

# Classification and Properties of Astrophysical Objects from the matched GALEX and SDSS catalogs

Alberto Conti<sup>(1)</sup>, Luciana Bianchi<sup>(2)</sup>, Wei Zheng<sup>(2)</sup> and the GALEX Team

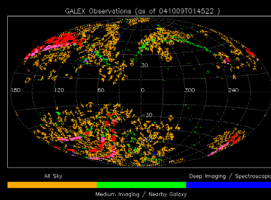
(1) Space Telescope Science Institute, (2) Johns Hopkins University

## The Data

We used data from the Galaxy Evolution Explorer (GALEX) imaging surveys MIS (Medium Imaging Sky Survey) and AIS (All Sky Imaging Survey) contained in the internal data release IR09. The MIS has exposure times varying between 1000 and 1700 sec., yielding a magnitude limit (1 $\sigma$ ) of 22.6 (FUV) and 22.8 (NUV), in the AB magnitude system, while the AIS has typical exposure time of about 100 sec, corresponding to limiting magnitudes FUV  $\sim$ 20, and NUV  $\sim$ 20.8.

The SDSS provides magnitudes in five photometric bands, *u g r i z*. The GALEX IR09 and SDSS DR2 overlap in non contiguous regions, covering a total of 124 (MIS) and 376 (AIS) square degrees, at high Galactic latitudes. More relevant to the analysis that will follow is the number of sources within each survey with photometric errors better than specific limits in any band. Because of the different spatial resolutions, 4.5 arcsec (GALEX FUV/NUV) and 1.2 arcsec (SDSS), some GALEX sources have more than one optical counterpart. We excluded from our analysis the sources with multiple matches, about 17% of the sample.

The Figure below shows the sky coverage of the GALEX surveys from IR09, and the overlap regions with SDSS DR2.



Pink: SDSS overlap with GALEX MIS  
Red: SDSS overlap with GALEX AIS

All-Sky Imaging Survey (AIS)	
Magnitude	20.5
Mean Redshift	0.2
Area	>16,000 deg
Cosmic Vol	1 Gpc <sup>3</sup>
# Galaxies	10 Million

Medium Imaging Survey (MIS)	
Magnitude	22.5
Area	1000 deg <sup>2</sup>
Cosmic Vol	1 Gpc <sup>3</sup>
Overlap	SDSS-DR2
T-Galaxies	3 Million

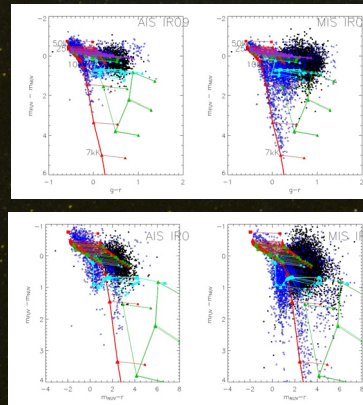
## Statistics of Matched Sources

Data:	GALEX IR09 + SDSS DR2
	AIS MIS
<b>Match area coverage</b>	376 124
(sq. degrees)	
<b>Number of Galax Fields</b>	462 120
<b>Number of Objects</b>	378560 485475
<b>No. object per unit area</b>	1004 3900
<b>Exp. Time (approx)</b>	100sec 1500sec
<b>Lim. Mag (AB)</b>	20.5 23.5
<b>Lim.Flux (FUV / NUV)</b>	1. / .5 e-16 .7 / 3. E-18
<b>Frac.3sigNUV</b>	0.90 0.96
<b>Frac.3sigFUV</b>	0.14 0.33
<b>Point-Like</b>	190115 128002
<b>Extended</b>	191902 359286

**Abstract:** We use the GALEX (Galaxy Evolution Explorer) Medium Imaging Survey (MIS) and All-Sky Imaging Survey (AIS) data available in the GALEX internal release IR09.9 matched to the SDSS release DR2 in the overlapping regions, to classify objects by comparing the multi-band photometry (far-UV and near-UV bands from GALEX, five optical bands from SDSS) to model colors. The matched source catalogs cover 124 (MIS) and 376 (AIS) square degrees and include about 485,000 and 378,000 sources respectively. The GALEX AIS data reach a typical magnitude of 20.5 (AB system) and the MIS of 23.5 in the UV. The catalogs allow us to significantly increase the statistics of several classes of astrophysical objects, such as hot stars and low-redshift QSOs (see Bianchi et al. ApJL in press for first results - available from <http://dolomiti.pha.jhu.edu>).

## Analysis: Classification of Sources

We compare colors, from GALEX far-UV, near-UV and SDSS *u g r i z* bands, to model colors of different astrophysical objects. We restrict the sample to magnitude error limits.



## Legenda for Color-Color Figures:

**Data**  
Error cuts: FUVerr=0.15, NUVerr=0.1, g,r err=0.05  
Black: Extended  
Blue: Point-Like

**Model Colors**  
Red triangles: stars as a function of Teff (max 50,000K)  
Red squares: WD (100,000K)  
Green: SSP as a function of age  
Purple: CSP as a function of age  
Cyan: QSO as a function of redshift  
Arrows correspond to E(B-V) = 0.5

Other models omitted for clarity

## Results

### Study of the Milky Way Structure using GALEX

#### Motivations and Goals:

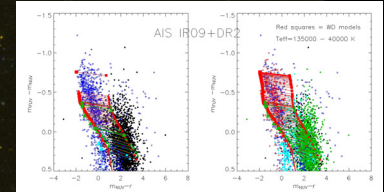
- **Massive hot stars**: snapshot of recent star formation
- **Galaxy evolution** – chemical and dynamical (winds, SN)
- **Star counts** delineate Galactic structure, -> formation
- **Evolved hot stars**: post-AGB, WD short lived, evolution of intermediate mass stars
- **Binaries**: active phases
- **Extinction** (3D maps)

#### AIS:

Out of 378560 objects, 138000 are detected in either or both NUV or FUV (plus SDSS bands) with err < 0.2 mag (90% have NUV only)  
Out of about 10000 objects w/ err < 0.2 in all bands 1500-4300  
Hot stellar candidates No./area= 4-11

#### MIS:

Out of 485475 objects, 132990 are detected in either of both NUV of FUV (plus SDSS bands) with err < 0.2 mag (20% have NUV only)  
Out of about 90000 objects w/ err < 0.2 in all bands, 1700-21000  
Hot stellar candidates No./area= 13-170



Same symbols as previous figures. The right panel includes more WD models. Colored points indicate spectroscopically confirmed objects (green: galaxies, cyan: QSO, red: stars)

## Low Redshift QSO Candidates

Error limit	AIS		MIS	
	QSO cand	Sp.conf	QSO cand	Sp.conf
<0.2 mag	1028	412	3141	611
	(2.7)	(1.1)	(25)	(5)
.05-.15mag	430	183	1236	517
	(1.1)	(.5)	(10)	(4)

For more information: <http://dolomiti.pha.jhu.edu>  
(see list of publications)  
or email: bianchi@pha.jhu.edu

**Acknowledgements:**  
We are extremely grateful to Bernie Shiao and Mark Seibert for invaluable and competent help with the GALEX database.  
We acknowledge NASA's support for construction, operation, and science analysis for the GALEX mission, developed in cooperation with the Centre National d'Etudes Spatiales of France and the Korean Ministry of Science and Technology.