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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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limit the impact of systematic effects on our results (Galliano 2018, hereafter G18). Finally, we perform a rigorous dust evolution modeling of individual objects in our sample, in order to unambiguously constrain the dust evolution timescales. Section 2 presents the data we have used. Section 3 presents our model and discusses the robustness of the derived dust parameters. Section 4 provides a qualitative discussion of the derived dust evolution trends. Section 5 describes the quantitative modeling of the main dust evolution processes. Section 6 summarizes our results. Several technical arguments are detailed in the appendices, so that they do not alter the flow of the discussion.

2. The Galaxy sample

This study focuses on global properties of galaxies. Integrating the whole emission of a galaxy complicates the interpretation of the trends, as we discuss in Sect. 4. However, it also presents some advantages: (i) we can include galaxies unresolved at infrared wavelengths; and (ii) we can provide benchmarks for comparisons to unresolved studies of the distant Universe or to one-zone dust evolution models.

Several upcoming studies on a subsample of resolved DustPedia galaxies will discuss the improvements that the spatial distribution of the dust properties provides (Roychowdhury et al., in prep.; Casasola et al., in prep.).

2.1. The infrared photometry

We present here the integrated, multiwavelength photometry of our sample, used to constrain the global dust properties of each galaxy. We focus on the mid-IR-to-submm regime, as it is where dust emits.

2.1.1. The DustPedia aperture photometry

We use the photometry of the 875 galaxies of the DustPedia sample presented by Clark et al. (2018, hereafter C18)[3]. Since we focus on the mid-IR-to-submm regime, we restrain the wavelength range to photometric bands centered between 3 μm and 1 mm. The list of photometric bands we have used is given in Table 1. C18 has provided a dedicated reduction of the *Herschel* broadband data and an homogenization of the *Spitzer*, WISE and *Planck* observations. Foreground stars have been masked. Aperture-matched photometry has been performed on each image and a local background has been subtracted from each flux. A consistent noise uncertainty was estimated for each measurement. IRAS fluxes from Wheelock et al. (1994) were added to the catalog. We refer the reader to C18 for more details about the data reduction and photometric measurement.

The SED model (Sect. 3.1), that we have applied to our data, performs a complex statistical treatment, allowing us to analyze even poorly sampled SEDs. However, the efficiency of such a model can be affected by the presence of systematic effects not properly accounted for by the uncertainties. In order to be conservative, we have therefore excluded a series of fluxes, based on the following criteria.

1. The C18 catalog flags about 22% of its fluxes, for different reasons: artifacts, contamination by nearby sources, incomplete extended emission, etc. We have excluded all the fluxes that are flagged. For 89 galaxies, all IR fluxes end up flagged. These galaxies have therefore been excluded.

Table 1. Number of galaxies observed through each photometric band.

Instrument	Wavelength (central)	Label	Number of galaxies 3σ detection	Total
WISE	3.4 μm	WISE1	725	751
	4.6 μm	WISE2	663	739
	11.6 μm	WISE3	554	728
	22.1 μm	WISE4	438	694
IRAC (*Spitzer*)	3.5 μm	IRAC1	277	292
	4.5 μm	IRAC2	359	390
	5.7 μm	IRAC3	100	113
	7.8 μm	IRAC4	116	130
MIPS (*Spitzer*)	23.7 μm	MIPS1	125	178
	71 μm	MIPS2	32	41
	156 μm	MIPS3	18	25
PACS (*Herschel*)	70 μm	PACS1	108	144
	100 μm	PACS2	273	456
	160 μm	PACS3	296	493
SPIRE (*Herschel*)	250 μm	SPIRE1	481	674
	350 μm	SPIRE2	446	658
	500 μm	SPIRE3	404	634
IRAS	60 μm	IRAS3	282	360
	100 μm	IRAS4	391	501
HFI (*Planck*)	350 μm	HFI1	217	275
	550 μm	HFI2	127	182
	850 μm	HFI3	93	125

Notes. During the inference process (Sect. 3.2), the observed fluxes are compared to the SED model integrated within the transmission of these filters, with the appropriate flux convention.

2. Several galaxies contain a significant emission from their active galactic nucleus (AGN). This emission is characterized by a prominent synchrotron continuum and copious amounts of hot dust ($T_{\rm dust} \gtrsim 300$ K), resulting in a rather flat mid-IR continuum. Our dust model (Sect. 3.1.1) is optimized for regular interstellar dust. Our distribution of starlight intensities (Sect. 3.1.2) is usually not flexible enough to account for the hot emission from the torus. We have therefore excluded 19 sources presenting such an emission at a significant level, following Bianchi et al. (2018), who used the criterion of Assef et al. (2018) based on the WISE1 and WISE2 fluxes to identify AGNs[4].

3. We have performed a preliminary least-squares fit with our reference SED model (Sect. 3.3), in order to identify where the largest residuals are.

- A few short wavelength bands present a large deviation from their SED model and their adjacent fluxes[5]. After inspection of the images, the discrepancies are likely due to residual starlight contamination.
- Several long-wavelength IRAS fluxes are significantly deviant from their nearby MIPS and PACS fluxes[6]. The reason of these discrepancies is obscure. However, Sect. 3.3

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[3] Available at `http://dustpedia.astro.noa.gr/Photometry`

[4] Those are: ESO 434−040, IC 0691, IC 3430, NGC 1068, NGC 1320, NGC 1377, NGC 3256, NGC 3516, NGC 4151, NGC 4194, NGC 4355, NGC 5347, NGC 5496, NGC 5506, NGC 7172, NGC 7582, UGC 05692, UGC 06728, UGC 12690.

[5] Those are: WISE2 and IRAC2 for ESO 0358−006, ESO 0116−012 and ESO 0358−006; and IRAC3 for NGC 3794.

[6] Those are: IRAS4 for NGC 254, NGC 4270, NGC 4322, NGC 5569 and UGC 12313; and both IRAS3 and IRAS4 for IC 1613, NGC 584, PGC 090942, IC 2574, UGC 06016, NGC 3454, NGC 4281, NGC 4633, NGC 5023, NGC 7715.