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AN UPDATED GRID OF SYNTHETIC SPECTRA FOR HOT DA WHITE DWARFS

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ABSTRACT

An update to a previously published grid of synthetic spectra for hot DA white dwarfs is presented. The updated data set encompass temperatures in the range $17,000\,\mathrm{K} \leq T_{\mathrm{eff}} \leq 34,000\,\mathrm{K}$ and gravities within $7.0 \leq \log\ g \leq 9.5$ c.g.s.. The new non-LTE stellar models are built for homogeneous hydrogen atmosphere models in the temperature range $17,000\,\mathrm{K} \leq T_{\mathrm{eff}} \leq 30,000\,\mathrm{K}$. All the models spectra cover a wavelength range from 900 Å to 2.5 μm in steps of 0.1 Å. Synthetic photometry in the HST/ACS, HST/WFC3, Bessel UBVRI and SDSS bands are also provided. These models can be used both for stellar classification purposes and for building theoretical stellar populations libraries.

Keywords: techniques: spectroscopic — stars: atmospheres — line: profiles —stars: white dwarfs — stars: fundamental parameters — globular clusters: general

1. INTRODUCTION

In a previous work on theoretical grids of WD-DA stars, a hybrid LTE/non-LTE grid of models was provided over a very wide range of temperatures (Levenhagen et al. 2017) (see also Bohlin et al. (2020)). In that work, DA white dwarf model spectra span $17,000\,\mathrm{K} \leq T_{\mathrm{eff}} \leq 100,000\,\mathrm{K}$ in steps of 1,000 K and $7.0 \leq \log g \leq 9.5$ in steps of 0.1 cgs. The hottest models (above 35,000 K) were evaluated in non-LTE. The cooler models, below 35,000 K, were evaluated in LTE regime. Also, below 30,000 K, we took into account the contribution of quasi-molecular Lyman satellites in the opacities (Allard et al. 2009).

In the present work, we have completed the non-LTE grid of model spectra for DA WDs. The new non-LTE models are computed between $17,000\,\mathrm{K} \leq T_{\mathrm{eff}} \leq 34,000\,\mathrm{K}$ in steps of 1,000 K and $7.0 \leq \log g \leq 9.5$ in steps of 0.1 dex, following the original grid sampling. The new synthetic spectra supersede the previous LTE calculations, comprising the same wavelength range as the former grid, beginning in the UV at 900 Å up to the IR at 2.5 μm. The disparities between the new non-LTE spectra and the older LTE grid are evaluated from the figure-of-merit (Balian & Eddy 1977), and are of the order of 5% for the hotter models, reaching 31% for the cooler spectra. Additionally, we compute updated synthetic magnitudes from the new model spectra.

2. ATMOSPHERE STRUCTURE, SPECTRAL SYNTHESIS AND SYNTHETIC PHOTOMETRY

All model atmospheres were built with the code TLUSTY (Hubeny 1988; Hubeny & Lanz 1995), version 205. For an authoritative description and user's manual, see Hubeny & Lanz (2017). All the atmospheres' structures were synthesized assuming plane-parallel geometry and horizontal homogeneity. The atmospheres are composed by pure hydrogen (16 level model atom), in hydrostatic and radiative equilibrium.

Given the temperature range, we have neglected convection in the atmosphere, although small instability zones at low depths in our low temperature grid side may be present (Tremblay & Bergeron 2008). The spectral synthesis was performed with the SYNSPEC code (Hubeny & Lanz 2011), version 50.

The LTE models computed previously (Levenhagen et al. 2017) for temperatures below 34,000 K exhibited significant flux differences from their non-LTE counterpart models. In the previous LTE models, all lines were set to detailed radiative balance as a simplifying assumption. The new set of models in non-LTE from 17,000 K to 30,000 K also include the Lyman quasi-molecular satellites of of Lyα, β, and γ that arise due to close H–H+ collisions (Allard et al. 2009). The method for computing the new non-LTE atmosphere structure follows the description provided in Levenhagen et al. (2017).

Additionally, we compute revised magnitudes from the new spectra for Bessel UBVRI, Sloan Digital Sky Survey (SDSS), HST/ACS, and HST/WFC3 in the AB system. For details on the synthetic photometry calculation refer to Levenhagen et al. (2017).

Updated spectral grid and photometric data are provided at the Vizier service and at `http://specmodels.iag.usp.br`.

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Software: TLUSTY, SYNSPEC, ROTIN

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