Dark Energy Session 2 & 3

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NASA-GSFC

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DE Session

- Session 2 – Science Requirements vs Performance
- Chris Hirata — WFIRST High Latitude Survey
- Charles Baltay — Supernova Survey with WFIRST
- Dan Scolnic — A Fully Realized Simulation of the WFIRST SN Survey
- Ryan Foley — Supernovae and the IFU
- Tim Eifler — Mitigation Strategies for WFIRST Weak Lensing Systematics

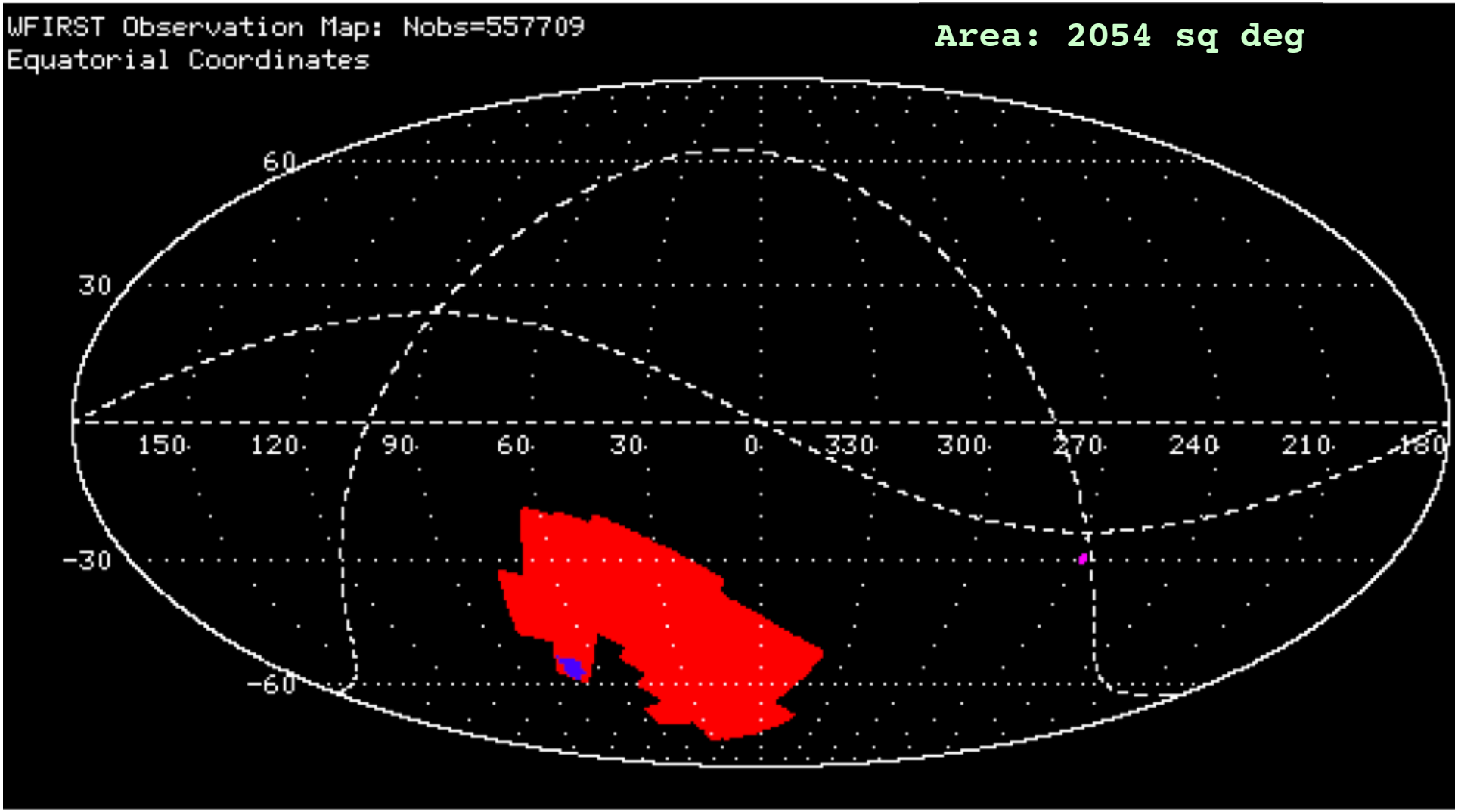
- Session 3 – Science Preparation and Follow-up Facility Needs
- Masahiro Takada — Dark Energy Interests in Japan
- Will Dawson — LSST – WFIRST Synergy: Blending Challenges
- Alessandro Rettura — Search for Most Distant Clusters with Spitzer & WFIRST
- Abhishek Prakash — New technique of Selecting Luminous Red Galaxies at High Redshift Combining Optical & NIR Photometry
- Peter Eisenhardt — Searching for Massive Distant Galaxy Clusters with WISE

WFIRST HLS Survey

- ✓ 2 year survey during 6-year baseline mission
- ✓ 4 filters: Y, J, H, F184 spanning 0.92—2 μm
- ✓ + grism, 1.35—1.89 μm bandpass (R=660)
- ✓ 2213 deg^2 footprint, subset of LSST footprint
  - Joint wavelength coverage is u band through 2 μm
  - Photo-z for weak lensing & redshift survey
- ✓ 5—7 observations per filter; 2 roll angles (imaging) or 4 (grism)
- ✓ This is a snapshot of where we are now, in Pre-Phase A these are not final decisions!

