ExoMol Molecular Line Lists for Exoplanetary Atmospheres. The C_3 Molecule

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Exoplanets' research has become a major field in astronomy during the last decades. Keppler mission has revealed up to 3,278 planet candidates with more than 900 confirmed exoplanets so far. Many of these exotic worlds are expected (or even proven) to have atmospheres. The next logical question is to determine their physical properties and chemical composition. Modelling the atmospheres of exoplanets, most of which are hot objects requires a comprehensive database of molecular abundances. The spectral data of most molecules become hugely complicated at elevated temperatures. ExoMol project [1] has been created to meet demands of exo-planetory science to provide appropriate data. ExoMol database will make a significant theoretical input to the models of atmospheres of exoplanets as well as of other astronomical objects including brown dwarfs, cool stars or even comets.

The C_3 molecule is a reactive species of major importance in both combustion and astrophysics. This triatomic molecule was first discovered in a cometary spectrum [2] and was also seen in atmospheres of cool carbon stars, supergiant circumstellar shells, and interstellar medium. As a part of the ExoMol project we aim at producing a C_3 line list (i.e. a spectroscopic catalogue of transitions) which will help to model the atmospheres of exoplanets, cool carbon-rich stars, comets and interstellar medium. The production of a rotation-vibration line list requires a mixture of first principles quantum mechanical methods and empirical tuning based on laboratory spectroscopic data. These and other aspects of line lists production and their astrophysical applications will be discussed with a specific reference to C_3.

This work was supported by the ERC under Advanced Investigator Project 267219.

[1] J. Tennyson and S. N. Yurchenko, *Mon. Not. R. Astron. Soc.* **2012**, *425*, 21.
[2] W. Hueeins, *Proc. Roy. Soc. London* **1882**, *33*, 1.