WNGA

WISE Nearby Galaxy Atlas

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1. OVERVIEW

The NASA Wide-field Infrared Survey Explorer (WISE) mission has produced the most comprehensive collection of mid-infrared imaging of galaxies likely to exist for decades. Unfortunately, this impressive resource will be under-utilized for nearby resolved galaxies because the standard WISE source catalogs are designed to properly measure point sources and not extended sources. We are unlocking this great wealth of data by constructing the WISE Nearby Galaxy Atlas (WNGA) of all WISE observed galaxies with diameters of at least 1 arcminute. The sample consists of ~20,000 galaxies . It will be made available to the astronomical community via the NASA/IPAC Extragalactic Database (NED). The WNGA will enhance the legacy of the WISE mission and expedite many research projects that require surface photometry and radial profiles of extended nearby galaxies.

2. BACKGROUND

Figure 1 illustrates the difficulties with extended source photometry provided in the standard WISE catalogs. The panels correspond to the four WISE passband (w1 [3.4μm], w2 [4.6μm], w3 [12μm], and w4 [22μm]) images of the galaxy NGC 6744. The panels are 22′ x 22′ and the red circles are the 7σ point source detections from the corresponding WISE catalog. The blue ellipse is the scaled 2MASS XSC aperture applied by the WISE pipeline as a result of a successful cross-match. The point sources and elliptical aperture are clearly inadequate for the galaxy. Our analysis indicates that the elliptical aperture includes only 39, 36, 20, and 22% of the total light of the galaxy in the w1, w2, w3, and w4 band respectively.

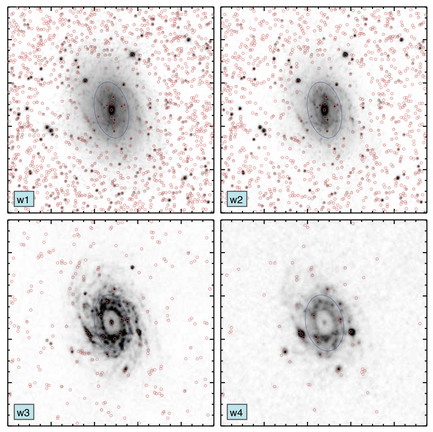


Figure 1: WISE Catalog. Source detections within 11′ of the galaxy NGC 6744 for each WISE band. Red circles are 7σ point sources. The blue elliptical aperture is measured due to position proximity of an extended 2MASS source but excludes ~60 to 80% of the galaxy light depending on the band.

3. SAMPLE

The WNGA will provide images, total magnitudes and radial profiles of all WISE observed galaxies with diameters ≥ 1′ and velocities less than 30,000 km s^{-1}, which lie above/below Galactic latitude of |b| ≥ 20°. Figures 2 and 3 describe the sample in further detail. Many input catalogs have been used to construct the target sample; the NASA/IPAC Extragalactic database (NED, Madore et al. 1992) and the HyperLeda database (Paturel et al. 2003) and the myriad of catalogs they both ingest are the primary sources along with the Uppsala General Catalog of Galalxies (UGC; Nilson 1973), the ESO/Uppsala Survey of the ESO(B) Atlas (ESO; Lauberts 1982), and the Third Reference Catalog of Bright Galaxies (RC3; de Vaucouleurs et al. 1991).

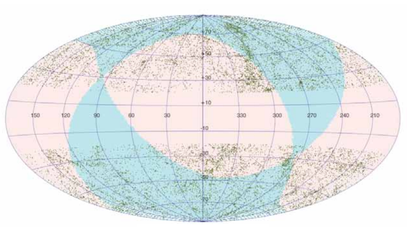


Figure 2: Sample spatial distribution in Galactic coordinates. The red region indicates the WISE preliminary data release footprint. The blue region represents the remaining sky covereage to be included in the final WISE data release.

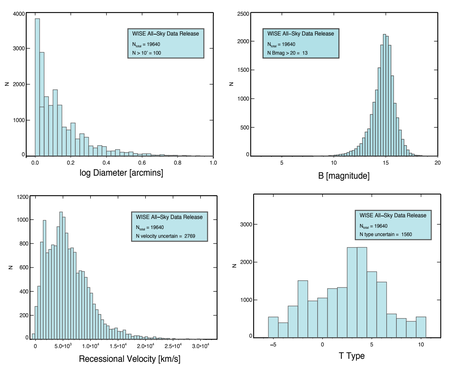


Figure 3: Distribution of the sample angular major diameters (Top Left) and B band magnitudes (Top Right). Distribution of the sample recessional velocities (Bottom Left) and morphological Hubble Stage T types (Bottom Right).

