The enclosed figures were prepared for a poster display at the June 1984 AAS meeting in Baltimore. They show representative samples of data obtained with the HRS during the pre-VAP test program at Ball Aerospace.
Measured Performance of the HRS

The data displayed here was obtained during the ground based calibration program at Ball Aerospace in Boulder, Colorado, in the spring of 1983. The analysis has been a continuing effort by members of the HRS Investigation Definition Team, the Science Institute, and Ball Aerospace. The instrument is presently in Boulder undergoing final alignment and refurbishment. A thorough test and recalibration will be carried out between July and November of 1984, after which the HRS will be shipped to Lockheed for integration with ST.

Pulse Height Distribution. The HRS contains two pulse counting Digicon detectors, each of which has 512 independent channels. For each channel, a discriminator threshold is set to isolate true photoelectron events from background electronic noise. The distribution of pulse heights shows that photoelectron events are clearly resolved against a very low background at energies near 23 keV.

Detector Dark Count. Careful attention to the design and construction of the detectors, their power supplies and electronics has resulted in extremely low dark count rates. This plot shows that, on average, each channel records one count every thousand seconds from dark noise. This sets the faint limit for detection of a signal with the HRS.

Linearity. For very bright sources the counting circuitry begins to saturate. For input event rates less than \(10^5\) counts per channel per second, the observed counting rate can be corrected for "paired pulses" with very little error. This saturation sets the bright limit for reliable measurements with the HRS. The total dynamic range is thus in excess of \(10^7\).

Pixel to Pixel Uniformity. For utmost photometric precision, the small irregularities in both the photocathode and the diode array must be corrected for. These measurements show that the photocathode has granularity with spatial scales comparable to a diode width, and amplitude of \(\pm 2\%\). The diodes themselves vary by less than 1% from one to the next.

Image Quality. Measurements of bright emission lines from a Pt-Ne hollow cathode lamp indicate very good imagery. These lines are intrinsically very narrow, so that their measured profiles are indicative of the instrumental broadening. The full theoretical spectral resolving power should be achieved when observing the spectra of point sources.
Sensitivity. The combination of a large aperture telescope, efficient reflective surfaces, and sensitive detectors will allow the HRS to observe sources significantly fainter than have been observable with previous UV instruments. The sensitivity curves shown here were based on HRS measurements of a calibrated UV continuum lamp, and the expected performance of the ST primary and secondary mirrors.

Echelle Blaze Function. The rapid variation of efficiency with wavelength is characteristic of Echelle spectrographs. The removal of this "ripple function" is an important step in the reduction of science data. Preliminary analysis indicates that the overall variation with wavelength is well represented by a theoretical efficiency function with the blaze angle as the only free parameter.

Scattered Light. Measurements of saturated molecular absorption bands show extremely low levels of stray and scattered light in the low and medium resolution modes. This plot shows measurements made of the spectrum and the adjacent background. The stray light in the core of the band less than 1% of the continuum brightness even before the raw data is reduced.

Echelle Scattered Light. The crowded formats of the Echelle modes result in generally higher levels of background light. These figures show absorption bands of CO and O2 after the diffuse background light was subtracted from the raw data. The residual light in the absorption lines is approximately 1% of the continuum brightness.
Pulse Height Distribution

Peak 23 keV

FWHM 2.78 keV

50% Threshold

Detector Dark Count

Overall average = 0.00094 C/S/d

Average counts/Sec/diode avg over 3 hr period

Time (hrs)
PIXEL TO PIXEL UNIFORMITY

Detector 1 Photocathode Response

Y-def = 2048

Detector 1 Diode Response

Error in Values
12.75 sec exposure
Ar-Neon Mini-Arc Continuum
L = 10 cm P = 5 Torr T = 300K
x - 14SO
(3-0) Band
CO 4TH Positive
HRS Grating 61

SCATTERED LIGHT

5100 A (CoKα x 2)

DENNIS EBETS
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SPACE TELESCOPE SCIENCE INSTITUTE