case we are now on the verge of seeing the birth of seismological investigation of non-variable stars.

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Detection of Highly Ionized N and O in the Infrared Spectrum of Nova Muscae 1983?

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This bright nova was discovered in January 1983 by Liller (1983, IAU Circular No. 3764), just before our scheduled infrared observing runs at the ESO 3.6 m and 1 m telescopes during which we were able to both monitor it photometrically between 1.2 μm and 10 μm and obtain low resolution 1.4-4.2 μm spectra. A detailed description and analysis of these data will be contained in an extensive paper combining ultraviolet, optical and infrared observations, which is now being prepared mostly by J. Krautter. As, to our knowledge, no previous infrared spectra of novae between 1 μm and 2 μm have been published, we would like to make use of this short article to report the discovery of a strong but broad emission feature at 1.56 μm which we can best explain at the moment as an unresolved group of recombination lines to He II, OV and NV – species normally associated with UV rather than IR spectroscopy.

The 1.45 μm – 1.8 μm spectrum shown in fig. 1 was obtained on Feb. 10 using the InSb CVF spectrophotometer at the ESO 1 m telescope. As expected, it contains the strong hydrogen recombination lines BR_ζ (10-4, 1.736 μm) and BR_η (11-4, 1.681 μm) plus a broad emission region resulting from unresolved hydrogen lines between $Br_{12\text{-}4}$ and the series limit. (Other bracket lines are present in the longer wavelength spectra, e.g., BR_γ (2.17 μ) and Br_α (4.05 μm) and their intensity ratios imply that at this stage the optical depth of the gas to hydrogen lines was intermediate between the optically thin and optically thick limits. Ratios of He II recombination lines on the other hand suggest that the gas was optically thick at the He II transitions. Taken together, these results are consistent with a very steep gas density distribution, as would be expected shortly after the nova outburst.)

The new discovery in fig. 1 is the strong feature at 1.56 μm which, as can be seen by comparison with the hydrogen lines, is broader than the instrumental resolution even though the latter was only R ~ 65. Features of this type, arising in a variety of astronomical objects, are usually attributed to emission bands of molecules in grain mantles. In the present case, however, the nearest known molecular feature is one at 1.53 μm observed in cool, C-rich Mira stars (Goebel et al., 1981, *Astrophysical Journal,* **246,** 455). If the 1.56 μm feature does arise in grain mantles therefore, the molecules responsible have not yet been found in other astronomical situations. The alternative explanation offered here is that this "broad" 1.56 μm feature consists of closely spaced emission lines. In fact, as shown in fig. 2, the feature can be adequately fit with just two lines, whose most probable centre wavelengths are 1.575 μm and 1.557 μm. The former can be identified with He II (13-7, 1.573 μm) and the second with XV (10-9, 1.554 μm) where, because the latter transition is quasi hydrogenic, the element X cannot be uniquely identified on the basis of the infrared spectrum alone. Given the strength of the emission, however, it would appear reasonable on abundance arguments to assume that C, N or O are responsible. Of these, C is essentially excluded by the extremely high (392 eV) ionization potential of CV. Also, the C IV infrared recombination lines,

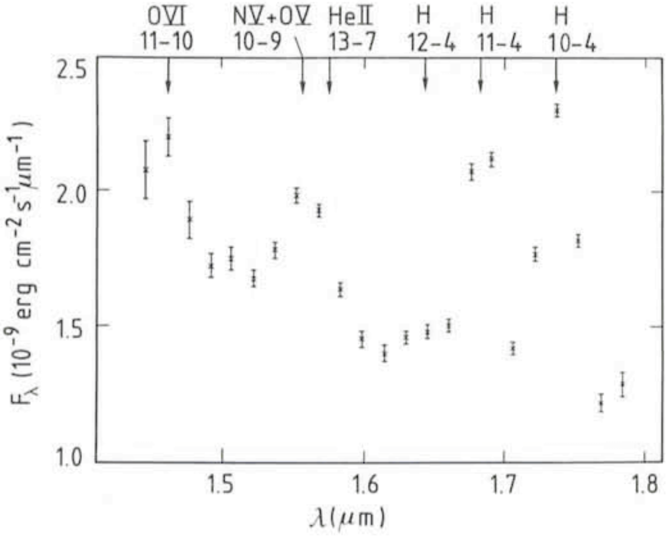

Fig. 1: *1.42–1.80 μm spectrum of Nova Muscae 1983. The intensity scale is in units of 10^{-9} erg cm^{-2} s^{-1} μm^{-1} and identified lines are indicated on the top of the spectrum.*

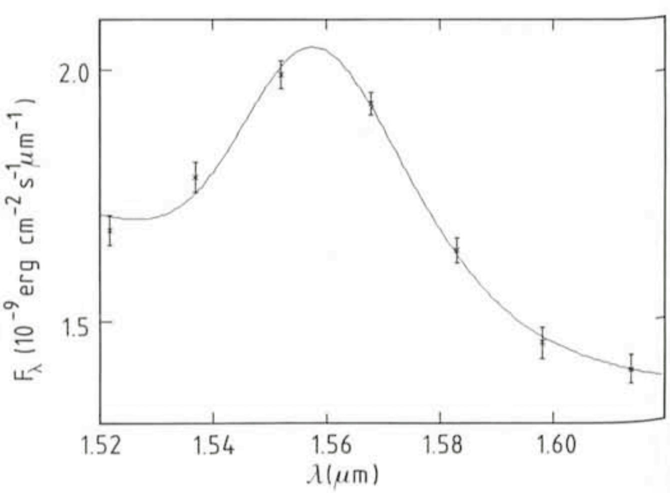

Fig. 2: *The 1.56 μm broad feature fitted with two Gaussian lines having the instrumental half-width of 0.017 μm. The best fit (minimum χ^2) parameters are λ_o = 1.557, I = 1.3 (± 0.1)·10^{-11} erg cm^{-2} s^{-1} and λ_o = 1.575, I = 3.6 (± 1.1)·10^{-12} erg cm^{-2} s^{-1} for the two lines.*

