The Diffuse UV Background: A GALEX View

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Definitions

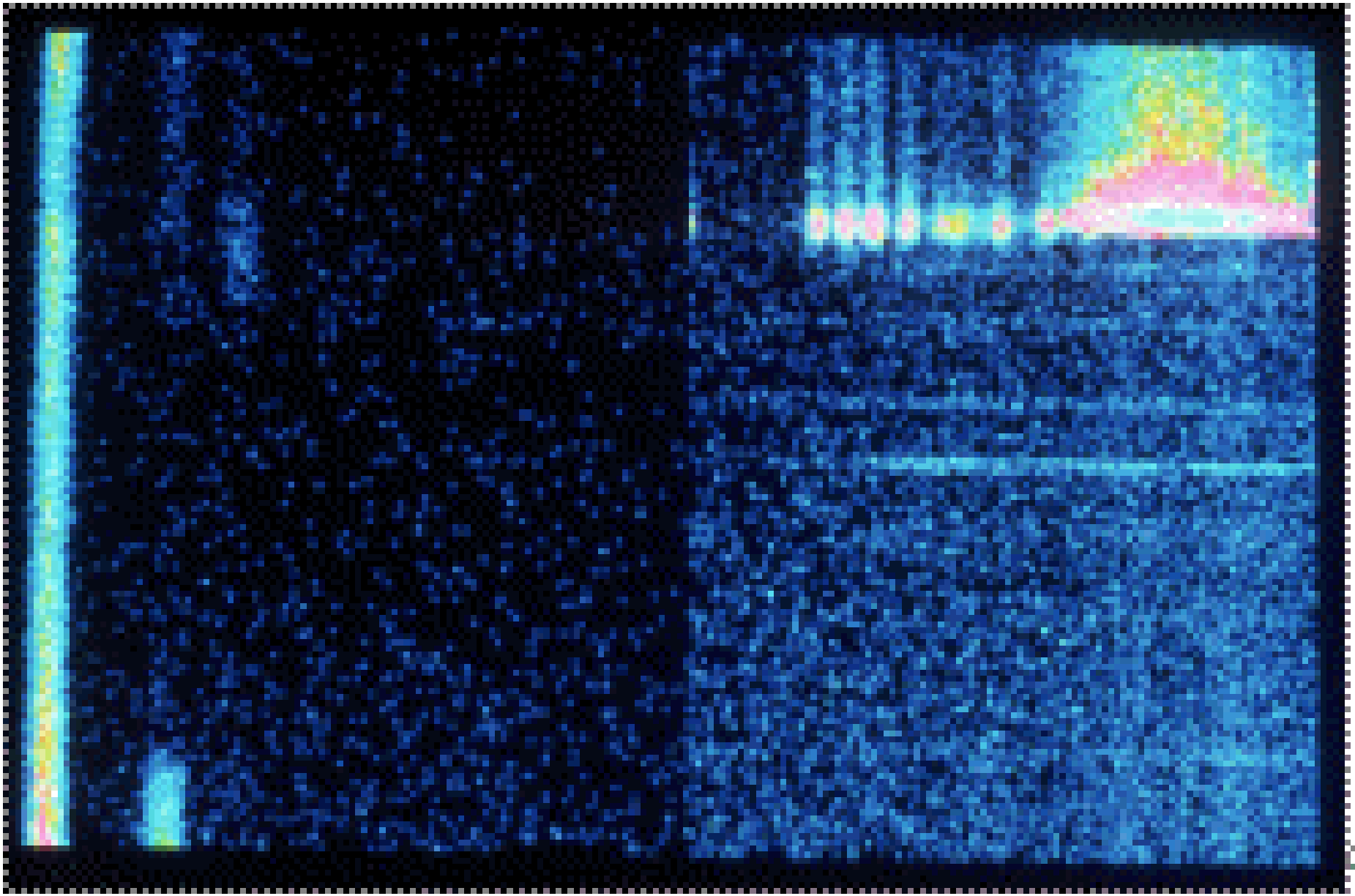
- Diffuse: Not stars.
- UV: 912 – 3200 Å.
  - Lower end is the Lyman limit.
  - Long wavelength side is limited by increasing numbers of stars.
  - Zodiacal light.
- Units: photons cm^{-2} s^{-1} sr^{-1} $Å^{-1}$.
  - 1.33×10^{-11} ergs cm^{-2} s^{-1} sr^{-1} $Å^{-1}$ at 1500 Å.

Sources

- Instrumental Background.
- Airglow.
- Zodiacal Light.
- Unresolved stars.
- Diffuse Galactic Light.
  - Dust.
  - Emission lines.
- Extragalactic Light.

The 1997 reference of diffuse night sky brightness
Leinert et al. 1998 A&A Supplement Series 127, 1

UVX Data



Early Observations

- Rocket Observations.
  - Hayakawa, Yamashita, & Yoshioka (1969).
  - Lillie & Witt (1969).
- OAO-2 (Witt & Lillie 1973)
  - Small field of view (intended for stellar work).
  - Variable dark count.
- Rocket flights from JHU and UCB.
- Review papers: Bowyer (1991); Henry (1991)

DGL Sources

- Unresolved stars (Henry 1977).
- Emission from gas.
  - Plasma emission (Jakobsen & Paresce 1981).
  - 2 photon emission (Deharveng et al. 1992).
  - H_2 fluorescence (Sternberg 1989).
- Dust Scattering (Jura 1978).
  - Reflection nebulae.
  - Scattering of the ISRF by interstellar dust.

Extragalactic Contributors

- Massive neutrinos (Kimble et al. 1981).
- Integrated light of galaxies (Paresce & Jakobsen 1980).
  - Martin & Bowyer (1989) claimed correlation.
- AGN (Bechtold et al. 1987).
- IGM (Jakobsen 1980).

Table 3 Components of the diffuse cosmic far ultraviolet background with approximate intensities[a]

Total intensity	300–1500
Galactic components	
Scattering by dust	200–1500
HII two-photon emission	50
H_2 fluorescence	100 (in molecular clouds)
Components of the "uniform" high-latitude background	
Dust (?)	200
Summed from all galaxies	50
HII two-photon emission	50
Hot gas line emission	10
QSOs/AGNs	<10
Intergalactic medium	<10
Unexplained	none to <200

[a] Intensities dependent upon view direction. Intensities of processes producing discrete features are averaged over the 1400–1850 Å band. Units are photon cm^{-2} s^{-1} $ster^{-1}$ $Å^{-1}$.

