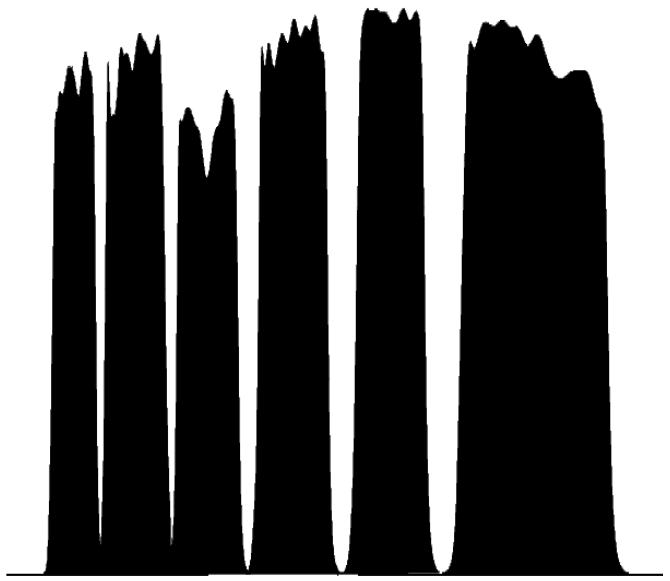
Establishing the low-redshift baseline with TAIPAN – connection to the ZFOURGE high-redshift galaxy survey

Lee Spitler

Macquarie University
& AAO



A renaissance in high-redshift galaxy surveys

High-redshift is defined as:

$1.5 < z < 3.5$

~9-12 Gyrs ago

3D-HST

A Spectroscopic Galaxy Evolution Survey with the Hubble Space Telescope

Z-FOURGE

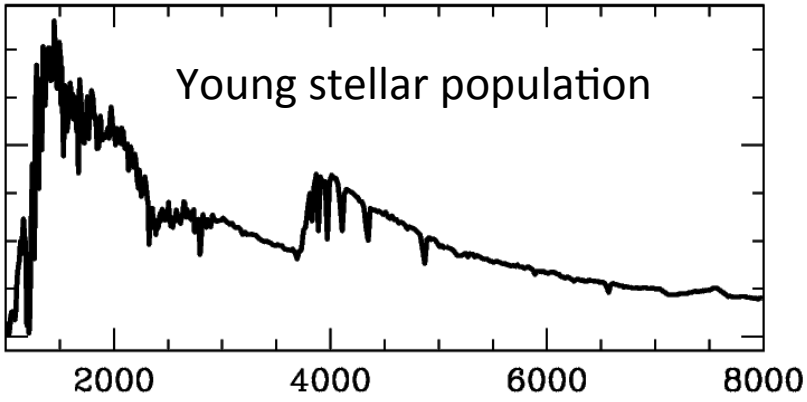
FourStar Galaxy Evolution Survey

UltraVISTA

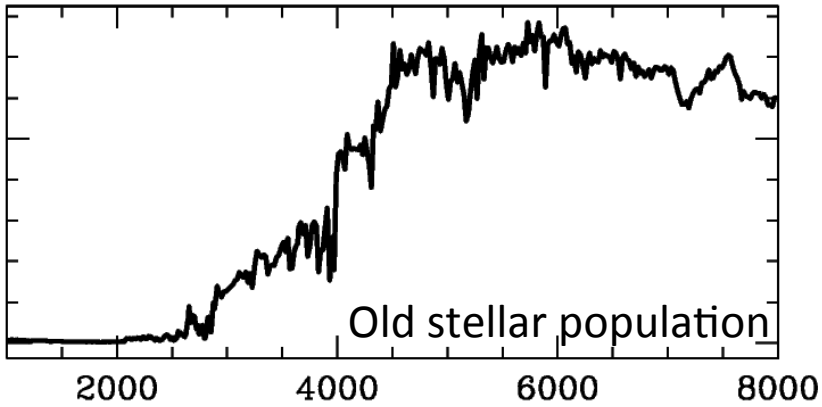
Ultra Deep Survey with the VISTA telescope

The common theme: near-infrared observations

Why?
Near-IR fills in a redshift gap at $1.5 < z < 3.5$



Rest frame Å



Rest frame Å

The result:
Rest-frame optical
Mass-selected census

- Data
  - Deep near-infrared broadband imaging
- Largest HST project to date
  - 902 orbits = 4 months of observing time
- Primary science
  - SNe and galaxy evolution
- 5 legacy fields
  - COSMOS, GOODS-S, GOODS-N, UDS, EGS
    deep: 0.04 deg^2 wide: 0.2 deg^2

UV

g

V

R

I

z

Y

J

H

Table 3
CANDELS Areas and 5σ Limiting Magnitudes

	CANDELS Wide [668 arcmin^2]	CANDELS Deep [120 arcmin^2]
Filter	Sensitivity [mag]	Sensitivity [mag]
F275W	...	27.8[a]
F336W	...	27.6[a]
F435W	27.8[b]	27.8
F606W	27.6	28.2
F775W	27.5[b]	27.5
F814W	27.5	28.4
F850LP	27.3[b]	27.3
F105W	26.6[b]	27.3
F125W	26.4	27.4
F160W	26.5	27.2

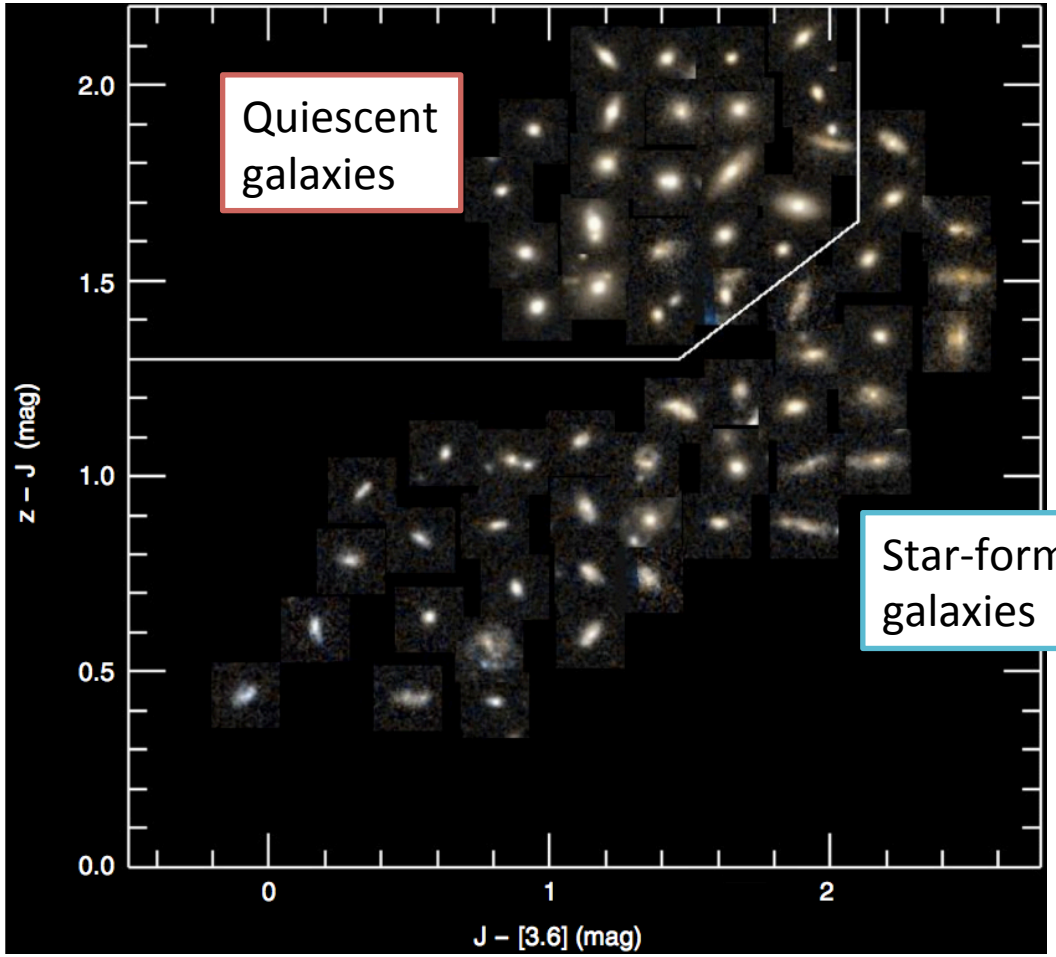
Note. — Limiting magnitudes correspond to 5× the photometric error within a 0.″25-radius aperture.

