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SPECTRAL BEHAVIOR OF THE SYMBIOTIC NOVA HM SGE IN THE ULTRAVIOLET

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ABSTRACT

Ultraviolet observations of the symbiotic nova HM Sge were obtained from the International Ultraviolet Explorer (IUE) through the interval from 1980 - 1992. Three line profiles demonstrating the variations of some emission lines at different dates are presented. We determined the reddening of HM Sge from the 2200 Å absorption feature; the estimated value is $E(B-V) = 0.34 \pm 0.02$. We studied CIV at 1550 Å, He II 1640 Å, and CIII] at 1909 Å produced in the wind from the hot star. The line flux variations at different dates could be explained in terms of the variations of temperature in the emitting region as a result of mass loss variations. The IUE observations can be explained by the models of Girard & Willson (1987); Formiggini et al. (1995).

RESUMEN

Se obtuvieron observaciones ultravioletas de la nova simbiótica HM Sge mediante el "International Ultraviolet Explorer" (IUE) durante el intervalo de tiempo 1980 - 1992. Se presentan tres perfiles de líneas que demuestran la variación de algunas líneas de emisión en distintos tiempos. Determinamos el enrojecimiento de HM Sge a partir de la absorción en 2200 Å, y obtuvimos un valor estimado de $E(B-V) = 0.34 \pm 0.02$. Esudiamos el CIV en 1550 Å, el He II en 1640 Å, y el C III] en 1909 Å, líneas que se producen en el viento de la estrella caliente. Las variaciones en el tiempo del flujo de las líneas podrían explicarse en términos de la variación de la temperatura de la región de emisión, como consecuencia de variaciones en la pérdida de masa. Las observaciones del IUE pueden explicarse mediante los modelos de Girard & Willson (1987) y Formiggini et al. (1995).

Key Words: binaries: symbiotic — stars: individual: HM Sge — ultraviolet: stars

1. INTRODUCTION

Symbiotic systems are a group of interacting binary stars consisting of a cool giant star, a hot white dwarf or a neutron star, and in some cases a nebula (Murset et al. 1997). These systems exhibit different outburst behaviors; some authors interpret them as due to different physical processes (Mikolajewska & Kenyon 1992; Kenyon & Webbink 1984). Symbiotic binaries are divided into two classes: S type, characterized by a stellar continuum, and D type, characterized by a thick dust shell. Symbiotic novae are a subgroup of symbiotic stars displaying a major thermonuclear eruption as a result of the accretion of matter from the cool red giant onto the hot component, with a long time - scale evolution of their decay (Tomov & Tamova 2001).

Some symbiotic systems exhibit a large variety of emission lines with different ionization states because not all systems have a nebula. The absence of emission lines may be due to the high density of the nebula. Some theoretical models attempt to interpret the spectra. Nussbaumer & Vogel (1987) employ a model consisting of a double star system with a nebula created by the mass loss of the cool component and ionized by the radiation of the hot component. As a result of their model calculations they suggest that nova-like nuclear processes were responsible for the eruption of HM Sge 1975. Slovak (1978) developed a model of a binary symbiotic system containing a late type variable.

HM Sge is a D type symbiotic nova consisting of a cool red giant Mira star with a pulsation period of 527 days (Murset & Schmid 1999; Munari & Whitelock 1989). In 1975, HM Sge changed in optical magnitude from 17 to 11 (Dokuchaeva 1976). This increase in brightness was interpreted as nova eruption resulting from a thermonuclear runaway (TNR) on the surface of the hot white dwarf due to an accumulation of accreted matter.

Puetter et al. (1978) suggested that HM Sge is a binary star system containing a dust embedded cool component and an optically hot component. In their model the flux is a result of a combination of optically thin dust emission and emission from the reddened photosphere of the cool component. The presence of a cool component is inferred from the shape of the continuum.

Lee (2009) adopted a wind accretion disk model and described the emission region by a Keplerian thin disk with Raman scattering occuring in a neutral region near the cool star. By using a Monte Carlo technique, they computed the line profiles that vary by the slow spherical stellar wind from the cool component, with the ionization front approximated by a hyperboloid.

