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HIGH AND LOW RESOLUTION ABSOLUTE SPECTROPHOTOMETRY OF THE SYMBIOTIC NOVA VVV-NOV-003 = OGLE-2011-BLG-1444

MUNARI, U.[1]; VALISA, P.[2]; CETRULO, G.[2]; POLESKI, R.[3,4]

[1] INAF Osservatorio Astronomico di Padova, Sede di Asiago, I-36032 Asiago (VI), Italy

[2] ANS Collaboration, c/o Astronomical Observatory, 36012 Asiago (VI), Italy

[3] Warsaw University Observatory, Al. Ujazdowskie 4, 00-478 Warszawa, Poland

[4] Department of Astronomy, Ohio State University, 140 W. 18th Ave., Columbus, OH 43210, USA

VVV-NOV-003, at coordinates α=17:50:19.3, δ=−33:39:07 (J2000), has just been discovered by Beamin et al. (2013) as the third likely Galactic Nova in the VISTA Variables in The Via Lactea (VVV) survey data. The equatorial coordinates α=17:50:19.27, δ=−33:39:07.3 corresponds to Galactic values l=−3.523, b=−3.294, thus placing the object less than 5° from the Galactic center. The VVV survey (Minniti et al. 2010) first detected VVV-NOV-003 at K_s=15.80 mag on 6 October 2011, and measured it at K_s=10.70 on 7 March 2012. The progenitor was fainter than the limiting magnitude of K_s=17.13 in the field, setting the outburst amplitude to at least ΔK_s >6.4 mag. Beamin et al. (2013) estimated an extinction A_V=2.67 mag from VVV reddening maps (Gonzalez et al. 2012).

Poleski and Udalski (2013) noted the coincidence of VVV-NOV-003 with the transient OGLE-2011-BLG-1444, discovered by the OGLE-IV survey on 26 Sept 2011 and announced at that time as a candidate microlensing event. The OGLE light and color curves in V and I_C bands covering the period 2010-2013 are shown in Figure 1 (adapted from Poleski and Udalski 2013).

As noted already by Poleski and Udalski (2013), the light curve in Figure 1 is a close match to that of symbiotic novae, an exclusive group of ∼25 stars known in the Galaxy (Munari 1997), where a white dwarf accreting from a cool giant companion (frequently a Mira variable), suddenly begins to burn hydrogen at the surface and keep burning it for decades or centuries, with the consequence that the object remains close to maximum brightness for an equivalent long period. The total energy release is of the order of 10^{47}-10^{48} erg (Murset and Nussbaumer 1994), similar to that liberated by the outburst of a classical nova and corresponding to the hydrogen burning of $\sim 5\times10^{-5}$ $M_\odot$ of accreted material of solar composition. A light-curve closely similar to that of VVV-NOV-003 in Figure 1 has been exhibited by the symbiotic nova HM Sge (Yudin et al. 1994). During the 40 years elapsed since its 1973 eruption, HM Sge has declined by just 1.8 mag at optical wavelengths. HM Sge displayed large amplitude oscillation in brightness soon after optical maximum, similar to those visible in the light curve of VVV-NOV-003 in Figure 1. In HM Sge, their amplitude reduced with time and nulled after about four years.

