Draft version December 20, 2024
Typeset using LATEX **preprint** style in AASTeX631

z0MGS–Dust Catalog Delivery

DESCRIPTION

This document provides a description of the data released as part of the study presented in Chastenet et al. (2025), consisting of *Herschel* images in the PACS and SPIRE bands available for 1578 galaxies, dust and radiation field parameters from resolved spectral energy distribution (SED) fitting for 819 galaxies, and integrated photometry and dust parameters for 877 galaxies.

For the SED fitting, we combine WISE data from Leroy et al. (2019) with our newly reduced, background-subtracted, convolved, regridded *Herschel* data to create infrared spectral energy distributions (SEDs) that we fit with the Draine & Li (2007) dust emission models. We do this modeling for all galaxies in our *Herschel* where WISE data is available from Leroy et al. (2019). In Chastenet et al. (2025) we explore scaling relations of dust and radiation field properties with other galactic information such as stellar mass, star formation rate, and related values.

In this delivery, we release the raw *Herschel* maps for all nearby galaxies with *Herschel* data (total number 1578) and higher level processed images (background subtracted, convolved, etc) for the galaxies we included in our SED fitting analysis (877 integrated and 819 resolved). For those galaxies, we also deliver the fitted dust and radiation field parameters results.

To determine which nearby galaxies had *Herschel* observations, we queried the *Herschel* Science Archive to return all galaxies with available PACS or SPIRE data in the HyperLeda database (Makarov et al. 2014), with measured heliocentric radial velocities $< 5\,000$ km s^{-1}. After adding in a small number of galaxies observed in PACS-SPIRE parallel modes, we have a sample of 1578 galaxies which we run through `Scanamorphos` (Roussel 2013) to create L0 → L2 data products. For galaxies with mid-infrared WISE data from the z0MGS WISE/GALEX Atlas by Leroy et al. (2019), we do additional processing steps so that we can perform a SED fit. These steps are described in detail in Chastenet et al. (2025).

MAPS

We provide four sets of FITS files:

- `[GalaxyName]_[Band].fits`: the *Herschel* images after `Scanamorphos` reduction and background subtraction at native resolution, in MJy sr^{-1}. The header of these maps includes the observation IDs from the *Herschel* archive used to create the final map. In the header of these maps, we add a few key elements that were used in the data processing as described in Chastenet et al. (2025):
  - `R25COEFF`: the A coefficient used to scale r_{25} to create the galaxy mask;
  - `COEFF[1,2,3]`: the coefficients of the plane describing the 2D-background;
  - `ADDGAL[x]`: the name(s) of any galaxy that was found in the cut-out and consequently masked;

- `[GalaxyName]_[Band]_conv250.fits`: the background-subtracted, convolved to SPIRE 250 18″ resolution, regridded *Herschel* maps, in MJy sr^{-1}. The headers of these maps also contain the background plane information, previously mentioned.

- `[GalaxyName]_DustParameters_conv250.fits`: a multi-extensions file containing the realizations maps (Gordon et al. 2014) of the Draine & Li (2007) dust parameters for pixels passing a 1σ S/N cut in the data. Each extension contains either a map of the dust parameter values, or a 2-slice cube with its associated 16^{th}–84^{th} percentiles. The maps and errors are calculated from 100 realization maps for each galaxy. The dust parameters included are:
  - $\log_{10}(U_{\mathrm{min}})$: minimum radiation field heating the dust grains, in dex;
  - q_{PAH}: mass fraction of dust mass in the form of grains with fewer than 10^3 carbon atoms, in %;
  - $\log_{10}(\gamma)$: fraction of dust heated by a power-law ($\alpha = 2$) of increasing radiation field intensities, from U_{min} to $\mathrm{U}_{\mathrm{max}} = 10^7$, in dex;
  - $\log_{10}(\Sigma_{\mathrm{d}})$: total dust mass surface density, in $\mathrm{M}_\odot\ \mathrm{pc}^{-2}$; note that the correction factor of 3.1 found in Chastenet et al. (2021, which brings the dust mass in M101 in line with the available heavy element abundance as a function of radius) is *not* included in the `.fits` files, but is included in the figures and scaling relations in the paper;
  - $\log_{10}(\overline{U})$: mass-average radiation field, in dex (this parameter is derived from U_{min} and γ, not free in the fit);
  - $\log_{10}(\Omega)$: scaling factor of a 5 000 K blackbody accounting for residual starlight in the first WISE bands, in dex.

- `[GalaxyName]_extra.fits`: a multi-extension file containing
  - the galaxy mask, with the used `R25COEFF` coefficient;
  - masks of the pixels passing the 1-, 2-, and 3σ S/N cuts;
  - the final "master-mask" at the SPIRE 250 resolution, masking the galaxy, stars, and bright sources.

Note on "terracing" in resolved maps - In some cases, the resolved maps of q_{PAH} and γ show the appearance of "terracing," where the parameters are not smoothly varying, but "jump." This is due to the limited parameter sampling of the models, particularly the coarser sampling of $\Omega_\star$. We compared our maps to those of Chastenet et al. (2021) for M101, where a finer parameter grid was used, and find that the q_{PAH} and γ are preserved despite this visual terracing appearance.

TABLE

The table gathers information about the galaxies included in the sample, as well as some specific values we used. It also provides the fluxes used to fit the integrated SED of each galaxy, and the resulting dust model parameter.

— Galaxy information

- `GALNAME`: Galaxy "common" identifier
- `PGCNAME`: Galaxy PGC identifier, from `galbase`[1]

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[1] https://github.com/akleroy/galbase/; built from the HyperLeda database (Makarov et al. 2014, http://leda.univ-lyon1.fr/).

- `RA_DEG`: Right ascension, from `galbase`; in degree
- `DEC_DEG`: Declination, from `galbase`; in degree
- `POSANG_DEG`: Position angle, from `galbase`; if none, set to 0 during processing; in degree
- `INCL_DEG`: Inclination, from `galbase`; if none, set to 0 during processing; in degree
- `DIST_MPC`: Distance, from `galbase`
- `R25_DEG`: Optical radius, from `galbase`; in degree
- `REFF_DEG`: Effective radius, from Sun et al. (in prep); in degree

— **Integrated Flux**; all are expressed in Jy, and within a $1r_{25}$ aperture; the (e) indicates another column with the associated error, described in the paper.

- `(e)WISE1`: band WISE 1
- `(e)WISE2`: band WISE 2
- `(e)WISE3`: band WISE 3
- `(e)WISE4`: band WISE 4
- `(e)PACS70`: band PACS 70
- `(e)PACS100`: band PACS 100
- `(e)PACS160`: band PACS 160
- `(e)SPIRE250`: band SPIRE 250

— **Dust Parameters** from the Draine & Li (2007) model; the (e) indicates another column with the associated error.

- `FIT_TYPE`: Type of fit available for the target where `I` indicates integrated, and `R` resolved. `R` implies an integrated fit is available as well.
- `(e)UMIN`: Minimum radiation field
- `(e)GAMMA`: Fraction of dust heated by a power-law combination of radiation field from the integrated fit
- `(e)UBAR`: Average radiation field, calculated from $U_{\rm min}$ and γ
- `(e)QPAH`: Fraction of dust mass in the form of PAHs from the integrated fit; in percent
- `(e)MDUST`: Total dust mass from the integrated fit; in solar masses; note that the Chastenet et al. (2021) correction factor for the dust mass mentioned earlier is also not included in this integrated values. To reproduce the figures and tables in Chastenet et al. (2025) the dust masses should be divided by 3.1.

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