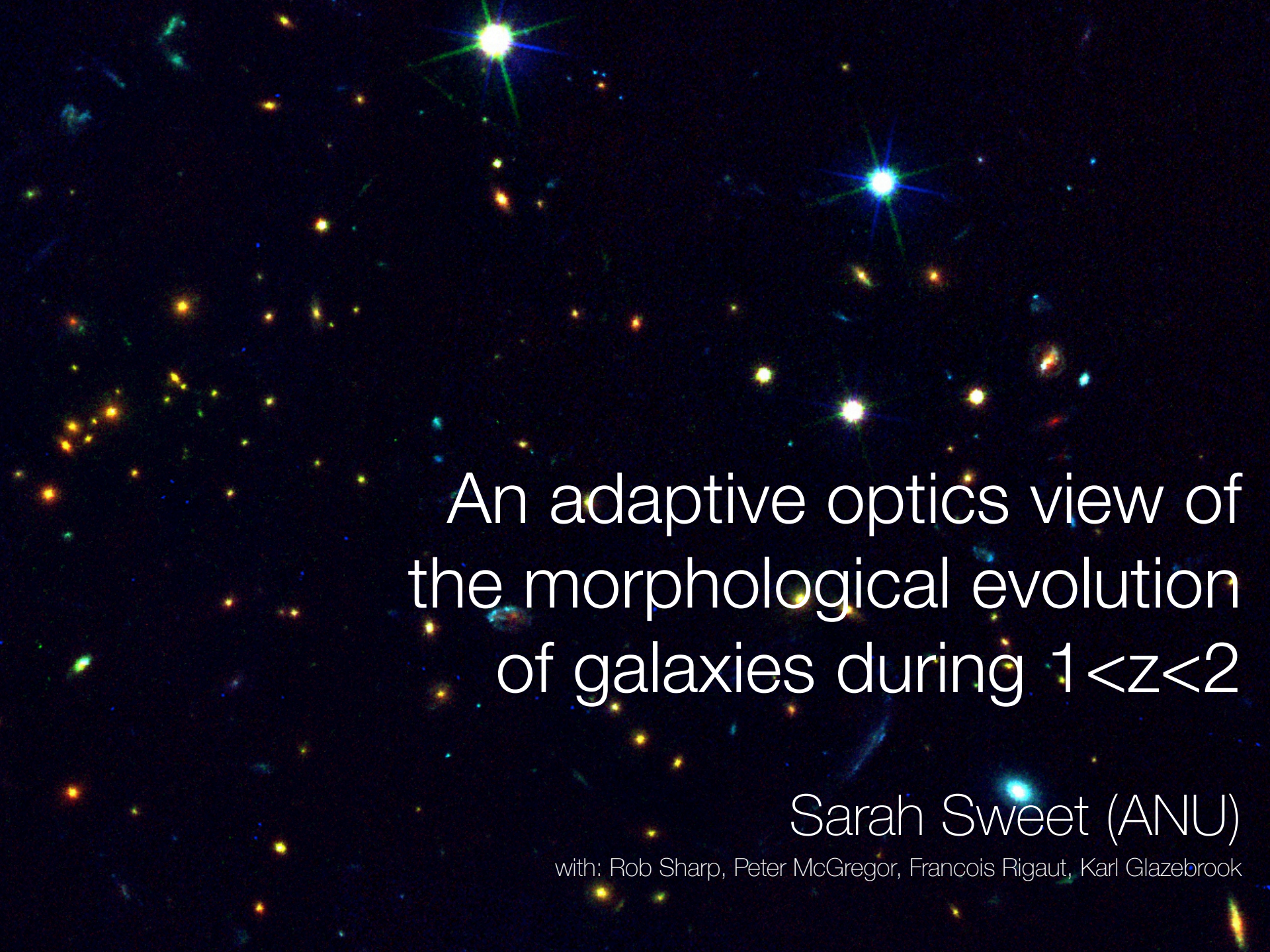


An adaptive optics view of the morphological evolution of galaxies during 1<z<2

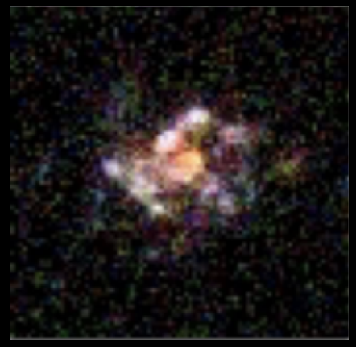
Sarah Sweet (ANU)