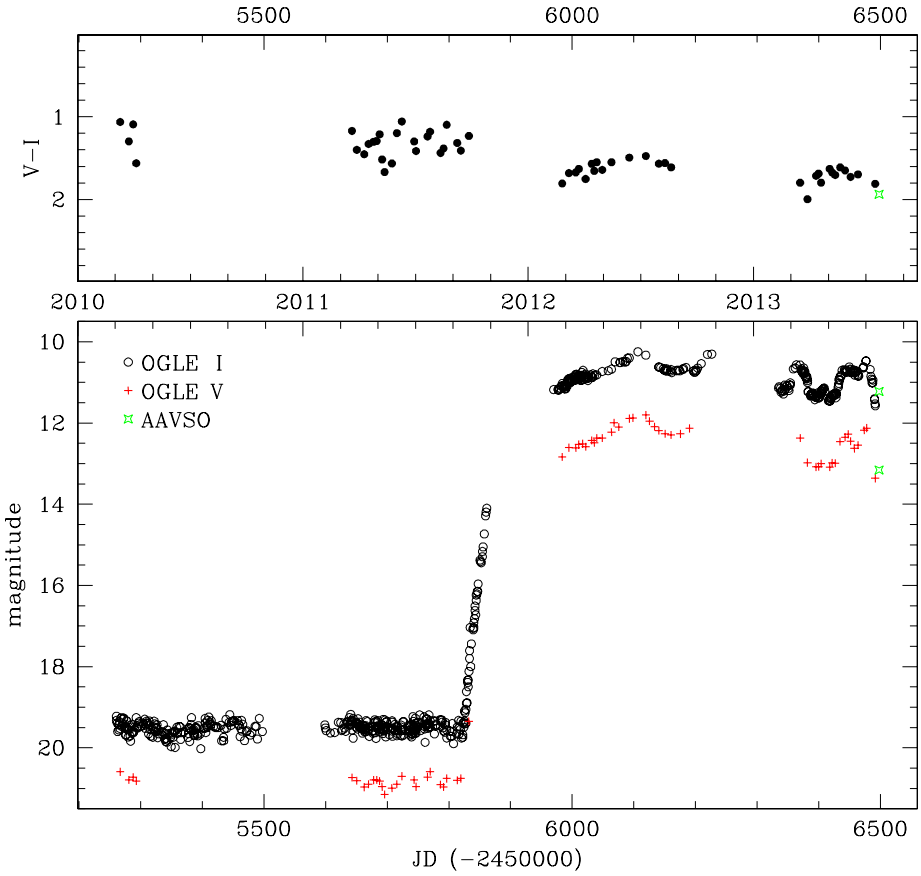

Figure 1. OGLE-IV light- and color-curves in V and I_C bands of the symbiotic nova VVV-NOV-003. The AAVSO data are the average of the few measurements collected since discovery announcement.

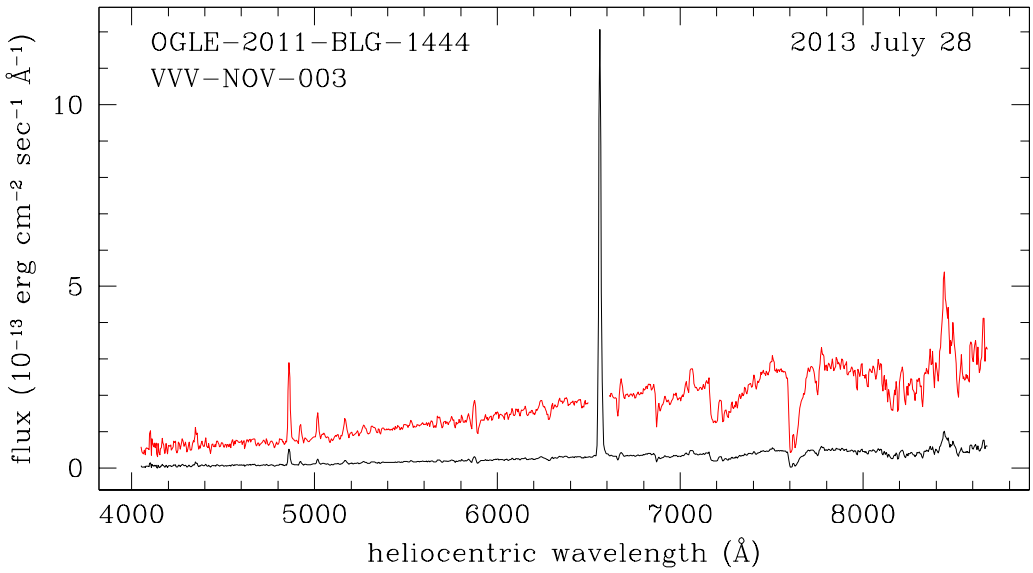

Figure 2. Low-resolution, fluxed spectrum of the symbiotic nova VVV-NOV-003 obtained on 2013 July 28 with the Multi-Mode Spectrograph on the Varese 0.61m telescope. A 5× stretched version is overplotted to enhance visibility of weak features.