[a] Available only in the CANDELS GOODS-North.

[b] Available only in the Deep flanking fields.

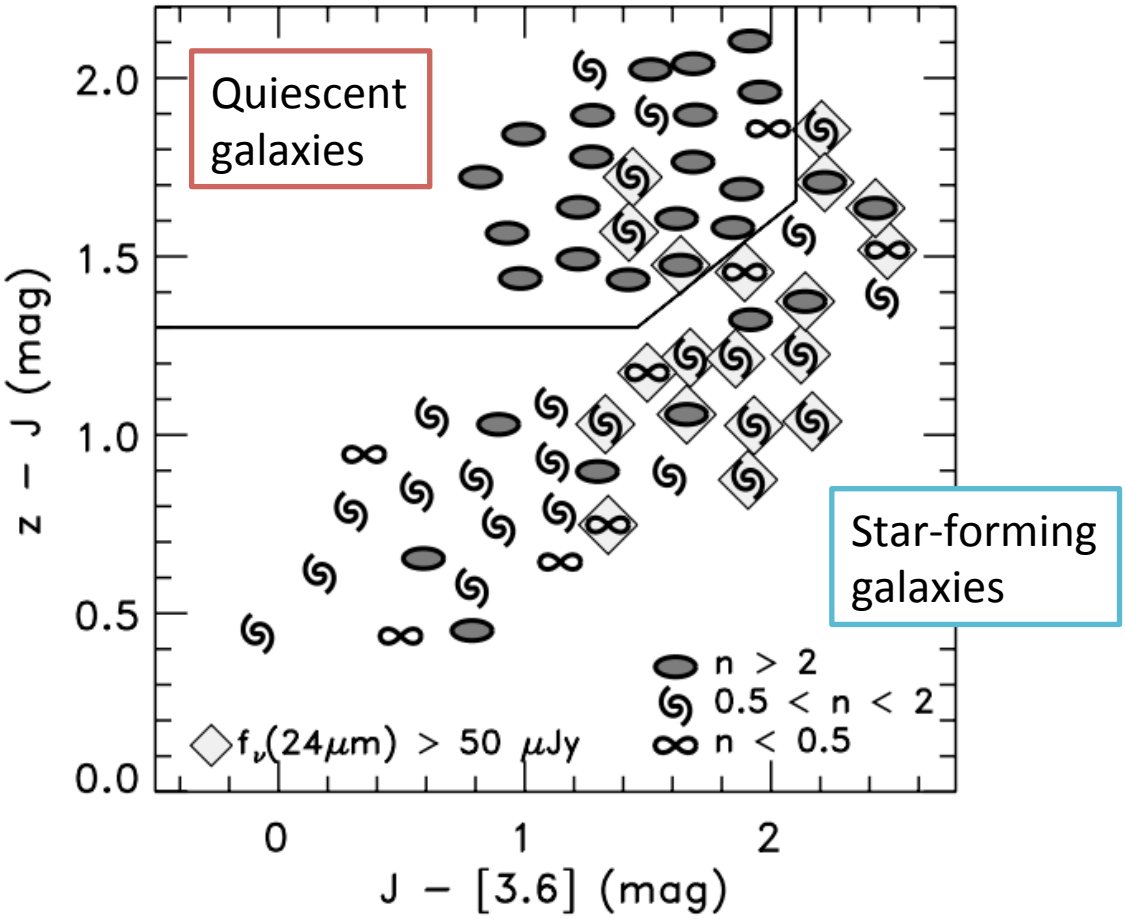
Grogin et al. 2011

NO K-band!



z=1.62
protocluster

Papovich et al. 2012



z=1.62
protocluster

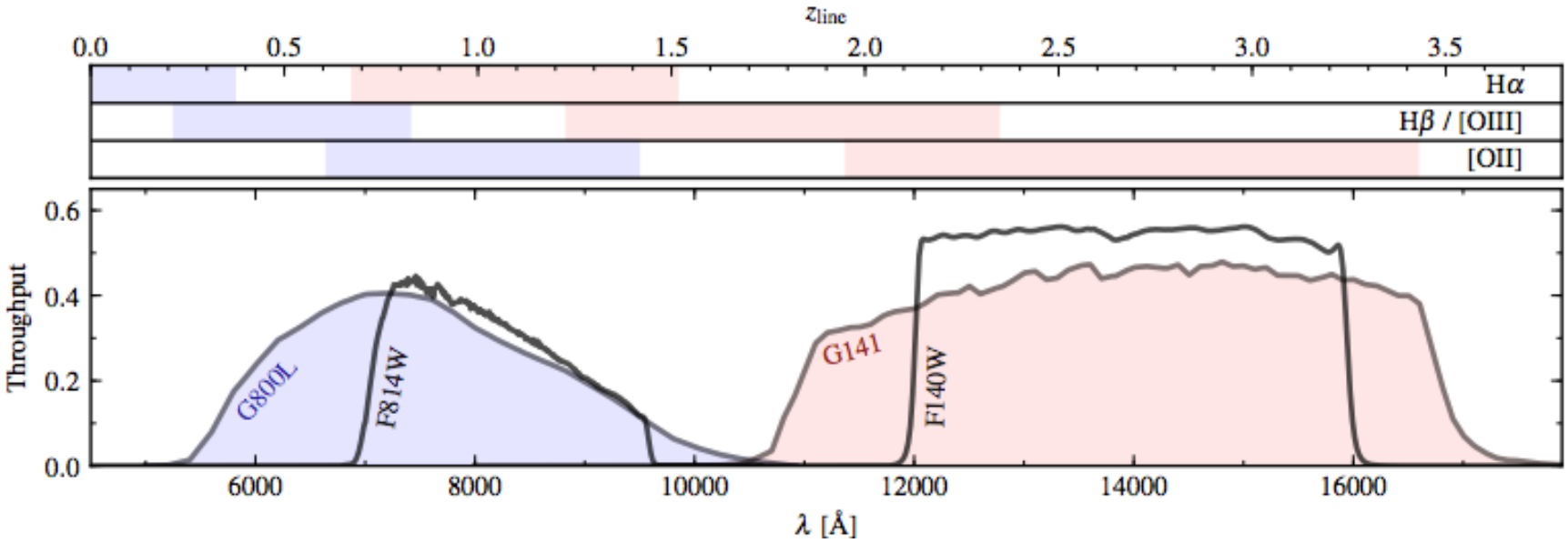
Papovich et al. 2012

A Spectroscopic Galaxy Evolution Survey with the Hubble Space Telescope

- Data
  - J+H-band grism spectroscopy
    R=130 resolution ~1000 km/s for Hα at z > 1
- 248 orbits with HST
- Primary science
  - ~10,000 galaxy spectra at z > 1
- Classic fields, 75% of CANDELS, 600 arcmin^2

