Test Campaign with the Flight Model of the JUICE Magnetometer

Irmgard Jernej, Patrick Brown, Hans-Ulrich Auster, Richard Baughen, Andreas Pollinger, Christian Hagen, Alexander Betzler, Alex Strickland, Rachel Hudson, Christoph Amtmann, Werner Magnes, Roland Lammegger, Michele Dougherty

In April 2021, performance tests with the Flight Model of the JUICE magnetometer took place in the Merritt coil system of the Conrad Observatory. With the coil system the magnetic environment of Jupiter was simulated so that the proper functioning of the magnetometer could be examined under realistic field conditions.

The Jupiter icy moons explorer (JUICE) is a planetary space science mission by the European Space Agency. The satellite was successfully launched on 14th of April 2023 from the European space port in French Guyana (Grasset et al., 2013, https://doi.org/10.1016/j.pss.2012.12.002). In July 2031 the spacecraft will enter the orbit around Jupiter and in December 2034 it will start the detailed investigation of Ganymede along a circular orbit 500 km and then 200 km above the surface. The JUICE spacecraft is equipped with a total of 10 scientific instruments, one of which is the JUICE magnetometer (J-MAG). It is led by Imperial College London. The instrument contains three sensors: two vector fluxgate sensors (IBS & OBS) and an optical scalar sensor (SCA), which provides accurate reference measurements for the in-flight-calibration of the two fluxgate sensors. OBS was built by Imperial College London, IBS by the Technical University Braunschweig and SCA was developed by the Austrian Academy of Sciences in cooperation with the Graz University of Technology. In flight configuration, the OBS and SCA sensors are mounted at the very end of a 10.6 m long boom whereas the IBS sensor is located 3 metres closer to the spacecraft.

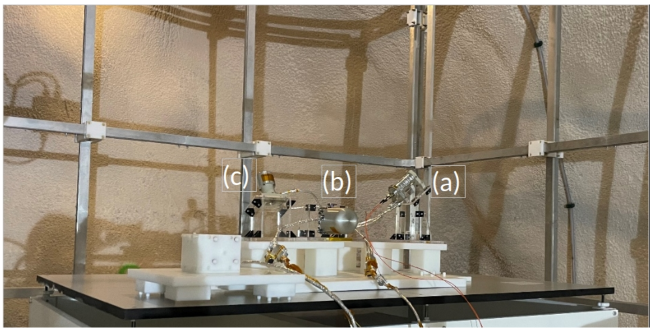

Figure 1: The scalar (a) and the two fluxgate sensors (b and c) in the center of the Merritt coil. Only the distance between OBS and IBS is not flight like.

In April 2021, part of the final performance tests of the J-MAG flight instrument took place with the sensors in the Merritt coil system of the Conrad Observatory. The magnetically clean and temperature stable conditions in conjunction with the large coil system provided a perfect environment for this test campaign. The sensors were installed on jigs that defined their position and orientation to each other as realised on the magnetometer boom aboard the JUICE satellite. Only the distance between IBS and the other two sensors had to be reduced. Firstly, the possibility for mutual interferences between the sensors were investigated: interference between the operational heaters and the magnetic field measurements, influence of the triple sensor configuration on the output of the sensors and magnetic field generated by the auxiliary coil of SCA at the position of OBS. Secondly, the transfer functions of the sensors were measured and thirdly, the magnetic field in the vicinity of Jupiter was simulated with the Merritt coil system, in order to confirm that the J-MAG operates accurately at the expected magnetic field strength and that the acquired field vector information needed to decide on the measurement mode of the scalar sensor is transferred correctly from the fluxgate sensors to the scalar sensor. The campaign at the Conrad Observatory confirmed that the J-MAG flight model meets the performance requirements of the JUICE mission.

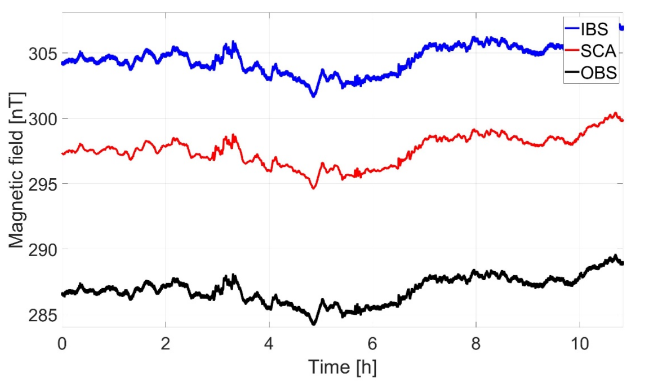

Figure 2: All three sensors follow the Earth's field variations along magnetic North during a several hours long continuous measurement. The Merritt coil system was used to reduce the Earth's magnetic field to approximately 300 nT. An artificial offset was added to IBS and OBS to get a clear separation between the readings of the three sensors.

Authors:
I. Jernej[1], P. Brown[2], H.-U. Auster[3], R. Baughen[2], A. Pollinger[1], C. Hagen[1], A. Strickland[2], R. Hudson[2], A. Betzler[1], C. Amtmann[4], W. Magnes[1], R. Lammegger[4], M. Dougherty[2]
1) Space Research Institute, Austrian Academy of Sciences, Austria
2) Blackett Laboratory, Imperial College London, United Kingdom
3) TU Braunschweig, Germany
4) Graz University of Technology, Austria

Corresponding author:
Irmgard Jernej
Space Research Institute, Austrian Academy of Sciences
Schmiedlstraße 6, 8042 Graz, Austria
Tel.: +43 (316) 4120 565
e-mail: irmgard.jernej@oeaw.ac.at