Molecular line lists for the opacity of exoplanets, cool stars and other atmospheres

Jonathan Tennyson

Department of Physics and Astronomy, University College London,
London WC1E 6BT, UK, Tel.: +44 20 7679 7809, E-mail: j.tennyson@ucl.ac.uk

At elevated temperatures the spectra of polyatomic molecules become extremely complicated with millions, or even billions, of transitions potentially playing an important role. The atmospheres of cool stars and "hot Jupiter" extrasolar planets are rich with molecules in the temperature range 1000 to 3000 K and their properties are strongly influenced by the infrared and visible spectra of these molecules. So far there are extensive, reliable lists of spectral lines for a number species including some stable diatomics, water, ammonia. Data is almost completely lacking for many key species such as methane.

The ExoMol project (www.exomol.com) aims to construct line lists of molecular transitions suitable for spectroscopic and atmospheric modelling of cool stars and exoplanets [1]. At elevated temperatures it is necessary to consider many millions, even billions, of lines for a single species. Line lists therefore are computed on the basis of robust theoretical models tested against available laboratory data rather than constructed experimentally. Illustrative examples will be discussed and as will progress on obtaining the full set of molecular data. The need to consider other aspects, such as pressure effects, in the radiative transport model will also be considered.

[1] J. Tennyson and S. N,. Yurchenko, Mon. Not. Roy. Astron. Soc. 2012, (submitted). arXiv:1204.0124