3D-HST

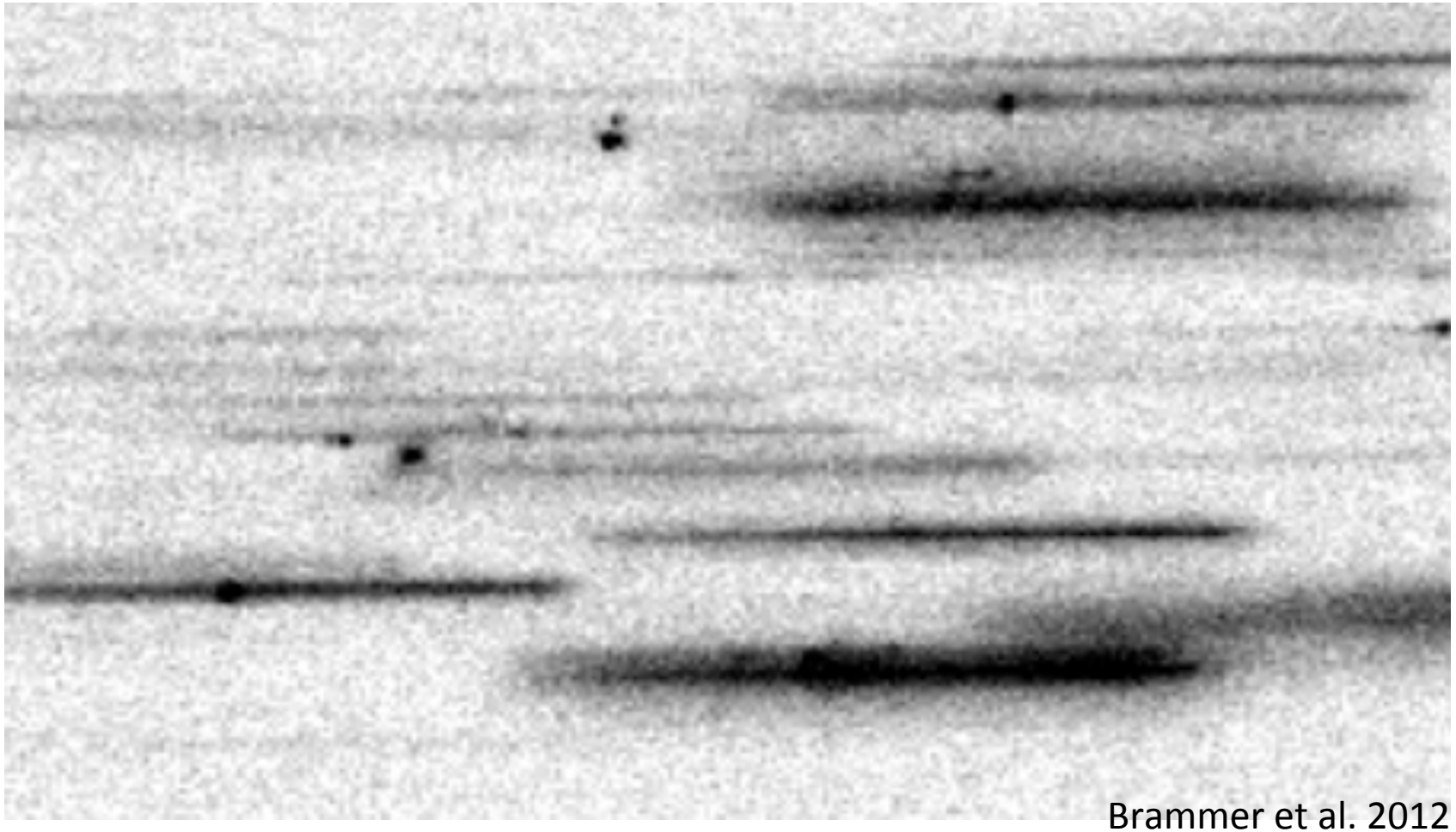
A Spectroscopic Galaxy Evolution Survey with the Hubble Space Telescope



