NOVA EXPLOSION OF MASS ACCRETING WHITE DWARFS

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Evolution of a mass accreting white dwarf has been computed from the onset of accretion through nova explosion. We have considered a white dwarf of $1.3M_{\odot}$ with the accretion rate of $1 \times 10^{-10} M_{\odot} yr^{-1}$. Because the thermal structure during the accretion phase has been fully taken into computation, the mass of the accreted hydrogen-rich envelope and the corresponding temperature distribution in the envelope have been determined. When the hydrogen-rich envelope of mass $\Delta M_H = 1.63 \times 10^{-4} M_{\odot}$ has been formed, a hydrogen-shell flashes commences. The flashing shell lies midway between the bottom of the envelope and the stellar surface; the mass lying above this shell is $5.7 \times 10^{-5} M_{\odot}$

We have found that the flash grows strong enough to lead to a nova-like explosion, even for normal abundance of the CNO elements. The main driving mechanism of this explosion is a rapid change in the internal structure of the envelope from white dwarf to supergiant characteristics. This change is quasi-static near the hydrogen-burning shell. However, the response of the envelope is so sensitive to the addition of entropy that the transition to the supergiant branch is very quick and the expansion of the envelope is very rapid. The expansion velocity exceeds the escape velocity at 150 km/sec. This is the effect of non-linearity in the giant-like stellar structure. (The effect of radiation pressure is less important because the bulk of the envelope is in convective equilibrium and the radiative energy flux never exceeded the local Eddington limit in the radiative zone).

The strength of our model is intermediate between the slow nova model for 1.25 $M_{\odot}$ white dwarfs computed by Sparks et al. (1978) and the fast nova model of the same mass by Prialnik et al. (1979) in the sense that the expansion velocity is intermediate. Further investigations are still needed in order to establish the quantitative relation between the strength of explosion and a condition for the accretion.

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