Bowyer 1991

Primack Model

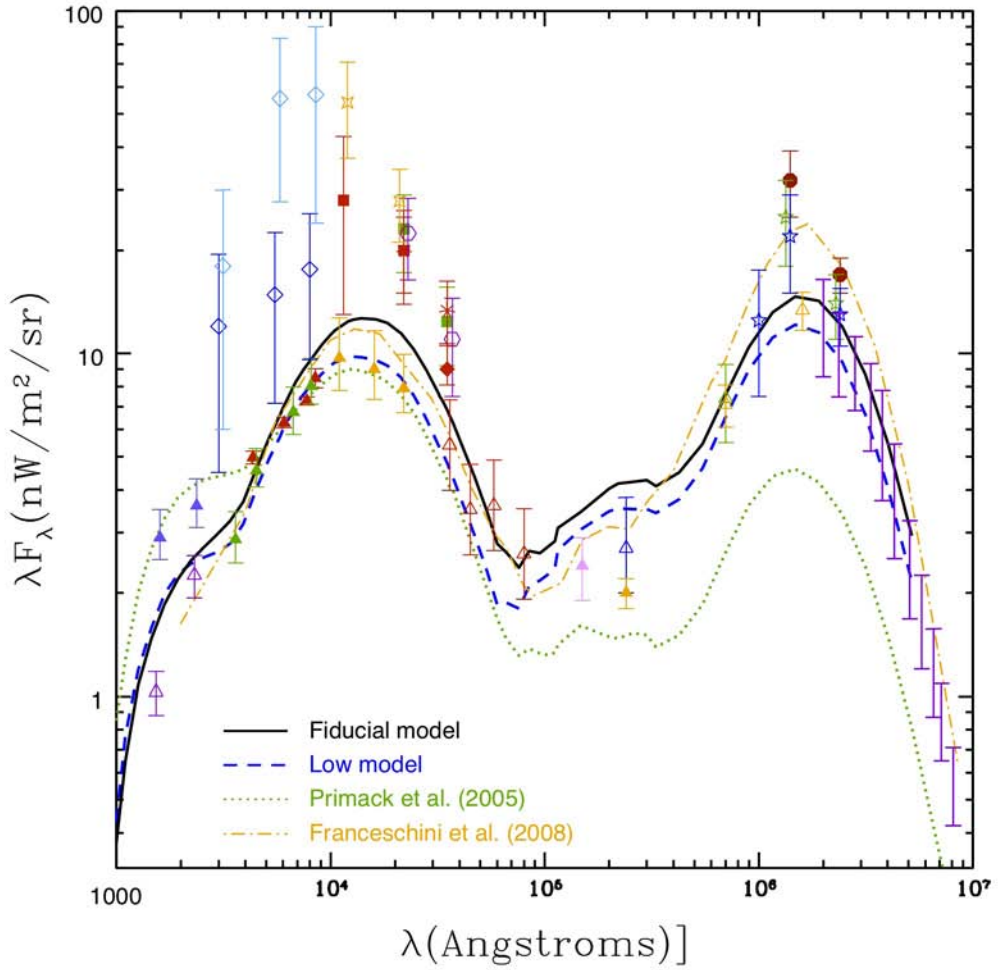
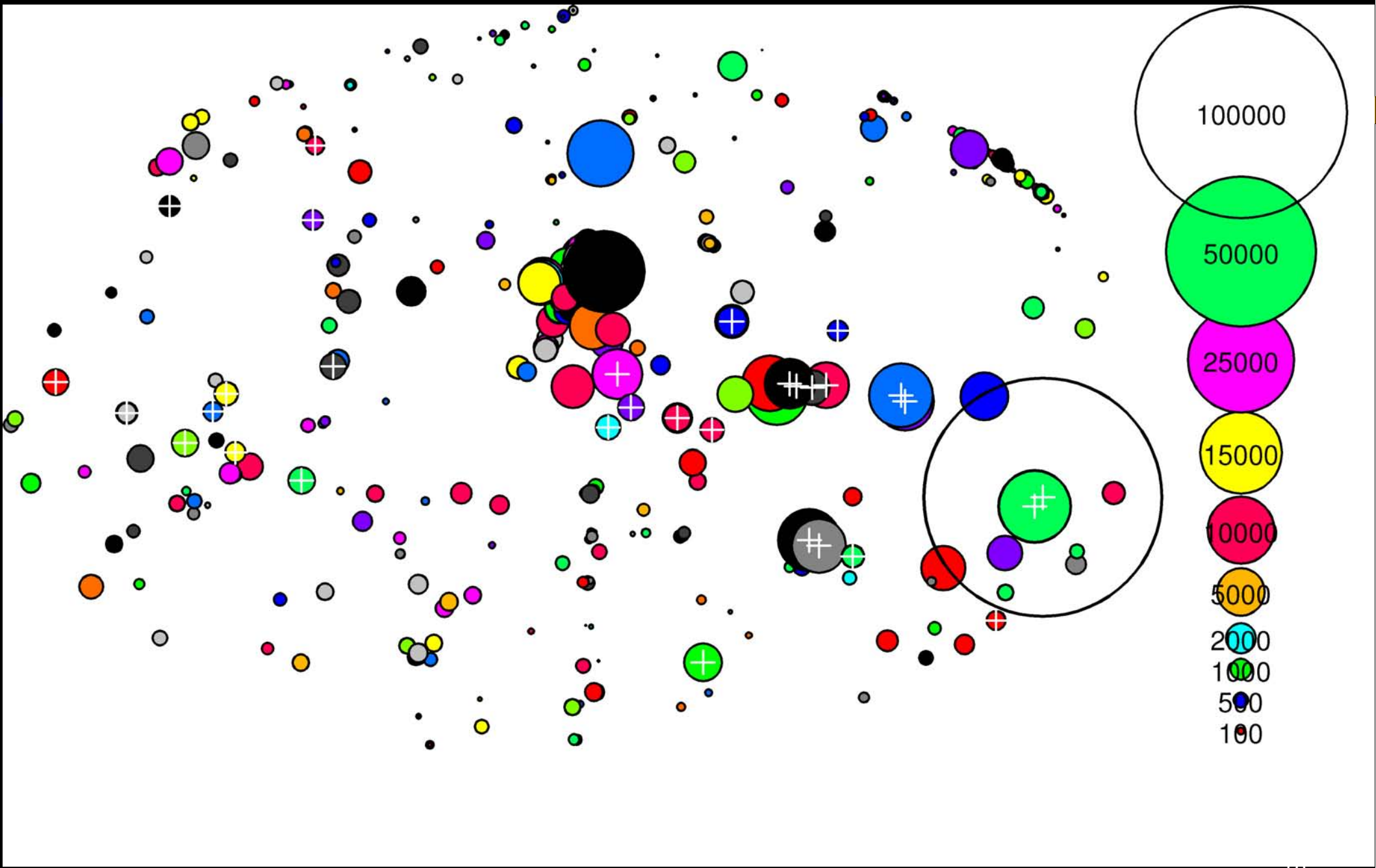
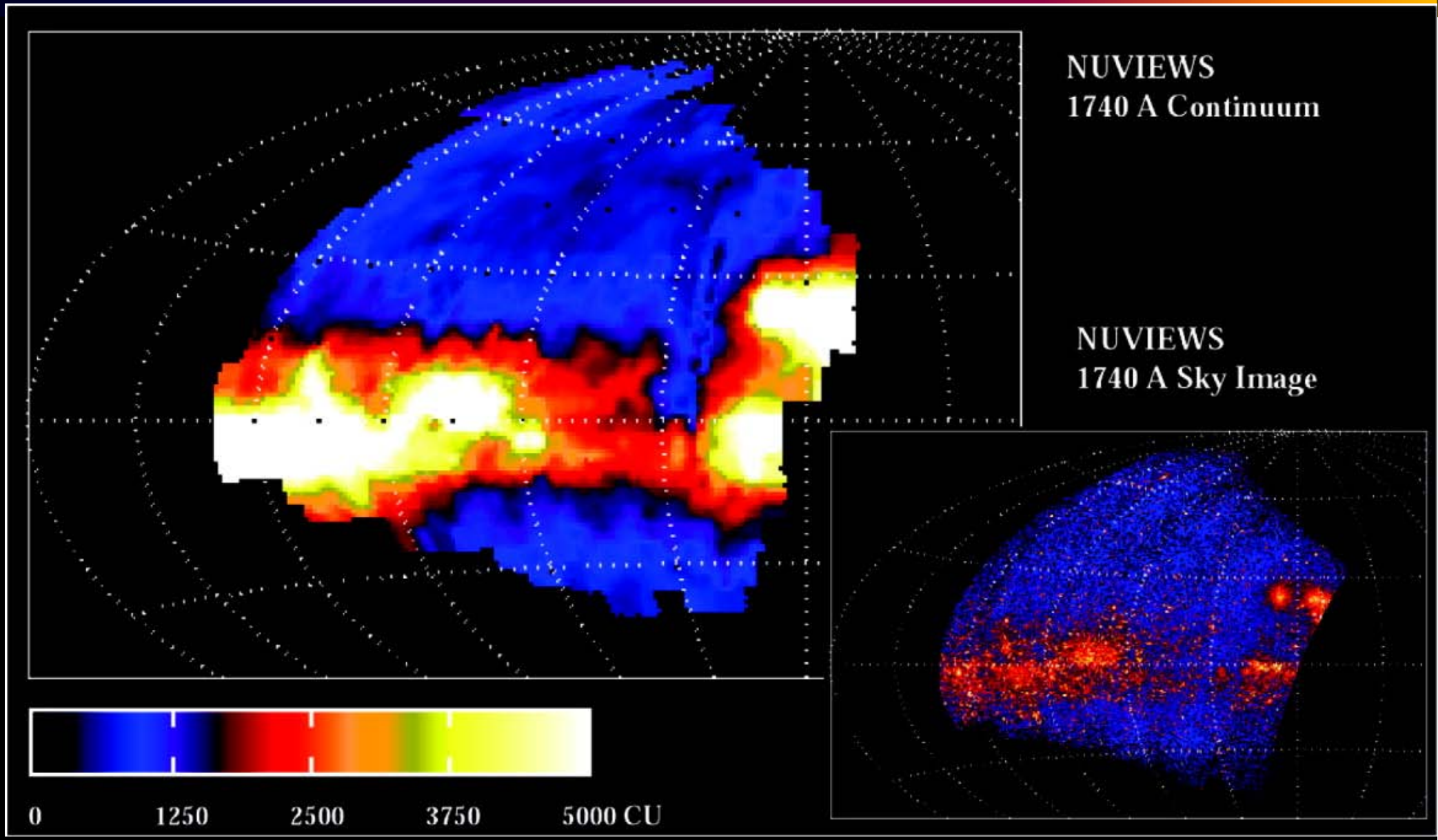


FIGURE 1. The predicted z=0 EBL spectrum from our fiducial (black) and low (dashed blue) models, compared with experiments at a number of wavelengths. Our previous model [32] is also shown for comparison (dotted curve). We have also shown the model of Franceschini et al. [33] for comparison (dash-dotted orange line). Upward pointing arrows indicate lower bounds from number counts; other symbols are results from direct detection experiments. Some points have been offset slightly to improve readability. **Lower limits:** The open blue-violet triangles are results from Hubble and STIS [23], while the magenta triangles are from GALEX [22]. The green and red triangles from Hubble Deep Field [20] and Ultra Deep Field [34] respectively, combined with ground based-data. Gold triangles are also from this same work by Madau & Pozzetti. Open red triangles are from IRAC on Spitzer [24], and the pink point at 15 μm is ISOCAM [26] on ISO. The remaining lower limits are from MIPS at 24, 70, and 160 μm on Spitzer [29, 27, 28, 30]. **Direct Detection:** The higher open blue triangles are from Bernstein [4], while the lower points are the original determinations from [2]. The high-reaching cyan points in the near-IR are from [10]. While the rest of the points in this region are based upon DIRBE data with foreground subtraction [6] (dark red squares), [8] (orange 4-stars), [25] (red diamond), [7] (purple open hexes), [5] (green square), [9] (red asterisks). In the far-IR, direct detection data is shown from DIRBE [18] (blue stars), and [15] (green stars), and also purple bars showing the detection of FIRAS [14].

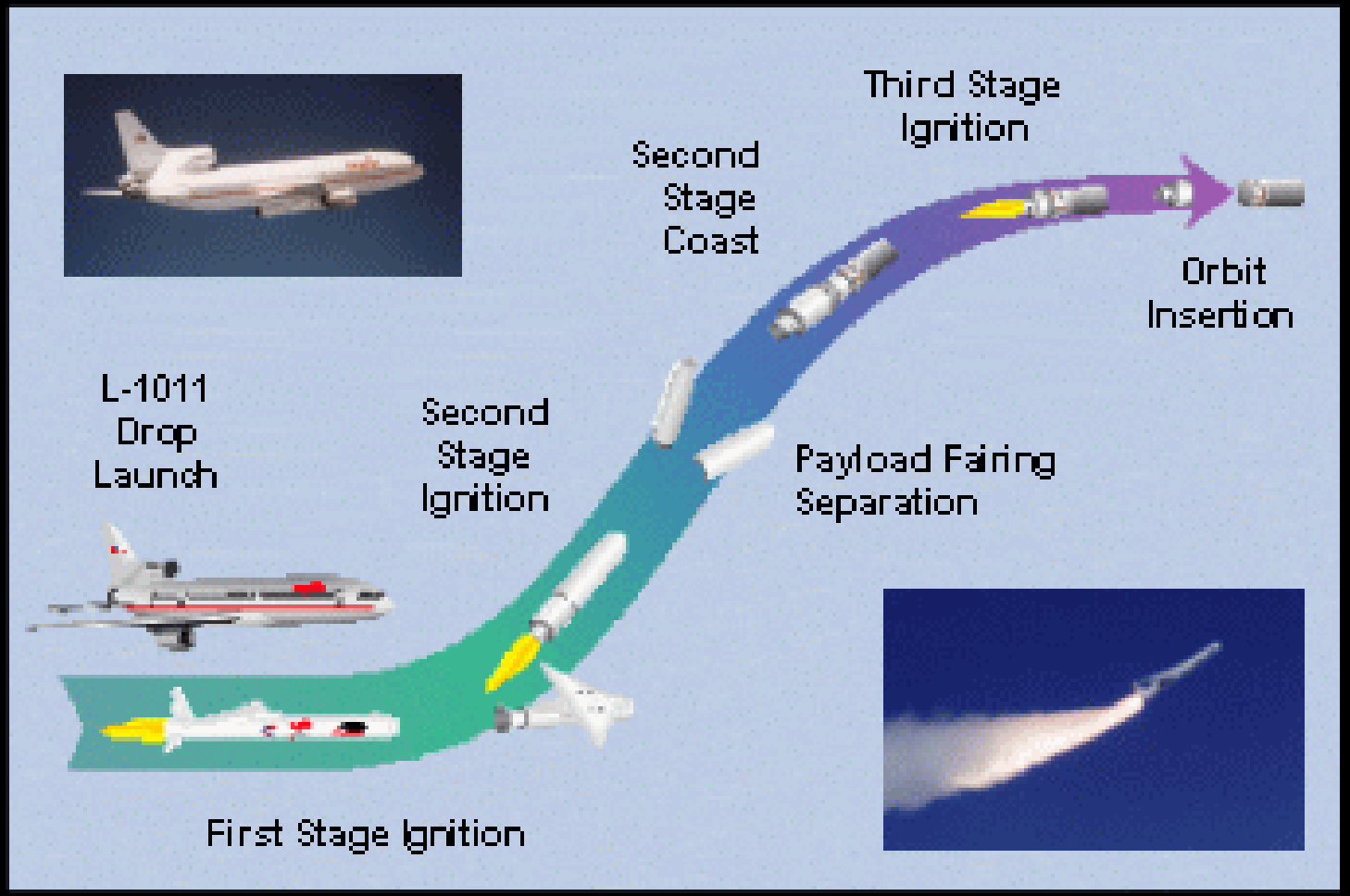

100000
50000
25000
15000
10000
5000
2000
1000
500
100

NUVIEWS (Schiminovich et al. 2001)