with: Rob Sharp, Peter McGregor, Francois Rigaut, Karl Glazebrook

Background

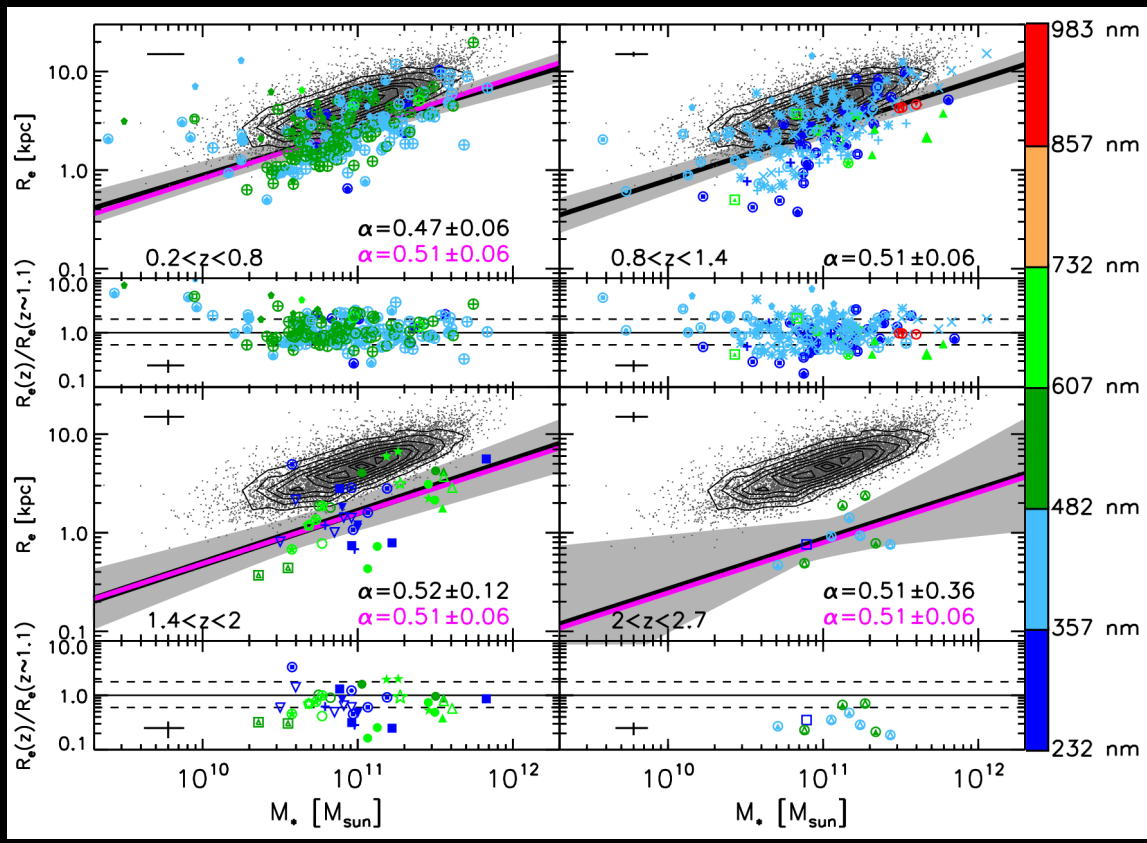
- Local galaxies: passive, red, pressure-supported spheroids and blue, star-forming disks

- High-z galaxies: compact, clumpy, irregular



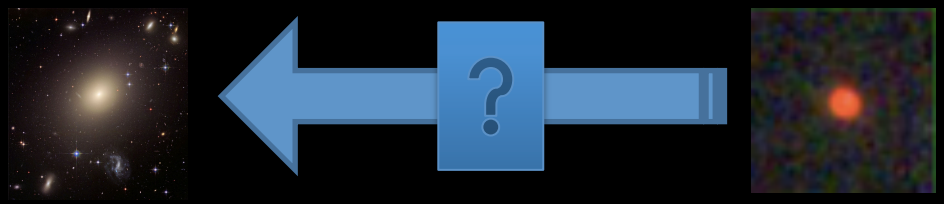
Size increase

- z=2 galaxies are 2-5 times more compact than at z=0 (e.g. Trujillo et al. 2007)
- Size-mass relation is lower at higher redshift (e.g. Damjanov et al. 2011)



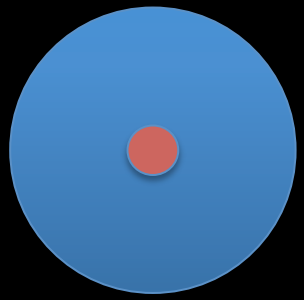
Size increase

- Few compact systems exist today: the most massive high-z galaxies logically become present-day passive ellipticals.

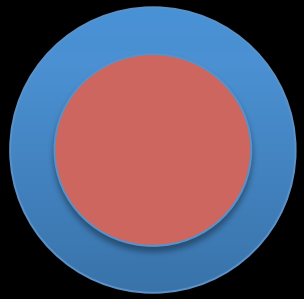


Two mechanisms for size increase

- Minor mergers
  - can provide a significant increase in size without the corresponding substantial stellar mass increase (e.g. Croton et al. 2006)
  - compact core remains



- Adiabatic expansion
  - large-scale mass loss such as AGN feedback (e.g. Fan et al. 2008)
  - total stellar light profile expands



Technical requirements

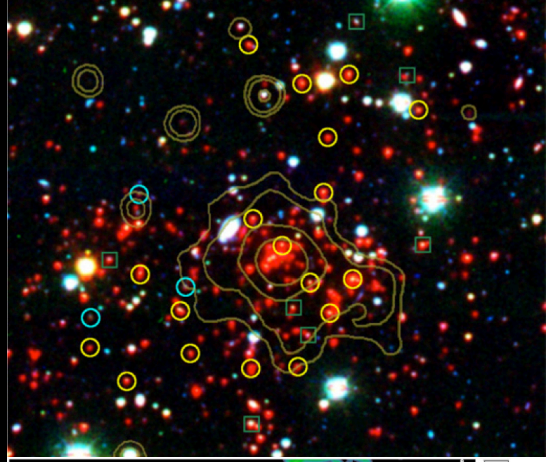
- Minor mergers or adiabatic expansion?
  - Multi-component fitting
    - Resolve bulge and disk
  - Wide field of view
    - measure whole cluster
  - Optical rest frame
    - trace stellar mass (main driver of galaxy properties such as colour, age and specific star formation rate e.g. Kauffmann et al. 2003)
- GeMS/GSAOI

