The Deepest HST Near-UV Image and the Ultraviolet Luminosity Function at 1.8 < z < 2.4

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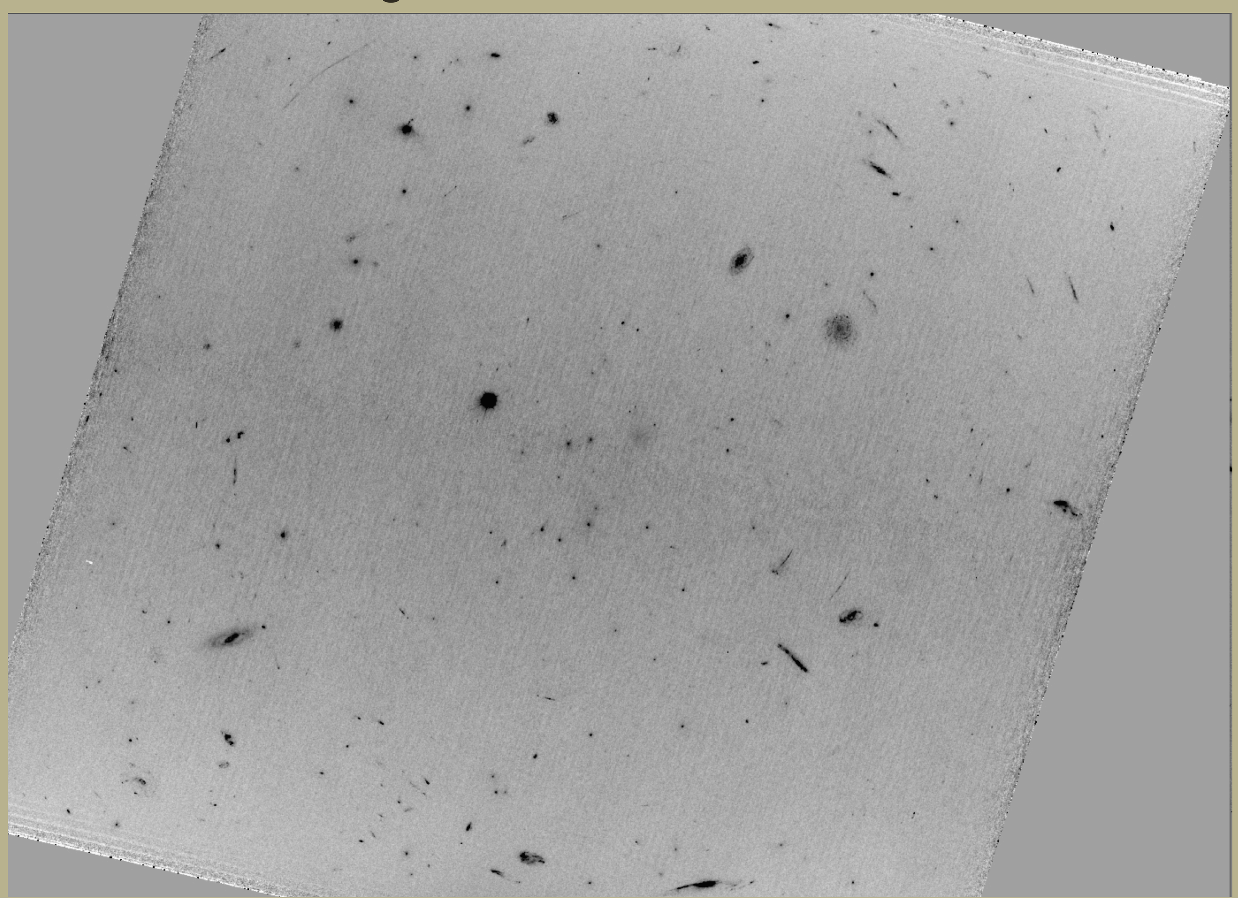
Abstract

