

Radio Continuum and Long-slit Optical Spectroscopy of the Planetary Nebulae Cn 3-1 and M 3-27

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Long-slit optical spectroscopy and VLA-B radio continuum ($\lambda = 3.6$ cm) observations toward the compact planetary nebulae Cn 3-1 and M 3-27 are presented. Optical spectra were taken at different position angles (PAs) with the 2.2 m telescope at Calar Alto (Spain), covering the range from 6549 to 6751 Å. The radio and optical data show that the ionized shell of Cn 3-1 is an ellipsoid (size $\simeq 6'' \times 5''$, PA $\simeq 72^\circ$) containing a bright ring-like equatorial zone (size $\simeq 2''6$, expansion velocity $\simeq 14$ km s⁻¹) and two bright point-symmetric arcs, extending from the equator towards the polar regions of the ellipsoid (Fig. 1). These arcs seem to be filamentary structures embedded in the ellipsoid. An ionized stellar wind has been detected through faint extended wings in the H α ($\simeq 660$ km s⁻¹) and [N II] ($\simeq 460$ km s⁻¹) emission lines. M 3-27 is unresolved at 3.6 cm (size $\leq 0''6$). The detected [N II] and [S II] emission lines arise in a compact ($\leq 1''4$) probably non-spherical region which is identified with the ionized shell of M 3-27. The H α emission from M 3-27 is dominated by strong emission from an ionized stellar wind and exhibits a Type III P Cygni profile with very extended wings ($\simeq 3000$ km s⁻¹). The estimated kinematic age and ionized mass of Cn 3-1 ($\simeq 1300$ yr, $4 \times 10^{-2} M_\odot$) and M 3-27 (≤ 530 yr, $\simeq 3 \times 10^{-4} M_\odot$) indicate that both objects are young planetary nebulae. Extended halos (size $\simeq 36''$ in Cn 3-1, $\simeq 24''$ in M 3-27) have been spectroscopically detected in both objects. An analysis of the kinematic and emission properties shows that both halos are reflection nebulosities and suggests that the distribution of neutral material in them probably is largely isotropic. The results suggest that the halos correspond to isotropic mass ejections occurred in the last $\simeq 2 \times 10^4$ yr of the AGB phase of the Cn 3-1 and M 3-27 progenitors.

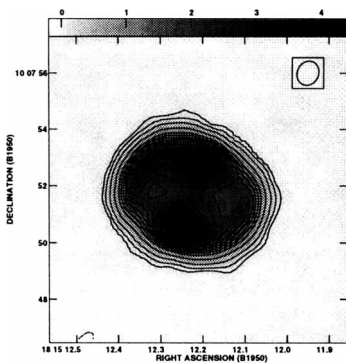


Fig. 1. Gray scale and contour 3.6 cm continuum map of Cn 3-1 obtained with the VLA-B. Gray levels are indicated in mJy beam⁻¹ (top scale). Contour levels are -3, 6, 12, 24, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130 times 30 μ Jy beam⁻¹, the rms noise in the map. The beam size is indicated at the top right corner ($0''88 \times 0''75$, PA -23°).