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ORIGINAL ARTICLE

Global spectral energy distributions of the Large Magellanic Cloud with interstellar dust

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Abstract The effects of dust on infrared emission vary among galaxies of different morphological types. We investigated integrated spectral energy distributions (SEDs) in infrared and submillimeter/millimeter emissions from the Large Magellanic Cloud (LMC) based on observations from the Herschel Space Observatory (HSO) and near- to mid-infrared observations from the Spitzer Space Telescope (SST). We also used IRAS and WMAP observations to constrain the SEDs and present the results of radiative transfer calculations using the spectrophotometric galaxy model. We explain the observations by using dust models with different grain size distributions in the interstellar medium of the LMC, noting that the LMC has undergone processes that differ from those in the Milky Way. We determined a spectral index and a normalization factor in the range of -3.5 to -3.45 with grain radii in the range of 1 nm–300 nm for the silicate grain and 2 nm–1 μm for the graphite grain. The best fit to the observed SED was obtained with a spectral index of -3.47, similar to the value derived by Piovan et al. (Mon. Not. R. Astron. Soc. 366(3):923, 2006a). The grain size distribution is described using a power law but with a break that is introduced below a_b, where a larger exponent is used. Changing the graphite grain size distribution significantly changed the SED pattern within the observational uncertainties. Based on the SED fits to the observations from submillimeter wavelengths to infrared radiation from the LMC using GRASIL (Silva et al., Astrophys. J. 509(1):103, 1998), we obtained a reasonable set of parameter values in chemical and geometric space together with the grain size distributions (Weingartner and Draine, Astrophys. J. 548(1):296, 2001) and a modified MRN model with the LMC extinction curve (Piovan et al., Mon. Not. R. Astron. Soc. 366(3):923, 2006a). For a given set of parameters including the disc scale height, synthesis of the starlight spectrum, optical depth, escape time scale, dust model, and star formation efficiency, the adopted dust-to-gas ratio for modeling the observed SEDs, $\sim 1/300$ (from the literature) yields a reasonable fit to the observed SEDs and similar results with the metallicity of the LMC as those reported in Russell and Bessell (Astrophys. J. Suppl. Ser. 70:865, 1989). The dust-to-gas ratios that are given as the metallicity caused the variation in the model fits. The difference mainly appears at the wavelengths near 100 μm.

Keywords Interstellar medium: dust · Stars: star formation · Dust: grain size distribution · Galaxies: spectral energy distributions · Galaxy: Large Magellanic Cloud

1 Introduction

Dust grains in the interstellar medium (ISM) of galaxies absorb and scatter stellar radiation, mainly at ultraviolet (UV) and optical wavelengths, and re-emit in the far infrared. Infrared observations from satellite telescopes have revealed that dust grains play an important role in reprocessing a significant amount of stellar radiation in the local universe. An appropriate treatment of dust reprocessing in galaxies is essential to determine physical quantities, including the star

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