



DustPedia: A Definitive Study of Cosmic Dust in the Local Universe



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Abstract. We report on the meeting of the DustPedia collaboration, a project funded within the European Union's Seventh Framework Programme (FP7) to exploit observations of dust emission from the Herschel Space Observatory for 875 galaxies in the local Universe.

Keywords. Galaxies, Interstellar medium, Dust, Gas, Herschel, Infrared observations.

Dust is a component of the interstellar medium (ISM) made of small (typically <1-mm) solid grains of refractory materials. Despite constituting only $\approx 1\%$ of the mass of the ISM, and only $\approx 1\%$ of the total baryonic mass of a galaxy, dust has a profound impact on its energy budget: on average, 30% of all the energy emitted by stars in a galaxy in the ultraviolet, optical, and near-infrared (NIR) wavelengths is absorbed by interstellar grains and emitted in the mid-, far-infrared (FIR), and sub-millimetre ranges.

DustPedia (www.dustpedia.com) is an FP7-funded collaboration (grant agreement n. 606847) of six European institutes, led by Jonathan I. Davies of Cardiff University. Its primary aim is the exploitation of data from the science archive of the *Herschel Space Observatory*, an ESA facility that operated from 2009 to 2013. *Herschel* provided a view of dust emission in nearby galaxies that was unprecedented in terms of spatial resolution and sensitivity, covering the FIR and sub-mm spectrum in the wavelength range from 70 to 500 μm .

The DustPedia consortium held its 5th management and board meeting at Villa il Gioiello on October 27-28, 2016. The main discussion topic was the completion of the science database: *Herschel* photometric observations for 875 nearby, resolved galaxies (larger than $1'$ in the sky) were reduced according to the latest specifications by the Cardiff University and Ghent University teams. Ancillary data from the ultraviolet up to sub-mm wavelengths were gathered from archives and catalogues of other space and ground observing facilities: in particular, all

DustPedia galaxies have been detected in the NIR by NASA's Wide-field Infrared Survey Explorer space mission. Photometry was carried out in a homogeneous way by the Cardiff group, and the overall quality was controlled by the INAF-Arcetri Astrophysical Observatory node. For a typical DustPedia galaxy, the Spectral Energy Distribution (SED) of stellar and dust emission consists of 25 photometric datapoints.

Besides the construction of the database, a major goal of the DustPedia collaboration is the definition of innovative analysis methods. The team at the CEA/Service d'Astrophysique (Saclay) presented preliminary results from HerBIE (Hi-ERarchical Bayesian Inference for dust Emission), a tool to extract from observed SEDs physical quantities such as radiation field intensities and dust masses, together with their probability distribution functions. The members of the Ghent node illustrated the application of the Monte Carlo radiative transfer code SKIRT to the galaxy NGC3031 (M81): a fitting procedure that allows 3-D analysis of dust and stellar geometrical distribution and of the dominant dust heating mechanisms in this and other large DustPedia objects. All of the analysis and modelling is conducted within the framework of THEMIS, The Heterogeneous dust Evolution Model for Interstellar Solids, which is able to describe dust properties in a wide variety of environments, from the diffuse ISM to dense clouds; THEMIS applications were presented by the model developers from the Institut d'Astrophysique Spatiale (Université Paris Sur).

Preliminary scientific results conducted during the quality control phase were also presented: an analysis of the global properties of the sample and of the characteristics of dust emission in early type galaxies were shown by colleagues at the National Observatory of Athens; the representatives of Arcetri presented the results from a study of the disks in the largest DustPedia spirals (Fig. 1) as well as initial investigations on the correlation between dust and ISM gas and on the average properties of the SEDs of spirals.

Since the meeting, a paper presenting the project has been published (J. I. Davies et al., 2017, Publications of the Astronomical Society of Pacific, 129:044102) and another describing the dataset and photometry has been accepted for publication (C. J. R. Clark et al, 2017, Astronomy & Astrophysics, in press). The database is publicly available at <http://dustpedia.astro.noa.gr>.

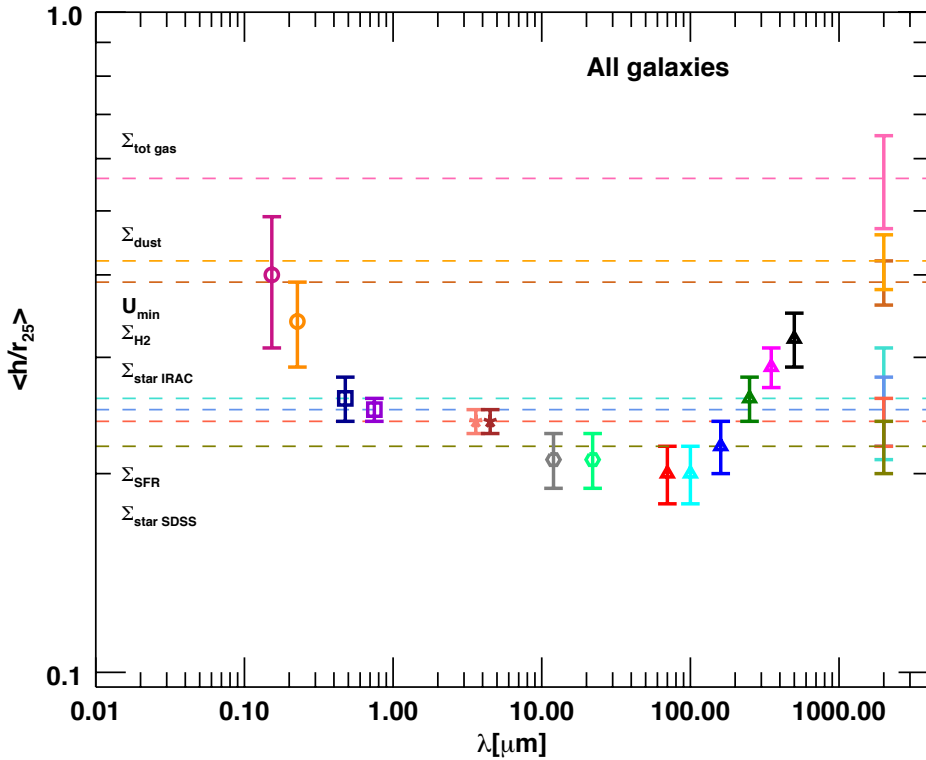


Figure 1. Average radial exponential scale-lengths of 18 large spiral galaxies, normalised to the optical radius R_{25} , for observations from the UV to the FIR, and for derived properties such as dust, gas and star-formation surface densities. The emission in the sub-mm and the dust mass surface density have a larger scale-length (i.e. a flatter radial distribution) than the bulk population of stars and molecular gas (Casasola et al., 2017, *Astronomy & Astrophysics*, 605, A18).