MUSYC: A census of protogalaxies at z=3

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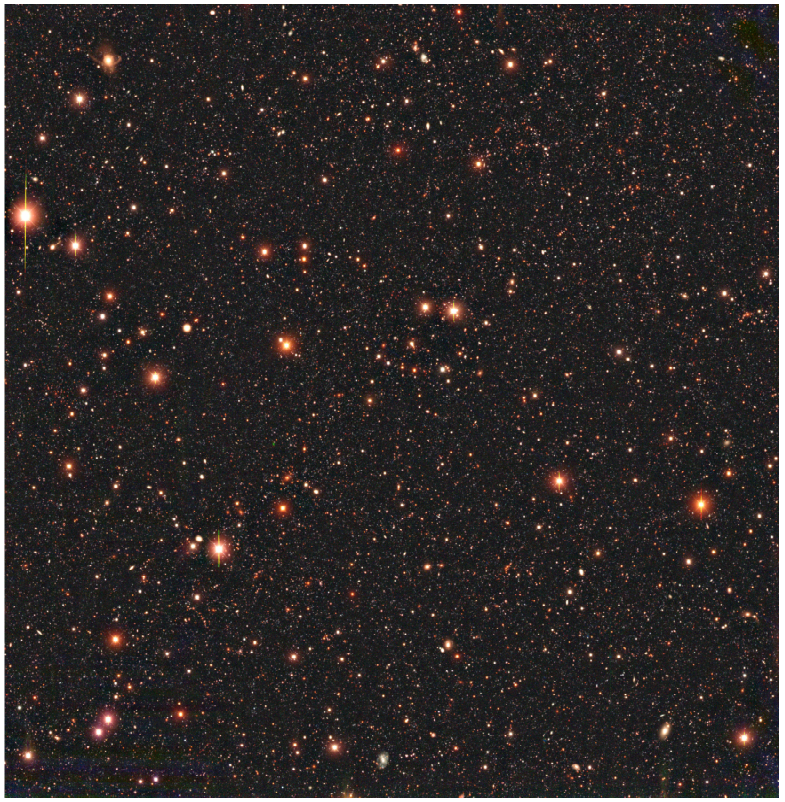


www.astro.yale.edu/MUSYC

Motivation

- Lyman break galaxies (LBGs) are not the precursors of the Milky Way (too massive, too highly clustered)
- Lyman □ Emitters (LAEs), Damped Lyman □ Absorbers (DLAs), and AGN could represent Milky Way precursors
- Test “Grand Unification” at z=3 by comparing LBG and AGN samples

