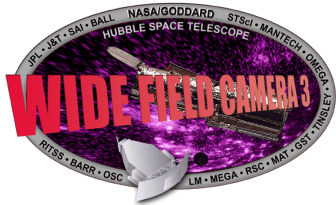


WFC3 Critical Design Review



SCIENCE OVERVIEW

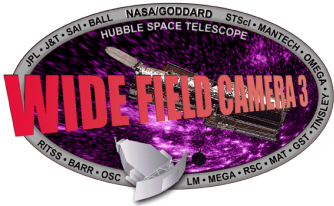
Dr. Ed Cheng



Topics



- What is WFC3?
- Scientific Goals
- Scientific Requirements Flowdown
- Science Management and the Facility Instrument

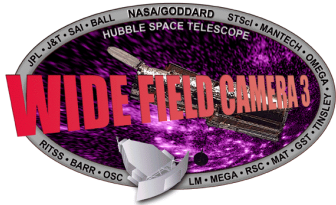


What Is WFC3?



- WFC3 is a facility instrument being developed on behalf of HST user community (several thousand astronomers).
 - Assures continued world class HST imaging science to end of mission
 - By 2010 WFPC2, STIS and ACS will be 17, 13 and 9 years old, respectively
 - Funded with re-programmed HST research funds (UPN459)
 - No Guaranteed Time Observer (GTO) team, no GTO observing time, no GTO funding (saves >\$20M)
 - Scientific Oversight Committee (SOC) chartered by Code S
 - “Badgeless” development team, led by HST Project

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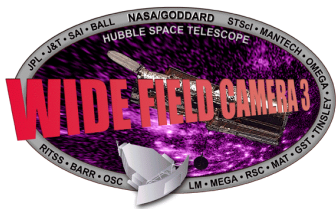


What Is WFC3? (cont)



- WFC3 will be the first “panchromatic” camera on HST.
 - Two channels cover Near-UV to Near-IR without cryogen
 - UVIS CCD channel backs up ACS while providing unique NUV capability
 - NIR HgCdTe channel improves upon NICMOS science
 - Improved field of view, resolution, sensitivity
 - Reduced wavelength range

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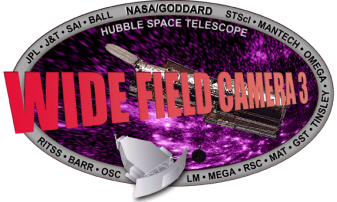


