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HYBRID OPTIONS FOR THE JUPITER GANYMEDE ORBITER

Abstract

The Jupiter Ganymede Orbiter is the ESA-led element of the ESA-NASA joint mission called Europa Jupiter System Mission (EJSM). While the NASA Jovian Europa Orbiter (JEO) will be dedicated to inner Galilean moons Io and Europa, the JGO will be dedicated to the study of the Jupiter's larger Galilean moons Callisto and Ganymede. JEO and JGO will execute a choreographed exploration of the Jupiter System before settling into orbit around Europa and Ganymede respectively.

JGO will be built to accommodate the moderate radiation environment outside of Europa orbit. It would consist mainly of a solar powered orbiter with 10 science instruments designed for in situ measurements and remote sensing of Jupiter and the inner satellites, close observations of Callisto and for extensive mapping of Ganymede.

The JGO orbiter belongs to the class of large interplanetary spacecraft with a wet mass of few tons and chemical propellant mass in the order of 2500 – 3000 kg. Previous JGO related studies performed by ESA clearly have shown that few important mission architecture aspects related to the launch and interplanetary transfer scenario are rather fixed as a result of the scientific objectives of the mission. The JGO baseline scenario considers an Ariane 5 ECA launch from Korou that inserts the spacecraft into a classical Venus-Earth-Earth Gravity Assist (VEEGA) transfer to Jupiter. The transfers require in some cases intermediate manoeuvres (DSMs) in between the body encounters that are applied by the on board chemical propulsion system.

An alternative to this pure chemical option is a hybrid propulsion configuration, which is a combination of electric and chemical propulsion. The hybrid option was analyzed by GMV and OHB in one of the three consortiums involved in the pre-phase A studies of the mission. This propulsion configuration makes use of Solar Electric Propulsion (SEP) to effectively and efficiently increase the available payload and mass margins at Jupiter arrival. The SEP does not introduce larger modification in the spacecraft configuration, since the solar panels are already available for operation in the Jovian environment, and makes use of what will be flight proven technology at 2020.

This paper introduces the hybrid option concept for JGO, addressing its advantages and drawbacks. The interplanetary transfers with chemical and hybrid options are presented. Finally, a comparison of both transfer strategies in terms of relevant mission analysis figures of merit (mass at arrival and total delta-V needed) is shown.