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Atmospheric Neutral Analyzer (ANA) for In-Situ Neutral Mass Composition and Velocity Distribution Measurements in Ionosphere-Thermosphere Coupling Studies

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The atmospheric neutral analyzer (ANA) is a new imaging instrument for in-situ measurements of both the mass composition of neutrals and their 2-dimensional velocities in the upper atmosphere. It combines radio-frequency mass analysis and CCD particle imaging to provide images of detailed 2D velocity distribution functions of individual mass species. It comprises an entrance aperture, electron source, ion accelerator, a radio-frequency (RF) ion mass analyzer, and an imaging particle detector. The electron source ionizes a collimated fraction of the incident neutral particles while preserving their velocities. The ion accelerator accelerates all ionized neutrals to a fixed energy in the perpendicular direction to the entrance aperture plane. The mass analyzer further accelerates those of a specific velocity (and hence mass) for further detection, using a RF electric field of specific amplitude and frequency. In the imaging particle detector, the detected ions produce charges on the surface of a micro-channel plate (MCP) detector, and a phosphor screen converts these charges to a visual image of the incident velocity distribution and registers the image on a CCD detector. We present the design of ANA and discuss its development in preparation for flight in Ionosphere-Thermosphere missions in the ILWS era.