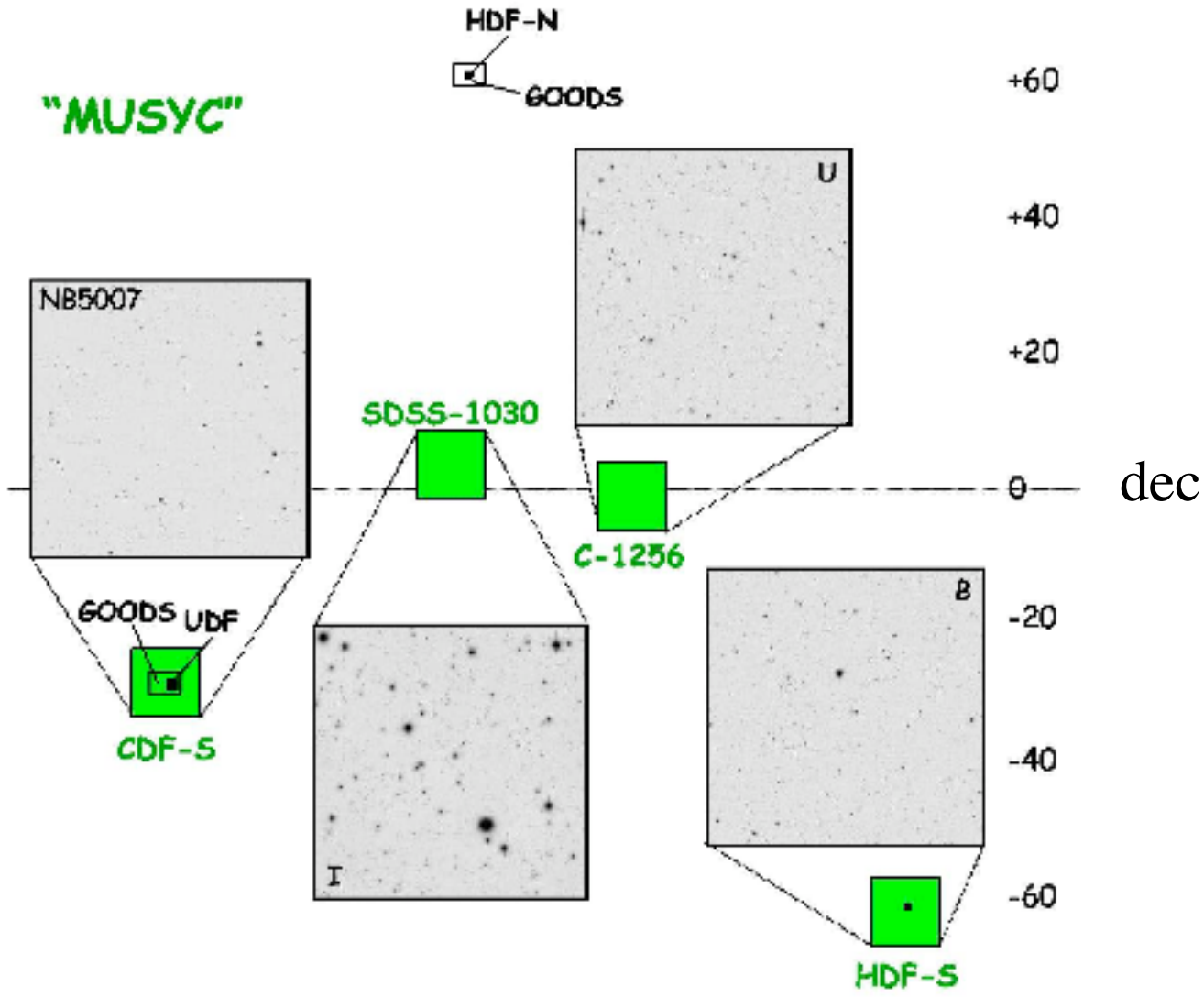
Method

- LBGs easiest to identify observationally, so study cross-correlation to determine bias and hence dark matter halo mass of each family of protogalaxies
- Test clustering by measuring cross-corr.