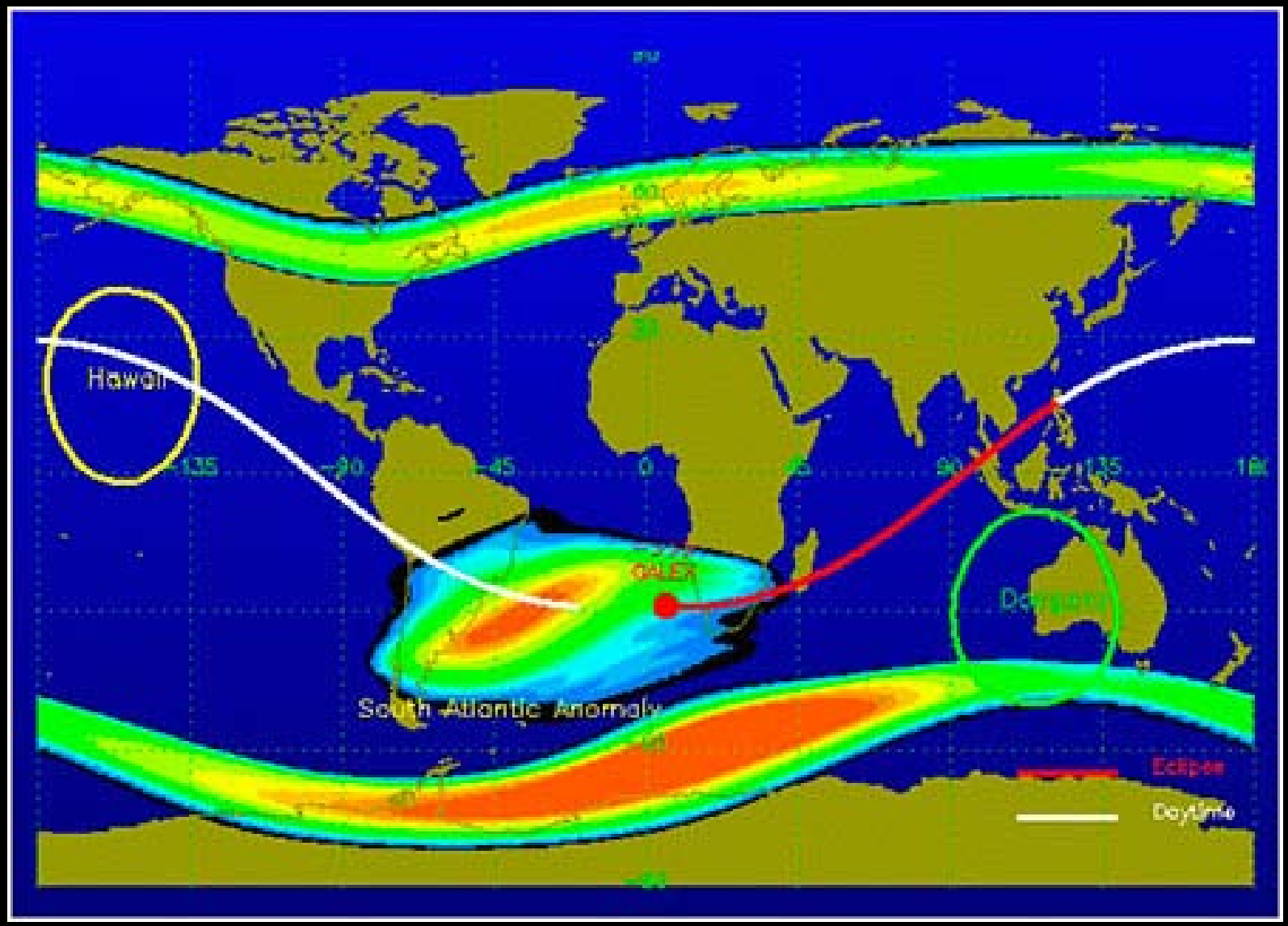


What is GALEX

- Galaxy Evolution Explorer
  - Launched by a Pegasus from an L1011.



GALEX Orbit



GALEX Field of View

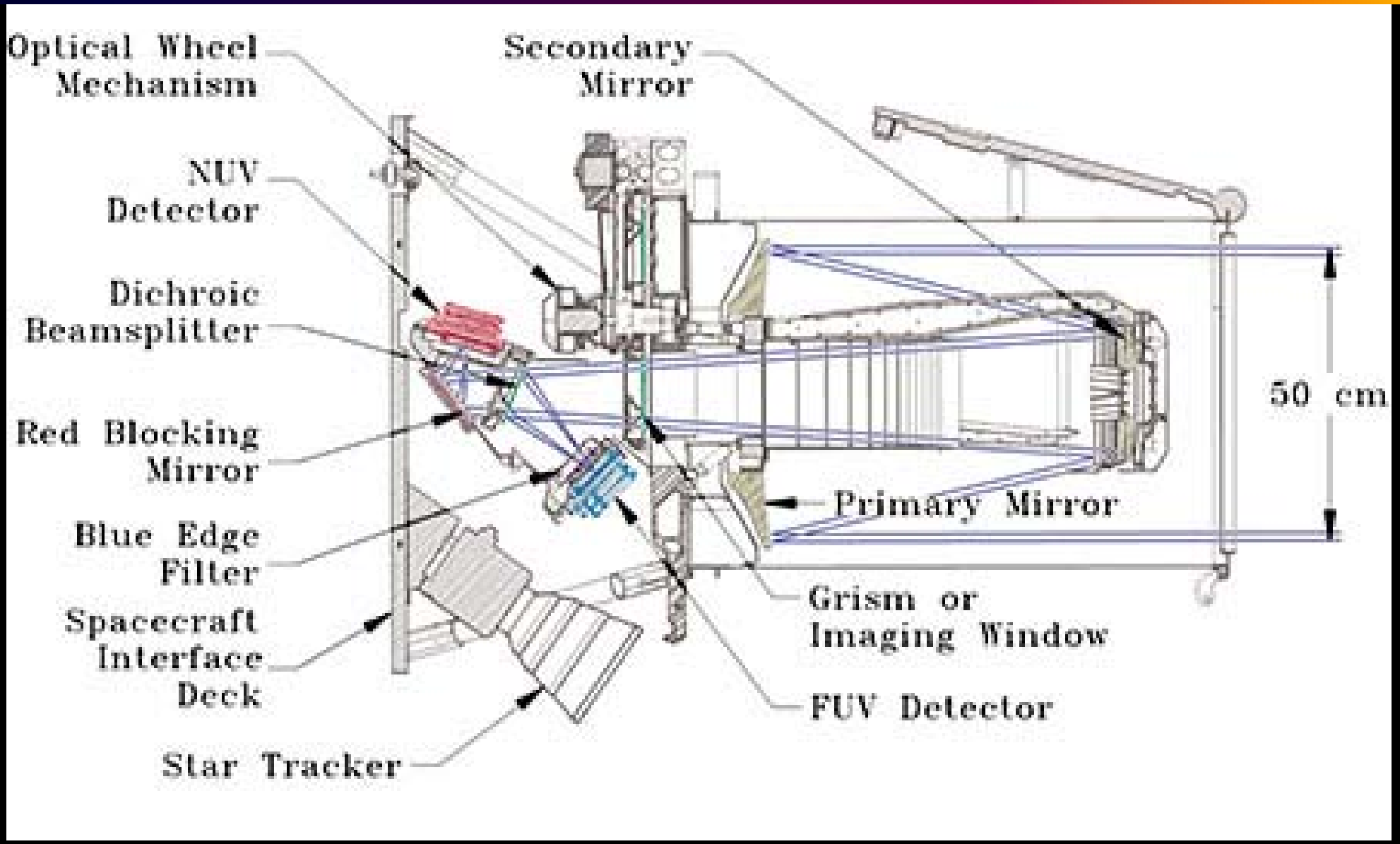


Full Moon
(relative area)



1.2 Degrees

Instrument


Optical Wheel Mechanism
Secondary Mirror
NUV Detector
Dichroic Beamsplitter
Red Blocking Mirror
Blue Edge Filter
Spacecraft Interface Deck
Star Tracker
Primary Mirror
Grism or Imaging Window
FUV Detector
50 cm

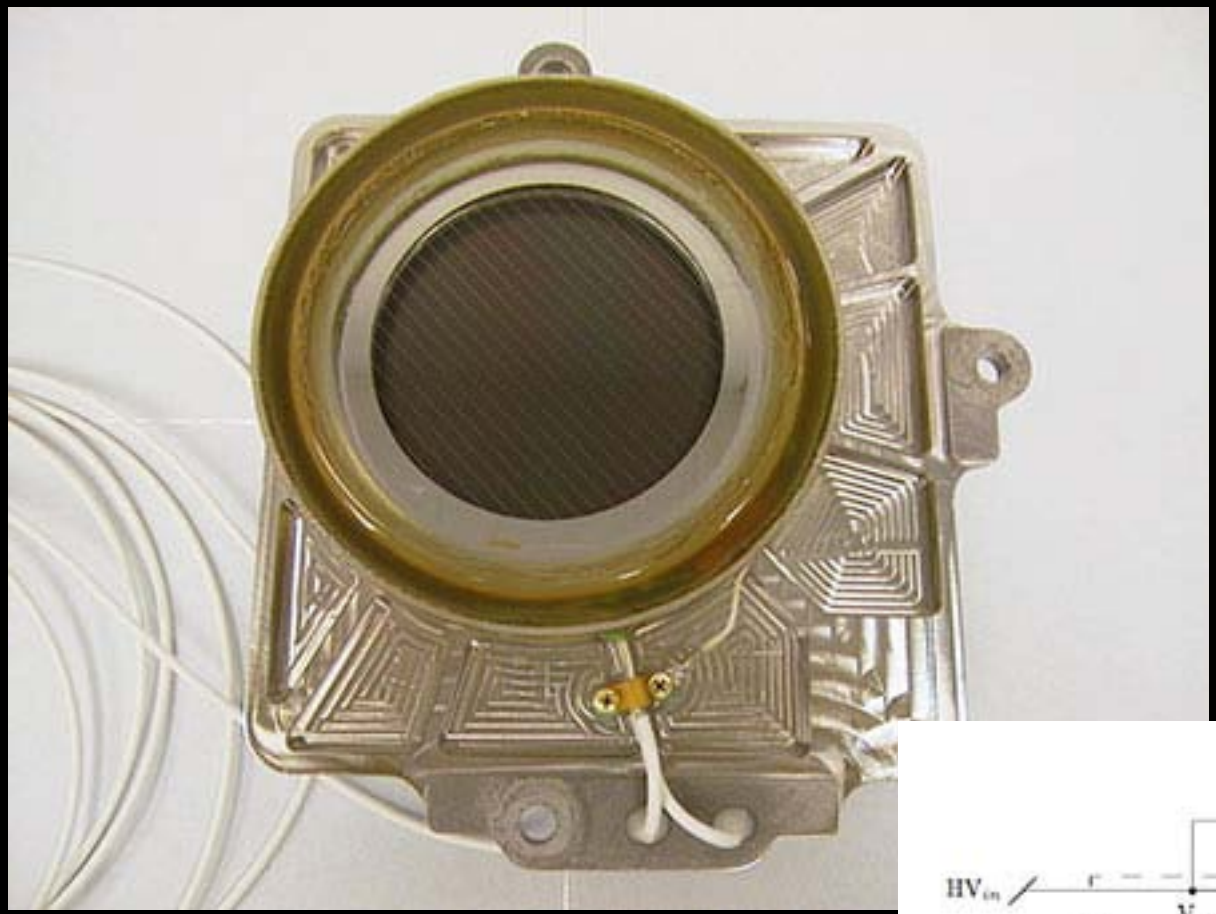
GALEX Optical Parameters

TABLE 1

THE *GALEX* OPTICAL PRESCRIPTION

Parameter	Value
Telescope:	
Type	Ritchey-Chrétien
Coatings	MgF_2-coated Al
Primary diameter	500 mm
Secondary diameter	230 mm
Focal length	2998 mm
Focal ratio	6
Place scale	68".80 mm^{-1}
Grism (CaF_2):	
Width (inscribed diameter)	124 mm
Thickness (center)	5.9 mm
Wedge	1°.37
Blaze angle	2°.33
Ruling	75 lines mm^{-1}
Imaging window (CaF_2):	
Diameter	124 mm
Thickness	6 mm
Dichroic (fused silica):	
Diameter	110 mm
Thickness	4 mm
Wedge	0°.119
Blue-edge filter (MgF_2):	
Diameter	74 mm
Thickness	2.5 mm
Red-blocking mirror:	
Diameter	110 mm

