

$z = 0$ Multi-wavelength Galaxy Synthesis (z0MGS): WISE & GALEX Atlas of 15,750 Galaxies

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Based on Leroy, Sandstrom, et al. (2019). The maps will be publicly available at <https://irsa.ipac.caltech.edu/data/WISE/z0MGS>

SUMMARY

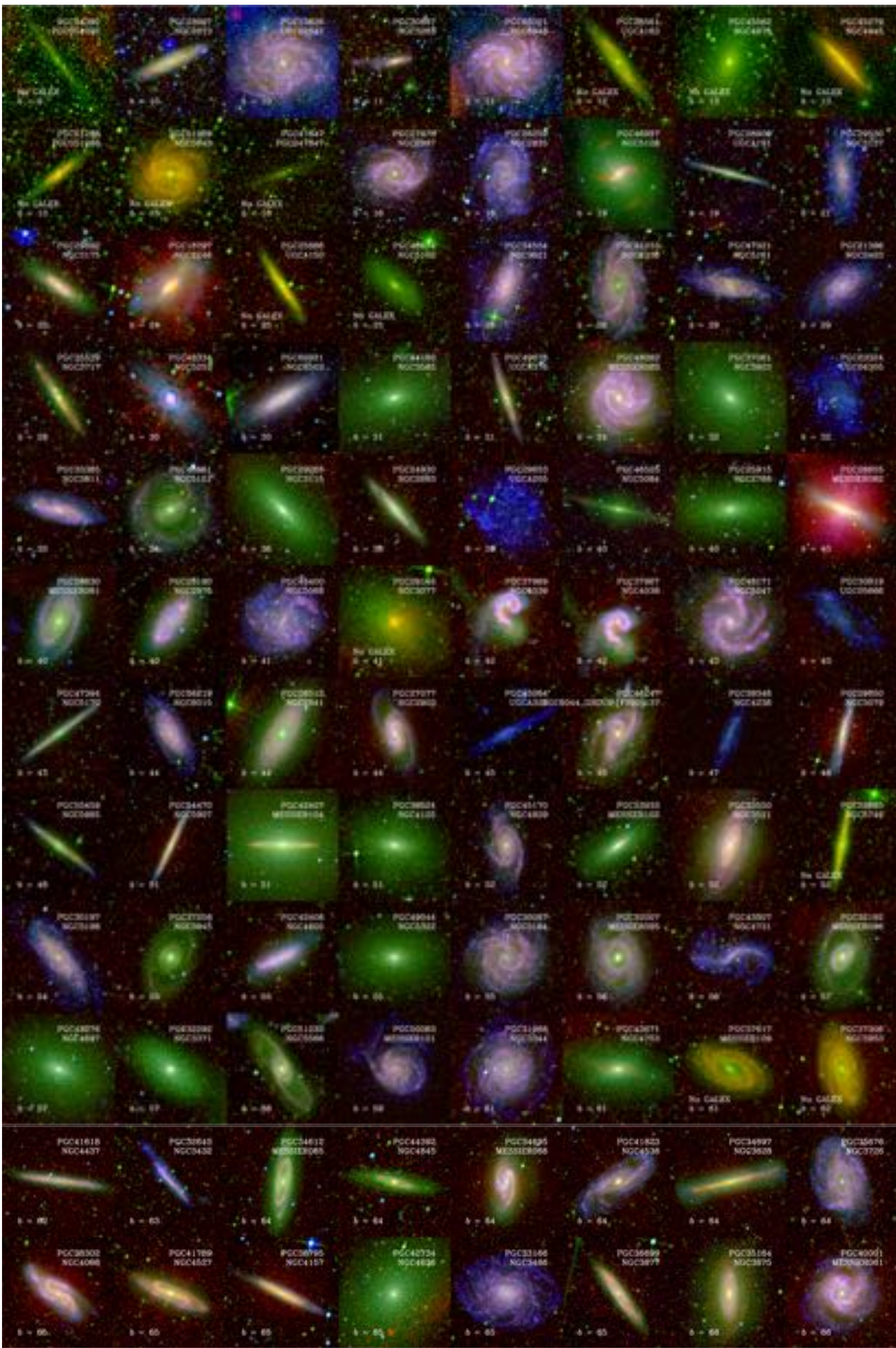
We present an atlas of UV and IR images of $\sim 15,750$ local galaxies ($d \lesssim 50$ Mpc), as observed by NASA's WISE and GALEX missions. These maps have matched resolution (FWHM $7.5''$ and $15''$), matched astrometry, and a common procedure for background removal. They represent the first part of a program (the $z = 0$ Multi-wavelength Galaxy Synthesis) to create a large, uniform database of resolved gas and dust in nearby galaxies.

