The UV Sky Surveys: a Road-map for Future UV Missions

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Abstract. Surveys of the sky in two bands, far-UV (FUV) and near-UV (NUV), are being performed by the Galaxy Evolution Explorer (GALEX). The UV surveys and the resulting catalogs of UV sources, linked to a multi-wavelength archive, allow us to detect and characterize with unprecedented sensitivity certain classes of astrophysical objects, including low-redshift QSOs, hot white dwarfs (WD) in the Milky Way, and star-forming galaxies. We characterize the nature of the UV sources detected in the major GALEX surveys, that have varying depth and coverage, and in particular we discuss the sample of GALEX-detected hot WDs in the context of Milky Way models.

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THE DATA. THE UV SKY SURVEYS.

GALEX is imaging the sky in FUV (1344-1786Å) and NUV (1771-2831Å) simultaneously, with a 1.2 degrees field-of-view and a resolution of 4.2/5.3$''$ [FUV/NUV] [7]. Surveys with different depth and coverage are in progress. The wider sky coverage is provided by the All Sky Imaging Survey (AIS) and the Medium [depth] Imaging Survey (MIS), that reach typical magnitude depths of 19.9/20.8 (FUV/NUV, AIS) and 22.6/22.7 (FUV/NUV, MIS) in the AB magnitude system. Deep and Ultra-deep surveys image selected fields down to very faint fluxes and the Nearby Galaxies Survey (NGS) has imaged several hundred galaxies with exposure times comparable to MIS, and corresponding to a limit of $\approx$ 27.5 mag/sq.arcsec for extended objects. In this paper we show sample results obtained from AIS and MIS in the third GALEX data release (GR3) (15,721 AIS fields and 1,017 MIS fields), and in particular we analyze the GALEX sources in areas overlapping with the sixth SDSS data release (DR6), for a total overlap of 3390 sq.deg. for AIS and 573 sq.deg. for MIS (we use only the central 1 degree diameter portion of the GALEX fields). The surveys' coverage and more details are given in [1, 2].

SAMPLE RESULTS

Figure 1 shows the UV sources on a color-color diagram, combining GALEX and SDSS photometry. From similar diagrams (e.g. [1, 4, 2]) we have extracted samples of normal and UV-peculiar QSOs [4, 3], and hot star candidates (mainly WD). Figure 2-left shows

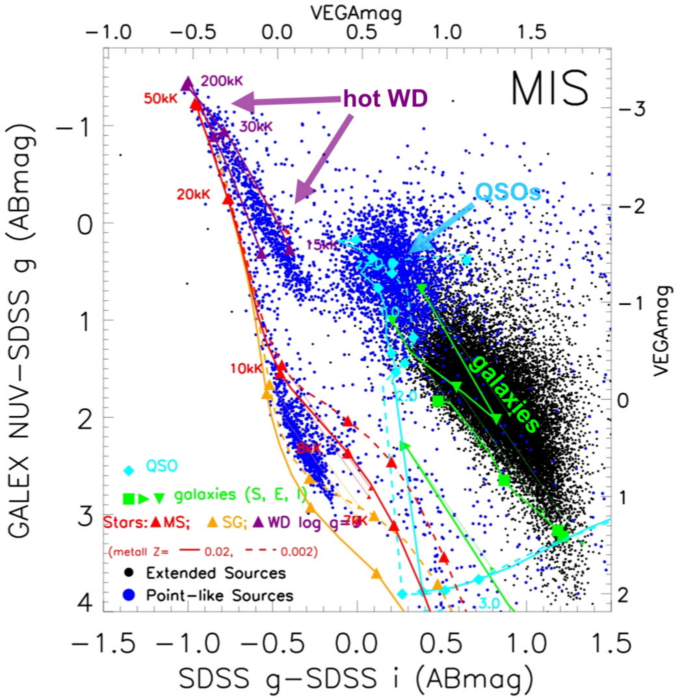

FIGURE 1. Color-color diagram for the GALEX UV sources, matched to SDSS sources, at MIS depth. Blue/black dots are pointlike/extended sources respectively. Model colors for stars (T_{eff} sequence, for different gravities), QSO (redshift sequence, cyan) and galaxies (age sequences) are shown. In the ≈ 2.5mag shallower AIS survey the relative number of stars and extragalactic objects is comparable, while at MIS depth the latter dominate. See [4, 2, 1] for more diagrams and details.

