Faint U-Band dropouts in the GOODS-CDFS field

Yogesh Wadadekar and Stefano Casertano

STScI, 3700 San Martin Drive, Baltimore MD 21210

SPACE TELESCOPE SCIENCE INSTITUTE
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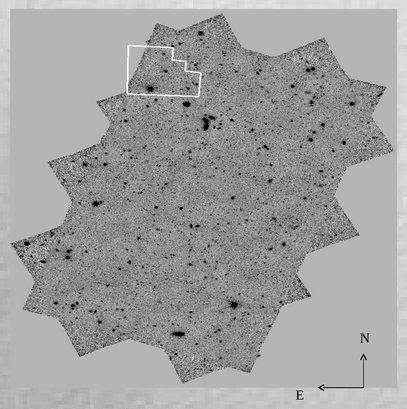
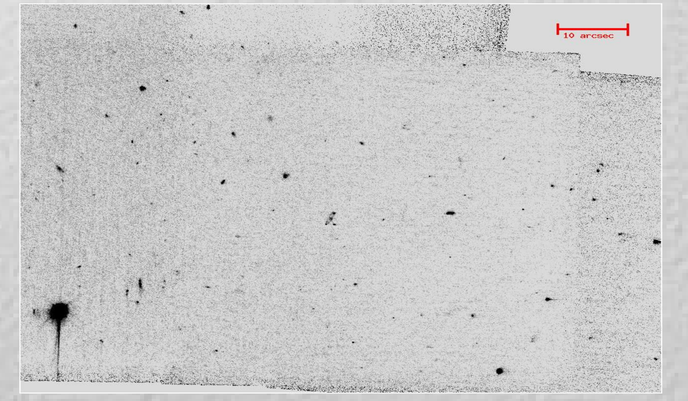
ABSTRACT We combine data from the deepest HST U-band (F300W) observations ever obtained using WFPC2, as part of the parallel observations of the Hubble Ultra Deep Field, with *BVi* images from the HST/GOODS survey to identify and study a sample of 117 faint Lyman break galaxies in the redshift range $2 < z < 3.5$. Here, we describe our data analysis procedure, dropout selection criteria and some early results.

Deepest U-band image

Using drizzle based techniques developed for the WFPC2 Archival Parallels project (Wadadekar et. al, in preparation), we constructed an accurately registered, cosmic ray rejected image from 409 individual WFPC2 exposures. This image has a total exposure time of 323.1 ksec over most of the WFPC2 area reaching a 10σ AB limiting magnitude of 27.5, about 0.5 mag deeper than the deepest previous U-band images, those in the Hubble Deep Fields. We combined this data with ACS/BVi data from the GOODS-CDFS dataset.



GOODS CDFS field with the coverage of the WFPC2/F300W data outlined in white. About 85% of the WFPC2 image falls within the GOODS footprint.

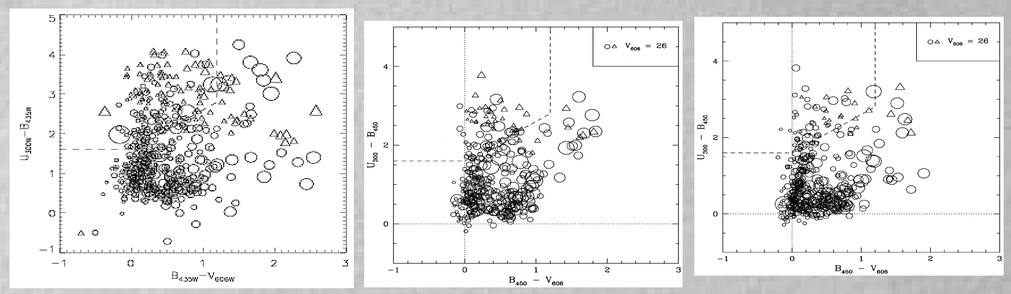


A portion of the final drizzled WFPC2 U-band image with 0.06 arcsec pixels. The GOODS data were binned from their original 0.03 arcsec pixel scale to 0.06 arcsec, and our U-band image was accurately registered to the GOODS WCS. CTE residuals are seen trailing bright point sources.

