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Session “COSPAR-22-TGCSS.1: Small Spacecraft - Big Science”

NanoMagSat, a nanosatellite LEO constellation for monitoring Earth’s magnetic field and ionospheric environment

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The geomagnetic field has been continuously monitored from low-Earth orbit (LEO) since 1999, complementing ground-based observatory data by providing calibrated scalar and vector measurements with global coverage. The successful ESA Swarm constellation is expected to remain in operation until at least 2025. Further monitoring the field from space with high-precision absolute magnetometry is of critical importance for improving our understanding of the dynamics of the multiple components of this field, as well as that of the ionospheric environment. The NanoMagSat project aims to deploy and operate a new constellation with a current baseline of three identical 16U nanosatellites, using two 60° inclined orbits offset by 90° RAAN and one polar LEO orbit, and hosting an innovative payload suite. This will consist of an advanced miniaturized absolute scalar and self-calibrated vector magnetometer (MAM) combined with a set of precise star trackers (STR), a compact high-frequency field magnetometer (HFM), a multi-needle Langmuir probe (m-NLP) and dual frequency GNSS receivers.

This payload suite will acquire high-precision/resolution oriented absolute vector magnetic data at 1 Hz sampling rate (for global magnetic field modelling purposes), very low noise scalar and vector magnetic field at 2 kHz (for ELF signal detection and down to meter-scale local electrical currents monitoring), electron density data at 2 kHz (for very small scale plasma density investigations), as well as electron temperature at 1 Hz. GNSS receivers will also allow top-side TEC and radio-occultation profiles to be recovered.

The three-satellite constellation design is such that all local times at all geographic locations between 60°N and 60°S will be covered in a little more than one month, much faster than Swarm, which the NanoMagSat is also designed to complement for even better coverage, should Swarm still be in operation at the time of launch.

After an initial Phase 0 study carried out with CNES support, NanoMagSat was next proposed in response to the ESA Scout call in 2019 and selected for a consolidation study which ran through 2020. It is currently undergoing an ESA-funded 18 month phase of Risk Retirement Activities (RAA), aiming at being ready for a possible final selection in 2023, targeting a launch in 2025.

This presentation will report on the way the project is currently moving forward technically, programmatically and scientifically. NanoMagSat is designed to complement and improve on many of the science goals of the Swarm mission at a much lower cost, also bringing innovative science capabilities for ionospheric investigations. It aims at forming the basis of a permanent collaborative INTERMAGSAT constellation of nanosatellites for low-cost long-term monitoring of the geomagnetic field and ionospheric environment from space, complementing the INTERMAGNET network of ground-based magnetic observatories. This presentation is also meant to initiate a discussion on the way the NanoMagSat project could contribute to the goals of the COSPAR Task Group on the Establishment of a Constellation of Small Satellites (COSPAR TGCSS).

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