GALEX Detector



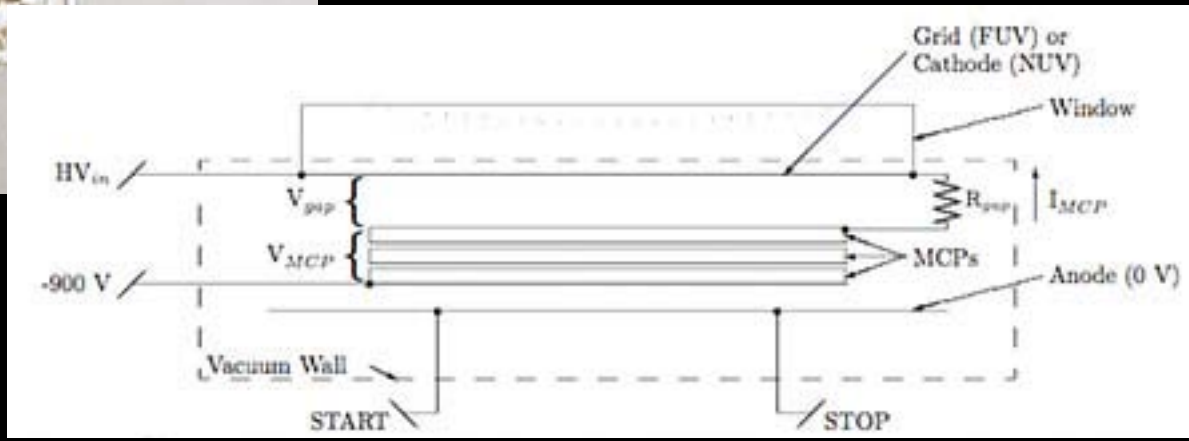


TABLE 2

SUMMARY OF MEASURED PERFORMANCE PARAMETERS FOR *GALEX*

Item	FUV Band	NUV Band
Bandwidth[a]	1344–1786 Å	1771–2831 Å
Effective wavelength[b]	1528 Å	2271 Å
Field of view	1°.28	1°.24
Peak effective area	36.8 cm^2 at 1480 Å	61.7 cm^2 at 2200 Å
Zero point (m_0)	18.82	20.08
Image resolution	4".3 FWHM	5".3 FWHM
Spectral resolution ($\lambda/\Delta\lambda$)	200	90
Detector background (typical):		
Total	78 counts s^{-1}	193 counts s^{-1}
Diffuse (cm^{-2})	0.66 counts s^{-1}	1.82 counts s^{-1}
Hot spots	47 counts s^{-1}	107 counts s^{-1}
Sky background (typical)[c]	2000 counts s^{-1}	20000 counts s^{-1}
Limiting magnitude (5 σ):[d]		
AIS (100 s)	19.9	20.8
MIS (1500 s)	22.6	22.7
DIS (30000 s)	24.8	24.4
Linearity:		
Global (10% rolloff)	18000 counts s^{-1}	
Global (50% rolloff)	91000 counts s^{-1}	
Local (10% rolloff)[e]	108 counts s^{-1}	295 counts s^{-1}
Pipeline image format	3840 × 3840 elements with 1".5 pixels	

[a] The bandpass is defined by wavelengths with effective area at least 10% of the peak.

[b] From eq. (3) of Fukugita et al. (1996).

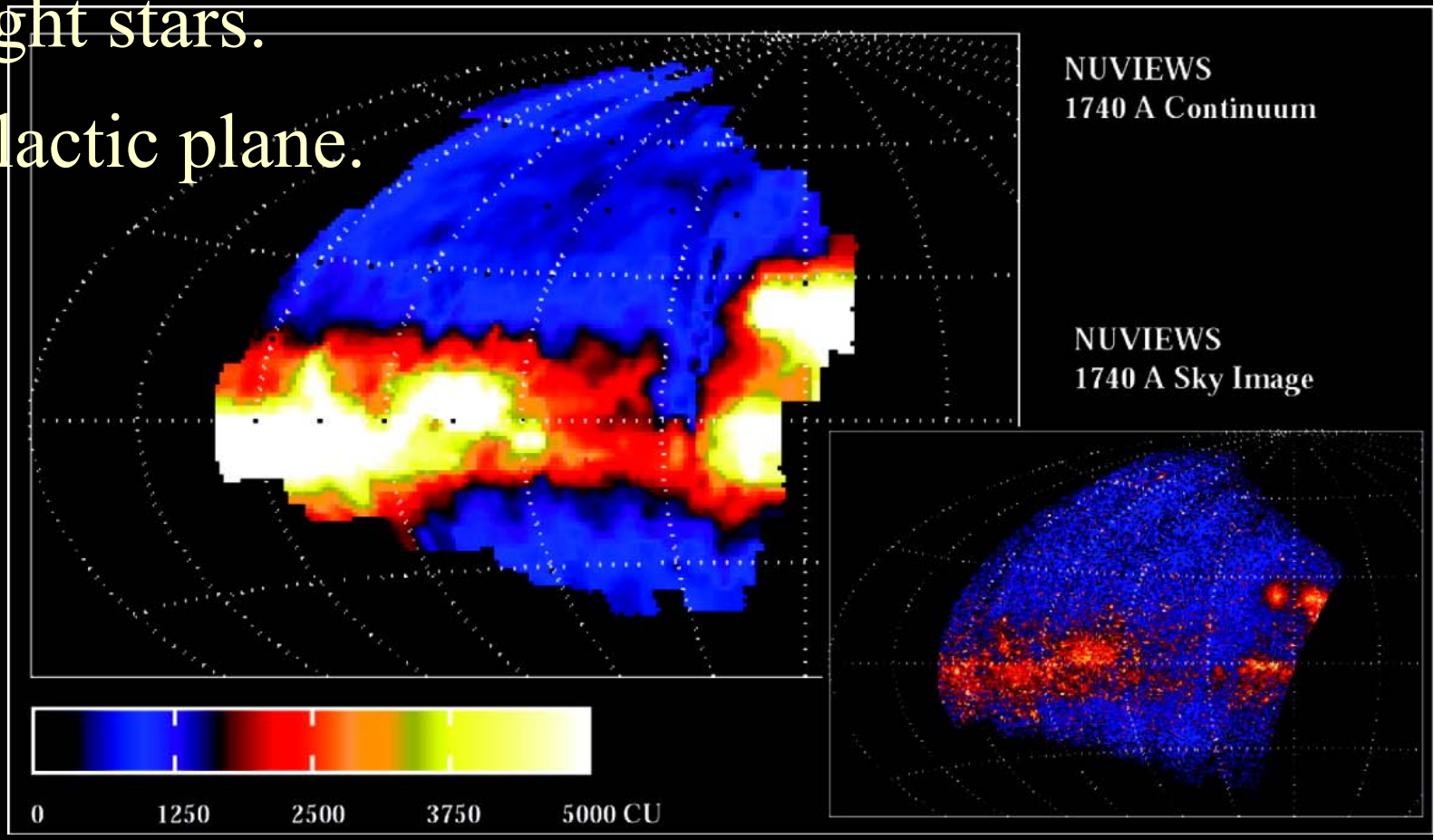
[c] These correspond to 690 and 745 photons s^{-} cm^{-} sr^{-}Å $^{-}$, respectively.

[d] Approximate All-sky (AIS), Medium (MIS), and Deep (DIS) Imaging Survey depths.

[e] These are worst-case values for point sources.

GALEX Safety Constraints

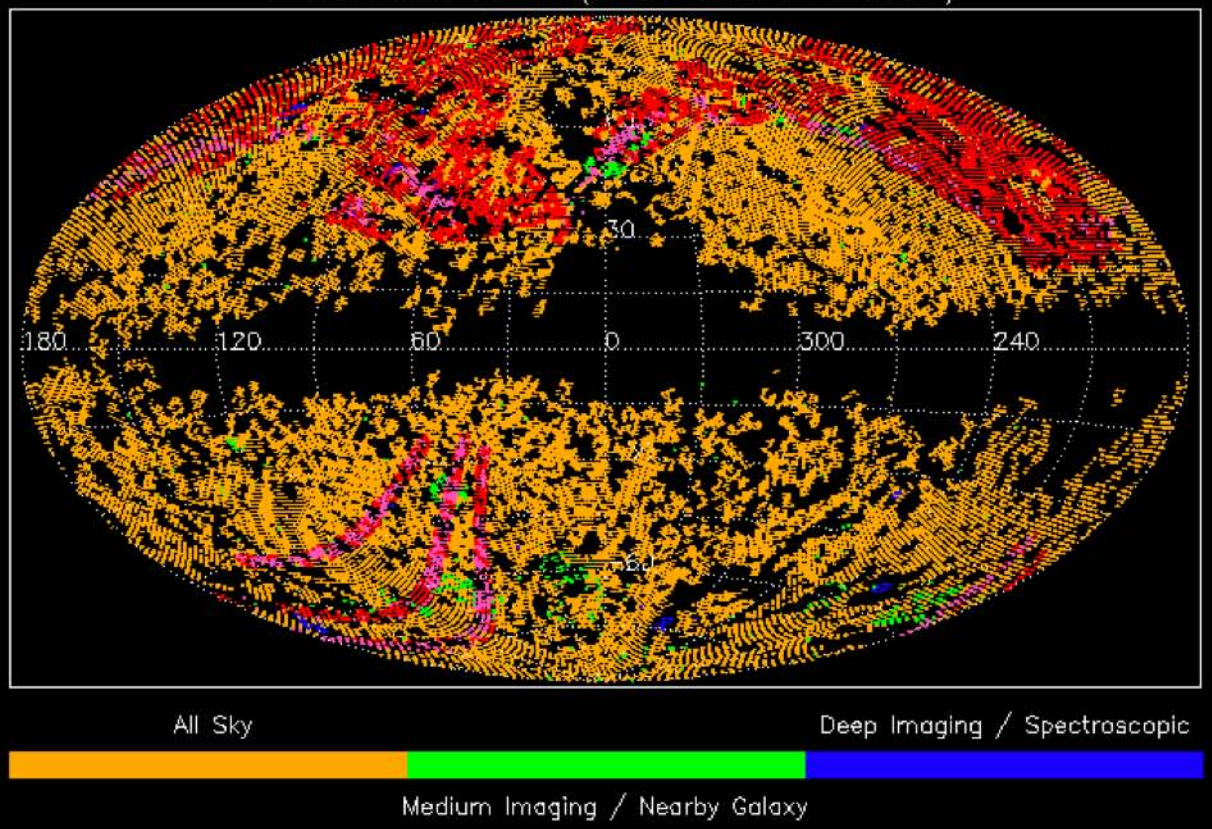
- Observes only during orbital night.
- Avoids Sun, Earth, Moon, planets.
- Avoids bright stars.
- Avoids Galactic plane.



