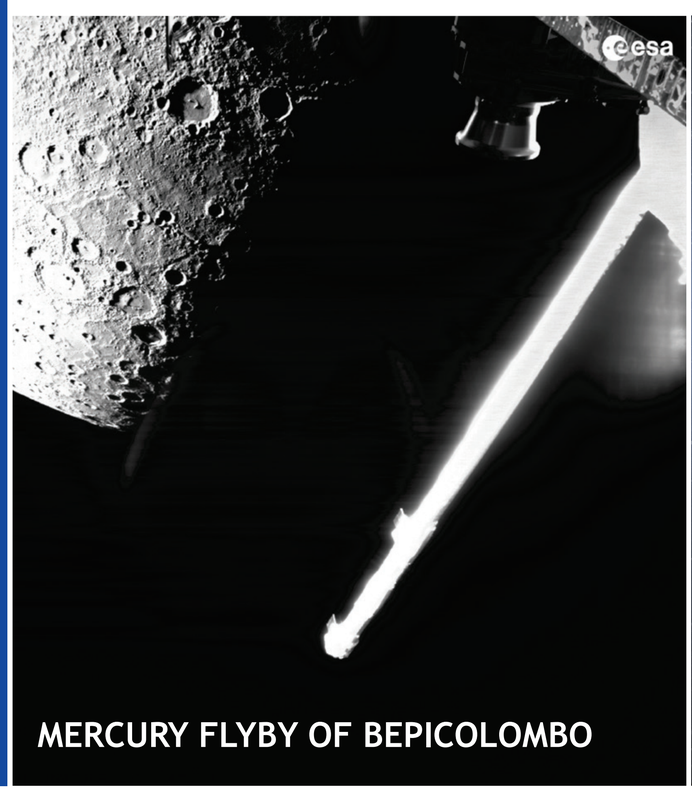
ÖAW IWF

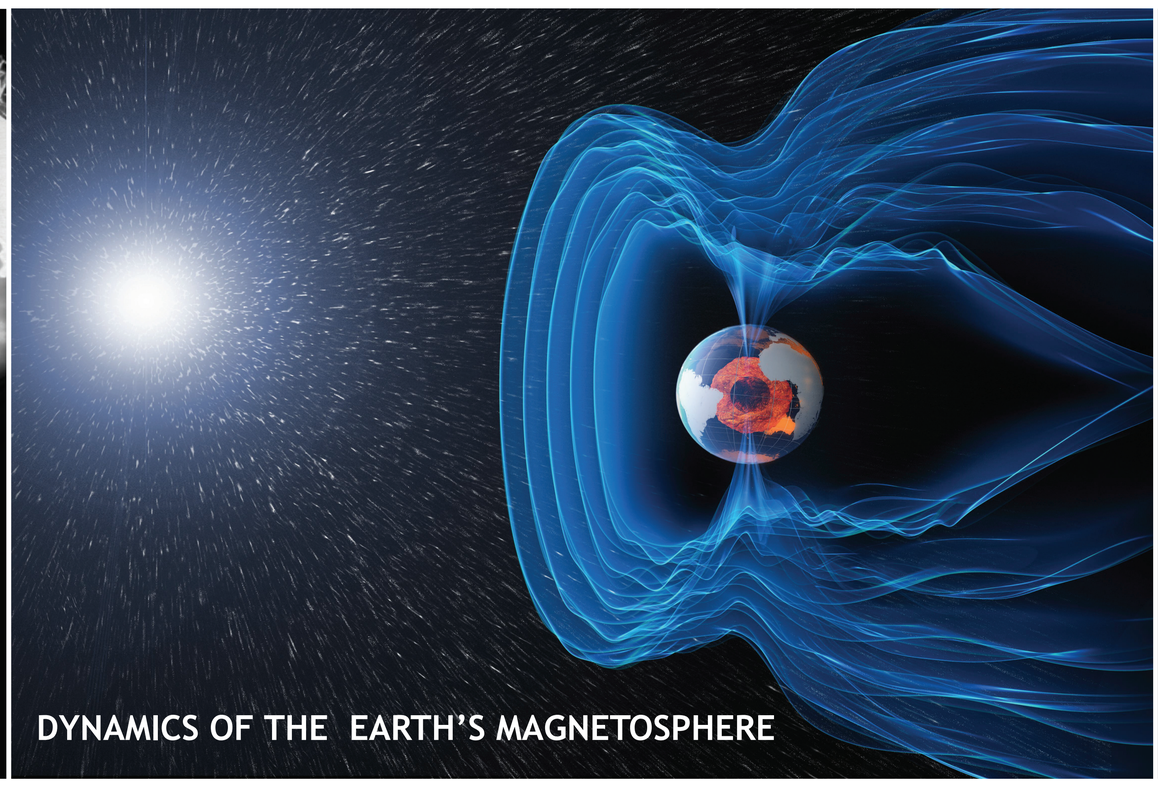
SPACE MAGNETOMETERS

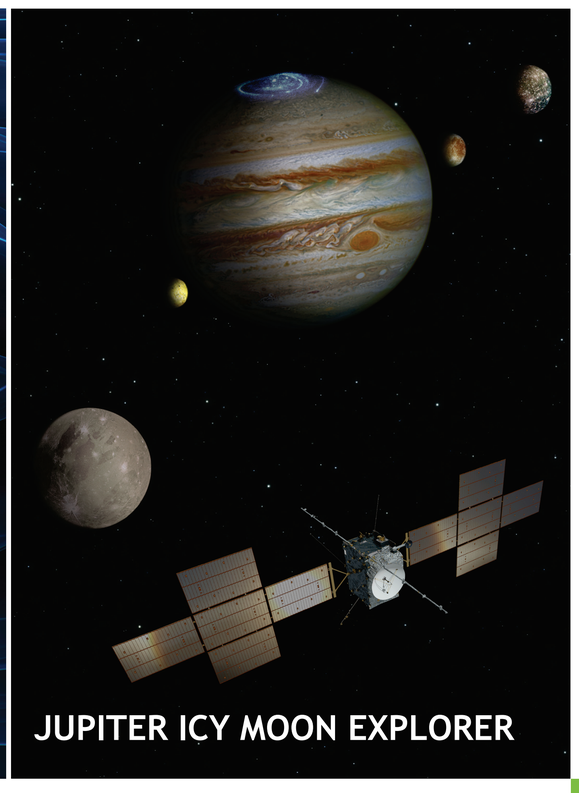
Werner Magnes, M. Agú, G. Berghofer, A. Betzler, M. Delva, D. Fischer, G. Fremuth, I. Jernej, C. Kürbisch, S. Laddha, M. Leichtfried, C. Lentz, R. Steinhöfler, A. Valavanoglou, R. Wallner, F. Weichbold, J. Wilfinger

