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High-resolution, 3D radiative transfer modeling of M51

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Abstract. We present a new technique developed to model the radiative transfer (RT) effects in nearby face-on galaxies. The face-on perspective provides insight into the star-forming regions and clumpy structure, imposing the need for high-resolution 3D models to recover the asymmetric stellar and dust geometries observed in galaxies. RT modeling of the continuum emission of stars and its interaction with the embedding dust in a galaxy's interstellar medium enables a self-consistent study of the main dust heating mechanisms in galaxies. The main advantage of RT calculations is the non-local character of dust heating that can be addressed by tracing the propagation of stellar radiation through the dusty galaxy medium.

Keywords. radiative transfer – dust, extinction – galaxies: individual: M 51 galaxies: ISM – infrared: galaxies

1. Model construction

We construct a high-resolution 3D radiative transfer model with the Monte-Carlo code SKIRT (Baes *et al.* 2011) accounting for the absorption, scattering and non-local thermal equilibrium emission of dust in M 51. The 3D distribution of stars is derived from the 2D morphology observed in IRAC 3.6 μm, *GALEX* far-ultraviolet (FUV), Hα and MIPS 24 μm maps, assuming an exponential vertical distribution with a scale height, h_z (based on the observed vertical extent in edge-on galaxies). The dust geometry is constrained through the FUV attenuation. The stellar luminosity, star formation rate and dust mass have been scaled to reproduce the observed stellar spectral energy distribution (SED), FUV attenuation and infrared SED.

2. Conclusions

We demonstrate the capabilities of a new RT modeling technique in the prototype analysis of the grand-design spiral galaxy, M51. The high-resolution 3D model of M51 enables us to study the heating by young (< 100 Myr) and old stars at every infrared (IR) wavelength. Although young stars dominate in mid-IR wavebands, the contribution from old stars becomes non-negligible ($\sim 40\%$) for $\lambda \geqslant 70$ μm, which questions the applicability of IR tracers of the star formation activity in star-forming galaxies such as M51.

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References

Baes, M., Verstappen, J., De Looze, I., *et al.* 2011, *ApJS*, 196, 22