**Results of the HssO Key Programme with the Herschel Space Observatory**

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The HssO (Herschel solar system Observations) programme (Hartogh et al., 2009) aims at determining the distribution, the evolution and the origin of water in Mars, the Outer Planets, Titan, and comets, using the three Herschel instruments HIFI, PACS and SPIRE. It addresses the broad topic of

water and its isotopologues in planetary and cometary atmospheres.

* The nature of cometary activity) and the thermodynamics of cometary comae was investigated by studying dust/gas properties (Bockelée-Morvan et al. 2010), composition (Biver et al, 2012, Bockelée-Morvan et al. 2014) and water production and excitation (Hartogh et al. 2010a, de Val-Borro et al., 2010, 2012,2014, Lis et al. 2013) in a sample of comets including one main-belt comet.
* The D/H ratio, the key parameter for constraining the origin and evolution of solar system materials, was determined for the first time in a Jupiter family comet to be the same as the terrestrial value (Hartogh et al, 2011a). D/H observed in an Oort cloud comet turned out to be not compatible with former observations (Bockelée et al, 2012). New measurements of D/H in Giant Planets, similarly to comets constraining the composition of proto-planetary ices, were obtained (Lellouch et al, 2010, Feuchtgruber et al, 2013).
* Isotopic ratios, diagnostics of the evolution of Mars’ atmosphere, were accurately measured in H2O and CO. The role of water vapour in the atmospheric chemistry of Mars is studied based on monitoring vertical profiles of H2O and HDO. Seasonal changes in H2O2 were observed and upper limits of HCl determined. Furthermore the first submillimetre determination of molecular oxygen in the martian atmosphere was performed (Hartogh et al, 2010 b/c) and a SPIRE full range spectrum obtained (Swinyard et al, 2010).
* A cometary origin of Jupiter’s stratospheric water was determined based on measuring its spatial distribution (Cavalié et al, 2013).
* The Enceladus water torus was directly detected/characterized for the first time and is probably the main source of water in Saturn’s and Titan’s upper atmospheres. (Hartogh et al. 2011b, Moreno et al. 2012).
* The composition of Titan’s atmosphere has been measured with high accuracy with SPIRE (Courtin et al, 2011), PACS (Rengel et al. 2014) and HIFI and includes the first detection of hydrogen isocyanide (HNC) (Moreno et al. 2011).

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