This atlas allows the prospect to estimate local and integrated star formation rates across almost the entire local galaxy population in a uniform way. The catalog of images will be publicly available at IRSA. We demonstrate that it agrees well with resolved intensity measurements from previous surveys, but highlight several key limitations.

We also deliver integrated fluxes for each target. We show that these measurements agree with previous work on smaller samples and place the local galaxy population in SFR- M_* space that is consistent with results from large-scale surveys. We also show the distribution of parts of galaxies in NUV-to-WISE1 vs. WISE1-to-WISE3 space, which captures much of the key physics accessed by these bands.

ATLAS IMAGES

Images of $\sim 1/3$ of the "big" galaxies in the atlas at $7''.5$ and on a common logarithmic scale: WISE W3 (red), WISE W1 (green), and GALEX NUV (blue). No masking has been applied, though we supply star and galaxy masks.

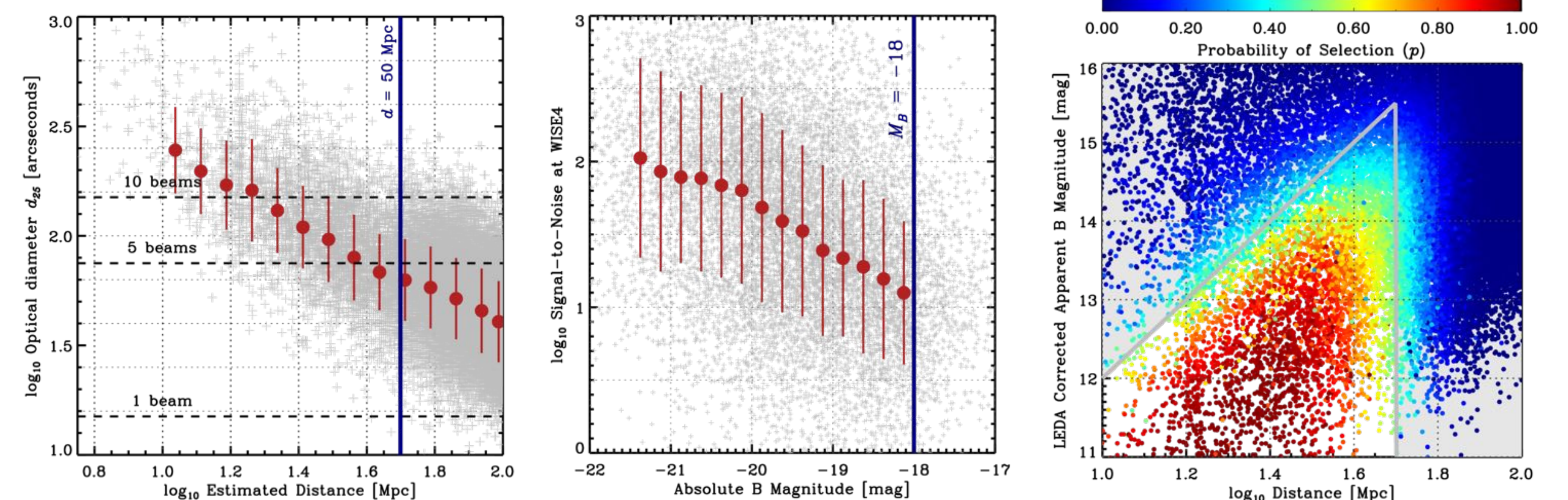


SAMPLE SELECTION

We select our sample based on proximity and luminosity, as explained below.

