The relations between dust intrinsic properties and galaxy global quantities in the nearby Universe

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Results of a case study of a sample of low-redshift galaxies are presented, to determine dust temperatures and emissivity indices through a less time-consuming method, and to connect these intrinsic dust properties with global galaxy properties, ISM and star-formation quantities. Dust temperatures (T_d) are determined for two cases - with β_d left free or fixed, based on the corresponding galaxy dust masses independently calculated in our previous work through a self-consistent method, without the need to perform a complete spectral energy distribution (SED) fit of the cold dust emission fluxes. The range and average dust temperatures are found to be consistent within errors with values from other studies. Simultaneously, the dust emissivity indices (β_d) are determined, and their evolution with temperature quantified, to check if the $T_d - \beta_d$ known degeneracy still appears with the current method. It is investigated whether β_d can be predicted from other relation or if it scales with other integrated dust / ISM or star-formation property, which could be used as a proxy. New and observed relations between T_d, β_d, the dust surface density and global / integrated galaxy and star-formation related quantities are presented and analysed in the context of dust/ISM formation and evolution. It is verified which of the star-formation quantities can constitute conclusive tracers of the dust temperature. The differential dust attenuation between nebular and stellar light is determined and its variation with stellar mass and star-formation related quantites is investigated, in comparison with results from other low and high redshift surveys (e.g. PHANGS-HST-JWST, ALPINE-CRISTAL-JWST).
The results and conclusions can be relevant for larger scales studies of low to mid-redshift galaxies from the latest surveys.