

TITLE: A Cubesat Mission to Venus: A Low-Cost Approach to the Investigation of Venus Lightning

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ABSTRACT BODY: The occurrence of Venus lightning has been detected by atmospheric probes and landers on Venus; by ionospheric satellites; by an orbiting visible spectrometer; at radio frequencies by the Galileo spacecraft while flying by Venus; and by an Earth-based telescope. However, none of these detectors has enabled us to determine the global occurrence rate of lightning in the atmosphere of Venus, nor the altitude at which this lightning is generated. Such measurements are needed in order to determine the processes that generate Venus lightning and to establish the importance of Venus lightning in controlling the chemical composition of the Venus atmosphere. A simple and affordable mission to perform this mapping could be achieved with CubeSat technology. A mother spacecraft with at least three CubeSat partners using RF detection could map the occurrence of lightning globally and determine its altitude of origin, with triangulation of precisely timed RF event arrivals. Such a mission would provide space for complementary investigations and be affordable under the Discovery mission program. We are embarking on a program to develop CubeSat-based instrumentation for such a mission. The initial task is to develop a lightning detector in a CubeSat development kit using a software defined radio (SDR) operating at decimeter wavelengths (5-50 MHz). This involves algorithm development as well as selecting or developing radio hardware for a CubeSat. Two units will be tested on the ground in a lightning zone such as New Mexico, where the Long Wavelength Array operates in the same frequency range. When the concept has been proven, flight subsystems such as solar panels, attitude sensing and communication radios will be added to the CubeSats to test performance in low Earth orbit. Experience gained from flight would enable a cluster of sensors to be proposed for a future Venus mission.