

Passive subsurface radar for exploration of the subsurface structures of Jupiter's icy moons by JUICE/RPWI

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Passive subsurface radar (PSSR) techniques using Jovian hectometric and decametric radiation (HOM/DAM) with long or short duration has been investigated for implementation on JUICE (Jupiter Icy Moons Explorer)/ RPWI (Radio and Plasma Wave Instrument).

In PSSR with continuous waves, the depth of the subsurface reflector can be determined by interference patterns found in the spectrogram of HOM/DAM emissions, which are caused by interference among the HOM/DAM emissions directly from the Jupiter (W1), arrived after surface reflection (W2), and arrived after subsurface reflection (W3). Fine patterns are caused by interference between W1 and W2, and between W1 and W3. Wide patterns are caused by interference between W2 and W3. In order to observe these interference patterns, RPWI is required to resolve 100 Hz, and possess a downlink spectra with a frequency range of 2 MHz and resolution of 1 kHz.

In PSSR with burst waves, the depth of the subsurface reflector can be determined by cross-correlation between the HOM/DAM emissions reflected at the surface and the subsurface reflectors.

The maximum detection depth is highly dependent on the vertical profile of temperature in the ice crust. The attenuation just below the ice crust surface is expected to be ignorable (~0 dB/km). Due to strong attenuation in the ice around melting temperature (>50 dB/km), it is difficult to detect the boundary between the ice crust bottom and the liquid ocean top, but possible to detect partial melts and high-porosity ice layers just below the surface.

Keywords: JUICE (Jupiter Icy Moons Explorer), RPWI (Radio and Plasma Wave Instrument), Passive Radar, Jovian HOM/DAM