Hirata

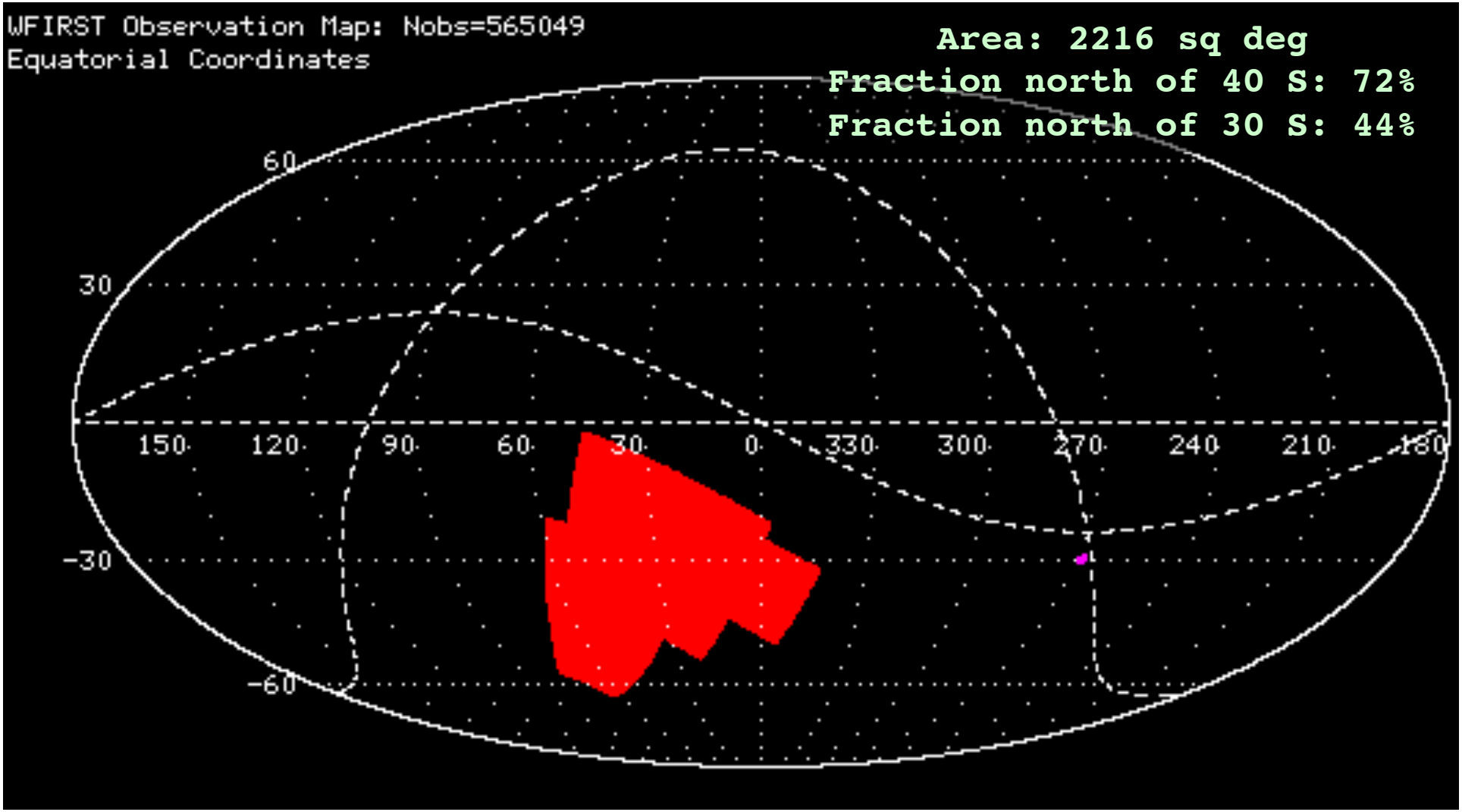
Compare to 2013 Version



Hirata

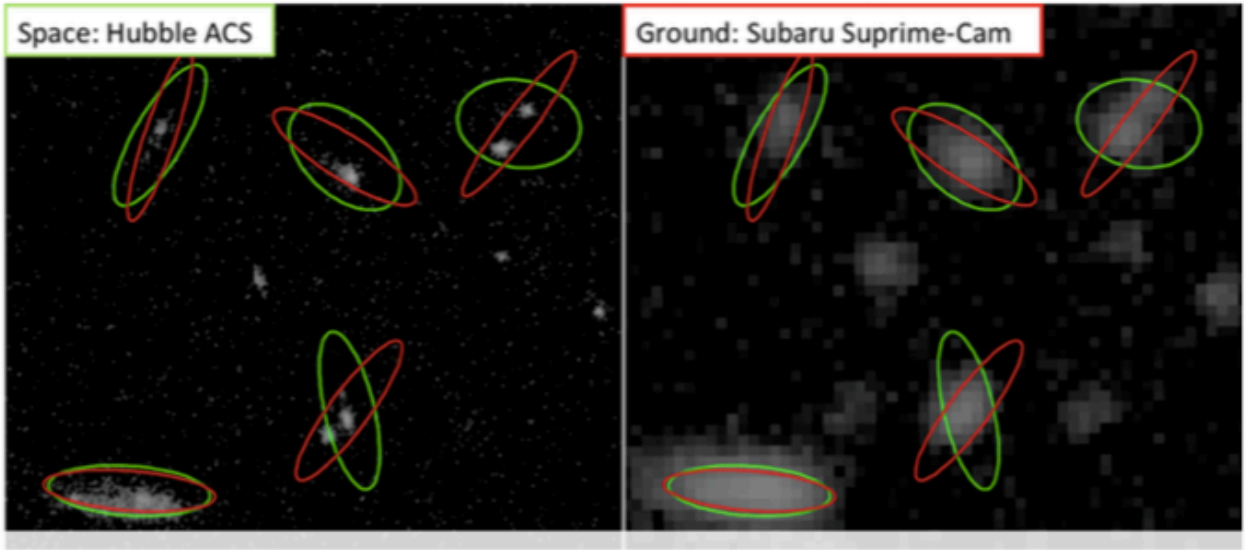
Example Footprint

[Equatorial Coordinates]