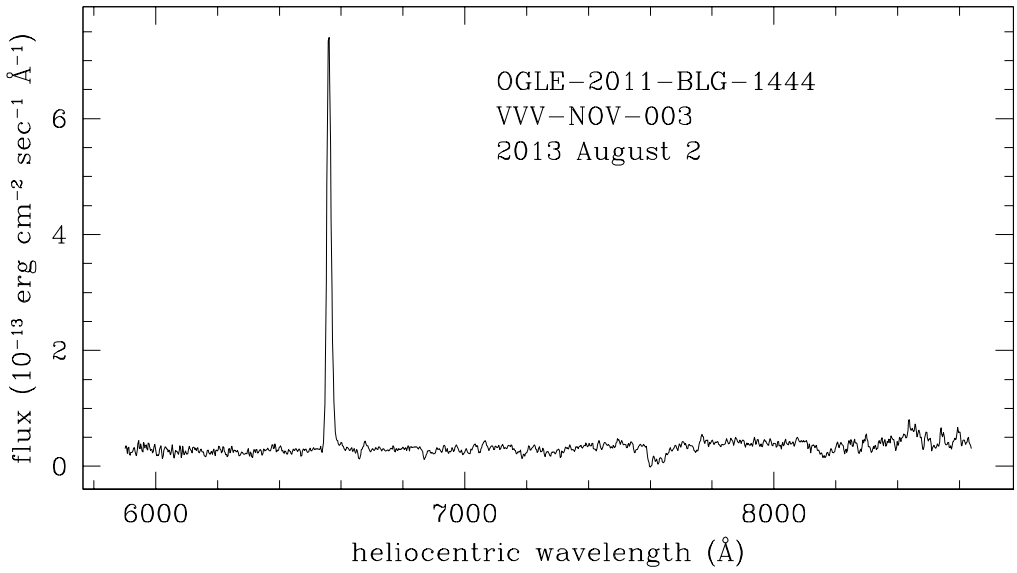

Figure 3. Low-resolution, fluxed spectrum of the symbiotic nova VVV-NOV-003 obtained on 2013 August 2 with the La Polse di Cougnes 0.70m telescope.

