Interference Tests with the JUICE J-MAG Qualification Model

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In August 2020, the J-MAG team carried out interference measurements with the qualification model of a magnetometer developed for ESA's JUICE mission. The follow-up flight instrument will be launched in 2022 and will explore the Jupiter system.

The JUpiter ICy moons Explorer (JUICE) is European Space Agency's (ESA) first mission to the outer solar system. It will carry a total of ten scientific experiments to study the gas giant Jupiter and three of its largest moons, Ganymede, Callisto and Europa. The mission will be launched in September 2022 and its arrival at Jupiter will take place in 2031.

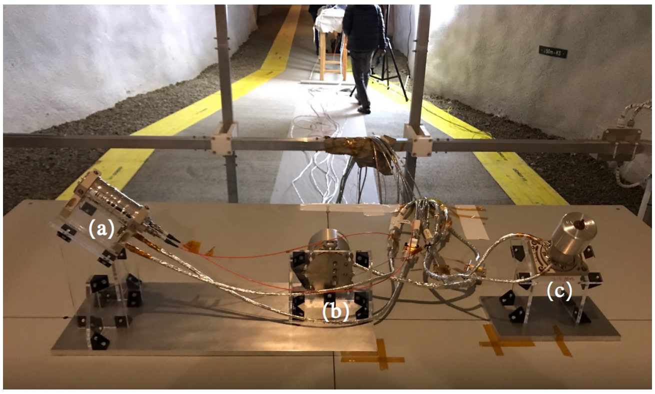

Figure 1: The optical scalar (a) and the two fluxgate vector sensors (b) and (c) were installed in the Merritt coil system in order to simulate the magnetic environment of Jupiter.

The J-MAG instrument is being developed for the JUICE mission by the J-MAG consortium, formed to implement, operate and exploit the magnetic field investigation on JUICE, led by Imperial College London (ICL). The instrument consists of a very specific design with two fluxgate vector sensors and one scalar sensor with low absolute error. One of the fluxgate sensors and associated electronics are provided by ICL, the second fluxgate sensor and associated electronics are developed by Technische Universität Braunschweig (TUBS), and the scalar sensor and associated electronics are provided by the Space Research Institute of the Austrian Academy of Sciences (AAS) in Graz, in close cooperation with the Institute of Experimental Physics of the Graz University of Technology (TUG). The J-MAG magnetometer will measure the magnetic field vector and magnitude (in the bandwidth from DC to 64Hz) in the spacecraft vicinity on a 10.5-meter-long boom.

The test campaign at the Conrad Observatory included timing tests to correlate the measurements of the individual sensors, a simulation of rotating fields with the new Merritt coil system in order to confirm that the on-board calculations needed to operate the scalar instrument are done properly, and several overnight measurements to characterize the stability and frequency response of the sensors. Additionally, the influence of supply voltage variations as well as of the sensors' operational and survival heaters on the magnetic field measurement of the other sensors were investigated.

The Merritt coil system located in the magnetically quiet and thermally stable environment at the Conrad Observatory provides a unique opportunity to evaluate the performance of the entire J-MAG instrument as a whole.

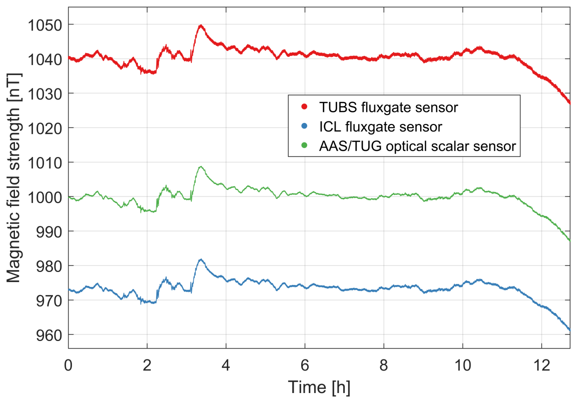

Figure 2: The Merritt coil system compensated the Earth field down to a strength of approximately 1000nT at the beginning of the measurement. The dynamic compensation of additional Earth field variations was paused afterwards and all three sensors followed the Earth field variations overnight. Gains and offsets of the fluxgate sensors are not calibrated in this plot which explains the DC shifts to the optical scalar sensor.

References:

[1] O. Grasset et al.: JUpiter ICy moons Explorer (JUICE): An ESA mission to orbit Ganymede and to characterise the Jupiter system, Planet. Space Sci. 78, 1-21., https://doi.org/10.1016/j.pss.2012.12.002, 2013.

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