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Title	A nearby galaxy perspective on dust evolution. Scaling relations and constraints on the dust build-up in galaxies with the DustPedia and DGS samples
Authors	Galliano, Frédéric; Nersesian, Angelos; BIANCHI, SIMONE; De Looze, Ilse; Roychowdhury, Sambit; et al.
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Table 3. Robustness assessment.

Quantity	Run	Median	68% interval	95% interval	Number of sources
$M_{\rm dust}/M_{\rm dust}^{\rm ref}$	Least-squares	0.86	0.128–1.50	2.83×10^{-6}–7.0	783
$M_{\rm dust}/M_{\rm dust}^{\rm ref}$	Non-hierarchical Bayesian	0.92	0.0223–1.22	0.000164–3.7	798
$M_{\rm dust}/M_{\rm dust}^{\rm ref}$	No *Planck* and IRAS data	1.19	1.00–1.60	0.69–2.44	783
$M_{\rm dust}/M_{\rm dust}^{\rm ref}$	Galliano et al. (2011) AC mixture	0.91	0.69–0.97	0.51–1.15	798
$q_{\rm PAH}/q_{\rm AF}^{\rm ref}$	Galliano et al. (2011) AC mixture	0.60	0.48–0.68	0.37–0.80	798
$M_{\rm dust}/M_{\rm dust}^{\rm ref}$	MBB with $\beta = 1.79$	0.85	0.61–1.08	0.35–1.39	798
$M_{\rm dust}/M_{\rm dust}^{\rm ref}$	MBB with β free	1.00	0.43–2.75	0.183–5.3	798
$M_{\rm dust}/M_{\rm dust}^{\rm ref}$	Draine & Li (2007) ISRF distribution	0.71	0.49–1.31	0.186–4.6	798
$M_{\rm dust}/M_{\rm dust}^{\rm ref}$	CIGALE	0.70	0.50–1.06	0.227–3.6	756

Notes. Statistics of the comparison between the reference run and the various tests of Figs. 4–6. The median, 68% and 95% intervals refer to the distribution of the quantity in the first column. See Sect. 3.3 for more details.

In this case, the far-IR coverage is provided by the sole *Herschel* data. There is thus no data longward 500 µm. The result is shown in panel c of Fig. 4. The absence of this data does not bias the fit, it simply introduces some scatter, consistent with the 1:1 relation (cf. Sect. 5.2 of G18 for more discussion on this effect). The irregulars are marginally overestimated, due to the lack of sufficient SPIRE detections. Some of these sources do not have any submm detections, higher dust masses are therefore allowed.

3.3.2. Influence of the dust model assumptions

With the Galliano et al. (2011) dust mixture. We have fit the full sample of Sect. 2 with the HB model of Sect. 3.1, replacing the `THEMIS` grain properties by those of the amorphous carbon (AC) model of Galliano et al. (2011). The far-IR opacity of the two grain mixtures are comparable (cf. Fig. 4 of Galliano et al. 2018). The only fundamental difference is that the aromatic features are accounted for by PAHs, not by a-C(:H). Panel a of Fig. 5 compares $M_{\rm dust}$ to our reference model. As expected, the two values are in good agreement. The moderate scatter is due to the mild difference between the two far-IR opacities. However, most of the ratios are 1σ-consistent with the 1:1 relation. Panel b of Fig. 5 compares the $q_{\rm PAH}$ of this run to the $q_{\rm AF}$ of the reference run. In Sect. 3.1.1, we noted that we should have $q_{\rm PAH}/q_{\rm AF} \simeq 0.45$. In the present case, we have a ratio of ≃0.6. A possible explanation of this difference is the following. The parametrization of the `THEMIS`'s aromatic spectrum shape is controlled by $f_{\rm VSAC}$ (Sect. 3.1.1), which alters the a-C(:H) mass. On the contrary, for the Galliano et al. (2011) AC model, the shape of the aromatic spectrum is controlled by the fraction of ionized PAHs, which does not alter the PAH mass. A systematically lower 8-to-12 µm ratio compared to the Galaxy's diffuse ISM would explain a $q_{\rm PAH}/q_{\rm AF}$ ratio higher than expected.

