NEUDOSE: A CubeSat to characterize space radiation

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Space radiation exposes astronauts to a stream of energetic and highly ionizing particles that can suppress immune system function, increase cancer risk, and possibly cause acute radiation sickness if the exposure is large enough [1]. As human exploration goals shift from short duration missions in Low Earth Orbit (LEO) to long duration missions into deep space, radiation protection for manned missions remains one of the key technological issues that must be solved [2]. This work presents the NEUtron DOSimetry and Exploration (NEUDOSE) CubeSat, which is the first in a series of satellite missions with the purpose of advancing radiation monitoring technology that will characterize the space radiation environment. Specifically, NEUDOSE will focus on measuring the neutral and charged particle dose rates in LEO where most of the preparatory activities for future deep space explorations will take place.

The NEUDOSE mission consists of a 2U CubeSat that is equipped with our novel Tissue Equivalent Proportional Counter (TEPC); an advanced radiation monitoring instrument with an electronic data acquisition system that will make in situ measurements of the charged and neutral particle dose rates. The NEUDOSE CubeSat, currently under development by students at McMaster University, provides a cost-effective approach to test new radiation monitoring instrumentation directly in the unique environment of outer space while simultaneously collecting new georeferenced spectra of the radiation environment in LEO. Data collected from NEUDOSE will be used to identify areas with elevated dose rates, incoming solar storms, and as baseline measurements to improve radiation modeling tools. To further develop the CubeSat payload, the NEUDOSE team has flown twice in near-space through an adapted version of the instrument on a High-Altitude Student Platform (HASP) Balloon in collaboration with NASA and Louisiana State University. An overview of the CubeSat and HASP mission concepts will be presented along with a preliminary design of the spacecraft, the TEPC payload as well as results from the HASP missions.

References: [1] N. R. C. U. C. on the Evaluation of Radiation Shielding for Space Exploration. Managing Space Radiation Risk in the New Era of Space Exploration. National Academies Press, 2008.

[2] N. R. Council. Pathways to Exploration: Rationales and Approaches for a U.S. Program of Human Space Exploration. Washington, DC: The National Academies Press, 2014.ISBN:978-0-309-30507-5.