Deep Near-infrared surveys with GLAO

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Why GLAO?

- Traditional AO systems can produce excellent image quality, but only over a small field of view (<1 arcmin radius).

- GLAO systems can work effectively with up to 4-8 arcmin diameter fields of view (e.g. Andersen et al. 2006; PASP 118, 1574)

- PSF improvement is typically modest over best natural seeing compared to full AO (~30%?), but sky coverage typically better.

Surveys

- Wide FOV leads to a survey speed much better than traditional AO systems, even if sensitivity for a given amount of integration time lower due to a larger PSF.
  - Especially well-suited for surveys of objects slightly extended on sub-arcsec scales like high-z galaxies.
- Survey niche is deep, medium wide (~100-1000 arcmin^2) (also no direct competition with JWST, MCAO systems).
- Also as feeder for MOS with similar FOV

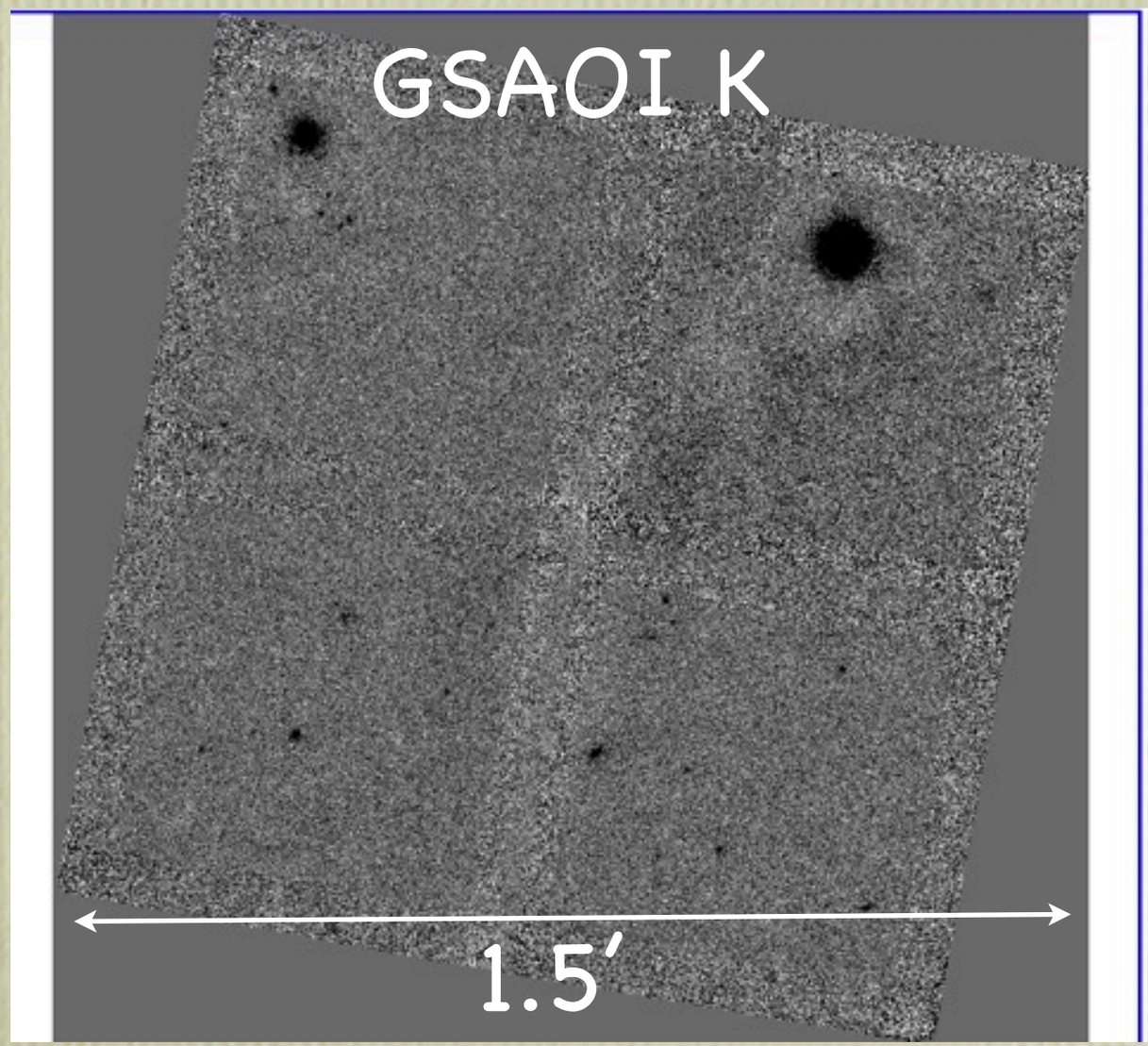
Science

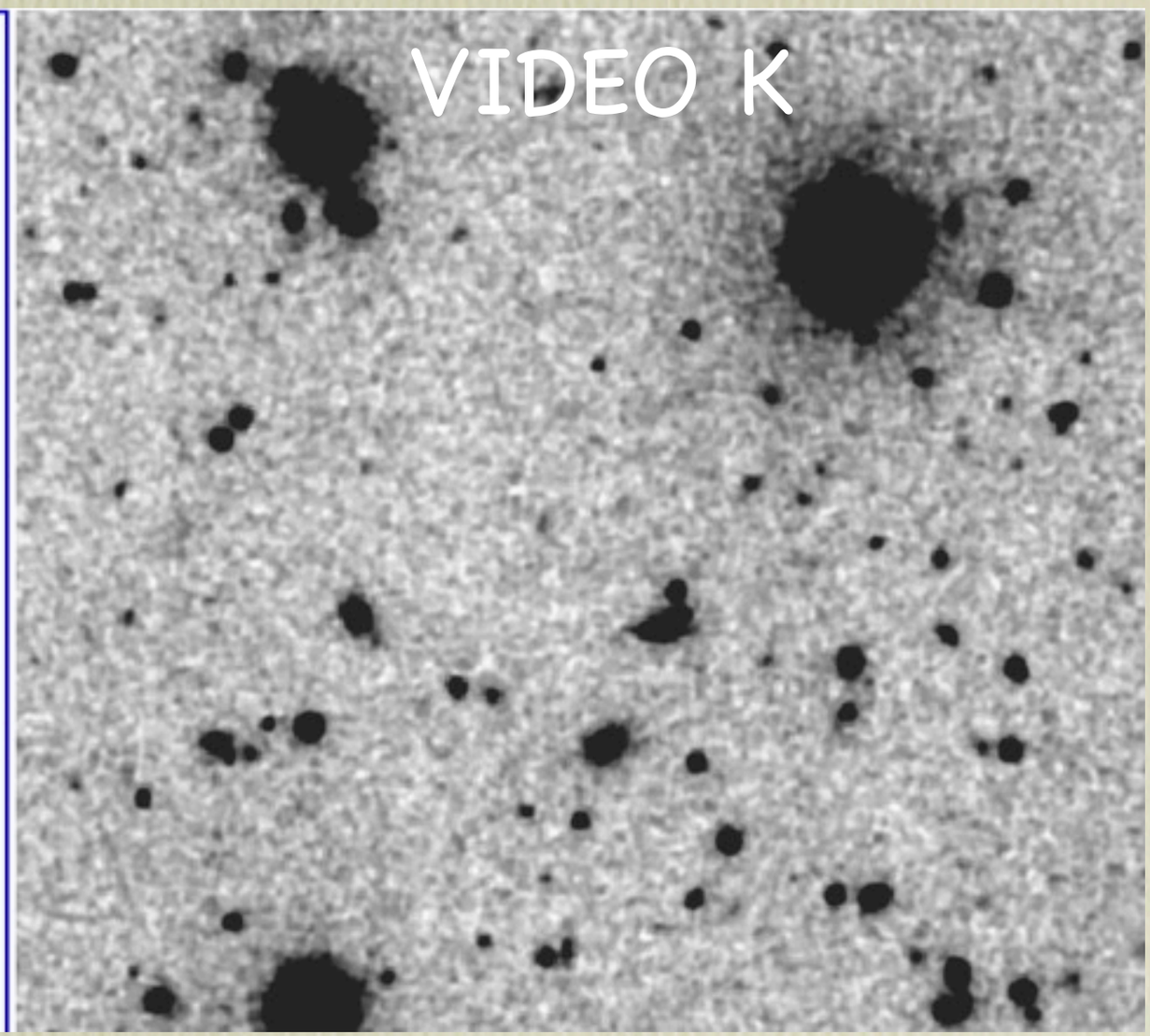
- Good for studying objects rare in very small fields, with areal densities ~0.1-1/square arcmin (z>1 ULRIGs, AGN etc).
- Field size well-matched to high-z clusters, study formation and evolution of morphology-density relation.
- Handful of strawman science cases follow...

