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EFFECTS OF CSPN MODELS ON PN SHELL MODELING

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Modeling planetary nebula shells (PNe) using different ionizing spectra for a hot central star (CSPN) of evolved PNe, we found that a blackbody model leads to wrong nebular diagnostics and abundances.

The aim of our investigations is to combine modeling of stellar atmospheres and of planetary nebula shells to obtain self consistent descriptions of the nebulae. For this purpose, spatially resolved roundish nebulae with well modeled central stars were selected (Rauch et al. 1999). As a test sample, the nebula NGC 2438 was selected, and the photoionization code Cloudy (Ferland 1996) was used for the modeling. To tune nebular parameters like density profile and filling factor, we used one of the new NLTE stellar model atmosphere fluxes with H–Ni element coverage by Rauch (2002) with $T_{\rm eff} = 110$ kK and $\log g = 7$ (cgs). The other geometrical parameters were derived from narrow-band images and long-slit spectra. This model was then used to calculate four different sets of artificial narrow-band surface brightness distributions in various species (H I, He I, He II, O III, N II, S II). The sources of illumination were: (a) the new NLTE model atmosphere by Rauch mentioned above; (b) a H–Ca NLTE model (Rauch 1997); (c) a NLTE atmosphere containing only H–He, and (d) a blackbody. The stellar fluxes were calibrated to have the same visual magnitude, $T_{\rm eff}$ and $\log g$. While Hα and Hβ are nearly unaffected by the different illumination sources, other lines change both in strength and spatial profile. For the low ionized species, the blackbody overestimates the lines by 30% ([S II]) to 45% ([N II]). Therefore, also the ratio Hα/[S II] vs. Hα/[N II] used for PN identification diagrams changes up to 15%. For the [O III] lines, the blackbody underestimates the real flux by 30%. He I λ4471 is underestimated by 20%, while He II λ4686, which also shows the strongest spatial change, is overestimated by 270% with the blackbody model (see Fig. 1). Models (b) and (c) underestimate the flux by about 20%. All diagnostic diagrams are therefore affected. This leads typically to an overestimation of the stellar temperature and nitrogen abundance. A blackbody model for the stellar atmosphere thus leads to wrong nebular parameters and should not be used anymore.

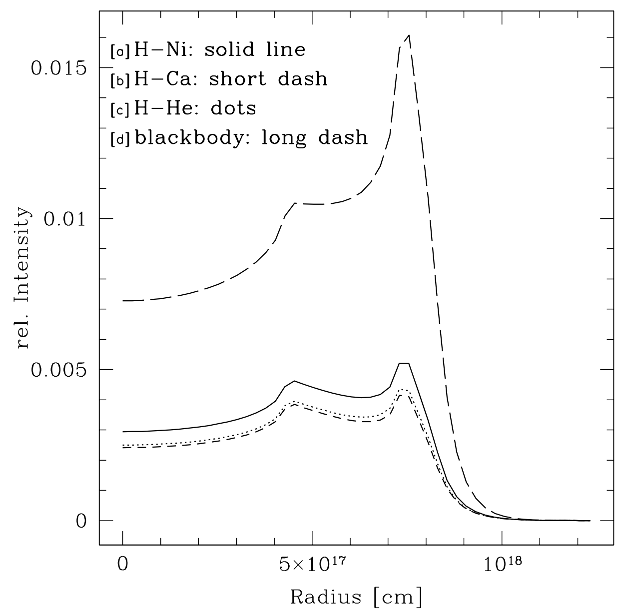

Fig. 1. Results of our PNe shell modeling from the line structure output of Cloudy for He II λ4686, the lines are normalized to the integrated Hβ flux. The blackbody model (d) overestimates the flux, the changes from model (a) to model (c) are also visible.

This work will be discussed more detailed in a forthcoming paper.

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