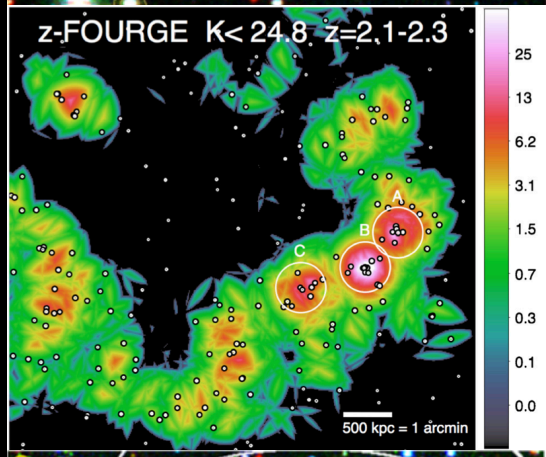
Limitations of previous studies

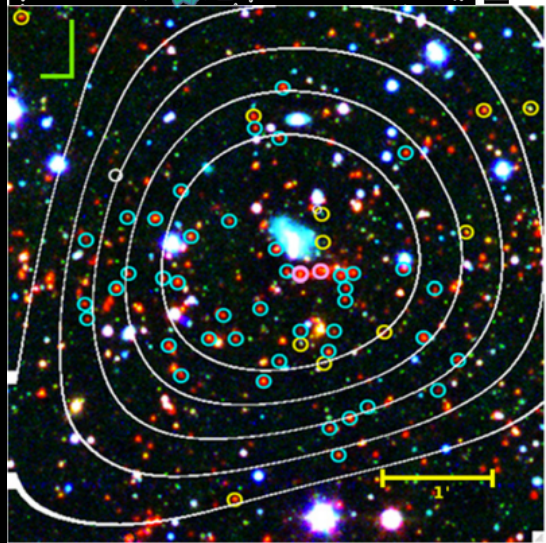
- Ground-based studies have
  - insufficient resolution for multi-component fits (no adaptive optics)
  - small field of view (single-conjugate adaptive optics)
- Reddest HST filter is F160W (~H-band)
  - traces UV rest frame at high z

Sample

- Galaxy clusters with sufficient (>2) NGS, spanning peak star formation
  - SPT z=1.067 cluster (Brodwin et al. 2010)
  - ZFOURGE z=2.095 cluster (Spitler et al. 2012, Yuan et al. 2014)
  - SPT z=1.48 cluster (Bayliss et al. 2014)

