

IT-SPINS: A CubeSat mission to image the nocturnal ionosphere

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The Ionosphere-Thermospheric Scanning Photometer for Ion-Neutral Studies (IT-SPINS) is an NSF-supported mission to study the nocturnal ionosphere on a CubeSat platform. The mission will provide two-dimensional (2D) tomographic imaging from by spinning the 3U CubeSat about orbit normal to retrieve tomographic images of ionospheric structures in the plane of the spacecraft orbit. IT-SPINS integrates a heritage photometer (CubeSat Tiny Ionospheric Photometer (CTIP)) into a heritage CubeSat bus developed by Montana State University. The CTIP sensor as the main payload on IT-SPINS will provide continuous nighttime line-of-sight observations of 135.6-nm nightglow produced by the recombination of oxygen ions with electrons in the upper atmosphere.

Observations from several rotations of the spinning spacecraft will be combined in a tomographic inversion approach to produce 2D altitude/in-track images of 135.6-nm volume emission rate ($\epsilon_{135.6}$). The primary scientific goal of this 6-month mission is to use the 2D images of $\epsilon_{135.6}$ to study the variability of the topside transition height (TTR), where O⁺ transitions to H⁺ and He⁺ and investigate the physics responsible for the TTR variability. In this way, IT-SPINS will provide a full geographically-extended characterization of the TTR (in terms of latitude, local time, and solar and geomagnetic activity) that can be incorporated in ionospheric models to improve models' ability to accurately model and predict ionosphere variability.

In this work we present our latest results and plans on spacecraft design and development. Specifically, we will discuss CTIP design and performance, and system engineering-related topics such as spacecraft bus, attitude determination and control subsystem, electrical power system, and communication system, and command and data handling system. We will also presents our latest simulation of IT-SPINS anticipated measurements.