Mixing in magnetically active RS CVn giants

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RS Canum Venaticorum (RS CVn) variables represent an intriguing class of detached binary star systems that exhibit enhanced levels of magnetic activity, resulting in various observable phenomena such as photometric variability, chromospheric emission lines, spots and flares [1][2].

Our primary research objective centers on the analysis of RS CVn stars, specifically aiming to ascertain the isotopic ratio of carbon-12 (^{12}C) to carbon-13 (^{13}C) as well as the ratios of carbon to nitrogen (C/N) in atmospheres of these stars characterised by chromospheric activity. The investigation of carbon and nitrogen abundance variations in stellar atmospheres offers invaluable insights into the compositional alterations incurred during stellar evolution. To gain a deeper understanding of how magnetic activity influences the processes of elemental mixing within the atmospheres of magnetically active RS CVn stars, we embark on a meticulous examination of the abundances of carbon, nitrogen, and oxygen.

Our study focuses on a sample of RS CVn stars giants, employing high-resolution spectroscopic data obtained from the 1.65-meter telescope at the Moletai Astronomical Observatory, affiliated with Vilnius University. Our investigation hinges upon the scrutiny of spectral features, notably the C_2 Swan (1,0) band head at 5135 Å and the C_2 Swan (0,1) band head at 5635.5 Å, which serve as indicators for determining carbon abundances. We analyse a spectral region spanning 7990 – 8010 Å, encompassing the $^{12}C^{14}N$ and $^{13}C^{14}N$ molecular bands, to assess the nitrogen abundance and carbon isotope ratios. Additionally, the oxygen abundance is derived through the evaluation of the forbidden [O I] line at 6300.31 Å.

In Figure 1, we compare the $^{12}C/^{13}C$ and C/N ratios of the investigated stars with models of the thermohaline- and rotation-induced mixing by [3], with the first dredge-up model, and just the thermohaline-induced mixing model by [4]. In Figure 1, the red symbols indicate the stars below the red giant branch (RGB) luminosity bump, the blue colour indicates the stars which are at the RGB bump, and the black colour marks the stars that are above the RGB bump.

Our findings substantiate prior observations, e.g. [5], corroborating the notion that in RS CVn stars characterised by low-mass and large chromospheric activity, processes involving enhanced mixing become operative beneath a luminosity function bump of the evolutionary sequence of red giants.

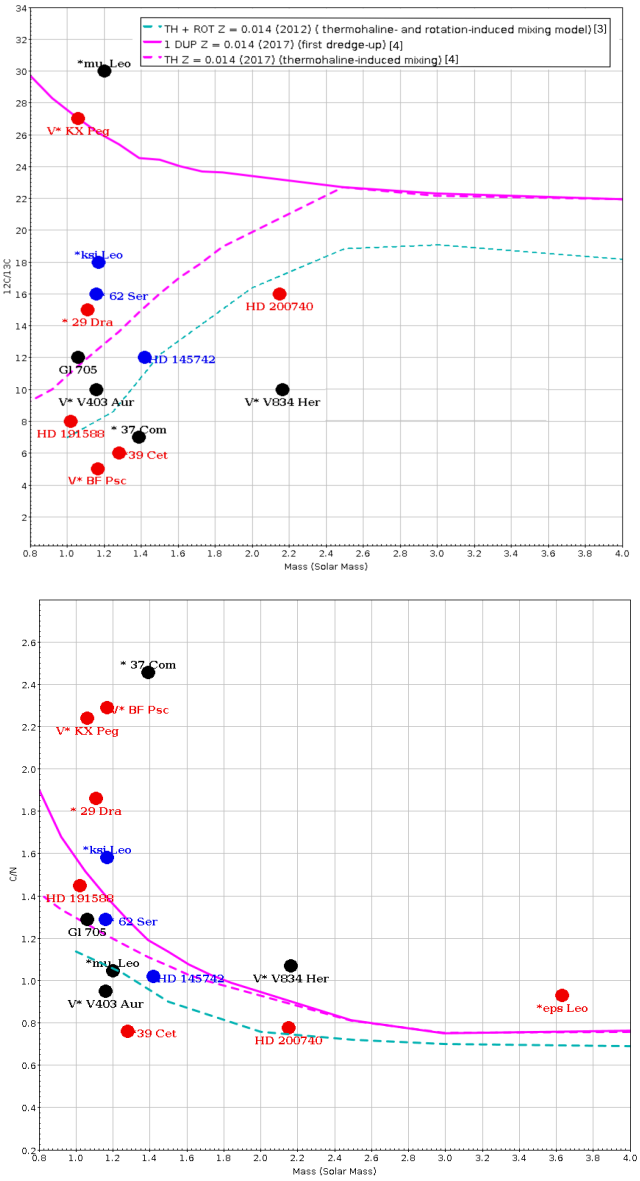

Figure 1: $^{12}C/^{13}C$ and C/N ratios of the investigated stars are compared with theoretical models.

Key words: RS CVn stars, stellar chemical composition

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