  e.g. $\xi_{LAE\text{-}LBG}(r) = b_{LAE}\, b_{LBG}\, \xi_{DM}(r)$
- b_{LAE}, b_{DLA}, b_{AGN} determine typical dark matter halo masses of LAEs, DLAs, AGN

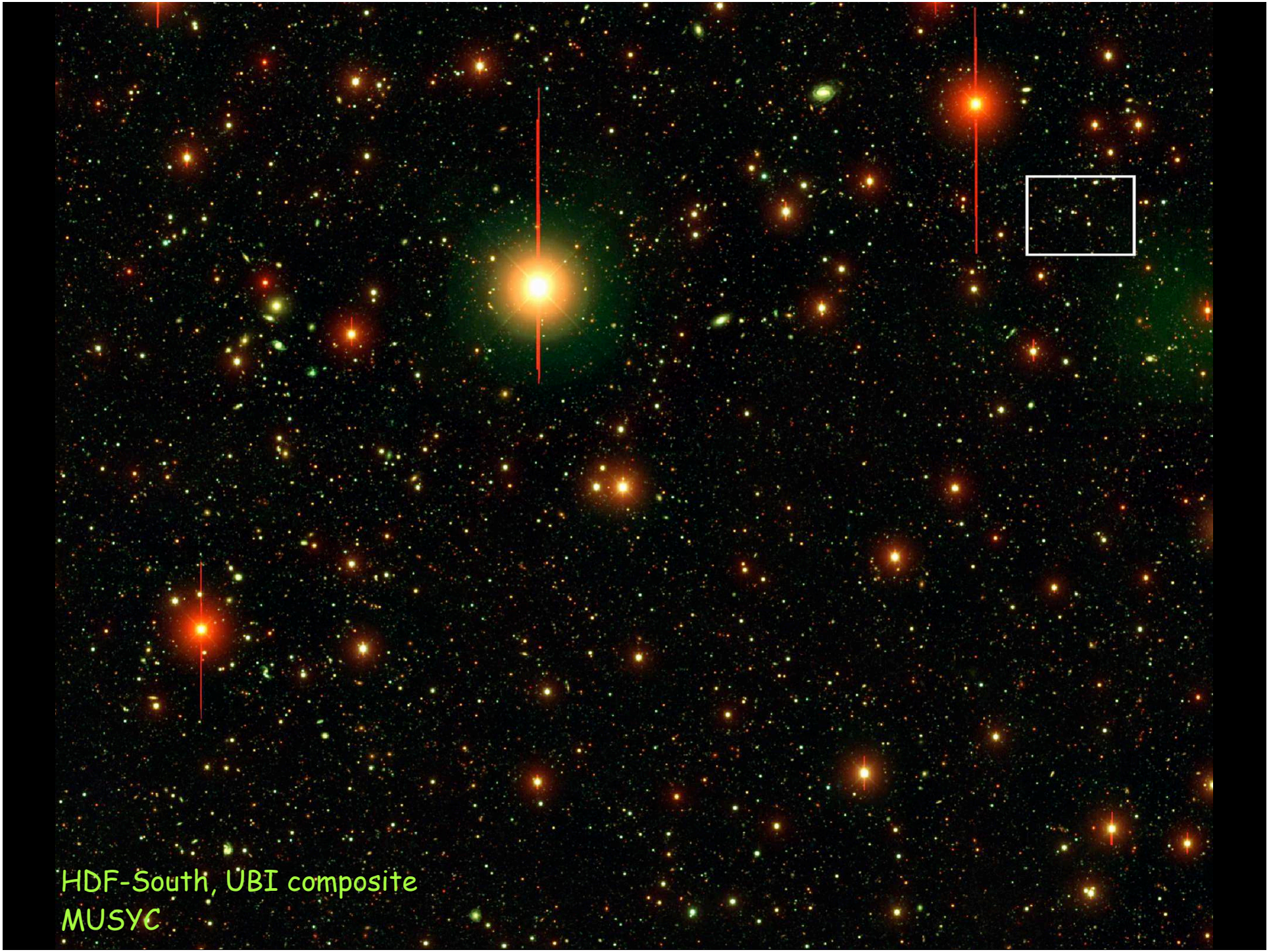
  (Gawiser et al 2001, ApJ 562, 628)