MORE ABOUT US



MERCURY FLYBY OF BEPICOLOMBO


DYNAMICS OF THE EARTH'S MAGNETOSPHERE

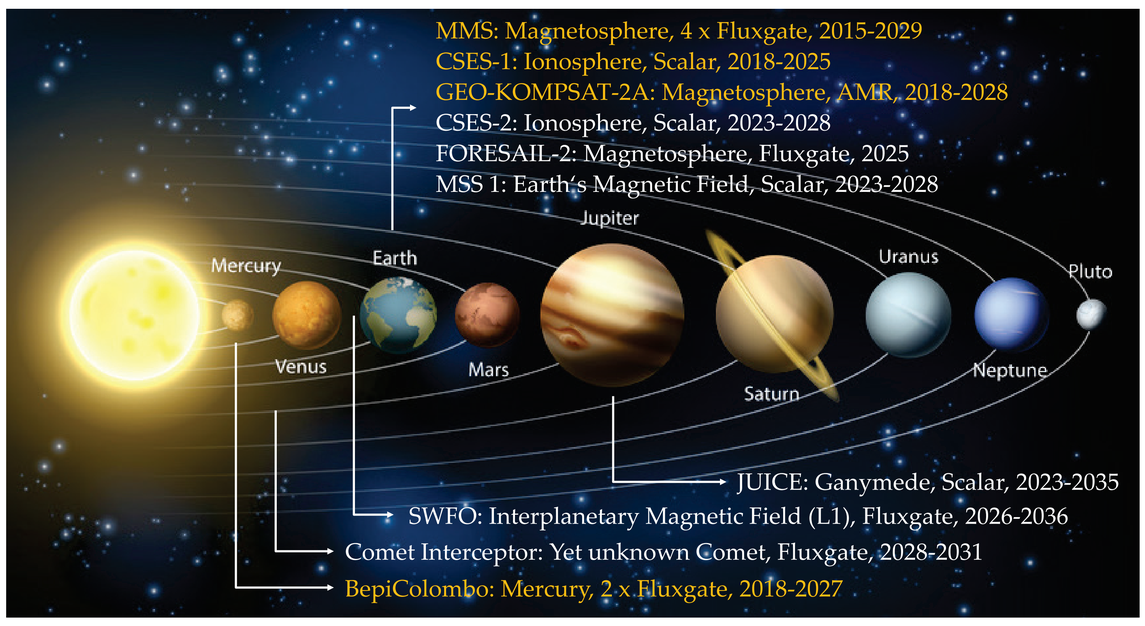

JUPITER ICY MOON EXPLORER

MAIN RESEARCH QUESTIONS

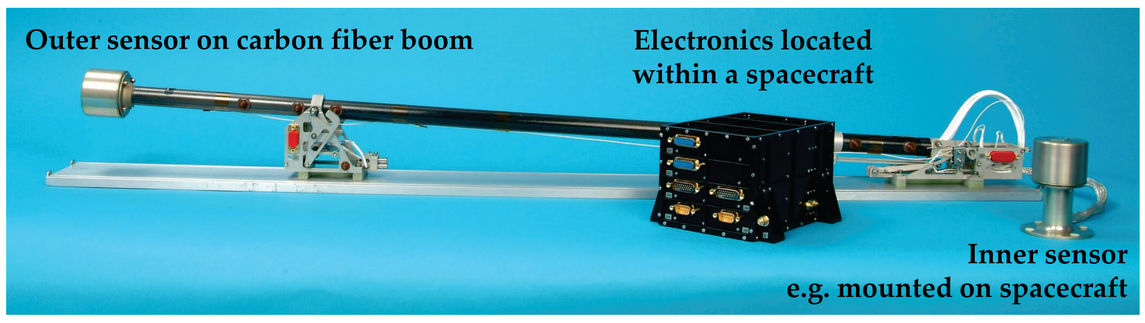
- **Design and development of high precision space magnetometers**
- **Ground and inflight calibration**
- **Miniaturization of frontend electronics for fluxgate magnetometers**
- **Development of optical magnetometers for scalar and vector field measurements**

MISSION INVOLVEMENT

Magnetic fields are one of the essential quantities measured during planetary space missions, as they reveal fundamental information about the interior of the studied body and its interaction with its space environment. The development of magnetometers has a long tradition at the IWF. At present, our group is involved in seven future and four more operational missions in space.



TYPICAL SPACE MAGNETOMETER DESIGN

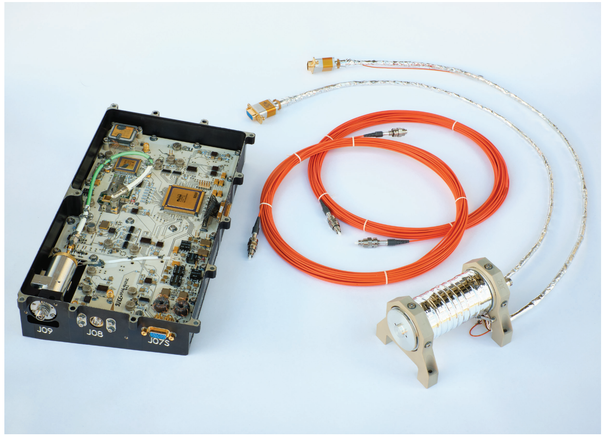


KEY EXTERNAL COLLABORATION

- Institute of Electronics, Graz University of Technology (TU Graz)
- Institute of Experimental Physics, TU Graz
- Imperial College London, United Kingdom
- Technische Universität Braunschweig, Germany
- University of New Hampshire, USA
- Institute of Space and Astronautical Science, Japan

OPTICAL MAGNETOMETER

The IWF has developed a new type of scalar magnetometer in co-operation with the Institute of Experimental Physics of TU Graz. It has experienced its space approval aboard the China Seismo-Electromagnetic Satellite CSES-1 in 2018. Three more instruments are ready for launch on JUICE, CSES-2 and the Macao Science Satellite (MSS) 1.


