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# PROBING THE ATMOSPHERES OF JUPITER AND ITS ICY MOONS WITH RADIO OCCULTATIONS BY THE JUICE SPACECRAFT

**Abstract**

The JUICE (JUpiter ICy Moon Explorer) mission to Jupiter will be launched in 2022, with a planned four year tour of the Jovian system. Jointly with the Israeli Space Agency and Accubeat Ltd, we are developing an Ultra-Stable Oscillator (USO) in order to perform accurate occultation measurements of Jupiter's atmosphere and ionosphere, and the ionospheres of Jupiter's icy moons Europa, Callisto and Ganymede. These measurements are part of JUICE's 3GM experiment (Gravity and Geophysics of Jupiter and the Galilean Moons), a comprehensive investigation addressing the scientific goals of the mission pertaining to gravity, geophysics and atmospheric science with radio occultations. 3GM is funded by the Italian Space Agency (in the role of lead funding agency), the Israeli Space Agency, and other national agencies. We plan on using these occultation measurements to infer the structure, composition and dynamics of these atmospheres.

Radio occultations have a long history in planetary exploration and have proven to be an efficient way of probing planetary atmospheres' density structure, from which temperatures, atmospheric dynamics and

composition of gaseous constituents can be inferred. To date, only a limited number of Radio-occultation soundings of Jupiter's atmosphere and those of Ganymede, Europa, Callisto and Io were made (by the Pioneer and Voyager flybys in the 1970s, and by the Galileo orbiter in the 1990s). The JUICE orbital tour permits the opportunity for numerous occultations of Jupiter and its Galilean Moons. On Jupiter, the occultations can provide a global longitudinal coverage focused around low latitudes, regions that are dominated by over 100 m/s atmospheric jet streams and strong, long-lasting vortices. We expect to be able to probe these regions to depths extending down to 1-2 bars. We will measure vertical ionospheric electron density profiles on the Galilean moons, and use these to characterize the ionization sources, variability and interaction with the Jovian magnetosphere.

The USO enables performing one-way radio occultation experiments, in which a signal, referenced to an onboard USO, is emitted from the spacecraft and subsequently received at a ground station. A second, more powerful, configuration, where the spacecraft transponder, locked to the USO, receives and samples the uplink signal, is also being considered. In both cases the USO is key to successful occultation measurements of JUICE since the stable one-way mode prevents double propagation in the atmosphere in the alternative two-way mode. In this presentation we will review the science, methods and goals of this experiment.