WFPC 90-04

WF/PC Sensitivity at 9000Å

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Analysis of WF/PC standard star observations by both the IDT (Faber) and the STScI (Horne *et al.*) shows that the sensitivity at 5500Å is within 90% of the value expected from the Thermal Vacuum Test 6 (TV6) results, while that at 9000Å is only 58% of what was predicted (as read from Faber's plot and Figure 1 of the Horne *et al.* report). No reason for the low response in the near IR is known.

However, the observed flight sensitivity at 9000Å is consistent with the measured quantum efficiency of similar Texas Instruments (TI) CCDs used at several ground based observatories. This suggests that neither decontamination procedures nor a UV-flood will increase the sensitivity in this spectral region.

The CCD quantum efficiencies (qe) list below are derived from the 1988 Handbook and are based on analysis of TV6 data. I believe that these are the values used in the sensitivity calculations done by the IDT and the STScI. Note that these values correspond to the CCDs after UV flooding, whereas the WF/PC has yet to be UV flooded in orbit. This should not make a significant difference at 9000Å. Verification of this comes from comparing the WF/PC throughput values in the 1985 WF/PC Handbook (preflood) and those in the 1988 Handbook (with UV-flood) - the average difference is only 12% for the WFC and 2% for the PC.

camera	CCD	TV6 qe (9000Å)
WFC	1	.41
	2	.32
	3	.34
	4	.31
PC	5	.44
	6	.47
	7	.40
	8	.44
average		.39

For comparison, I researched measurements of the qe of various similar TI CCDs at 9000Å. The Palomar data is the average of data from Oke *et al.* (1988, PASP **100**, 116), and from latest measurements by D. Hamilton (private communication). The NOAO data

is taken from published values in the NOAO Newsletter over the last several years. These measurements were done by different individuals, using different laboratory and telescope setups. All these TI CCDs were fabricated in the same manner as the flight CCDs.

Observatory	TI#	qe (9000Å)
Palomar	4	.27
	6	.23
CTIO	1	.20
KPNO	2	.25
	3	.22
	6	.25
average		.24

The ratio of (average ground TI/average WF/PC) = 0.62, which is consistent with the observed value of the difference in sensitivity (.58). I therefore conclude that the WF/PC CCDs now have roughly the same sensitivity at 9000Å as do other TI chips from the same source. There may be a problem with the TV qe data.

A similar analysis at 5000Å indicates that the mean qe difference is only 20%, and is probably due to the coronene coating and the lack of UV-flood.

Several uncertainties remain in this analysis. First, how successful was any WF/PC screening process in selecting CCDs with greatly enhanced qe at 9000Å? Could this account for the difference between the TV results and the Palomar/NOAO data? One check would be to see if any qe tests were done at JPL before the CCDs were installed in the cameras. Second, since the qe values presented in the 1985 Handbook and the latest TV6 values agree so well, it suggests that all the TV data is suspect at 9000Å. But then why are the 5000Å measurements not a problem? Finally, the coronene coating on the flight devices acts as an antireflection coating which will boost the qe somewhat (Blouke *et al.* 1981, SPIE **290**, 6).

A similar analysis can not be done at 2300Å, where the observed flux is only a fourth of that expected. First, the published qe measurements do not extend that far into the UV for the ground based TIs. But even if they did, the Palomar/NOAO TIs are not coated with coronene as are the flight devices. A direct comparison would therefore be meaningless.