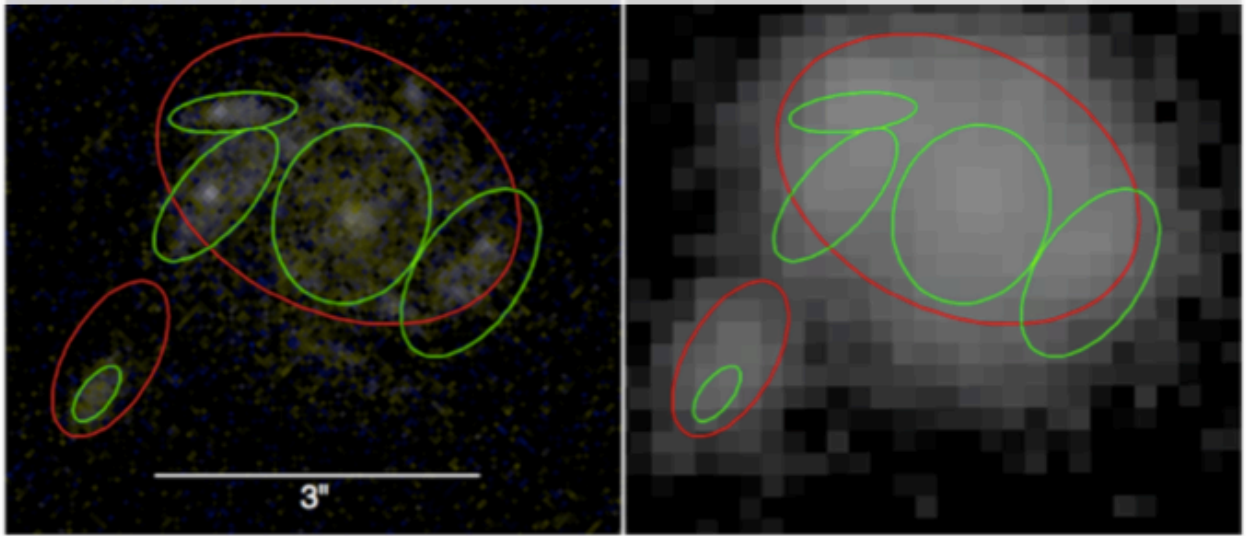


Hirata

Galaxy Blending

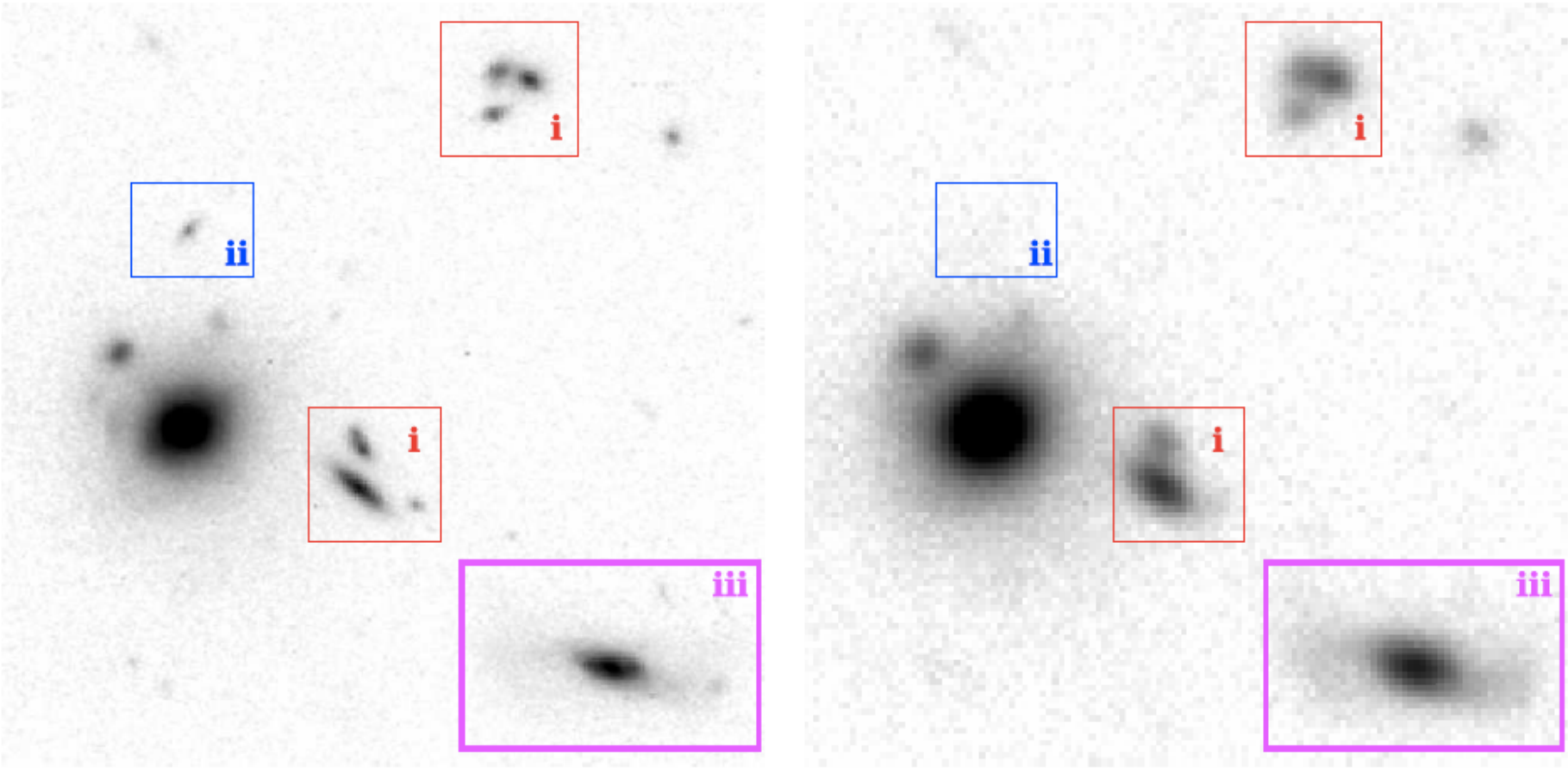


Failure modes from ground & space



Dawson / Schneider