Strawman science -I. NIR field survey

- Science goals:
  - Characterize morphologies and luminosities of large numbers of host galaxies of luminous starbursts (Herschel/submm galaxies) and AGN hosts at z~1-4 in fields with good multiwavelength data.
  - Near-IR allows rest-frame optical studies, less affected by dust than shorter wavelengths (in particular K-band is not practical with HST).
  - Study environments of massive galaxies, AGN hosts etc free from blending.

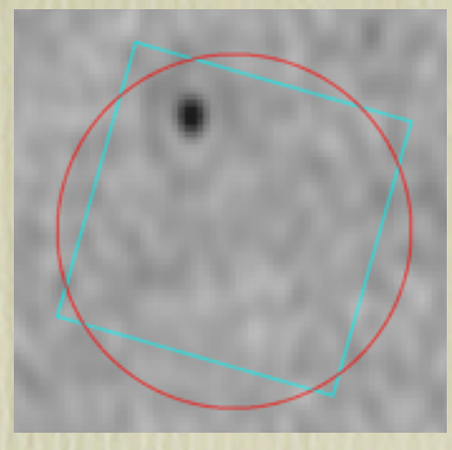
Example - pilot with GeMS/ GSAOI





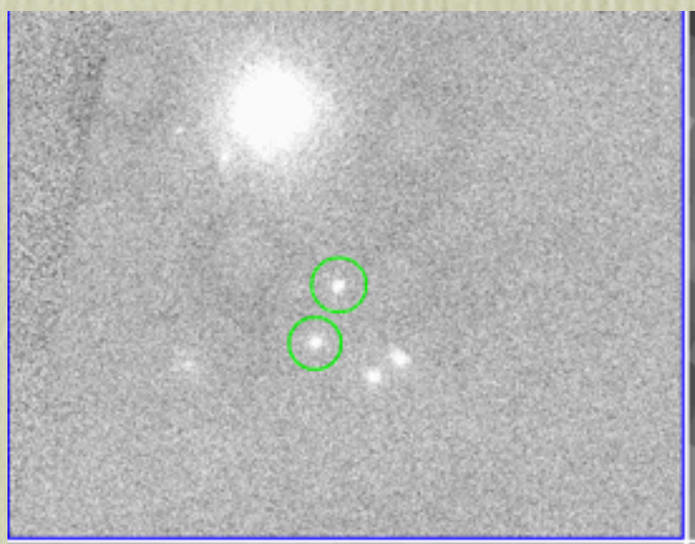
- image FWHM~0.14”