Sky coverage – GALEX GR3

CURRENT
(May 2007)
fields:
AIS 27925
MIS 1673
DIS 151
NGS 307

GR3release
AIS 15721
MIS 1017
DIS 122
NGS 296
GI 288
Spectra 39



Sources/ sq. deg

AIS ~5000
MIS ~13000
DIS ~30k

sources GR3release

total 110M
AIS 85M
MIS 13.5M
DIS 3M
NGS
GI 4M

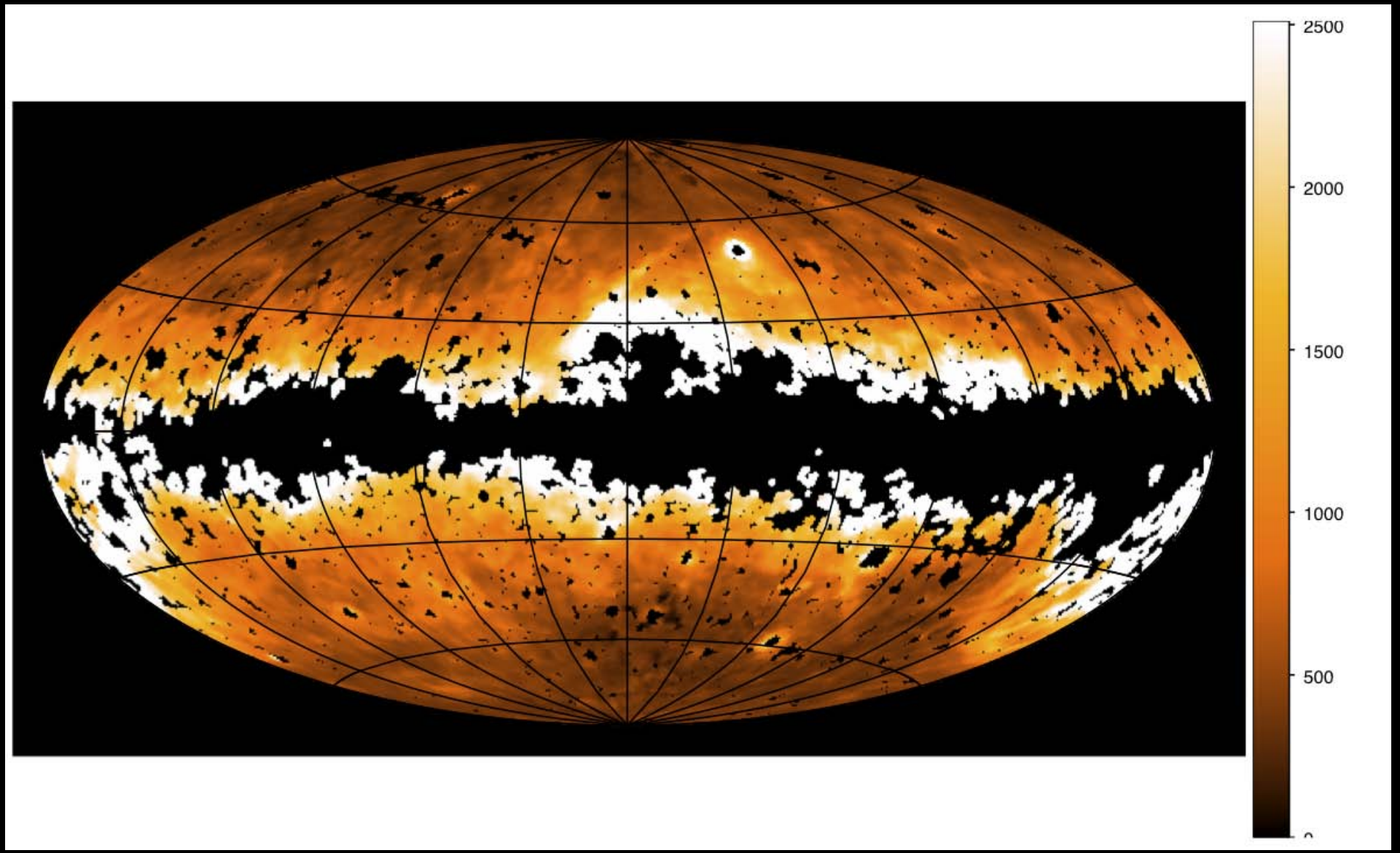
GALEX GR3 Red = AIS and SDSS overlap, 3390 sq.deg (out of 12128)
SDSS DR6 Purple = MIS and SDSS 573sq.deg. (*) (out of 792)
(*) reducing field radius to 0.5deg

