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A photoionization model of the spatial distribution of the optical and mid-IR properties in NGC595

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We present a set of photoionization models that reproduce simultaneously the observed optical and mid-infrared spatial distribution of the HII region NGC595 in the disk of M33 using the code CLOUDY. Both optical (PMAS-Integral Field Spectroscopy) and mid-infrared (8 mi and 24 mi bands from Spitzer) data provide enough spatial resolution to model in a novel approach the inner structure of the HII region. We define a set of elliptical annular regions around the central ionizing cluster with an uniformity in their observed properties and consider each annulus as an independent thin shell structure. For the first time our models fit the relative surface brightness profiles in both the optical (Halpha, [OII], [OIII]) and the mid-infrared emissions (8 mi and 24 mi), under the assumption of a uniform metallicity (12+log(O/H) = 8.45; Esteban et al. 2009) and an age for the stellar cluster of 4.5 Myr (Malumuth et al. 1996). Our models also reproduce the observed uniformity of the R23 parameter and the increase of the [OII]/[OIII] ratio due to the decrease of the ionization parameter. The variation of the Halpha profile is explained in terms of the differences of the occupied volume (the product of filling factor and total volume of the shell) in a matter-bounded geometry, which also allows to reproduce the observed pattern of the extinction. The 8 mi/24 mi ratio is low (ranging between 0.04 and 0.4) because it is dominated by the surviving of small dust grains in the HII region, while the PAHs emit more weakly because they cannot be formed in these thin HII gas shells. The ratio is also well fitted in our models by assuming a dust-to-gas ratio in each annulus compatible with the integrated estimate for the whole HII region after the 70 mi, and 160 mi Spitzer observations.

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