

IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Interactive Presentations - IAF MATERIALS AND STRUCTURES SYMPOSIUM (IP)

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CHALLENGES IN THE DESIGN OF ULTRALIGHT MECHANISMS FOR DEEP SPACE
EXPLORATION - BASED ON RPWI INSTRUMENTS FOR ESA JUICE MISSION

Abstract

The Radio Plasma Wave Instrument (RPWI), onboard the ESA JUICE mission, will investigate the cold plasma properties around Jupiter's icy moons. The essential part of the RPWI are the mechanisms: RWI 3-axial antenna and four LP-PWI booms with Langmuir Probes. Both types of mechanisms will be deployed on low Earth orbit, although, they will have to survive the extreme environmental conditions during the cruise to Jupiter (hot case at 0.645 AU, long cold Jovian eclipse) and in operational phase in Jupiter vicinity. The challenge becomes even harder, when considering the size of mechanisms after their deployment (2.5 m for the antenna and 3 m for each boom) and restricted mass requirements (less than 2 kg for each mechanism).

This paper includes the characterization of the environmental loads and conditions during the JUICE mission and the description of both mechanisms designs with solutions necessary to fulfil these difficult requirements. Many of mechanical solutions were implemented during the design phase, including the selection of materials, coatings and processes. All of these activities were carefully applied after the detailed test campaigns. The most important of these results are also presented in this article. The final part of the paper provides information on the complications encountered during the test campaign, mainly the temperature limitations of thermal vacuum chambers causing difficulties with performing thermal vacuum cycling in the full temperature range expected during the mission. The summary of mechanisms development is presented at the end of the paper, together with solutions that were rejected during the design phase (along with the explanation why they were not applied in the final design).