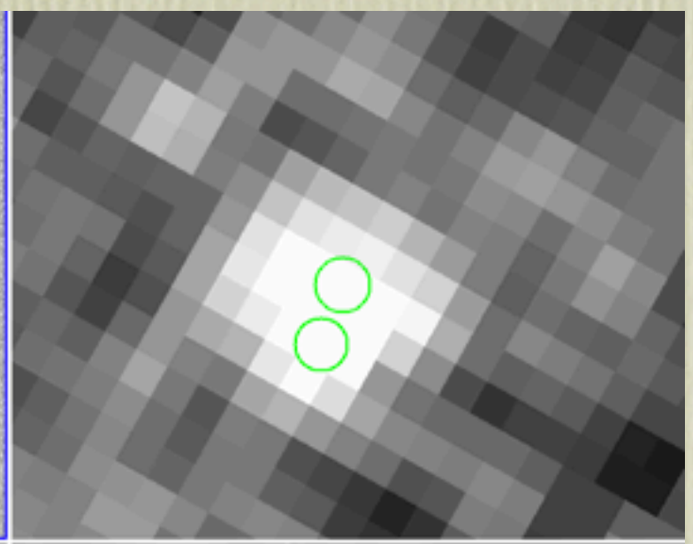
Quick science: I-Candidate multiple AGN



ATNF/ATLAS
1.4GHz

GSAOI-K



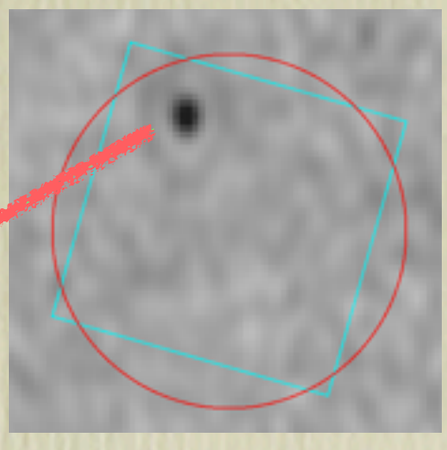


SWIRE
24mu

SWIRE
8mu

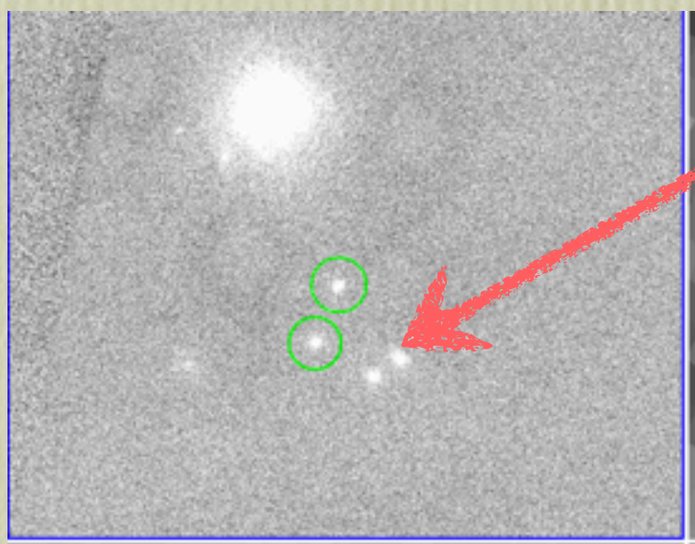
SERVS
4.5mu