Scientific Mandate

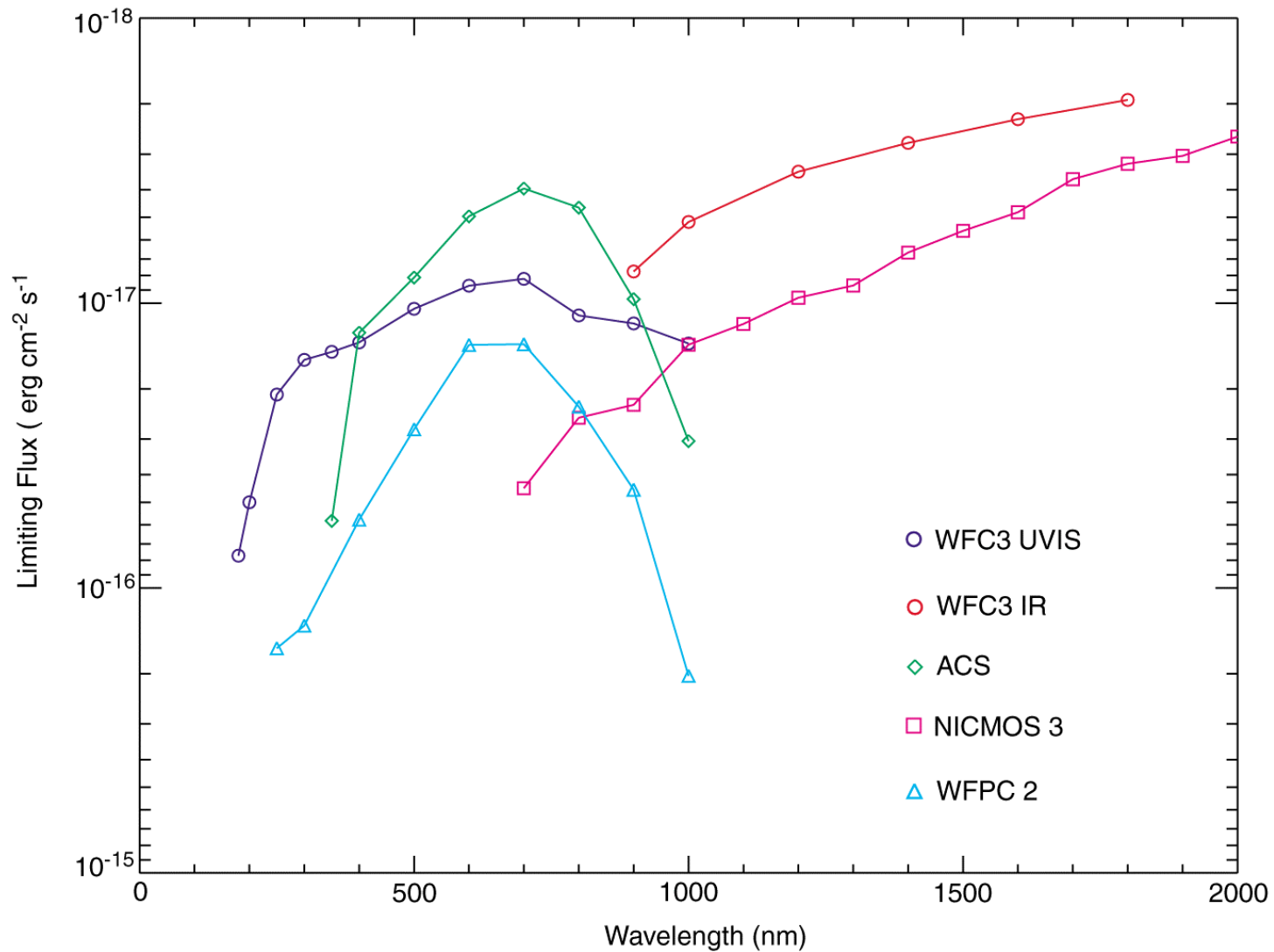


- Backup imaging capability for HST.
 - Ensure an imaging capability through 2010 (lifetime).
 - Address on-orbit CCD degradation issues (photometry).
 - Radial bay operation not thermally constrained (efficiency).
 - No aft shroud cooling system
- Provide a wide field and wide spectral range imaging capability.
 - Statistical studies of rare objects require large field-of-view.
 - Current scientific models need input from a “panchromatic” approach to observations.

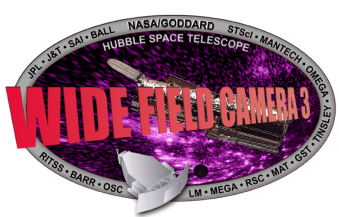
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WFC3 Improves HST Imaging Sensitivity



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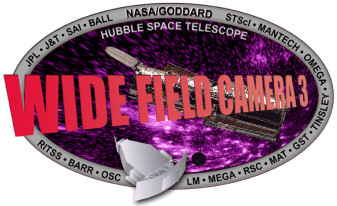