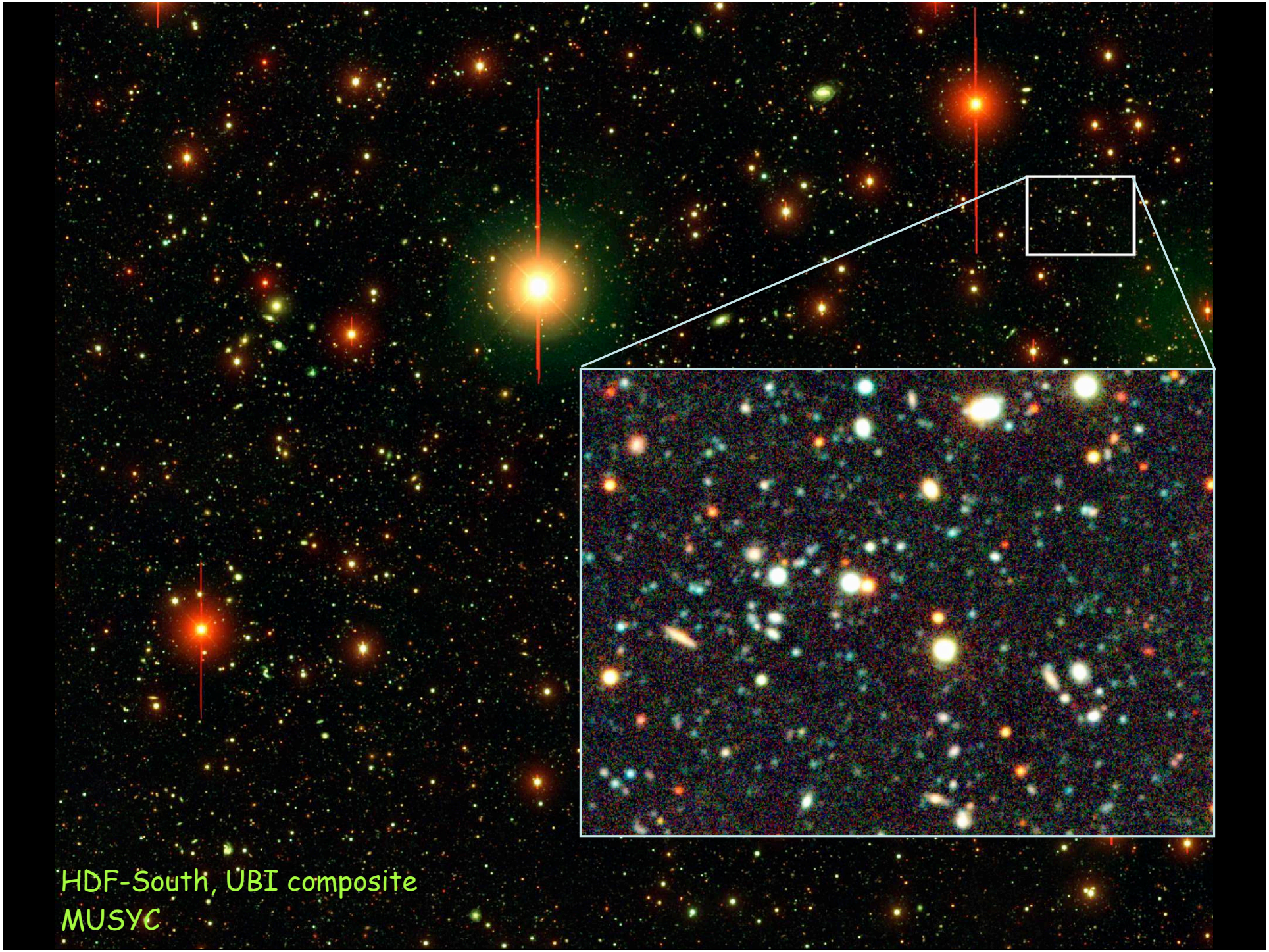
MUSYC (Multiwavelength Survey by Yale-Chile)

