# The Faint Infrared Galaxy Survey: **FIGS**

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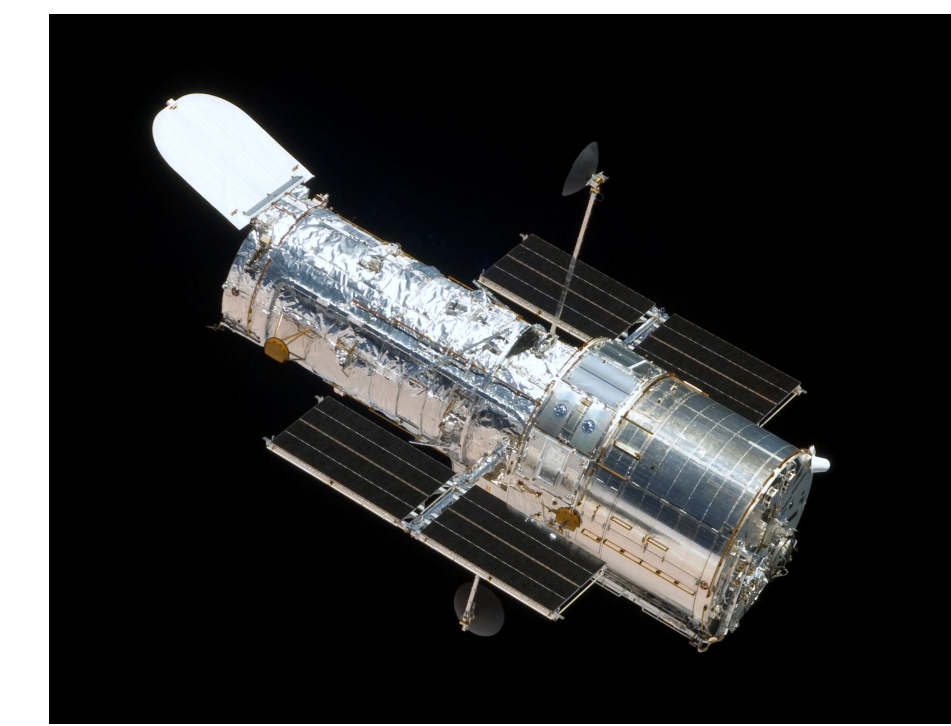
FIGS in a nutshell:

FIGS is a unique project that uses the WFC3 IR grism G102, to produce low resolution spectra for 6000 sources in 4 separate fields. FIGS will:

(1) **Probe the reionization epoch by spectroscopy of galaxies at z = 5.5-8.5**, whether or not they show Lyman-alpha (LyA) line emission. Continuum breaks are hard to detect from the ground and LyA lines may be scarce at these redshifts. Spectroscopic redshifts will probe galaxy clustering and improve luminosity measurements, thereby improving estimates of reionizing photons by at least 40%.

(2) **Robustly measure the fraction of galaxies with high EW LyA, to measure the neutral fraction of the IGM**. We are sensitive to LyA lines in the central period of reionization where we expect to see a change in LyA fraction.

(3) **Illuminate the formation processes of early type galaxies at 1<z<2**, down to a few 10^9 solar masses.

(4) **Study star-formation, dust extinction and metallicity evolution during the peak of star-formation at z=1-2**, using hundreds of low-mass emission line galaxies.

The Fields:

We have preselected target fields with fairly secure z ~ 7 and 8 candidate galaxies based on candidate lists from three independent selection efforts (Yan et al 2012, Finkelstein et al 2012, Oesch et al 2012). This increases our efficiency relative to a blind search. We cover 60% of the z ~ 8 candidates by covering 20% of the area. Four fields were selected. The FIGS fields were specifically selected because deep IR/WFC3 imaging data of these fields already exists. Two are located in the GOODS-N field and two are in the GOODS-S field.

The Observing Strategy:

In order to spectroscopically detect the continuum emission of sources as faint as mag_{AB}=26.5, each field is observed for a total observing time of 10 orbits, split into 5 distinct visits of 2 orbits each. Different roll angles are used for each visit as the use of multiple roll angles is crucial in dealing with spectral contamination.
Figures on the right show the first round of observations of the UDFPAR2 and GN2 fields, each observed at one roll angle.


