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# JUICE PLANETARY PROTECTION ANALYSIS

**Abstract**

Scheduled for launch in 2022, with arrival in the Jovian system in 2029, JUICE is the first ESA large-class mission in the Cosmic Vision programme and it will spend three-and-a-half years examining the giant planet's turbulent atmosphere, its enormous magnetosphere, its set of tenuous dark rings and its satellites. In particular it will dedicate considerable time in the Jovian system to study the large icy moons Ganymede, Europa and Callisto, which are thought to have oceans of liquid water beneath their icy crusts – perhaps even harbouring habitable environments: 26 flybys will have to perform around Ganymede, Europa and Callisto, navigating through the Jovian system to visit the three Galilean moons and guaranteeing that Europa will not be contaminated under any possible mission failure. Because of its subsurface ocean that could potentially host life, Europa is actually the most sensitive body, which is driving the planetary protection case.

These ambitious mission goals make JUICE planetary protection analysis especially critical, intending by planetary protection the guiding principle in the design of an interplanetary mission, aiming to prevent biological contamination of both the target celestial body and the Earth (this latter only in the case of sample-return missions): since JUICE does not foresee any return to Earth, the main planetary protection challenges concern Mars and Europa contamination. In fact, the Red Planet and icy Jovian moon are, together with Enceladus, the only solar system bodies classified as category IV (the highest after Earth category V) and applicable to planets and moons "where there is a significant chance that contamination carried by a spacecraft could jeopardize future exploration".

As Airbus Defense  Space subcontractor, DEIMOS has been in charge of the JUICE planetary protection analysis, especially focusing on the Mars fly-by (during the outbound cruise) and on Europa impact probability in case of any spacecraft failure during the Jupiter tour. The dynamically chaotic nature of the Jovian system sensibly increases the complexity of long term propagations and challenges the state-of-the-art techniques usually employed for impact probability calculations. In the proposed paper the solution adopted and the JUICE planetary protection analysis will be presented, detailing the Monte Carlo campaign results for the long and short term Mars and Europa scenarios, and illustrating the solutions obtained for the 41 arcs considered for the cruise phase and for the 123 arcs of the Jupiter tour.