Wide Field / Planetary Camera-II for the Hubble Space Telescope

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Abstract
The Wide Field / Planetary Camera-II will be available to replace the WF/PC at the first opportunity for in-orbit Shuttle maintenance and refurbishment of the Hubble Space Telescope. It is fundamentally an engineering "clone" of the original radial camera, which nevertheless incorporates a number of science and operational enhancements based on improved technologies. Generic WF/PC performance issues identified and understood early in the WF/PC-II program provide the opportunity for carefully considered, cost effective hardware refinements. The result is improved science performance and operational efficiency for WF/PC-II which will be highly visible to the GO astronomer, and will provide savings in data reduction and calibration overhead.
Biased-platinum-gate CCD technology is introduced for the eight imaging sensors, in order to provide long and short term QE stability while obviating the solar UV light channel. Signal chain electronics have been modified in several ways to improve science performance and operational efficiency. The WF/PC set of 48 filters has been reviewed and a number of modifications have been implemented. The WF/PC-II is well into construction at JPL, scheduled for delivery in late 1991.

WF/PC-II CCD Technology
Sensors are drawn from an existing inventory of 800x800 Texas Instruments CCDs, but differ from WF/PC sensors in new processing of the (illuminated) backside surface and improved control of the packaging procedures. WF/PC-I UV flooded CCD technology is adequate, but provides little margin against QE instabilities and hysteresis, and has substantial operational impact for HST. Our goal is to improve QE stability, with as much margin as possible, in order to simplify photometry procedures and improve the viability of a long-term image calibration database. New processing steps demonstrate long and short term QE stability beyond requirements for 1% photometry. These steps include 1) selection of "thick p+" sensors from the existing inventory of unpackaged chips, 2) use of lumogen rather than coronene as the UV phosphor, 3) application of a platinum flashgate, and 4) electrically biasing the flashgate to a fixed potential. Each step independently

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adds margin against QE instabilities and hysteresis. Taken together, these steps are more than adequate for 1% photometry. Lumogen provides better quantum efficiencies in the FUV. Manufacturing procedures will be finalized this fall, based on extensive laboratory investigations now in progress with flight-packaged test devices. Packaging of flight sensors, following critical review of process qualification test results, will commence in December 1988. The UV light flood is obviated, hence the WF/PC solar UV light channel will be eliminated.

Signal Chain Electronics
Residual image removal circuitry has been added to the standard exposure sequence. This eliminates the potential difficulties associated with deeply overexposed star images, which would otherwise impose themselves in subsequent WF/PC exposures. The WF/PC "missing code" phenomenon has been eliminated. This recovers the otherwise ambiguous three least significant bits of the digital pixel values. Baseline stabilization circuitry has been added, adding margin against particle radiation upset events in the on-chip amplifier. "Partly-inverted" clock voltages are implemented for parallel phases, improving full well, cosmetics, and performance during overexposures.

FUV Performance
A FUV-attenuating condensate was identified in testing of the WF/PC, with substantial impact on operational efficiencies and FUV performance. Steps are being taken to eliminate sources of such contamination in WF/PC-II, through vacuum qualification of material samples and individual flight components prior to assembly. In addition, improved venting of the instrument to space will reduce the risk of condensation.

Filter Set
A baseline filter set has been defined, following an STScI workshop and HST Science Working Group concurrence. The ability of vendors to meet filter specifications has been demonstrated, and procurement of the filter set is in progress. Filters which were not requested in GTO proposals have been studied, most of these (six filters) have been modified or eliminated for WF/PC-II. WF/PC "UBVRI" is supported, providing continuity with the WF/PC system (avoids the Balmer jump). Stromgren photometry is now supported. The wide (30% FWHM) WF/PC filter sequence is extended with four new filters in the UV and FUV. Filters near the IS absorption feature have been adjusted for compatibility with other instruments. Narrow-band filter profiles are standardized in spectral shape and width to improve the determination of line ratios, especially in objects with significant velocity structure or red-shifts. "Quad" format filters are introduced for some red-shifted emission lines, polarizers, and solar system methane bands. A laboratory set of high fidelity witness filters will track the filter performance over time, as part of an integrated plan for fabrication, testing, and verification of on-orbit filter performance. The 48 baseline filters are fabricated with currently available technologies, however parallel and independent development of advanced technology broad-band UV and FUV filters is being pursued.

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