Luciana Bianchi Montreal Oct. 2007

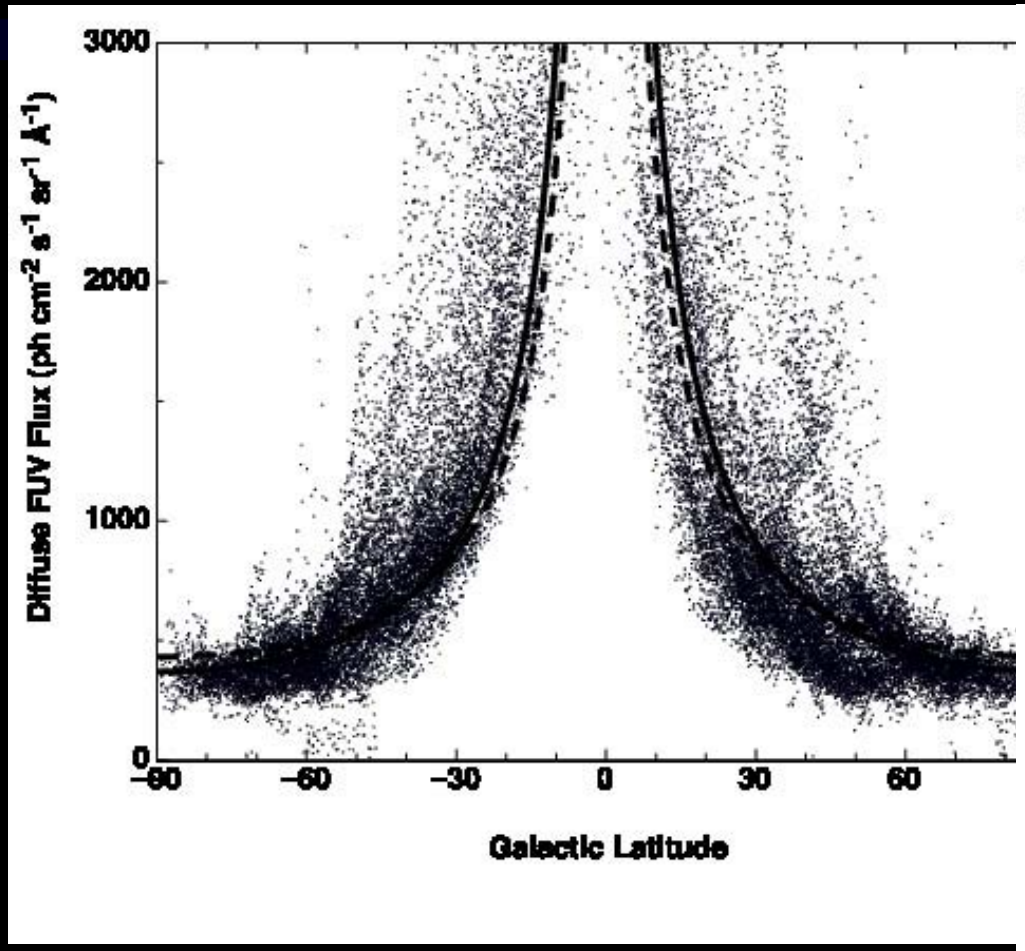


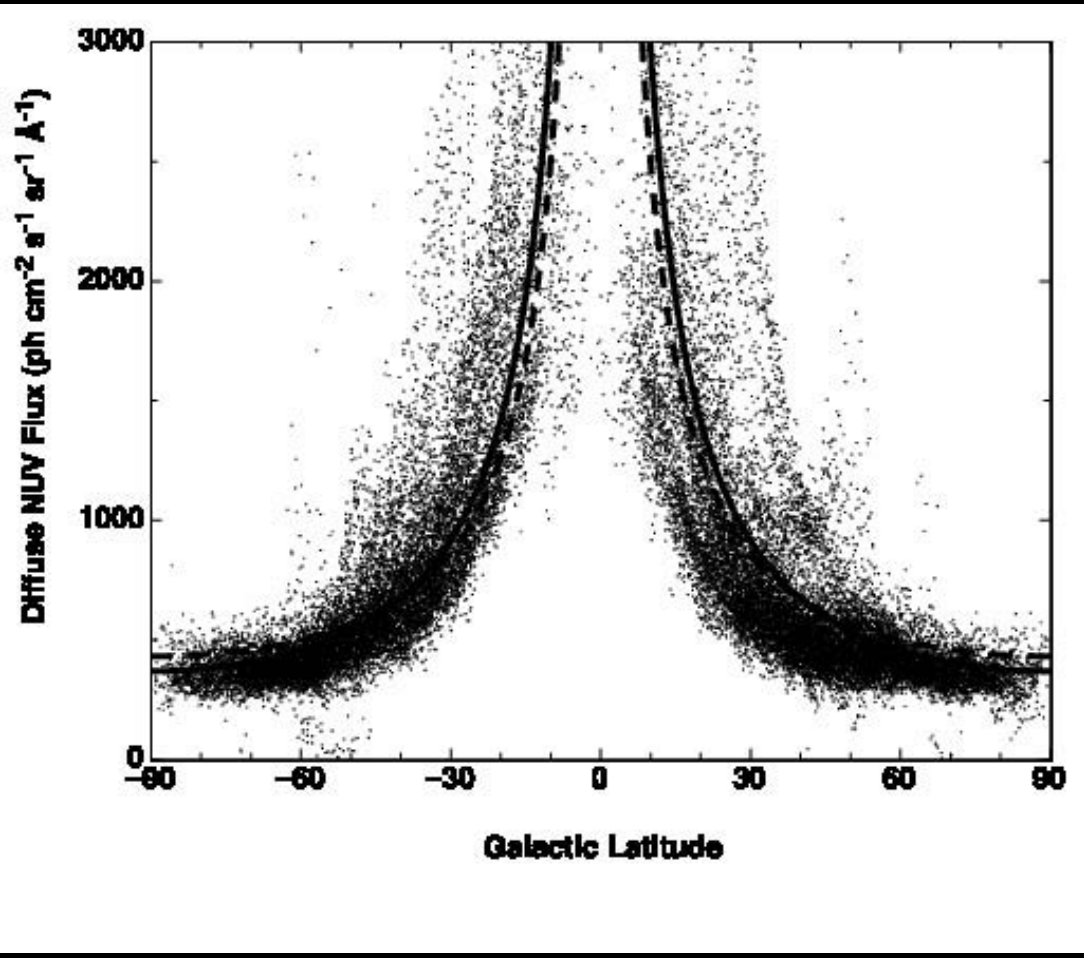
GALEX Data Products

A GALEX View of the Sky

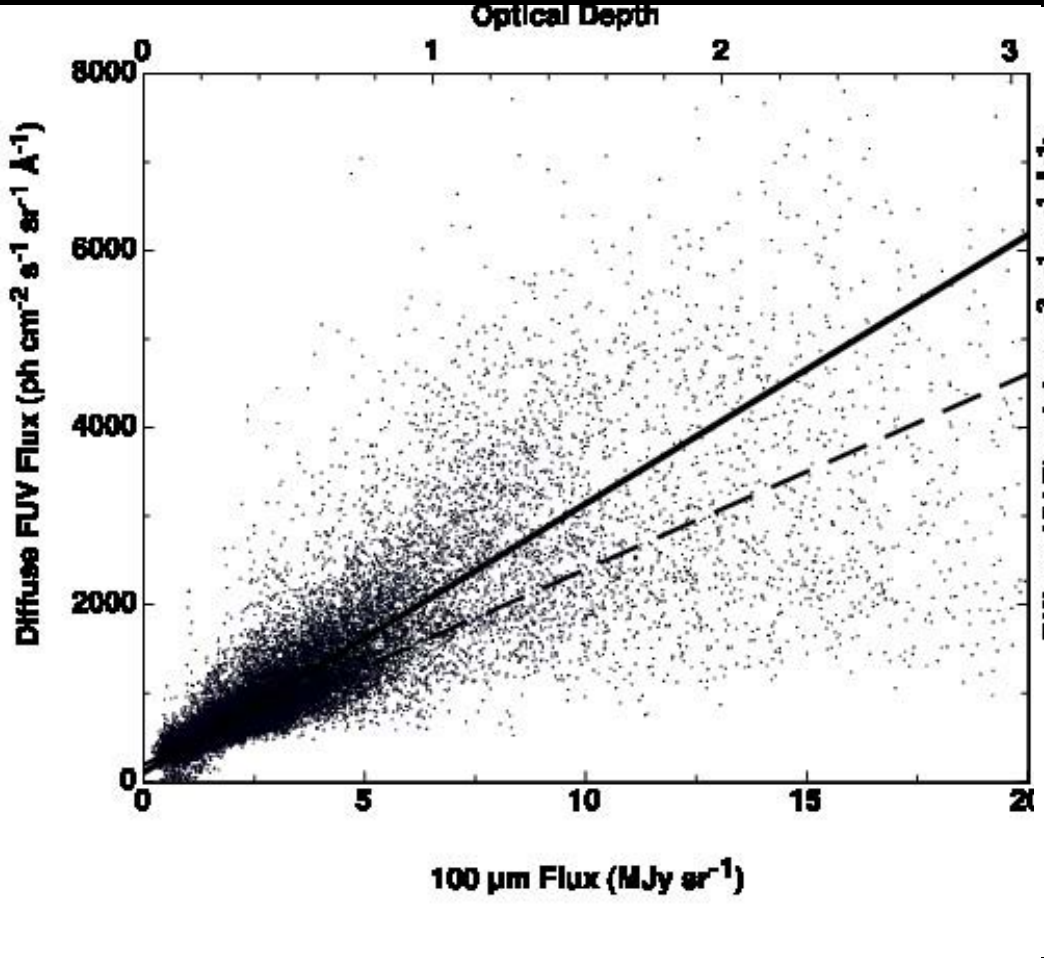


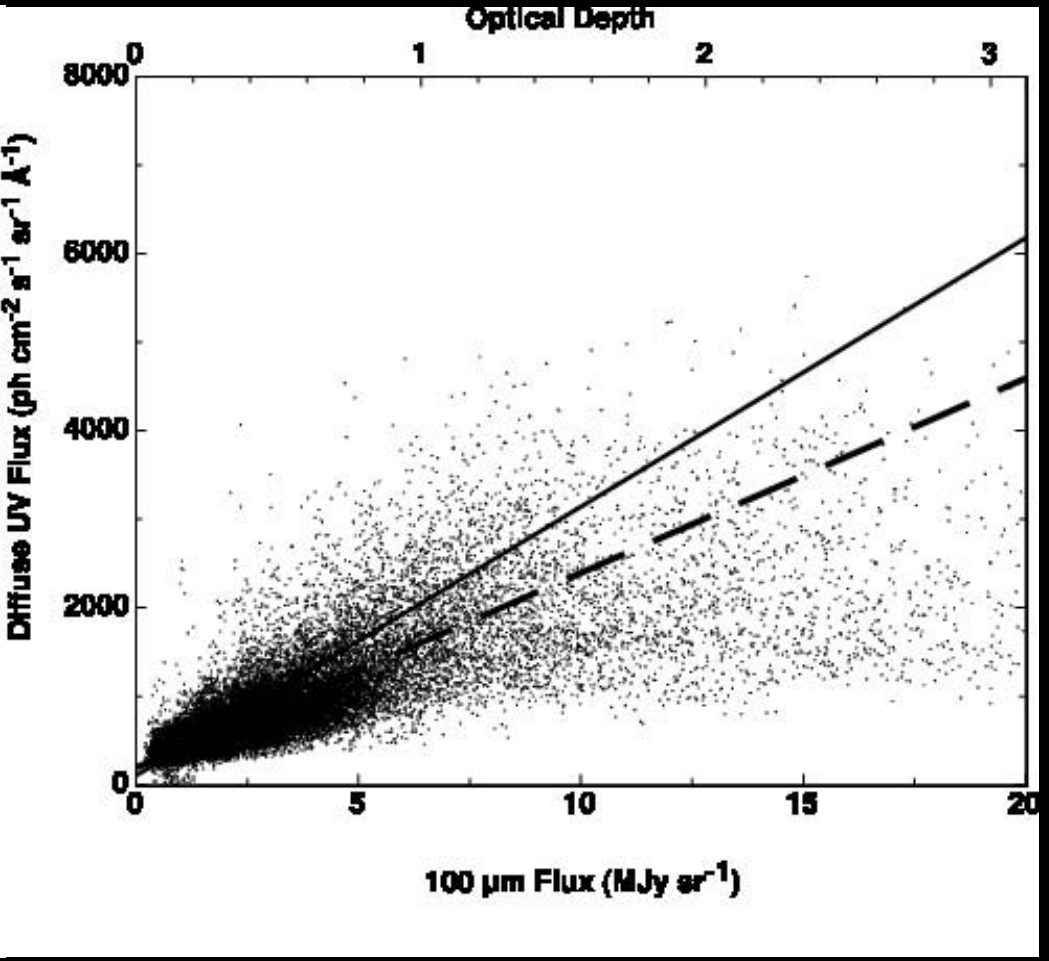
Cosecant laws



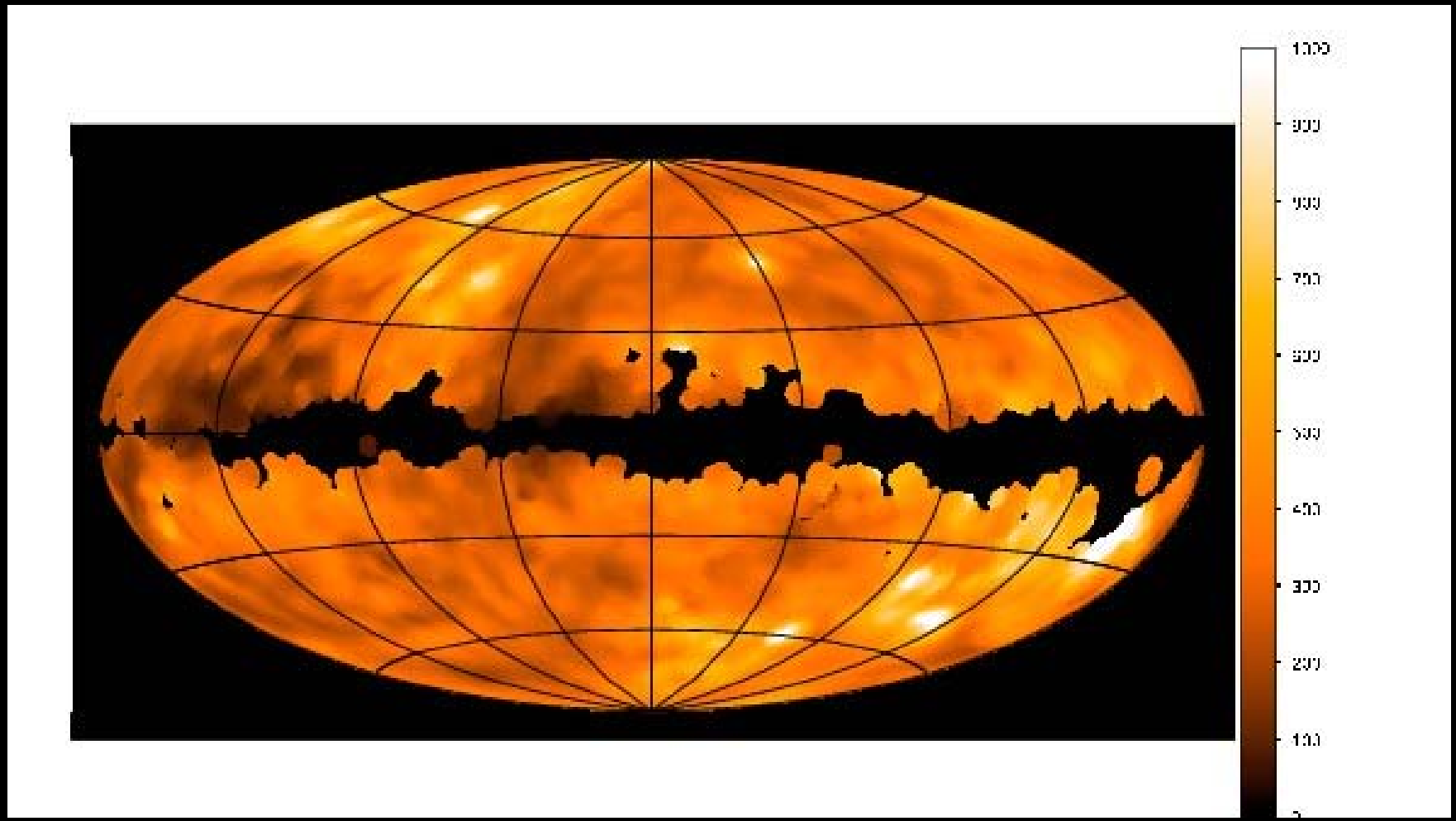