GN2

UDFPAR2
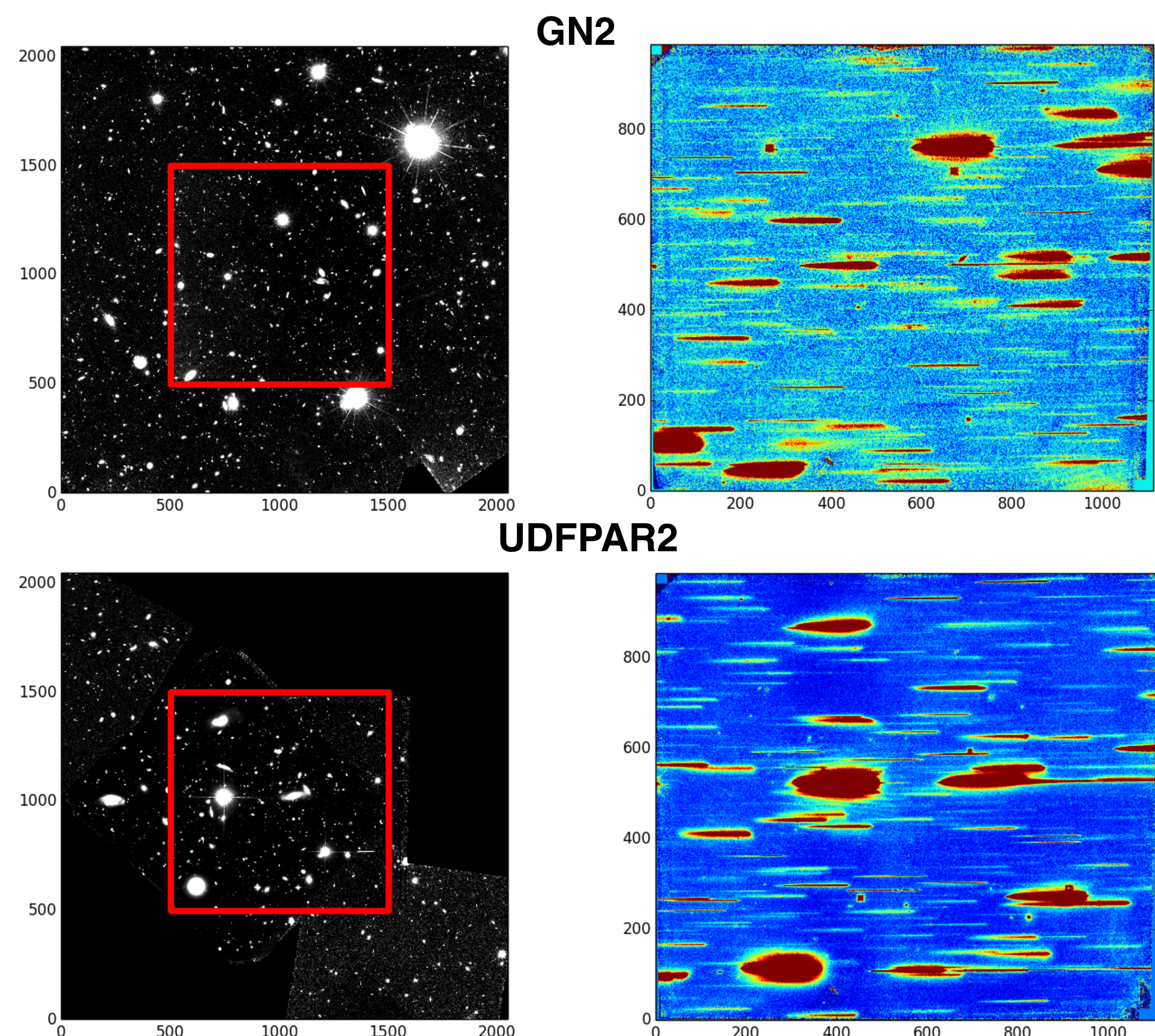
FIGS versus Ground Based Observations:
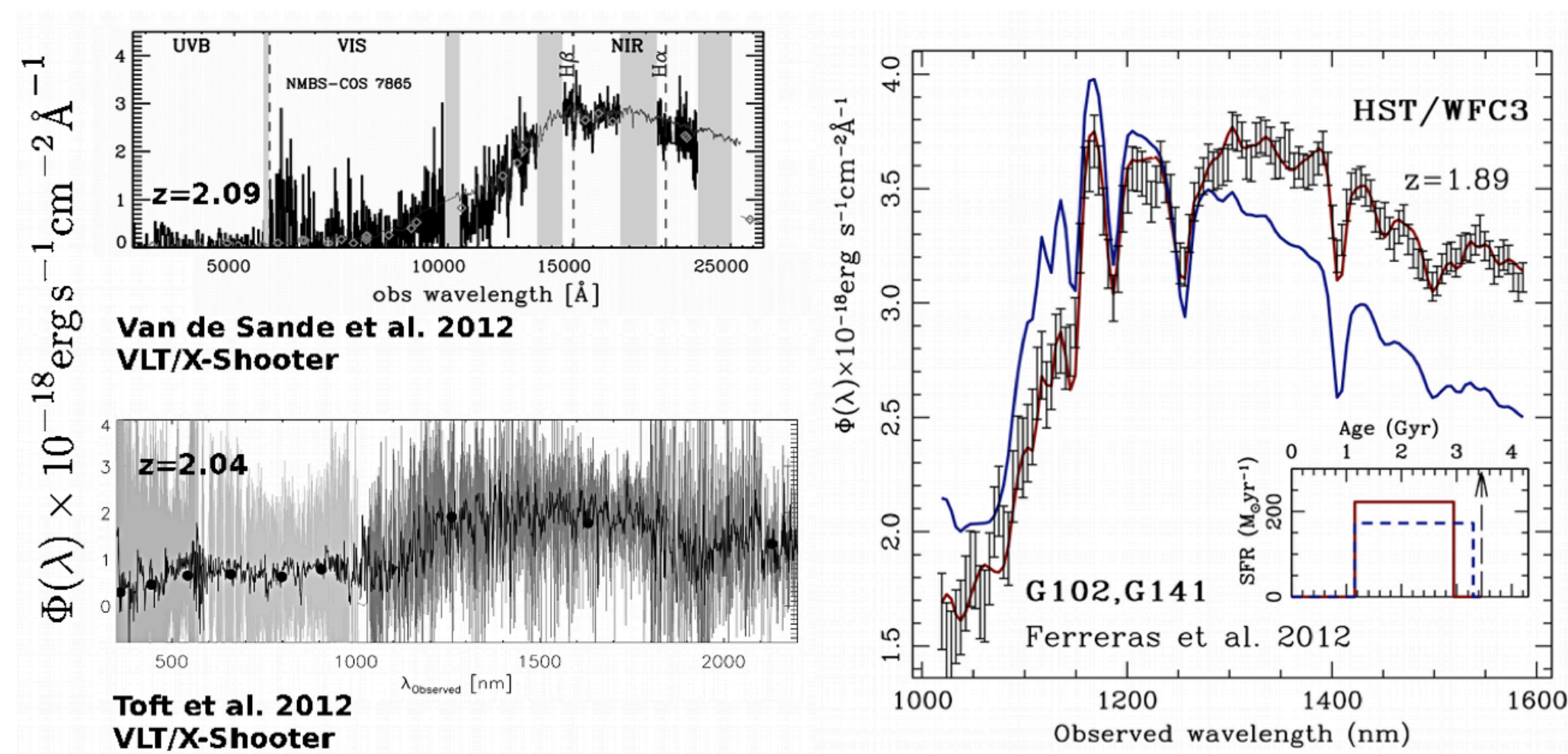
HST versus ground-based spectroscopy in the z~2 range. Left: Some of the best/ deepest massive galaxy spectra taken from the X-Shooter instrument on the VLT, with exposure times of seven hours (K=20, top) and five hours (K=20.2, bottom). Right: WFC3 slitless grism data from the ERS (exposure time of 1 hour, F160W=19.8) achieves a significantly higher SNR (notice the flux scales are identical). The red curve shows the best fit, whereas the blue curve extends the star formation rate for 500 Myr, illustrating the robust constraint on quenching timescales. The inset