Effects of different resolution, different passbands



(a) Hubble Space Telescope WFC3 $F125$ (125μm) (b) Subaru Hyper Suprime-Cam i band (0.75μm)

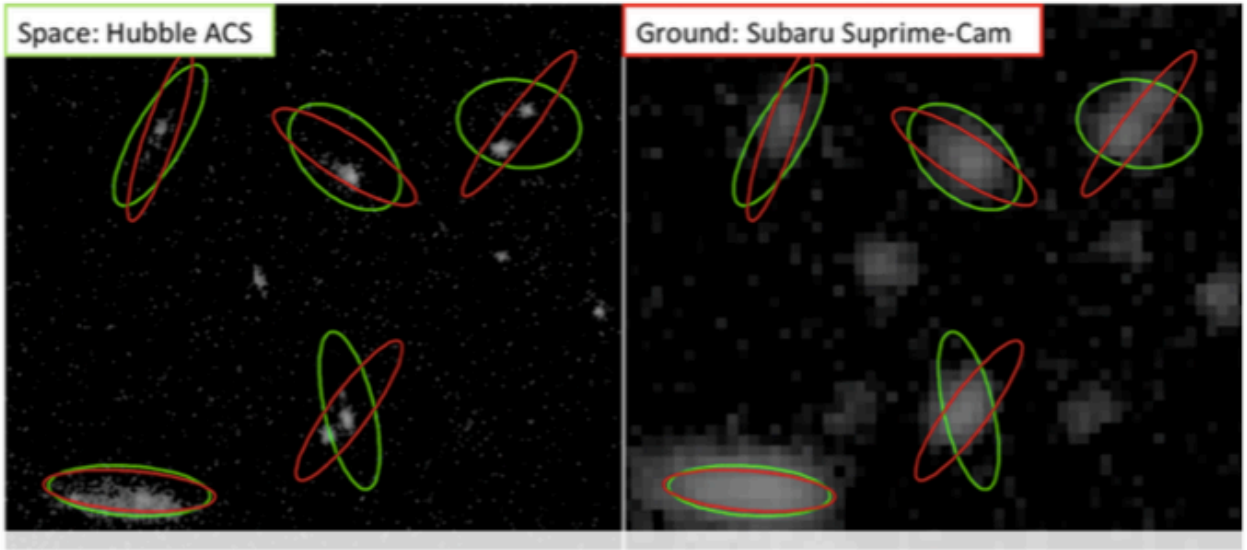
(Like WFIRST)

