

The water Ortho-to-Para ratio in the coma of comet 67P/C-G measured with VIRTIS-H.

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Water is present in ortho and para forms, corresponding to nuclei spin isomers. The Ortho Para Ratio (OPR) has been measured in about 20 comets, with half of the values found below the high temperature limit of 3, corresponding to a nuclear spin temperature of 30K. The OPR could reflect the temperature conditions at molecular formation (or condensation) in the solar nebula or in the pre-solar molecular cloud. However recent laboratory studies have shown that the OPR can be modified and re-equilibrated in solid and gas phases. Thus the interpretation of the OPR is quite puzzling.

We present measurements of the water OPR obtained from the analysis of VIRTIS-H spectra of the nu3 and nu1 bands of water near 2.7 micron. Preliminary work was presented by Debout (PhD Thesis 2015) and Debout *et al.* (EPSC 2015), who considered STP055 datacubes (pre-perihelion, 6-11 May 2015), and found values for the OPR ranging between 2 and 3.

At the nominal spectral resolution of VIRTIS-H ( $R \sim 2500$ ), the ortho and para lines are well resolved. A database of synthetic fluorescence spectra including fundamental bands and hot bands of water has been generated and used to determine independently the OPR and the rotational temperature from the observations.

We greatly expand the analysis first presented in 2015 by including all the available data from the mission.