The Importance Of Panchromatic Science

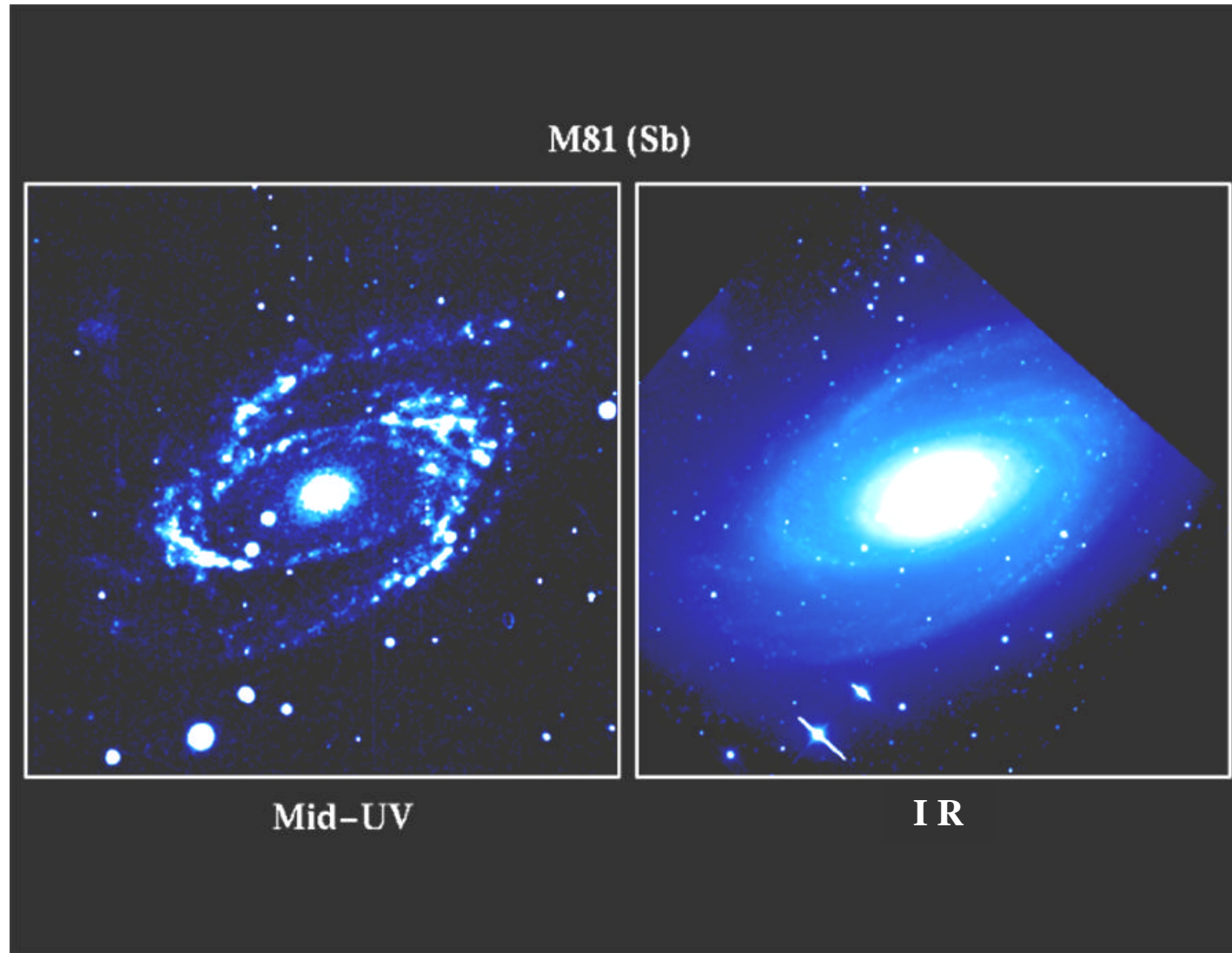


- A synoptic view of the Universe requires knowledge over a wide spectral band.
 - Astrophysical models are becoming very sophisticated.
- Galaxies look very different in the near-UV than in the near-IR.
 - UV highlights star-forming regions and areas of energy production.
 - IR highlights dusty regions and areas that absorb and redistribute (“recycle”) energy.
 - A complete architectural model of a galaxy needs to understand all these components.

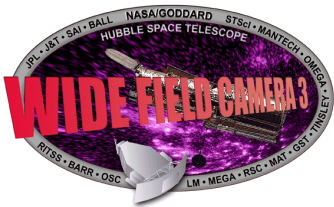
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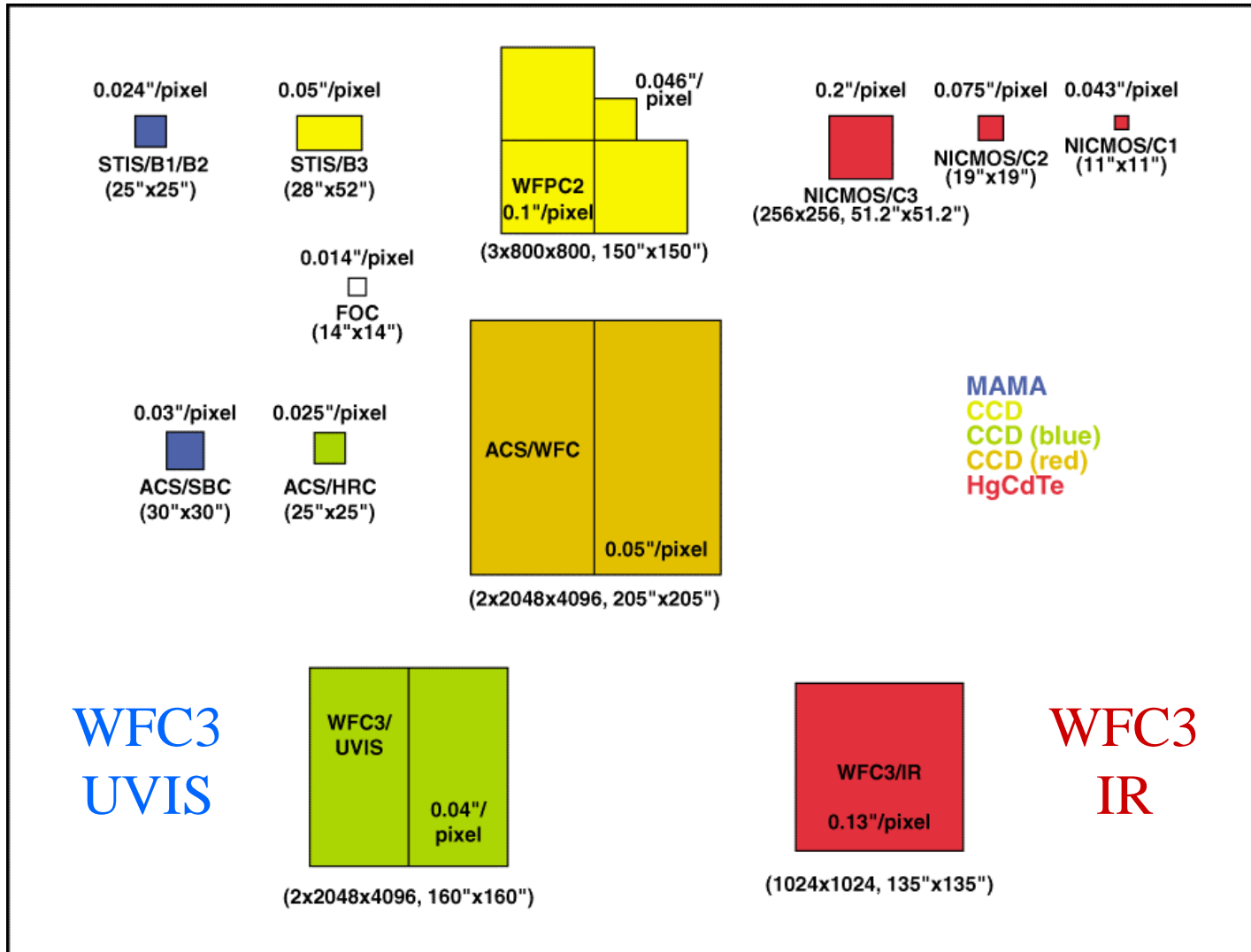
The Panchromatic Galaxy