Ciatti et al. (1977), using optical photometric and spectroscopic observations, reported that HM Sge has nebular emission lines similar to V1016 Cyg. HM Sge may evolve to a compact planetary nebula like IC 4997 and Hb 12, and later on to an extended nebula such as M 2 - 9. Stover & Sivertsen (1977) using optical spectroscopic observations found a typical nebular emission spectrum. They called it a new emission line object, with R.A.=19:39, Dec=+16:38 representing the coordinates of HM Sge.

Taranova & Yudin (1982) found that the infrared flux variations of HM Sge indicated the presence of a cool Mira star, while Corradi et al. (1999), from optical spectroscopy, reported that HM Sge has a large-scale outflow which they attributed to a fast wind from the hot white dwarf. Mueller & Nussbaumer (1985) used ultraviolet observations from IUE to calculate the temperature of the nebula and deduced that the emitting region is radiatively ionized.

Feibelman (1982) also using IUE observations, found that HM Sge has undergone large temporal variations in the ultraviolet emission line fluxes, with a trend toward higher ionization and excitation levels. Nussbaumer & Vogel (1990) proposed a model for HM Sge consisting of a binary system associated with a nebula formed by the loss of mass from the Mira star. This nebula is ionized by the radiation of the white dwarf. They also reported that the radiation temperature increased from 4×10^4 K in 1976 to 1.7×10^5 K in 1989.

Eyres et al. (2001), using Hubble Space Telescope observations discussed the nebular conditions of HM Sge and deduced that the true value of reddening is $E(B-V) = 0.35$. They identified a number of discrete features with radio and optical emission embedded in the extended nebula, and measured directly for the first time the positions of the binary components of HM Sge. They estimated the projected angular binary separation to be 40 ± 9 mas. Temperature and density diagnostics revealed two distinct regions in the surrounding nebula.

Stauffer (1984) reported that the optical emission lines are produced in a colliding region of the wind from the hot white dwarf and the wind from the cool Mira, and interpreted the outburst of HM Sge as a result of a hydrogen flash in the envelope of the hot star.

The important observational characteristics in our study are that firstly, the ultraviolet emission line fluxes have nearly the same spectral behavior, indicating a possible common origin in the wind of the hot white dwarf; and secondly the modulations of the mass loss rate are interpreted as due to the increase and decrease in the temperature and density.

In this paper we present an analysis of the ultraviolet data obtained with the International Ultraviolet Explorer (IUE) of HM Sge. Previous studies are those of Mueller & Nussbaumer (1985); Nussbaumer & Vogel (1990). In § 2 we discuss the IUE observations and in § 3 we present the method of determining the reddening. § 4 shows the results and discussion of the spectral behavior of emission lines in the colliding wind from hot white dwarf. § 5 contains the conclusions of this paper.

2. ULTRAVIOLET OBSERVATIONS OF HM SGE WITH IUE

The International Ultraviolet Explorer (IUE) observations have been retrieved from the INES (IUE Newly Extracted Spectra) site at http://ines.vilspa.esa.es. The ultraviolet spectra with low resolution (6 Å) and short wavelength (1150 - 1950 Å) were used in the reduction and analysis. For more information and description of the ultraviolet spectra see Rodriguez - Pascual et al. (1999) and Gonzalez et al. (2001).

The IUE observations have been used in some previous studies, e.g. Mueller & Nussbaumer (1985), They calculated the line fluxes of some emission lines