Brammer et al. 2012

3D-HST

A Spectroscopic Galaxy Evolution Survey with the Hubble Space Telescope

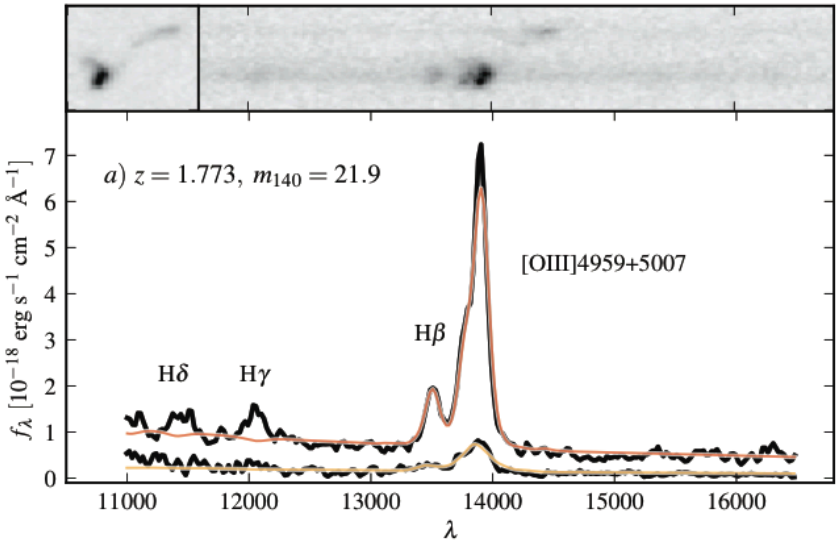


Brammer et al. 2012

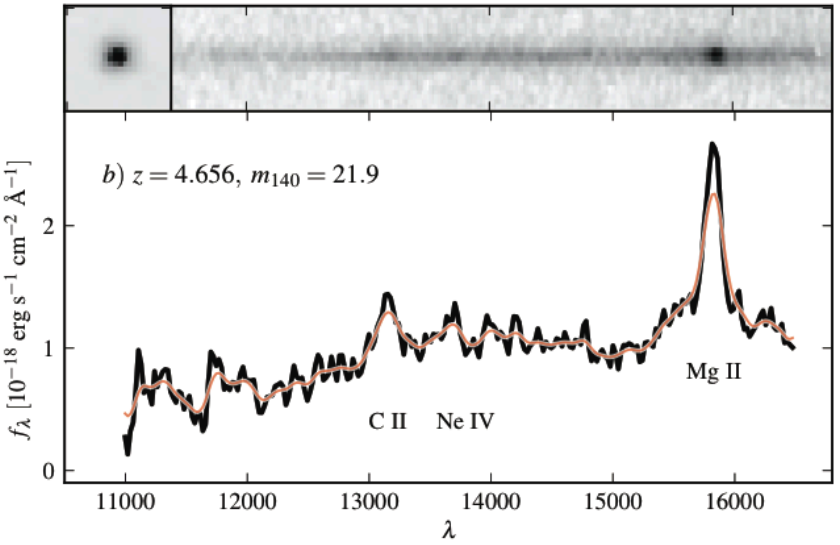
3D-HST

A Spectroscopic Galaxy Evolution Survey with the Hubble Space Telescope

z=1.77 extended galaxy



z=4.656 quasar

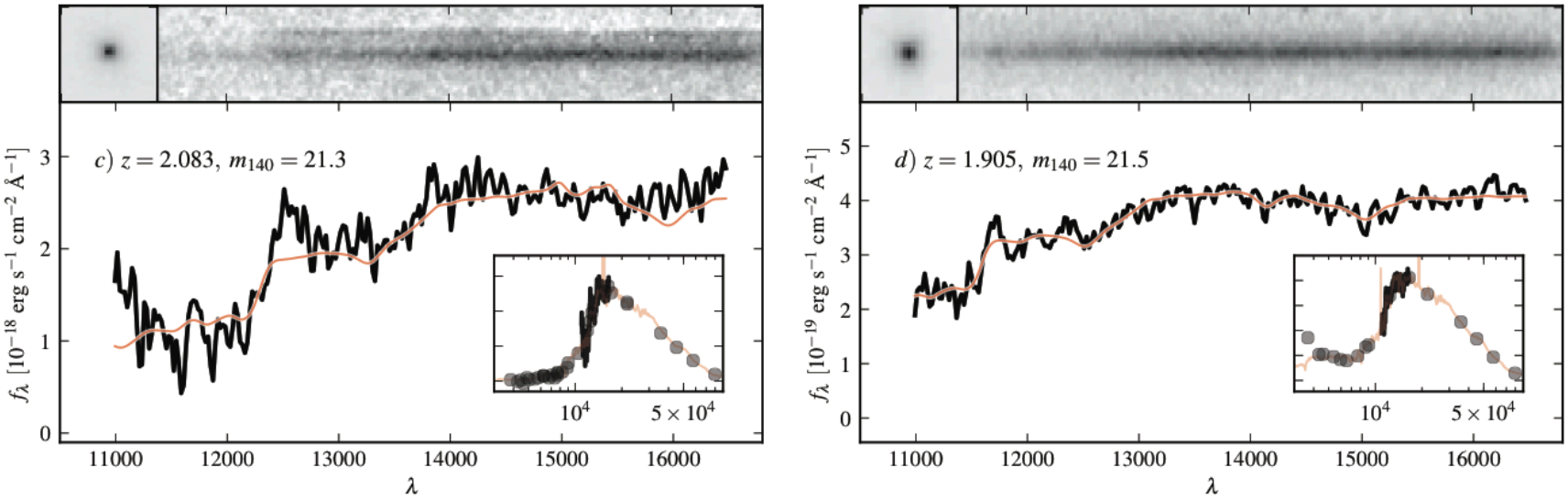


Brammer et al. 2012

3D-HST

A Spectroscopic Galaxy Evolution Survey with the Hubble Space Telescope

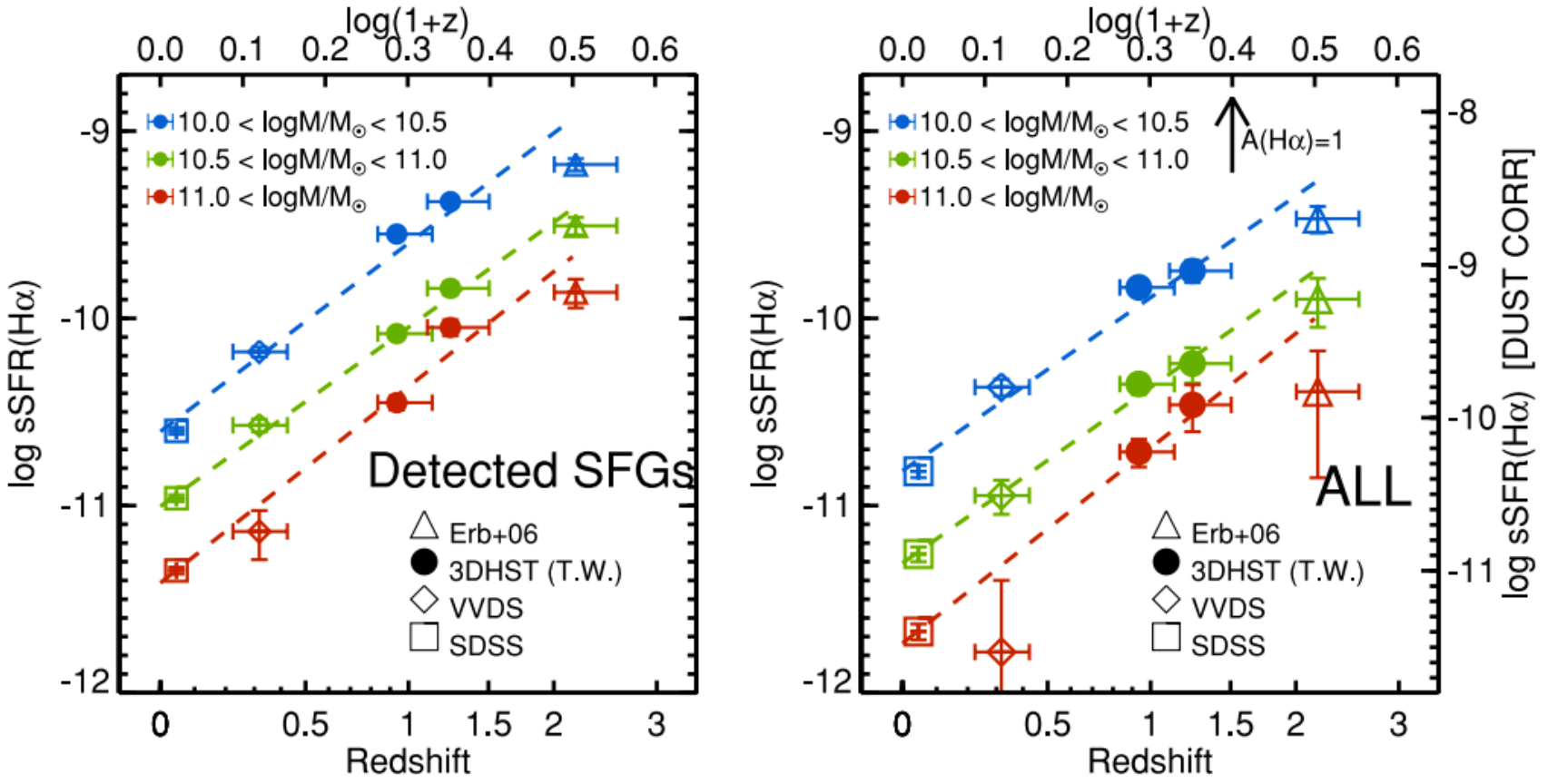
Massive, old galaxies @ z=2



Brammer et al. 2012

3D-HST

A Spectroscopic Galaxy Evolution Survey with the Hubble Space Telescope



Fumagalli et al. 2012

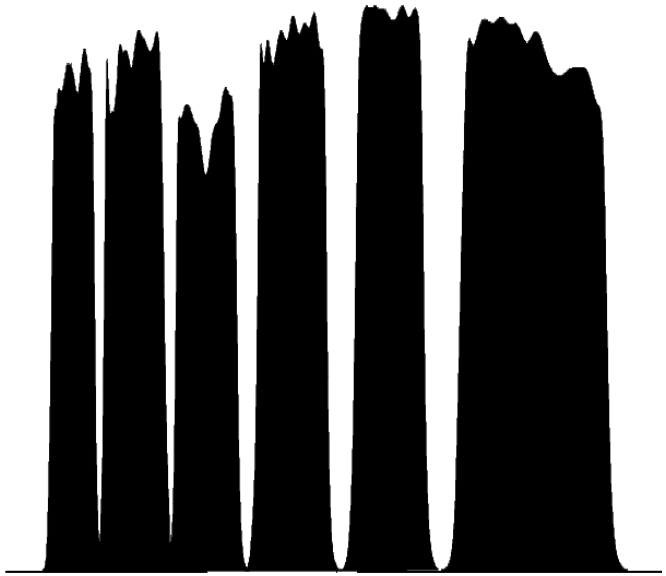
Z-FOURGE

FourStar Galaxy Evolution Survey

- A ~50 night Magellan survey using FourStar near-infrared camera
- Data
  - 5 **medium-band** filters + Ks broadband
- Primary science
  - Accurate photometric redshifts: 1-2% level
- 3 legacy fields – observing complete
  - COSMOS, GOODS-S, UDS
    11x11 arcmin^2 each

