

Extragalactic Survey of UV Galaxies Using GALEX

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Abstract: We report here the results of the study of extragalactic radiation using number counts of galaxies at high galactic latitudes. For this study nine GALEX DIS targets around ELAISN1 in the North Pole. The overlapped regions of two missions cover an area of ~ 2 square degrees in the selected region. By comparing the point source catalogs of GALEX and Spitzer, we obtained the UV flux (both FUV & NUV) in magnitude for each matching galaxy. We then calculated the number counts of galaxies, N Objects/square degree/magnitude, from the region and compared it with the existing values in the literature. There is drop out of galaxies at the fainter end which is due to low resolution and sensitivity of GALEX when we compared it with Spitzer Extragalactic Representative Volume Survey (SERVS) region – ELIAS-N1 - centered at $16^h 10^m 01^s$, $+54^\circ 30' 36''$. From this study we could establish the presence of unresolved objects in the GALEX field.

Keywords: GALEX, UV Number counts, UV magnitude, Extragalactic survey, resolved galaxies, unresolved objects

I. Introduction

The number counts of detected galaxies from two wavelength bands can provide an open scenario of extragalactic contribution. The Pegasus launched Galaxy Evolution Explorer (GALEX) in 2003 under NASA's Small Explorer (SMEX) is the first Ultraviolet (UV) mission to conduct two imaging surveys in far UV band (FUV:135 nm-180nm) and near UV band (NUV:180-200 nm) with significant spatial resolution of $3'' - 6''$. The working of this satellite were narrated by D. C. Martin et al. 2005 [1] & Morrissey et al. 2007 [2]. Analysis of GALEX observations at high galactic latitude is momentous for understanding more about the extragalactic light and its contribution in the UV sky.

There has been significant work on number counts carried out in UV band (Table 1). Measuring the number counts of field galaxies within an observed area as a function of the magnitude of galaxies is one of the fundamental techniques used for the study of extragalactic light, galaxy evolution throughout cosmic time and can be used to test theoretical models of galactic evolution. Further, the changes in the slope of number count distributions reflect physical changes in the underlying galaxy populations.

Table 1

Author	Instrument	Wavelength	Area covered	Magnitude limits
Millard et al. (1992)[3]	Balloon borne Telescope	2000Å	6 square degree	15.0-18.5
Gardner et al. (2000)[4]	Hubble Space Telescope	NUV-2365Å FUV- 1595Å	1.54 arcmin ²	24.5-29.5
Teplitz et al. (2006)[5]	Hubble Space Telescope	1600Å	3.77 arcmin ²	20.5-28.5
Xu et al. (2005)[6]	Galaxy Evolution Explorer	FUV- 1530Å NUV 2310Å	20 square degree	14.0-23.8

II. Observations

In this study, 9 GALEX deep imaging surveys (DIS) catalogs were taken from the North Polar Region. Details are given in the Table 2. These targets are from an optically thin region. The dust (E (B-V)) variation in the field is 0.01 – 0.05, which corresponds to an optical depth of 0.0812 – 0.406 (Schlegel 1998) [7]. The standard GALEX pipeline (Morrissey et al. 2007) provides a catalog of UV sources based on the detection and flux measurements with SExtractor (Bertin & Arnouts, 1996)[11] for each flux calibrated image but, given the GALEX point spread function of 4.5 and 5.4 arcsec in the FUV and NUV bands, respectively. The data files

used in the study were in Flexible Image Transport System (FITS: Well et al. 1981)[8]. These images contain both point sources and diffuse background components. Here the diffuse back ground is subtracted and the edge effects were eliminated by the usage of central 0.55° from 1.25° GALEX field of view.