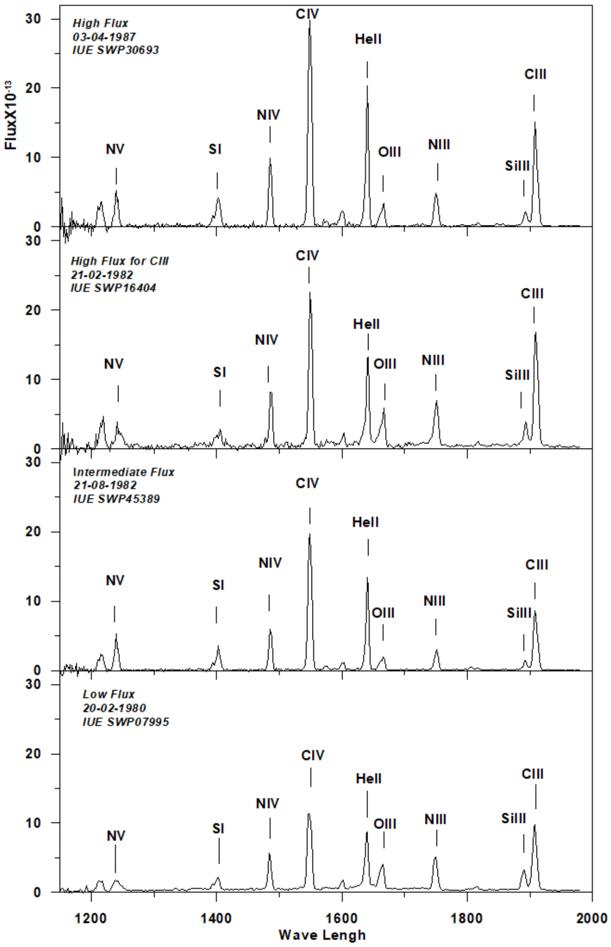

Fig. 1. IUE spectrum of HM Sge during different stages (The flux is plotted in units of erg cm^{-2} s^{-1}Å^{-1}).

such as CIV 1550 Å; the variations of CIV through the period from January 1978 to April 1982 were 4.6×10^{-12} to 15.9×10^{-12} erg cm^{-2} s^{-1}.

Feibelman (1982) analyzed CIV 1550 Å in different epochs and found variations in the flux of the line in order of 5.02×10^{-12} to 12.93×10^{-12} erg cm^{-2} s^{-1}; Nussbaumer & Vogel (1990) found variations in the flux of the CIV line of order 9.4×10^{-12} to 20×10^{-12} erg cm^{-2} s^{-1}.

The log of the IUE observations is listed in Table 1. Figure 1 shows the variations in line fluxes with time. The MIDAS software was used for processing the spectra. For the estimations of the fluxes of emission lines we used the integrate/line command in the MIDAS software suite to estimate the continuum level and to integrate the flux of the emission line above the continuum.

TABLE 1

LIST OF IUE OBSERVATIONS

Image ID	Dispersion	Aperture	Observation Date	J.D.
SWP07995	Low	Large	1980-02-20	2444290.15734
SWP09898	Low	Large	1980-08-25	2444477.28274
SWP09943	Low	Large	1980-08-29	2444480.65055
SWP13546	Low	Large	1981-03-22	2444685.99707
SWP13548	Low	Large	1981-03-22	2444686.25105
SWP14704	Low	Large	1981-08-09	2444826.30751
SWP14756	Low	Large	1981-08-14	2444831.01329
SWP15353	Low	Large	1981-10-31	2444909.42918
SWP15355	Low	Large	1981-11-01	2444909.69151
SWP16402	Low	Large	1982-02-21	2445022.13708
SWP16404	Low	Large	1982-02-21	2445022.35865
SWP16705	Low	Large	1982-04-07	2445066.51274
SWP16706	Low	Large	1982-04-07	2445066.55572
SWP16752	Low	Large	1982-04-13	2445072.63036
SWP16753	Low	Large	1982-04-13	2445072.69293
SWP25552	Low	Large	1985-03-30	2446155.31349
SWP28896	Low	Large	1986-08-14	2446155.31349
SWP28897	Low	Large	1986-08-14	2446657.36038
SWP30693	Low	Large	1987-04-03	2446888.58032
SWP30694	Low	Large	1987-04-03	2446888.64367
SWP31033	Low	Large	1987-05-23	2446939.37905
SWP33154	Low	Large	1988-03-25	2447245.68857
SWP33155	Low	Large	1988-03-25	2447245.79245
SWP35921	Low	Large	1989-04-03	2447619.73762
SWP35922	Low	Large	1989-04-03	2447619.79851
SWP36951	Low	Large	1989-09-07	2447777.19521
SWP37572	Low	Large	1989-11-12	2447843.02143
SWP37573	Low	Large	1989-11-12	2447843.14039
SWP38638	Low	Large	1990-04-21	2448002.60074
SWP38939	Low	Large	1990-04-21	2448002.70632
SWP39837	Low	Large	1990-10-15	2448180.41296
SWP39838	Low	Large	1990-10-15	2448180.47445
SWP42154	Low	Large	1991-08-01	2448470.46081
SWP42547	Low	Large	1991-09-24	2448524.19478
SWP42548	Low	Large	1991-09-24	2448524.30658
SWP45354	Low	Large	1992-08-16	2448850.97169
SWP45355	Low	Large	1992-08-16	2448851.01356
SWP45387	Low	Large	1992-08-21	2448855.75214
SWP45389	Low	Large	1992-08-21	2448855.86235
SWP46011	Low	Large	1992-10-19	2448915.12249
SWP46012	Low	Large	1992-10-19	2448915.21653