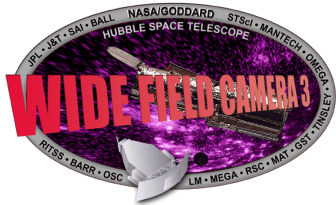
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HST Imaging FOV



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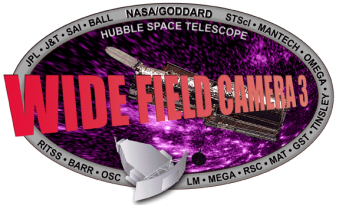


The Importance Of Field-Of-View



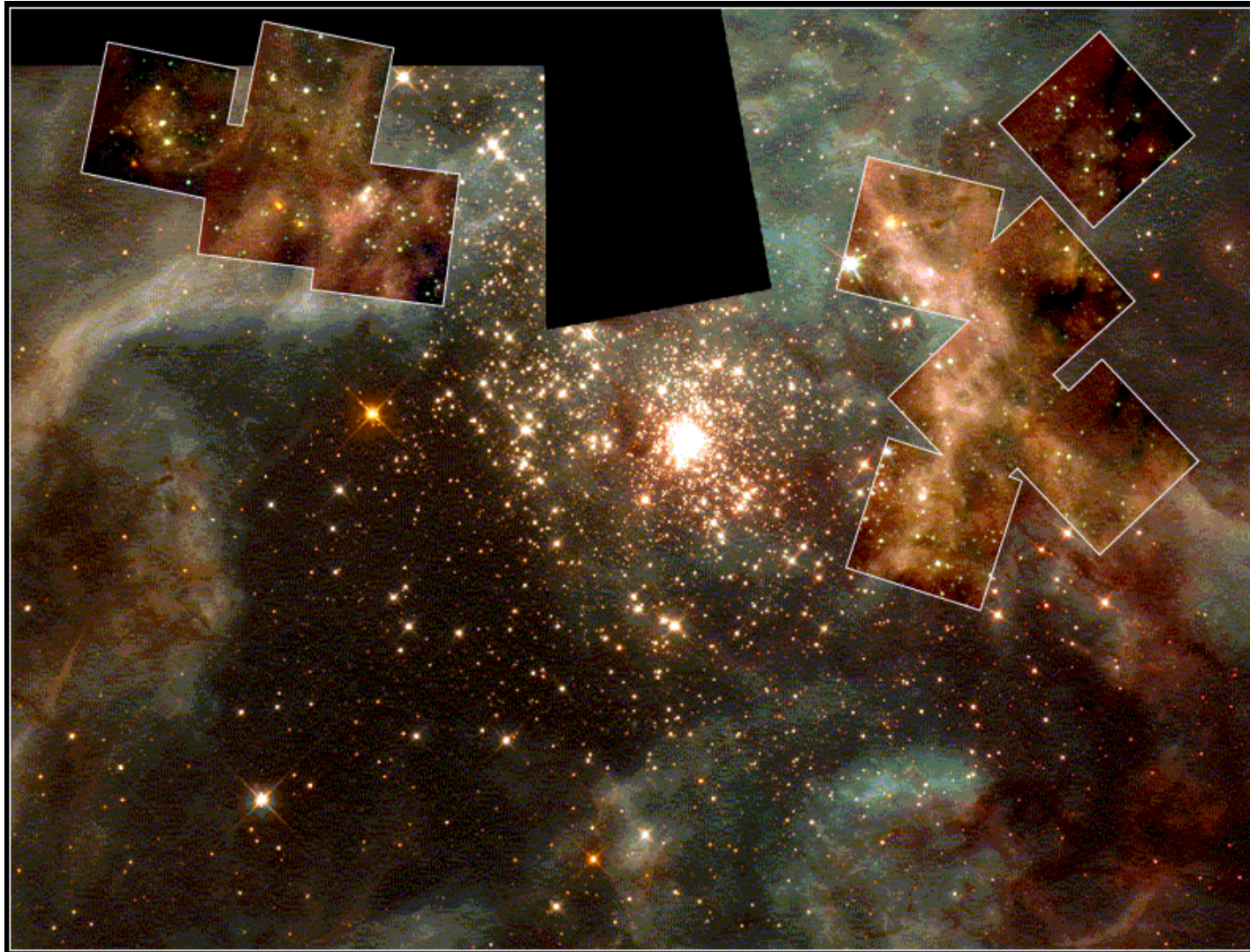
- Statistical studies or discoveries of rare (dim, far away, or exotic) objects require large areas of sky coverage.
 - Distant galaxy clusters need to be studied as a group.
- Studies of large objects are far more efficient without the need for extensive mosaicing.
 - The stars within globular clusters need to be studied as a group.

