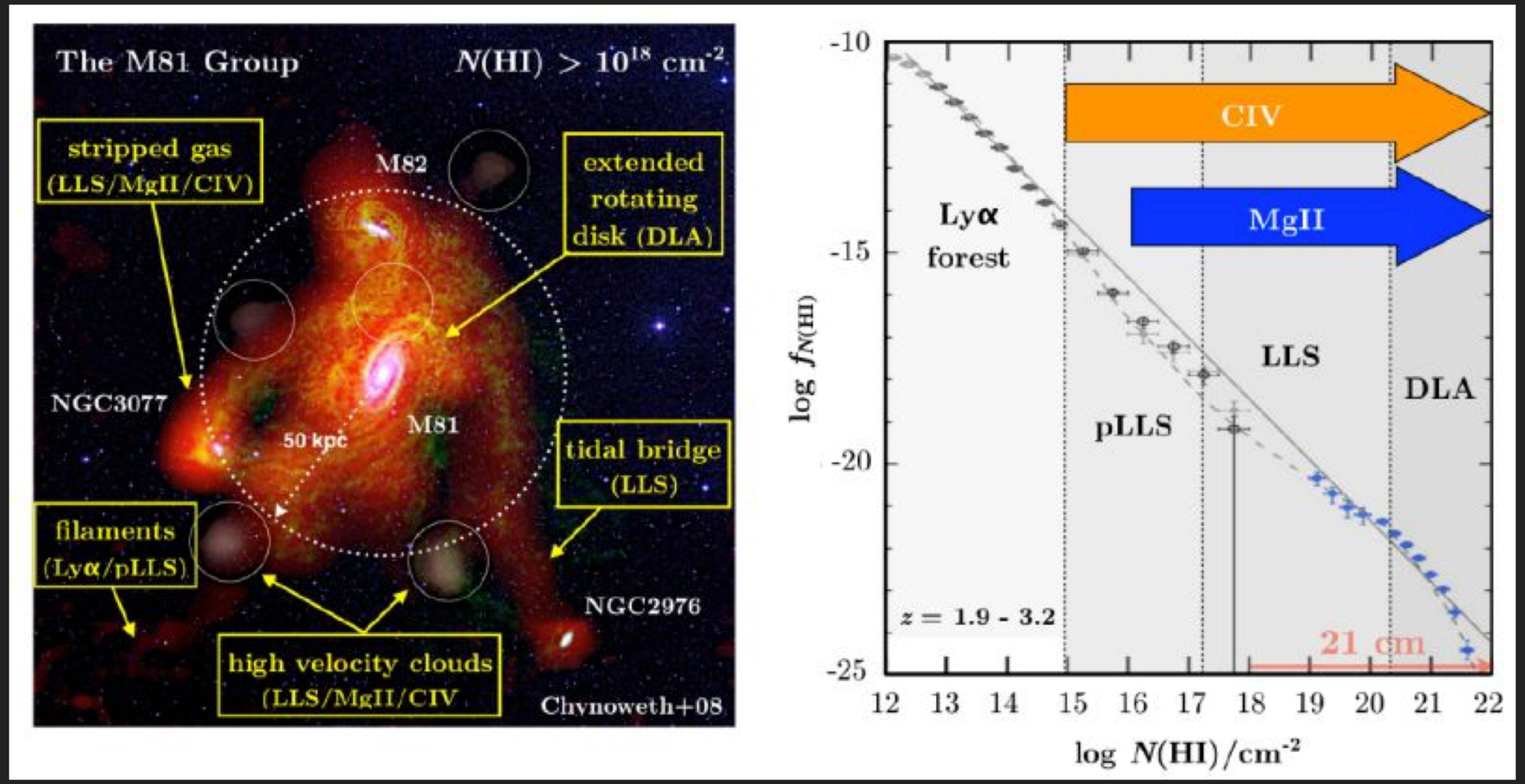
SPATIALLY RESOLVED PANCHROMATIC STUDIES OF THE BARYON CYCLE IN AND AROUND GALAXIES AND GROUPS

- *4HS spectra*
- *LSST*
- *VHS –> Euclid*
- *WISE*
- *SKA 21cm*
- *SKA continuum*
- *eRosita Xray*

Lyα absorbers from Kim et al. (2013)



https://ned.ipac.caltech.edu/level5/Sept17/Chen/Chen1.html

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TESTS OF GRAVITY AND GROWTH OF STRUCTURE

- Where 4HS shines is peculiar velocity science and GRoS:
  i.e., mapping the large scale density and velocity fields,
  enabling tests of gravity on the very largest scales (>> 10 Mpc).