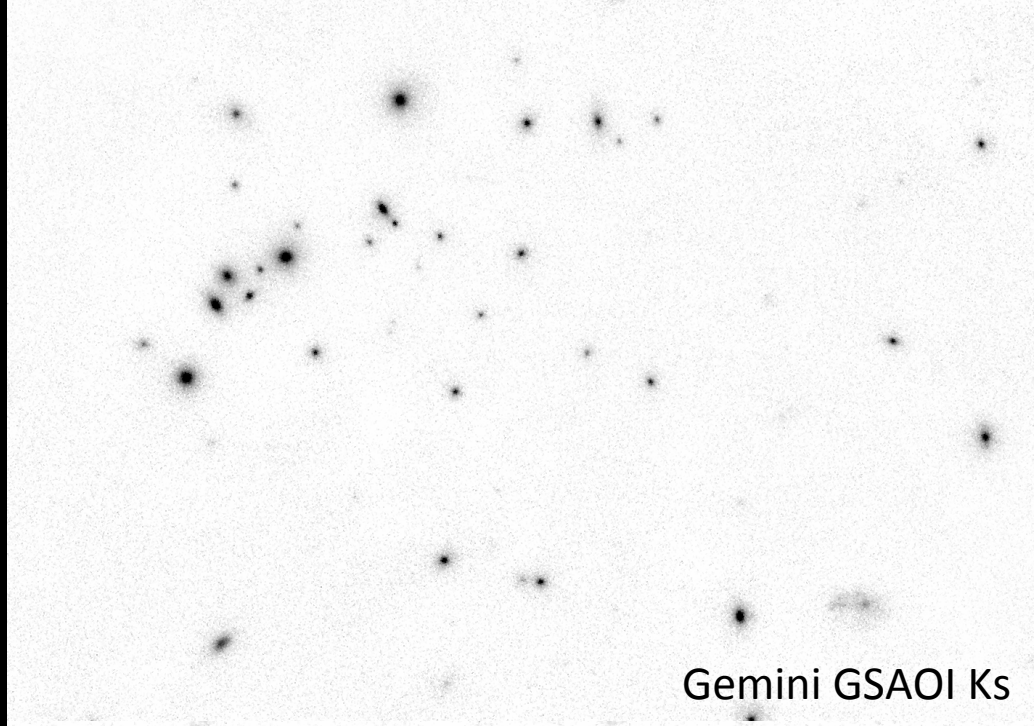




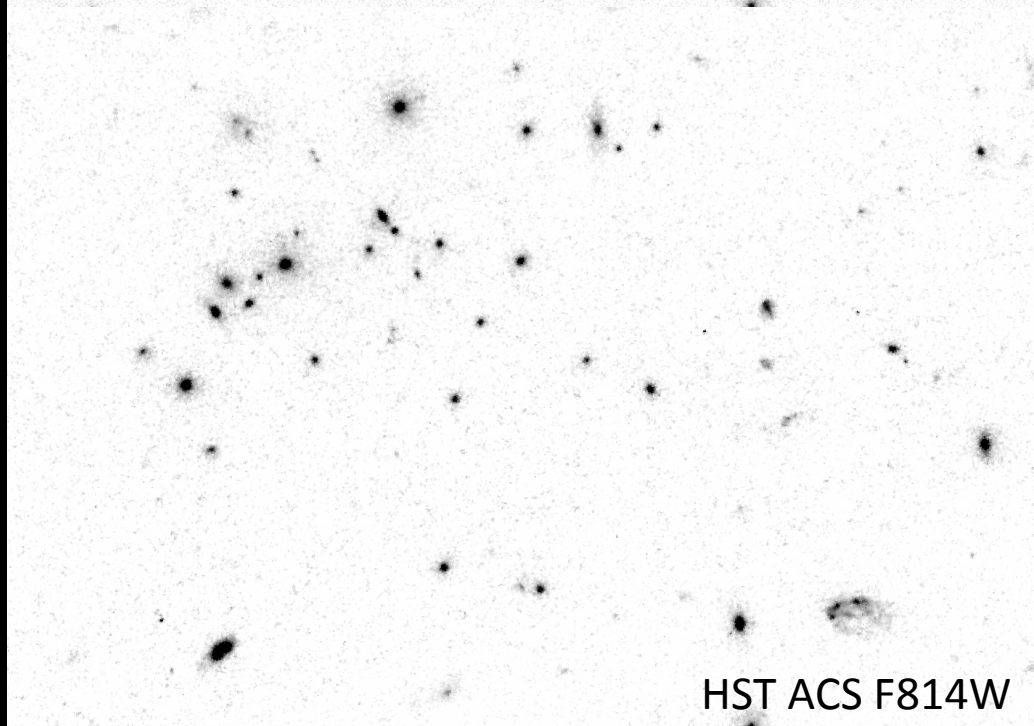


Data Quality

- ~2 times better resolution than HST
  - FWHM 80-120 mas
- Redder wavelengths
- Lower sensitivity
  - μ_{Ks} ~ 22 AB mag/arcsec^2 (at 3σ after 6 h)



Gemini GSAOI Ks

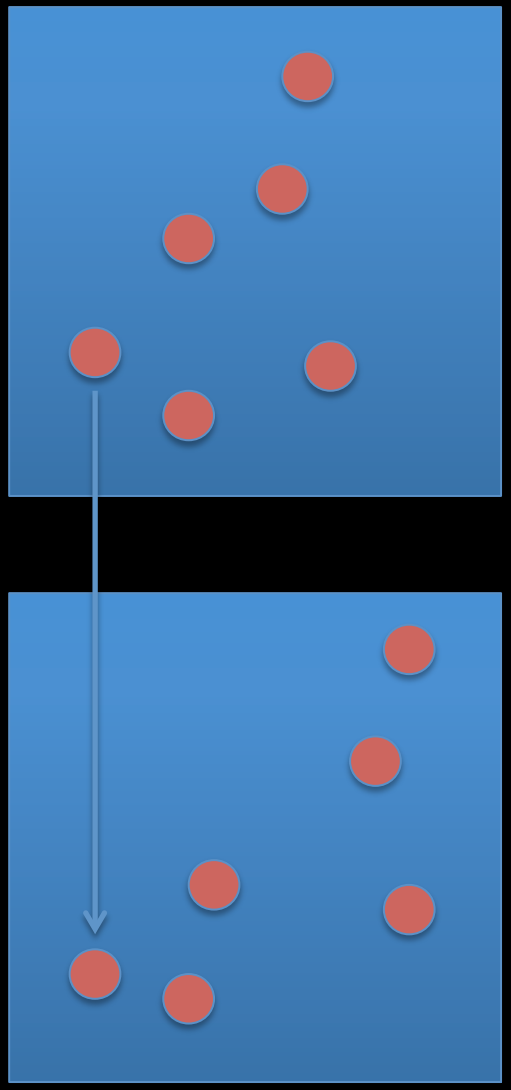


HST ACS F814W

False-colour image of z=1 cluster:
Gemini Ks (this work) = red, HST F814W = green, HST F606W = blue

Distortion

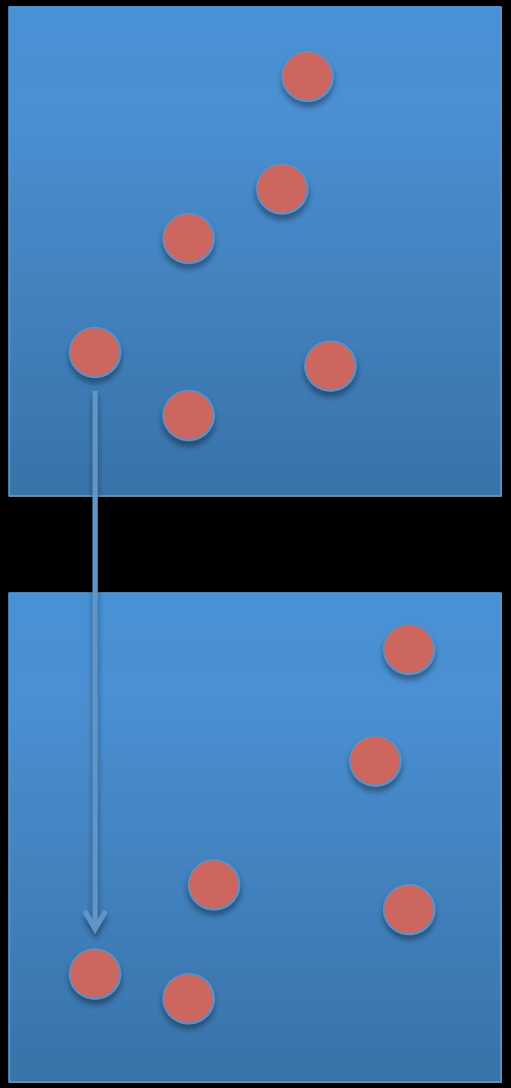
- Mostly static, off-axis parabola
- Also dynamic:
  - relative movement of the laser and natural guide stars
  - position angle
  - airmass



