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The NanoMagSat project aims to deploy and operate a new constellation concept of three identical 16U gravity-gradient stabilized nanosatellites with no propulsion but stable enough attitude control, using two inclined (~ 60°) and one polar LEO, for investigating both the Earth's magnetic field and the ionospheric environment. Drawing from the lessons learnt from the ESA Swarm mission, which it is designed to complement and succeed, it will also provide new science opportunities thanks to its innovative constellation design and miniaturized payload.

The 3-satellite constellation will cover all locations/local times (LT) and will further ensure that all LT at all locations between 60°N and 60°S will be covered in a little more than one month, much faster than Swarm, which NanoMagSat is also designed to complement for even better coverage, should Swarm still be in operation at the time of launch. Each satellite will carry the same innovative payload suite. This will first include an advanced Miniaturized Absolute scalar and self-calibrated vector Magnetometer (MAM) using the same principle as the ASM instrument successfully operated on the Swarm mission [1], collocated (on an ultra-stable optical bench, at the tip of a deployable boom) with a set of star trackers (STR) also based on Swarm space heritage, to provide very accurate attitude restitution. It will further include a new compact High Frequency Magnetometer (HFM) [2] (at mid-boom), as well as a multi-Needle Langmuir Probe (m-NLP) with space heritage [3] and dual frequency GNSS receivers (all on the satellite body). 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 data at 2 kHz (for ELF signal detection and down to decameter-scale local electrical currents monitoring), electron density data at 2 kHz (for very small-scale plasma density investigations), as well as electron temperature data at 1 Hz. GNSS receivers will also allow top-side TEC and ionospheric radio-occultation profiles to be recovered. Possibility of using the STRs to further recover the energetic proton omnidirectional flux (above 100 MeV), as recently demonstrated on Swarm [4] is also considered.

In this presentation, we will provide an overview of the current status and science objectives of the NanoMagSat project, with special emphasis on the possibility it will provide to investigate the ionospheric dynamics and environment, using both in-situ measurements and its ability to remotely sense the ionosphere using e.g., ELF whistlers, TEC and ionospheric radio-occultation profiles.

This project was proposed to ESA within the context of its SCOUT program, and is currently undergoing a 18 months Risk Retirement Activity phase funded by ESA and due to end in July 2023, aiming at implementation for a launch possibly as early as 2026.

References

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