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What's Inside A Star Forming Region?

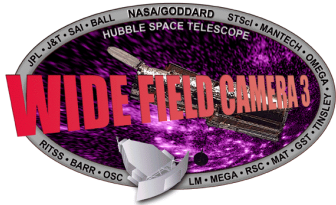


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December, 2000

WFC3 Critical Design Review

11

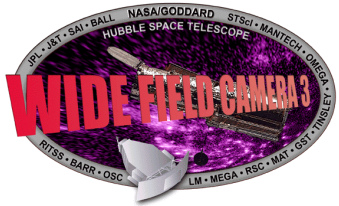


The Importance Of Near-IR Observations

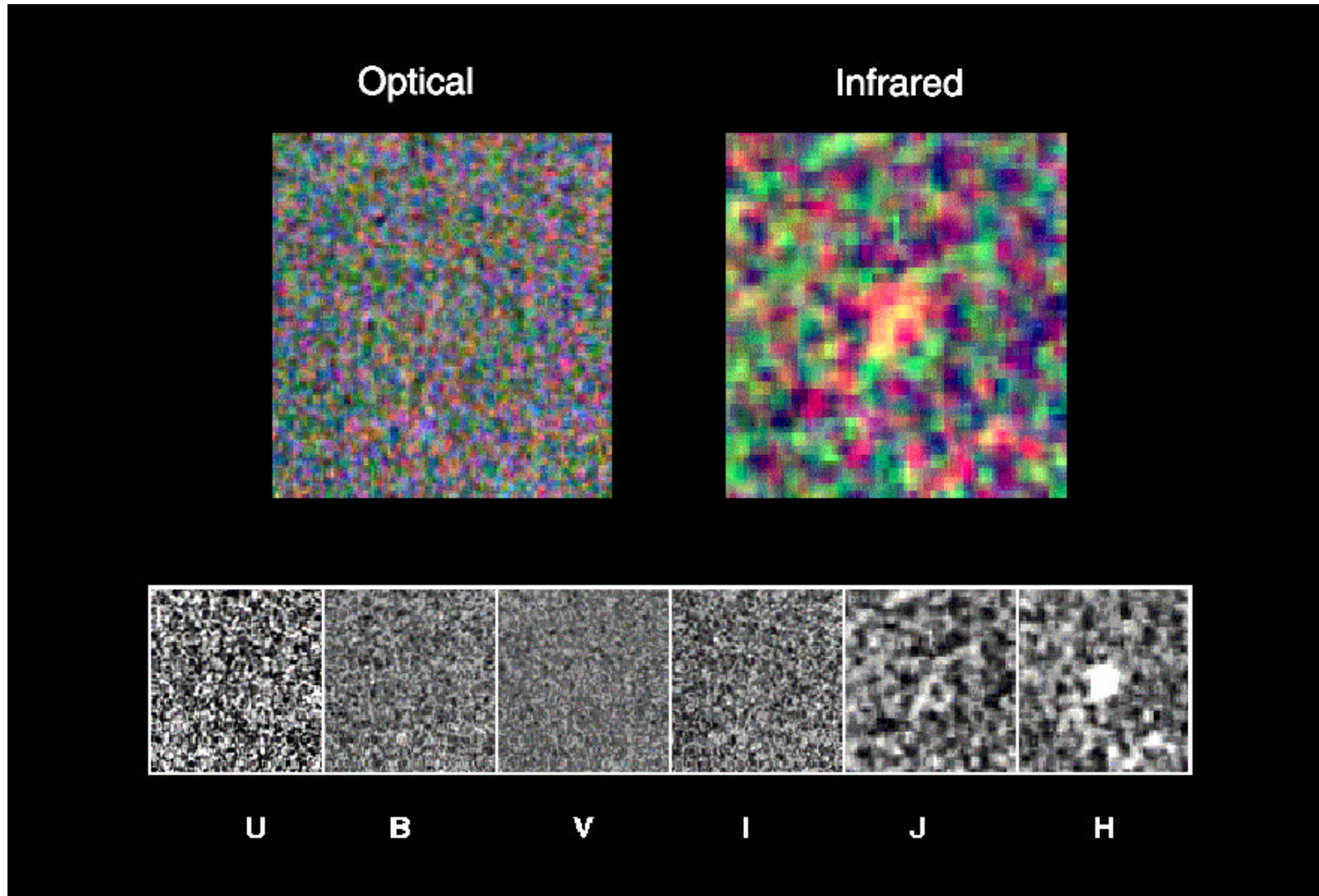


- IR observations are a unique handle on the structure of the early Universe.
 - Redshifted light at restframe UV and visible shows up in the IR.
- IR observations can look through dust to observe previously hidden regions of the Universe.
 - Star forming regions and galactic centers are particularly interesting.
- HST is warm, but can be **very competitive** at wavelengths shorter than 1.8 μm .

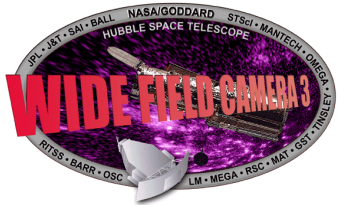
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How Much Energy Is The Universe Hiding In The Near-IR?



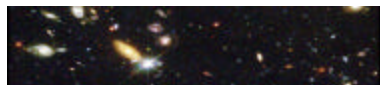
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Instrument Definition: The Science White Paper



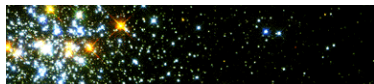