The Z-FOURGE Survey

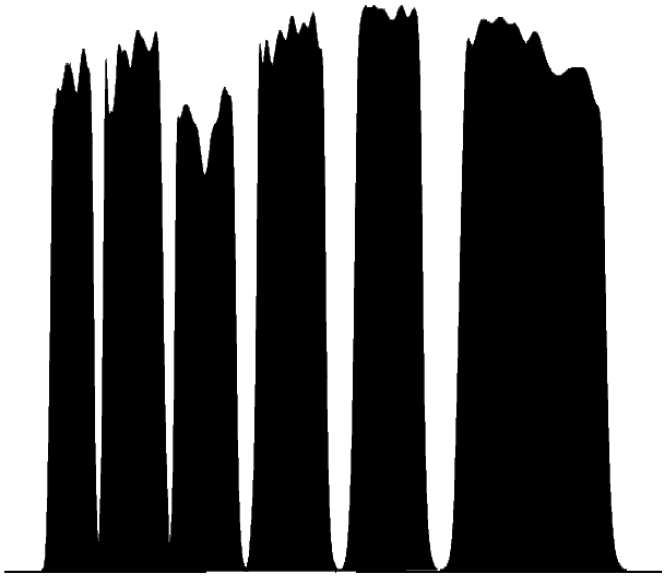
The
FourStar Galaxy Evolution
Survey



Glazebrook, Kacprzak, Labbé (PI),
Kelson, McCarthy, Monson, Murphy,
Papovich, Persson, Quadri, Spitler,
Straatman, Tilvi, Tran, van Dokkum

