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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
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relatively coarse dust evolution model grid with a frequentist fitting approach. Although interesting, their approach does not allow them to rigorously quantify parameter degeneracies and uncertainties. The comparison with their results is therefore limited. We have discussed the main discrepancies between the present work and theirs in Sects. 2.1.2 and 5.2.3.

DL20 have analyzed the JINGLE galaxy sample, following a methodology similar to ours, fitting the IR SED of each galaxy, and subsequently fitting one-zone dust evolution tracks to their derived $M_\star$, $M_{\rm gas}$, $M_{\rm dust}$, Z, and SFR. They adopted a nonhierarchical Bayesian approach. To our knowledge, this is the first article, similar to ours, to perform a rigorous fit of dust evolution models, with clearly quantified parameter uncertainties. Their results however qualitatively differ from ours. DL20 find an overall high SN II dust yield, and a low grain growth efficiency (the tuning parameters are not assumed universal in their study). In our opinion, the discrepancy between our results and those of DL20 comes from the two following points. Firstly, DL20's metallicity coverage is more limited than ours. They have only one source below $12 + \log({\rm O/H}) = 8.0$, and none below $12 + \log({\rm O/H}) = 7.8$ (cf. e.g., their Fig. 7). Consequently, they do not sample the stardust regime, below the critical metallicity. Disentangling SN II dust condensation, grain growth, and shock destruction, with their data, is therefore rendered difficult. Secondly, the posterior distribution of the dust evolution parameters inferred by DL20, as seen in their Figs. G.7–G.12 (they focus their analysis on their galaxy bins 3 and 4), rarely goes down to zero probability within the range allowed by their uniform prior. It means the weight of evidence provided by their data is relatively mild. Our inference of $\epsilon_{\rm grow}$ and $m_{\rm gas}^{\rm dest}$ are consistent with their PDF, as they fall in a high probability domain in all their models. We simply have a smaller uncertainty, thanks to our low-metallicity coverage. This is more pronounced for their distribution of $\delta_{\rm SN}$ (their $f_{\rm survival}$). DL20 would have also benefitted from extending their prior range down to smaller values, as they do not consider yields below $\delta_{\rm SN} = 10\%$, while we infer a value around $\delta_{\rm SN} \simeq 1\%$.

6. Summary and conclusions

This article has presented an observational study aimed at constraining the timescales of the main processes controlling the evolution of interstellar dust in galaxies. The principal highlights are the following.

1. We have gathered the 3 µm-to-1 mm photometry and ancillary data of 798 nearby galaxies from the DustPedia (Davies et al. 2017) and DGS (Madden et al. 2013) surveys. We have attempted to create the most conservative, homogeneous sample, by controlling the factors that could lead to systematic biases (Sect. 2):

- the DustPedia and DGS IR data reduction and photometry have been performed consistently;
- the stellar mass and SFR have been estimated using the same IMF;
- the metallicities have been estimated using one uniform calibration;
- the total gas masses have been derived from $[{\rm H\,I}]_{21\,{\rm cm}}$ and $^{12}{\rm CO}(J=1\rightarrow0)_{2.6\,{\rm mm}}$ observations, when available. When CO data was not available, the molecular gas mass was estimated from a scaling relation.
- Resolved interferometric $[{\rm H\,I}]_{21\,{\rm cm}}$ observations of 20 of the lowest metallicity objects were used in order to extract the gas mass corresponding exactly to the IR photometric aperture.

2. We have performed a hierarchical Bayesian dust SED fit of the 798 galaxies, using the code `HerBIE` (G18) with the `THEMIS` grain properties (Jones et al. 2017).

- This allowed us to infer the dust mass, $M_{\rm dust}$, mean starlight intensity, $\langle U\rangle$, and the mass fraction of aromatic-feature-emitting grains, $q_{\rm AF}$, in each galaxy (Sect. 3.2). The inferred parameters are given in Appendix H.
- We have compared our inferred parameters to a series of additional runs, as well as to independent literature studies, in order to demonstrate the influence of the different assumptions of our model and assess the robustness of our results (Sects. 3.3 and 3.4).

3. We have displayed several well-known scaling relations involving $M_\star$, $M_{\rm gas}$, $M_{\rm dust}$, $12 + \log({\rm O/H})$, SFR, $q_{\rm AF}$, and $\langle U\rangle$, for our sample (Sect. 4).

- We have shown that there is a drastic evolution with metallicity of the dust-to-metal mass ratio (by two orders of magnitude). We have extensively discussed the different biases that could artificially produce such a trend, concluding they were unlikely (Sect. 4.1.3).
- We have noticed that early-type galaxies have a systematically lower dust-to-gas mass ratio than other types in the same gas-to-stellar mass ratio range. We have investigated the possibility that this was resulting from the enhanced dust destruction due to thermal sputtering in the hot X-ray emitting gas permeating these objects. This scenario is supported by a rough negative correlation between the dust-to-star mass ratio and the X-ray photon rate per dust grain (Sect. 4.1.2).
- We have displayed the well-known trends of $q_{\rm AF}$ with $12 + \log({\rm O/H})$, and $\langle U\rangle$. Our data indicate the correlation with $12 + \log({\rm O/H})$ is significantly better (Sect. 4.2). It implies that, at the scale of a galaxy, the overall abundance of small a-C(:H) grains might be principally controlled by the efficiency of their formation (stardust production and/or shattering of larger carbon grains). The photodestruction of small a-C(:H) might overall be circumscribed around star forming regions.

4. We have performed a hierarchical Bayesian fit of a one-zone dust evolution model to the derived $M_\star$, $M_{\rm gas}$, $M_{\rm dust}$, $12 + \log({\rm O/H})$, and SFR of a subsample of 556 late-type and irregular objects (Sect. 5).

- We have inferred the efficiency of the three main dust evolution tuning parameters (Sect. 5.3): (i) the IMF-averaged SN II dust yield is $\langle Y_{\rm SN}\rangle \lesssim 0.03\,M_\odot/{\rm SN}$; (ii) the grain growth efficiency parameter (Mattsson et al. 2012) is $\epsilon_{\rm grow} \gtrsim 3000$; (iii) the average gas mass cleared of dust by a single SN II shock wave is $m_{\rm gas}^{\rm dest} \gtrsim 1200\,M_\odot/{\rm SN}$. Our results therefore imply that dust production is dominated by grain growth in the ISM above a critical metallicity of $12 + \log({\rm O/H}) \simeq 8.0$. They also suggest that the massive amounts of dust detected in high redshift systems ($z \gtrsim 6$) likely grew in the ISM.
- We have shown that ELMGs were crucial in constraining these parameters, as they sample a regime where dust production is dominated by SN II condensation. A steep, strongly nonlinear, dustiness-metallicity relation, such as the one we have found, is the unambiguous evidence that stardust can not dominate the content of solar metallicity systems.
- We have shown and explained why these conclusions were, to first order, independent of our IMF assumption (Sect. 5.3.3).
- Our model fails at reproducing the relation between the sSFR and the dust-to-star mass ratio. We suspect this is due to the oversimplicity of our SFH, inflow, and outflow prescriptions.