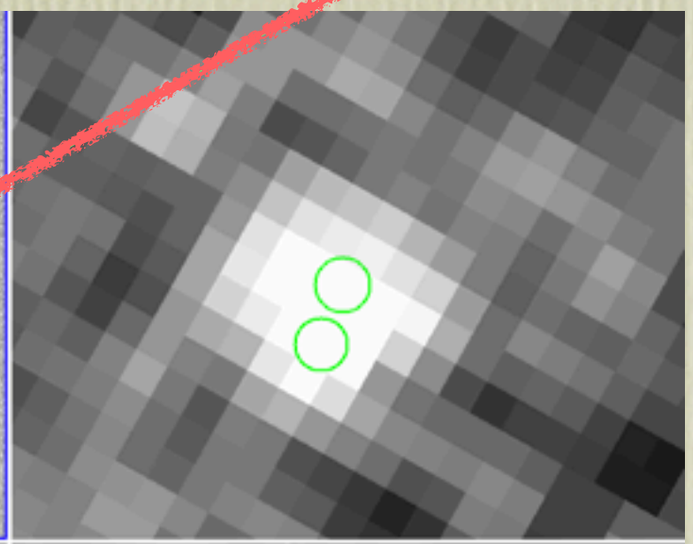
Quick science: I-Candidate multiple AGN



ATNF/ATLAS
1.4GHz

GSAOI-K





SWIRE
24mu

SWIRE
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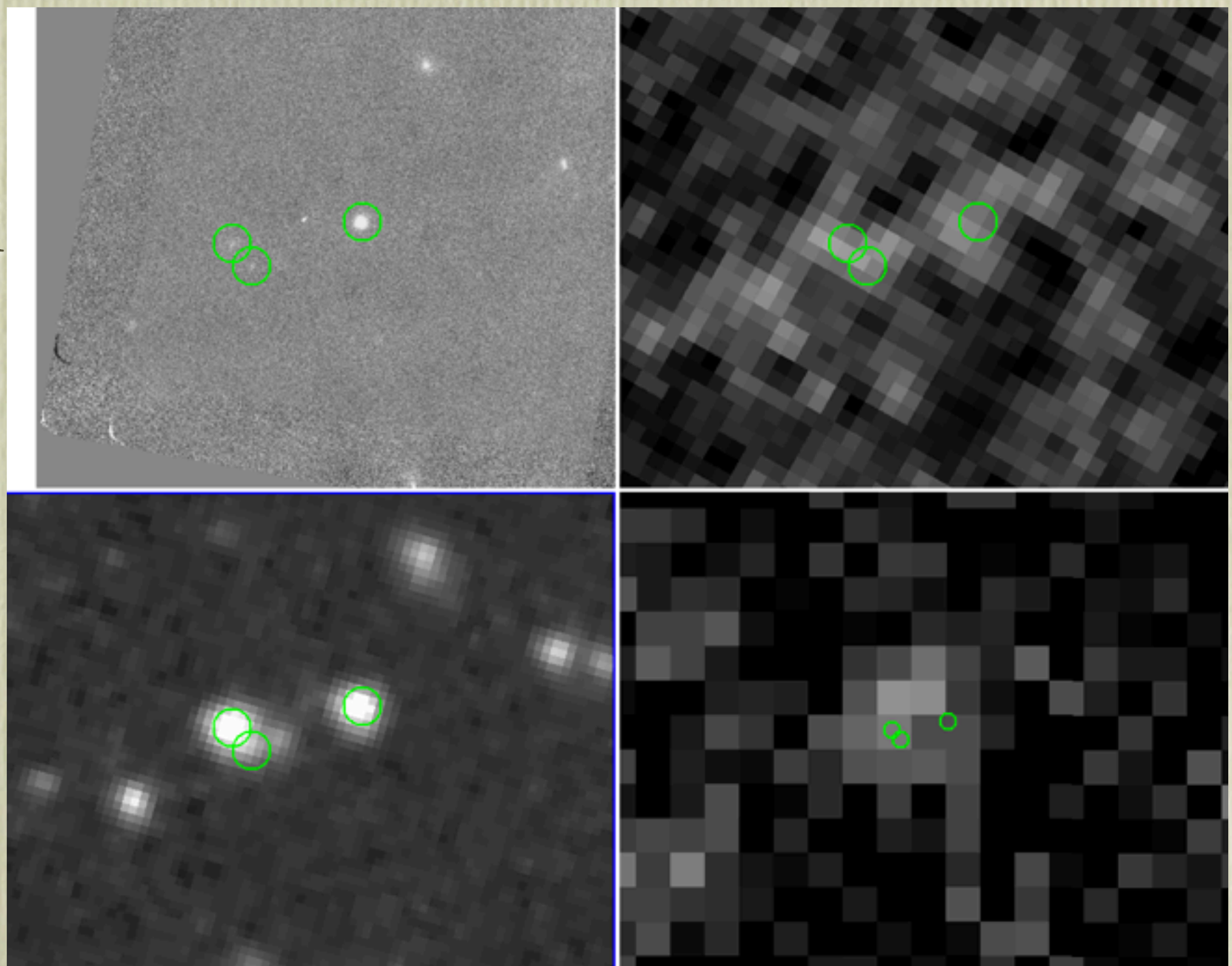
SERVS
4.5mu

