

THE SWARM ABSOLUTE SCALAR MAGNETOMETER

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Abstract

The Swarm mission, conducted by the European Space Agency (ESA), will provide the best ever survey of the Earth's magnetic field and its temporal evolution. This will be achieved by a constellation of three satellites to be launched by the end of 2013.

The Absolute Scalar Magnetometer (ASM), proposed by CNES and CEA-LETI with the scientific support from IPGP, was selected by ESA in 2005 as the Swarm magnetic reference. Its performances are therefore crucial for the mission's success. Thanks to a new dedicated design, the ASM will offer the best precision and absolute accuracy ever attained in space, with similar performances all along the orbit. This paper presents the new features, capabilities and performances of this instrument as well as the last status.

The ASM operating principle is based on the atomic spectroscopy of the helium 4 metastable state. It makes use of the Zeeman's effect to transduce the magnetic field into a frequency, the signal being amplified by optical pumping.

The ASM will thus deliver high resolution scalar measurements at 1 Hz for the in-flight calibration of the Swarm Vector Field Magnetometer (VFM) over the 4 year mission. It can also be operated at a much higher sampling rate (burst mode at 250 Hz).

In addition, thanks to an innovative architecture, the ASM will be able to carry out continuous vector measurements, hence delivering simultaneously both the magnitude and direction of the ambient magnetic field measured at the same point, which is a premiere on a single instrument. While the main advantage of this vector capability lies in the lack of offsets or drifts, its precision is by design significantly lower than the scalar's. This capacity will be used in flight on an experimental basis, the nominal Swarm vector data being delivered by the VFM.

Swarm will offer a unique opportunity to validate the ASM vector data in orbit by comparing them with the VFM's, thus opening the way for a potential in-space cross calibration. This will be done during the Swarm commissioning phase, in close partnership between CNES, CEA-LETI and IPGP.