SPECTRAL PECULIARITIES IN NOVA VULPECULAE 1984 N° 2

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This slow nova has been observed spectroscopically at Observatoire de Haute-Provence in two wavelengths regions : 330-460 nm (plate factors : 4 and 8 nm), and 750-1100 nm (plate factors : 23 and 26 nm/mm).
Time coverage includes the following stages : close to maximum of light, early nebular phase and advanced nebular stage.

1. Days 8 to 12 after maximum.

Spectra are similar to those of classical novae : strong continuum, wide emission bands with double structure, flanked by a moderate strength absorption component at -1400 km/s.The following ions are identified : H I, O I, C I, N I, Mg I and II, Ca I and II, Fe II, Ti II, Si II and Sr II.
Magnesium lines are remarkably strong : Mg I at 880.6 nm is detected for the first time in a nova spectrum while the Mg II doublet at 787.7 and 789.6 nm is quite conspicuous. Measurements are a lot easier than in the blue region crowded with blends. The strength of the Magnesium features is confirmed by IUE observations.

2. Days 273 to 296 after maximum.

At this early nebular phase the continuum has dropped and neutral or weakly ionized elements are no more observed, with the exception of O I 844.6 nm (probably excited by Hydrogen Lyman β coïncidence). Lines belonging to the following spectra are present : He I (1083 nm is very strong), He II, N III. Forbidden lines belong to [O III], [O II], [Ne III], [S II], [Ne V]. [Fe III] at 376 nm, and [N I] at 1039.5 and 1040.4 nm are also seen. Lines are broad (1450 km/s) and structureless. Although the spectrograph sensitivity is very low around 330 nm, the [Ne V] lines are saturated indicating an abnormally high strength for these features.

3. Days 491, 565 to 578, 628 and 641, 893 and 922 after maximum.

During this extended period, we observe a stengthening of the nebular lines due to [O II], [O III], [Ne III] and [Ne V]. Many changes occur in the near infrared. On day 496, the visual brightness variation ΔMv is still as low as 5.4 magnitudes, but we note an important weakening of the Hydrogen Paschen lines compared to day 273, with a very similar ΔMv of 5.2. The same occurs for [N I]

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and O I lines. On the other hand, He I (1083.0 nm) and He II (1012.4 nm) remain strong while [S III] lines (906.9 and 953.2 nm) increased, as well as a line at 991.8 nm of the highly ionized ion S VIII. The presence of a "coronal" type plasma is confirmed by the [Fe VII] (at 376.0) and [Fe XI] lines at 789.1 nm.

We attempted to evaluate energy radiated per unit time in the [Ne III] and [Ne V] lines on day 577 in comparing the nebular line intensities to 109 Vir observed under the same conditions. The resulting fluxes F are shown in the table below with an estimated error of the order of 35% :

Ion	Line (nm)	F (ergs cm $^{-2}$ s $^{-1}$)	L_{line}/L_s
Ne^{2+}	386.9	$1.0\ 10^{-10}$	29.1
Ne^{2+}	396.7	$2.2\ 10^{-10}$	61.3
Ne^{4+}	334.6	$8.6\ 10^{-11}$	24.1
Ne^{4+}	342.6	$3.9\ 10^{-11}$	10.4

In the last column of the table, we estimated the power radiated in each line, in units of solar luminosity, referring to a distance of 3 kpc, following Gehrz et al. (Astrophys. J. 298, L 47, 1985). These figures may be compared to the 80 L_s radiated in the 12.8 m μ [Ne II] line on day 140, according to these authors.

The observed intensity ratio F(334.6)/F(342.6) = 0.365, compared to its theoretical value for an optically thin case (0.475) does not indicate any optical depth effect in the [Ne V] lines, especially if we realize that the [Ne III] $^1S - ^1D$ line at 334.2 nm may also contribute to the strength of 334.6 nm.
The same conclusion can be also drawn from the F(386.9)/F(396.7) ratio, for which we observe a 3.3 value instead of 2.3, noting however that neighbouring Hydrogen lines somewhat vitiate these measurements.
He I, He II, [O III] and [S VIII] lines continue to increase on day 629. Another noticeable feature is the well marked P Cygni profile of C IV (770.9 and 772.6 nm). The absorption component is displaced by -3000 km/s. It indicates a strong stellar wind leading to a high mass loss rate. Such a velocity has already been found for the C IV ions in the resonance doublet of C IV at 154.8 - 155 nm in Nova HR Del.

On day 893, the visual brightness decrease since maximum is about 7 magnitudes and the strongest features in the near infrared are the [S III] lines with reach about 10 times the local continuum. [S VIII] has dropped dramatically, but other coronal lines develop, namely [Fe XI], [Ni XV] and the nebular lines [A III] at 713.5 nm and [Cl IV] at 804.6 nm.
An unidentified emission around 825.2 nm arises around day 500. The full paper will be published elsewhere.

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