Modified black body with $\beta = 1.79$. We have fit the photometry of Sect. 2, longward 100 µm, with a Modified Black Body (MBB; e.g., Sect. 2.2.2 of G18). In this first test, we fix the emissivity index $\beta = 1.79$ and the level of the opacity to mimic the far-IR opacity of `THEMIS`: $\kappa(\lambda) = 0.64\,{\rm m^2\,kg^{-1}} \times (250\,\mu{\rm m}/\lambda)^{1.79}$ (e.g., Sect. 3.1.1 of Galliano et al. 2018). Panel c of Fig. 5 compares $M_{\rm dust}$ to our reference run. We can see that $M_{\rm dust}$ is about 0.8 times lower. This value is consistent with what Galliano et al. (2011, Appendix C.2) found in the LMC. This difference is due to the fact that a MBB is an isothermal approximation. Since a SED fit is roughly luminosity weighted, the MBB does not account for the coldest, less emissive, but massive regions in the galaxy. It thus systematically underestimates the mass.

Modified black body with free β. Similarly to the previous test, we have fit the photometry of Sect. 2, longward 100 µm, with a MBB, but letting β free, this time. Such a model can potentially infer the grain optical properties through the value of β and the grain physical conditions through the temperature, $T_{\rm d}$. This potentiality is however limited by the mixing of physical conditions (e.g., Sect. 2.3.1 of Galliano et al. 2018). Panel a of Fig. 6 compares $M_{\rm dust}$ to our reference run. We can see the dust mass is not extremelly biased, although there is some scatter. The β–$T_{\rm d}$ relation of this run is presented in Appendix E.

With the DL07 ISRF distribution. We have fit the full sample of Sect. 2 with the physical model of Sect. 3.1, replacing the ISRF distribution of Eq. (2) by the DL07 prescription:

$$\frac{{\rm d}M_{\rm dust}}{{\rm d}U} = M_{\rm dust}\left[(1-\gamma)\delta(U-U_{\rm min}) + \frac{\gamma(\alpha-1)U^{-\alpha}}{U_{\rm min}^{1-\alpha}-(U_{\rm min}+\Delta U)^{1-\alpha}}\right]. \quad (3)$$

This prescription is our Eq. (2) plus a uniformly illuminated component at $U = U_{\rm min}$, with the parameter γ controlling the weight of the two components. We follow DL07 by fixing $\alpha = 2$ and $U_{\rm min} + \Delta U = 10^6$. Consequently, the far-IR and submm slope, beyond the large grain peak emission (≃100 µm), is the slope of the large grain emission at $U = U_{\rm min}$, making this model very similar to a fixed-β MBB in the far-IR and submm range. In comparison, the ISRF distribution of our reference run allows us to account for a flattening of the far-IR and submm slope, by mixing different ISRF intensities, down to lower temperatures (Sect. 2.3.1 of Galliano et al. 2018). Apart from the ISRF distribution, the other features are similar to our reference run: THEMIS grain mixture and HB method. Panel b of Fig. 6 compares $M_{\rm dust}$ to our reference run. We notice, as expected, the same systematic shift, here by a factor ≃0.7, as for the fixed-β MBB (Table 3).

3.3.3. Comparison to `CIGALE` results

Nersesian et al. (2019) have modeled the DustPedia sample, using the code `CIGALE` (Boquien et al. 2019), which fits the dust SED with: (i) the `THEMIS` grain properties; (ii) the DL07 ISRF distribution; and (iii) a nonhierarchical Bayesian method. Panel c of Fig. 6 shows its comparison to our reference run. As expected, it is very similar to the DL07 ISRF distribution test in panel b of the same figure. In particular, the mass is shifted by the same ≃0.7 factor (Table 3). We note that Nersesian et al. (2019) did not analyze the sources from the DGS, which are mostly the