3. METHOD OF ESTIMATING THE REDDENING

The reddening of HM Sge was determined using the 2200 Å absorption feature. We used the best data set of *Short Wavelength Prime* spectra (SWP) with low resolution (6 Å) in the range of wavelengths between 1150 - 1950 Å and *Long Wavelength Redundant* (LWR) spectra with low resolution (6 Å) in the range of wavelengths between 2000 - 3000 Å. The spectra are binned in 15 Å bins for SWP and 25 Å bins for LWR. The following observations were selected for our determination of the reddening (LWP08880 - LWP12920 - LWP19016 - LWP24119) & (SWP28896 - SWP33154 - SWP38638

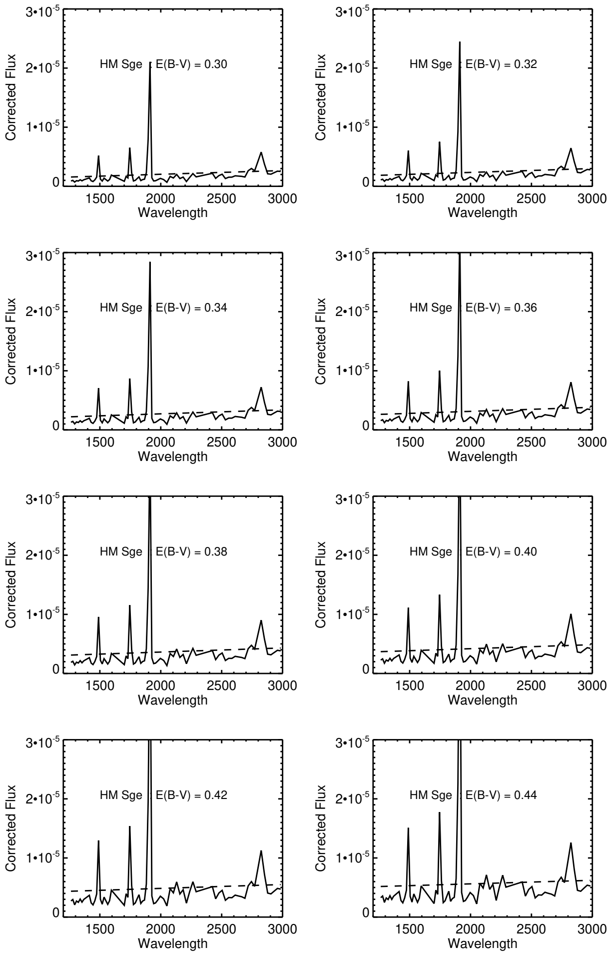

Fig. 2. Reddening determination for HM Sge.

- SWP46011) which gave the best smoothing spectrum suitable for our determination of the reddening value.

The most suitable value is determined by visual inspection of the plots for the best fit to the 2200 Å absorption feature, which represented the best agreement between observations and standard theoretical (dashed line) values. The estimated value of the reddening for HM Sge is $E(B-V) = 0.34 \pm 0.02$ as shown in Figure 2.

