AIAA Aerospace Ground Testing Conference, Colorado Springs, CO, June 20-23, 1994

Ground Testing of the Wide Field/Planetary Camera - II
or
"Bringing Hubble back into Focus"

David B. Gallagher
Jet Propulsion Laboratory, California Institute of Technology
4800 Oak Grove Drive
Pasadena, California 91109

and

Jewel C. Beckert
Jet Propulsion Laboratory, California Institute of Technology
4800 Oak Grove Drive
Pasadena, California 91109

ABSTRACT

The Wide Field/Planetary Camera - II (WF/PC-II) is a Scientific Instrument designed to be installed on the Hubble Space Telescope (HST) in December of 1993. The Camera will be replacing WF/PC-1 (also built by JPL) and has been designed to correct for the spherical aberration that is present on the Primary Mirror of HST. The unique application and design of the Science Instrument required that special attention be paid to both optical alignment and thermal stability. Since the Camera is not a fully redundant Instrument, it was critical that rigorous ground testing be performed. The current climate at NASA also resulted in a high visibility, "cannot fail" mission which must be delivered on schedule and budget. We detail the Integration and Test phases of the WF/PC-II Project which lead to the delivery of the Science Instrument to Goddard Space Flight Center both ahead of schedule and under budget. Emphasis is placed on the System Testing of the Camera with particular attention placed on the Environmental Testing phase, The discussion will include but not be limited to System Ambient Testing, Vibration Testing, Acoustic Testing, and Thermal Vacuum Testing. Special attention is also placed on the issue of contamination since the primary advantage of HST over ground-based telescopes is Ultraviolet performance which is particularly sensitive to molecular contamination. It was required that WF/PC-II conform to an extremely high level of both molecular and particulate cleanliness. This effort resulted in a state of the art approach to controlling molecular contamination.

The WF/PC-II is a 610 pound, CCD Camera with three f/12.9 cameras and one f/30 camera, Prior to the discovery of the spherical aberration on HST, it was intended that the WF/PC-II merely be a "clone" of WF/PC-1 with upgraded CCD detectors. Many of the differences between the two cameras exist due to the correction for the aberration by WF/PC-II. The CCD's are Loral 800 X 800 front-side illuminated, Iumogen coated detectors. They are far superior to the WF/PC-I CCD's in that they have no Quantum Efficiency Hysteresis (QEH), deferred charge, or residual image problems. Additionally, they have about 7 electrons of read noise and are cosmetically excellent. The WF/PC-II contains several unique features other than the CCD's. In order for the correction of

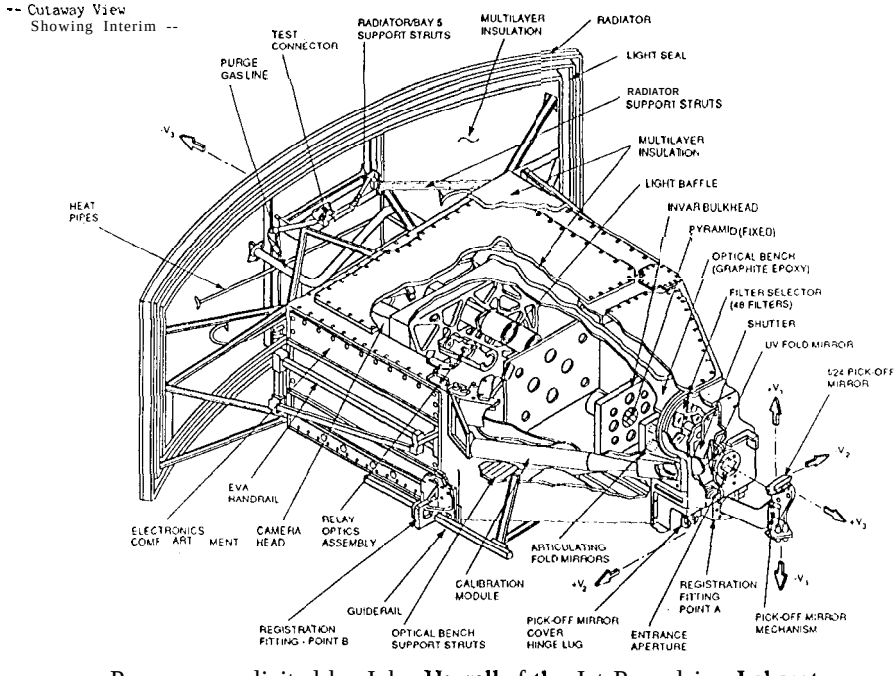
the Spherical Aberration to work properly, it is critical that the Optics with the corrective surface be precisely aligned with the incoming optical beam. This constraint is much tighter than on WF/PC-I. This concern over alignment led to the implementation of Articulating Fold Mirrors (AFM's). These AFM's are electrostrictive ceramic actuators within the Fold Mirror structure that provide tip/tilt adjustments up to +/- 1 milliradian in each axis.

The Ultraviolet imaging benefit of being outside the atmosphere could be compromised by even a small number of monolayer of molecular contamination. To insure cleanliness, materials were carefully screened before selection and each component of the Camera was painstakingly baked out in a chamber. In addition to this, we have taken the additional steps of installing zeolite molecular adsorber blocks in strategic locations and changing the venting path of the Camera. These, and other issues influenced the content and sequencing of testing tasks.

During the peak periods of Integration and Test of the Instrument there were over 100 people working on the Project, Managing a team of this size in addition to planning and running a 32 day Thermal Vacuum test presented a challenge and will also be discussed. It was discovered that while a Project Management System (PMS) was useful, one key to success was to maintain great flexibility in the scheduling and performance of tasks. The problems that were encountered during the Integration and Test phases of the Project as well as the associated solutions and work-arounds will be presented also.

SUMMARY

The purpose of the presentation is to detail the successful building and testing of the WF/PC-II. Although, there are no groundbreaking new technologies revealed, it is clear that a well thought out plan was implemented successfully and there exists an opportunity to share in lessons learned.



Paper was solicited by John Harrell of the Jet Propulsion Laboratory.