FOS APERTURE THROUGHPUT VARIATIONS WITH OTA FOCUS

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Instrument Science Report CAL/FOS-085
August 1992

The attached figures show the variation in the throughput for several FOS entrance apertures as a function of the focus error with respect to the HST "optimal focus" position. The results were derived from point spread functions computed using the Telescope Image Modeling (TIM) version 27 software package and should be used to make small corrections to the FOS aperture transmissions for changes in focus. These small corrections are relative to unity at the focus positions where the transmission was last measured. The last FOS aperture transmission data were obtained in June 1991 at focus error=+1 on the blue side and in December of 1991 at focus error between -8 and -19 microns on the red side. The reason for the uncertainty in late 1991 is the question of whether the OTA focus changed gradually or made a sudden jump toward negative focus error sometime during the hiatus of more than 4 months in precise measurements.

An increase in focus position will increase the throughput by approximately 0.3 percent/micron for the 4.3 arcsec square and by 0.5 percent/micron for the 1.0 arcsec circular aperture.

The optimal focus for the 0.25 arcsec wide slit is in the 0 to +10 micron range. The throughput for the slit increases as the focal length increases up to +10 microns at wavelengths above 2000 Angstroms. At 1400 Angstroms, the throughput for the slit remains within 1% of the maximum in the 0 to +10 range of focus. At a focus position of +5, the throughput for the slit is within 4% of the maximum throughput for all wavelengths. If the focus is set below 0, results show a loss of throughput for the slit at all wavelengths. At a focus position of -10 this loss varies from 2 percent at 1400 Angstroms to 13 percent at 8000 Angstroms. Below -10 the slit throughput is lost at approximately 0.5 percent/micron. The 0.5 arcsec circular aperture results (not plotted) are simular to the slit in the focus range analyzed.

The peak throughput for the 0.3 arcsec aperture ranges from -10 at 1400 Angstroms to +10 at 8000 Angstroms. For all wavelengths, the throughput is within 10% of the maximum throughput for all focus positions between -10 and +10. Outside this range, throughput decreases as much as 1% per micron.

SUMMARY

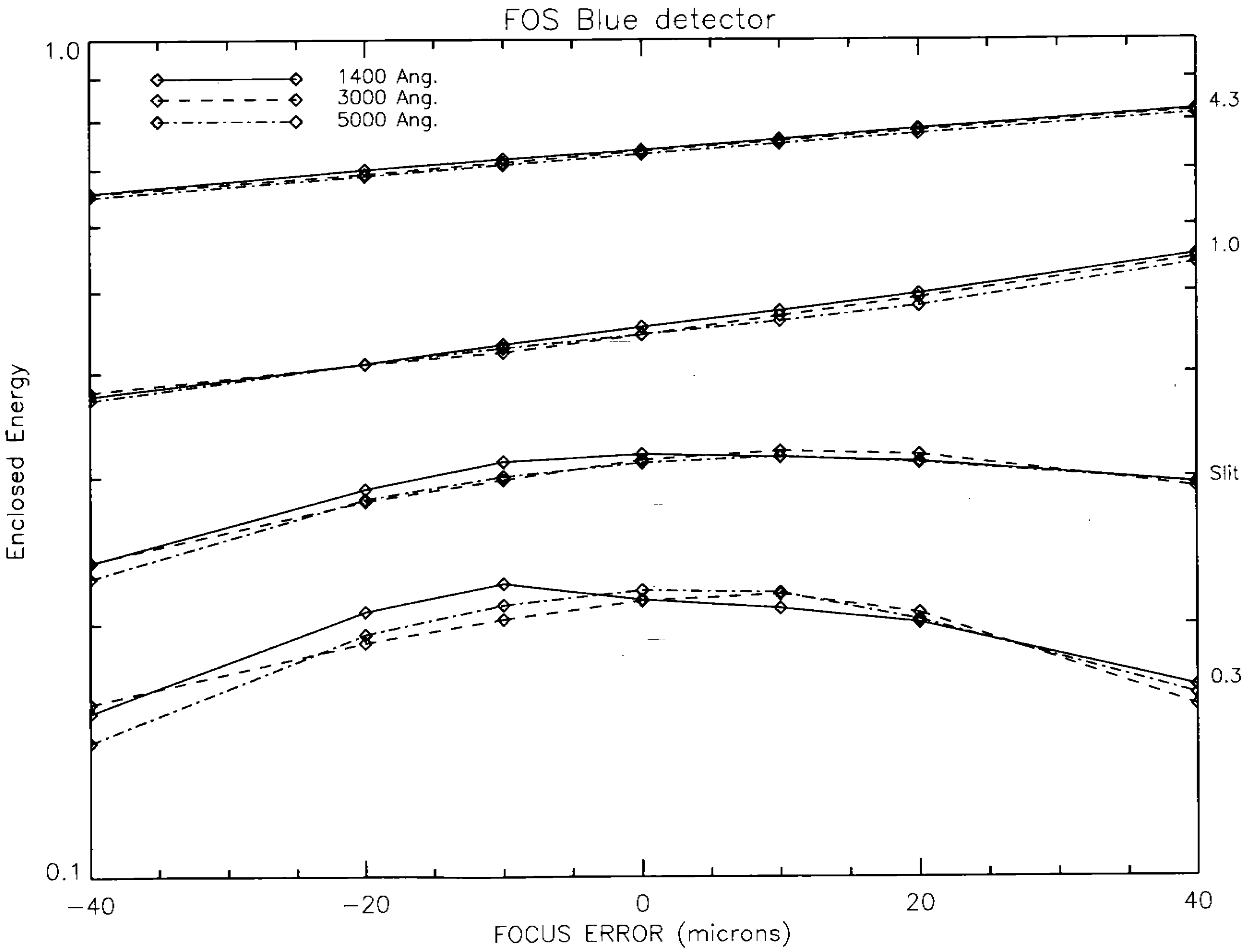
No one focus position optimizes all wavelengths and all apertures. For the 4.3 arcsec aperture, a large positive focus is optimal. The optimal focus for the slit varies from 0 at 1400 Angstroms to +20 at 8000 Angstroms. For the 0.3 arcsec aperture the optimal focus varies from -10 at 1400 Angstroms to +10 at 8000 Angstroms. Our analysis indicates that the optimal focus for the FOS is between 0 and +5 where both the slit and 0.3 arcsec aperture are within 6% of the maximum throughput at all wavelengths.