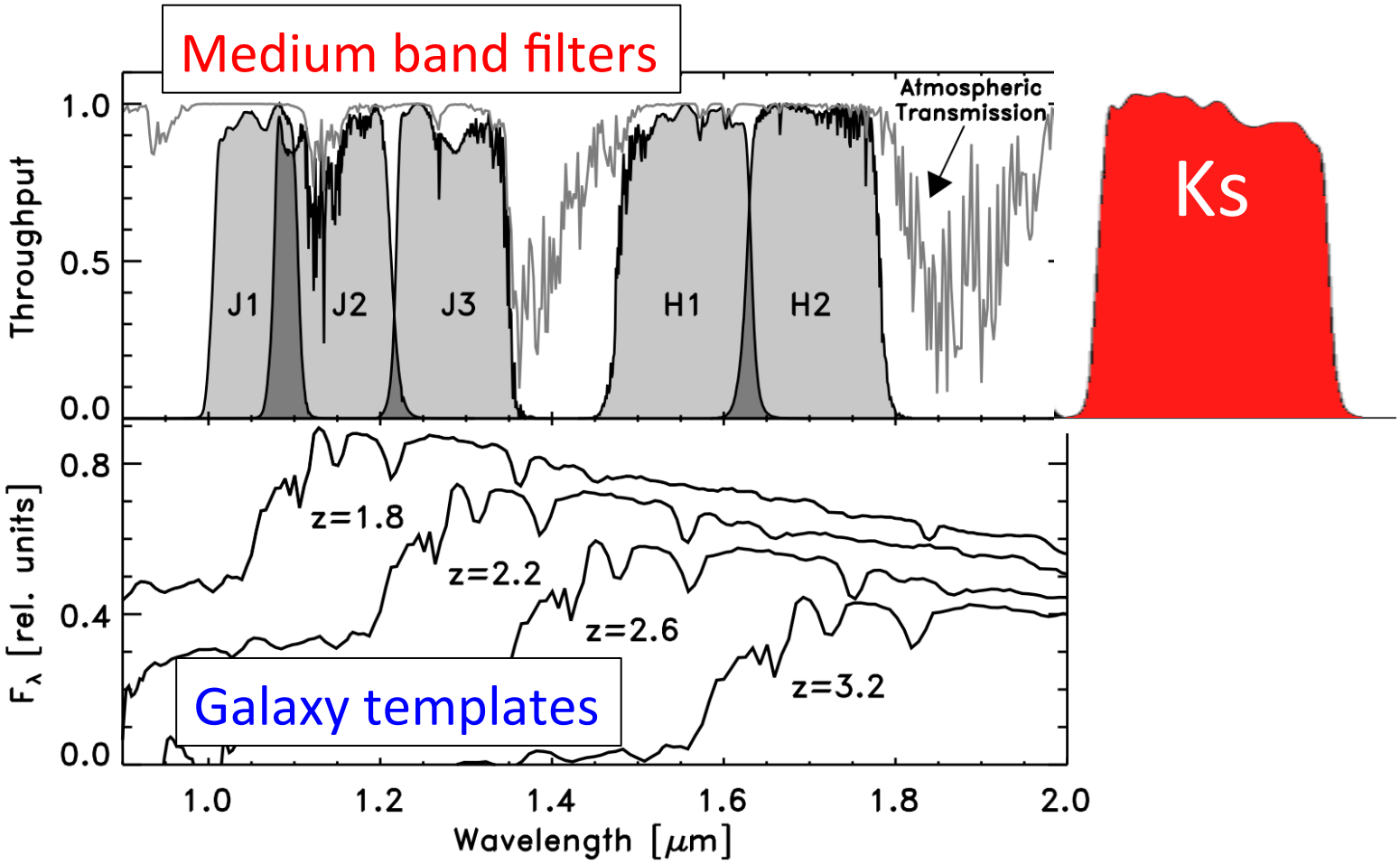
http://z-fourge.strw.leidenuniv.nl/

Primary objective: accurate distances



Z-FOURGE

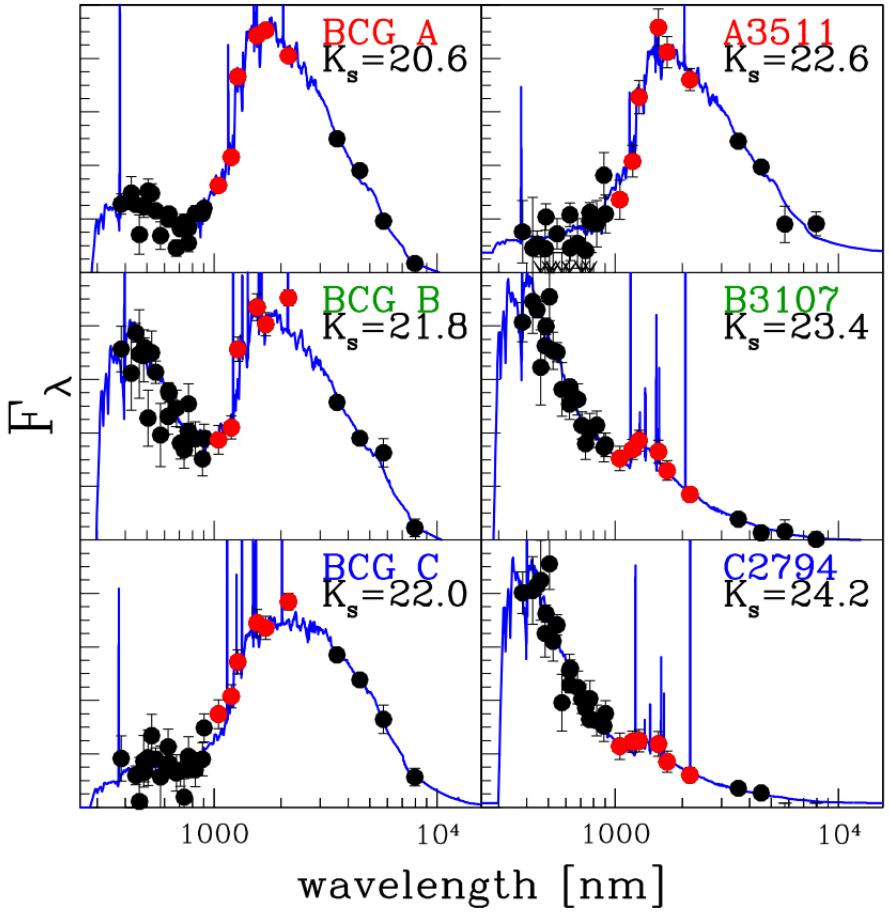
FourStar Galaxy Evolution Survey



1-2% redshifts uncertainties, σ/(z+1), at 1.5 < z < 3.5

Z-FOURGE

FourStar Galaxy Evolution Survey



32 bands total

Spitler et al. 2012

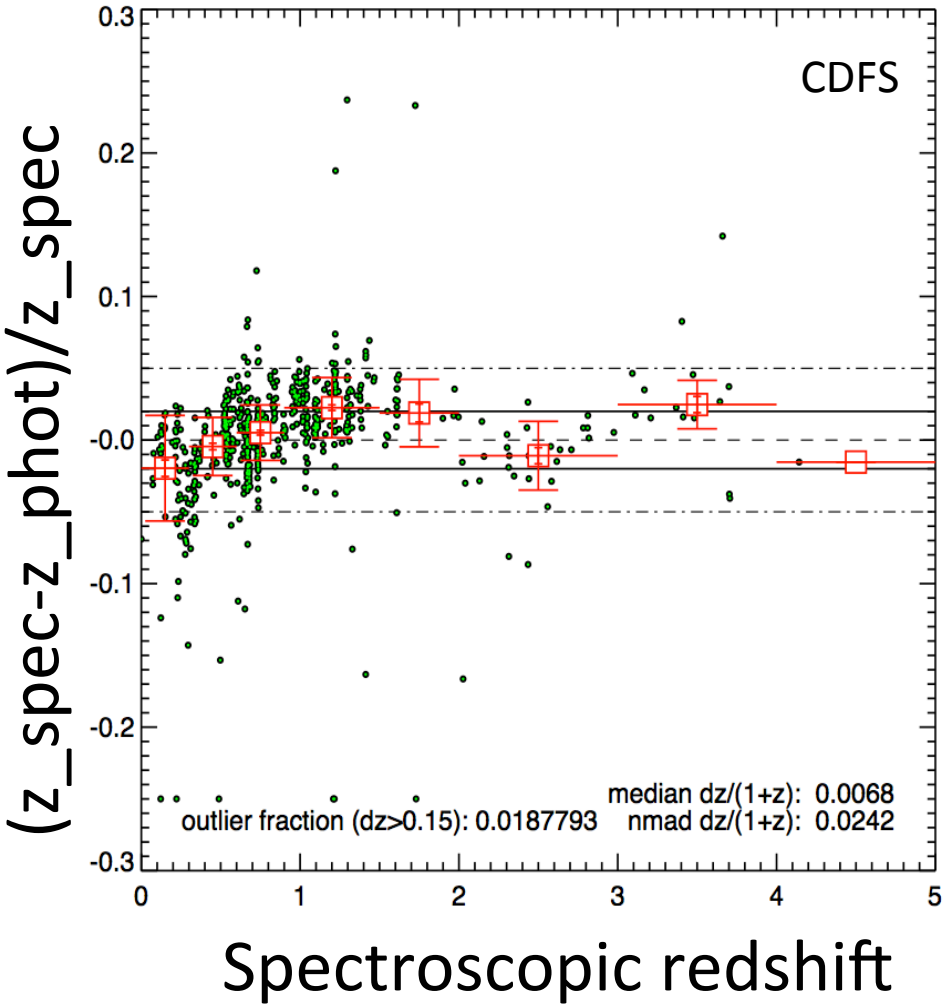
Z-FOURGE data **COSMOS legacy data** **EAZY galaxy templates**

