Performance, Operation and their Feasibilities for Jupiter and Icy Moons: High Frequency Receiver of Radio & Plasma Wave Investigation (RPWI) aboard JUICE

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We are now at the final stage of the development of PFM/FM of Radio & Plasma Wave Investigation (RPWI) aboard the ESA JUICE mission, toward the luanch in 2022. RPWI provides an elaborate suite for electromagnetic fields and plasma environment around Jupiter and icy moons, with 4 Langmuir probes (LP-PWI; 3-axis E-field -1.6 MHz, and cold plasmas), a search coil magnetometer (SCM; 3-axis B-field -20 kHz), and a tri-dipole antenna system (RWI; 3-axis E-field 0.08-45 MHz, 2.5-m tip-to-tip length).

RWI with High Frequency (HF) Receiver have enough sensitivity reaching the galactic background for the highly-resolved Jovian radio emissions from magnetosphere (aurora etc.), atmosphere (lightning), and icy moons. Its direction and polarization capabilities enable us to identify the source locations and characteristics. Their developments are under the collaboration of Japan, France, Poland and Sweden, based on the H/W and S/W designs of Kaguya-LRS, BepiColombo-PWI, Arase-PWE, and Cassini-RPWS. In this paper, we provide the performance and operation concepts with their feasibilities. These are now realistic and enable us to achieve the best performances and quiet environment with enough tolerance for wide temperature range around Venus-Jupiter and harsh plasma environment (charging & intense radiation).

The most difficult parts of the RPWI HF are the sensing of the ionospheres, surface, and subsurface of icy moons duirng the flyby operations and on the orbit around Ganymede. The ionospheres are remotely sensed by the occultation of Jovian radio signals, which has a capability to detect the highest ionopheric density in usual status and expected plume ejection events. The surface and subsurfaces are challenging topics. It is based on the passive subsurface radar (PSSR) concept which sounds the icy crusts of Galilean satellites by the reflections of Jovian radio emissions (HOM/DAM). For continuous and coherent waves, reflector information is determined by spectrum patterns caused by the interference among the direct wave, reflected one from surface, and scattered one by subsurface. For burst waves, the reflection component is determined by cross-correlation of the waveforms for msecs length. It is not easy to reach the top of subsurface ocean directly, because of the strong attenuation in the ice close to its melting temperature just close to the ocean region. However, we arelooking forward to see real data and support the subsurface studies executed by RIME (active radar sounder) and many other payload teams.

Keywords: Jupiter, JUICE, RPWI, Magnetosphere, Icy moons, Subsurface ocean

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