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Pulsations and Dust Formation in R Coronae Borealis Stars

Geoffrey C. Clayton

Center for Astrophysics and Space Astronomy, Campus Box 389, University of Colorado, Boulder, CO 80309

Barbara A. Whitney

Harvard-Smithsonian Center for Astrophysics, 60 Garden St., Cambridge, MA 02138

Warrick A. Lawson

Department of Physics, University College, University of New South Wales, Australian Defence Force Academy, Canberra ACT 2600, Australia

The observed correlation between pulsational phase in RCB stars and the timing of their declines shows empirically that the stellar pulsations and dust formation are intimately connected (e.g., Lawson et al. 1992). However, the nature of this relationship and the process of dust formation itself are not well understood. We have shown that it is likely that dust is forming in close proximity (< 2 stellar radii) to the RCB star photosphere, based on time scales for acceleration of the dust, eclipse of the chromospheric region, and dispersal of the dust (Clayton et al. 1992, 1993; Whitney, Balm & Clayton 1993; Whitney et al. 1993). The temperature at which amorphous carbon forms can be as high as 4000 K, and can occur in conditions far removed from thermodynamic equilibrium, as long as a mechanism exists to contain carbon atoms within a given volume. A likely form of carbon condensate is fullerenes such as C_{60} (Whitney, Balm & Clayton 1993). Shocks in the stellar atmosphere due to the pulsations may provide such a mechanism for containing the carbon. However, no spectroscopic signature related to the dust formation has been seen. We have searched unsuccessfully for IR emission bands of C_{60} (Clayton et al. 1995a).

High dispersion visible and ultraviolet spectra and UBVRI photometry, covering a complete pulsation of the RCB star, RY Sgr, have been obtained (Clayton et al. 1994). The UV spectra were the first high dispersion data ever obtained for the star. The visible spectra showed the typical line splitting and radial velocity variations which have been observed previously. The simultaneous UV spectra showed much smaller, and phase shifted, velocity variations than those seen in the visible. No evidence was seen of shock induced emission at Mg II. Visible spectroscopy and polarimetry of R CrB covering 7 years has also been obtained (Clayton et al. 1995b). These spectra clearly show CN and C_2 band variations correlated with pulsational phase. Polarimetric variations are also seen which are related to dust formation episodes.

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