STUDY OF DIFFUSE NUV AND FUV RADIATION USING GALEX DEEP IMAGING SURVEYS

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INTRODUCTION

GALEX observations provide the highest spatial resolution images of the diffuse UV background, with an effective spatial resolution of about 5". 11 GALEX DIS observations were taken (Table. 1) both in FUV (1350-1750Å) and NUV (1750-2850Å) bands for the analysis of diffuse UV radiation from the GALEX archive. These targets are from an optically thin region. The dust map (Schlegel et al 1998) of the region and the GALEX field of view (1.26^{o}) of the targets are shown in Fig. 1. E(B-V) variation in the field is 0.01 - 0.05 which corresponds to an optical depth of 0.0812 - 0.406.

Point sources were removed from each GALEX observation using the merged catalogue given in the archive to extract the diffuse signal. The signal to noise was increased by binning the image to 2' pixels which also enables us to remove unidentified faint sources from the field. Airglow, zodiacal light and dust scattered starlight are the 3 major components of the diffuse radiation. Method of extraction of these components are explained in detail in Sujatha et al. 2009.

Table.1: Details about the regions

Tile_name	RA_Cent	Dec_ Cent	Nuv_ Exptime	Fuv_ Exptime	Fuv_ Visits	Nuv_ Visits
SIRTFFL_00	259.11	59.91	52917.15	52016.95	39	41
SIRTFFL_01	260.41	59.34	26006.1	30922.1	24	20
SIRTFFL_02	260.09	58.5	39037.05	26859.35	25	30
SIRTFFL_03	258.33	58.86	39830.4	29570.9	28	30
SIRTFFL_04	256.98	59.72	3874.45	3874.45	3	3
SIRTFFL_05	260.68	60.7	5305	5305	4	4
SIRTFFL_06	257.58	60.45	27658.75	3668	9	22
SIRTFFL_07	260.54	60.81	34376.55	21276.1	20	25
SIRTFFL_08	262.61	59.15	40639.6	22540	20	28
SIRTFFL_09	257.2	59.72	15737.4	3197.5	9	12
SIRTFFL_10	256.99	58.8	27383.75	10757.7	15	21

ERROR ANALYSIS

The visits of each observation are grouped into two sets to determine possible error in each observation. The results are tabulated in Table 2. The error in the FUV observations of SIRTFFL_06 & 09 are very high compared to others because of the lack of enough good visits ,which is also clear from its FUV-FUV correlation .

Table.2: Scatter in the observations

Tile_name	Scatter		Correlation - Coefficient	
	FUV	NUV	FUV-FUV	NUV-NUV
SIRTFFL_00	35.85	14.42	0.87	0.95
SIRTFFL_01	22.17	14.74	0.97	0.95
SIRTFFL_02	53.91	58.54	0.89	0.87
SIRTFFL_03	33.56	17.36	0.99	0.97
SIRTFFL_04	50.96	28.55	0.82	0.82
SIRTFFL_05	46.16	31.08	0.81	0.72
SIRTFFL_06	86.7*	16.07	0.67	0.93
SIRTFFL_07	36.41	22.89	0.85	0.95
SIRTFFL_08	32.4	22.52	0.89	0.96
SIRTFFL_09	161.47*	18.68	0.41	0.95
SIRTFFL_10	42.78	11.31	0.97	0.99

Table.4: Correlation between IR, NUV & FUV regions

Tile_Name	FUV-NUV Correlation	IR-FUV Correlation	IR-NUV Correlation
SIRTFFL_00	0.14	0.42	-0.09
SIRTFFL_01	0.61	0.73	0.62
SIRTFFL_02	0.32	0.3	0.44
SIRTFFL_03	0.85	0.92	0.82
SIRTFFL_04	0.54	0.75	0.71
SIRTFFL_05	0.29	0.18	0.37
SIRTFFL_06	0.49	0.56	0.51
SIRTFFL_07	0.34	0.4	0.52
SIRTFFL_08	0.14	0.52	0.14
SIRTFFL_09	0.31	0.35	0.5
SIRTFFL_10	0.9	0.93	0.87

ABSTRACT

We present here preliminary results of the analysis of 11 GALEX DIS observations from nearby regions which are at medium latitude. We have estimated the error in the data of each of the observations from its visits. Different components of diffuse UV radiation were quantified and separated after removing the sources from each of the field. We then studied the dependencies of these components to factors such as solar activity, sun angle and Infrared 100 micron intensity, specific to each of these components.

