A new near-IR C2 linelist for improved chemical analysis of hydrogen deficient carbon-rich giants

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Abstract

Diatomic carbon (C2) is ubiquitous in astronomical environments, from comets and stars to translucent clouds and the interstellar medium. In particular, the C2 bands (mainly the Ballik-Ramsay and Phillips transitions) are an important source of opacity in the near-IR region of carbon stars such as the hydrogen deficient carbon-rich (HdC) or R Coronae Borealis (RCB) stars. Present C2 linelists are still not accurate enough (e.g., in wavelength positions) to model the near-IR spectra of HdC and RCB stars, strongly limiting our ability to properly model their complex spectra and to extract the elemental (an isotopic, when possible) abundances of key elements like C, N, O, F, etc. We have generated a new near-IR C2 linelist (both Ballik-Ramsay and Phillips systems) with the PGopher code, using the Chen et al. (2015) molecular constants to compute line positions and the DUO code to compute line intensities. The synthetic spectrum constructed for the benchmark HdC star HD 137613, using this new C2 linelist, provides an unprecedented match to its high-resolution (R_˜50,000) observed spectrum. The new C2 linelist is thus expected to significantly improve the near-IR chemical analysis for HdC and RCB stars but also for normal carbon stars (e.g., C-rich AGB and dwarf stars) and even Solar System bodies like comets.

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