

## Detecting Electrons and Ions with a Single Detector in Miniaturised Low Energy Particle Analysers

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Electrostatic energy analysers for eV to low keV particles typically analyse either electrons or positive ions. Instruments that do study both usually use separate detectors. Using a single detector for both electrons and ions potentially enables more compact instruments with reduced spacecraft resource requirements.

CATS (Cylindrical And Tiny Spectrometer) is one such approach to this challenge. It is a prototype highly miniaturised instrument that uses a concentric cylindrical geometry to measure multiple energies of electron and ion simultaneously. It has been demonstrated experimentally with 0.5-8 keV electrons using an ion-implanted CCD for a detector. It is being adapted for use in PoleCATS: a student-led experiment on the REXUS (Rocket EXperiments for University Students) European sounding rocket programme. The current geometry has ~7% energy resolution and ~7 degree by ~3 degree angular resolutions. Conceptually the design can be adjusted to tune the instrument parameters for a range of applications.

An alternative approach to the challenge is to adapt a conventional top hat geometry instrument so that it can sample alternately electrons and ions in continuous positive to negative inner hemisphere electrode voltage sweeps. While, unlike CATS, the electron and ion measurements would not be made simultaneously, the elegant focussing properties of the powerful and well-understood top hat geometry are preserved and existing, well-evolved instrument designs can be leveraged. By placing suitable dynodes (secondary electron emitters) at the exit of the analyser it is intended that a single MCP can be used to study electrons and ions over a wide range of energies. Initial simulations and development work on this project will be discussed.

Keywords: plasma analyser, miniaturised instrumentation, direct detection of low energy electrons with a CCD, SIMION simulations, low energy electron and ion spectrometer, CATS Cylindrical And Tiny Spectrometer