Eyres et al. (2001) reported the reddening for HM Sge as $E(B-V) = 0.35$; Ivison et al. (1991) found the reddening to be $E(B-V) = 0.58$; Muellar & Nussbaumer (1985) determined a reddening of $E(B-V) = 0.61$, Murset et al. (1991) found the reddening to be $E(B-V) = 0.63$. Our estimated value is very close to that determined by Eyres et al. (2001) using the extinction map method.

4. RESULTS AND DISCUSSION

4.1. *Method of Calculating the Line Fluxes of Emission Lines.*

We fitted the observed portions of the wings of emission lines by a Gaussian function. The "integrate/line" command in the software ESO/MIDAS was effectively used to estimate the continuum level and to integrate the flux of the CIV 1550 Å, He 1640 Å and CIII] 1909 Å emission lines above this continuum. For the measurements of emission line fluxes, we determined the integrated fluxes for the emission lines in units of erg cm^{-2} s^{-1}.

4.2. *Time Variations of the Spectral Lines from the Wind of Hot Star*

The CIV spectral line at 1550 Å is a resonance emission line, the He II spectral line at 1640 Å is a recombination line, and the CIII] emission line at 1909 Å is an intercombination line, previously discussed by Mueller & Nussbaumer (1985), Nussbaumer & Vogel (1990).

The line fluxes of CIV & He II and CIII] emission lines vary with time over short and long time scales, from hours to years. There was a steady increase in line fluxes until April 1982, and they reached a maximum flux in April 1987. The origin of the emission lines may be the wind from the hot white dwarf since their spectral behavior is similar. Table 2 contains fluxes for CIV, He II and CIII] emission lines and Figures 3, 4, 5 represent the spectral behavior of such lines. The errors for the measured line fluxes are in the range of 1σ, as determined by the methods reported in Lenz and Ayres (1992).

The transferred mass from the cool star (Mira) to the hot white dwarf increases the temperature of the hydrogen layer on top of the white dwarf (WD). The transfer of mass leads to an outburst and consequently to a rise in both luminosity and radiation pressure. The increased radiation pressure will eject some of the atmosphere of the WD as a stellar wind. At this stage HM Sge contains a wind from a cool Mira and a wind from the white dwarf. As a result of the motion of two winds toward each other, the collision between them occurs at some distance and forms what is known as the colliding wind region. As a result of this collision, two shocks are formed, one toward the white dwarf, the other toward the cool star, (Girard & Willson 1987; Formiggini et al. 1995).

The radiation from the hot WD increased the temperature of this facing shock and led to a steady increase in the line fluxes of CIV, He II and CIII] until 1982, reaching a maximum in 1987. The shock

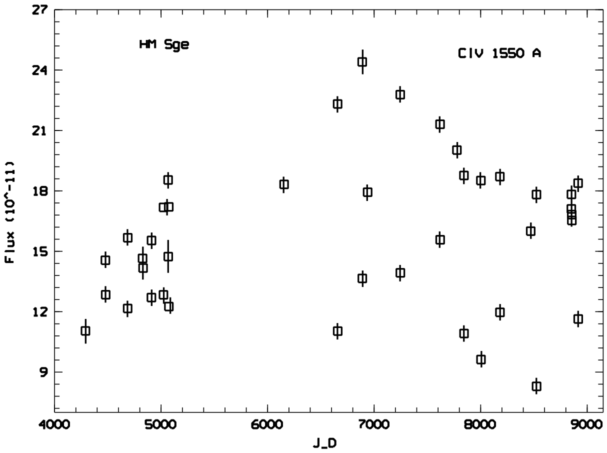

Fig. 3. Time evolution (JD - 2440000) of the CIV emission line flux. The 1σ error bars are shown on each data point (The flux is plotted in units of erg cm^{-2} s^{-1}Å^{-1}).