the density of UV-selected WDs as a function of Galactic latitude. Only single-WD candidates are shown; a most interesting application of this work is also the selection of hot-WD candidates in binary systems, in which the hot WD is elusive at optical wavelengths: such objects are discussed elsewhere. Figure 2-right compares the density of WD candidates as a function of magnitude at one sample latitude to predictions from Milky Way (MW) models, computed with TRILEGAL [5]. The currently assumed MW halo geometry (based on counts of low-mass stars, e.g. [5]), predicts fewer faint WDs than we observe. A better match to the observed densities (at various latitudes) can be obtained with different halo geometry (twice the scale-height derived by [5] based on 2MASS stellar counts), shown in Fig.3, or a flatter initial-final mass relation than the current TRILEGAL default [6] in the intermediate-mass range.

Most of the GALEX-selected WD candidates are previously unknown. A follow-up program (Bianchi's H901) was approved during FUSE's last observing cycle, that would have allowed us to significantly increase the FUSE database of hot evolved objects and possibly populate hitherto elusive post-AGB evolutionary paths. Unfortunately only one target was observed before FUSE ceased operations, and its spectrum is extremely weak.

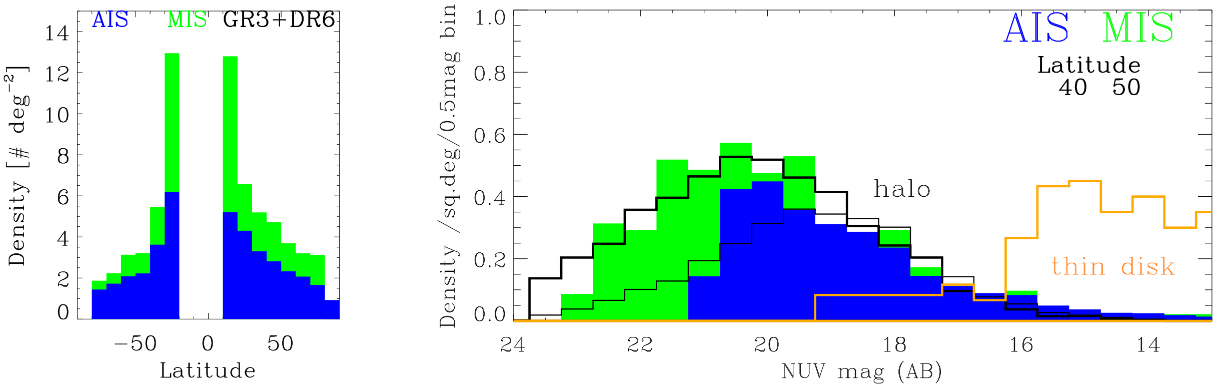

FIGURE 2. **LEFT:** Density of hot WD candidates, selected from the FUV-NUV and NUV-r colors (all magnitudes combined) are shown as a function of Galactic latitude. Error cuts (<0.3mag) in FUV and NUV are applied to the sample. If the same restriction is extended to the optical band, the density of objects in the MIS sample is reduced by about 30% (GALEX is 'deeper' than SDSS for hot WD) but the loss is much smaller for the brighter AIS sample. The asymmetry between negative and positive latitudes is likely due to extinction by dust in the Galactic disk: the average E(B-V) of the sources within each latitude band varies by up to a factor of two among corresponding latitudes. Although the area coverage is still limited, and the statistical significance consequently poor, at some latitudes, the Milky Way structure is clearly seen. **RIGHT:** Number/sq.deg. of WD candidates as a function of magnitude for our fields in the latitude range 40<b<50. Black histograms are the TRILEGAL model predictions for the standard MW halo geometry (thin line: oblate spheroid with q=0.65 and scale height *h*=2800pc) and for an *ad hoc* oblate spheroid with q=0.85, *h*=5600pc (thick line). The latter fits the data, but is incompatible with stellar counts for low-mass stars; the model may be more plausibly matched to the data with a different initial-final mass relation for intermediate mass stars. The predicted disk component is also shown (orange) but sources in the bright magnitude range are saturated in the SDSS r-band and excluded from this sample.

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