INFRARED SPECTROSCOPY OF THE TRANSITION OBJECTS CRL 618 AND CRL 2688

S.C. Beck, S.V.W. Beckwith
Astronomy Department, Cornell University

We have observed CRL 618, an infrared object believed to be in transition between the red giant and planetary nebula stages, in seven lines of vibrationally excited H_2 and the Brackett α and γ lines of ionized hydrogen. The H_2 observations were made in 1979 and repeated in 1982, extending over more than four years monitoring of H_2 emission from this source. The intensity of H_2 emission approximately tripled between August 1977 and November 1979 and may have increased by another 15-20 per cent between November 1979 and February 1982. This increase in emission occurred during the same time period that the radio free-free flux roughly doubled (Kwok and Feldman, 1981). The object may now be in a more quiescent phase following a strong flare. The H_2 lines appear to be in thermal equilibrium at $\approx$ 2000 K and to suffer only small extinction. The Brackett α and γ lines are more heavily obscured, with $\approx$ 2 mag. of 2.17 μm extinction. These results support the model that the compact H II region is behind and expanding into the dense molecular material where the H_2 is found. The mass of hot H_2 is $\approx 4 \times 10^{-4}$ $M_\odot$ and of total ejecta $\approx .1$ $M_\odot$, so the mass-loss rate is probably $> 5 \times 10^{-5}$ $M_\odot$ y^{-1}.

CRL 2688 is apparently at an earlier stage than CRL 618 and has no observed H II region. The source has been mapped in the near-infrared continuum and in the 1-0 S(1) line of H_2, and the spatial distributions of intensity show clearly how the H_2 is excited in an outflow from a central disk of dense material. Continued monitoring of these sources may provide further detail on the expansion and brightening of the H II regions and neutral envelopes as the central stars evolve rapidly into planetary nebulae.

Kwok, S. and Feldman, P.A.: 1981, Ap. J. Lett., 247, L67.

COHEN: Could the failure to detect H_2 in the fainter lobe of CRL 618 be due to the extra extinction of that lobe?

BECK: The extra extinction to that lobe is very small (A_V = 2 mag, equivalent to about 0.2 mag at our wavelength). We detected H_2 in the bright lobe with a signal/noise ratio of over 20, so the extra extinction to the faint lobe will not explain our failure to detect H_2.

https://doi.org/10.1017/S007418090009361X Published online by Cambridge University Press

KWOK: Dr. Bignell and I have been monitoring the radio flux of GL 618 at the VLA during the last two years, and the radio flux increase has indeed slowed down.

BECK: Will you continue to monitor it?

KWOK: Yes.

WANNIER: In CRL 618 and CRL 2688 (as well as NGC 7027, discussed by the previous speaker), we have mapped the CO J = 1 → 0 line using the 20 m telescope at Onsala. We have found that the molecular clouds have sizes of 40-50 arcsec in all three sources, with no indications of asymmetry. These results confirm previous tentative observations of extended CO emission. This work was carried out in collaboration with H. Olofsson and L.-A. Nyman (Onsala) and with R. Sahai (Caltech).

https://doi.org/10.1017/S007418090009361X Published online by Cambridge University Press