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The stability of massive hot white dwarfs: Consequences of finite temperature in the structure and on the onset of instabilities

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In this work, we investigate the structure, the radial stability, pycnonuclear reaction and inverse β-decay in white dwarfs with a finite temperature. Regarding the matter within hot white dwarfs, we consider that it is composed of nucleons and electrons confined in a Wigner-Seitz cell surrounded by free photons. Since photons are being considered, in order to connect smoothly the interior solution with the vacuum solution outside the star, i.e., with the aim to obtain a null pressure at the star's surface, a temperature distribution is implemented. The temperature depends on the mass density considering the presence of the isothermal core. We found that the temperature produces remarkable effects on the equilibrium and radial stability of white dwarfs. We compare our results with massive white dwarfs estimated from the Extreme Ultraviolet Explorer Survey and Sloan Digital Sky Survey. We note that these massive white dwarfs are well described by our curves with higher central temperatures. Our results suggest that these hot massive stars detected are within the range of white dwarfs with more radial stability. This result is important since it could explain their existence. We also obtain that the maximum mass point and the zero eigenfrequency of the fundamental mode are determined at the same central energy density. Furthermore, we show that pycnonuclear reactions occur in almost similar central energy densities, and the central energy density threshold for inverse β-decay is not modified. For central temperatures $T_c \leq 1.0 \times 10^8$ [K], the onset of the radial instability is attained before the pycnonuclear reaction and the inverse β-decay.

Primary author: NUNES, Sílvia (ITA)

Co-authors: Prof. ARBAÑIL, José D. V. (Universidad Privada del Norte); MALHEIRO, Manuel (Instituto Tecnológico de Aeronáutica)

Presenter: NUNES, Sílvia (ITA)

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