NOVA OPHIUCHI 1988: 0.9–1.35 μm SPECTROSCOPY

DAVID K. LYNCH, RICHARD J. RUDY, GEORGE S. ROSSANO, PETER ERWIN
Space Sciences Laboratory
The Aerospace Corporation
Los Angeles, CA 90009

R. C. PUETTER
Center for Astrophysics and Space Sciences
University of California at San Diego
La Jolla, CA 92093

Near IR grating spectrophotometric observations ($\lambda / \Delta\lambda \simeq 400$) of Nova Ophiuchi 1988 between 0.9 and 1.35 μm on September 22.2, 1988 UT (J.D. = 2447426.7) are reported. We observed the nova with the Lick Observatory 3-meter Shane telescope using the Aerospace cooled grating spectrometer. A 7.5 arc sec aperture was used. The detector was a germanium photodiode, cooled to 77 K and used in conjunction with a charge integrating amplifier. These are the first IR observations ever made of a slow nova.

Figure 1 shows the spectrum which contains Paschen emission lines β, γ, δ, ε, ζ, η, He I λ1.083 μm, and a very weak continuum, all consistent with a post-maximum, early nebular phase. Figure 1 also shows a number of possible weak lines including [Fe II] and He I as well as an unidentified feature at 1.01 μm in the far red wing of Pa_δ. The line to continuum ratio for He I λ1.083 is about 300. The emission lines are resolved in the stronger features (Pa_δ, Pa_ζ, Pa_β, and He I λ1.083) and show a mean FWHM of 900 ± 150 km/sec.

The discovery of Nova Ophiuchi 1988 (March 27, 1988) occurred several months after peak brightness. Based on the light curve and previous slow novae, we suggest that the outburst took place no earlier than November 16, 1987, with m_v (max) ≃ 8. Using case B Paschen line ratios (Brocklehurst 1971), we derive a visual extinction of $A_v = 2.6 \pm 1$ mag and a distance of 1.6 kpc ± 0.8 .

The absence of certain spectral lines provides some information about the temperature and density of the line emitting region. High densities are implied by the lack of detectable forbidden lines, notably those of [S II] λ1.0287, λ1.0320, λ1.0336, and λ1.0370, and

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[S III] λ.9069 and λ.9532. If we assume $T_e = 10^4$ K, then the absence of these features suggests that n_e exceeds 10^6 cm^{-3}. The He II lines at 1.0127 μm and 0.1630 μm, are not present in our spectrum, thus indicating that $T_e < 20{,}000$ K.

The strength of the He I λ1.083 μm line relative to the hydrogen lines provides additional information about the nebula's density and temperature, as well as information about the He/H abundance. Following the general analysis of Osterbrock (1974), the ratio of the intensities of λ1.083 to Paγ, which is insensitive to reddening is, was used to calculate the He/H abundance. Based on Paschen γ and He I λ1.083, we derive a H/He ratio that is near the solar value. This result is consistent with the observed correlation between nova speed and heavy element enrichment.

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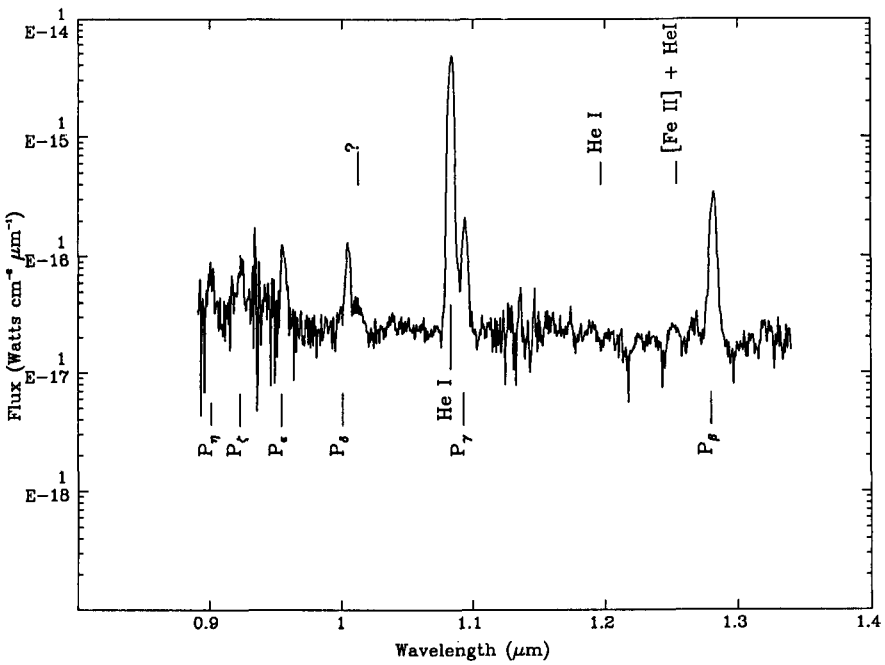

Figure 1: Spectrum of Nova Ophiuchi 1988 on September 22.2, 1988.

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