Table 2

Tile Name	R.A (deg)	Dec (deg)	NUV exposure (s)	FUV exposure (s)	Observation period (yy/mm/dd)	NUV Visits	FUV Visits
ELAISN1_00	243.39857	54.97495	26877.2	28704.15	06/30/03-07/13/07	24	26
ELAISN1_02	241.71892	54.58220	20762.25	6088.3	07/06/04-07/25/06	20	6
ELAISN1_04	243.27428	53.89461	17790.8	3222.25	07/06/04-07/23/06	17	6
ELAISN1_08	241.00041	55.05557	18242.05	5412.25	05/01/05-07/24/06	20	7
ELAISN1_09	241.60668	53.53182	20289.65	7062.45	05/02/05-04/11/08	16	5
PS-ELAISN1_MOS12	242.89621	55.00035	26349.5	6929.1	05/09/09-06/10/11	21	5
PS-ELAISN1_MOS14	243.95513	54.19786	28044.65	6977	05/09/09-06/10/11	22	5
PS-ELAISN1_MOS15	242.39651	53.99999	26780.8	6889	05/09/09-06/10/11	21	5
PS-ELAISN1_MOS16	241.37386	45.45194	26881.85	6951.2	05/09/09-06/10/11	22	5

III. Number Counts Of Galaxies

There are totally 37,548 galaxies in this field and the stars are removed from the catalog by using the prescription of Groenewegen et al. (2002)[9] and Fadda et al. (2004)[10] based on the stellarity index value (CLASS_STAR) given below:

If Class Star > 0:85 For R < 23;

Class Star > 0:90 Otherwise: (1)

The GALEX photometric catalog produced using SExtractor, extracted the flux details in CPS for the matching objects. The flux is then converted into AB magnitude as follows

$$\text{Fuv: } M_{ab} = -2.5 \times \text{Log}_{10}(\text{Cps}) + 18.82$$

$$\text{Nuv: } M_{ab} = -2.5 \times \text{Log}_{10}(\text{Cps}) + 20.08 \quad (2)$$

The duplicate objects obtained from the field due to the overlapping of GALEX FOV are removed carefully. Number counts of galaxies, $\log(N/\text{sq.deg}^2/\text{mag})$ for FUV & NUV, from GALEX ELAISN1 region are plotted against AB magnitude in Fig 2 and 3. The FUV and NUV magnitude range for the objects in the field is 17.5- 26.5. The ‘square box’ represents the results of Xu et al (2005)[6] who measured the bright FUV and NUV galaxy counts between magnitudes 14 and 23.8 using 36 Medium depth Survey fields and 3 Deep Survey fields obtained with GALEX.

Our results are in good agreement with that of Xu et al. (2005) up to the level of magnitude less than 22 because DIS observations of GALEX have several thousands of second’s exposure time and hence the data are 80% complete to NUV magnitude of 23 and FUV magnitude of 23.5, but the source confusion is significant in these observations. There is a drop out of number counts of galaxies occurs using GALEX at fainter side.