See also Michael Schneider's talk

(Like LSST)

Strauss

Galaxy Blending



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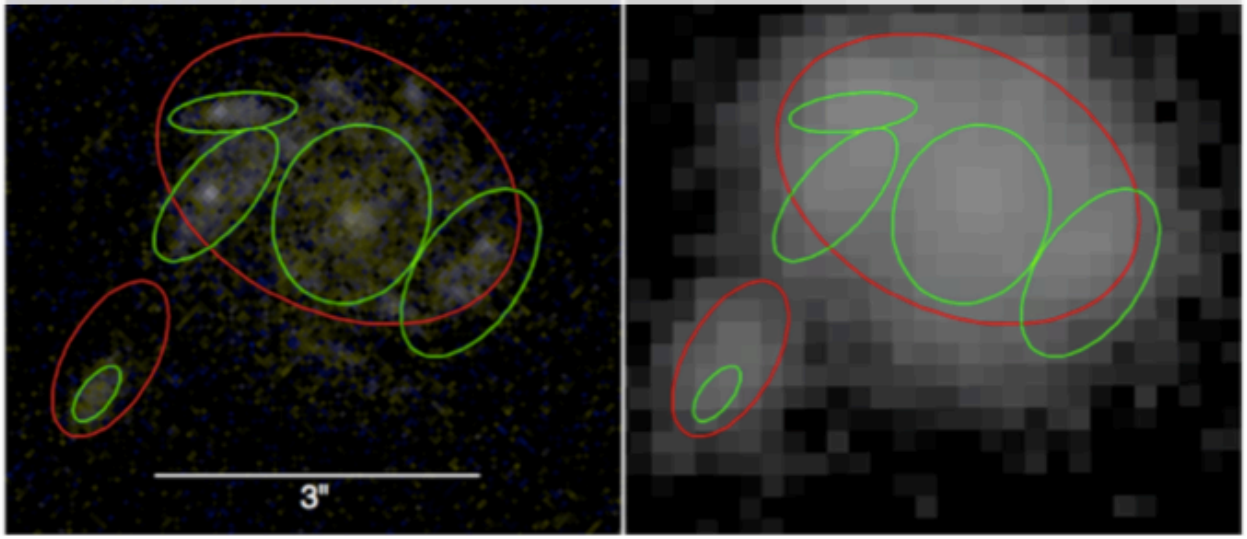
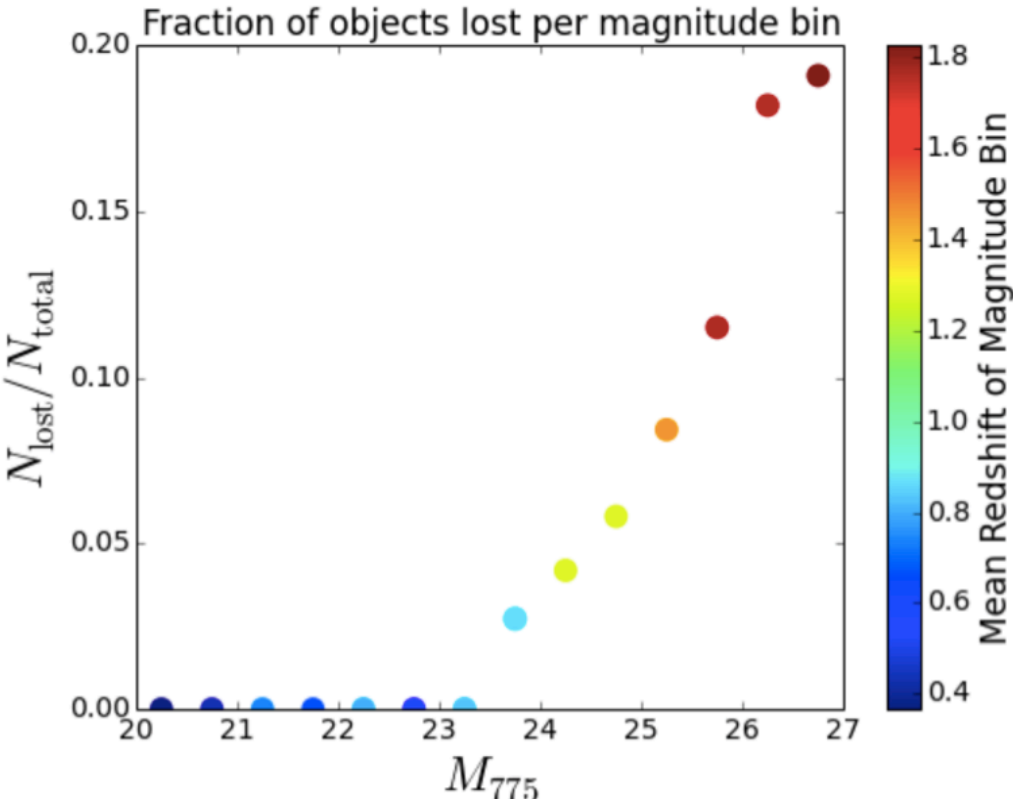


Dawson / Schneider

Galaxy Blending

Fainter space galaxies more likely to be "lost"

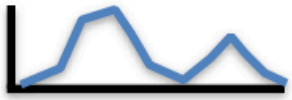


Dawson

Galaxy Blending

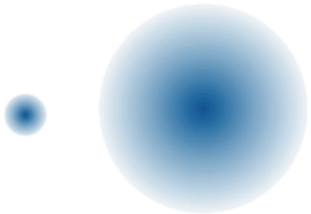
Key observables: tools in mitigating blending

- Color spatial gradients



- Photometric redshifts

- Light profile morphology



- Space imaging
  - Best ground seeing epochs (more for LSST)

Dawson

SN Ia Survey Strategy

- Use the 0.28 sq degree imager to discover supernovae in two filter bands
- Use IFU spectra to get light curves with roughly a 5 day rest frame cadence
- 7 spectra on light curve from -10 rest frame days before peak to +25 rest frame days past peak, S/N = 6 per pixel (S/N = 15 per synthetic filter band)
- 1 reference spectrum after supernova has faded, for galaxy subtraction with S/N = 6 per pixel
- 1 deep spectrum near peak for subtyping, spectral feature ratios etc. with S/N = 10 per pixel

SN Ia Survey Strategy

- Do a 3 tier survey, scanning different areas of sky for different redshift ranges

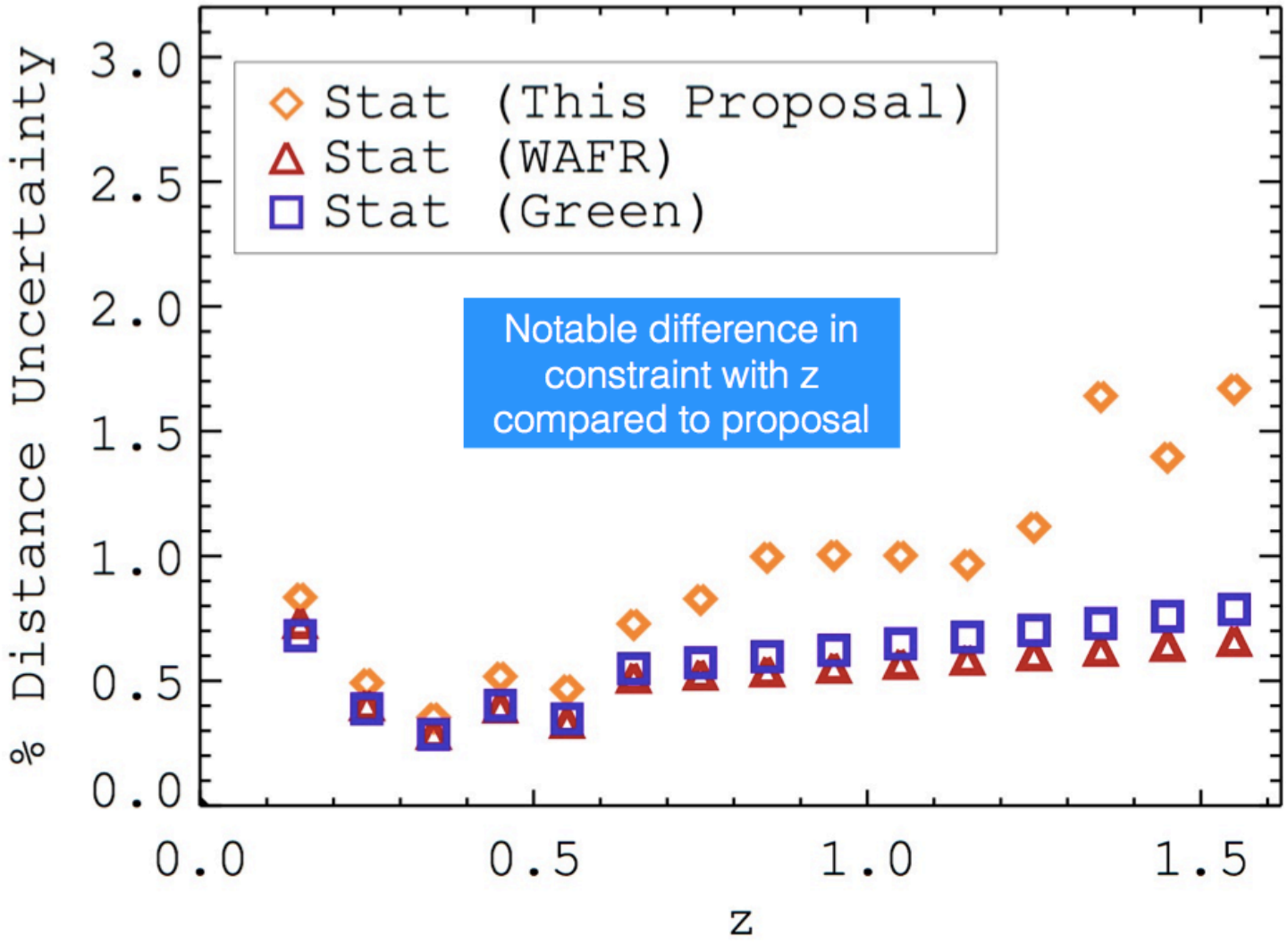
Tier	Z max	Sky Area Sq Degrees
1	0.4	27.44
2	0.8	8.96
3	1.7	5.04