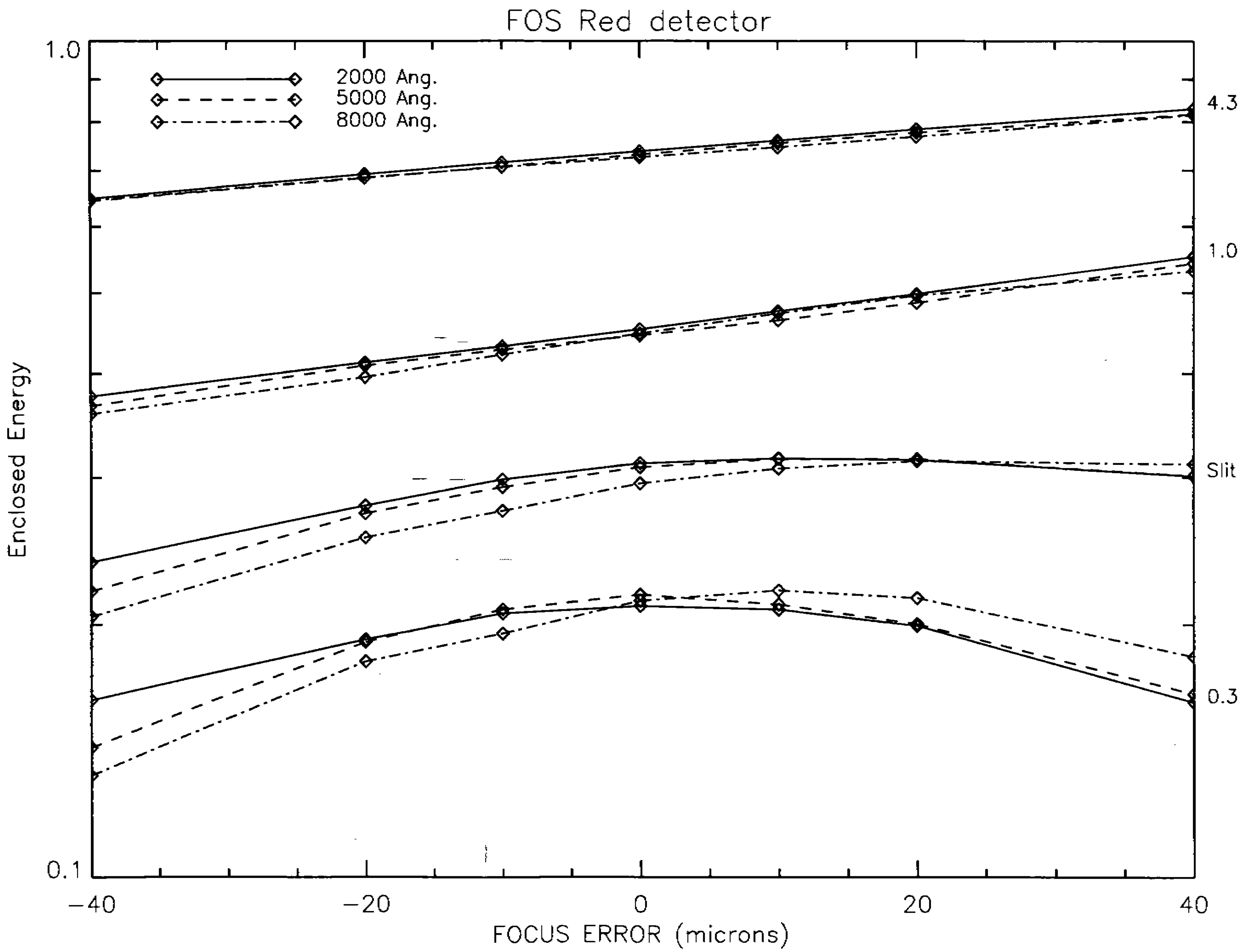
The HST focus was estimated to be at -19 microns on August 20, 1992 (C. Burrows, private communication). On August 23, 1992, the OTA focus position was moved from -19 to -5 microns from optimal focus. This focus should be monitored carefully and refocused to near zero as soon as the focus gets to -10 microns.

RECOMENDATIONS

The safest guess for the red side reference position in December 1991 is probably at the -12 micron position that is based on a linear change in focus with time between the bracketing measurements. The possibility of -19 microns for this focus means that the FOS flux measurements can be systematically off by as much as 7% for the smallest aperture. The OTA focus should be monitored more frequently to reduce the chances of getting more than a 5 micron uncertainty again.

We recommend that the telescope focus be moved to the 0 to +5 micron range whenever the focus is determined to be outside of the -10 to +10 range.


FOS Blue detector
1400 Ang.
3000 Ang.
5000 Ang.
4.3
1.0
Slit
0.3
1.0
0.1
Enclosed Energy
−40
−20
0
20
40
FOCUS ERROR (microns)


FOS Red detector
2000 Ang.
5000 Ang.
8000 Ang.
1.0
0.1
Enclosed Energy
4.3
1.0
Slit
0.3
−40
−20
0
20
40
FOCUS ERROR (microns)