4. PROCESS

We construct each WNGA image by drizzling the level 1b (single) image products using version 3.8.3 of the Image Co-addition with Optional Resolution Enhancement (ICORE) software (Masci & Fowler 2009; Masci 2013). To minimize background problems, we selected the 1b images with moon angles greater than 25°, and with epochs at least 2000 seconds from an annealing event. We combine the resulting image sets on an output scale of 1″/pixel. The WNGA pipeline performs elliptical annular photometry in 6″ steps approximately equal to a resolution element in the W1 band to measure the flux. Foreground stars and contaminating neighbor galaxies are masked prior to measurement and this masking is accounted for in computing the flux within each annulus. The influence of partially resolved and unresolved background galaxies is mitigated by allowing our sky value to contain flux from these objects. This is achieved by setting a masking brightness limit. This produces an accurate sky that accounts for these fainter galaxies that will be present in the measurement annulii but are very difficult to detect and mask. Asymptotic total magnitudes are dervied from the the integration of the galaxy radial profile up to the point where the profile curve of growth has mathematically converged within the errors. Figure 4 are WNGA example output products for NGC 3368 in all 4 WISE bands.

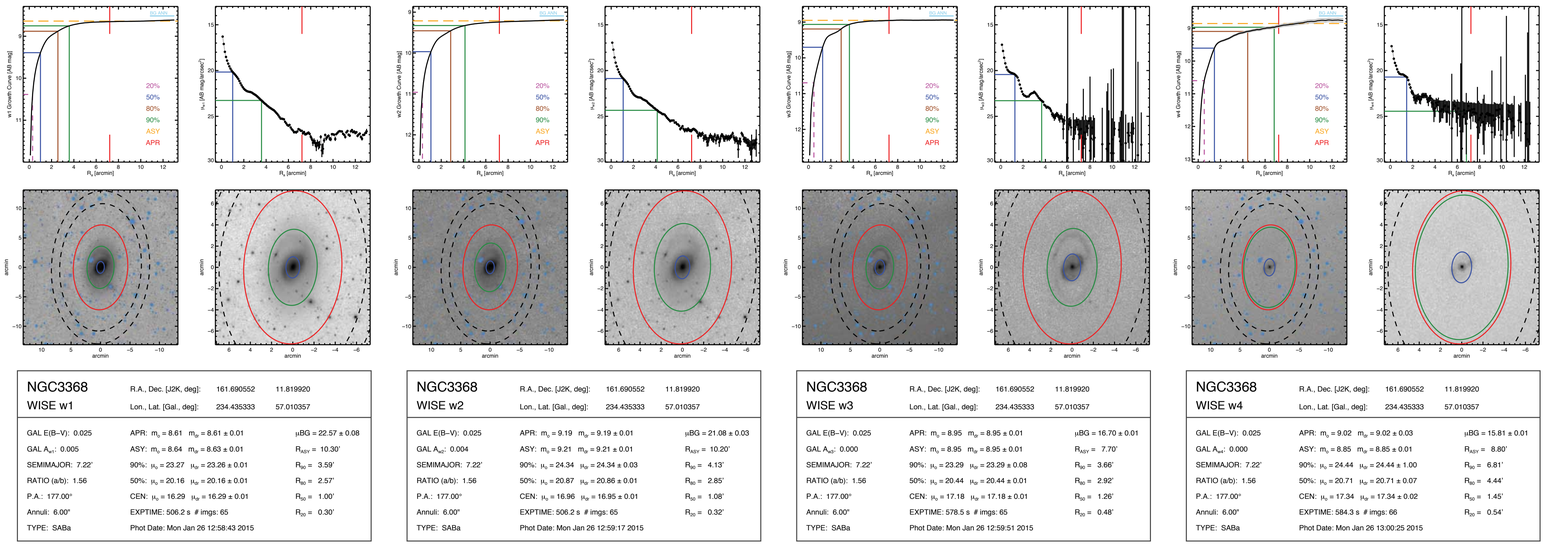


Figure 4: WNGA photometry for the WISE W1, W2, W3, and W4 imaging of the galaxy NGC 3368. For each band the total light growth curve and radial profiles are plotted. Images highlight the 50% (blue) and 90% (green) light radii as well as a uniform fixed aperture (red). Wider field images also show masking and sky annuli (dashed). Tables summarize measurement results.