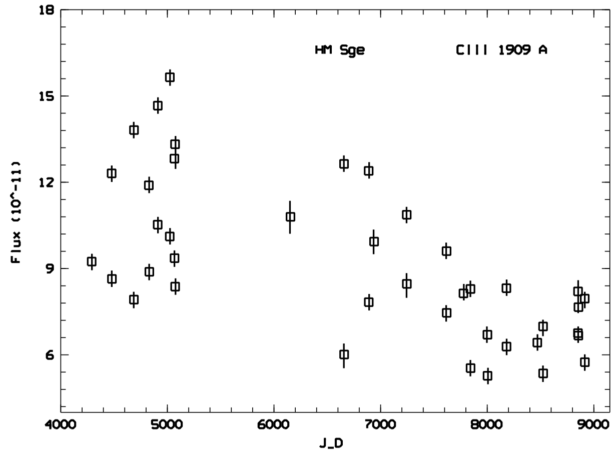

Fig. 5. Time evolution (JD - 2440000) of the CIII] emission line flux. The 1σ error bars are shown on each data point (The flux is plotted in units of erg cm^{-2} s^{-1}Å^{-1}).

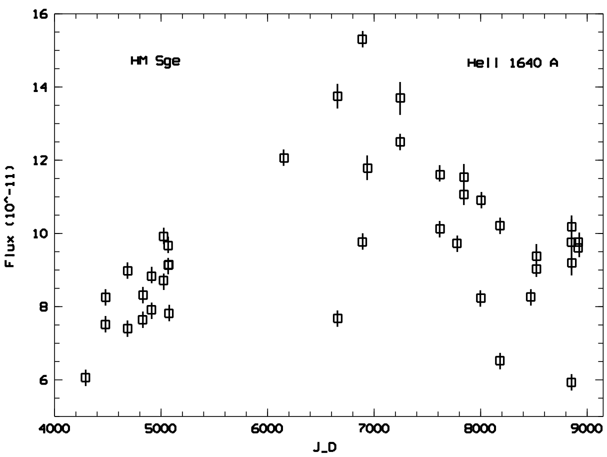

Fig. 4. Time evolution (JD - 2440000) of the He II emission line flux. The 1σ error bars are shown on each data point (The flux is plotted in units of erg cm^{-2} s^{-1}Å^{-1}).

facing the WD weakened with time. The decline in this shock led to a decrease of the velocity of the hot wind, and consequently a decrease in the rate of mass loss from the hot white dwarf; so, both the density and temperature of the emitting region (wind of WD) decreased and therefore the line fluxes decreased.

The spectral behavior of the symbiotic nova HM Sge differs from the ultraviolet spectral behavior of classical novae such as GQ Mus, (Sanad & Abdel-Sabour 2016). The nature of the physical environment in the emitting regions of the two systems is different, and consequently the effect of the physical conditions on the emission lines also differs, as do the wind of the hot white dwarf for HM Sge and the expanding shell of ejecta for GQ Mus.

Similarly, the spectral behavior of HM Sge differs from the spectral behavior of PU Vul, because of different physical environments. For PU Vul, there is a nebula around the white dwarf, which is partially eclipsed by a cool giant star, as opposed to the wind of a hot white dwarf in the case of HM Sge (Sanad 2016).

However, the spectrum of HM Sge is similar to the ultraviolet spectral behavior of both V 1016 Cyg and AG Peg, since the spectral lines are produced in the same emitting region with similar physical effects: a wind from a hot white dwarf for the three symbiotic novae (Sanad 2017 a,b).

The velocity of the emitting region can be determined from the expansion of this region. The Full Width at Half Maximum (FWHM) of emission lines increases as a result of the Doppler shift. Table 3 shows the velocities of the CIV line.

The integrated fluxes (F) of CIV 1550 Å, He II 1640 Å and CIII] 1909 Å are used to determine the average ultraviolet luminosities from the following equation. The distance of ≈ 1000 pc to the HM Sge is used, as estimated by Richards et al. (1999).

$$L_{UV} = 4\pi F d^2.$$

The ultraviolet luminosity of the emitting region is $\approx 4 \times 10^{34}\,\mathrm{erg\,s^{-1}}$. This value is comparable to that derived by Willson et al. (1984).