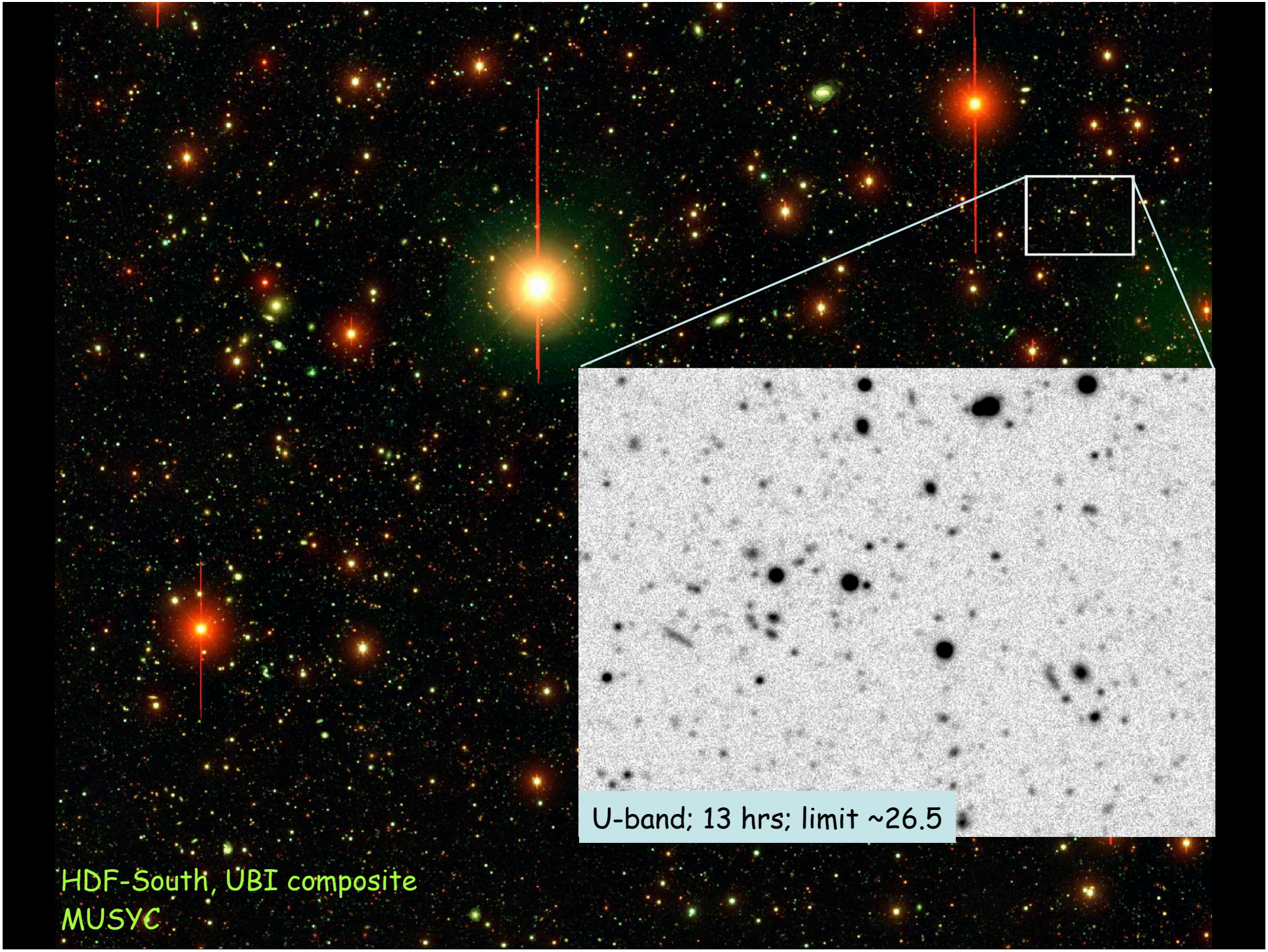
- Square degree comprised of four 30'x30' fields (CDF-S, HDF-S, SDSS1030+05, Cast1256+01)
- Deep UBVRIzJHK imaging (to U,B,V,R_{AB}=26.5, K_{AB}=23) to select LBGs/AGNs completed in 3/4 fields (survey began in 2003!)
- Deep narrow-band imaging for z=3.1 LAEs (almost) completed in CDF-S
- Spectroscopic follow-up started with Gemini-GMOS, Magellan-IMACS, VLT-VIMOS