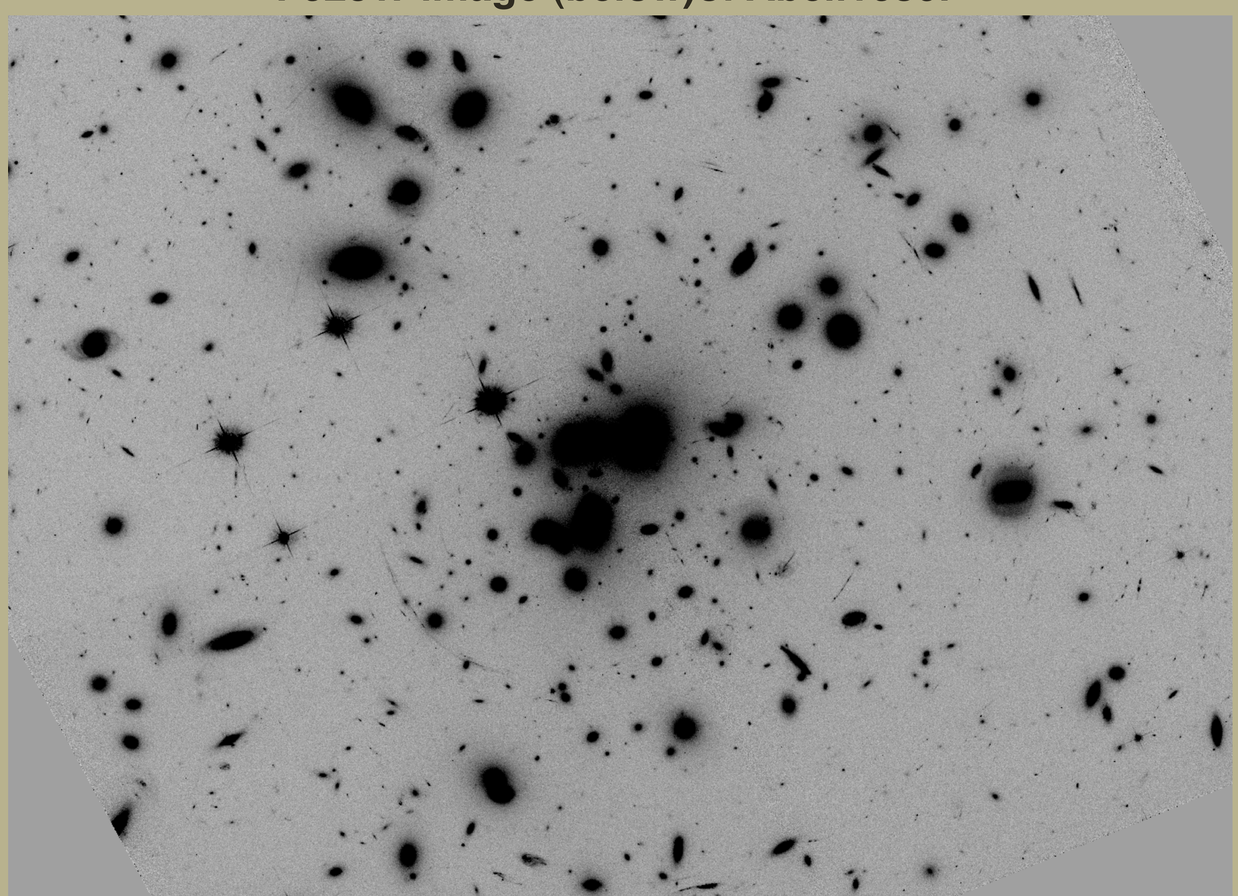
Given the steep faint end slope of the ultraviolet luminosity function at z>2 ,low luminosity galaxies(SFR < 5$M_{\odot}$/yr) appear to dominate the global star formation density. Unfortunately these faint galaxies are often beyond the detection limits of most surveys. Given these current shortcomings, we have conducted a deep HST ultraviolet survey of the rich cluster, Abell1689. The strong gravitational lensing provides large magnifications of a large number of faint, background galaxies. We present the HST UV images of Abell1689, including the deepest near-UV image ever obtained. We also use these new data along with the existing HST optical images to identify z~2 Lyman Break galaxies. We found 88 ''dropouts'' and use them to extend the z~2 luminosity function ~100 times fainter than previous determinations at this epoch. Our measurement of luminosity function faint end slope (α = -1.71± 0.041) is in agreement with the results by Reddy & Steidel (2009) and Bouwens et al. (2007).

Observation

We have obtained the deepest near-UV images with the WFC3/UVIS channel on HST in two bands, F275W (30 orbits) and F336W (4 orbits). The 5σ depth in a 0.2'' radius aperture for F275w and F336W is 28.70 (AB) and 27.90 (AB) respectively. In order to recognize the Lyman Break galaxies at z~2, we also used the existing HST/ACS images in F475W (4 orbits) band. Reduction of images was done by Multi_Drizzle process in Pyraf. Photometry is done by running SExtractor in dual image mode, using F475W as the detection image.



Fig(1):A HST/WFC3 F275W image (above) and HST/ACS F625W image (below)of Abell1689.



Results

Selection Method

The Lyman Break galaxies are found by F275W 'dropout'. The color selection criteria is similar to Oesch et al. 2010.

