A. Activity: Science Requirements for Pointing and Role Stability

**STScI Lead:**
G. Kriss, with assistance from S. Casertano (NIRCam rqmnts), M. Regan (NIRSpec rqmnts), and B. Rauscher (MIRI rqmnts).

**Origin:**
This is a contract deliverable requested by Matthew Greenhouse.

**Description:**
Working closely with the science instrument teams, develop the science requirements for each instrument relevant to pointing and roll stability. This information is a necessary input to the error budgets for the Level 2 requirements on image quality, and it will also be used to optimize the location of the instruments in the focal plane.

**Products:**
A short (~3 page) document deliverable to Matt Greenhouse and published on the STScI Documents Server.

**Cost to Completion:**
- NIRCam Draft: 3 FTE days
- NIRSPEC Draft: 1 FTE days
- MIRI Draft: 1 FTE days
- Assemble, circulate, edit 1st draft: 1 FTE days
- Revise and circulate penultimate draft: 2 FTE days
- Incorporate revisions and publish: 2 FTE days
- TOTAL: 10 FTE days

**Status:**
- NIRCam: discussions with the NIRCam team have just been initiated.
- NIRSpec: extensive discussions and email exchanges with P. Jakobsen have defined most of the relevant issues.
- MIRI: extensive discussions, team meeting presentations, and email exchanges have defined the MIRI requirements.

**Milestones:**
- 5/31/02 Due Date listed on Monthly Reports.
- 11/18/02 Circulate early draft document within STScI
- 12/02/02 Circulate draft document to instrument teams
- 12/13/02 Circulate penultimate draft for internal approval
- 12/20/02 Publish Final Report on STScI Document Server
B. Activity: Limitations of GSC2 for JWST Guide Stars

STScI Lead: G. Kriss, with assistance from J. Stys

Origin: GSFC/STScI

Description:
The small field of view (~11 sq. arc min) of the CSA-proposed design for the FGS units on JWST requires that stars as faint as JAB=19 be used for guiding to ensure that the 95% probability of successful guide star acquisition is met anywhere in the sky. For typical expected stellar spectral types at these magnitudes, the corresponding J385 magnitude in GSC2 is near the catalog limit (J385=21). Use overlapping regions of the Sloan Digital Sky Survey (SDSS) and the Two-Micron All-Sky Survey (2MASS) to characterize the suitability of the faint end of GSC2 for providing acceptable JWST guide stars.

Product:
- A report to be published on the STScI Document Library.
- If warranted, submit a paper to PASP.

Cost to Completion:

<table>
<thead>
<tr>
<th>Task</th>
<th>Duration</th>
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<tr>
<td>Outline of report</td>
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<td>Preparing first draft</td>
<td>6 FTE days</td>
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<td>Preparing final report</td>
<td>4 FTE days</td>
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Status:
- The comparisons of GSC2, SDSS, and 2MASS are complete.
- A viewgraph presentation was made at the FGS technical interchange meeting at GSFC in July.
- The report must be assembled, circulated for comments, and published.

Milestones:
11/08/02 Finish outline of report and assign appropriate writing and figure-making tasks to Jeff Stys and Jerry Kriss.
11/12/02 Present verbally at TIM with CSA at Goddard
12/06/02 Circulate draft report
12/20/02 Publish final version in the document library
C. Activity: Operational Workarounds for Inadequacies of GSC2

STScI Lead: Ed Nelan

Origin: GSFC/STScI

Description:
The small field of view (~11 sq. arc min) of the CSA-proposed design for the FGS units on JWST implies that at high galactic latitudes there is a significant risk that no guide star will be available from GSC2. However, it is expected that the proposed FGS will have the sensitivity to go approximately two magnitudes fainter than GSC2, which according to galactic models, will assure that a suitable, but uncataloged guide star will be present. This study addresses the means by which such guide stars can be identified to support science observations when needed (i.e., there are insufficient candidate stars at the desired location in GSC2).

Products:
A report to be published in the STScI/JWST Document Library.

