THE STRUCTURE OF NGC 6720: THE RING NEBULA IN LYRA

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New observations have been made of the [OIII] 5007Å line profile from the central and outer regions of 6720 in order to study in detail the radial velocity structure of the nebula. This data was obtained using a Fabry-Perot Interferometer working at a resolution of 67,000. The line profile is clearly split in the centre indicating the presence of a gaseous envelope surrounding, and in radial expansion from, the central star at a velocity of 25 ±5 km/sec. Irregularities in the emission intensities indicate local patchiness in this shell.

These data are combined with monochromatic electronographic data to show that NGC 6720 is spheroidal in form rather than toroidal or barrel-shaped.

It has been found possible to reproduce the observed intensity variations fairly well using a spheroidal shell model.

From the radial velocity data there is little evidence for a velocity asymmetry along either the major or minor axis of the nebula and thus no basis upon which it is possible to distinguish between an oblate or prolate structure. (Paper to be submitted to Astronomy and Astrophysics.)

DISCUSSION

Terzian: In the model you discussed the stellar poles should be in the direction of the minor axis of the nebula.

Atherton: Yes, that is true.

Osterbrock: Can you describe a little more fully the model, and the assumptions on which it is based?

Atherton: The model is an oblate spheroid of gas. It's assumed that the star is rotating; the gas is thrown off. Under the influence of the stellar rotation and gravitational breaking it forms an oblate spheroid.

Melnick: I am curious about the rotation velocities you assume for the progenitor red giant star. If, in order to produce the observed eccentricities, you require rotation velocities much in excess of a few

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kms^{-1}, the rotation velocities of the main sequence star from which the red giant later develops will be unreasonably large.

Atherton: The assumed rotational velocity of the progenitor ranges from 5 → 20 kms^{-1}. However, the study by Phillips and Reay is concerned only with showing how the structure of planetaries can, generally, be explained in terms of the development of shells subsequent to their ejection. The physics of the ejection process is not considered in any detail. The important point to note is that the intensity variations in NGC 6720 can be explained in terms of a spherical shell of gas.

EXAMPLES OF MULTIPLE SHELL STRUCTURES IN PLANETARY NEBULAE AND CERTAIN PECULIAR EMISSION NEBULAE

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There is increasing evidence that multiple shell structures occur often in planetary nebulae and emission nebulae surrounding Oef and Wolf-Rayet Stars, yet the multiple shell structures in the two classes of objects are very different. In planetary nebulae they are defined by an internal structure filled by [OIII] 5007 emission, and an outer shell that is most noticeable in the light of singly-ionized species such as [OII], [SII] or [NII]. Planetary nebulae with multiple shell structure are well exemplified by NGC 6853 (The Dumbbell Nebula) and NGC7293 (The Helix Nebula). The most pronounced effect is [OI] condensations plus [NII], [OII], [SII] "shadows" and complementary [OIII] structure.

The multiple shell structures surrounding Oef and Wolf-Rayet stars, such as NGC 7635 and NGC6164-5, do not show strong excitation differences between inner and outer shell structures. Certainly two, and possibly three, shells exist in NGC 7635, with the most central shell being very symmetrical (and appropriately called the Bubble Nebula). The structure of NGC 7635 is most easily explained by multiple shell ejection of the central star. However, radiation pressure must play an important role as exemplified by the NGC6164-5 nebulosity which shows a hole or empty shell region between the central 10' shell and the few degree outer structure which is possibly interacting or mixed with an H II region.

DISCUSSION

Balick: Do photographic surveys like this show anything of interest in the region of NGC 7027?

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