Scolnic & Foley – SN simulations

- A fully realized simulation of the WFIRST SN survey
- Created 4 tools for publicly available software
  - WFIRST-specific simulation libraries for full simulation of SN survey
  - Light-curve fitting routines to incorporate best spectral models for Near-IR data
  - Conversion program between SNANA output and COSMOMC/COSMOSIS input
  - Routines to measure cosmological parameters specific to WFIRST, when combining with other probes
- Find larger distance measure uncertainties at z>0.5 than SDT report
- Spectral typing and redshifts require higher S/N ratios than found in SDT report

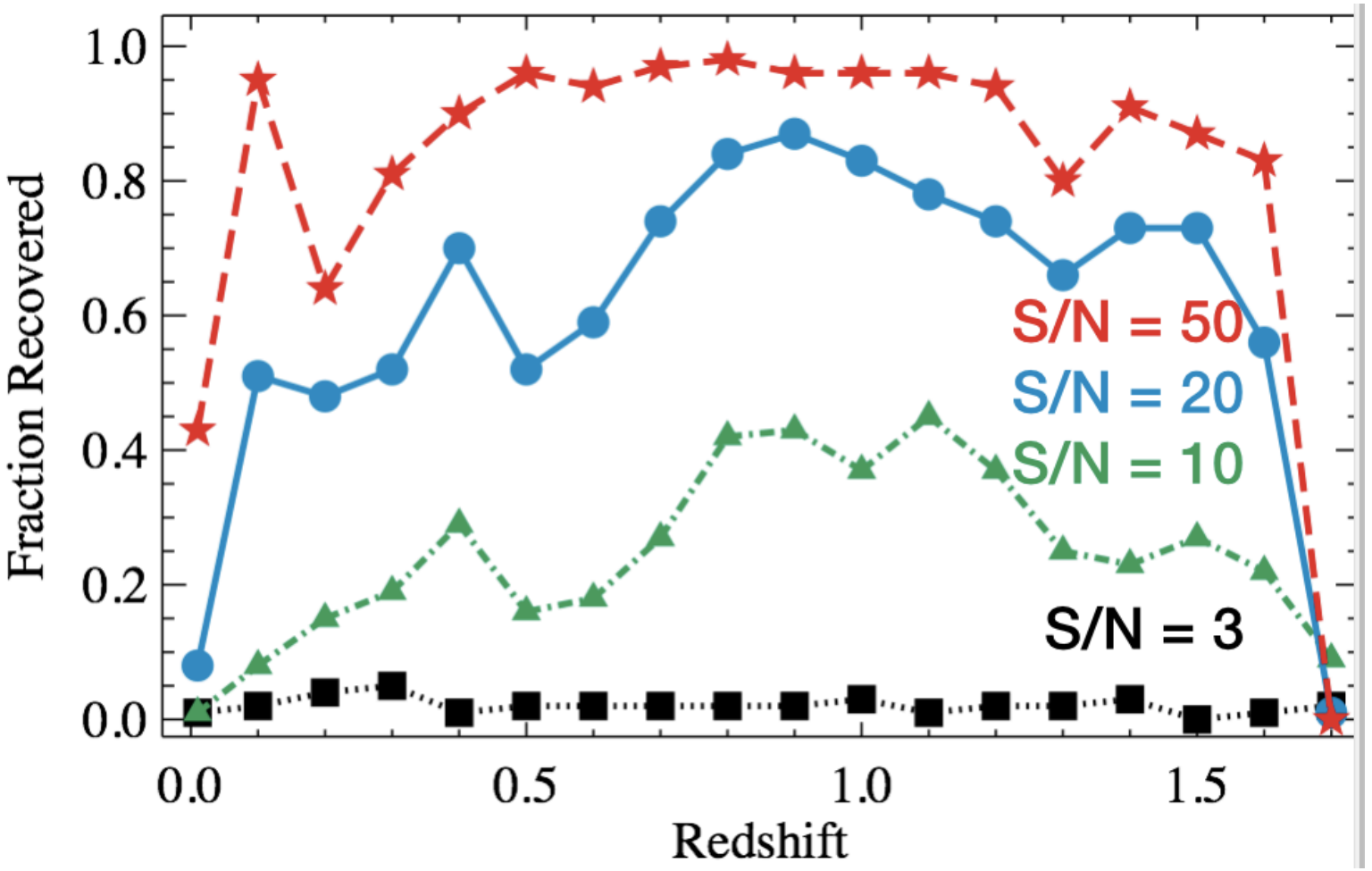
Scolic / Foley

Distance Uncertainty



Scolic / Foley

Fraction of SNe Recovered



Foley / Scolic

Foley / Scolic Recommendations

R ≥ 100 improves recovery rate, gives more precise (less biased) distances, and allows for additional systematic tests

S/N > 20 needed for robust classification

Spectroscopy from Ground?
Could do everything at z < 1 with dedicated 8-m telescope

Distances through imaging with single high-S/N spectrum?