Distortion solution: faint sources

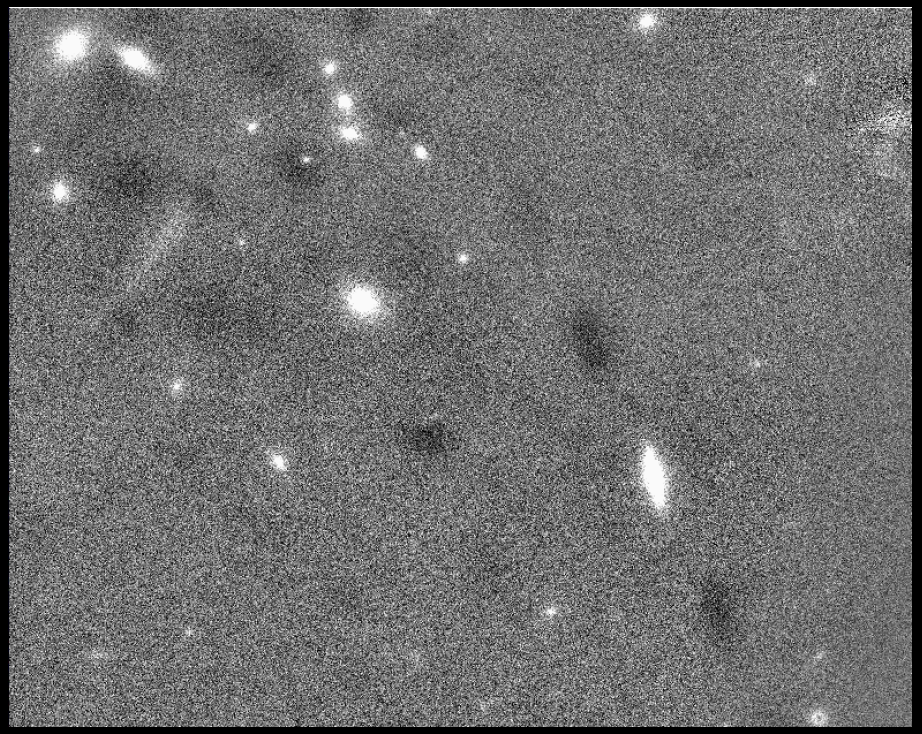
- Calculate astrometric correction on star field with SCAMP
  - Same epoch and PA as science
- Apply to science images with Swarp

