Video: NASA's sounding rockets

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The spectacle of a mammoth rocket 'breaking the surly bonds of Earth' takes our breath away. Equally amazing are the secrets revealed to us by science missions these rockets have launched – and NASA puts careful thought into what kind of mission will best achieve that science. Sometimes a large, multi-instrumented mission on a giant rocket is the best way to go. But other missions are better suited to a smaller, less expensive rocket as the key to getting a quick answer to a tightly focused science question. Like a sounding rocket. A sounding rocket is an instrument-carrying rocket designed for research, such as taking measurements and performing scientific experiments during a sub-orbital flight.

Kristina Lynch, Professor of Physics at Dartmouth College says, "A sounding rocket experiment can be designed in six months. From proposal acceptance through data analysis, a mission can be done in 1-3 years, as opposed to many more years for a typical satellite mission. The trade-off is that you only get 10 minutes in space – but, as my colleagues in the sounding rocket community say, 'It's a great 10 minutes!'"

Sounding rockets afford a certain amount of flexibility. Because they can be launched from temporary sites all over the world, sounding rockets can be used for remote field studies. They can also be used to develop and test new scientific instrumentation for use in more costly, longer duration orbital missions. And because of their low cost and short lead time, sounding rocket missions are perfect for use by university graduate students, particularly to gather data for PhD dissertations.

Sounding rockets are especially well suited for studying areas of the Earth's upper atmosphere inaccessible by orbital missions, providing the only way to directly sample the lower portion of near-Earth space with scientific probes. Furthermore, they are ideally suited to position an experiment for an up-close look at auroras – beautiful green curtains of light that sometimes dance across the night sky.

While auroras can be wondrous to behold, they are sparked by geomagnetic storms with potential side-effects such as satellite malfunctions and power outages. Telecommunications, air traffic, power grids, and Global Positioning System signals are vulnerable. So, understanding this layer of near Earth space is vital.

Lynch says, "Sounding rockets are used to get above the part of Earth's atmosphere where we live and breathe. Above 60 miles (100 km), the atmosphere includes an electrically charged gas where charged particles flit around, collide, respond to magnetic and electric fields, and produce an aurora. These 'northern and southern lights' appear flame-like, but the movement looks slower than that of a flame, and their structure can be more orderly. We want to understand this movement and structure. Is the movement fast or slow? Why? Where is it going?"

Lynch is working on a sounding rocket mission that could provide some answers. ISINGLASS, short for Ionospheric Structuring: In Situ and Ground-based Low Altitude StudieS, launched on March 2 and is one of about 20 sounding rockets that NASA will be launching in 2017.

ISINGLASS deployed an array of payloads launched by a single rocket to take measurements at several locations in an aurora simultaneously. Understanding what the aurora's visual patterns signify within the aurora itself can serve as an analog to help scientists understand what's happening farther out, even extending this information to auroras on other planets.

All it takes is "a great 10 minutes."

Provided by NASA