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Probing Ice Giants' Gravity Fields and Atmospheres through Radio Tracking from Earth

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Several mission concepts were proposed in the last few years for the in-situ exploration of the Ice Giants, both by NASA and ESA. In most cases, an orbiter was dedicated to the study of the giant planet(s) and its largest moons. In previous studies, an initial high inclination orbital phase with a very low pericenter distance (as for Juno and Cassini proximal orbits) was foreseen, to enable a detailed mapping of the planet gravity field. In addition, the orbiting mission scenario usually required multiple close flybys of the Ice Giants' major satellites to determine their gravity fields, search for satellite atmospheres, sound the interiors, and image their surfaces at high resolution. Moreover, while the spacecraft would be probing the planetary system(s) it would be occulted by the planet atmosphere as seen from the Earth. Such a configuration offers a unique opportunity to study remotely the physical properties of the occulting atmosphere (probing both its neutral and charged components) using radio links as the spacecraft is being occulted. Indeed, non-null refractivity causes the radio signal to depart from the path which would be expected in vacuum. Additionally, atmospheric occultations also affect the phase velocity of the radio waves. Both changes modify the wave frequency and conversely, from the time variation of the Doppler measurements, the refractivity profile can be retrieved.

This talk will give an overview of the achievable gravity and atmospheric science objectives in potential Ice Giants mission concepts, through a careful design of the spacecraft radio frequency system and the analysis of the tracking data acquired both on the ground and on-board.