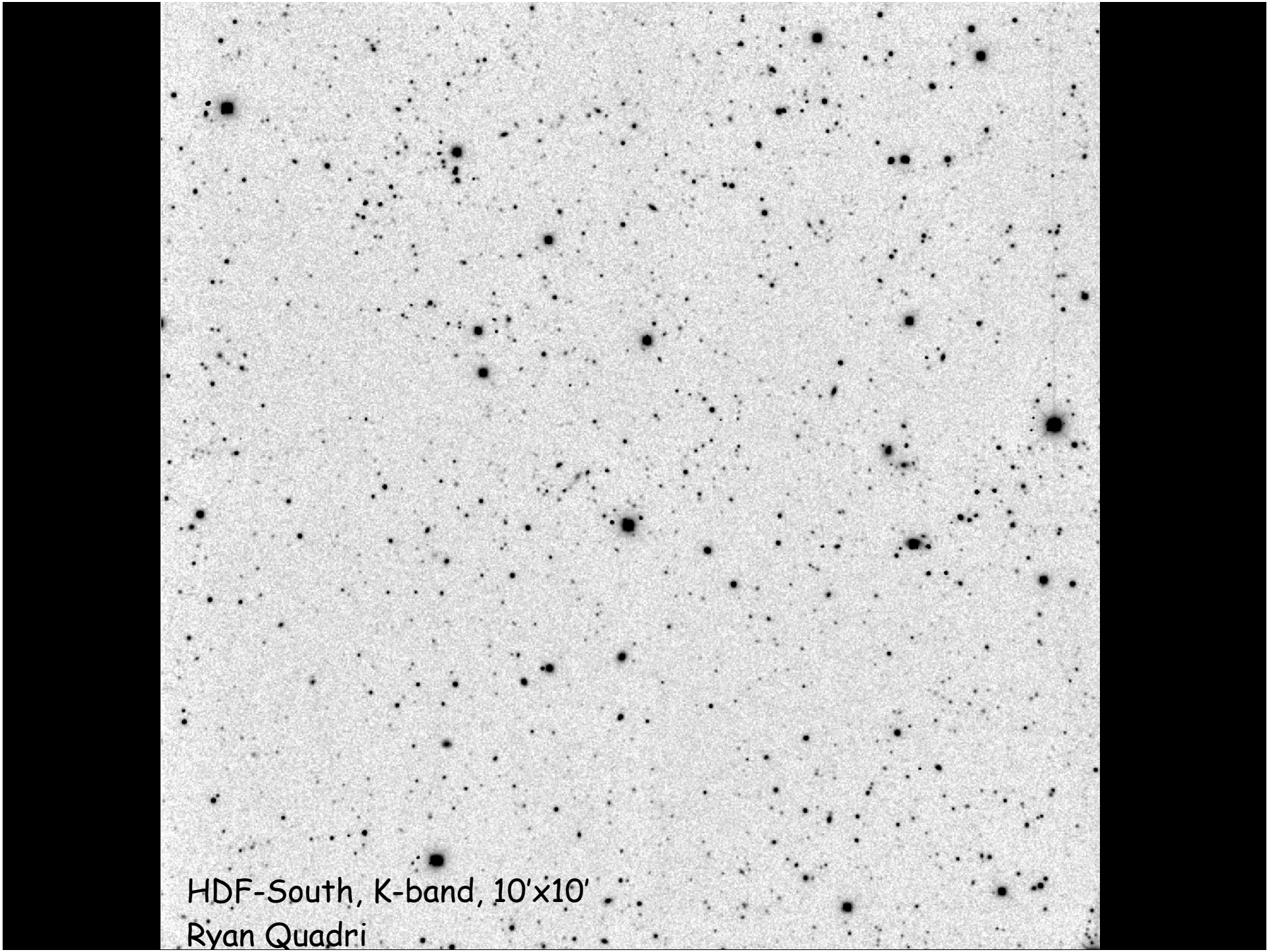

HDF-N
GOODS
"MUSYC"
+60
+40
+20
0
-20
-40
-60
U
NB5007
SDSS-1030
C-1256
B
GOODS UDF
CDF-S
I
HDF-S
dec
0
RA
24


HDF-South, UBI composite
MUSYC


HDF-South, UBI composite
MUSYC

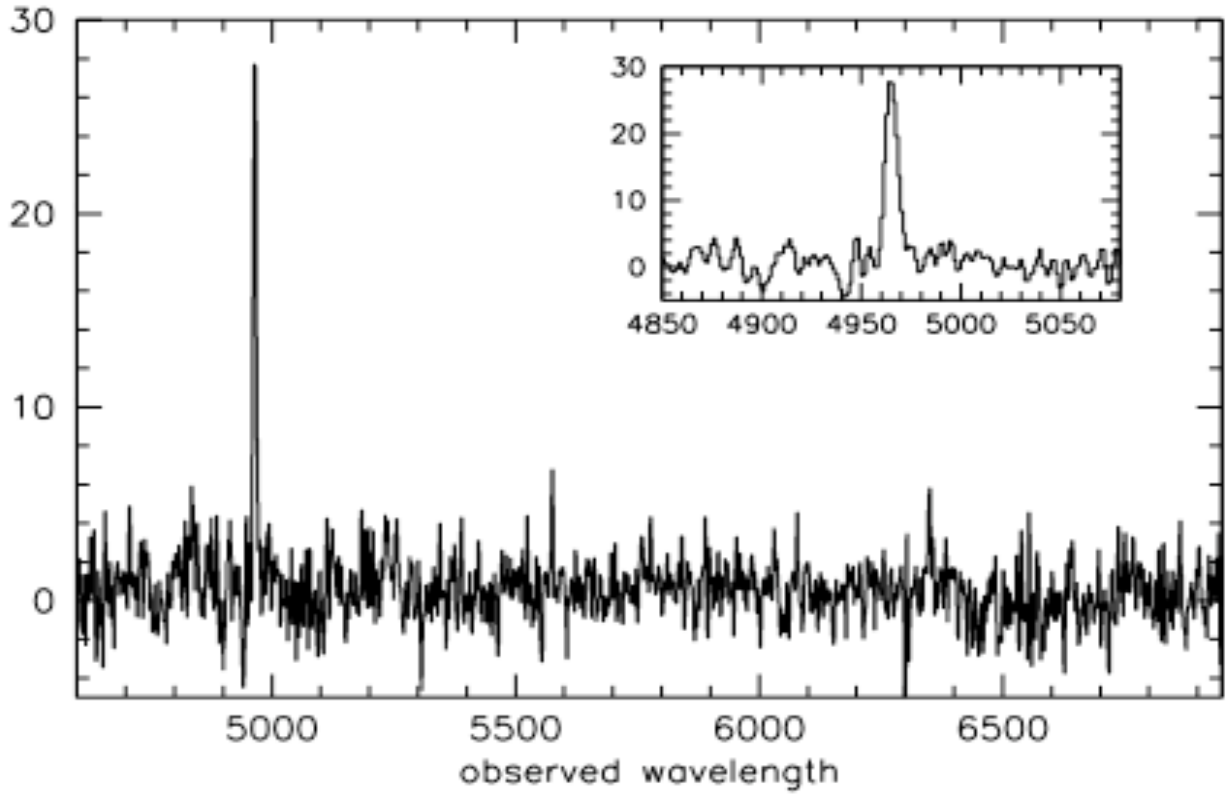

HDF-South, UBI composite
MUSYC


U-band; 13 hrs; limit ~26.5
HDF-South, UBI composite
MUSYC


HDF-South, K-band, 10′x10′
Ryan Quadri

MUSYC: Other Science Projects

1. Evolved galaxies at z=3 selected in J-K
2. AGN demographics at 0<z<6
3. Galactic structure from a proper motion + color survey for white dwarfs and brown dwarfs
4. Low surface-brightness galaxies
5. Public outreach: will add our survey data to Hayden Planetarium's Digital Universe project and produce explanatory materials in Spanish