EAZY Brammer et al. 2008

Z-FOURGE

FourStar Galaxy Evolution Survey

Medium-bands
Reduce outliers
Reduce systematics
Improve redshifts

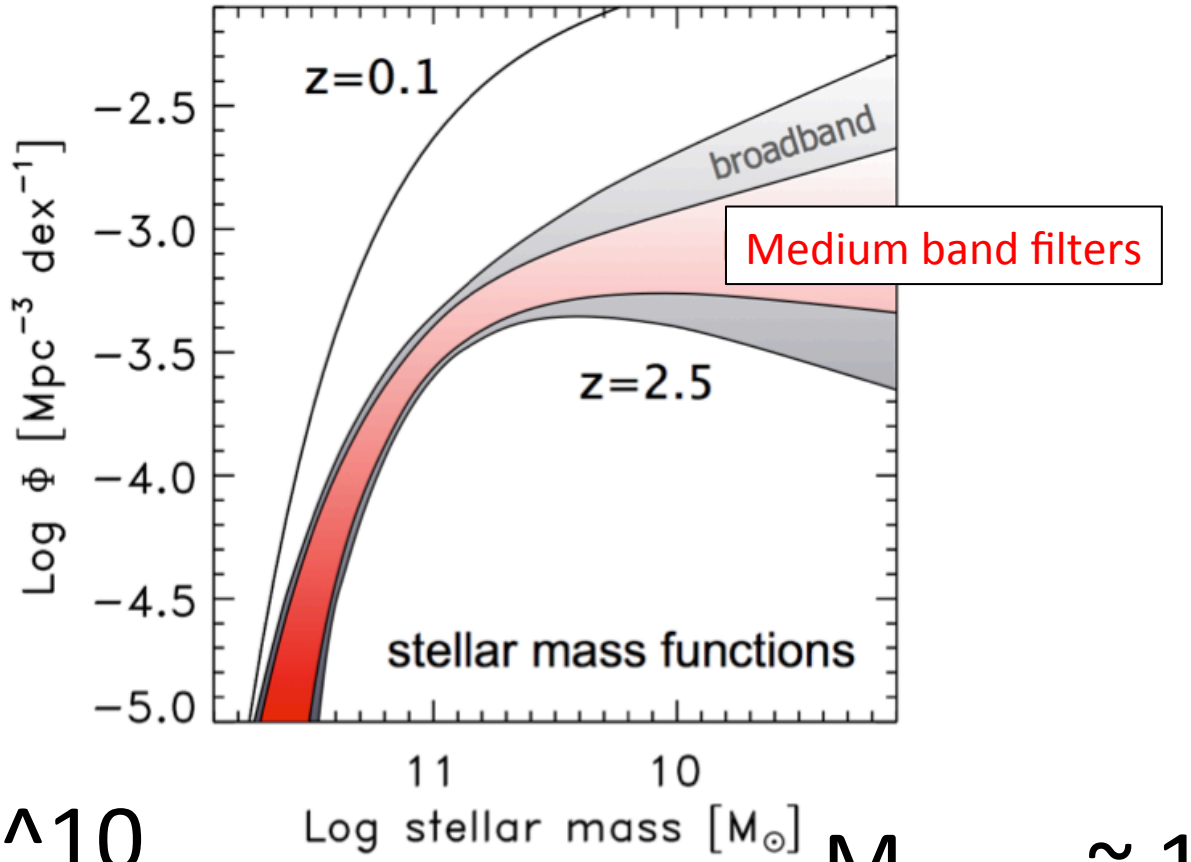


C. Straatman et al. in prep.

Z-FOURGE SCIENCE GOALS

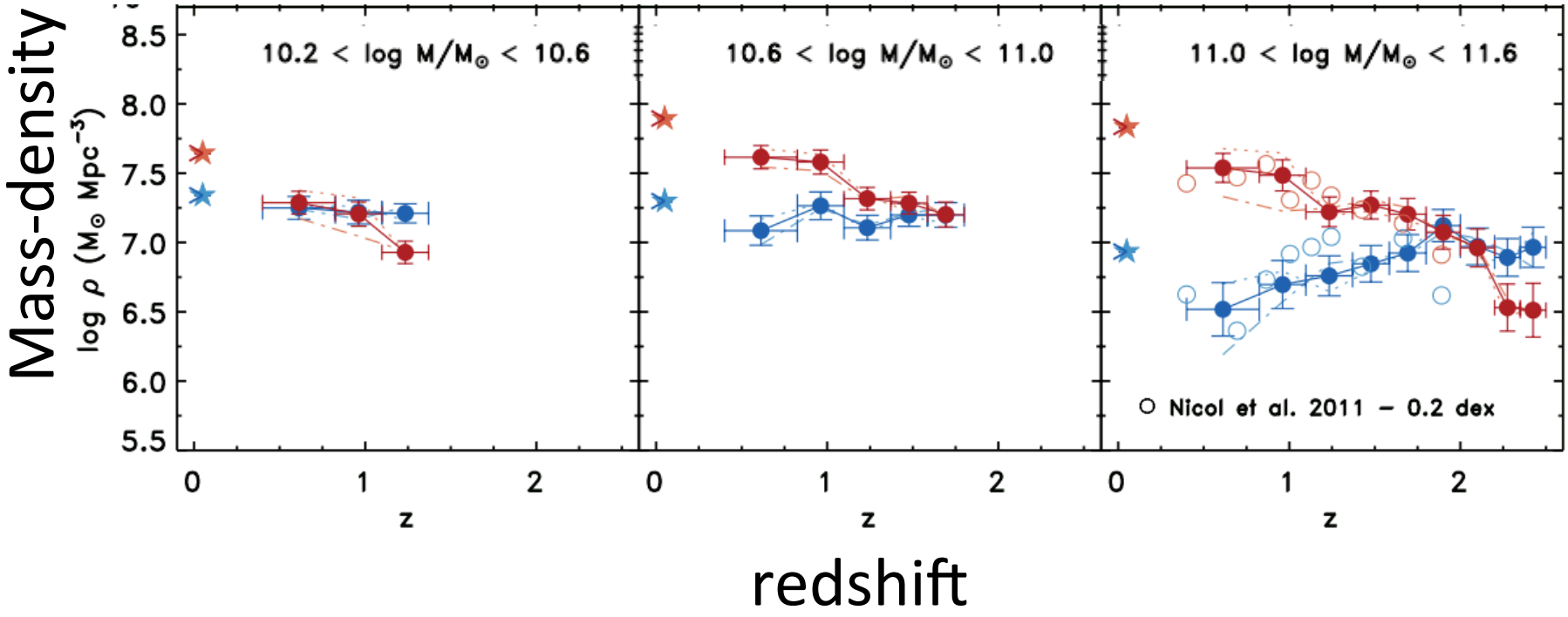
Z-FOURGE

FourStar Galaxy Evolution Survey



$M_{stellar}$ ~ 10^10
for passive galaxies

$M_{stellar}$ ~ 10^9
for SF-galaxies

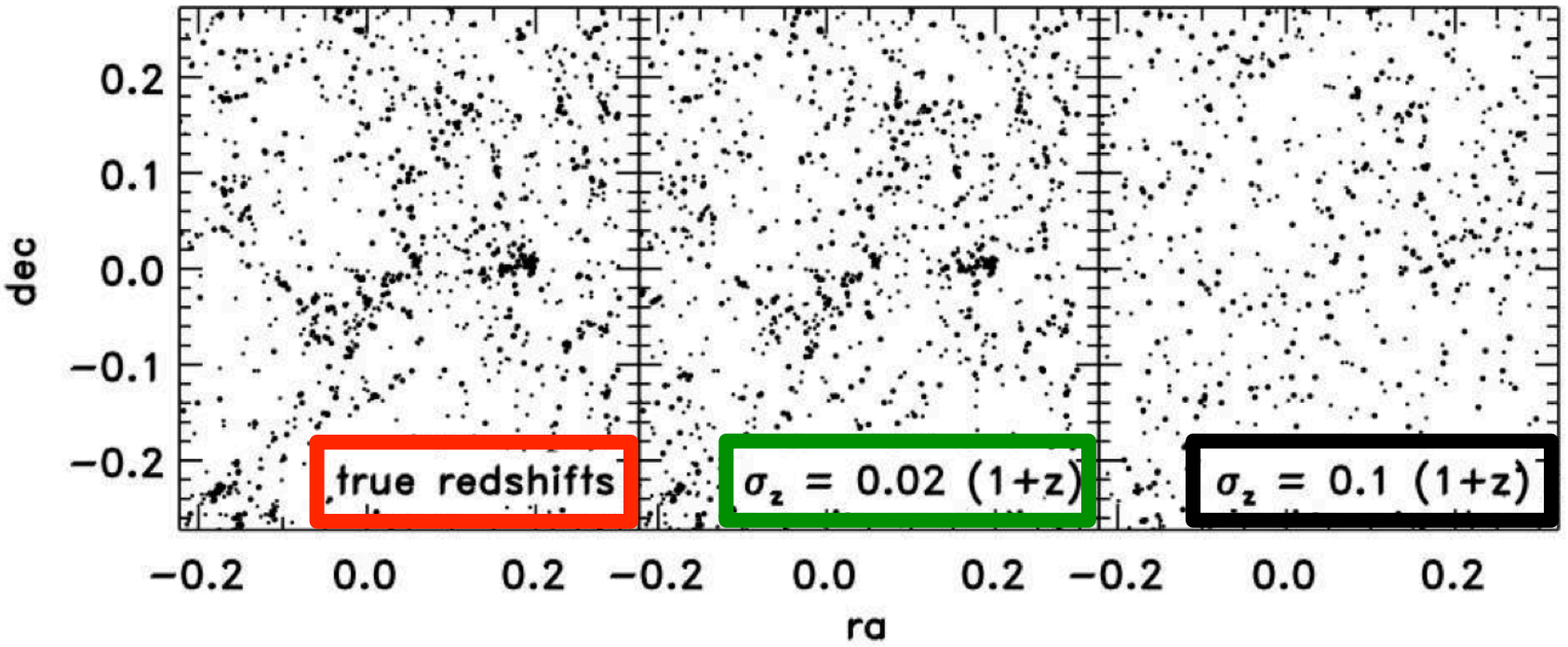


NEWFIRM Medium-band Survey Brammer et al. 2009

Z-FOURGE

FourStar Galaxy Evolution Survey

redshift z=2 **Medium-band** **Broad-band**

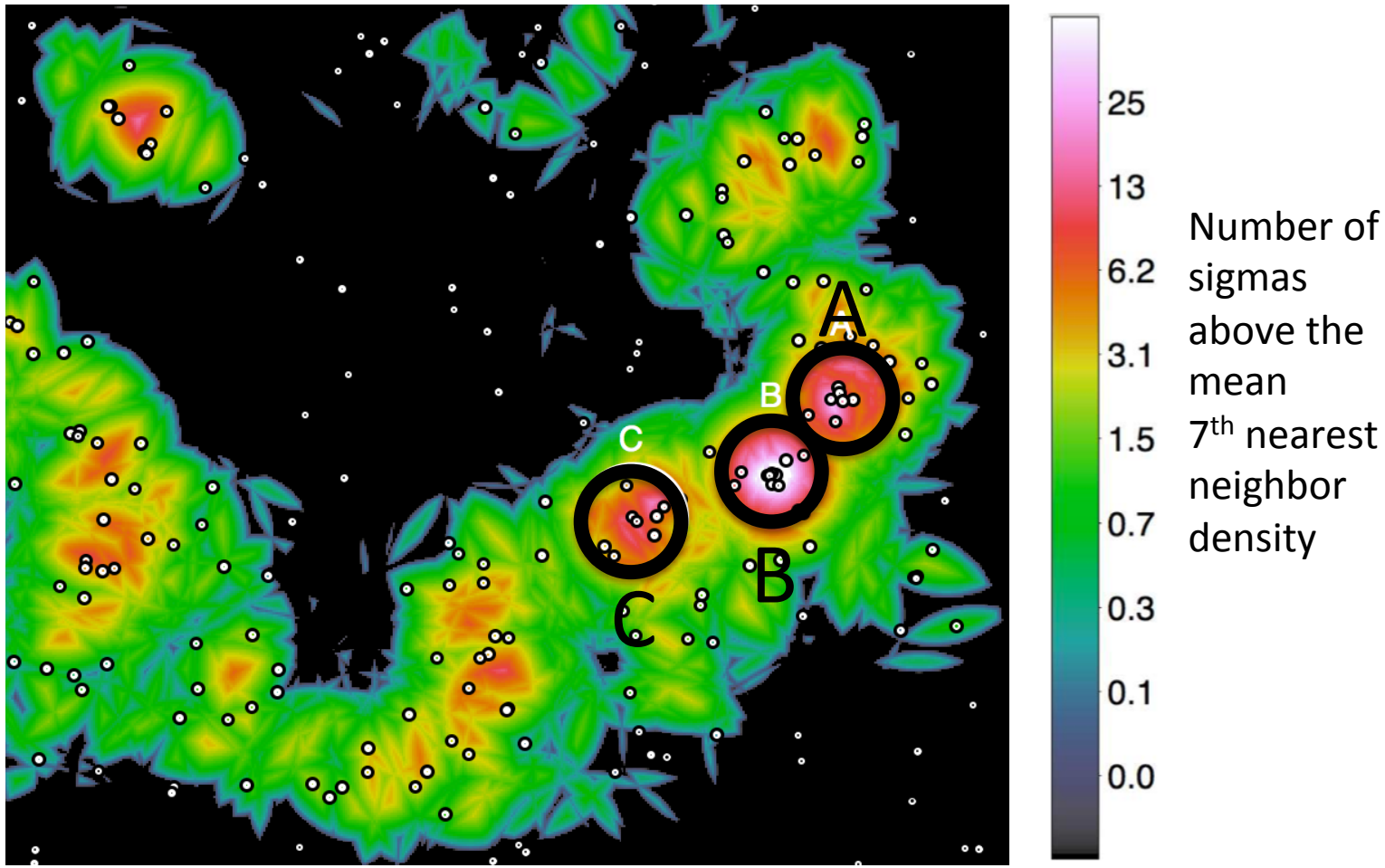


mock H_{AB} < 25 galaxies from the Millennium Simulation (Kitzbichler & White 2007)

Z-FOURGE

FourStar Galaxy Evolution Survey

Slice at
z=2.0-2.2

