Modeling the interactions between Callisto's neutral and ionized environments and the Jovian magnetosphere

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Callisto is the most distant of the four Galilean moons, orbiting at around 26.3 Jovian radii from its planet. Composed of equal parts rock and ice, the moon has a tenuous atmosphere composed mainly of O_2 [Cunningham et al., 2015] and CO_2 [Carlson, 1999], as well as an ionosphere characterized by densities of up to 10^4 cm^{-3} [Kliore et al., 2002]. During flybys of Callisto, NASA's Galileo mission detected an induced magnetic field compatible with the signature of a subglacial ocean. The moon's environment interacts with the Jovian magnetosphere (surface erosion, Alfvén wings, etc.), whose physical characteristics vary greatly during its orbit, with a wide excursion in magnetic latitude.

While the JUICE mission plans to carry out several flybys of Callisto, the interaction between the moon and Jupiter's magnetosphere remains poorly understood. Simulations describing the neutral and ionized environments of the Jovian satellite must therefore be set up. These simulations will use the LatHyS hybrid multi-species parallel 3D model [Modolo et al., 2016; 2018] already used to describe the environment of Ganymede and Europa in particular. The Larmor radii of freshly generated pick-up ions of O_2^+ and CO_2^+ being larger than the moon radius, a kinetic approach for the ion dynamic is more appropriate than a fluid model and is enable to capture asymmetries in Callisto's plasma interaction. Simulation results will be compared with Galileo in-situ observations.