Magellan-IMACS spectrum of z=3.08 LAE

Conclusions

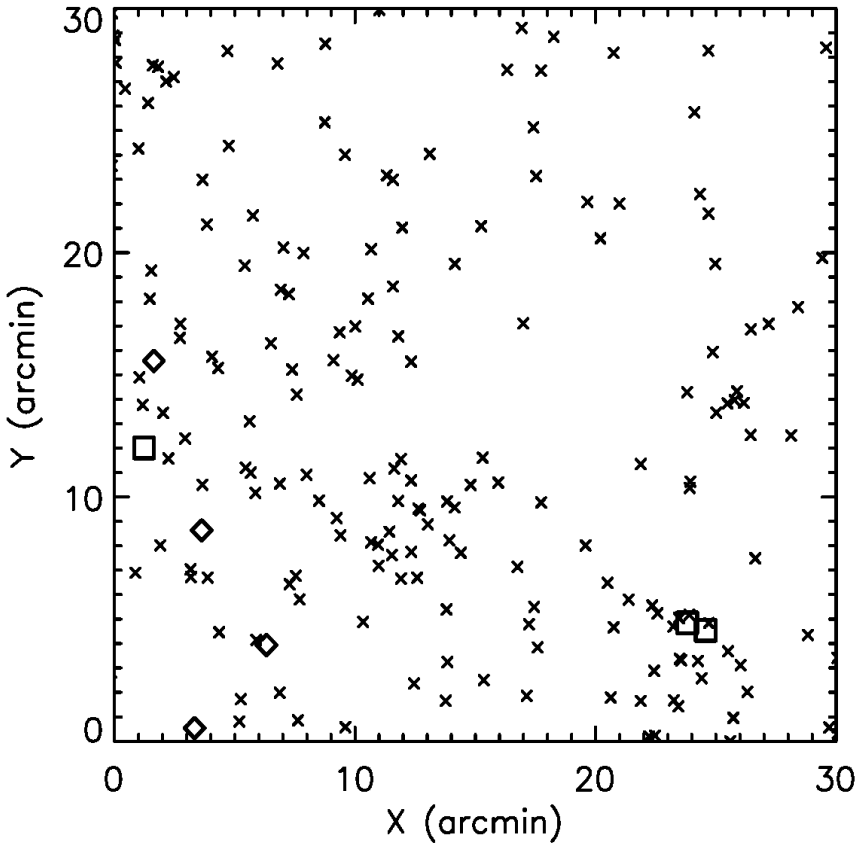
- Whether or not M_{BH} - M_{bulge} relation holds, we can explore the relationship between M_{halo}, M_{bulge}, and M_{BH} to provide clues to bulge formation.
- We are just starting to assemble the pieces of the galaxy/BH formation puzzle but that's MUSYC to my ears…
- Positions open for new Andes Fellows

MUSYC vs. Steidel et al.

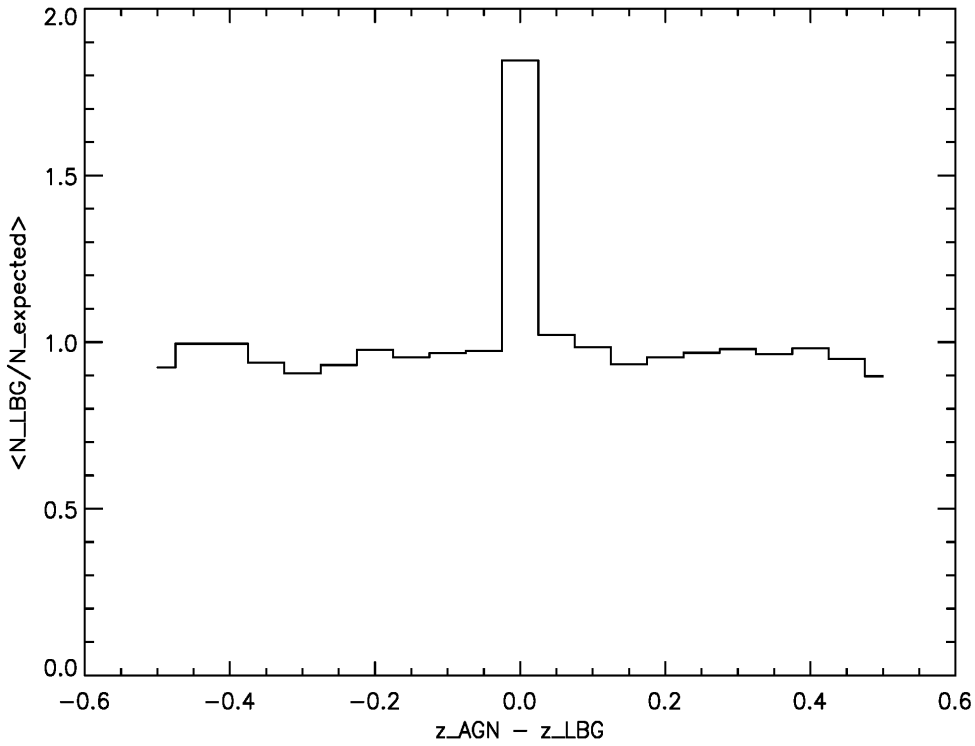
Advantages:

1. More area spread over fewer fields.
   □(□)= sqrt(n_{field}/(N_{LBG} N_{AGN})) so MUSYC will have 5x better (cross-)correlation statistics than Steidel et al.
2. Sample of ~100 Lyman alpha emitters in blank fields.
3. NIR fluxes (or limits) to break age/dust degeneracy and measure LBG stellar (bulge?) masses.
4. Chandra/XMM/SIRTF coverage in 3/4 fields.
5. In E-CDF-S, ACS images give morphologies.

