3D-HST Data Release v3.0

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ABSTRACT

3D-HST is a 248-orbit Treasury program to provide WFC3 and ACS grism spectroscopy over four extra-galactic fields (AEGIS, COSMOS, GOODS-South, and UDS), augmented with previously obtained data in GOODS-North. We present a new data release of the 3D-HST survey, version v3.0. This release follows the initial v0.5 release that accompanied the survey description paper (Brammer et al. 2012). The new v3.0 release includes the deepest near-IR HST grism spectra currently in existence, extracted from the 8-17 orbit depth observations in the Hubble Ultra Deep Field. Contamination-corrected 2D and 1D spectra, as well as derived redshifts, are made available for > 250 objects in this 2′ × 2′ field. The spectra are of extraordinary quality, and show emission features in many galaxies as faint as F140W = 26 – 27, absorption features in quiescent galaxies at z ∼ 2, and several active galactic nuclei. In addition to these extremely deep grism data we provide reduced WFC3 F125W, F140W, and F160W image mosaics of all five 3D-HST/CANDELS fields.

1. Overview

3D-HST is an HST Treasury program executed in Cycles 18 and 19. The survey uses the ACS and WFC3 grisms, providing slitless spectroscopy for all objects in the fields of these instruments. The primary and most innovative aspect of the survey is 2-orbit depth WFC3/G141 spectroscopy, covering the wavelength range 1.1 µm – 1.65 µm. Owing to the low sky background from space and the excellent sensitivity of WFC3 we reach a point-source continuum depth of $H_{140} \sim 23$ at 5σ in 2 orbits. In addition to the G141 grism data the 3D-HST data comprise direct WFC3 images in the $H_{140}$ filter, parallel ACS G800L grism exposures, and direct images in the ACS $I_{814}$ filter.

The survey fields are four of the fields of the CANDELS Multi-Cycle Treasury program: GOODS-South, UDS, AEGIS, and COSMOS. The fifth CANDELS field, GOODS-North, was observed by program GO-11600 (PI: Weiner) in Cycle 17 to the same 2-orbit G141 depth as 3D-HST.

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(but without parallel ACS grism data). We have included these GOODS-North data in our analysis. CANDELS is primarily an imaging survey, providing $J_{125}$ and $H_{160}$ data at two different depths over the five fields. The 3D-HST grism data cover approximately 80% of the area of the CANDELS fields, and form a spectroscopic complement to the CANDELS imaging.

The reduction, analysis, and interpretation of the slitless spectroscopy is not straightforward. The spectra of neighboring objects can overlap, which means a full 2D model of all spectra needs to be constructed and subtracted prior to analyzing the object of interest. Furthermore, the “PSF” of the grism spectra is effectively the (wavelength-dependent) morphology of the galaxy, complicating the fitting procedure. STScI provides software\textsuperscript{4} to analyze grism spectra but this is not optimized for faint-object spectroscopy; we therefore developed fully independent, custom packages that enable optimal modeling and fitting of interlaced 2D spectra. We find that these tools work very well, even on the deepest (17-orbit) grism data that are currently available (see below).

A further complication is that the grism spectra are often difficult to interpret without information from other wavelengths, as correct identification of faint emission lines usually requires some prior information on the likely redshifts of the objects. Data at other wavelengths are also crucial for measuring stellar masses, rest-frame colors, star formation rates, and other parameters. With these goals in mind we have created photometric catalogs in the 3D-HST fields, as a first and necessary step to interpret the grism spectra.

2. Data release v3.0: extremely deep spectroscopy in the UDF and WFC3 mosaics

2.1. Spectroscopy

We are providing the G141 grism spectra in the only region of the survey which was observed multiple times: the Hubble Ultra Deep Field. We have used this field to test our fitting procedures and to extract and analyze the deepest near-IR spectra of faint galaxies currently available. The G141 spectra are based on a combination of 8 orbits of 3D-HST data and 9 orbits of CANDELS supernova follow-up data. An analysis of the 17-orbit spectrum of a candidate $z \sim 12$ galaxy in this field was presented in Brammer et al. (2013). We provide > 250 spectra and redshifts over the $2' \times 2'$ UDF. This density of > 60 spectra per arcmin$^2$ far exceeds what has been achieved in any other survey or can reasonably be done from the ground.

2.2. WFC3 mosaics

As part of our commitment to release all ancillary data used in the 3D-HST program we are providing our reduced WFC3 mosaics of all five 3D-HST/CANDELS fields as part of data release

\textsuperscript{4}http://axe-info.stsci.edu
v3.0. The mosaics include the deep and wide $J_{125}H_{160}$ data obtained as part of the CANDELS program, the 3D-HST $H_{140}$ imaging, and the Early Release Science observations (and UDF flanking fields) in GOODS-South. The CANDELS project has also released several of the imaging mosaics. Our reduction uses the same tangent point and pixel scale as CANDELS, which means 3D-HST and CANDELS objects can be trivially matched and compared. We are preparing to release our photometric catalogs in these five fields, including derived photometric redshifts and stellar population parameters. The catalog release (v3.1) will be accompanied by a paper describing the reduction of the mosaics and the making of the catalogs (Skelton et al., in preparation).

3. Links

Information on the 3D-HST survey, as well as links to the data release, publications, pointing layout, and other information can be obtained from the 3D-HST website:

- [http://3dhst.research.yale.edu](http://3dhst.research.yale.edu)

The data release page and the accompanying comprehensive release notes can also be accessed directly:

- [http://3dhst.research.yale.edu/Data.html](http://3dhst.research.yale.edu/Data.html)

We have created several tools to explore the data release. For the Ultra Deep Field we provide an HTML table with image thumbnails and spectra, which can be ordered according to ID, magnitude or redshift. An interactive image browser displays grism redshifts on UDF objects and allows users to scroll around the field using a google maps-like interface. Clicking on an object brings up the HTML table with the object at the top.

- UDF HTML catalog with RGB thumbnails, spectra, and fits
- UDF interactive image browser

Image browsers for all five fields can be used for roaming the 3D-HST/CANDELS fields or to go directly to particular locations by entering coordinates:

- AEGIS $I_{814}J_{125}H_{160}$ RGB mosaic
- COSMOS $I_{814}J_{125}H_{160}$ RGB mosaic
- GOODS-South $I_{814}J_{125}H_{160}$ RGB mosaic
- GOODS-North $I_{775}J_{125}H_{160}$ RGB mosaic
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