Investigation of HSP VIS Loss in Sensitivity

HSP ISR 17

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I. Abstract

The VIS detector in the HSP has been experiencing a loss in sensitivity over
the past two years. This report describes the analysis that shows no
evidence suggesting an electronic failure in the VIS detector.

II. Background on VIS Detector

The HSP is comprised of five detectors: Four Image Dissector Tubes (IDT's)
and one Photo-Multiplier Tube (PMT). Two of the IDT's, UV1 and UV2, are
solar blind ultra-violet detectors, whereas the remaining IDT's, POL, VIS
and the PMT, are sensitive to light at visible wavelengths.

The VIS detector has a bialkali cathode on suprasil faceplate which is
sensitive from 1600 to 7000 A. The plate for the VIS contains thirteen
filters mounted in two rows and positioned 36 mm ahead of the ST focal plane.
For each filter plate, there is an aperture plate located at the ST focal
surface containing 48 apertures arranged in two columns that are postioned
directly behind the corresponding columns of filters. Nine of the filters
have two 1.0 arcsecond and two 0.4 arcsecond apertures. In addition, the
VIS tube has another aperture through which radiation passes to a dichroic
filter that sends red light to the PMT and blue light to the IDT.(1)

III. Throughput on the VIS.

University of Wisconsin analysis of science data obtained with the VIS and
POL tubes indicate a loss of sensitivity in the VIS, but not in the POL tube.
This trend as first noted in HSP ISR 16, HSP 2912 Calibration Report, (2)
is represented in Figure 1, a plot of the total flux from observations of
VID998 in all four Image Dissector Tubes taken at various times.(3) Since
both detectors, the VIS and the POL, use the same photocathode material and
operate under similar conditions, both should experience similar degradation
of their respective photocathodes. IDT 1 (POL) shows no loss of sensitivity,
and in fact has shown a slight increase in sensitivity since launch.
Degradation of the VIS tube was first noticed as a gradual decrease in the
throughput of the 5500 A filter (F551W). Since then, loss of sensitivity has
been seen on the other filters on the the VIS tube.

IV. Measurement of Flux.

The degradation is found by measuring the flux of the star through the
finding aperture (VCLRV_T). Two separate targets, VID998 and BD+75,
were used as photometric standards. The accuracy of the flux calibrations
is at the level of photon counting statistics or better for the test. The
VIS tube sensitivity has decreased by about a factor of 3 to 3.5 from
April 91 through June 93.(2)
V. Trending of HSP Engineering Data for Detector 3.

The electro-mechanical performance for the VIS tube has been trended since January 1991. The detector 3 telemetry parameters monitored are included in table 1. The data were extracted from HSP_SAVE files processed by OMS from AEDP files. Data are incomplete for the period between launch, April 1990, until the end of October 1990 when the OMS system became fully operational. Data drop-outs in the telemetry exist where an HST safing event occurred. The plots were generated by using the IRAF task SGGRAPH. Figures 2 through 4 show the detector 3 temperature from January 1991 until July 1993. Figures 5 through 7 show the system controller temperature from January 1991 until July 1993.

VI. Conclusions

There has been no trend detected in the performance of any of the HSP Detector 3 electronic components and thermal parameters. Since 1991, the VIS tube engineering data has been nominal. There is no evidence in telemetry to suggest a electro-mechanical failure in the VIS tube.

VII. References


3. Evan E. Richards Space Science and Engineering Center, 1225 West Dayton Street, University of Wisconsin, Madison, Wisconsin 53706
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<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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<tr>
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**Telemetry Description**

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Figure 6: HSP SYSTEM CONTROLLER TEMPERATURE DURING 1992