THE EFFECTS OF TIME-DEPENDENT CONVECTION ON WHITE DWARF RADIAL PULSATIONS

Arthur N. Cox
Theoretical Division
Los Alamos National Laboratory

Sumner G. Starrfield
Physics Department
Arizona State University and
Theoretical Division
Los Alamos National Laboratory

Abstract. After the discovery of pulsations in white dwarfs, predictions were made that these DA and the hotter DB stars should be pulsating in radial modes with periods of a few seconds or less. The mechanisms are the normal kappa and gamma effects that periodically block the flow of radiative luminosity and the blocking effect of the frozen-in convection at the bottom of the convection zone. Blue edges of the instability strips are between 12,000K and 13,000K for the DA and between 32,000K and 33,000K for the DB variables. Extensive observations, however, have shown that these stars pulsate only in the few-hundred-second nonradial modes and not in any few-second radial modes. We have added the time dependent convection model of Cox, Brownlee, and Eilers (1966) to our pulsation analyses to further investigate the white dwarf radial modes. Since the time scale of the convection is usually short compared to the radial pulsation periods, convection is able to carry luminosity rapidly enough to nullify the kappa and gamma effects periodic radiation blocking. We find that most, and maybe all, radial pulsations for 0.6 solar mass carbon-oxygen white dwarfs with thin hydrogen or helium surface layers are stabilized for both these DA and DB classes, now finally in agreement with observations.

https://doi.org/10.1017/S0252921100011672 Published online by Cambridge University Press