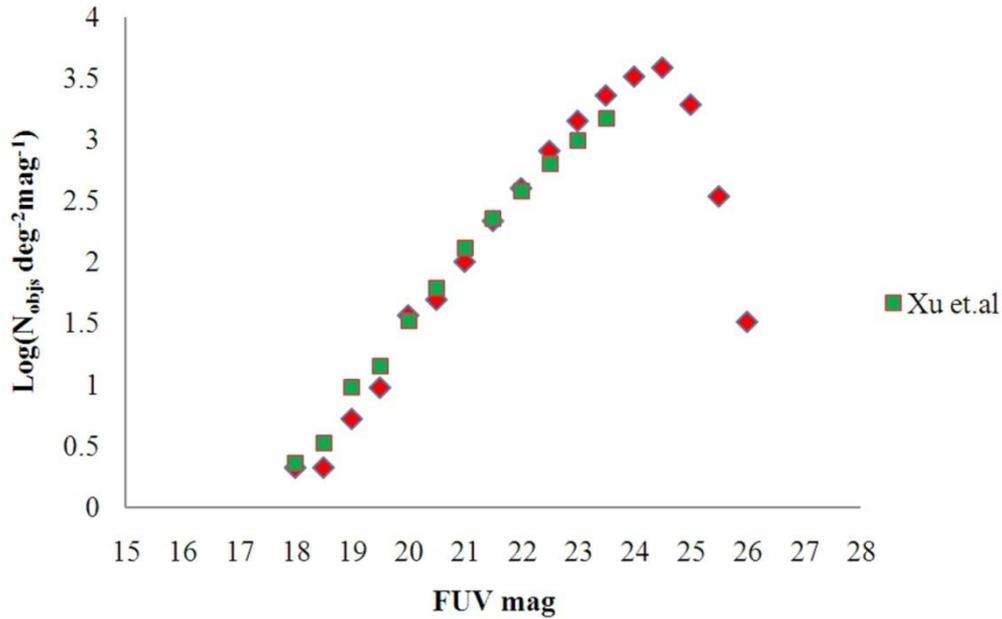


Fig 2 Number counts as a function of FUV magnitude

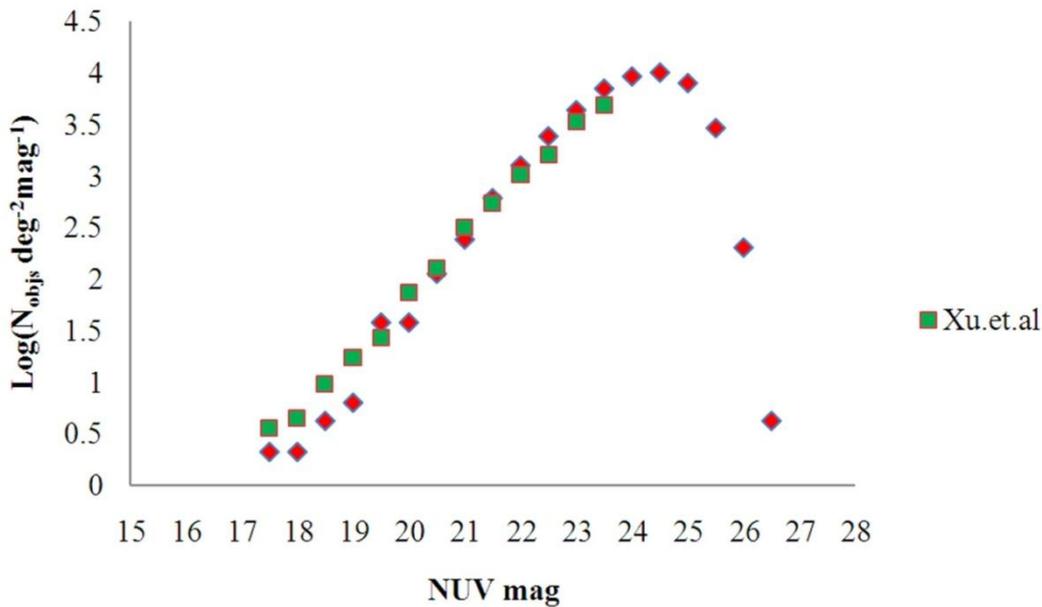


Fig 3 Number counts indicates a drop out at 24.5 NUV magnitude

IV. Results And Discussions

We report here the results of preliminary study for the measurement of extragalactic radiation in the GALEX fields. The FUV and NUV number counts of galaxies estimated as a function of AB magnitude from the Spitzer overlapped GALEX observed region in ELAISN1. Bright UV galaxy counts between 14 and 23.8 magnitudes in FUV and NUV were measured by Xu et al. (2005) using 36 Medium depth Survey fields and 3 Deep Survey fields obtained with the GALEX from an area ~ 20 deg². Our technique of estimation of number counts is different from that of Xu et al (2005) but the results are in good agreement with each other especially in the bright end, whereas the inconsistency/incompleteness in the faint end (AB magnitude >23) is mainly due to the source confusion and magnitude compatibility with diffuse sources. The drop out of counts in the fainter side indicates low sensitivity of GALEX and also the presence of unresolved objects in the this field.

V. Future Work

Spitzer spacecraft is more sensitive to galaxies than GALEX, therefore we need to identify the Spitzer positions of galaxies in GALEX fields directly, estimate the flux around each object and redo the analysis without considering the GALEX catalog derived by SExtractor. This may avoid the source confusion in the fainter magnitude side and produce better results. With this we can directly calculate the contribution of extragalactic background light (EGL) in the GALEX bands by integrating the emissions of these galaxies or by integrating the formula,

$$I_{\text{EGL}} = 10^{-0.4(m_0 - m_{\text{AB}})} * N(m_{\text{AB}})$$

Where m_0 is the zero point magnitude that corresponds to the AB magnitude of a 1 c/s flat-field corrected detection and N is the number counts. These measurements set a lower limit for the total FUV/NUV background light.

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