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Status of the Ganymede Laser Altimeter (GALA) for ESA's Jupiter Icy Moons Explorer (JUICE)

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The Ganymede Laser Altimeter (GALA) is one of the instruments selected for ESA's Jupiter Icy Moons Explorer (JUICE). A fundamental goal of any exploratory space mission is to characterize and measure the shape, topography, and rotation of the target bodies. A state of the art tool for this task is laser altimetry because it can provide absolute topographic height and position with respect to a body centered reference system.

With respect to Ganymede, the GALA instrument aims at mapping of global, regional and local topography; confirming the global subsurface ocean and further characterization of the water-ice/liquid shell by monitoring the dynamic response of the ice shell to tidal forces; providing constraints on the forced physical librations and spin-axis obliquity; determining Ganymede's shape; obtaining detailed topographic profiles across the linear features of grooved terrain, impact structures, possible cryo-volcanic features and other different surface units; providing information about slope, roughness and albedo (at 1064nm) of Ganymede's surface.

After several flyby's (Ganymede, Europa, Callisto) it is scheduled that the JUICE orbiter will enter first into an elliptical orbit (200 km x 10.000 km) for around 150 days and then into a circular orbit (500 km) around Ganymede for 130 days.

Accordingly to the different orbits and trajectories, distances to the moons respectively, the spot size of the GALA laser varies between 21 m and 140 m.

GALA uses the direct-detection (classical) approach of laser altimetry. Laser pulses are emitted at a wavelength of 1064 nm by using an actively Q-switched Nd:Yag laser. The pulse energy and pulse repetition frequency are 17 mJ at 30 Hz (nominal), respectively. For targeted observations and flybys the frequency can be switched to 50 Hz. The emission time of each pulse is measured by the detector. The beam is reflected from the surface and received at a 25 cm diameter telescope. The returning laser pulse is refocused onto a silicon avalanche photodiode (APD) through back-end optics including a narrow bandpass interference filter for isolating the 1064 nm wavelength. The APD-signal is then amplified, sampled and fed to a digital range finder. This system determines the time of flight, pulse intensity, width and full shape. The GALA instrument is developed in collaboration of institutes and industry from Germany, Japan, Switzerland and Spain.