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Using the BT2 water line list to interpret cometary spectra in the near IR

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Fundamental transitions from water molecules in cometary coma are absorbed by the Earth's atmosphere. However, solar pumped fluorescent (SPF) transitions to vibrationally excited lower states are able to be detected by high-resolution ground-based observation.

Interpretation of the relative intensities of SPF lines requires a knowledge of the allowed pumping and de-excitation routes together with relevant Einstein A coefficients and degeneracy factors. These data are included in the recently computed, ab initio, Barber-Tennyson water line list (BT2) which contains details of more than 500 million water lines.

We discuss how SPF water lines are being used to determine water production rates, rotational temperatures in the inner coma and nuclear spin temperatures, which are thought to be indicative of temperatures in the region of the primordial nebula where the water molecules were formed. We also discuss the discovery in the spectrum of 9P/Tempel 1 (Deep Impact) of lines originating from higher vibrational states. These lines have not previously been recorded in cometary spectra, and our team at UCL is examining possible mechanisms for their production.