On the Evolutionary Status of the WR-type PNN

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Some observed parameters of planetary nebulae with H–deficient (mostly WR–type) nuclei (PNN) are compared to those of H–rich ones and to theoretical predictions from the born again scenario. An example is shown in Fig. 1

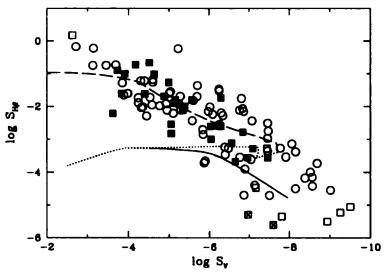

Figure 1: $S_{H\beta} - S_V$ diagram. $S_{H\beta}$ – surface brightness of the nebula in Hβ, $S_V = F_V/(\pi\theta^2)$, F_V – stellar flux in the V band, θ – nebular angular radius. Circles: H–rich PNN, squares: H–deficient PNN (filled squares: WR–type PNN, crossed squares: A 30 and A 78). The curve shows the evolution of a model with a late He–shell flash (see text).

The H–deficient PNN occupy practically the same region in Fig. 1 as the H–rich ones. $S_{H\beta}$ is a measure of the expansion stage of the nebula while S_V informs on the evolutionary stage of the central star. Therefore Fig. 1 suggests that the evolutionary status (time elapsed since leaving the AGB, evolutionary rate in the PN phase) is similar for both groups of objects. This seems to imply that the H–deficient PNN arrive directly from the AGB and confirms the conclusion of Górny & Stasińska (1995) that there is no systematic difference in mass between the H–deficient and the H–rich PNN.

Some authors suggest that the H–deficient PNN are born again nuclei after a late helium shell flash. The curve in Fig. 1 shows the expected evolution of a nebula with a flashing PNN (based on Iben at al. 1983). The model PNN ionizes a 0.2 $M_\odot$ nebula expanding at 20 km/s. Dashed curve shows the initial evolution during the H–burning phase. Dotted curve shows the fast return of the PNN towards the AGB caused by the onset of a late He–shell flash. The final evolution as a born again, He–burning, H–deficient PNN is displayed by a full curve.

As can be seen from Fig. 1 the born again nuclei are expected to appear at positions significantly shifted in respect to the H–burning PNN. This is in contradiction with the observations. Thus we conclude that most of the H–deficient PNN, especially the WR–type PNN, are not born again central stars. They presumably originate directly from the AGB. Note, however, that positions of a few H–deficient PNN, including A 30 and A 78, in Fig. 1 are compatible with the predictions of the born again model.

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