

FAST

Description of the Experiments

Electrostatic Analyzer (ESA)

Ion and Electron ESA Spectrometers (IES and EES)

The IES and EES measure 32 pitch angle directions simultaneously (11.25 degree resolution), and sweep over 48 energy steps in 1/64 of a spacecraft spin. The energy range is nominally 3 eV to 25 keV and 4 eV to 30 keV for ions and electrons, respectively. Each spectrometer consists of two half sensor heads with 180x10 degree field-of-views (FOVs) that are mounted on opposite sides of the spacecraft to form a 360 degree planar FOV. The out-of-plane response is roughly Gaussian with a FWHM of about 5 degrees. The planar FOV is within the spacecraft spin plane which is oriented with the spin vector normal to the nominal magnetic field direction. This orientation facilitates continuous pitch angle measurements. Deflectors are used to steer the sensor FOV out of this plane by up to 10 degrees to account for variations of the magnetic field direction during the orbit. In general, the pitch angle distribution always includes both the parallel and anti-parallel magnetic field directions.

Burst data consists of a 32 angle by 48 energy bin array of counts. Counts are pseudo-log compressed from 16 to 8 bits onboard. The first energy step is a high voltage retrace and should be ignored. Detector anodes rotate by 1/2 an anode (5.625 degrees) each sweep.

Survey data is averaged burst data which has been despun onboard. Slow survey is averaged into a 32 angle by 48 energy array each 1/2 spin (~2.5 s). Some blurring of the angular resolution results from the half anode rotation on alternate sweeps. Fast survey is averaged into a 64 angle by 48 energy array that maintains the angular resolution. Fast survey time resolution varies from 1/16 to 1/4 of a spin.

Stepped Electron Spectrograph (SES)

The SES consists of six pairs of ESA half analyzers to form six full pitch-angle (360 degree) sensors. Each sensor has 22.5 degree resolution and twice the geometric factor of the electron spectrometer, giving an overall sensitivity 12 times the electron spectrometer. As with the spectrometers, orientation of the sensor FOVs is the spin plane to give complete angular coverage for nominal magnetic field orientations. These sensors do not have deflectors, so that out of plane variations in the magnetic field can result in the detectors missing narrow field aligned beams. Several different energy level schemes are used for the SES to optimize different science goals. The sensors can be operated at 6 fixed energy levels to optimize time resolution, or can toggle over 12, 24 or 48 energy steps. The sensors can also track the energy flux peak with 6 or 12 energy steps. Finally the sensors can be swept over the entire energy range, with sensors shifted by 1/6 of a sweep so the entire energy range is covered 6 times faster than the spectrometer.

Burst data consists of six count arrays (SES1, SES2,...SES6) of 16 angles by N energies, where N=6, 12, 24, or 48. Counts are pseudo-logged. The first energy step is a high voltage retrace. Detectors rotate a fraction of an anode in a sweep.

Survey data is averaged burst data which has been despun onboard. Slow survey is averaged into 16 angles by N energies, where N=6, 12, 24, or 48 and where N for burst may differ from N for survey data. Some blurring of the angular resolution results from the anode rotation during the average. Fast survey is generally identical to slow survey but with much faster time resolution.