The radius of the hot white dwarf is determined to be 9.3×10^8 cm by the following equation, assuming the mass of the hot white dwarf to be 0.7 $M_\odot$,

TABLE 2

IUE LINE FLUXES OF CIV, He II AND CIII] IN UNITS OF 10^{-11} erg cm^{-2} s^{-1}

Image ID	CIV 1550 Å	He II 1640 Å	CIII 1909 Å	Observation Date	J.D.
SWP07995	11.04	6.06	9.24	1980-02-20	2444290.15734
SWP09898	14.55	7.51	12.30	1980-08-25	2444477.28274
SWP09943	12.84	8.25	8.64	1980-08-29	2444480.65055
SWP13546	12.16	7.40	7.92	1981-03-22	2444685.99707
SWP13548	15.67	8.97	13.81	1981-03-22	2444686.25105
SWP14704	14.64	7.64	11.89	1981-08-09	2444826.30751
SWP14756	14.16	8.31	8.88	1981-08-14	2444831.01329
SWP15353	12.70	7.91	10.52	1981-10-31	2444909.42918
SWP15355	15.53	8.83	14.66	1981-11-01	2444909.69151
SWP16402	12.83	8.71	10.11	1982-02-21	2445022.13708
SWP16404	17.17	9.91	15.64	1982-02-21	2445022.35865
SWP16705	18.54	9.66	12.82	1982-04-07	2445066.51274
SWP16706	14.73	9.13	9.36	1982-04-07	2445066.55572
SWP16752	17.20	9.14	13.32	1982-04-13	2445072.63036
SWP16753	12.25	7.81	8.37	1982-04-13	2445072.69293
SWP25552	18.32	12.05	10.79	1985-03-30	2446155.31349
SWP28896	22.31	13.74	12.63	1986-08-14	2446155.31349
SWP28897	11.03	7.67	6.01	1986-08-14	2446657.36038
SWP30693	24.40	15.30	12.39	1987-04-03	2446888.58032
SWP30694	13.65	9.76	7.83	1987-04-03	2446888.64367
SWP31033	17.93	11.78	9.93	1987-05-23	2446939.37905
SWP33154	22.78	12.50	10.86	1988-03-25	2447245.68857
SWP33155	13.92	13.70	8.46	1988-03-25	2447245.79245
SWP35921	21.31	10.12	9.60	1989-04-03	2447619.73762
SWP35922	15.57	11.60	7.45	1989-04-03	2447619.79851
SWP36951	20.02	9.72	8.13	1989-09-07	2447777.19521
SWP37572	18.76	11.06	8.29	1989-11-12	2447843.02143
SWP37573	10.91	11.53	5.53	1989-11-12	2447843.14039
SWP38638	18.51	8.23	6.69	1990-04-21	2448002.60074
SWP38939	9.62	10.90	5.27	1990-04-21	2448002.70632
SWP39837	18.71	6.52	8.31	1990-10-15	2448180.41296
SWP39838	11.96	10.21	6.28	1990-10-15	2448180.47445
SWP42154	16.01	8.26	6.42	1991-08-01	2448470.46081
SWP42547	17.81	9.02	6.98	1991-09-24	2448524.19478
SWP42548	8.29	9.37	5.35	1991-09-24	2448524.30658
SWP45354	17.10	5.93	6.75	1992-08-16	2448850.97169
SWP45355	17.82	9.75	8.20	1992-08-16	2448851.01356
SWP45387	16.82	10.18	6.66	1992-08-21	2448855.75214
SWP45389	16.53	9.19	7.65	1992-08-21	2448855.86235
SWP46011	18.38	9.60	7.95	1992-10-19	2448915.12249
SWP46012	11.63	9.76	5.74	1992-10-19	2448915.21653