We also apply the WNGA pipeline to other survey imaging data. Modules exists to support GALEX, SDSS, and 2MASS imaging. Consistent photometery -- both matched aperture and radial profiles -- offer reliable spectral energy distributions from the UV to the mid-IR. Figure 5 displays pipeline photometry examples of NGC3368 for the the far-UV, near-UV, u, g, r, i, z, J, H, and Ks bands. Figure 6 demonstrates the resulting UV to IR SED and the physical paramters derived from SED fitting using LePHARE (Arnouts et al. 1999; Ilbert et al. 2006) based on PEGASE and Bruzual & Charlot population synthesis models.

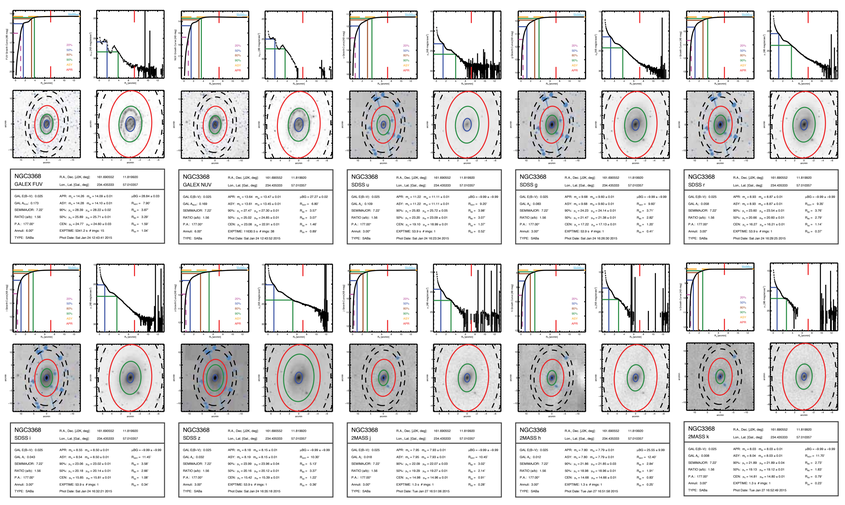


Figure 5: WNGA photometry for the GALEX, SDSS, and 2MASS imaging of the galaxy NGC 3368.

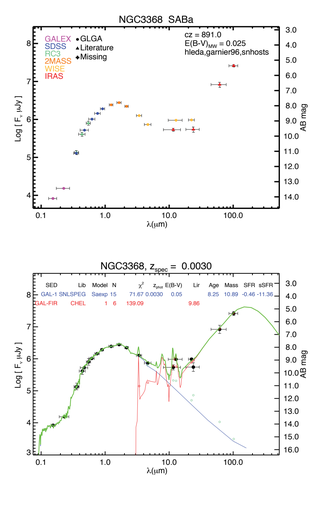
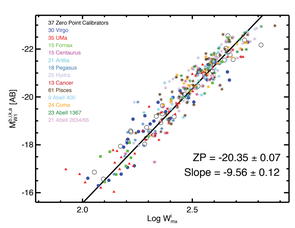


Figure 6: SED fitting of WNGA photometry.

5. APPLICATION

The first application of early-release WNGA data is the calibration of the WISE W1 and W2 Tully-Fisher Relation (Neill et al. 2014; see poster #25). The WNGA is also a coordinated effort with the ``Cosmic Flows with WISE'' (see talk by B. Tully at this meeting) and will produce the W1 and W2 photometry for ~4,100 galaxies in that program.



6. DATA RELEASE

The public release of the WNGA will occur in two phases. Release 1 will include ~8,000 galaxies with diameters greater than 1.5 arminutes and is sheduled for the spring of 2015. Release 2 will include the remaining ~12,000 galaxies with diamters between 1 and 1.5 arc-minutes and is scheduled for winter 2015-16.

7. REFERENCES

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