Optical scalar magnetometer for ESA's Jupiter mission JUICE

The instrument is based on two-photon spectroscopy of free alkali atoms. In a special laser-based excitation mode, three different magnetic field dependent resonances arise in the presence of an external magnetic field. This enables an omni-directional all-optical scalar magnetic field measurement without the need for moving parts, feedback coils and active electronics at the sensor.

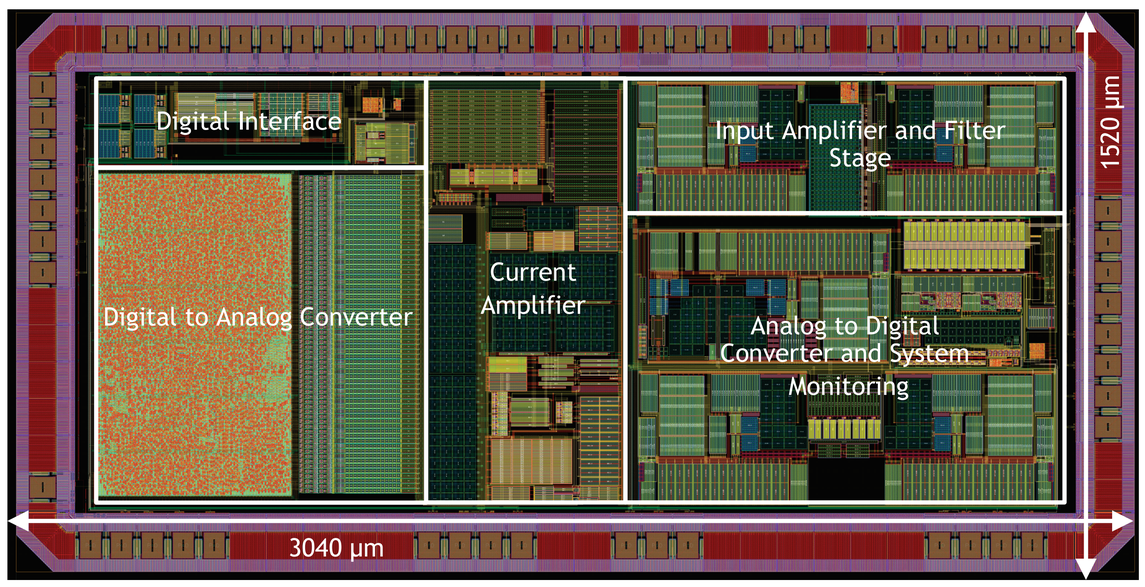
Ellmeier et al. 2023, Measurement: Sensors.

Further development will expanded the system to a vector mode based on the non-linear Hanle effect. First studies have just started in the frame of the Young Researcher Program in interdisciplinary space science and planetary research (YRP@Graz).

MICROCHIP BASED NEAR-SENSOR ELECTRONICS

The IWF and the Institute of Electronics of TU Graz collaborate on the next generation of the space-proven magnetometer front-end microchip. It includes the readout electronics for magnetic field sensors and is optimized in terms of size and power consumption. The currently developed prototype shall prove a larger dynamic range and an increased radiation hardness. It will be qualified for spaceflight in the frame of the Finish FORSESAIL-2 CubeSat mission.

Scherzer et al. 2022, LASCAS.



Prototype of the next generation magnetometer front-end microchip

IWF — INSTITUT FÜR WELTRAUMFORSCHUNG, WWW.OEAW.AC.AT/IWF, WERNER.MAGNES@OEAW.AC.AT