SCAMP and Swarp (Bertin 2002, 2006) from astromatic.net



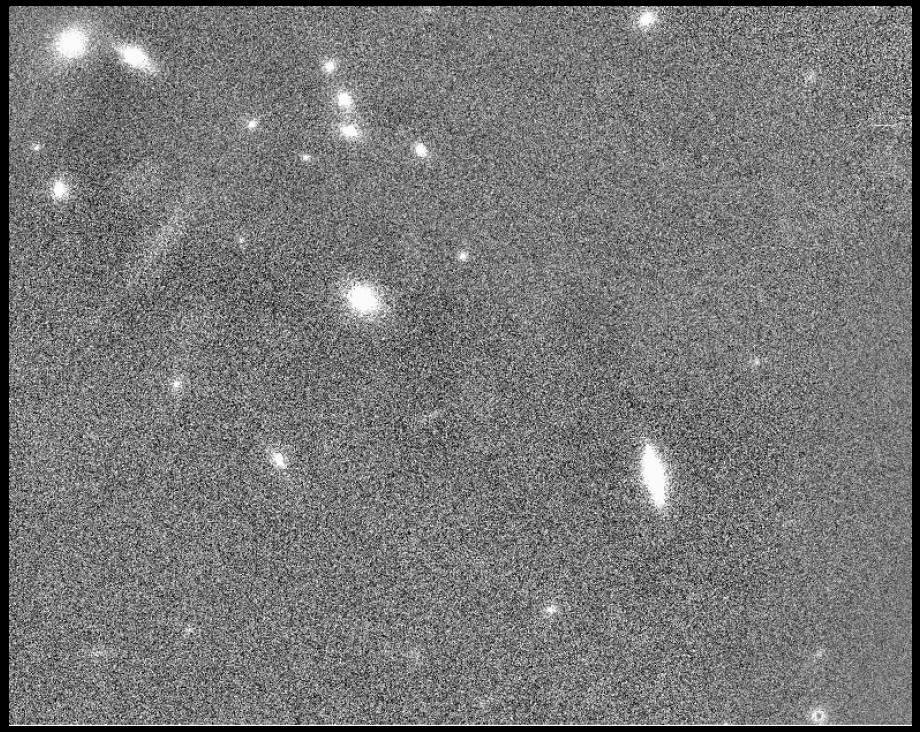
Sky ghosting

- Insufficient masking of faint sources in object sky frames



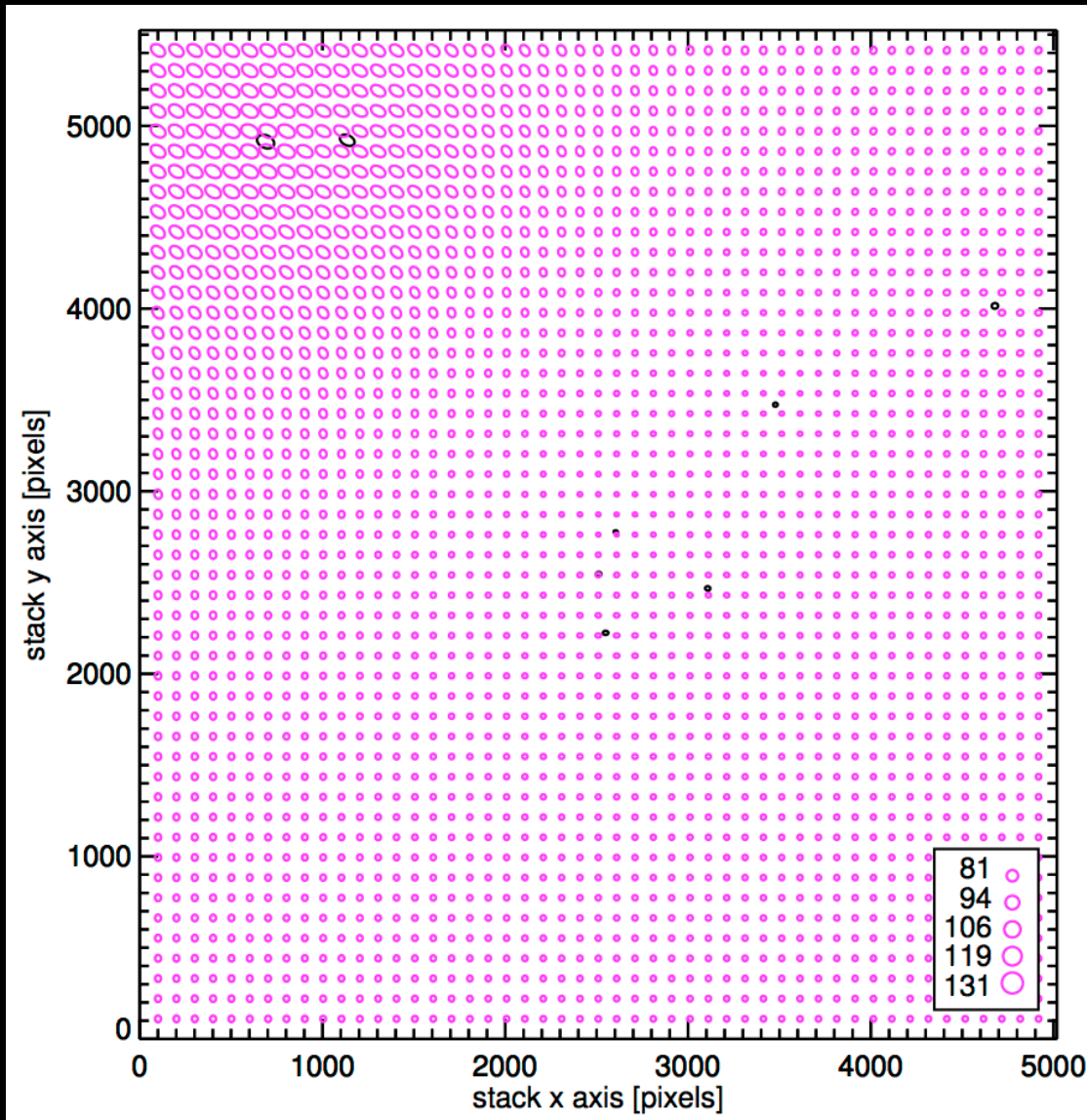
Sky ghosting solution

- Create mask from stacked image
- Calculate and apply reverse distortion correction to each CCD
- Offset to each dither position for use with object sky frames