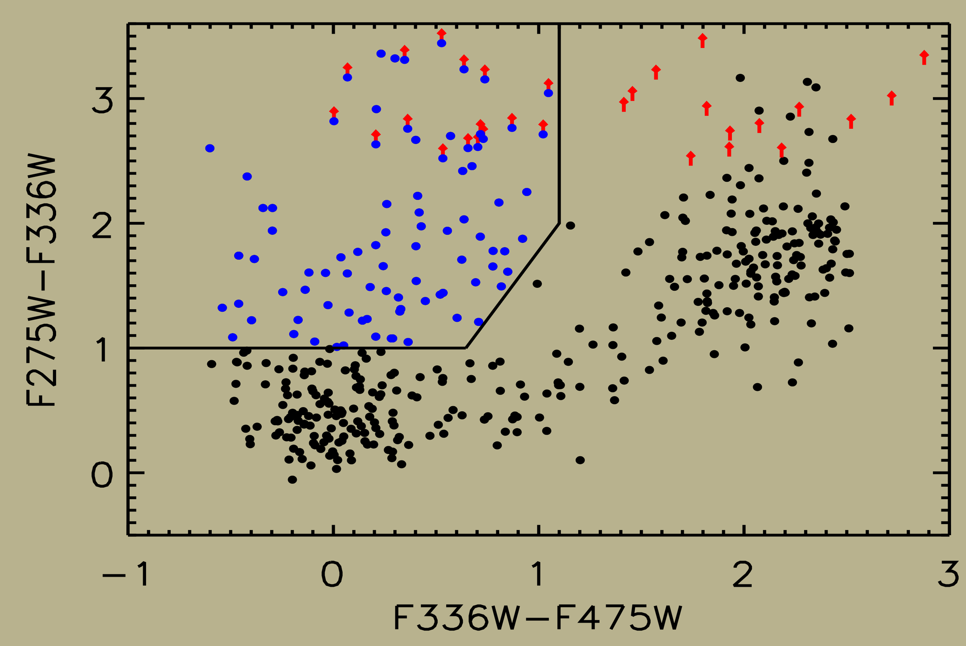
F275W – F336W > 1

F275W – F336W > 2.2(F336W –F475W)-0.42

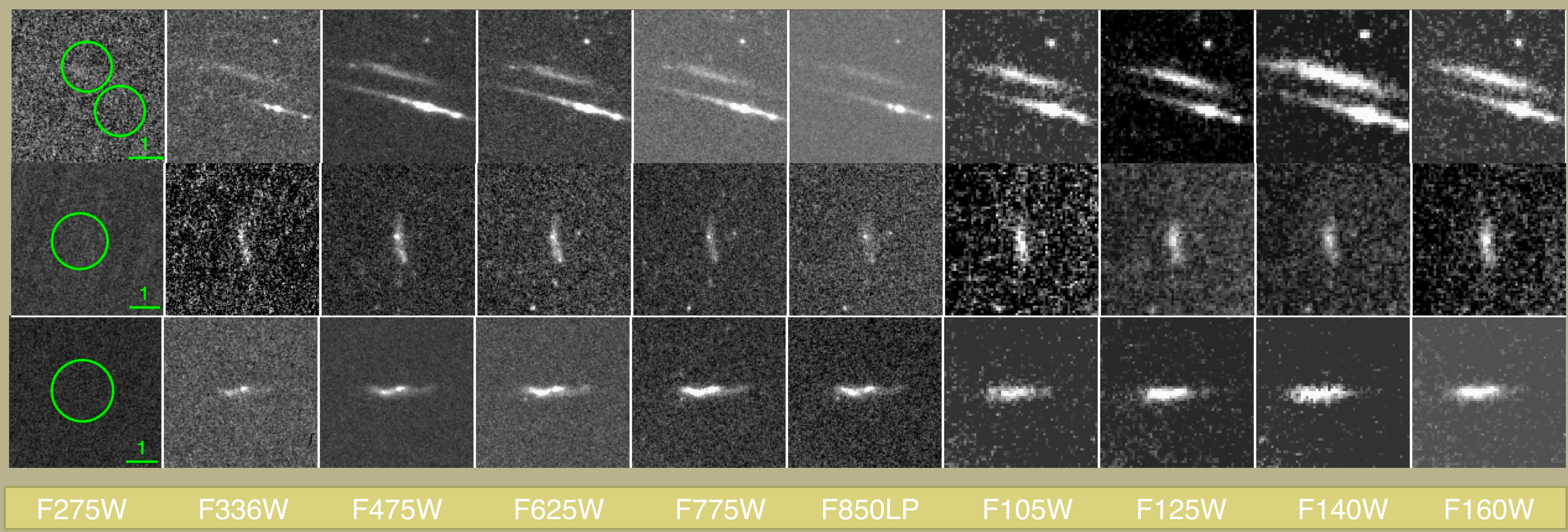
F336W–F475W < 1.1

S/N(F336W) > 5 , S/N(F475W) > 5

The criteria select galaxies between 1.8 < z < 2.4.



