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DEVELOPMENT OF A SET OF INSTRUMENTS FOR A SMALL SATELLITE MISSION TO OBSERVE THE LEO ENVIRONMENT IN THE PRESENCE OF A DECREASING SOLAR CYCLE

Abstract

Space environment has been traditionally an issue of big concern for both, manned and unmanned spacecraft designers. For most missions targeted by small satellites, where low cost, fast delivery, and innovation through the application of commercial electronics revolution into space, dictate the design and development process, space environment interaction with a satellite represents a milestone, toward to which, different approaches have been treated: from small satellite constellations to a close to fully-traditional-redundant systems. Depending on the selected approach, the mission requirements, the designated orbit and the acceptable risk level, space environment remains as a major concern as well as a dynamic field of study by itself, which requires a better understanding with a focus on space environment-to-satellite interaction process. Such understanding requires a different kind of input data, in order to provide a complete model of the small satellite system behavior under different conditions of operations. Particularly, the effects on a satellite in the presence of a decreasing solar cycle, where the levels of solar activity yield to the opportunity, on one hand, to perform science and on the other to act as a testbed for technology development. Important data will be provided from the interaction with galactic cosmic rays (GCR) as the Sun cycle continues its transition to its minimum. For this purpose, we develop a set of space environment instruments intended to be used onboard Ten-Koh satellite. Ten-Koh satellite, developed by Kyushu Institute of Technology, in Japan, and to be launched in late 2018, will operate among its different payloads, a double Langmuir probe (DLP) system for plasma sheath characterization around a spinning spacecraft, with a settable bias voltage between -10 [V] to 10 [V] and a current capability measurement from 100 [pA] to 1 [uA]; a small 3-axis magnetometer instrument for measuring the Earth's magnetic field variations in the range from $-2\text{x}10^{-4}$to $2\text{x}10^{-4}$[T], with a resolution of 4 [nT], which will provide attitude readings at the same time; a charged particle detector (CPD) intended for observing electrons (1 – 10 [MeV]), protons (1 – 1000 [MeV]) and ions (up to 1000 [MeV] for H, up to 500 [MeV] for He, Be, B, and up to 5 [MeV] for C, O, Si, Fe). The design, tests and expected results are presented.