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Development of Ion and Neutral Mass Spectrometers (INMS) for Heliophysics and Planetary Missions

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Goddard's Geospace Physics Laboratory is developing INMS concepts that can be used for future Geospace missions to the Earth's ionosphere and for future planetary missions to bodies with atmospheres and ionospheres, in collaboration with the Planetary Environments Laboratory. Our group is designing ion mass spectrometers (IMS) for energy-per-charge range 1 V to 50 kV that can be used for solar wind ion composition measurements, the Earth's magnetosphere , lunar orbiters, and planetary magnetospheres. We will focus this presentation in our efforts and results for future CubeSat Missions to the Earth's ionosphere and a High Precision Electric Gate (HPEG) design that can be used with a reflectometer to achieve very high mass resolution capability. The HPEG design has been patented by Goddard with E. C. Sittler Jr. as inventor. The HPEG design allows for miniaturization so it is ideally suited to CubeSat missions. Engineers at Goddard's Instrument Electronics Development Branch have prototyped a pulse generator that can deliver a required train of pulses with $\sim$ ns pulses on a Field Programmable Gate Array (FPGA) platform that will allow miniature designs of the HPEG. The burst of pulses can be triggered at MHz rates. We will present initial lab results for a simpler CubeSat design instrument and a more complex version using the HPEG.