corresponds to the star formation history of both cases, with the arrow locating the age of the Universe at the redshift of the galaxy. FIGS will provide comparable quality data for a large sample (≥ 100 galaxies), for the crucial redshift range z=1-3, and down to masses of $5 \times 10^9 M_\odot$.
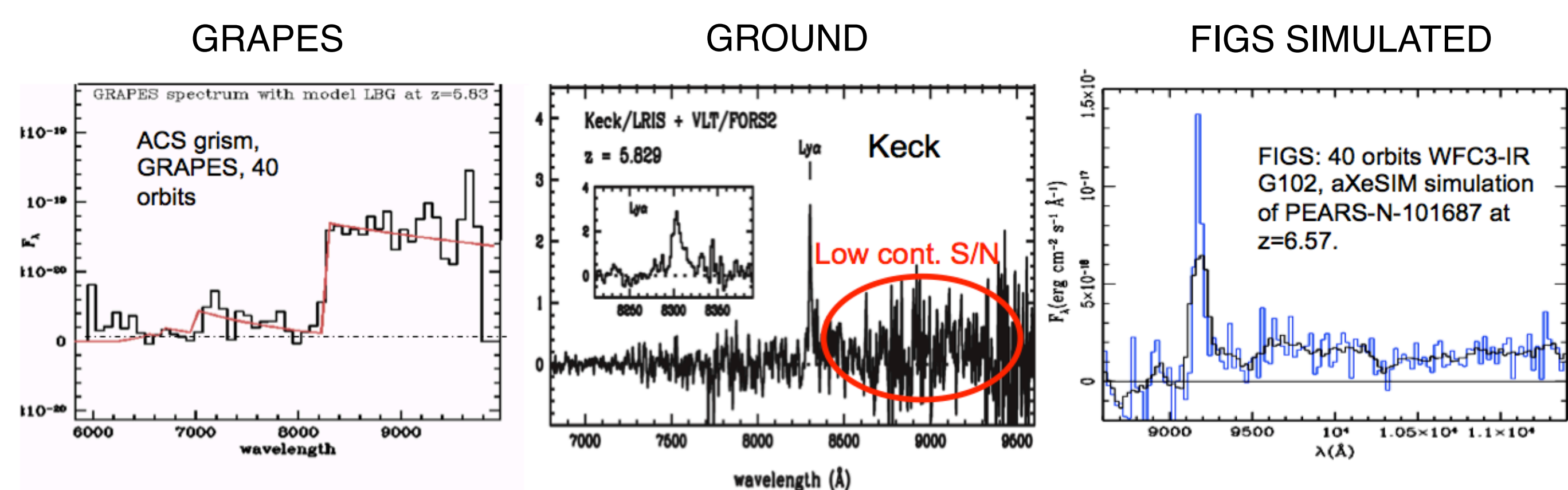
Long integrations with HST grisms can detect continuum breaks at the highest accessible redshifts. Left: A 40-orbit ACS G800L spectrum of a z = 5.83 galaxy in the HUDF, from the GRAPES HST Treasury survey (Malhotra et al 2005). The red curve is a model LBG spectrum including Madau (1995) IGM opacity. Even the Lyβ break is seen. Middle: Keck spectrum of the same source