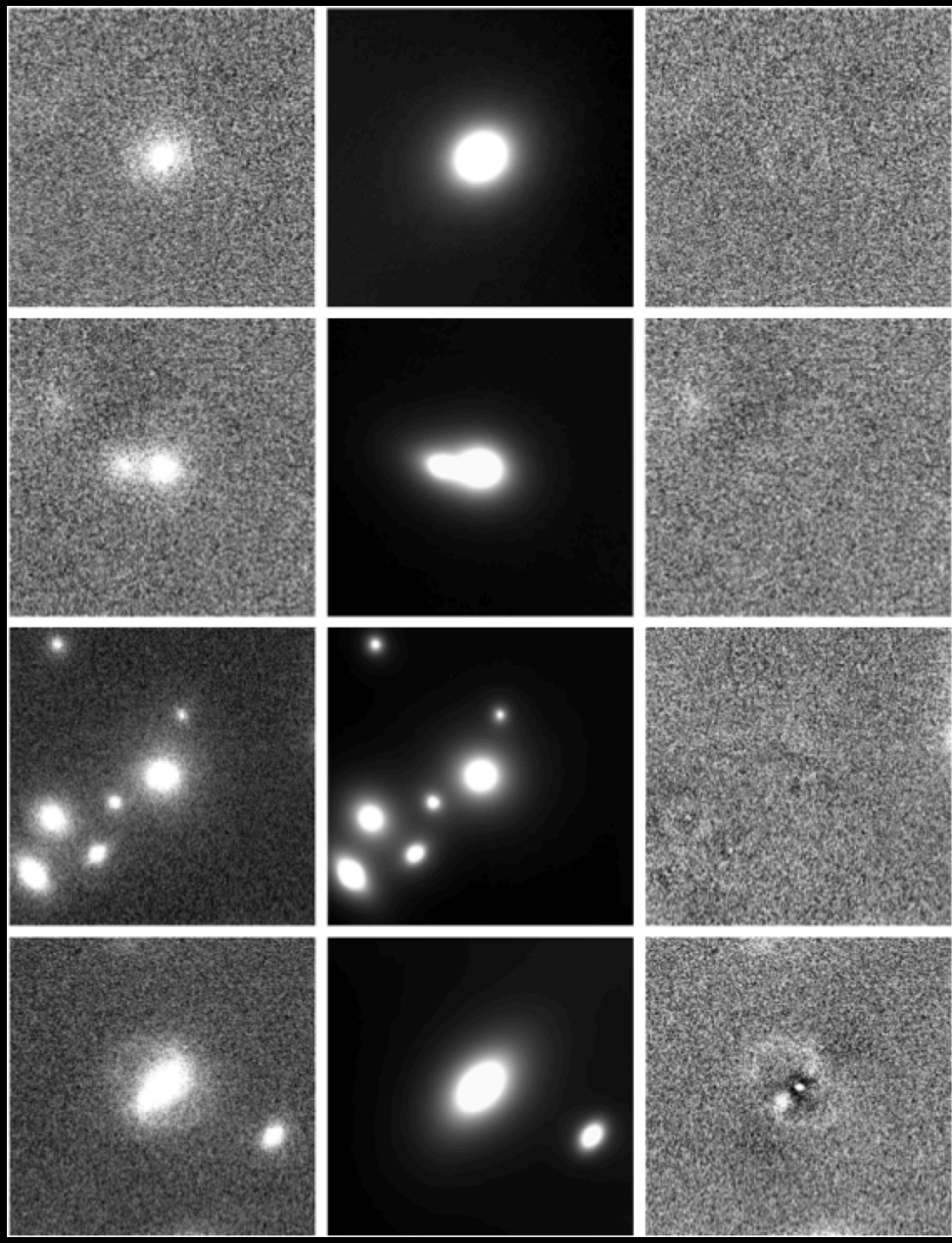
PSF

- PSF varies strongly across field
- Interpolated parameters of Moffat fits to stars to generate PSF at location of each galaxy