Proximity: PSF of WISE limits our resolution to be $15''$ (for $22\mu\text{m}$) and $7''.5$ (for $\lambda \lesssim 12\mu\text{m}$). At distance of 50 Mpc, this translate to 3.6 and 1.8 kpc (roughly the scale length of the stellar disk). Left panel of the figure below shows that we are able to resolve galaxies with 5 beams (in average) at 50 Mpc.

Luminosity: we select galaxies with $M_B \leq -18$ mag motivated by sensitivity and completeness. Middle panel of the figure below shows the S/N at WISE4 for galaxies outside 25 Mpc. We can detect galaxies with $S/N \gtrsim 10$ on average. This selection extends down to dwarf spirals ($\gtrsim 10^9 M_\odot$) and $0.3-0.5 Z_\odot$.



LOCAL GALAXIES RELATIONS

This project aims to place local galaxies in the context of the full galaxy populations (including high redshift). To do this, we leverage the GALEX-WISE-Sloan Legacy Catalog (Salim et al. 2016; 2018), that combined GALEX and WISE photometry with SDSS observations and made stellar population synthesis modeling.

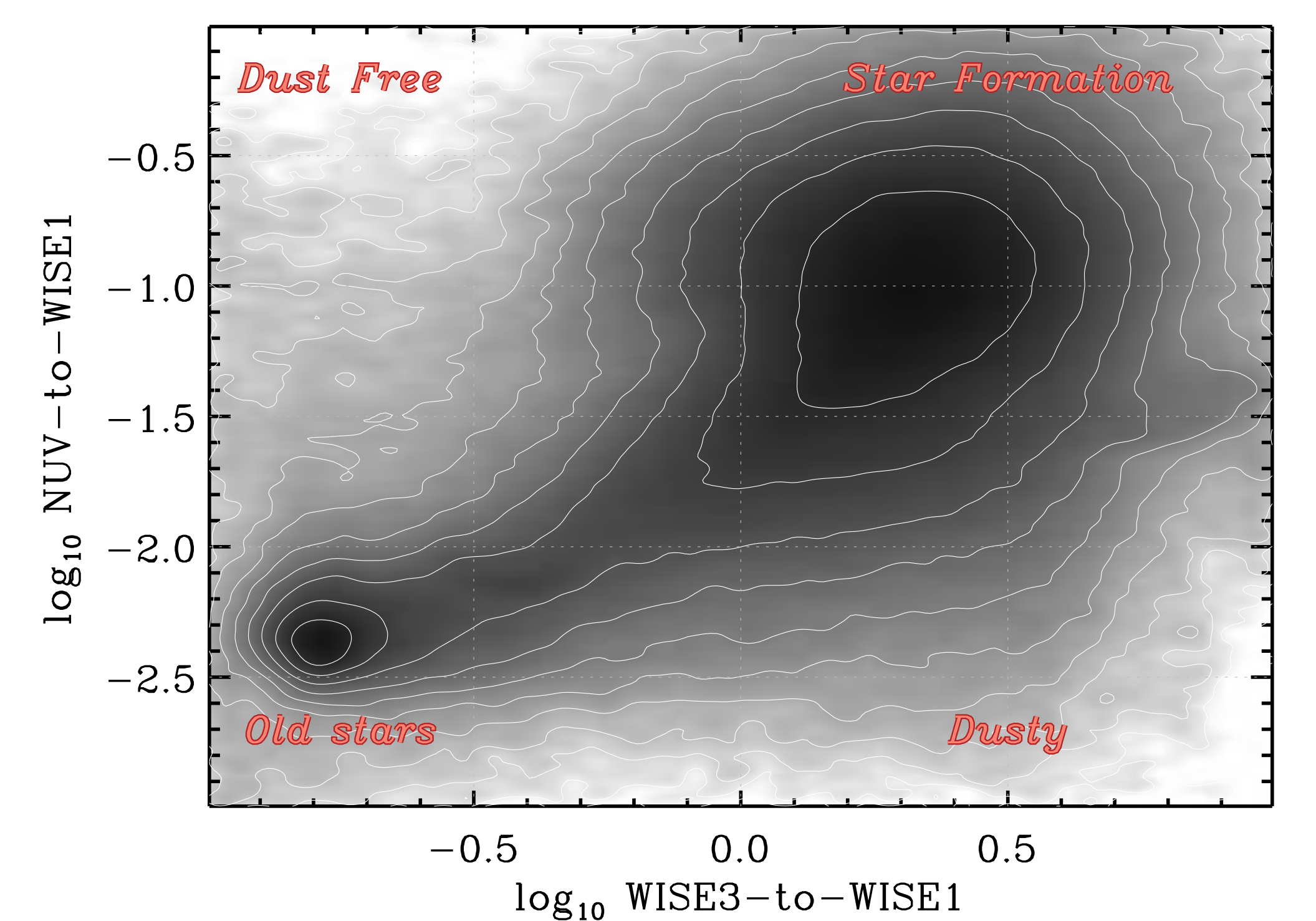
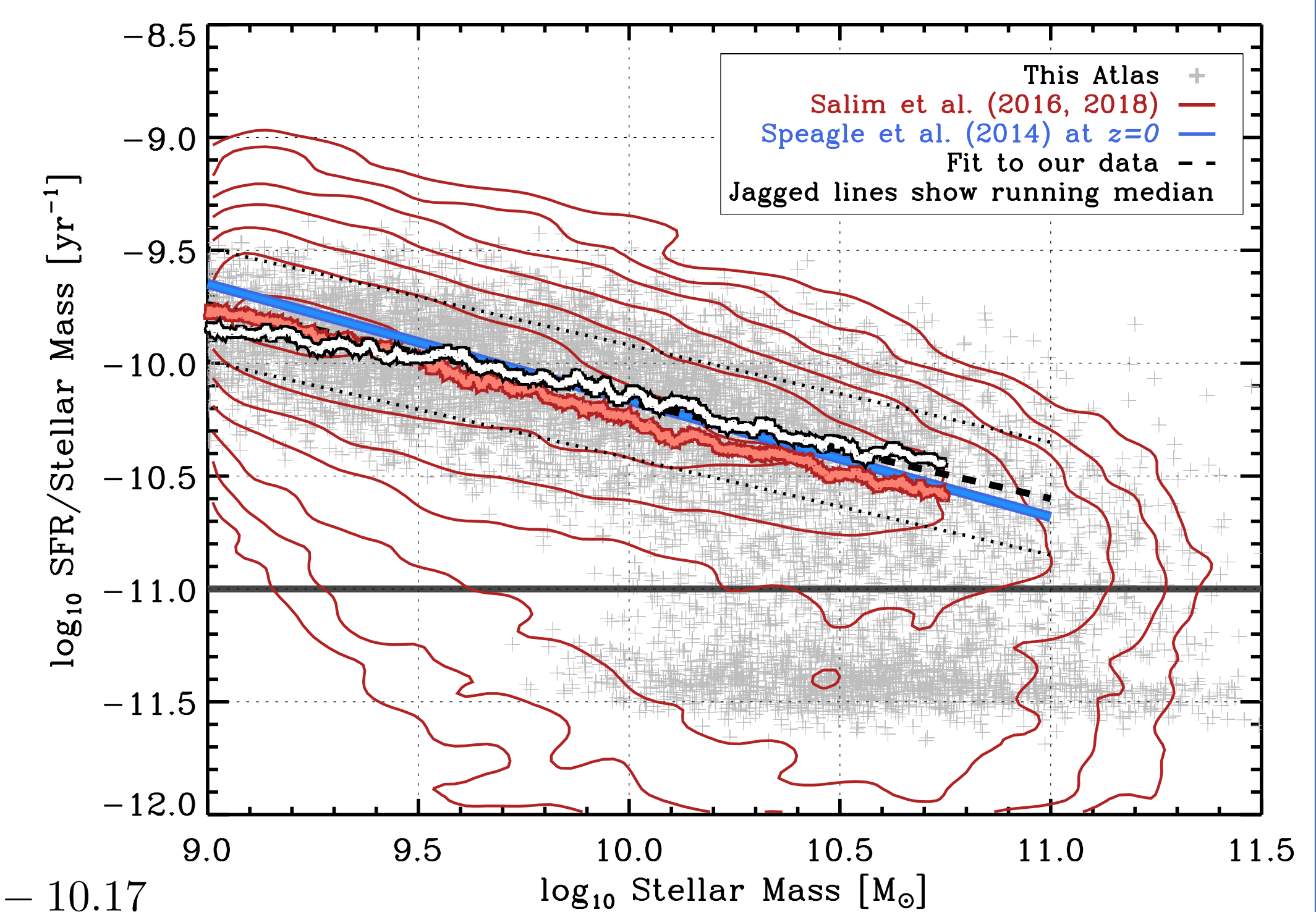
Right figure shows the specific SFR against the stellar mass for the whole sample (grey plus signs). We calculate the running median above $\log_{10} \text{SFR}/M_\star = -11 M_\odot \text{ yr}^{-1}$ (white line). This running median shows a good agreement with larger local galaxies population studied by Salim et al. (2016) and the relation at $z = 0$ from Speagle et al. (2014).