The WFC3 Science White Paper highlights areas where one may expect the contribution of WFC3 to be “ground-breaking.” We have considered programs in each of the following themes:



High-z Universe (Sect. 4.2 and 5.1)



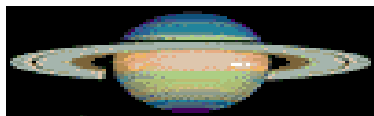
Nearby Galaxies (Sect. 6.1)



Resolved Stellar Populations (Sect. 4.1)

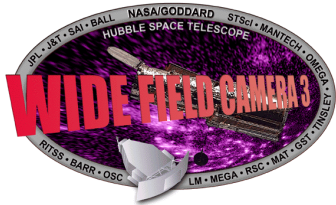


Stars and Interstellar Medium (Sect. 6.2)



Solar System (Sect. 5.2 and 6.3)

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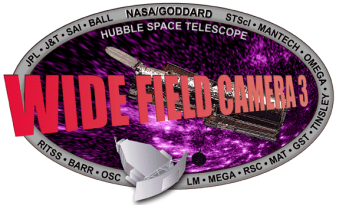


Instrument Definition: Design Reference Mission (DRM)



- A set of 43 observing proposals.
 - Based on the contents of the Science White Paper.
 - Designed to stress the capabilities of the instrument.
- We have developed tools to rapidly assess instrument performance given varying instrument configurations.
 - Provides 0th order assessment of the impacts of performance trades.
- The DRM may evolve somewhat as the SOC updates science goals

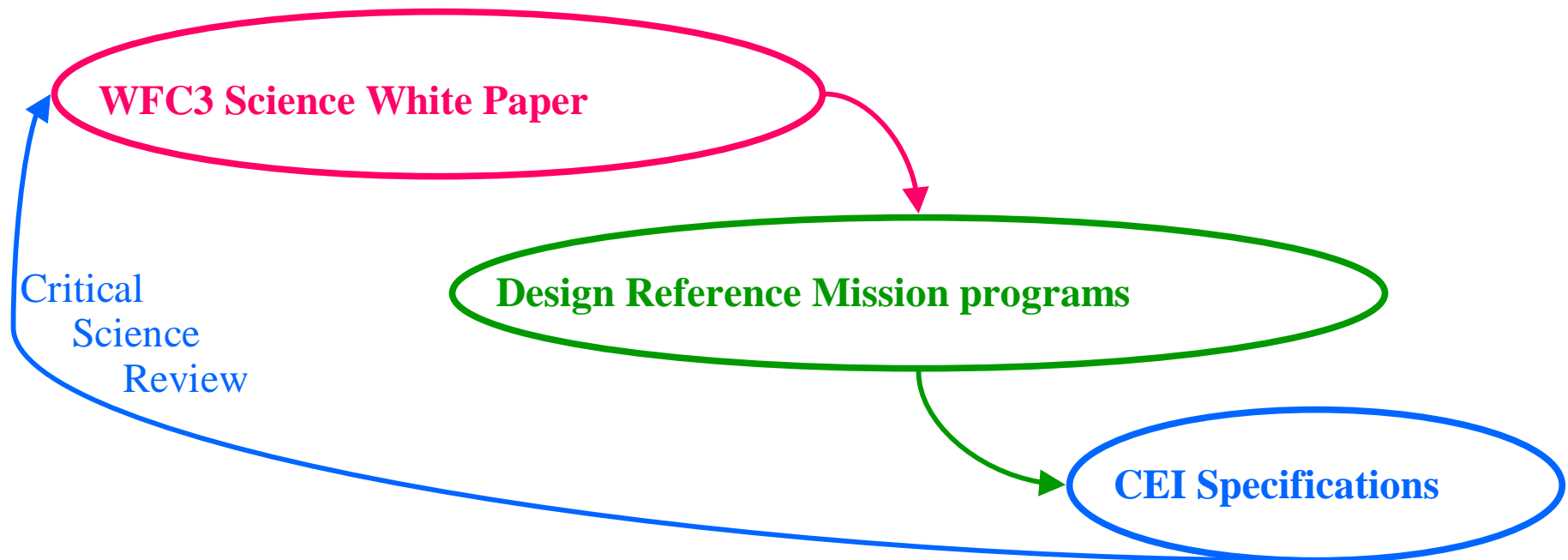
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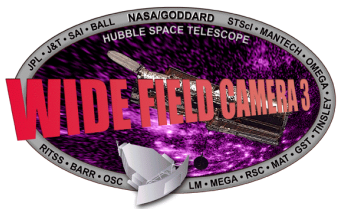
Scientific Requirements Flowdown



