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ASTERIA: A Balloon-Borne Experiment for Infrasound Detection

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ASTERIA (Aloft Stratospheric Testbed for Experimental Research on Infrasonic Activity) is a small (<20 kg) payload designed to measure infrasound disturbances from a balloon-borne platform at altitudes near 60,000 ft (∼20 km). A balloon platform is expected to have two advantages over ground-based infrasound stations: a relatively benign wind environment and exposure to higher signal strengths within a stratospheric duct. ASTERIA's nominal sensitivity requirements are to measure waves between 0.1 to 20 Hz at the 0.1 Pa level with signal-to-noise ratios of 5 or better. At the time of this writing, we have tested wave sensors based on the differential pressure transducers recently flown by Bowman et al. (2014) on a NASA/HASP (High Altitude Student Payload); our modified pressure sensor was tested in a NOAA piston-bellows facility in Boulder, CO. Our goal of characterizing 0.1 Pa amplitude waves requires that combined noise sources are below the the 0.02 Pa rms level. ASTERIA carries five differential transducers with port inlets arranged a diamond-like pattern (one zenith- and one nadir-facing port, plus three horizontal ports equally spaced in azimuth). Baffling for these sensors is a hybrid of perforated tubing and porous barriers, as described in Hedlin (2014). Other noise sources of concern include the electronic amplification of the transducer voltages and low-frequency pressure waves caused by pendulum or twisting modes of the payload. We will report on our plans to characterize and reduce these noise sources. The ASTERIA payload is intended to fly on long-duration super-pressure balloons for intervals of ∼100 days. We plan to conduct an experiment in the summer or fall of 2015 in which a calibrated disturbance is set off and detected simultaneously from stratospheric ASTERIA payloads and ground-based stations.

References:
1) Bowman et al. 2014, "Balloons over Volcanoes Scientific Report," HASP 2014 final report.
2) Hedlin 2003, "Infrasonic Wind-noise Reduction by Barriers and Spatial Filters," Acoustical Soc. of Am. 114, 1379-1386.