Quick science II - Herschel source ID

GSAOI-K

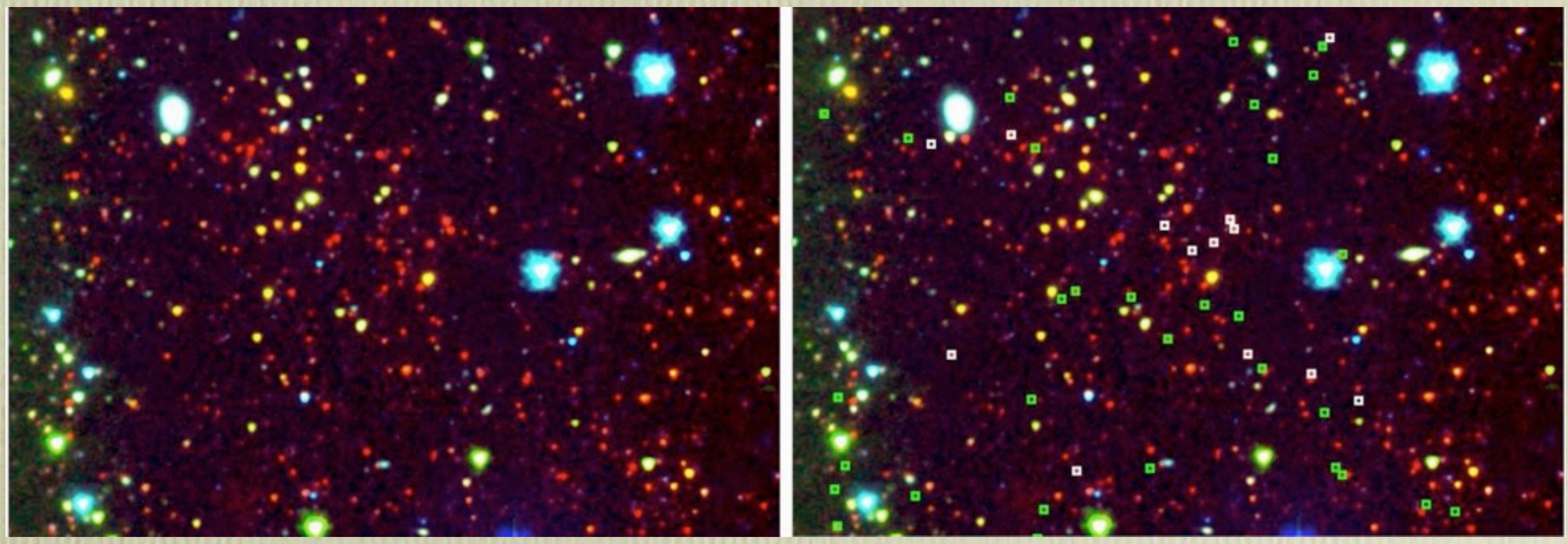


SWIRE 24mu

SERVS 4.5mu

HerMES 250mu

Strawman science -II. High-z cluster



- z=1.63 cluster from Muzzin et al. 2013, 7'x5', right-hand panel shows spectroscopic cluster members in white, foreground objects green.
- Use GLAO for morphology-density studies in field through cluster environments, also to feed MOSFIRE for spectra.

Strawman science III. QSO absorber studies.

- A field a few arcminutes in diameter is also needed to try to identify and characterize absorption systems seen in quasar spectra.
- Some may be associated with outflows from galaxies. High resolution of GLAO needed to estimate inclinations of disk galaxies and thus likely outflow directions.
- Deep GLAO-fed spectroscopy needed for candidate absorber redshifts.

Strawman science IV. Narrow-band surveys

- Deep narrow-band surveys in the near-IR can find emission line galaxies at high redshifts.
- GLAO ideal combination of depth and area for many such surveys.
  - H-alpha surveys done with UKIRT (HiZELS), but could go deeper to probe faint end of the luminosity function.
  - Ly-alpha surveys in J-band - so far no luck, but again GLAO on Keck could go deeper.
  - CIII]??

Summary

- GLAO has the ability to deliver consistent high performance both for feeding “workhorse” instruments and for surveys on scales of ~100-1000 arcmin^2
- To do this, need to take maximum advantage of wider field of view possible with GLAO.
  - Wide FOV increases survey speed.
  - Wide FOV increases sky coverage as easier to find suitable NGS asterisms.