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Diffraction-limited speckle interferometry and modeling of the circumstellar envelope of R CrB at maximum and minimum light

K. Ohnaka, T. Blöcker, K.-H. Hofmann, N. R. Ikhsanov, G. Weigelt

Max-Planck-Institut für Radioastronomie, 53121 Bonn, Germany

Y. Balega

Special Astrophysical Observatory, Nizhnij Arkhyz, 35147, Russia

V. I. Shenavrin, B. F. Yudin

Sternberg Astronomical Institute, 119899 Moscow, Russia

Y. S. Efimov

Crimean Astrophysical Observatory, Nauchny 98409, Ukraine

We present the first speckle interferometric observations of R CrB, the prototype of a class of peculiar stars which undergo irregular declines in their visible light curves. The observations were carried out with the 6 m telescope at the Special Astrophysical Observatory near maximum light ($V = 7$, 1996 Oct. 1) and at minimum light ($V = 10.61$, 1999 Sep. 28). A spatial resolution of 75 mas was achieved in the K-band. The dust shell around R CrB is partially resolved, and the visibility is approximately 0.8 at a spatial frequency of 10 cycles/arcsec. The two-dimensional power spectra obtained at both epochs do not show any significant deviation from circular symmetry. The visibility function and spectral energy distribution obtained near maximum light can be simultaneously fitted with a model consisting of the central star and an optically thin dust shell with density proportional to r^{-2} and amorphous carbon as its constituent. The inner boundary of the shell is found to be 82 $R_\star$ (19 mas) with a temperature of 920 K near maximum light. However, this simple model fails to simultaneously reproduce the visibility and spectral energy distribution obtained at minimum light. We show that this discrepancy can be attributed to thermal emission from a newly formed optically thick dust cloud. Simultaneous fits of the observed SED and visibility with models including a thermally emitting dust cloud suggest the presence of a newly formed dust cloud as hot as 1200 K with a radius of $4 - 5$ $R_\star$, in addition to an optically thin dust shell whose inner boundary is ~ 170 $R_\star$ with a temperature of ~ 690 K. Alternatively the discrepancy can be attributed to an unusual extinction curve of dust grains in the obscuring cloud which was present in front of the star at minimum light. The details of the observations and modeling are described in Ohnaka et al. (2001, A&A 380, 212).