ON EVOLUTIONARY STATUS OF STARS WITH THE R CRB PHENOMENON

A.E. Rosenbush
Main Astronomical Observatory of National Academy of Sciences of Ukraine,
Kyiv-22, GSP-650, Golosiiv, Ukraine.
E-mail: mijush@mao.gluk.apc.org

ABSTRACT. Two key features are important for understanding the evolution of stars with the R Coronae Borealis variability: the state of high mass loss rate and the carbon overabundance. The hydrogen deficiency is a consequence of these two characteristics. This idia allows us to build one of several possible evolutionary chains from observable states of some stars: from a low mass star of the FG Sge type with a thin hydrogen shell through the phases of V854 Cen - R CrB - UV Cas to a star of the XX Cam type with hydrogen completely lost.

Key words: R CrB stars: hydrogen-deficient stars: stellar evolution.

The first phase, the FG Sge phase, with a duration of about hundred years is characterized by a final flash of helium shell. The star flashes by 3-5 mag, its luminosity comes nearer to the Eddington limit. An intensive mass loss leads to an overabundance of carbon in the stellar atmosphere and conditions are created for the start of dust condensation that may appear at once as the R Coronae Borealis type light minimum. The star passes to the V854 Cen phase with a duration of several thousands of years. The star is surrounded by a spherical dust permanent envelope with the thinckness τ¡3. The radius of dust clusters is r*cong*0.01-0.03 micron. A denser dust layer (up to *tau*¡8, r=0.1-0.3 micron) arises sometimes on the inner boundary of the envelope as a result of pulsations. An R Coronae Borealis minimum is observed again. At this phase the hydrogen deficiency arises to 0.1-0.01. The decrease of the hydrogen abundance supports conditions of constant condensation of particles with small radii only (r¡0.01 micron): the permanent dust envelope exists but it does not influence the visual stellar brightness. But, as before, the conditions for a growth of particles up to r=0.1-0.3 micron arise sometimes, and then a visual extinction appears. As a result, we observe the R CrB phase that terminates as the UV Cas phase after tens of thousands of years: a complete end of dust condensation due to the hydrogen depletion. The mass loss is finished, the star enters the XX Cam phase: no R Coronae Borealis minima are observed (the only minimum for 100 years had a symmetric shape, and this might be an eclipse), only hydrogen tracks are found.

Stellar luminosity in this chain seems to change slightly: within an order of magnitude around 10^4 of the luminosity of the Sun. The temperature is 5000-7000 K. The stellar mass is 0.6-0.7 M_o masses of the Sun. A star has a thin hydrogen shell, with a mass of 0.01-0.1 M_o lost during about 100000 years, this shell is represented at present as a fossil dust envelope with a radius of up to some parsecs and a temperature of some tens of degrees.

The V854 phase duration should be specified after of its fossil dust envelope radius is determined, this radius may be no more than 1 arcmin against 18 arcmin in R CrB itself.

It is likely that the existence of at least two more chains has to be assumed in order to obtain the hydrogen deficit in extreme helium and cool hydrogen-deficient stars. The first chain extends from cool Wolf-Rayet stars of carbon sequence through V348 Sgr, MV Sgr and DY Cen. The second chain extends from the normal carbon stars of the early R0-R5 spectral classes through U Aqr, S Aps, RS Tel, etc.

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