A linear fit to our data above $\log_{10} \text{SFR}/M_\star = -11 M_\odot \text{ yr}^{-1}$ and above $\log_{10} M_\star / M_\odot$ yields

$$\log_{10} \text{SFR}/M_\star [\text{yr}^{-1}] \approx (-0.43) \left(\log_{10} \frac{M_\star}{10^{10} M_\odot} \right) - 10.17$$

Star-forming galaxies show $\sim \pm 0.25$ dex scatter about this line in our data.

A key goal of the atlas is to provide the resolved maps of galaxies, not only integrated measurements. On the right figure, we illustrate this aspect of the atlas, showing the range and distribution of data in the NUV-to-W1 (traces the specific SFR) and W3-to-W1 (traces the dust-to-stellar luminosity) parameter space. In total, a few million lines-of-sight contribute to the data. This figure indicates a wide range of dustiness and the degree of star formation.

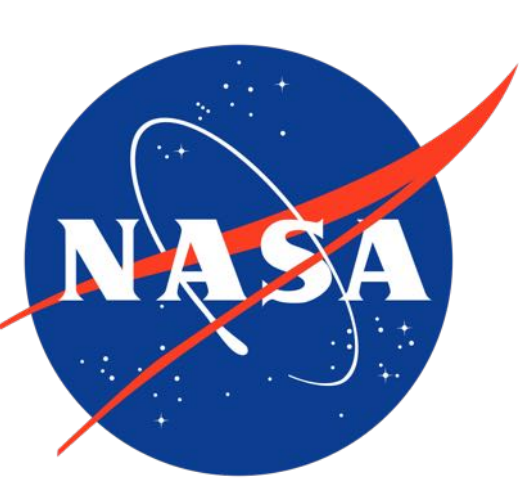


FUTURE WORK

1. New and archival HI cubes of several hundreds of local galaxies from VLA (1990s—now), including all northern galaxies with available Herschel maps (Utomo et al. in prep, Chiang et al. in prep).
2. Multi-resolution atlas of resolved IR SED and dust properties in several hundreds galaxies based on archival multi-bands of Herschel observations (Chastenet et al. in prep).

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