Table.3: Airglow and Zodiacal Light values

Tile_Name	Sun Angle to LOS	Average FUV_AG	Average NUV_AG	λ-λsun	β	Average ZL	Correlation Coefficient	
							Solar Flux - NUV_TEC_MIN	Solar Flux - FUV_TEC_MIN
SIRTFFL_00	89.17-95	238	243	84.17-128	81.76	365	0.89	0.68
SIRTFFL_01	90–98.2	131	136	90.67-193.5	81.59	367.3	0.81	0.66
SIRTFFL_02	87.82-98.37	186	169	77-206.54	80.76	372	0.98	0.92
SIRTFFL_03	87.04-98.83	153	152	71.46-199	80.67	381	0.98	0.97
SIRTFFL_04	98.97-98.98	67	52	182.62-183.2	81.01	342	only 2 visits	
SIRTFFL_05	97.07-97.11	91	48	187.47-190.2	82.84	342		
SIRTFFL_06	90.08-98.07	132	123	92-195.65	81.78	358	0.94	
SIRTFFL_07	87.01-96.73	202	141	65-201.2	82.9	380	0.94	0.85
SIRTFFL_08	89.37-97.74	145	152	86.3-163.1	81.87	363	0.92	0.86
SIRTFFL_09	90.29-97.15	71	154	92.5-144.04	81.08	367	0.96	only 2 visits
SIRTFFL_10	86.99-98.15	168	161	72.65-147.51	80.24	365	0.95	0.61

AIRGLOW ESTIMATION AND SOLAR FLUX DEPENDENCE

Airglow is one of the major component of diffuse radiation in the field and is due to the resonantly scattered OI lines at 1304, 1356 and 2471 Å from the Earth's ionosphere. We extracted this component using the total count rate from the spacecraft state file of each visit assuming that the airglow contribution is negligible to the TEC_MIN in the local midnight. The calculated values are tabulated in Table 2. We have also studied the variation of FUV & NUV TEC_MIN with solar activity (Fig.2.). The airglow emission is dependent on the solar flux but perhaps not with a simple linear correlation. In our procedure, we estimate the level empirically from our data.

Fig.2a:

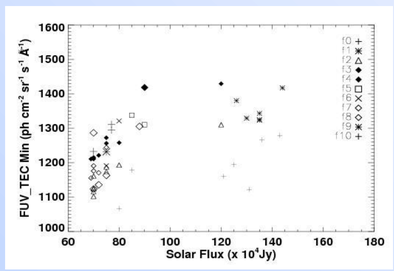
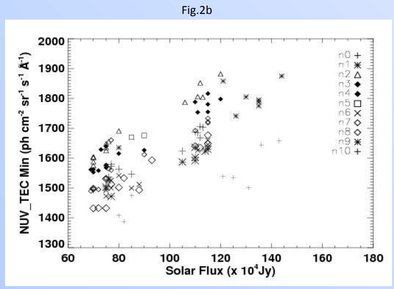


Fig.2b



ZODIACAL LIGHT CONTRIBUTION

Zodiacal light, is another major contributor in NUV images - which is sunlight scattered radiation from the interplanetary dust grains - is estimated for each observation from Leinert et al (1998) and tabulated in Table 3.

