

## The Nature of UV-selected Galaxies in the Chandra Deep Field South

D.F. de Mello, J.P. Gardner

*Laboratory for Astronomy and Solar Physics, Code 681, Goddard Space Flight Center, Greenbelt, MD 20771, USA*

T. Dahlen<sup>1</sup>, C.J. Conselice<sup>2</sup>, N.A. Grogin<sup>1</sup>, A.M Koekemoer<sup>1</sup>

<sup>1</sup>*Space Telescope Science Institute, USA* <sup>2</sup>*Caltech, USA*

### Abstract.

We report the first results of the ongoing survey using HST/WFPC2 (F300W) in parallel with ACS within the Chandra Deep Field South. A sample of 34 objects were identified in the WFPC2 images and their counterparts were found in the ACS images taken by the GOODS team; 6 of them are stars. Galaxies were classified as early-, late-types, and starbursts by template fitting which was also used to determine their photometric redshifts ( $z < 1$ ). Analysis of the light concentration, asymmetry and clumpiness shows that this sample is a mixed bag, containing dwarf ellipticals, early- and late-spirals, and peculiar objects which resemble mergers in progress. This result has important implications for galaxy evolution since the intermediate redshifts are the epoch when the rise in the volume-averaged star formation rate occurs.

### 1. The UV-selected Sample

In this contribution we report the first results of a survey using the HST/WFPC2 (F300W) in combination with the HST/ACS multi-wavelength images. UV observations probe unobscured star formation, therefore, observing in the UV directly accesses the population of objects that contributes to the ‘observed’ rise in the star-formation rate at intermediate- $z$  (Madau et al. 1996). For parallel fields that fell within the Great Observatories Origins Deep Survey (GOODS) fields, we took near-UV images with the F300W filter (U band) of galaxies that have been imaged at redder wavelengths with ACS. We detected 58 objects on the U-band image using SExtractor v2.2.2 (Bertin & Arnouts 1996, hereafter SE) in 8 WFPC2 images of the Chandra Deep Field South. Their magnitude range is  $18 < m_U < 26$  where  $m_U$  (AB system) is SE’s `mag_auto`. These numbers agree with what is expected with the U band (6 objects in 2 to 3-orbit exposure). For comparison, the HDF project included a long (45 orbit) U exposure and has 133 objects with  $23.5 < m_U < 25$  (Vega system). The next step was to match the U-band catalog with the ACS B-band catalog ( $B_{435}$ ) produced by the GOODS team (Giavalisco et al. 2004). We adopted a maximum offset radius of 1.5 arcsec between the WFPC2 coordinates and the ACS B band, and identified a total

of 34 objects; 6 of them were identified as stars. Photometric redshifts were estimated by the GOODS team (Mobasher et al. 2004). The majority (26 out of 28) of the objects in the U-band sample has  $z < 1$ .

## 2. Results

Template fitting obtained from the photometric- $z$  estimation were used to classify galaxies as early-, late-types (Coleman et al. 1980) and starbursts (Kinney et al. 1996). A total of 17 were classified as starbursts, 9 as late-types and 2 as early-types. The colors of the starbursts which were reproduced by the stellar evolutionary synthesis code Starburst99 (Leitherer et al. 1999) are typical of a mixed population of bursts with ages  $< 1$  Gyr. Galaxy morphology was evaluated by measuring the light concentration (C), asymmetry (A) and clumpiness (S) of the ACS images in the rest-frame B band using the method by Conselice (2003). Early-type galaxies are expected to have a high concentration index and low asymmetries whereas late-type (disks) galaxies have low light concentration and high asymmetries. Three objects in the U-band sample have X-ray emission. The point-like object is one of the most powerful CXO sources (Giacconi et al. 2002) in the entire ACS field (Soft X-ray flux =  $4.00 \pm 0.05 \times 10^{-14}$  and Hard X-ray flux  $8.06 \pm 0.17 \times 10^{-14}$ ), it is a Type I AGN. The other two objects are extended and have total X-ray (0.2-8keV) fluxes  $1.77 \times 10^{-16}$  and  $2.66 \times 10^{-16}$  erg s $^{-1}$  cm $^{-2}$  which are three orders of magnitude lower than the Type I AGN ( $1.15 \times 10^{-13}$ ). The object with the lowest X-ray flux has a spectral type typical of starbursts and peculiar late-type morphology. The third object has a spectral type similar to intermediate-late spirals.

The majority of the galaxies have lower values of light concentration and higher asymmetries than typical early and late-type galaxies. Based on the morphologies we conclude that near-UV sources at intermediate- $z$  originate in a variety of objects: dwarf ellipticals, early- and late-spirals and peculiar objects which resemble mergers in progress. Intermediate redshifts are an important epoch when the rise in the volume-averaged star formation rate occurs. The population of objects that contributes to this rise is not homogeneous, but made of galaxies of different types experiencing strong star-formation. A gallery of objects are at <http://goods.gsfc.nasa.gov/goods/duilia/gallery>.

## References

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