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Radio diagnostics and analysis on the Puerto Rico CubeSat

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Abstract

The Puerto Rico CubeSat is a collaboration between Interamerican University of Puerto Rico, the University of Puerto Rico, the Ana G. Méndez University System, NASA Marshal Space Flight Center, the University of Alabama at Huntsville, the Swedish Institute of Space Physics, and Mälardalens University. Principle goals include providing aerospace and systems engineering experiences to students at the participating institutions. Mission objectives include the acquisition of space weather data to aid in better understanding the Sun to Earth connection. The Puerto Rico CubeSat is a 3U configuration, $10 \times 10 \times 30$ cm. Active attitude control will be used to align the long (3U) axis along the orbital path, and the satellite will rotate along the 3U axis to assist in thermal management. The Puerto Rico CubeSat will carry two scientific payloads. One is CARLO (Charge Analyzer Responsive to Local Oscillation), which is designed to measure ion turbulence from 0 to 10 kHz. CARLO will operate in a ram configuration, thus giving it the ability to distinguish between ambient and spacecraft-induced irregularities in plasma density. The second payload is GIMME-RF, a 0 to 30 MHz radio instrument, consisting of a digital 4-channel direct sampling receiver board, atmospheric-noise-limited preamplifiers, and four electrically short monopole antennas. The antennas are connected electronically, as dipoles, to enable measurements of the full 3-dimensional electric field vector signal, which, in turn makes it possible to characterize the radio emissions in terms of Stokes parameters and to perform direction finding. GIMME-RF will use artificial neural network technology to automatically identify radio data of interest. All radio data will be downloaded at 1% time resolution, and radio data of special interest (automatically identified or human selected) will be downloaded at full time and frequency resolution. CARLO and GIMME-RF are complementary instruments, as CARLO will measure low-frequency plasma turbulence, which affects radio propagation in the high-frequency radio band. The satellite communications system

will operate at frequencies between 902 and 928 MHz and will share the same antenna used by GIMME-RF. The Puerto Rico CubeSat is expected to be ready for launch in 2016; a launch vehicle has not yet been identified. Support for the Puerto Rico Cubesat comes from the Puerto Rico Industrial Development Company (PRIDCO), the Puerto Rico NASA Experimental Program to Stimulate Competitive Research (EPSCoR), and the Interamerican University of Puerto Rico Bayamón Campus. The GIMME-RF payload is supported by the Swedish National Space Board (SNSB), with in-kind contributions from Málardalen's University and the Swedish Institute of Space Physics.