The Critical Science Review (CSR) has ensured that the instrument design satisfies the scientific requirements defined in the Science White Paper and Design Reference Mission.



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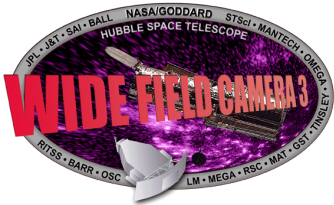


The Critical Science Review



- Conducted as the main part of the July SOC meeting.
 - 24-25 July 2000 at STScI.
- 5 hour presentation by the Science IPT covering:
 - Scientific requirements flowdown process,
 - WFC3 scientific capabilities (focus on unique capabilities),
 - Science-related instrument specifications,
 - CEI Specifications (review of changes from prior discussion), and
 - Estimated instrument performance and ability to meet scientific goals.
- SOC organized itself into 5 sub-committees.
 - Discussed consensus conclusions and debriefed the HST Project Scientist and the STScI Director
 - Delivered an 11 page report on 3 August 2000.

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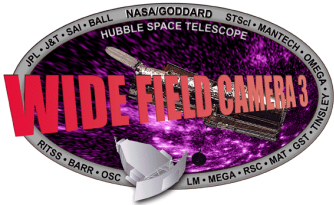


CSR Report Summary



- “We feel well informed about the status of the Project and the current design.”
- “We find that the present WFC3 design does indeed meet the scientific performance specifications we expected.”
- “We believe that the Contract End Item Specifications reflect the best compromise between scientific performance and the stringent constraints on budget and schedule within which the Project must work.”
- “It is our judgement that the WFC3 Project is well managed and properly configured to deliver the camera within its budget, in time for the 2003 HST Servicing Mission.”

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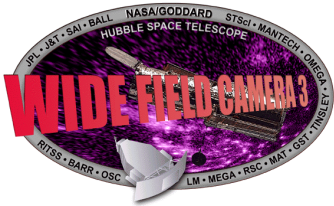


CSR Detailed Comments



- “Since the detectors are the most critical items on the path to a successful instrument, we commend the Project for establishing the Detector Characterization Laboratory and for the recent progress in placing contracts with the two principal detector vendors and with a backup CCD vendor. We urge unrelenting attention to the issue of detector delivery.”
- “We recommend that the SOC and the Science IPT develop concrete plans for a candidate set of Key Projects for WFC3.”
- “We believe that the greatest current threats to budget and schedule lie outside the HST Project. NASA must maintain a more reliable schedule of Shuttle launches and not penalize the budgets of scientific payloads for delays beyond their control.”
- “The realized WFC3 will be essential to the success of HST in its final decade of operation and a critical pathfinder for the Next Generation Space Telescope.”

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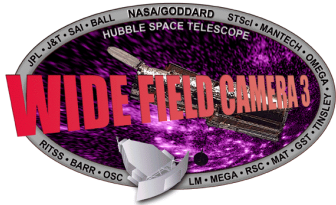
CSR Concerns And Actions



All items have been resolved with the SOC

- Shuttle schedule and associated budgetary impacts.
- Completion of contract negotiations with external contractors.
- Schedules for detector delivery at Marconi and Rockwell
“must be pursued with unrelenting scrutiny.”
- Planning for I&T and SMOV needs development and SOC role needs to be defined.
- CEI clarifications requested on 7 items:
 - CCD cosmetics, cross-talk, UV spec on backup devices.
 - IR long 1 cutoff, scattered light.
 - SOC updates on status of filters (esp. F300X).
 - ETC development (enhancements to www page).

