

## Investigation of the Galilean Moons with the Ganymede Laser Altimeter (GALA)

HUSSMANN, Hauke<sup>1\*</sup> ; LINGENAUER, Kay<sup>1</sup> ; MICHAELIS, Harald<sup>1</sup> ; KOBAYASHI, Masanori<sup>2</sup> ; THOMAS, Nicolas<sup>3</sup> ; LARA, Luisa M.<sup>4</sup> ; ARAKI, Hiroshi<sup>5</sup> ; BEHNKE, Thomas<sup>1</sup> ; GWINNER, Klaus<sup>1</sup> ; KIMURA, Jun<sup>6</sup> ; NAMIKI, Nori<sup>2</sup> ; NODA, Hiroto<sup>5</sup> ; OBERST, Juergen<sup>1</sup> ; ROATSCH, Thomas<sup>1</sup> ; RODRIGO, Rafael<sup>4</sup> ; SASAKI, Sho<sup>7</sup> ; SEIFERLIN, Karsten<sup>3</sup> ; SPOHN, Tilman<sup>1</sup> ; BARNOUIN, Olivier<sup>8</sup> ; BREUER, Doris<sup>1</sup> ; CASOTTO, Stefano<sup>9</sup> ; CASTRO, Jose<sup>4</sup> ; CHOBLET, Gael<sup>10</sup> ; CHRISTENSEN, Ulrich<sup>11</sup> ; FERRAZ-MELLO, Sylvio<sup>12</sup> ; GIESE, Bernd<sup>1</sup> ; KALLENBACH, Reinald<sup>11</sup> ; KURITA, Kei<sup>13</sup> ; LAINEY, Valery<sup>14</sup> ; LICHOPOL, Alexander<sup>1</sup> ; LOETZKE, Horst-georg<sup>1</sup> ; LUPOVKA, Valery<sup>15</sup> ; MOORE, William B.<sup>16</sup> ; RODRIGUEZ, Adrian<sup>6</sup> ; SANTOVITO, Maria rosaria<sup>17</sup> ; SCHREIBER, Ulrich<sup>18</sup> ; SCHROEDTER, Rolf<sup>1</sup> ; SOHL, Frank<sup>1</sup> ; DEL TOGNO, Simone<sup>1</sup> ; VERMEERSEN, Bert<sup>19</sup> ; WIECZOREK, Mark<sup>20</sup> ; YSEBOODT, Marie<sup>21</sup>

<sup>1</sup>DLR Institute of Planetary Research, Berlin, Germany, <sup>2</sup>Chiba Institute of Technology, Planetary Exploration Research Center, Chiba, Japan, <sup>3</sup>Physics Institute, University of Bern, Switzerland, <sup>4</sup>CSIC, Instituto de Astrofísica de Andalucía, Granada, Spain, <sup>5</sup>National Astronomical Observatory of Japan, Mizusawa, Japan, <sup>6</sup>Earth-Life Science Institute, Tokyo Institute of Technology, Japan, <sup>7</sup>Osaka University, Toyonaka Japan, <sup>8</sup>Space Dept., The Johns Hopkins University Applied Physics Laboratory, Laurel, MD, USA, <sup>9</sup>University of Padua, Dept. of Physics and Astronomy and Center for Space Studies, Padova, Italy, <sup>10</sup>Laboratoire de Planetologie et Geodynamique de Nantes, France, <sup>11</sup>Max Planck Institute for Solar System Research, Katlenburg-Lindau, Germany, <sup>12</sup>Institute of Astronomy, Geophysics and Atmospheric Science, Sao Paulo, Brasil, <sup>13</sup>University of Tokyo, Earthquake Research Institute, Tokyo, <sup>14</sup>IMCCE-Observatoire de Paris, France, <sup>15</sup>Moscow State University of Geodesy and Cartography, (MIIGAiK), Russia, <sup>16</sup>Hampton University, National Institute of Aerospace, USA, <sup>17</sup>CO.R.I.S.T.A. Consortium of Research on Advanced Remote Sensing Systems, Napoli, Italy, <sup>18</sup>Technische Universität München, Fundamentalstation Wettzell, Germany, <sup>19</sup>Astrodynamics & Space Missions, Faculty of Aerospace Engineering, TU Delft, Netherlands, <sup>20</sup>Institut de Physique du Globe de Paris, France, <sup>21</sup>Royal Observatory of Belgium, Brussels, Belgium

The icy moons of Jupiter ? Europa, Ganymede, and Callisto ? are believed to contain global subsurface water oceans underneath their icy crusts. The possibility is intriguing that these large liquid water oceans represent "habitable" environments. Investigation of the latter is a major objective of ESA's Jupiter Icy Moons Explorer (JUICE) mission. The Ganymede Laser Altimeter (GALA) is one of the instruments focusing on aspects related to the presence and characterization of subsurface water oceans by measuring Ganymede's tidal deformation. GALA will further contribute (a) to the exploration of the surface morphology and physical properties of Ganymede, Europa and Callisto, (b) to determination of their interior structures from a combination of shape, topography and gravitational field data, and (c) to understanding the satellites formation and evolution especially with respect to subsurface water oceans. GALA will investigate the surface and topography of Ganymede in particular. Topography data is needed to account for the effects of topographic heights on the gravity field and to account for near surface mass distribution anomalies above the reference figure; to support geological studies, e.g. to identify and characterize tectonic and cryo-volcanic regions on the icy moons and to identify periodic variations of Ganymede's shape due to tides.

Investigations by GALA will furthermore contribute to determine the orientation and rotational state of Ganymede and to study surface characteristics (roughness, slopes, and albedo) on Ganymede, Europa, and Callisto.

The instrument can be operated from ranges smaller than about 1000 to 1300 km (depending on the different albedo values and surface slopes of Europa, Ganymede and Callisto) during flybys and orbital pericenter passages. The main phases for acquiring data at Ganymede are the final circular orbit phases, where continuous operations are possible from altitudes around 500 km and 200 km, respectively.

Here, we will give an overview on the GALA experiment focusing on its scientific goals and performance.

Keywords: Laser altimetry, Satellites of Jupiter, Ganymede, Tides