TABLE 3

CIV (FWHM) IN kms^{-1}

Image ID	CIV (FWHM)	Observation Date	J.D.
SWP07995	1457	1980-02-20	2444290.15734
SWP09898	1263	1980-08-25	2444477.28274
SWP09943	1477	1980-08-29	2444480.65055
SWP13546	1417	1981-03-22	2444685.99707
SWP13548	1311	1981-03-22	2444686.25105
SWP14704	1323	1981-08-09	2444826.30751
SWP14756	1403	1981-08-14	2444831.01329
SWP15353	1411	1981-10-31	2444909.42918
SWP15355	1258	1981-11-01	2444909.69151
SWP16402	1423	1982-02-21	2445022.13708
SWP16404	1085	1982-02-21	2445022.35865
SWP16705	1226	1982-04-07	2445066.51274
SWP16706	1429	1982-04-07	2445066.55572
SWP16752	1199	1982-04-13	2445072.63036
SWP16753	1479	1982-04-13	2445072.69293
SWP25552	1357	1985-03-30	2446155.31349
SWP28896	1291	1986-08-14	2446155.31349
SWP28897	1702	1986-08-14	2446657.36038
SWP30693	1216	1987-04-03	2446888.58032
SWP30694	1632	1987-04-03	2446888.64367
SWP31033	1501	1987-05-23	2446939.37905
SWP33154	1185	1988-03-25	2447245.68857
SWP33155	1520	1988-03-25	2447245.79245
SWP35921	1238	1989-04-03	2447619.73762
SWP35922	1501	1989-04-03	2447619.79851
SWP36951	1212	1989-09-07	2447777.19521
SWP37572	1207	1989-11-12	2447843.02143
SWP37573	1556	1989-11-12	2447843.14039
SWP38638	1183	1990-04-21	2448002.60074
SWP38939	1665	1990-04-21	2448002.70632
SWP39837	1178	1990-10-15	2448180.41296
SWP39838	1538	1990-10-15	2448180.47445
SWP42154	1194	1991-08-01	2448470.46081
SWP42547	1243	1991-09-24	2448524.19478
SWP42548	1731	1991-09-24	2448524.30658
SWP45354	1189	1992-08-16	2448850.97169
SWP45355	1212	1992-08-16	2448851.01356
SWP45387	1202	1992-08-21	2448855.75214
SWP45389	1244	1992-08-21	2448855.86235
SWP46011	1194	1992-10-19	2448915.12249
SWP46012	1502	1992-10-19	2448915.21653

Nussbaumer & Vogel (1990).

$$R_{WD} = 0.78\times10^{9}\left[\left(\frac{1.44M_\odot}{M_{WD}}\right)^{2/3} - \left(\frac{M_{WD}}{1.44M_\odot}\right)^{2/3}\right]^{1/2} \text{cm.}$$

Our calculated value of the radius is comparable to that calculated by Murset et al. (1997).

The rate of the wind mass loss is determined from the following equation (Bode & Evans 2008):

$$M^{\bullet}_{wind} = \frac{3.3\times10^{-11}}{\alpha_w}\left(\frac{R_{WD}}{M_{WD}}\right)^{1/2} L_{UV}\, M_\odot \text{yr}^{-1},$$

where α_w is an arbitrary parameter. We found an average value of the rate of wind mass loss to be $\approx 5\times10^{-6} M_\odot$ yr^{-1}. This value is comparable to that calculated by Livio et al. (1989) and Nussbaumer & Vogel (1990)

The Steffan-Boltzmann equation is used to calculate the temperature of the emitting region,

$$L = \sigma A T^4,$$

where $\sigma \approx 5.6704\times10^{-5}$ erg cm^{-2} s^{-1} K^{-4} is the Steffan Boltzmann constant, and $A = 4\pi\, r^2$ is the surface area. The average temperature is $\approx 1\times10^5$ K. Our estimated value is comparable to that reported by Nussbaumer & Vogel (1990) and Muellar & Nussbaumer (1985).

5. CONCLUSIONS

In this paper we studied ultraviolet observations of the symbiotic nova HM Sge obtained by the IUE. The main purpose of this work was to constrain and diagnose the emitting region (wind of the hot star) using some specific spectral lines (CIV, He II & CIII) and to estimate some physical parameters. The calculated physical parameters agree with previous determinations. The main results are as follows:

1. The accumulation of mass from the Mira star leads to an outburst of HM Sge.

2. The emission lines are produced in the wind from the hot white dwarf. This emitting region is formed as a result of the collision between two winds from the two stars and, consequently, the collision leads to the formation of two shocks, one toward the white dwarf and the other toward the cool Mira.

3. The line flux modulations are attributed to the variations of mass loss.

4. The estimated ultraviolet luminosity, wind mass loss rate and temperature are consistent with previous calculations.

5. The ultraviolet observations with the IUE can be interpreted with the wind models of symbiotic novae.

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