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Molecular Hydrogen Emission from the Cometary Globules in the Helix Nebula (NGC 7293)

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The discovery of many dense, dusty condensations in the Helix Nebula, NGC 7293, by Meaburn et al. (1992) was the first direct evidence of the real inhomogeneity of the medium of a planetary nebula. On account of the small distance of the Helix nebula from the Sun (~200pc), the knots (cometary globules) can be resolved from the ground and studied in detail from HST imaging (O'Dell & Handron, 1996). The condensations typically have a projected diameter of $<2''$ and hence sizes of $<6\times10^{15}$cm. The condensations consist of a dusty core, visible as absorption against the background high ionization central region of the nebula for the foreground globules, and with a bow-shaped ionization front, strong in low ionization emission. The emission is displaced in the direction towards the central star, often with an outwardly-directed radial tail.

Images in the $S(1)$ v$= 1-0$ emission line of molecular hydrogen have been obtained to determine if the globules are indeed sites of molecular emission and if so how it is distributed and related to the dust absorption core and the ionized flow around the globules. The ESO NTT SOFI instrument was used with a narrow band 2.12 μm filter and images in seeing of $1.2''$ were obtained. H_2 emission had previously been detected in the Helix by Storey (1984) and by ISOCAM imaging (Cox et al. 1998) but the exact site of the emission was not known, though expected to be the neutral globules or the flows around them. Strong H_2 emission was detected at the sites of many of the globules and more diffuse emission found in some of the tails and over the bright helical ring. The images have been registered with ground-based (NTT) images in Hα+[N II] and [O III] filters to locate the site of the H_2 emission and its relation to the optical emission and the dust globules. In all cases the H_2 emission is co-spatial with the low ionization emission, and in some cases is displaced in the direction towards the central star. In no case was H_2 emission found in the neutral globule core. Some of the radial tails also display H_2 emission.

Photo-evaporating flows have been employed to explain the cometary knots in the Helix nebula (e.g. López-Martin et al. 2001) and, on account of their projected size and advantageous aspect, the Helix cometary globules make an excellent laboratory. The excitation conditions in the flows can be probed by H_2 spectrometry.

References

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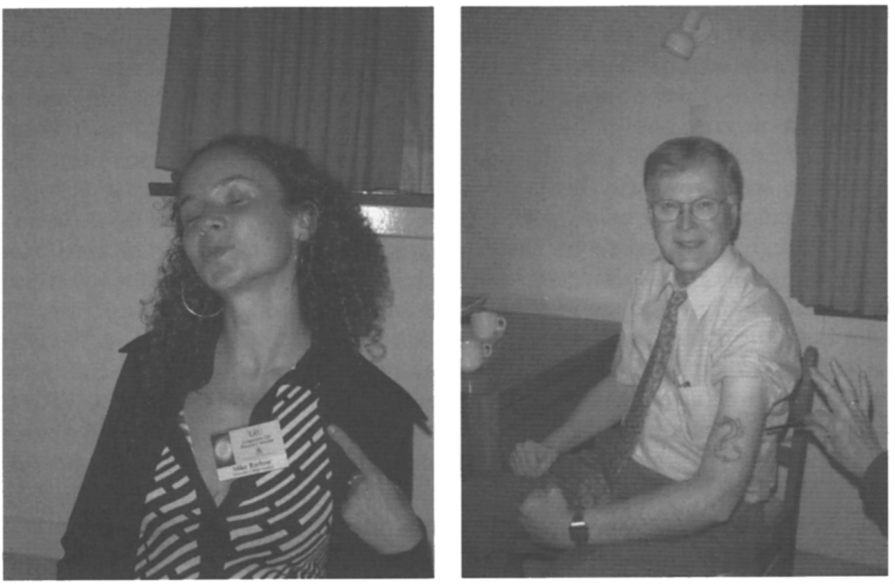

Left: Barbara Ercolano posing as Mike Barlow. Right: Howard Bond showing off his newly acquired tattoo. Photos courtesy of O. de Marco.

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