AN ADVANCED RADIO SOUNDER FOR A MISSION TO JUPITER AND ITS ICY MOONS

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ABSTRACT

A new planetary advanced radio sounder (PARS) for the radio sounding of Jupiter's icy moons and the surrounding Jovian magnetosphere is under development. It will provide unique remote sensing observations of the plasma and magnetic field environments and the subsurface conductivities of Europa, Ganymede, and Callisto. The instrument will cover the frequency range from 1 kHz to 40 MHz in order to make it possible to automatically assess the spatial structures of ionospheric plasma above the moons from the orbiting spacecraft, and then select the most suitable frequencies for radio probing of the icy moons surfaces. In-situ plasma and magnetic field resonance measurements will supplement the remote sounding measurements similar to the Radio Plasma Imager (RPI) observations from the Imager for Magnetopause-to-Aurora Global Exploration (IMAGE) satellite. Local measurements of induced magnetic fields from salty subsurface oceans are significantly affected by contributions from ionospheric current systems, particularly along inclined moon orbits, so remote imaging of the associated plasma density structures will be critical to modeling of the ionospheric backgrounds for magnetic sensing of oceans below the icy surfaces of these three moons.
The electron densities in the moons' ionospheres are expected to be lower than ~7 MHz, which will allow frequencies from 9 to 40 MHz to be used for subsurface probing. Precision group height techniques based on the phase difference on echoes at two closely spaced, simultaneously transmitted frequencies will measure the accurate depths of subsurface stratifications. The ionospheric (topside) profile measurements will be used to determine the diurnal variations in the sources and sinks of plasma, and will also allow estimating the ionospheric retardation and correct the propagation delays of subsurface echoes.