e.g., the 10-9, 2.429 μm, observed in other high excitation objects such as Wolf-Rayet stars (Aitken et al., 1982, *Monthly Notices of the Royal Astronomical Society,* **200,** 698) are not present in our spectrum of the nova. On the other hand, the weak feature marginally detected at 1.45 μm could be attributed to OVI, and a NV resonance line is present in the UV spectrum. Tentatively, therefore, we attribute the newly discovered 1.56 μm feature to an unresolved group of recombination lines dominated by He II, OV and NV. One consequence of this interpretation is that, combined with our upper limit on CIV, the required abundance ratio C/(N+O) is lower than solar, in line with current nova theories. It should be mentioned, however, that our spectrum at longer wavelengths clearly shows another broad emission feature at 3.5 μm which has been observed in other novae (e.g., Black and Gallagher, 1976, *Nature* **261,** 296) and has been attributed by Blades and Whittet (1980, *M.N.R.A.S.* **191,** 701) to fluorescent excitation of formaldehyde in dust grain mantles. It may therefore not prove possible to totally exclude a molecular origin for the 1.56 μm feature until higher resolution spectra can be obtained of future nova.

Photometric and Spectroscopic Mass Ratios of W UMa Stars

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Introduction

W UMa binary stars represent a typical case of astronomical objects for which theory and techniques of data reduction are much more developed and up to date than observations. While the analysis of photometric observations by means of synthetic light curve methods (Wilson and Devinney, 1971 *Astrophysical Journal,* **166,** 605) yields good photometric elements, the absence of reliable spectroscopic data makes the determination of the absolute elements of these systems and therefore of their evolutionary status problematic.

W UMa Stars

W UMa stars are the commonest type of binaries near the sun. The typical object of this class is a solar-type contact binary (luminosity class V) with a mass ratio $q = 0.6$, a period of 0.35 day and spectra from A7 to G5. While a first glance produces the idea of an "easy" type of objects (two stars more or less on the main sequence), a more detailed examination of these systems yields a lot of theoretical problems on their evolutionary status and on the physical processes involved in the mass and energy exchange between the two components. According to Binnendijk (1970, *Vistas in Astronomy* **12,** 217) W UMa's can be subdivided into A-type and W-type systems. The classification is performed according to the geometry of the primary eclipse: A-type systems have a transit, whilst W types have an occultation as primary eclipse. In other words, for A-type objects the eclipsed star, at primary minimum, is the larger and more massive companion, and the reversal is true for W-type ones. There are also other physical differences between these subclasses: A-type systems have an earlier spectral type, a higher luminosity, a larger mass, and a smaller mass ratio (Rucinski, 1973, *Acta Astronomica* **23,** 79; 1974, *Acta Astronomica* **24,** 119) than W UMa's of W type. Notwithstanding the numerous works regarding the age of W UMa's, the problem is still open. There are two hypotheses: the first favours the "youth" of W UMa's and their short intrinsic lifetimes (Van't Veer, 1979, *Astronomy and Astrophysics* **80,** 287; 1980, *Acta Astronomica* **30,** 381) whilst the second, because of the presence of some W UMa stars in old clusters (Rucinski, 1980, *Acta Astronomica* **30,** 373), supports high stellar ages.

Determination of mass ratio

Concerning the spectroscopic determination of the mass ratio of these systems there are some problems, mainly due to the shortness of periods and faintness of components: these facts prevent us from obtaining well distributed points on the radial velocity curves and hence reliable mass ratios. The mass ratio can, however, be determined also from the photometry (Wilson, 1978, *Astrophysical Journal* **224,** 885), using light curve synthesis models. However, the reliability of this type of determination is questionable, owing to the problem of the non-uniqueness of the solution. In other words there are well-behaving systems for which the solution is unique whilst other systems may have many local minima on the hypersurface of possible solutions in the space of the parameters, so it can happen that with a differential correction procedure, one obtains a solution in a local minimum and not in the absolute minimum of the hypersurface mentioned above, with obvious consequences on the reliability of the mass-ratio determination (Mancuso, S. Milano L., Russo G., Sollazzo C., 1979, *Astrophys. Sp. Science,* **66,** 475). Taking into account these conclusions on the reliability of the "photometric mass-ratios" we decided to begin a work of mass-ratio determination both by solving with the Wilson and Devinney method the observed light curves (Maceroni, Milano, Russo, Sollazzo, 1981, *Astronomy and Astrophysics Suppl.* **45,** 187) and by observing radial velocity curves.

Observations and Data Reduction

The aim of our observing programme was to get spectra of a sample of W UMa's, with known photoelectric light curves. During December 1981 we got 60 low-resolution spectra (74 Å/mm) for YY Eri, TY Pup and UZ Oct on IIa-O, nitrogen-baked emulsion with the RV Cassegrain spectrograph at the ESO 1.5 m telescope, to measure radial velocities and get reliable absolute elements, using both spectroscopic and photometric observations*. The spectra were digitized with the Perkin-Elmer PDS microdensitometer at Naples Observatory. The

* In the same observing run, a number of spectra were obtained using the three-stage image tube available at the 1.5 m; unfortunately these spectra turned out to be too noisy for our purpose.