Multi-Point Magnetic Field Measurements
A Science - Oriented, University 6U CubeSat Constellation

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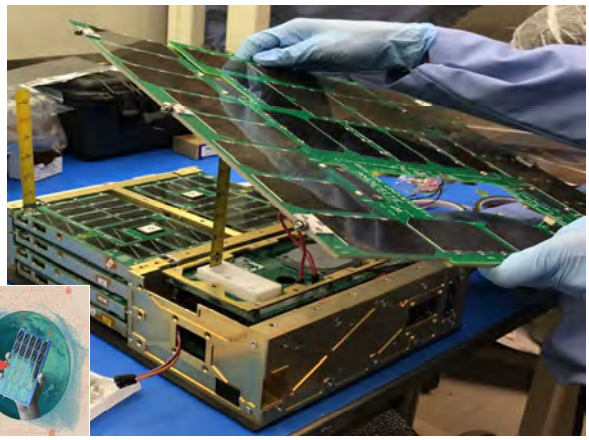
Abstract

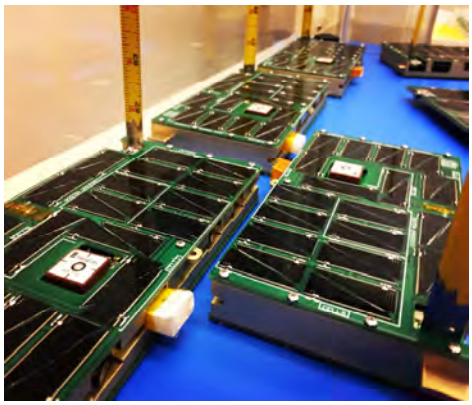
Over the past few years Boston University's Space Physics and Technology lab has developed a 6U CubeSat that deploys a swarm of 8 magnetometers to measure the fine-scale structure of the magnetic field. Through the use of three-axis measurements we hope to flood the space weather community with a fine mesh of magnetic field data to further research of space weather. Though the combined effort of the Space Physics community and the engineering design community this satellite has come from an idea to a reality. This was with the selection to fly by the Air Force University Nanosat Program, and the launch opportunity provided by NASA's Educational Launch of Nanosatellites (ELaNA) initiative. This coming spring of 2019, ANDESITE will launch on board one of Rocket Lab's Electron rocket. The two-pronged mission is described below.

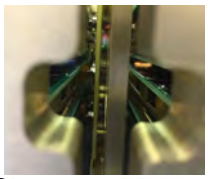


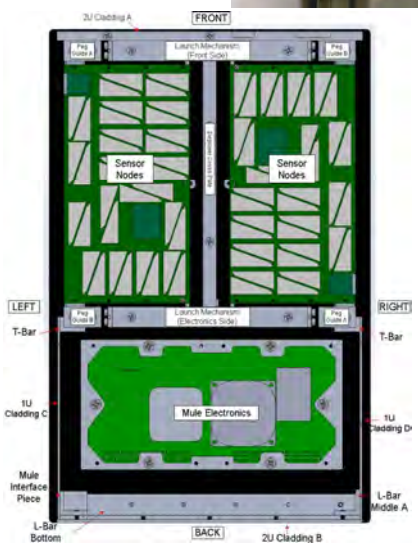
ANDESITE and Concept of Operations

ANDESITE is a 6U (30x20x10 cm) CubeSat that deploys eight smaller "pico-satellites," which we lovingly call toast or nodes, that each have their own self-contained scientific magnetometer, power system and radio communication system. The nodes are ejected from the mule in pairs of two, after which they drift further away from the 6U mule while relaying data back through the mule and the Global Star sat-phone network to Earth. This swarm will be able to take measurements at distances from each other that other larger satellites would never dare to approach. This allows us to measure the magnetic field in a way that has never been done before.

ANDESITE has been a student endeavor beginning in 2014. It has taken a multitude of disciplines to bring this satellite to the place it is today. ANDESITE was completed and ready for launch Fall 2017. However, due to the complexity of the mission and complications with launch vehicles the launch has been delayed until this covming Spring 2019. This time has allowed the team to refine the software to give ANDESITE the best chance we can.



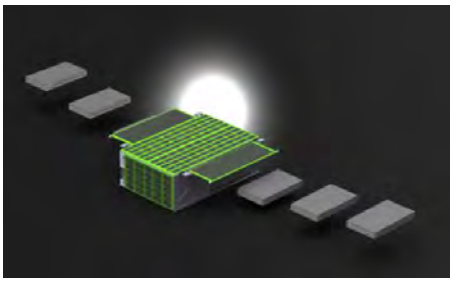




ANDESITE is a complex satellite with an unique mission. Due to this we had to conform to an FCC requirement to wait to deploy the nodes till we are under 400KM. As we are being deployed at 500KM and have no additional thrust we must rely on drag to decrease our orbit. This may take as long as 2 years, and upwards of 10 years. This obviously poses a problem to the survivability of a spacecraft that was design to operate for approximately 4 months. During our delays we have had time to mitigate this risk as much as possible. The primary adjustment was to give the satellite the best chance to recharge itself as possible. Previously there were only panels on one surface, we have added additional panels to the bottom of the wings, drastically increasing our chances of survivability.

Phase One

Phase One focuses on the Mule, the main 6U CubeSat body, successfully reaching orbit and establishing connection to the GlobalStar network. Looking to be BU's first successful satellite in orbit this connection is essential to being able to reach our first criteria for success. The biggest problem TERRIERS, Boston University's first satellite, was its inability to charge itself in space, this ended up resulting in a failed mission. The main face of the satellite has a surplus of solar potential. Ideally even at an angle there would be enough solar power to charge the satellite. However, as previously mentioned, with the addition of solar panels to the underside of the wings there should be very few orientations in which ANDESITE will not be receiving charge. During the deorbit the 6U Mule itself will be collecting Magnetic Field data. This allows us to test our protocol for collecting data before we eject the nodes and have a significant increase in data coming in.



Phase Two

After successfully becoming Boston University's first successful satellite and surviving the de-orbit period the first pair of nodes will be released. Once ejected the inhibit switches will be released and the nodes will begin collecting data. They will transmit this data back to the mule to be transferred to earth through the previously established connection with the Global Star network. With the first pair ejected there will be three points of data, including the mule, for one full orbit. After one orbit the next pair will be ejected. This will happen two more times until all four pairs have been ejected and a total of nine data points are being collected at once. It is through these nine points that the fine mesh is created. Once the data is back on earth it will be possible to use it to assist in the study of our magnetic field and space weather.