from Dickinson et al (2004). The ground-based redshift confirmation depends on the Lyα line, which would be suppressed if the IGM were mostly neutral. Right: Simulated FIGS G102 spectrum of the z = 6.57 galaxy PEARS-N-101687 (Rhoads et al 2013). This is one of the highest redshift object confirmed by any HST grism program. FIGS spectroscopy will simultaneously detect the continuum and the Lyα line (if present) for galaxies in the Epoch of Reionization.
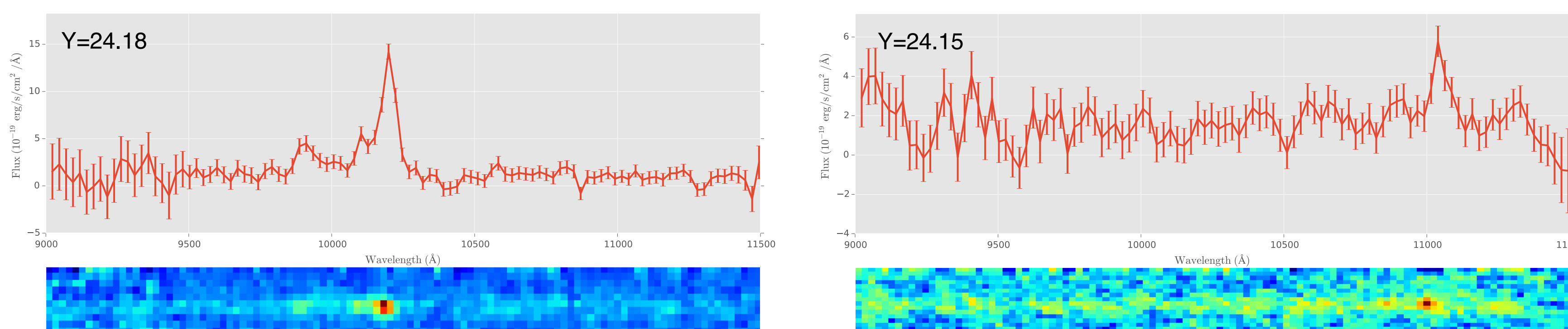
Extracted and calibrated spectra of two faint (m_{AB}~24.1) sources in UDFPAR2 with prominent emission lines. These spectra are based on 2-orbits deep data. The completed FIGS survey will be 10 orbits deep.