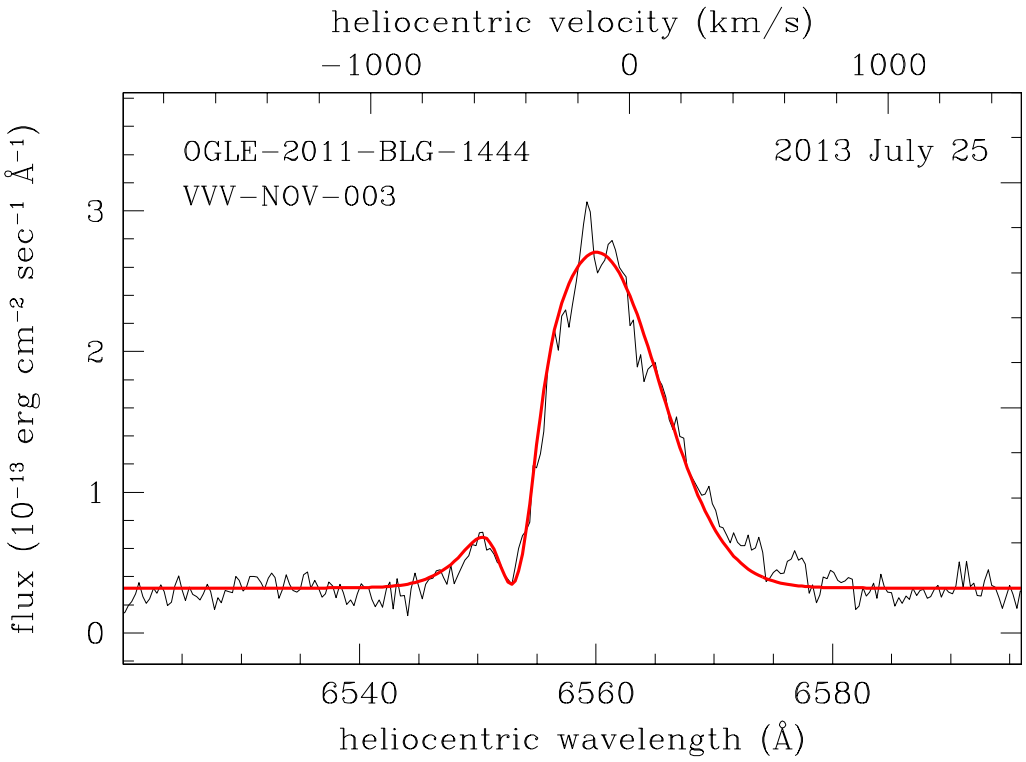

Figure 4. High-resolution Hα profile of VVV-NOV-003 obtained on 2013 July 25 with the Multi-Mode Spectrograph on the Varese 61cm telescope. The fit with two Guassians (one in emission and the other in absorption, as described in the text) is overplotted. The flux recorded on the continuum is too weak to show the second absorption which is well visible on the low resolution spectra −1100 km/s from the emission.

Table 1. Integrated fluxes of the emission line (in units of 10^{-13} erg cm^{-2} sec^{-1}) on the VVV-NOV-003 spectra of Figures 2 and 3.

$\lambda_\circ$	ion	flux	$\lambda_\circ$	ion	flux	$\lambda_\circ$	ion	flux
4101	Hδ	1.25	5876	HeI	1.86	8498	CaII	3.25
4340	Hγ	2.00	6563	Hα	184	8542	CaII	4.04
4861	Hβ	6.16	6678	HeI	2.12	8598	HI P14	4.80
4923	FeII #42	1.09	7065	HeI	1.67	8662	CaII	2.73
5018	FeII #42	1.98	7772	OI	1.90			
5169	FeII #42	2.07	8446	OI	15.2			

We obtained low dispersion fluxed spectra of VVV-NOV-003 with the Varese 0.61 m and La Polse di Cougnes 0.70 m telescopes, which are part of the ANS Collaboration network of telescopes (Munari et al. 2012). They are presented in Figures 2 and 3. The very low hight above the horizon reached by VVV-NOV-003 at culmination when observed from northern Italy, just $\sim$11°, prevented from reaching a higher S/N. A high resolution (resolving power 11 000) Hα profile of VVV-NOV-003 was obtained with the Multi Mode Spectrograph on the Varese 0.61m telescope operating in echelle mode. It is shown in Figure 4 where a fit with two Gaussians is superimposed (that in emission is centered at an heliocentric velocity of -126 km/s and has a FWHM=575 km/s, the one in absorption is centered at -432 km/s and has a FWHM=150 km/s).

The low resolution spectra in Figures 2 and 3 are very similar to those displayed by the symbiotic nova V4368 Sqr close to maximum (Grebel et al. 1994, Bragaglia et al. 1995, Munari et al. 2009). Table 1 lists the integrated flux of the principal emission lines we observed in VVV-NOV-003. There are two distinct P-Cyg absorption components simultaneously present: one, at a lower outflow velocity, is shifted by -300 km/s with respect to the emission component and is well visible in the high resolution Hα profile of Figure 4; the other, faster component is instead obvious in the low resolution spectra where it is shifted by -1100 km/s for Balmer lines and between -850 and -1050 km/s for HeI 5876, 6678, 7065 Å and OI at 7772 Å. The large inversion in the ratio of the emission lines of OI at 7772 and 8446 Å suggests fluorescent pumping by hydrogen Lyman-β.

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