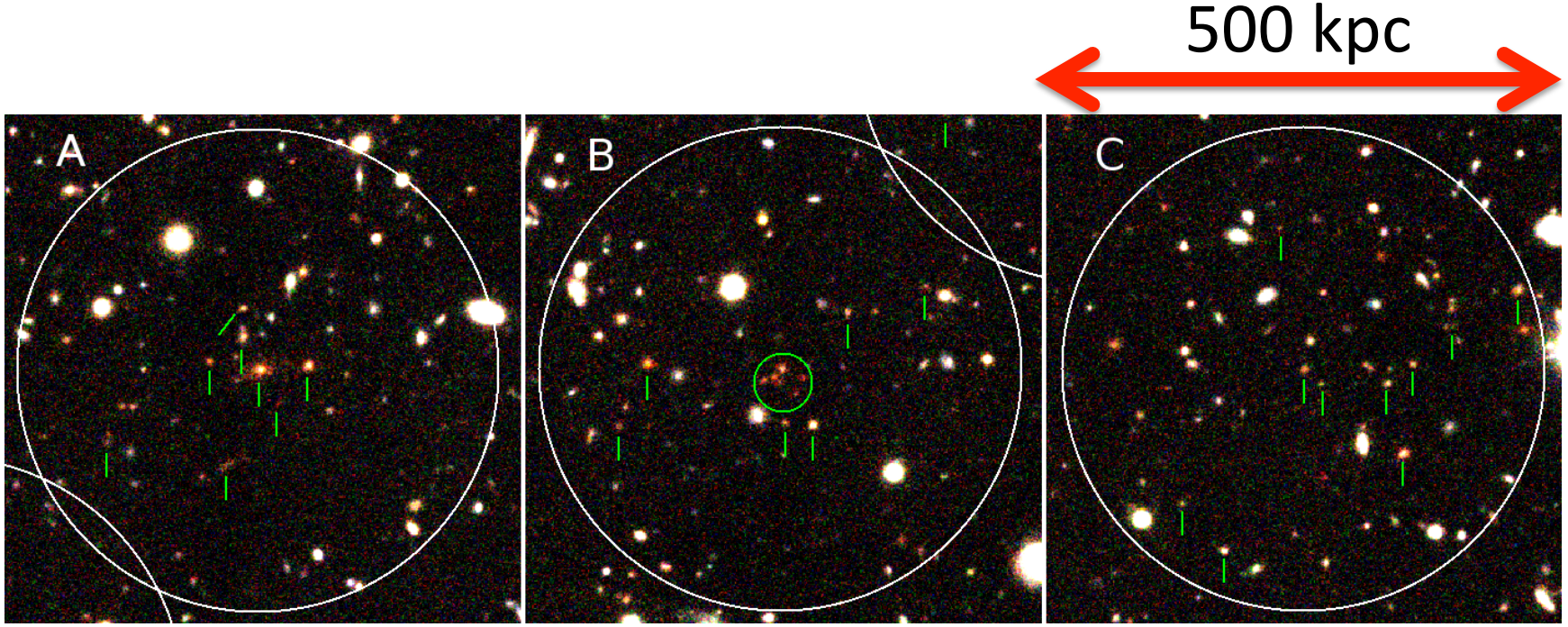


Number density map of a protocluster

Spitler et al. 2012

Z-FOURGE

FourStar Galaxy Evolution Survey



Central galaxy

$M_{stellar}$ =3x10^11 =1x10^11 =1x10^11 M_{sun}

Old, extended stellar halo

Old + SF, compact satellites within 30 kpc

Young, star-forming members

3D-HST

A Spectroscopic Galaxy Evolution Survey with the Hubble Space Telescope

Z-FOURGE

FourStar Galaxy Evolution Survey

UltraVISTA

Ultra Deep Survey with the VISTA telescope

Conclusions

- Lots of exciting work being done in the near-IR
- Soon will finally have complete census of galaxies out to z ~ 3 or ~12 billion years ago
- Long lists of science goals and potential outcomes
- TAIPAN will help to solidify redshift zero
  - Mass functions, environment, star-formation rates