- Goal: Fundamental Plane distances/peculiar motion
  measurements for ~800,000 ETP galaxies at $z < 0.15$;
  –> ~2 % measurement of growth rate of structure parameter, f
  (c.f. ~10% from 6dFGSv; ~5% from Taipan).

- Wholly complementary to BAO/RSD experiments (e.g. DESI; 4CRS).

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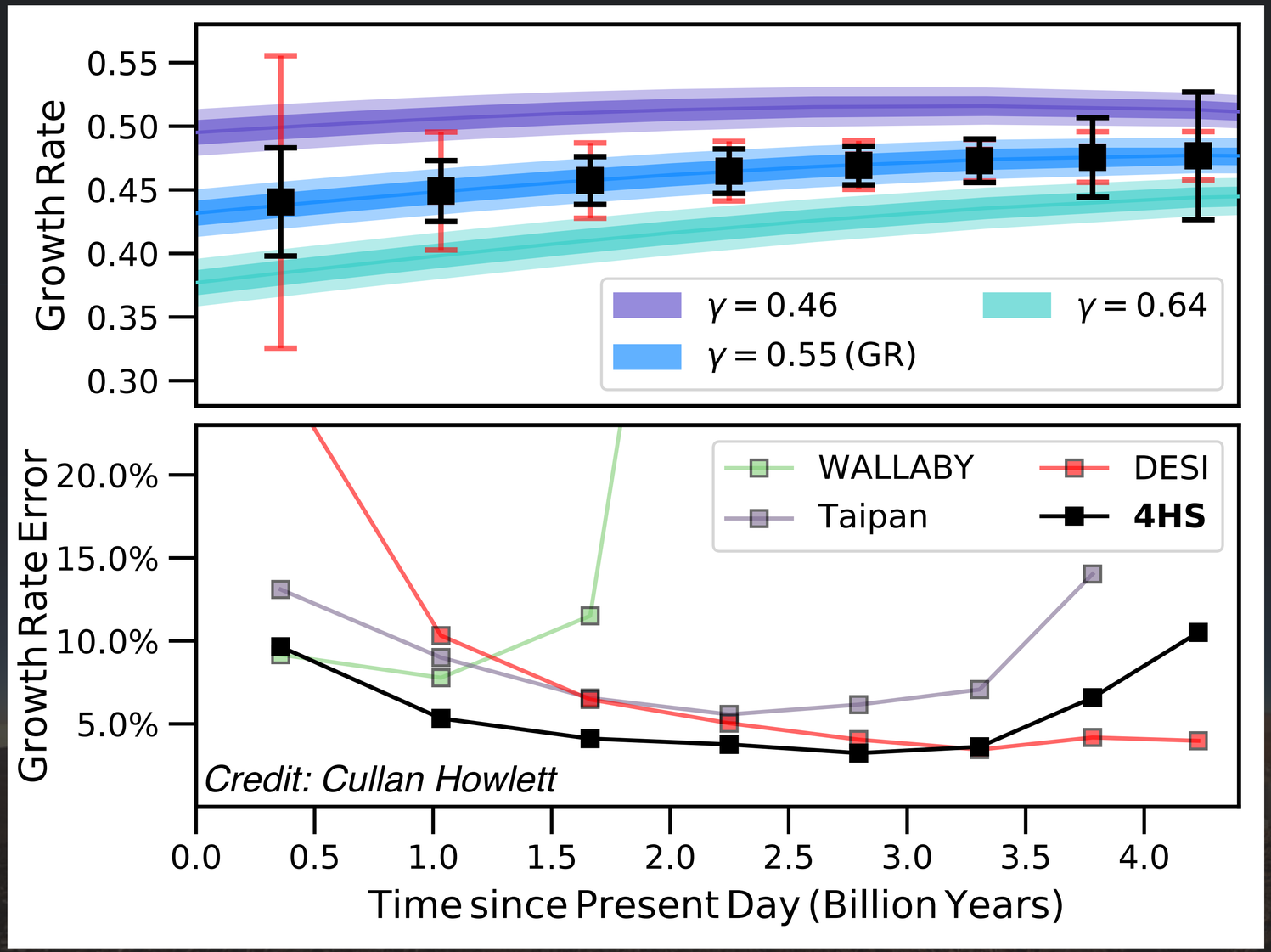
TESTS OF GRAVITY AND GROWTH OF STRUCTURE

