We present the results of our polarimetric and spectropolarimetric monitoring of V838 Monocerotis, performed at Asiago and Crimean observatories during and after the multiple outbursts that occurred in January-March 2002. The polarization of the object is mainly due to interstellar polarization ($P \sim 2.48\%$). Intrinsic polarization up to $\sim 0.7\%$ at 5000 Å is present during the second maximum of the object (February 2002). This intrinsic component increases toward shorter wavelengths but our limited spectral coverage (5000-7500 Å) does not allow conclusive inferences about its origin. A strong depolarization across the H$_\alpha$ profile is observed. The interstellar polarization gives a lower limit to the reddening of E(B-V) $> 0.28$, with E(B-V) $\sim 0.5$ being the most probable value. A normal ratio of total to selective absorption ($R_V = 3.22 \pm 0.17$) was derived from the wavelength of maximum interstellar polarization. This suggests a low (if any) contribution by circumstellar material with peculiar dust to gas ratio. A polarimetric map of a portion of the light echo shows a complex polarization distribution reaching $P_{\text{max}} = 45\%$. ($\text{Stars:}$) Stars: individual: V838Mon – Techniques: polarimetric Stars: peculiar

Introduction

V838 Monocerotis developed a spectacular multiple outburst in January-March 2002, reaching V=6.7. Its spectral characteristics changed dramatically during its evolution. The progenitor had the temperature of a F star, while during the outburst V838 Mon evolved from a cool K giant to a late M giant. Profile of spectral lines also changed during the ourburst, and a strong H$_\alpha$ emission appeared during the second maximum, when the object reached its peak visual magnitude. A prominent light echo was discovered by Henden et al. (henden02). The evolution of V838 Mon from January to April 2002 is described by Munari et al. (munari02). The study of the polarization can shed light on some physical properties. On one hand the interstellar polarization gives clues on the distance and the absorption toward the object. On the other, the presence of intrinsic polarization, its wavelength dependence, its variations during the evolution of the object and the polarization across line profiles provide clues on the physics of the object. Wisniewski et al. (wisniewski) present 2-epoch spectropolarimetric observations of V838 Mon. They reveal the presence of intrinsic polarization during the outburst, with variations across the profile of emission lines.

Here we present the results of our more extensive polarimetric and spectro-polarimetric monitoring of V838 Monocerotis, performed at Asiago and Crimean observatories from January to November 2002. The results presented here supersede the preminary analysis of part of the same dataset included in Munari et al. (munari02).

Observations

Asiago

Polarimetric and spectropolarimetric observations of V838 Monocerotis were performed using the polarimetric mode of AFOSC at the 1.82m telescope at Asiago Observatory (Italy). The AFOSC instrument is described by Desidera et al. (afosc). The polarimeter is presented in detail elsewhere (Pernechele et al. pola,fosce)and first results based on its use were presented by Giro et al. (symbiotic). Here we recall the main characteristics of the Wollaston: $90^\circ$, $-45^\circ$ and $45^\circ$ separated by 20 arcsec. These four beams are in principle sufficient to determine the first three elements of the Stokes vector, i.e. the intensity $I$ and the two linear polarization parameters $Q$ and $U$. The Wollaston can be housed in the filter wheel or in the grism wheel of AFOSC. In the first case, spectropolarimetry can be performed by inserting a grism in the grism wheel, and in the latter imaging or
photo-polarimetry is obtained by inserting a filter in the filter wheel.

For the spectropolarimetry, we used three different grisms: Grism #4, (wavelength range 4500-7800 Å; resolution 4.3 Å/pixel), Grism #7, (4350-6550 Å; 2.2 Å/pixel), Grism #8, (6250-8000 Å; 1.8 Å/pixel). In all cases a slit 2.5 arcsec wide and 18 arcsec long was used.

Our observational procedure includes spectra taken at position angles of 0° and 90°, to properly eliminate the spurious effects introduced by the different behaviour of the grism for the two polarimetric states. Flat fields were taken at both slit position angles (0° and 90°) to avoid spurious polarization effects due to screen reflections.

Observations were mostly performed in service mode as a target of opportunity, and this explains some inhomogeneities of the instrument set-up used and, in some cases, the lack of observations on standard stars.

First spectropolarimetric observations were performed very early after the first maximum (January 10), and then we continued our monitoring covering the relevant phases of the evolution of this peculiar object for nearly 2 months. In particular, the maximum of visual magnitude (Feb 2002) is well covered by our observations.

When the object became too faint for spectropolarimetry, we continued our monitoring in polarimetric imaging. Deep images obtained in V band also allow a study of the polarization of the light echo and of stars in the direction of V838 Mon.

Table `specobs` presents the journal of observations.

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<th>Target Date UT</th>
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<th>Obs.</th>
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