

The Europa Clipper Gravity and Radio Science (G/RS) Investigation

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NASA's Europa Clipper flagship mission launched on October 14, 2024 and will arrive at Jupiter in April 2030. There, it will investigate the habitability of Jupiter's moon Europa. Gravity and Radio Science (G/RS) is one of ten complementary investigations devoted to understanding Europa through studies of its ice shell and ocean, its composition, and its geology. G/RS makes use of the Europa Clipper telecommunications system to obtain radiometric tracking data during the Europa flybys.

Unlike past missions, the primary raw data for the G/RS investigation are obtained from Open-Loop Receivers (OLR) at the Deep Space Network (DSN) ground stations. Indeed, the flyby geometry, spacecraft attitude, and spacecraft antenna configuration are such that the signal-to-noise ratio of the return radio signals will be small (<10 dB-Hz) and insufficient for the typical closed-loop tracking. Processing of the OLR with special retracking algorithms will be necessary to obtain range-rate (Doppler) observations. Given the lack of a stable oscillator onboard Europa Clipper, two-way tracking will be used to achieve high frequency stability, leveraging the accurate DSN clocks. Radio tracking during the flybys will be performed at a single frequency (X-band), so careful modeling of media perturbations is important to maximize the G/RS results. We will discuss recent work to assess the impact of media perturbations from the Io Plasma Torus on orbit reconstruction and geophysical parameter recovery.

G/RS will obtain measurements of Europa's static and time-variable gravity field. The tidal Love number k_2 will verify the presence of a subsurface ocean and help constrain the ice shell. The moment of inertia, derived from degree-2 gravity coefficients, will help determine the interior structure. The radio tracking data will also be sensitive to Europa's ionosphere when geometry allows.

We will present the G/RS investigation and observation plans, its expected performance, and provide a first look at the tracking data during cruise.