Rotating hot white dwarfs

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We consider the effects of rotation and temperature on the structure of white dwarfs in order to compare them with the estimated data from observations.

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In this work we construct the mass-radius relation for white dwarfs (WDs) using the Chandrasekhar equation of state (EoS) within general relativity. First we perform computations for zero temperature uniformly rotating WDs at the mass shedding limit within the Hartle formalism [1] and calculate the masses and average radii. Afterwards we superpose our results with the estimated mass-radius relations obtained from the Sloan Digital Sky Survey Data Release 4 (SDSS 4) by Tremblay et al. [2] As one can see on the left panel of Fig. 1 the difference between theory and observations is quite noticeable.

In order to overcome this problem S. M. de Carvalho et al. [3] proposed to include the finite-temperature effects in the EoS. Following this idea we performed similar analysis for static WDs at finite-temperatures by solving the Tolman-Oppenheimer-Volkoff equation (see Ref. 4 for details). The results of Ref. 4 are shown on the right panel of Fig. 1. As one can see by the inclusion of the temperature in the EoS one can cover all the estimated data from observations.

It should be stressed that from the observations usually one infers the effective surface temperature and the surface gravity of WDs. All the rest parameters are estimated by using certain models. However there also exist techniques to measure the masses of WDs in close eclipsing binaries. The data inferred from close binaries are more reliable. Therefore in order to perform more realistic computations one needs to take into account the effects of rotation and temperature together for selected WDs with known

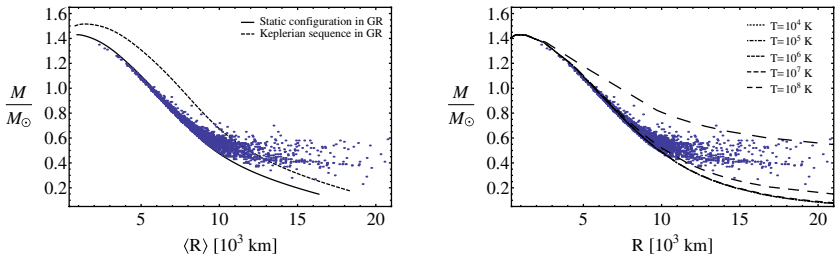

Fig. 1. Mass-radius relation of uniformly rotating WDs obtained with the Chandrasekhar EoS for T = 0 K case (left panel) and mass-radius relation of static WDs for selected finite temperatures from T =10^4 K to T = 10^8 K (right panel) and their superposition with the estimated masses and radii of white dwarfs taken from the SDSS 4 (blue dots).

parameters. Only after that one can make further predictions. This issue is out of the scope of the present work and will be published elsewhere.

In conclusion, we calculated the masses and radii of cold rotating and hot static white dwarfs in general relativity i.e. the effects of the rotation and finite-temperature were considered separately. We compared and contrasted our results with the estimated data from the observations of WDs. Our results cover all the data. For more detailed analysis one needs to consider both effects together and work with more or less model-indepent data.

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