CORRELATION STUDIES OF DIFFUSE UV RADIATION

We have studied the variation of total diffuse UV radiation relative to IR 100 micron intensity (Fig.3), which is a measure of interstellar dust grains in the region. In Fig. 3 and Fig. 4, we have plotted the entire signal observed in the data without subtracting the different components. Much of the scatter in the plots is due to the varying zodiacal light and airglow and the actual scatter (Table 2) is much less than shown. Fig. 4 is FUV - NUV correlation of 11 observations. The correlation details of FUV-NUV & IR-UV are given in Table.4.

Fig.3a

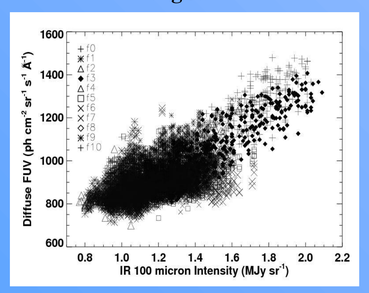


Fig.3b

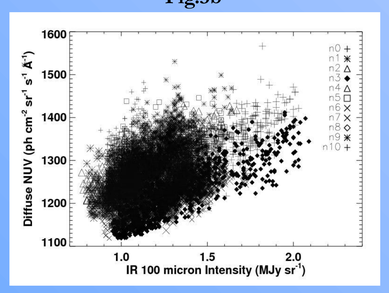
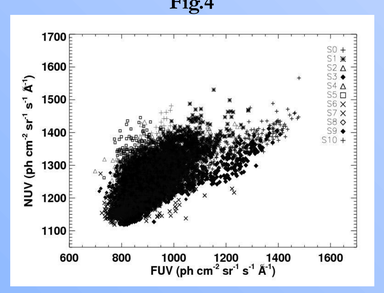


Fig.4



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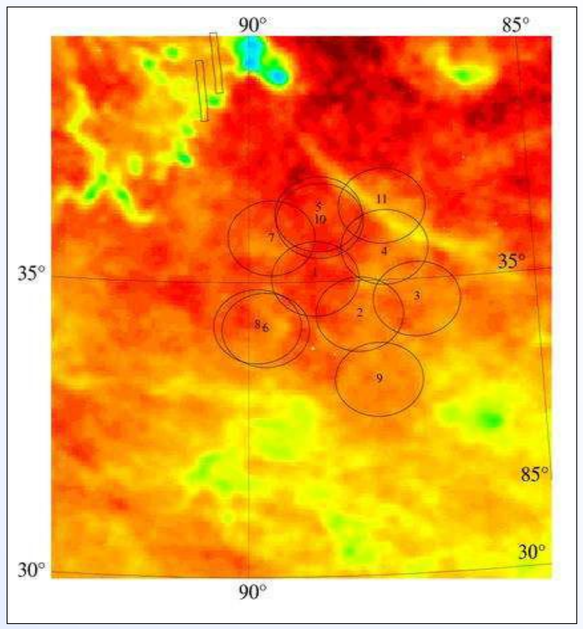
[3] Leinert,C., et al. 1998, A&AS, 127, 1-99.

Fig.1: Schlegel's Dust-map for the region with GALEX FOV.



RESULTS AND DISCUSSION

These observations are from an optically thin region. The data shows an intrinsic scatter which varies between 10 to 60 ph cm^{-2} s^{-1} sr^{-1} Å^{-1} both in FUV & NUV, much greater than what can be attributed to photon noise.

We observe that the airglow contribution empirically estimated from the data in the fields is very much depending on the solar activity at the time of observation, however not with a simple linear correlation. In our fields the average airglow contribution varies between 50 to 250 ph cm^{-2} s^{-1} sr^{-1} Å^{-1} .

We find that the total diffuse UV radiation increases linearly with the IR 100 micron intensity, which is from the entire volume of dust due to the low optical depth in the IR. We could also see that the FUV and NUV data in the observed regions are correlating well.

These are preliminary results of our analysis. In depth studies of the correlations we observed, extraction of dust scattered component in this radiation and the modeling of the same to extract the optical properties of dust grains in this region are underway.

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