SPACE TELESCOPE SCIENCE INSTITUTE

TIPS: 18 January 1996
FOS
Koratkar

Summary: 21 December 1995 - 17 January 1996

Instrument: Nominal operation
Acquisition: 12 successful (8 ACQ/BIN and 4 ACQ/PEAK); 0 failures
Pointing: 64% within 1 arcsec
Science: 10 GO/GTO programs
Calibration: 4 programs (Darks, YBASES, Polarimetry, HDF-parallel Earthshine)
Publications and Communications: HST Data Handbook
Other: IS Reviews, Cycle 6 Phase II GO support

Description of FOS Detectors:

FOS provides digitized spectra over the wavelength range 1150 Å -- 8500Å.

Spectra detected on either of two available Digicon detector assemblies which have their own optical paths.

Digicons are a category of image tubes that use semiconductors/semiconductor arrays to detect photoelectrons from a photocathode. These are photon-counting devices.

Digicons are capable of detecting single photoelectron.

Digicons are characterized by a wide dynamic range, low noise, high photometric accuracy and high reliability.

Description of a Digicon Detector Assembly:

The Tube:

The two FOS Digicons differ only in their photocathode and face plate materials.
Blue detector: Bialkali photocathode on a MgF_2 faceplate (1150Å - 5000Å).
Red detector: Trialkali photocathode on a quartz faceplate (1700Å - 8500Å).

Diode array of 512 diodes, each diode is 50µm wide and 200µm high.

Magnetic and Electric components:

Deflection coils to selectively image the photocathode active area onto the diode array. The optical image is focused on more than one location on the photocathode (YBASE location). The deflections can be a fraction of a diode, which provides higher sampling to realize the full spectral resolution (NXSTEPS), or a full diode, which smooths out diode-to-diode variations (OVERSCAN).

The permanent magnet focus assembly is used to provide an external magnetic field for single loop focusing of the electron image onto the diode array.

Uniform electric field to accelerate the photoelectrons onto the diode array.

The uniform acceleration and single loop focusing provide a good one-to-one mapping of the photocathode onto the diode array.

Magnetic shield to protect detector from external magnetic field.

Pulse Detection Electronics:

Each diode is connected a preamplifier, amplifier, discriminator and counter.

Other associated components:

Heat pipes.
Temperature sensors.

Counting the photons:

Incident photons $\rightarrow$ photoelectron
Photoelectron detected by diode $\rightarrow$ current pulse
Current pulse amplified and counted if it exceeds a preset discriminator threshold

Retrieving the Flux information:

Location of the spectrum:
A selective area of the photocathode is magnetically deflected, hence knowledge of where the spectrum is formed on the photocathode is required.

Geo-magnetically induced motion correction:
The magnetic shielding around the detector assembly does not fully protect the detector from the external earth's magnetic field.

Paired pulse correction:
If an object is bright, the photoelectrons arrive at the diode array at a rate such that the current pulses are generated at a rate faster than the electronics can count.

Background correction:
Along with the target photons, cosmic rays can hit the photocathode and produce photoelectrons. These photoelectrons are also detected by the diode array.

Flat Field correction:
The photcathode can have blemishes which could mimic or affect the measurement of the line profile or line flux.
The photocathode material has granularity which needs to be smoothed out.

Inverse sensitivity correction:
Photocathode material has certain sensitivity to the dispersed photon and emits the photoelectrons accordingly. A translation which converts the observed counts to number of observed photons then provides the flux information.

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