NEUTRAL HYDROGEN ASSOCIATED WITH THE PLANETARY NEBULA NGC 6302

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Observations of HI in absorption made with the Very Large Array towards the thermal radio emission of the planetary nebula NGC 6302 show two velocity components at 6 and -40 km s^{-1} (radial velocity with respect to the local standard of rest). The 6 km s^{-1} component is almost certainly due to a line-of-sight cloud, but the -40 km s^{-1} component is most probably associated with NGC 6302. We interpret this absorption component as coming from the neutral, outer part of an expanding ($\sim$ 10 km s^{-1}) ring whose inner part is ionized and produces the thermal continuum. The mass in atomic hydrogen of the outer (neutral) part of the ring is $\sim$ 0.06 $M_{\odot}$. NGC 6302 is in an evolutionary stage intermediate to those of protoplanetary nebulae such as GL 2688 and evolved planetary nebula such as NCG 7293. This is the first detection of neutral hydrogen associated with a planetary nebula.

THE KINEMATICAL STRUCTURE OF THE BIPOLAR NEBULAE M2-9 and M1-91

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Both nebulae are of similar appearance consisting of a central core and two highly symmetrical, elongated lobes. Using the large vertical Coude spectrograph of the 2.2-m telescope on Calar Alto, Spain, we obtained long-slit spectra in the red of high spectral (12 km s^{-1} FWHM) and spatial (2") resolution from various positions within the nebulae. Our data indicate high similarity in the kinematical structure of both nebulae. The central cores are dominated by very broad emission lines. The Hα profiles (width ≈ 1600 km s^{-1} at 5% level in M2-9) exhibit an absorption feature blue-shifted by ≈ 20 km s^{-1} relative to the emission maximum, similar to profiles observed in some Herbig-Be-stars. The [NII] profiles (width ≈ 150 km s^{-1} at 5%) show some

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structure, probably due to kinematical effects in the core region. The lobes are dominated by strong, rather symmetrical, narrow (≈ 20 km s^{-1} FWHM) emission lines. However, Hα presents the superposition of a weaker second component, which is considerably broader (total width ≈ 170 km s^{-1}) and red-shifted relative to the narrow component. We propose that this broad component represents emission originating in the central core and being scattered by dust particles in the ionized gas flowing radially outwards through the lobes. Thus, the observed velocity difference of ≈ 20 km s^{-1} between both line components directly measures the outflow velocity of the gas-dust mixture. Using this result and the observed difference in the radial velocity of the lobes, we derive an inclination angle of the polar axis with respect to the line-of-sight of ≈ 60^{o} (M2-9) and ≈ 85^{o} (M1-91). Assuming that the mass flow fills up the volume of a cone, we deduce an aperture angle ≈ 40^{o} for both objects from the width of the narrow lines, comparable with the geometrical appearance of the lobe structure. Our data do not support a rotation of M2-9 around its polar axis.

HIGH-RESOLUTION SPECTROSCOPY OF NGC 7026

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Up to now, the geometrical and kinematical structure of the well-known bizarre nebula NGC 7026 has not been discussed in the literature. Using the large vertical Coude spectrograph of the 2.2 m telescope on Calar Alto, Spain, we obtained long-slit spectra covering the nebula at 5 different position angles, in the ranges from 4730 to 5050 Å and from 6470 to 6770 Å. The high spectral (up to 6 km s^{-1} FWHM) and spatial resolution (seeing-limited ≲ 2") reveals a rather complex structure in the lines of Hα, Hβ, [OIII] λλ 4959, 5007, HeI 6678, HeII 6560, [NII] λλ 6548, 6583, and [SII] λλ 6716, 6731. Generally, the lines exhibit a double "bowed" appearance; both components consist of several condensations of small angular extent. The velocity field suggests a non-spherical expansion of an elongated thin shell structure. The observations can be explained by an ovoidal or "bipolar" configuration of the nebula consisting of an expanding equatorial toroid (V_{exp} = 54 km s^{-1} in [SII]) and two blobs moving at higher velocities outwards along the polar axis (inclination angle with respect to the line-of-sight: