SPACE ENVIRONMENT TECHNOLOGIES

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Galactic radiation detected using ARMAS technology on Blue Origin flight

Mission Payload Focuses on Radiation Detection Technology

Los Angeles, California – Space Environment Technologies, an international space weather research and operations company, announced today that it successfully executed a suborbital mission reaching space on Blue Origin's New Shepard space vehicle. New Shepard's NS-12 flight marks the highest altitude measurements to date for the Automated Radiation Measurements for Aerospace Safety (ARMAS) program and measured the radiation environment deriving from Galactic Cosmic Rays. The ARMAS Suborbital mission launched from Blue Origin's West Texas Launch Site at 11:53 a.m. CST on Wednesday, December 11, 2019, reaching an altitude of 106 km with a flight duration of 10 minutes, 16 seconds.

The ARMAS program has developed real-time monitoring technology to manage radiation risks for commercial aviation and commercial space transportation crew and passengers. The ARMAS Suborbital mission, managed by Space Environment Technologies (SET) and partially funded through NASA's Flight Opportunities program (FOP) and Small Business Innovative Research (SBIR) offices, was developed by a team led by Principal Investigator Dr. W. Kent Tobiska of Space Environment Technologies. ARMAS uses an innovative approach with dosimeter sensors linked to ground-based servers that result in advanced space radiation research and improved aviation and space-flight safety.

"The Blue Origin New Shepard flight with ARMAS fills in a final piece of the puzzle for understanding and managing the radiation environment at all altitudes. It gives us information for achieving full operational management of radiation hazards extending from the Earth's surface to the top of the atmosphere. We can now confidently plan for reduced radiation exposure to commercial aviation passengers as well as commercial space flight customers starting in mid-2020," said Dr. W. Kent Tobiska, Principal Investigator for ARMAS.

While in flight, ARMAS dose data are retrieved in real-time. For systems with Iridium satellite links or WiFi, the data are downlinked to the ground and assimilated by NASA's Nowcast of Atmospheric Ionizing Radiation for Aviation Safety (NAIRAS) model of the global radiation environment. As ARMAS data are ingested into NAIRAS, the accuracy of radiation dose rates along air and space flight paths improves. The goal of ARMAS is to assist air and space traffic management by monitoring global radiation "weather" and allowing commercial air and space traffic to avoid higher radiation areas. One ultimate objective of this program is to reduce crew and passenger radiation exposure by providing the information to flight service operators so they can fly in lower radiation regions or spend less time in higher radiation locations. Accurate real-time monitoring of the dynamically changing radiation from galactic cosmic rays, solar flares, or the Van Allen radiation belts is an example of space weather services managing an environment that affects the health and productivity of a technologically advancing society.

Along with the ARMAS Suborbital system, Skycorp Inc. flew an Apple iPhone 11 Max Pro to investigate the effects of neutrons and muons on deep sub-micron semiconductor memory that is induced by interactions between cosmic radiation and the atmosphere. The advanced sensors of the iPhone 11 helps characterize the operating environment, while the ARMAS Suborbital experiment provided a calibration of the radiation environment. It is expected that this and future experiments will provide data to improve deep sub-micron semiconductor design.

About Space Environment Technologies.

Space Environment Technologies (SET) Space Weather Division (SWD) is headquartered in Southern California and conducts fundamental space research and provides advanced space weather products and services to U.S. Government and commercial aerospace customers. These include NASA, NOAA, USAF, NSF, and commercial aerospace organizations. SET SWD transitions research models into operations, such as the JB2008 thermospheric density model, the USGS Dst index, the ARMAS aircraft radiation measurement system, and the AWSOME total dose and SEU system for avionics' radiation hazard management in Low Earth Orbit vehicles. SET SWD is particularly active with

1. the NASA *Nowcast of Atmospheric Ionizing Radiation for Aviation Safety* (NAIRAS) global radiation model development in 2009-2011 that SET has been operationally supported at NASA Langley Research Center since 2012;
2. the NASA Phases I, II, IIE, III *Automated Radiation Measurements for Aerospace Safety (ARMAS)* SBIR (2011-2019) that builds radiation detection instruments and ground system to monitor real-time aircraft radiation dose rates;
3. the MDA Phases I, II, IIE *Advanced Weather Simulation and Operational Modeling Effort (AWSOME)* SBIR project (2014-2018) that built a server-based, real-time, operational space weather radiation environment coupled with operational CREME96 model routines that produce spectra for linear energy transfer (LET) of high Z (HZE) particles, protons, and electrons for any user-supplied parts lists; and
4. the NASA *RADIation environment using ARMAS data in the NAIRAS model (RADIAN)* Cooperative Agreement enabling SET to provide ARMAS data for assimilation into the NASA NAIRAS global radiation model; this allows the specification of the radiation environment from the surface to Low Earth Orbit.

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ARMAS Suborbital instrument package