IR Correlations

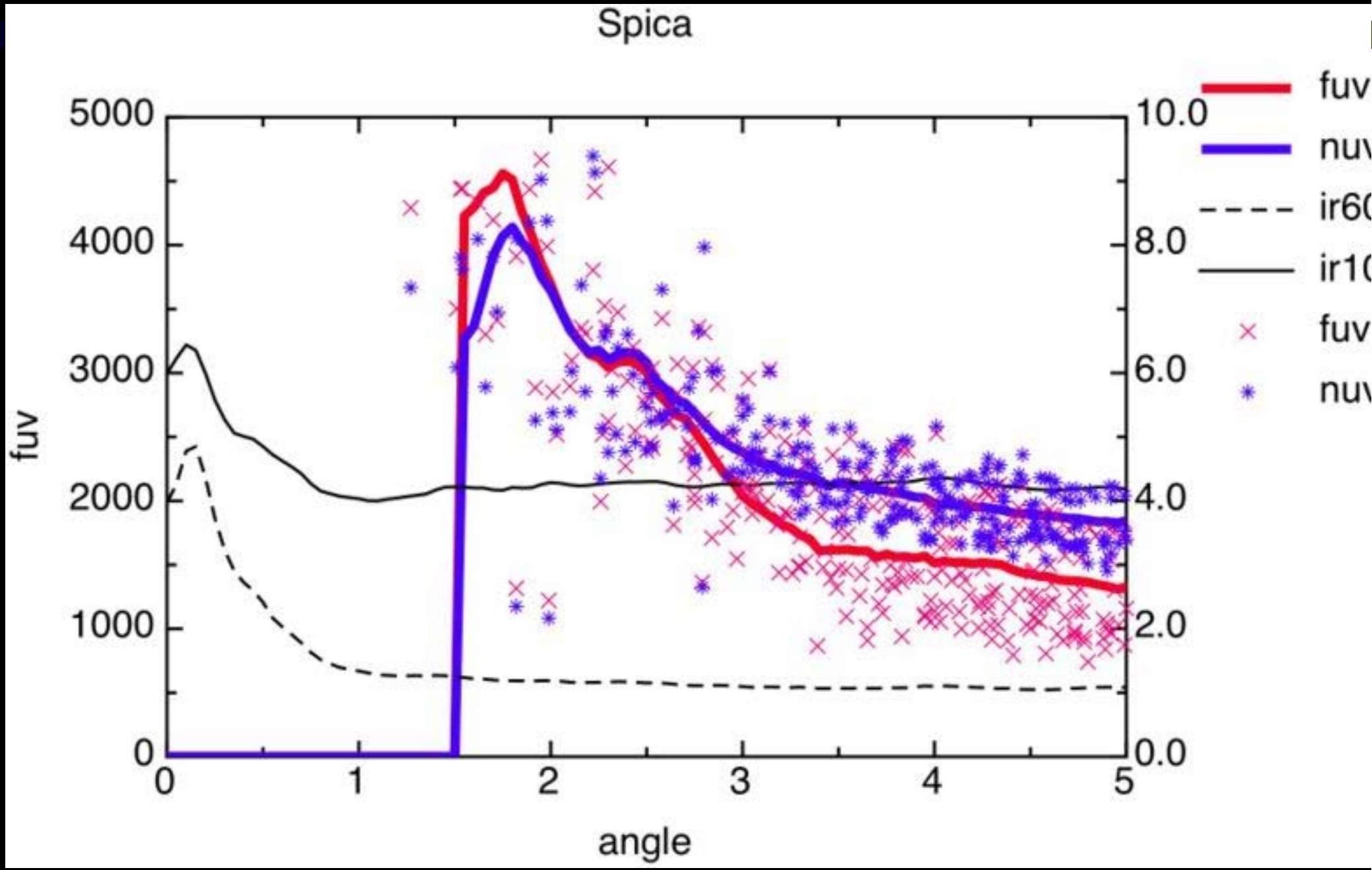




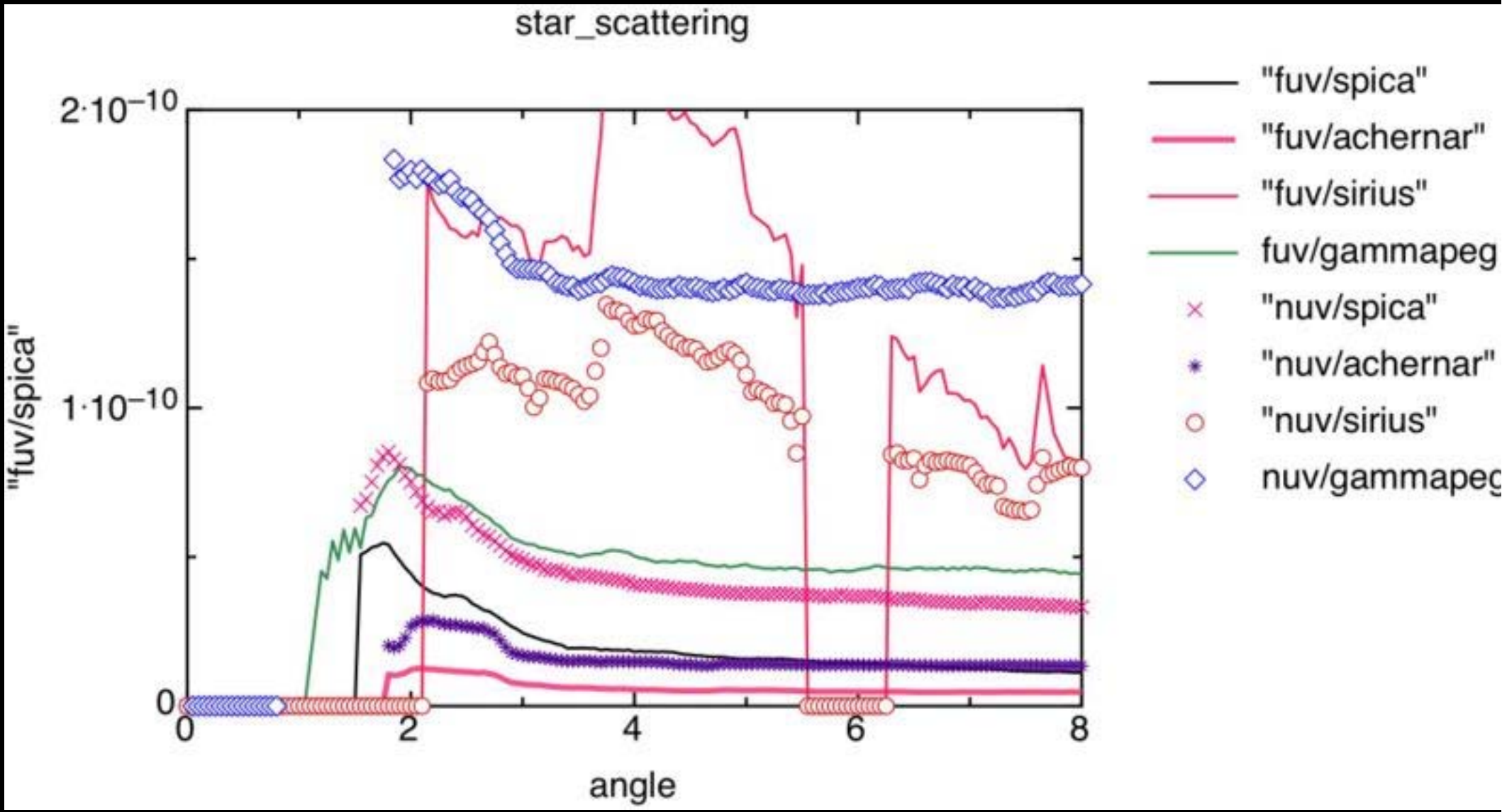
UV/IR Ratio



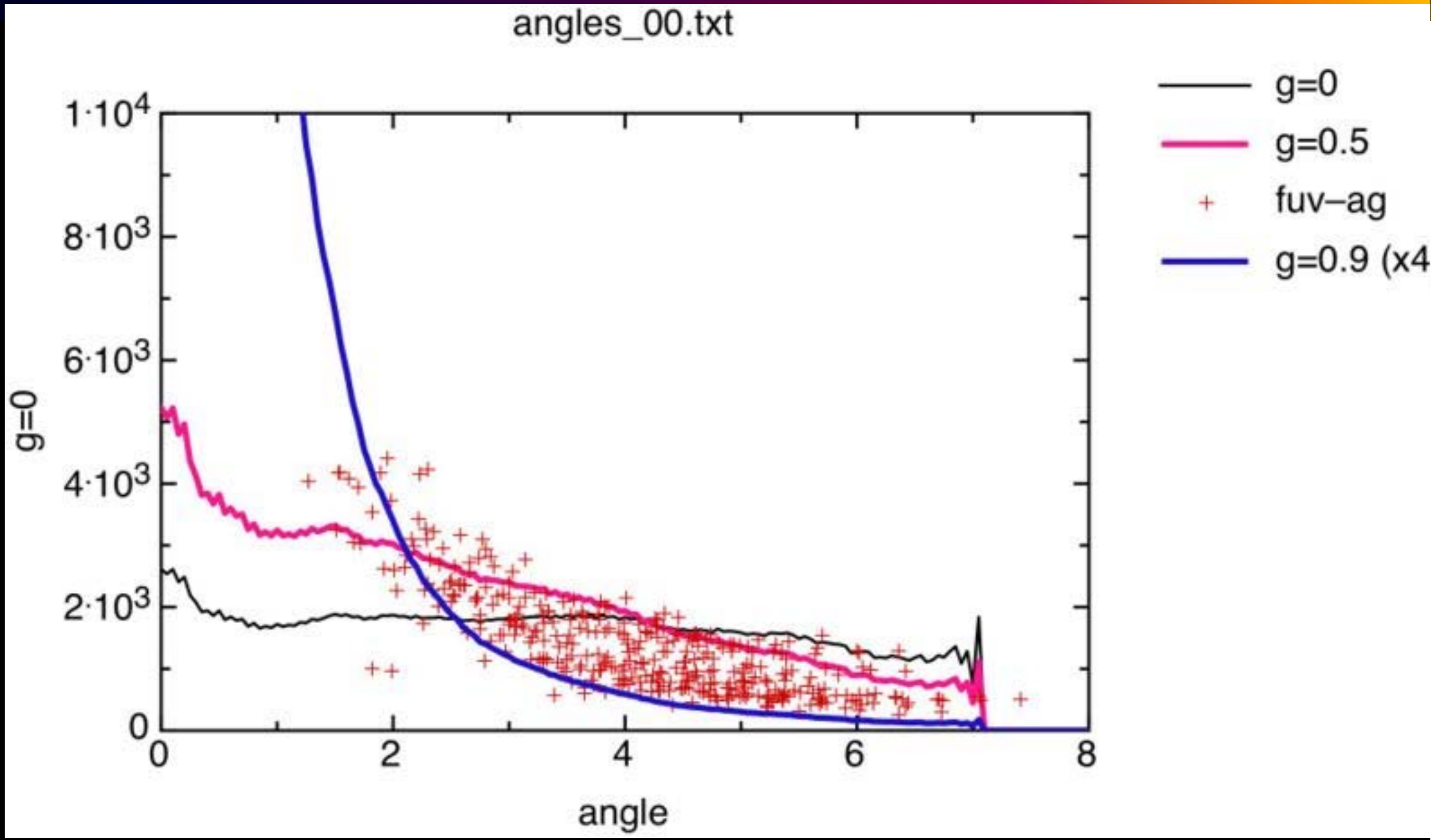
Spica


Spica
5000
4000
3000
2000
1000
0
fuv
0
1
2
3
4
5
angle
10.0
8.0
6.0
4.0
2.0
0.0
fuv
nuv
ir60
ir10
fuv
nuv