Figure(2):Color selection of z~2.1 lensed galaxies (blue) behind Abell1689.



Figure(3):Postage stamps(5 arc sec) of lensed Lyman Break galaxies .

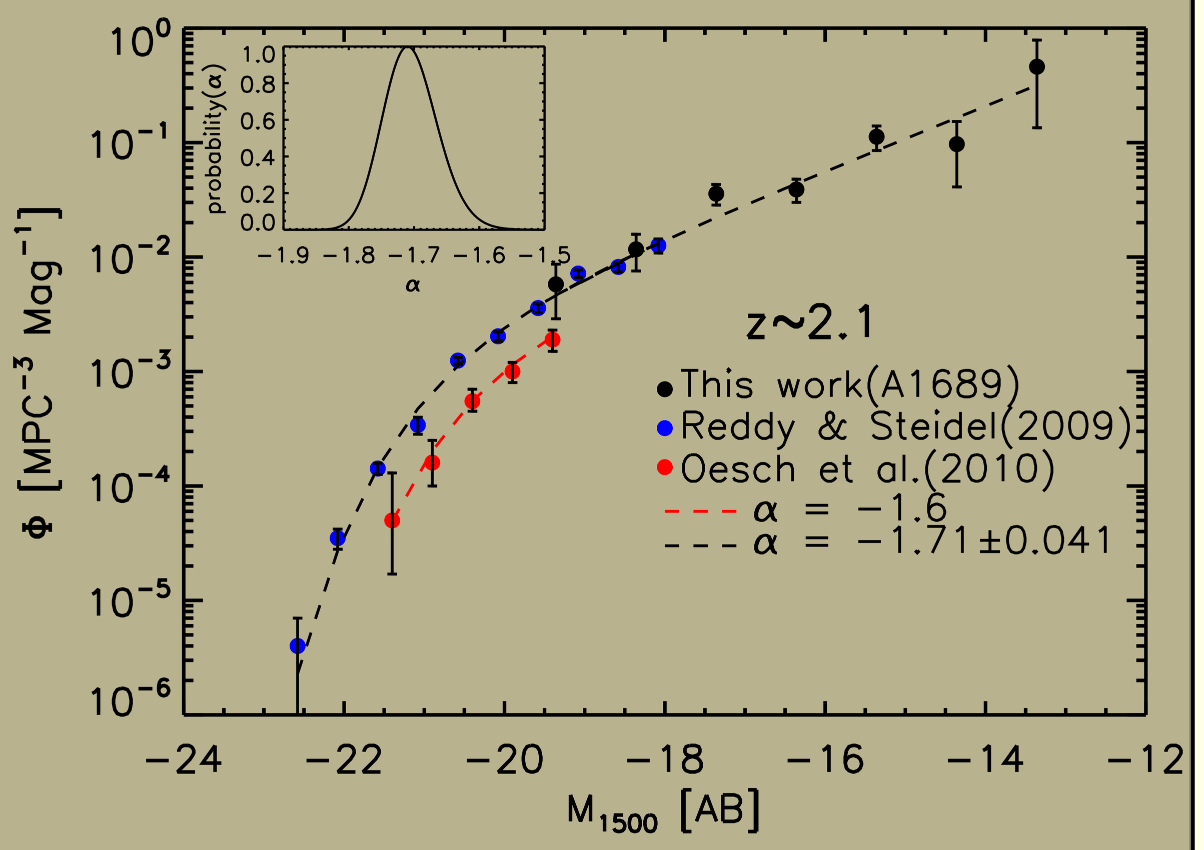
Luminosity Function

Strong gravitational lensing by cluster Abell1689 has allowed us to extend the luminosity function at z~2 30-100 times fainter. The UV luminosity function is computed using :

$$\Phi(M_i)dM_i = \frac{N_i}{V_{eff}(M_i)}$$

Where the N_i is the number of galaxies in bin i. The effective volume is computed by considering the completeness as a function of magnitude ,redshift, reddening and magnification.

The best estimate of Schechter parameters are α = -1.71± 0.041, M* = -20.66 ± 0.075 and Φ* = 0.00288 ± 0.0004 which are found by least squares method.



Figure(4): Rest-frame UV Luminosity function at 1.8 < z < 2.4

Future Work

We have been awarded a new Hubble program for Abell1689 to get deep imaging in F225W and F336W bands to identify the Lyman break galaxies at z~1.5 and z~2.5 respectively. These new data will identify 150 additional star forming galaxies, allowing us to complete the census of star formation at its peak (1< z <3).

References

Bouwens, R. J., Illingworth, G. D., Franx, M., & Ford, H. 2007, ApJ, 670, 928

Oesch, P. A., et al. 2010, ApJ, 725, 150

Reddy, N. A., & Steidel, C. C. 2009, ApJ, 692, 778