- mapping the cosmic density and velocity fields directly measures the gravitational growth of structure.
- checking consistency between velocity field and density distribution measures the effect of gravity on >10 Mpc scales.



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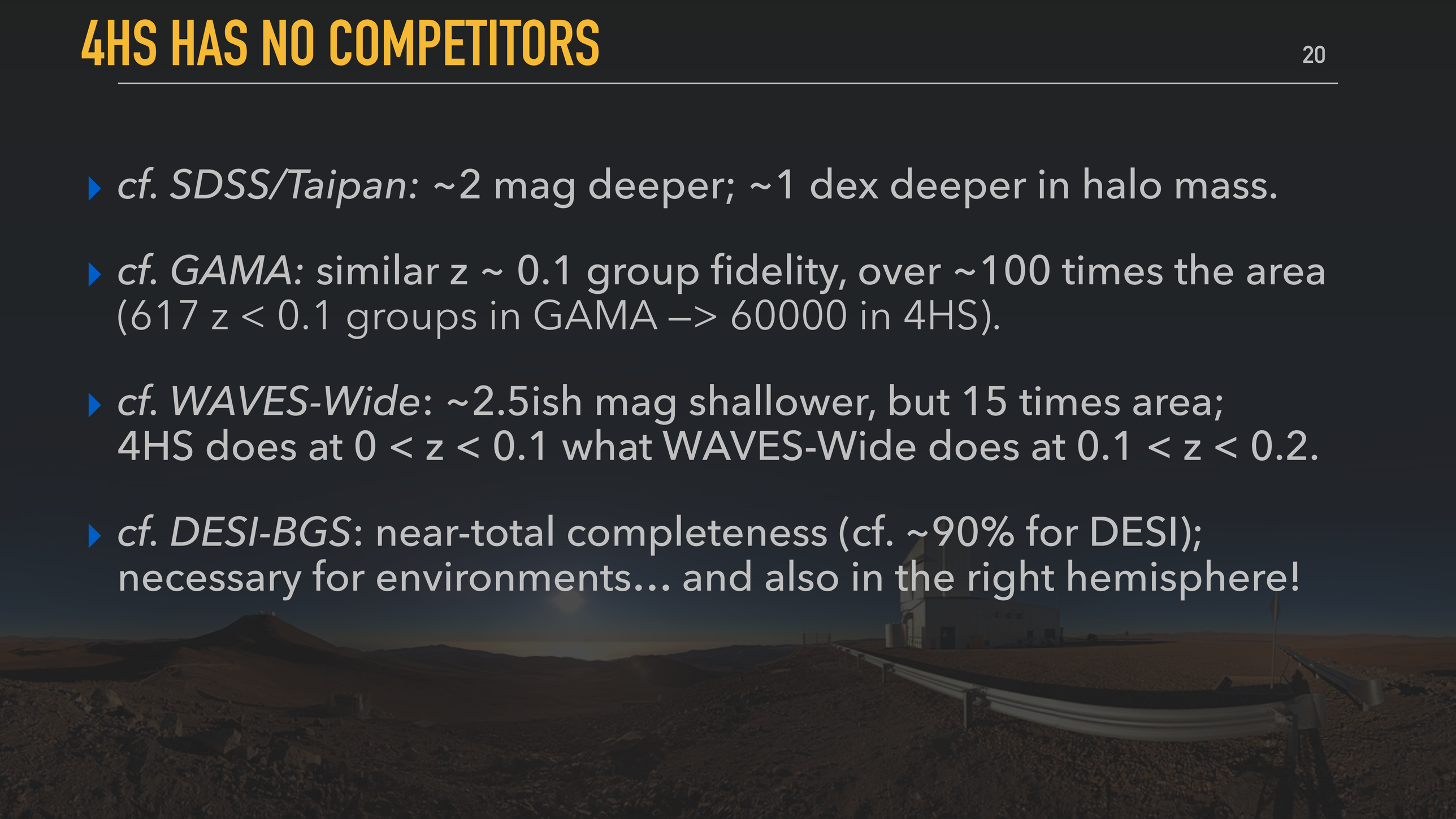
A GENERATIONAL DATASET FOR TRANSIENT SCIENCE

