Modeling Hydrogen-Deficient Planetary Nebulae

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Hydrogen-deficient planetary nebulae have central regions devoid of hydrogen. (See Harrington 1996 for a review of these nebulae.) They are characterized by exceptionally strong collisionally excited lines of [O III] and [Ne III], but relatively weak or undetected recombination lines of He or other elements. Such nebulae cannot be modeled successfully unless we include some source of heating in addition to photoionization by the central star.

These nebulae are all dusty, exhibiting strong thermal IR emission. We have previously demonstrated that in the case of IRAS 18333-2357, photoelectrons ejected from carbon grains can provide the required heating (Borkowski & Harrington 1991). In this poster, we present further studies of the hydrogen-deficient nebulae IRAS 15154-5258, Abell 30 and Abell 78. New observations include *HST* WFPC2 images and FOS spectra, as well as ground-based data.

Spectral observations of A30 with *HST* provide a convincing demonstration of the link between dust and heating of the gas. IR images have shown that the dust is associated with the equatorial ring but not the polar knots (Borkowski et al. 1994). Our UV observations of these two regions with $1''$ apertures show a dramatic difference in the ratio of collisionally excited lines to He recombination lines (see Table). This ratio, which is a measure of the energy input per photoionization, is so high in the dusty equatorial ring that photoionization heating alone would require a central star with $T > 500,000K$. The (low-dust) polar knot, on the other hand, may be primarily heated by photoionization of the gas by radiation from the central star, which has a known temperature of $115,000K$.

Spectra of Abell 30 Knots from HST FOS & WFPC2

Ion	λ	Knot 3 (Polar)	Knot 4 (Ring)
O IV]	1400	24	300
C IV	1550	42	595
He II	1640	100	100
C III]	1909	45	131
[Ne IV]	2424	65	340
He II	4686	11	12
[O III]	5007	195	830
He I	5876	6.7	6.2

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