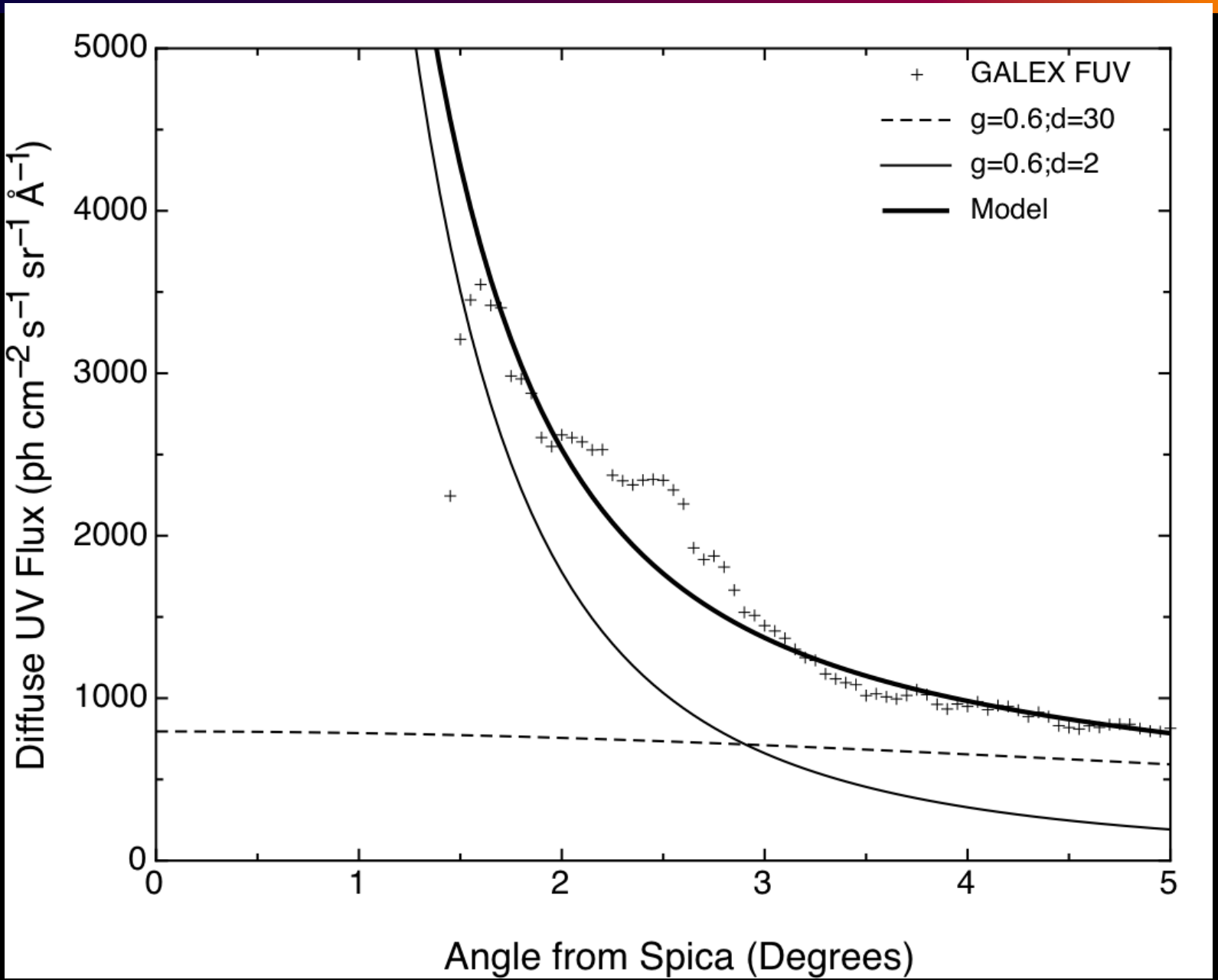
Other Stars


star_scattering
"fuv/spica"
"fuv/achernar"
"fuv/sirius"
fuv/gammapeg
"nuv/spica"
"nuv/achernar"
"nuv/sirius"
nuv/gammapeg
2·10−10
1·10−10
0
"fuv/spica"
0
2
4
6
8
angle

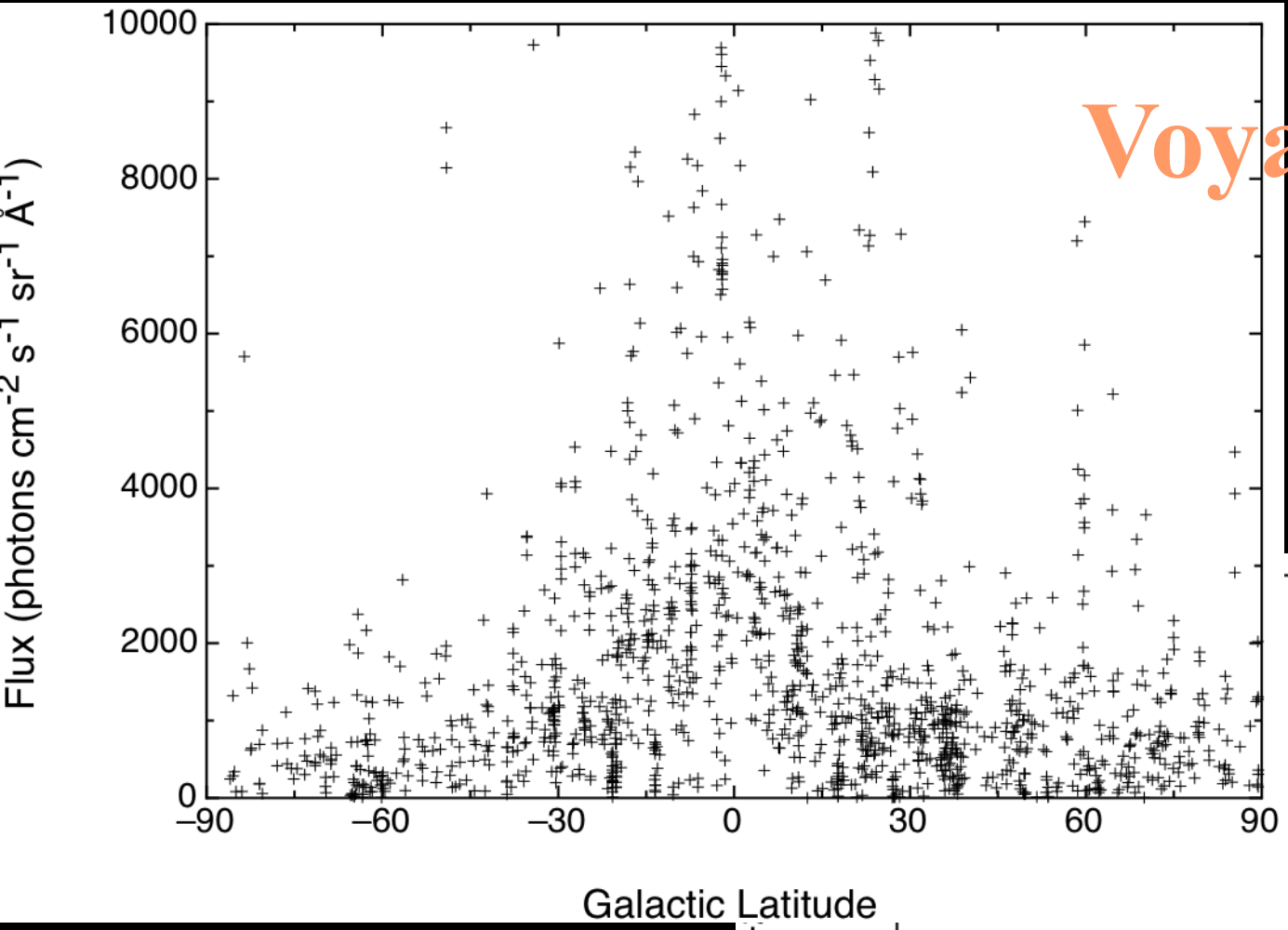
Phase function dependence

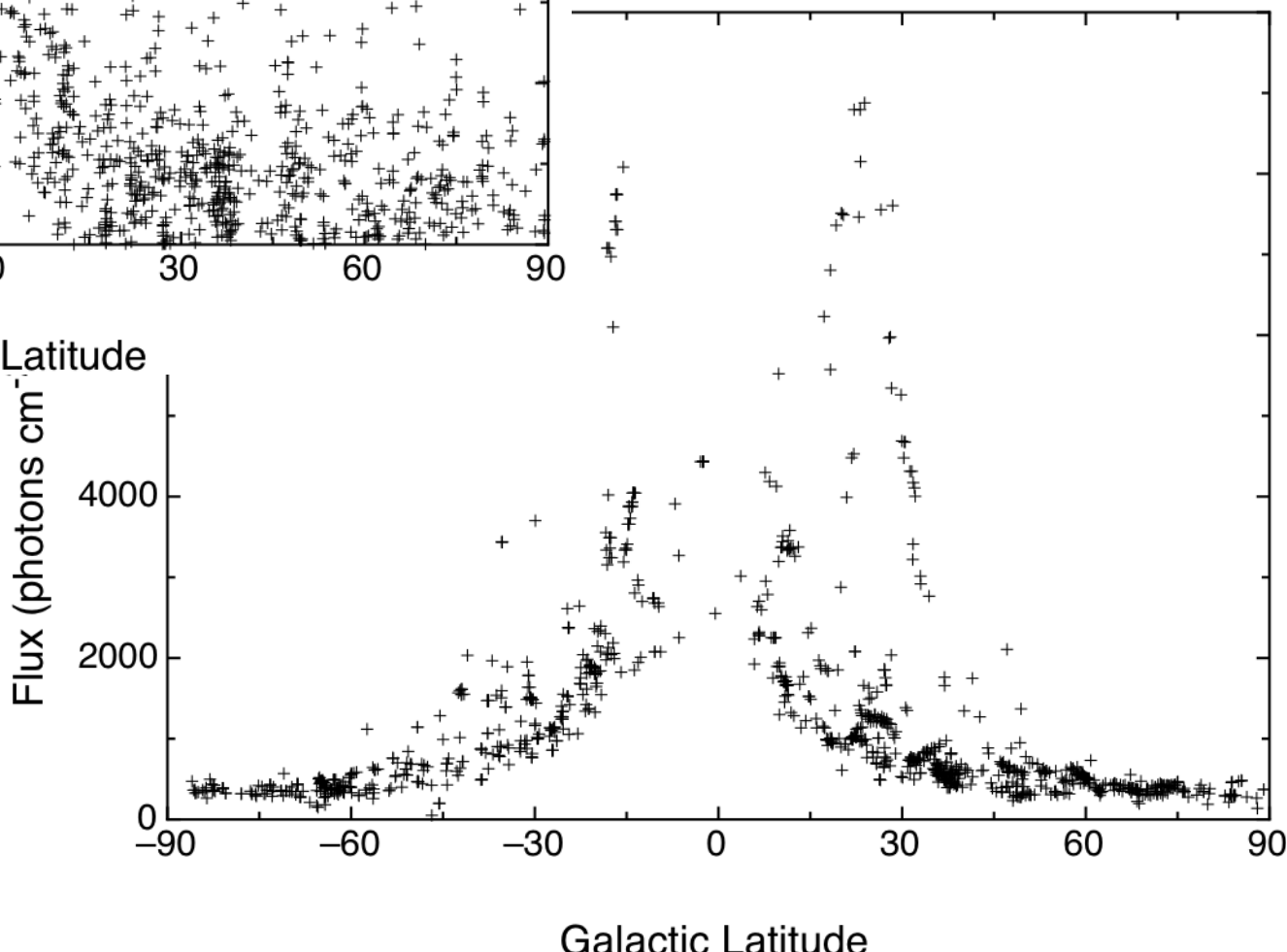


Two Clouds


GALEX FUV
g=0.6;d=30
g=0.6;d=2
Model
Diffuse UV Flux (ph cm^{-2} s^{-1} sr^{-1} Å^{-1})
Angle from Spica (Degrees)
0
1000
2000
3000
4000
5000
0
1
2
3
4
5

Voyager/GALEX





Modeling