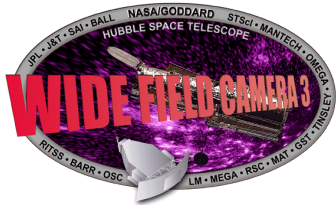
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Additional Recent External Reviews



- June 1, 2000 – NASA Headquarters - chartered “Simmons” Review.
 - High-level technical and programmatic review.
 - Positive comments from the panel.
- June 13, 2000 – Origins Subcommittee presentation.
 - Positive comments regarding the instrument.
 - Concern over potential cost overruns.

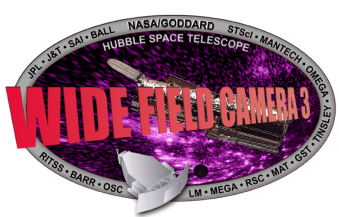


Internal Reviews Completed



- June 10, 2000 – HST Project programmatic review.
 - Reestablished that the budget and schedule are credible.
 - Reconfirmed HST Project commitment to build WFC3 for the established budget and schedule.
- July 26, 2000 – WFC3 Subsystem Peer Reviews completed.
 - A total of 15 detailed subsystem reviews covering all major technical areas of the instrument.
 - Actions are being tracked. Those that are reasonable to close before the CDR have been closed.

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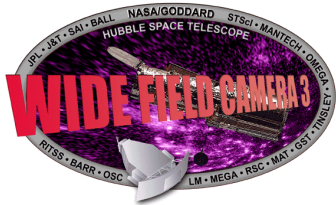


Science Management



- WFC3 is a facility instrument.
 - Selected to provide an extremely capable instrument for the entire HST community.
 - Led by an Instrument Scientist in the role of the traditional PI.
 - Supported by a Science Integrated Product Team (SIPT) in the role of the traditional “Science Team”.
 - Guided by a Scientific Oversight Committee (SOC) to ensure that community interests are properly balanced.
 - Not selected to perform a particular scientific program under a PI-led science team.
- SIPT is an integral part of the development project.

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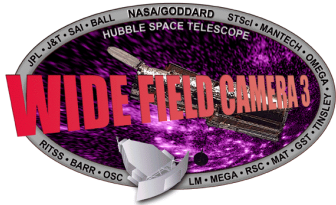


SOC Roles



- Establishes the overall scientific balance of the observations that the instrument will perform.
- Creates the “Science White Paper”.
- Creates the Design Reference Mission.
- Participates in the tradeoffs of instrument design and technical feasibility.
- Participates in planning for the on-orbit performance verification phase.

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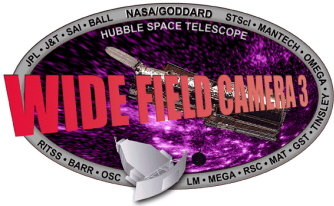


Scientific Oversight Committee



SOC Member	Affiliation
Bruce Balick	University of Washington
Howard Bond	Space Telescope Science Institute
Daniela Calzetti	Space Telescope Science Institute
Marcella Carollo	Columbia University
Michael Disney	University of Wales At Cardiff
Michael Dopita	Institute Of Advanced Studies Mt. Stromlo & Siding Spring Observatory
Jay Frogel	Ohio State University
Donald Hall	University of Hawaii
Jon Holtzman	New Mexico State University
Gerard Luppino	University Of Hawaii
Patrick McCarthy	Carnegie Observatories
Robert O'Connell (Chair Person)	University of Virginia
Francesco Paresce	European Southern Observatory
Abhijit Saha	National Optical Astronomy Observatory
Joseph Silk	University of California, Berkeley
John Trauger	Jet Propulsion Laboratory
Alistair Walker	NOAO CTIO
Brad Whitmore	Space Telescope Science Institute
Rogier Windhorst	Arizona State University
Erick Young	University of Arizona

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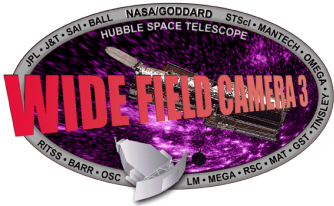


SIPT Roles



- Supports the SOC in all its activities.
- Creates the instrument CEIS.
- Interacts daily with the instrument developers, making trades as necessary.
 - Runs performance predictions against the DRM.
 - Trades with significant scientific impact are brought back to the SOC.
- Selects the flight detectors.
- Plans and executes the instrument ground calibration.
- Plans and executes the on-orbit performance verification.

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Conclusion



- The “facility instrument” concept is new to HST and most of Code S.
 - WFC3 is a trailblazer for future endeavors.
- To date, this has been an unqualified success.
 - Serious scientific trades and discussions have been rapidly and productively concluded.
 - The (justified) skepticism of many at the start has subsided.
 - Interactions with the WFC3 developers and the HST Project are close and productive.
- The currently conceived WFC3 will have an unprecedented ability to produce outstanding, breakthrough scientific results.

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