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# SCIENCE GOALS AND TECHNICAL CHALLENGES IN THE DESIGN OF AN ICE PENETRATING RADAR FOR THE JUPITER ICY MOONS

**Abstract**

This contribution presents the science goals and the concepts of the Ice Penetrating Radar (IPR) instrument included in the model payload of the Jupiter Icy Moons Explorer (JUICE) mission. This instrument is an adaptation to the new JUICE mission profile (which includes flybys to Europa) of the radar concept designed for the Jupiter Ganymede Orbiter (JGO) in the Europa Jupiter System Mission (EJSM) [1]. The IPR instrument is a radar sounder at low frequency (HF/VHF band) designed to penetrate the surfaces of Jovian moons for performing a sub-surface analysis. In the scenario of the JUICE mission, IPR will acquire data during the flybys on Callisto and Europa, and will operate on Ganymede during the two circular orbital phases.

The IPR instrument can be optimized for acquiring information in the first few kilometers of the sub-surface with a relatively high range resolution, or for achieving high penetration with a reduced range resolution. At the present, the option recommended for optimizing scientific returns is based on a system

with 6-9 km penetration capability and a vertical resolution of 30 m. This system can achieve a large number of scientific goals on Jupiter moons related to geology and geophysics, to the structure of the sub-surface patterns and icy layers, and to the detection of shallow liquid resources.

The paper will address the main scientific goals related to the current design of the IPR. Then the attention will be focused on the main technical challenges. These will be analyzed and discussed by pointing out the most recent developments in terms of: i) instrument concept and parameters tuning; ii) signal-to-clutter and signal-to-noise ratio; iii) constraints for the choice of the instrument central frequency (Jupiter radiation noise, penetration capability) and bandwidth; iv) acquisition strategy during Europa flybys; v)radiation environment.

References [1] L. Bruzzone, G. Alberti, C. Catallo, A. Ferro, W. Kofman, R. Orosei, "Sub-Surface Radar Sounding of Jovian Moon Ganymede," Proceedings of the IEEE, Vol. 99, No.5, pp. 837-857, 2011.