The dropout technique (eg. Steidel et al. 1995, AJ, **110**, 2519) relies on the redshifted Lyman break entering the U-band at $z \sim 2$, making such galaxies very faint in the U-band (dropouts) while being relatively blue in *B-V* color, due to active star formation. We adapted the dropout technique to our combination of WFPC2/ACS filters identifying the region of color-color space which contained predominantly unobscured star-forming galaxies in the redshift range $2 < z < 3.5$. We used recent population synthesis models (Bruzual and Charlot, MNRAS, **344**, 1000) to model the color distribution of galaxies spanning a wide range in age, metallicity, dust attenuation (Charlot & Fall 2000, ApJ, **539**, 718), redshift and star formation history. The statistical opacity of the IGM was modeled using the prescription of Madau (1995, ApJ, **441**, 18).

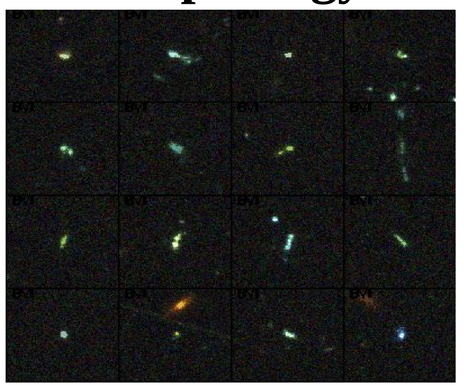
Star forming galaxies at $2 < z < 3.5$ (U dropouts)

We used Sextractor in dual image mode for source photometry using the ACS *i* band image for source detection. The increased depth over the HDFs permits identification of objects with $U\text{-}B > 3.5$ for the first time. We tentatively identify 117 U-dropouts using our selection criteria, compared to 68 and 74 dropouts in the HDF-N and HDF-S respectively, over a comparable area.



Color-color plot highlighting the candidate U-band dropouts (above the dashed line) for our sample (left), the HDF-S (Casertano et al. 2000, ApJ, **120**, 2747 - center) and the HDF-N (right). Objects undetected in F300W are plotted as triangles at the 1σ limit of their *U-B* color. Objects with $U\text{-}B > 3.5$ are detected for the first time in our sample. Symbol sizes scale inversely with magnitude.

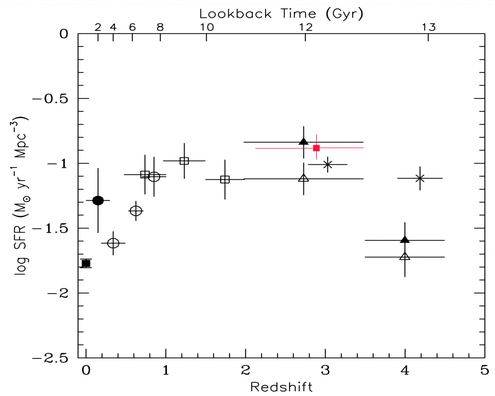
Morphology



BVi color composite of 16 typical dropouts from our sample. Each cutout is 5x5 arcsec in size. The dropout galaxy is located at the center of each panel.

As with the HDF U-dropouts, morphology is varied, ranging from small compact and relatively regular objects to highly fragmented, diffuse and irregular ones.

Star formation history



SFR density vs. redshift. The $z > 2$ points are Lyman break objects in the HDF-N (open triangles), HDF-S (filled triangles), the Steidel et al. (1999, ApJ, **519**, 1) ground based survey (crosses) and our sample (red square). Our error bars are very similar to those of the HDFs.

We plot our preliminary measurement of the SFR density (red square), derived from the UV luminosity density. A detailed comparison of the properties of our sample with regard to number density, clustering, star-formation rate, and morphology with the HDFs is in progress.

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