

Spectroscopy and Photometry of MWC 137

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Abstract. MWC 137 is an object with a strong emission-line spectrum associated with an 1′-size H II region Sharpless 266. It was included in a catalog of planetary nebulae in 1967, in the first list of objects with the B[e] phenomenon in 1976, and in a list of Herbig Ae/Be stars in 1984. A recent analysis of the stellar and nebular spectra of MWC 137 by several authors suggested that it is most likely a B[e] supergiant located at a distance 4–6 kpc away from the Sun. No high-resolution spectra of the object have been published so far. We present the results of our analysis of high-resolution optical spectra of MWC 137 obtained in 2004–2016 and *UBVRI* photometry.

1. Introduction

MWC 137 was discovered in the Mount Wilson survey of emission-line stars (Merrill & Burwell 1933). Its emission-line spectrum is among the strongest for Galactic stars (equivalent width of the H α line is 395–665 Å, Zickgraf 2003, Wheelwright et al. 2010), so that no absorption lines of the stellar atmosphere have been observed so far. The first hypothesis about the nature of MWC 137 (planetary nebula) was rejected. There are two alternative interpretations of the nature and evolutionary status of MWC 137 since the 1990’s: a pre-main-sequence Herbig Be star (Hillenbrand et al. 1992) and a distant evolved supergiant at a stage of active mass loss (Esteban & Fernandez 1998). Both hypotheses have some supporting evidence, but the distance estimates that are crucial for the luminosity determination have been based on indirect criteria only.

2. Observations

We took spectra at the 2.12 m telescope of the Observatorio Astronómico Nacional San Pedro Martir Observatory (Mexico, optical, échelle, $R = 18000$, 6 spectra, 2006–2016), 2.7 m Harlan J. Smith telescope at McDonald Observatory (USA, $0.36\text{--}1.05\ \mu\text{m}$, $R \sim 60000$, 2 spectra, 2005–2006), 3.6 m Canada-France-Hawaii Telescope (Mauna Kea, USA, $0.36\text{--}1.05\ \mu\text{m}$, $R \sim 60000$, 1 spectrum, 2004), and 3 m telescope at Lick Observatory (USA, $0.46\text{--}2.5\ \mu\text{m}$, $R \sim 700$, 2 spectra, 2007 and 2014). *UBVRI* photometry of a $10' \times 10'$ region around the object was obtained at two 1 m telescopes of the Tien-Shan Astronomical Observatory (near Almaty, Kazakhstan) in 2014–2016.

3. Results

The spectra show that MWC 137 is a B0-type star affected by a strong interstellar reddening. Most emission lines have triple-peaked profiles, whose central peak may be due to mass transfer between components in a binary system. Comparison with several B- and A-type supergiants that are projectionally close to MWC 137 and located at distances 2–4 kpc from the Sun shows that MWC 137 is most likely a distant object (3–4 kpc) rather than a nearby one (~ 1 kpc). Evidence for a large distance toward MWC 137 includes strong diffuse interstellar bands and a two-component structure of the interstellar Na I and K I lines. Assuming that the circumstellar material makes the star brighter by $\Delta V \sim 1$ mag, an interstellar reddening of $A_V \sim 4$ mag, and a distance of 3–4 kpc, luminosity of MWC 137 would be $\log L/L_\odot = 4.9 \pm 0.2$.

Our results indicate that MWC 137 is a supergiant rather than a young star, in agreement with recent findings by Muratore et al. (2015) and Mehner et al. (2016). The absence of absorption lines indicates a strong circumstellar veiling, whose contribution to the object's brightness is uncertain and requires accurate modeling. Our photometry of the brightest stars within $1'$ of MWC 137 ($V = 15\text{--}16$ mag) shows that their distances may be ≥ 4.5 kpc assuming spectral types from Mehner et al. (2016) and main-sequence luminosities. A more accurate optical photometry of fainter stars around MWC 137 is needed to better constrain the distance and luminosity of the object.

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