1. Introduction

Characterizing the dust properties across different galactic environments is an important milestone in understanding the physics of the interstellar medium (ISM) and galaxy evolution (Galliano et al. 2018, for a review). Interstellar grains have a nefarious role of obscuring our direct view of star formation (e.g., Bianchi et al. 2018). The subsequent unreddening of ultraviolet-(UV)-visible observations relies on assumptions about the constitution and size distribution of the grains, as well as on the relative star-dust geometry (e.g., Witt et al. 1992; Witt & Gordon 2000; Baes & Dejonghe 2001). Dust is also involved in several important physical processes, such as the photoelectric heating of the gas in photodissociation regions (PDR; e.g., Draine 1978; Kimura 2016) or H_2 formation (e.g., Gould & Salpeter 1963; Bron et al. 2014). The uncertainties about the grain properties have dramatic consequences on the rate of these processes and are the main cause of discrepancy between PDR models (Röllig et al. 2007). Finally, state-of-the-art numerical simulations of galaxy evolution are now post-processed to incorporate the full treatment of dust radiative transfer in order to reproduce realistic observables (e.g., Camps et al. 2016, 2018; Trayford et al. 2017; Rodriguez-Gomez et al. 2019; Trčka et al. 2020). These simulations rely on assumptions about the dust emissivity, absorption and scattering properties, which change from galaxy to galaxy (e.g., Clark et al. 2019; Bianchi et al. 2019).

We are far from being able to predict the dust composition, structure, and size distribution in a given ISM condition. Ab initio methods are currently impractical because of the great complexity of the problem. Empirical approaches face challenges, too. The last four decades have shown that each time we were investigating a particular observable with the hope of constraining the grain properties, these properties were proving themselves more elusive because of their evolution. Firstly, the diversity of extinction curve shapes within the Milky Way (Fitzpatrick 1986; Cardelli et al. 1989) and the Magellanic Clouds (Gordon et al. 2003) can be explained by variations of the size distribution and carbon-to-silicate grain ratio (Pei 1992; Kim et al. 1994; Clayton et al. 2003; Cartledge et al. 2005). Secondly, elemental depletion patterns strongly depend on the density of the medium, suggesting that dust is partly destroyed and reformed in the ISM (Savage & Mathis 1979; Crinklaw et al. 1994; Jenkins 2009; Parvathi et al. 2012). Thirdly, variations of the infrared (IR) to submillimeter (submm) emissivity as a function of the density of the medium, whether in the Milky Way (Stepnik et al. 2003; Ysard et al. 2015) or in the Magellanic Clouds (Roman-Duval et al. 2017), are interpreted as variations of the grain mantle thickness and composition, and grain-grain coagulation (e.g., Köhler et al. 2015; Ysard et al. 2016). Fourthly, the wide variability of the relative intensity and band-to-band ratio of the mid-IR aromatic feature spectrum, witnessed within the Milky Way and nearby galaxies, is the evidence of the variation of the abundance, charge, and size distribution of the band carriers (e.g., Boulanger et al. 1998; Madden et al. 2006; Galliano et al. 2008a; Schirmer et al. 2020). Finally, the wavelength-dependent polarization fraction in extinction and emission provides additional constraints on the composition of the grains, as well as on their shape and alignment (e.g., Andersson et al. 2015; Fanciullo et al. 2017).

To understand the evolution of the global dust content of a galaxy, one must be able to quantify the timescales of the processes responsible for dust formation and destruction. These processes can be categorized as follows.

Stardust production takes place primarily in the ejecta of: (i) Asymptotic giant branch (AGB) stars; and (ii) type II supernovae (SN II; core-collapse SN). SNe II potentially dominate the net stardust injection rate (e.g., Draine 2009, for a review), but their actual yield is the subject of an intense debate. Most of the controversy lies in the fact that, while large amounts could form in SN II ejecta (e.g., Matsuura et al. 2015; Temim et al. 2017), a large fraction of freshly formed grains could not survive the reverse shock (e.g., Nozawa et al. 2006; Micelotta et al. 2016; Kirchschlager et al. 2019). Estimates of the net dust yield of a single SN ranges in the literature from $\simeq 10^{-3}$ to $1\,M_\odot$/SN (e.g., Todini & Ferrara 2001; Ercolano et al. 2007; Bianchi & Schneider 2007; Bocchio et al. 2016; Marassi et al. 2019).

Grain growth in the ISM refers to the addition of gas atoms onto pre-existing dust seeds (e.g., Hirashita 2012). It could be the main grain formation process, happening on timescales $\lesssim$1 Myr (e.g., Draine 2009). It is however challenged due to the lack of direct constraints and because we currently lack a proven dust formation mechanism, at cold temperatures.

Grain destruction can be attributed to: (i) astration, that is their incorporation into stellar interiors during star formation; (ii) sputtering and shattering by SN blast waves. The second process is the most debated, although it is less controversial than stardust production and grain growth efficiencies. Timescales for grain destruction in the Milky Way range from $\simeq$200 Myr to $\simeq$2 Gyr (Jones et al. 1994; Slavin et al. 2015).

In the Milky Way, there is a convergent set of evidence pointing toward a scenario where: (i) stardust accounts for at most $\simeq$10% of ISM dust; (ii) most grains are therefore grown in the ISM (e.g., Draine & Salpeter 1979; Dwek & Scalo 1980; Jones et al. 1994; Tielens 1998; Draine 2009). The goal of this paper is to explore how particular environments could affect these conclusions, by modeling nearby extragalactic systems. By studying nearby galaxies, we also aim to provide a different perspective on these questions.

Several attempts have been made in the past to quantify the evolution of the dust content of galaxies via fitting their spectral energy distribution (SED; e.g., Lisenfeld & Ferrara 1998; Morgan & Edmunds 2003; Draine et al. 2007; Galliano et al. 2008b; Rémy-Ruyer et al. 2014, 2015; De Vis et al. 2017a; Nersesian et al. 2019; De Looze et al. 2020; Nanni et al. 2020). Although these studies provided important benchmarks, most of them were limited by the following issues: (i) their coverage of the parameter space was often incomplete, especially in the low-metallicity regime, which is crucial to quantify stardust production (cf. Sect. 5); (ii) potential systematic effects, originating either in the SED fitting or in the ancillary data, were questioning some of the conclusions; (iii) dust evolution models were most of the time not fit to each galaxy, but simply visually compared[1], which can lead to some inconsistencies (cf. Sect. 5.2.3).

The present paper is an attempt at addressing these limitations. We rely on the homogeneous multiwavelength observations and ancillary data of the DustPedia project (Davies et al. 2017) and of the dwarf galaxy sample (DGS; Madden et al. 2013). We adopt a hierarchical Bayesian[2] (HB; cf. Sect. 3.1) approach when comparing models to observations, in order to

[1] Among the cited studies, only Nanni et al. (2020) and De Looze et al. (2020) perform an actual fit of individual galaxies.

[2] In principle, we should say Bayesian-Laplacian, in place of Bayesian, as Pierre-Simon Laplace is the true pioneer in the development of statistics using the formula found by Thomas Bayes (Hahn 2005; McGrayne 2011).