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Author: Prof. Premkumar Saganti  
Prairie View A&M University, United States

A NOVEL SPACECRAFT WITH AN INNOVATIVE PAYLOAD FOR DEEP SPACE RADIATION  
MEASUREMENTS

**Abstract**

Shinen2 spacecraft was launched on December 3, 2014 as part of Hayabusa2 mission (an asteroid exploration mission on a second sample return challenge) of JAXA. Currently, Shinen2 is in an elliptical orbit around the Sun, traversing between Venus and Mars orbits. After one year, in December 2015, Shinen2 passed closer to Earth on its continued trajectory towards Mars. Shinen2 spacecraft, designed and built by the Kyushu Institute of Technology (KIT-Japan), is a hexagonal shaped, 15-kg, 47 x 49 x 49-cm structure built with light-weight and durable Carbon Fiber Reinforced Polymer (CFRP) with dual batteries charged by solar panels on each side of the structure and redundant UHF transmission systems at 437 MHz. Shinen2's only payload is a radiation detector designed and built by Prairie View AM University in collaboration with NASA Johnson Space Center (NASA-JSC), University of Texas (UT-Austin), and University of Nevada Las Vegas (UNLV). The radiation particle pixel detector (PPD), a 10 x 10 x 10-cm cube structure was designed and developed as: (i) low weight ( 800 gr), (ii) low power ( 1 W), (iii) high reliability over few years ( 5+ years), (iv) high tolerance in deep-space harsh radiation environment for a broad range of temperatures, and (v) with a unique capability to provide data downlink over a low bit rate communication transmission (few kilobytes) from deep-space. This payload uses two CMOS (Complementary Metal Oxide Semiconductor) sensors and custom designed radiation-hardened FPGA (field-programmable gate array) along with other radiation hardened electronics to sustain the deep-space radiation environment with capability to estimate energy and measure the particle flux of radiation environment in deep-space. Initial data is very promising and will be presented with current plans for advanced payload developments.