Session 3

- Abhishek Prakash - Luminous Red Galaxies – key for large scale spectroscopic survey
  - LRGs are the gold standard, best-understood BAO sample
  - LSST y-band and Euclid y & j-band can target luminous LRGs at z>1
  - WFIRST j band can be used to target LRGs at even higher redshifts

- Peter Eisenhardt Searching for Massive Distant Galaxy Clusters with WISE
  - 20 spectroscopically confirmed z ~ 1 MaDCoWS
  - Initial set of CARMA SZ masses up to 6×10^{14} M_O
  - IRAC richness correlates well with mass

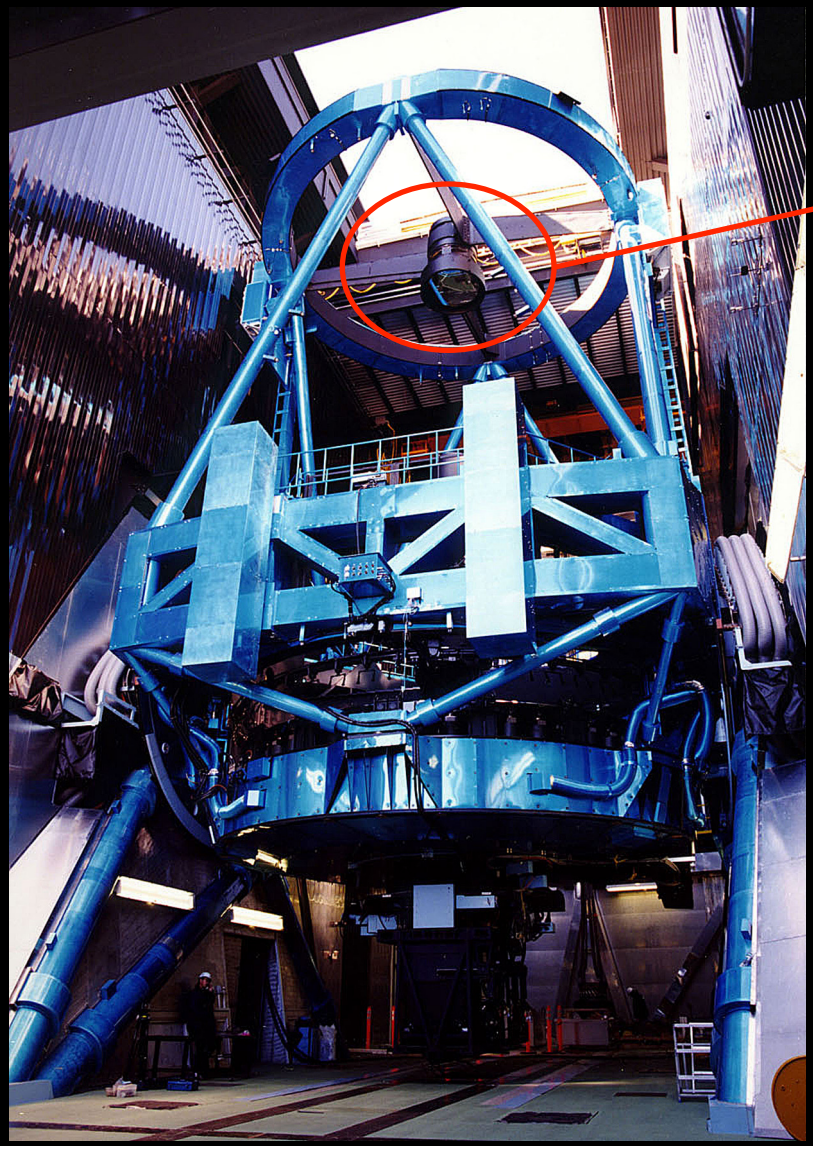
  - Richnesses for thousands of AllWISE MaDCoWs can be measured in a few hundred hours with Spitzer
  - Adding together NEOWISE data now being collected would extend MaDCoWs to z > 1.5, sampling the epoch of star formation in clusters and probing massive structure growth, and provide outstanding targets for JWST and WFIRST

Session 3

- Alessandro Rettura Search for Most Distant Clusters with Spitzer & WFIRST
  - Ongoing large Spitzer cluster surveys will provide high-redshift targets for WFIRST
  - Enable unique, exciting, synergic, multi-wavelength studies of the Spitzer-selected sample
  - Provide training sets to identify additional high-redshift clusters outside of the Spitzer footprint.

- Masahiro Takada Dark Energy Interests in Japan: Subaru SuMIRe HSC/PFS project
  - Hyper Suprime-Cam (HSC): 2014-19, ~1B gals, 1400 deg2
  - Prime Focus Spectrograph (PFS): 2019-22, ~4M spec-z, 1400 deg2
  - Imaging and spectroscopic surveys for the same region of the sky at the same telescope
  - 2400 autonomously positioned fibers in 4 spectrographs

Hyper Suprime-Cam



- largest camera
- 3m high
- weigh 3 ton
- 104 CCDs (~0.9B pixels)