Disadvantage: Current redshifts are from simulations.



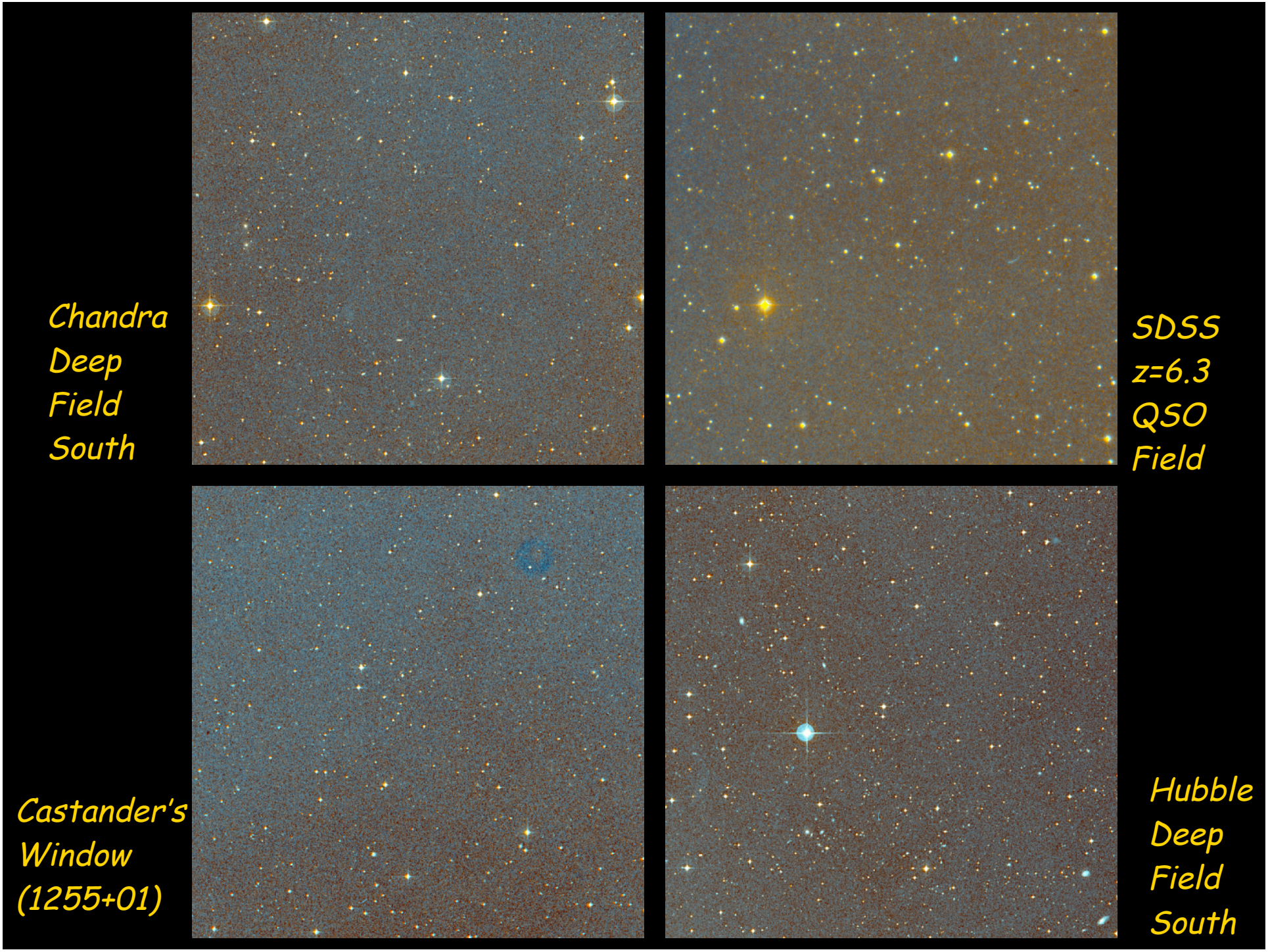
Distribution of NL AGN (diamonds), BL AGN (squares), and LBGs (crosses) in a cube of our pencil beam survey ($\Delta z = 0.1$)



Redshift histogram for one quarter-square-degree field, summed over e.g. all broad-lined AGN

Unique aspects

- Deep U-band (MOSAIC)
- Deep near-IR imaging (ISPI)
- Fields available at any time of the year
- Very large range of follow-up facilities
- Enthusiastic team !


Chandra
Deep
Field
South
SDSS
z=6.3
QSO
Field
Castander's
Window
(1255+01)
Hubble
Deep
Field
South