

IUE AND OPTICAL OBSERVATIONS OF HE 2-104

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ABSTRACT. He 2-104 has been classified as both a planetary nebula and as a symbiotic star. Optical and ultraviolet spectra and CCD images have been obtained in order to learn more about the evolutionary state of this object. The spectra of the object indicate that it could be either a symbiotic star or a very high excitation planetary nebula. The CCD images show a nebulosity with a radius of about 4 seconds of arc and faint bipolar outer structures extending out approximately 25 seconds of arc from the center of the nebula.

1. THE OPTICAL AND ULTRAVIOLET SPECTRA

Spectroscopic observations with a resolution of about 10 Å were obtained of He 2-104 with the SIT Vidicon on the 1.5 m telescope at CTIO in April 1984 and May 1985. The average emission line fluxes are given in Table 1. To within the errors of observation and calibration (about 25%) the emission line fluxes did not vary in the two epochs of observation.

The spectrum shows a very steep Balmer decrement and the strong [O III] 4363 Å emission (comparable in strength to H-γ) that are characteristic of high density objects. [Fe VI] is observed in the spectrum, as it is in some symbiotic stars and a few highly ionized planetary nebulae (e.g. NGC 7027, M 1-1, He 2-111).

Ultraviolet observations were obtained with the International Ultraviolet Explorer satellite on April 24 and 25, 1985. Large aperture exposures were made with both the SWP (160 minutes) and LWP (60 minutes) cameras. The ultraviolet line fluxes are given in Table 1. The emission lines are, once again, typical of either a planetary nebula or a symbiotic star, except that Mg II and Si III] emission

lines are seen more commonly in symbiotic stars. There is no evidence for continuum on the IUE spectra, even at the shortest wavelengths.

CCD IMAGES

CCD images of He 2-104 were obtained with [O III] and H-alpha narrow band filters by using a TI chip on the 0.9 m telescope at CTIO in May 1986. The images show a bright nebula with a radius of about 4 seconds of arc and faint bipolar outer structures extending about 25 seconds of arc out from each side of the center of the nebula. Long exposures of the faint bipolar loops reveal faint, clumpy structures that are reminiscent of Herbig-Haro objects.

CONCLUSIONS

The nebulosity associated with He 2-104 would seem to put the object into the classification of planetary nebula. However, a 400 day Mira pulsation has been observed in the infrared (Whitelock, private communication). This means that there are two possibilities for He 2-104. It could be one of the rare symbiotics (like R Aqr) that show nebulosity. It could be a planetary nebula with a binary nucleus where the cooler component happens to be in the Mira state. Further studies of this unique object are necessary.

Table 1

Wavelength A	Flux*	Wavelength A	Flux*	Wavelength A	Flux*
1240	sat.	3868	11.9	4861	13.6
1550	6.3	3889	4.6	4959	16.0
1640	4.5	3968	4.6	5007	43.2
1750	2.4	4072	0.8	5146	0.9
1890	1.2	4101	3.7	5176	1.5
1909	4.8	4340	6.8	5411	0.3
2732	0.5	4363	7.7	5755	0.8
2800	1.9	4471	0.8	5876	5.5
2837	0.8	4640	1.9	6300	2.0
3123	2.9	4686	3.3	6563	155.0
		4716	1.2	6584	12.7

* 10^{-10} erg cm^{-2} s^{-1}