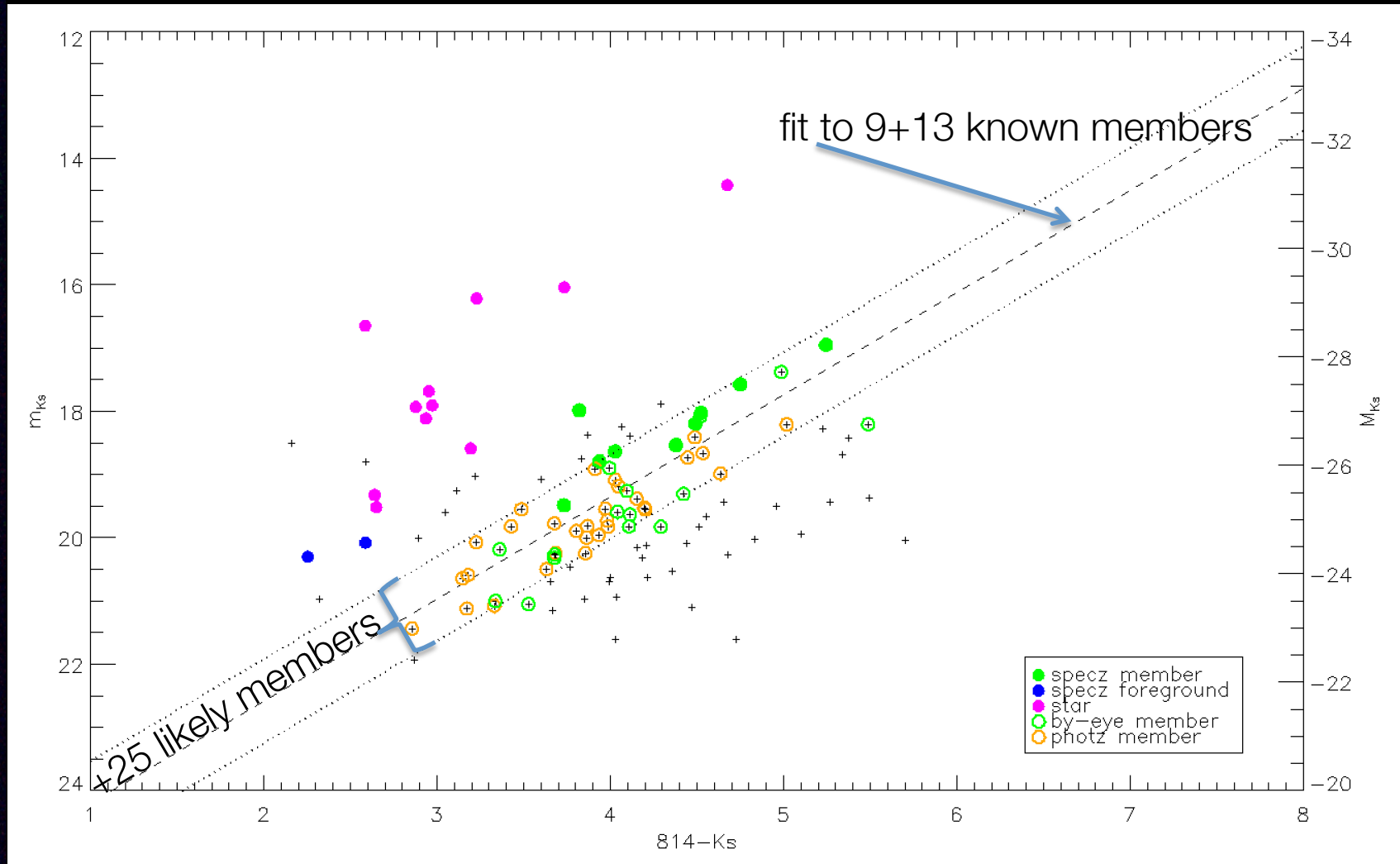


Profile fitting

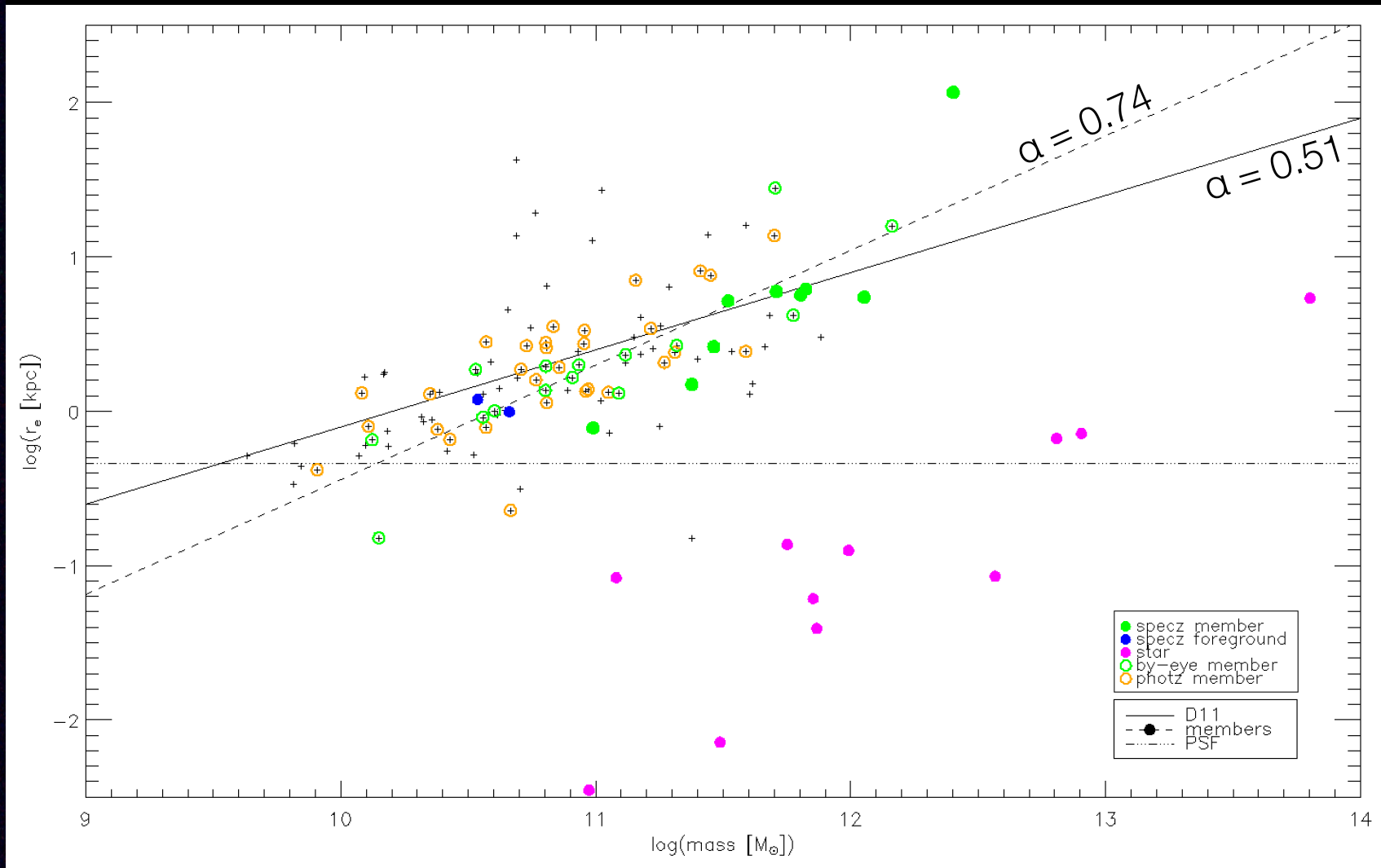
- Most galaxies are well fit by a single Sérsic profile



Cluster membership selection



Size-mass relation



Summary

- Measured rest-frame optical size-mass relation with GeMS/GSAOI high-resolution near-infrared imaging:
  - Steeper slope than rest-frame UV
- Data processing:
  - Distortion correction
  - Ghosting
  - Varying PSF
- Trace the buildup of size from z~2 to today