- A comprehensive legacy catalogue of galaxy properties *and halo masses* for $z < \sim 0.1$ transients, incl. SNe, GWs, etc.

- Plus: improved distance and redshift estimates, based on group-averaged systemic redshifts, and large-scale density/bulk flow modelling.

4HS HAS NO COMPETITORS

- *cf. SDSS/Taipan:* ~2 mag deeper; ~1 dex deeper in halo mass.
- *cf. GAMA:* similar z ~ 0.1 group fidelity, over ~100 times the area (617 z < 0.1 groups in GAMA –> 60000 in 4HS).
- *cf. WAVES-Wide*: ~2.5ish mag shallower, but 15 times area; 4HS does at 0 < z < 0.1 what WAVES-Wide does at 0.1 < z < 0.2.
- *cf. DESI-BGS*: near-total completeness (cf. ~90% for DESI); necessary for environments… and also in the right hemisphere!



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ADDITIONAL SCIENCE SYNERGIES

- *Milky Way and Magellanic dust:*
  4HS can efficiently push much closer into traditional ZOA, many 1000s of sightlines through low-to-moderate Av.
- *Gravitational lensing:*
  4HS represents the best opportunity to make full use of LSST/Euclid for low redshift galaxy/group lensing.
- *Dwarf galaxies and Compact Stellar Systems:*
  Stellar and AGN/QSO partner surveys enable/allow a proper census of barely-to-unresolved extragalactic objects.
- *Rare things, including high-z descendents and analogues:*
  High value local targets for ALMA, MUSE, MeerKAT, …

4HS IS BUILT FOR 4MOST . . . AND VICE VERSA.

- Strong complementarity between 4HS and existing Consortium Surveys.
  Esp. WAVES, Cosmology, Clusters, Transients; but even Magellanic Clouds!
- 4HS fits very naturally into the unique 4MOST operations model.
  In particular, 4HS eases existing difficulties with observing pressure, efficiency, and scheduling flexibility.
- 4MOST is the only facility *and survey* capable of delivering this project:
  Large FOV, high fibre density, rapid reconfigurability, low exclusion, but esp. the consortium structure, including partner stellar surveys.
- Long-lasting legacy value is an intrinsic part of our survey design:
  A panchromatic (Xray-optical-infrared-radio+21cm) view of galaxies, defining the local point of reference for galaxy evolution studies, for at least a generation.

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I THINK THIS IS THE BEGINNING OF MANY BEAUTIFUL FRIENDSHIPS...

- We are keen to share legacy data resources within 4MOST (TiDES!)
- We are very well placed to make meaningful contributions to IWGs 2 (Strategy), 4 (Selections), 5 (Simulations), 8 (4XP), and 9 (Class'n).
- We hope to coordinate closely to support all wide LR/HR surveys, incl. shared fibre time costs with S5/Clusters, S7/WAVES, S9/4CRS.
- We see the real power of working *with* the unique 4MOST model.
- Let's talk, because together everyone achieves more:
  Michelle Cluver & Edward Taylor: 4hs-pi@astro.swin.edu.au