Cost to Completion:
- Study of using early NIRCam observations: 2 FTE days
- Study of using early ground-based observations: 5 FTE days
- Study of allowing roll freedom: 3 FTE days
- Preparing draft report: 3 FTE days
- Preparing final report: 2 FTE days
- TOTAL: 15 FTE days

Status:
- A viewgraph presentation on possible workarounds was presented at the FGS technical interchange meeting at GSFC in July.
- The operations concept for the NIRCam option is nearly complete.

Milestones:
- 11/12/02 Present verbally at TIM with CSA at Goddard
- 11/15/02 Circulate Draft report
- 12/06/02 Publish final report
D. Activity: Study the Science Requirements for PSF Symmetry

STScI Lead: Stefano Casertano

Origin: STScI

The need for a revised document came up in a STScI/JPL conference on PSF requirements. The trigger for the specific study was confusion in the interpretation of existing Level 2 requirements on the part of PSF modelers at GSFC and JPL, reported by Anand S.

Description:

Study the definition of PSF asymmetry in the current Level 2 requirements; clarify its meaning and determine how it matches the science requirements of DRM programs. Develop an improved set of definitions and metrics to describe the PSF asymmetry and its impact on science programs. Consider requirements on both absolute PSF quality and calibration of asymmetries.

The study has focused thus far on cosmic shear via weak lensing (DRM program P003), but other programs can be impacted as well (AGN, proto-planetary disks).

Products:

Report(s) on study results. Eventually, revised Level 2 requirement.

Cost to completion:

0.5 weeks (20h) for initial report; 3.5 weeks (140h) for full activity.

Status:

First report, based on absolute PSF requirements - i.e., without calibration - was completed and given limited circulation in May 2002. The report includes a strawman level 2 requirement in the absence of calibration. The next step depends on a realistic assessment of the PSF calibratability, which in turn depends on its expected spatial and temporal variability. At the moment, not enough information is available to make a realistic assessment; more data have been promised by JPL and GSFC once the Prime is firmly on board.

Milestones

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<td>First report</td>
<td>(May 2002)</td>
<td>Completed May 10, 2002</td>
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<tr>
<td>Revision, final report</td>
<td>(December 2002)</td>
<td>Revision 30% complete</td>
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<tr>
<td>Proposed Level 2 requirement</td>
<td>(December 2002)</td>
<td>Open</td>
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E. Activity: Using Astronomical Sources for Calibration
Determine usefulness of astrophysical line sources as calibrators in lieu of internal lamps.

STScI Lead: Stefano Casertano

Originator: JWST Project

Description: Study the characteristics of several classes of astrophysical line sources to determine whether they can be used in place of internal sources for the calibration of NIRSPEC and MIRI. (Only single-slit mode of MIRI is being considered at the moment.) Estimate the additional cost in observing time and the limitations associated with the using external sources as calibrators.

Products: 1) A standard Report that describes the result of the study. 2) A comprehensive Atlas that presents the details of the information we gathered on these sources in an organized fashion and makes them available for further study.

Cost to completion: 2 weeks (80h) total, of which 1 week for lead, 1 week for supporting DA Sherie Holfeltz.

Status: The Atlas is complete and is going through an internal review. The Report is 80% complete.

Milestones

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<td>ETA October 18, 2002</td>
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<td>Draft atlas</td>
<td>(October 31, 2002)</td>
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<tr>
<td>Final report</td>
<td>December 31, 2002</td>
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<tr>
<td>Final atlas</td>
<td>December 31, 2002</td>
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F. Activity: Tests of Flat-fielding Methods and Algorithms
Determine whether self-calibration techniques are needed to achieve the flat-field fidelity for required by the DRM proposals.

STScI Lead: Stefano Casertano

Originator:
STScI - follow-on from calibration studies.

Description:
We have identified flat field fidelity as one of the possible limiting factors in calibration quality as a part of my calibration report, and have established that self-calibration will most likely suffice in determining the flat field to the required accuracy. However, enabling self-calibration places operational and planning/scheduling requirements on how observations are taken and processed. Also, its computational demands could potentially become an obstacle to data processing. We are investigating whether classic calibration techniques based on "empty sky" methods could achieve an adequate level of flat field accuracy.

Products:
Report.

Cost to completion:
3 weeks (120h) total, of which 1 week for lead, 2 weeks for support DA Sherie Holfeltz.

Status:
Draft report exists; small improvements needed. Some runs must be repeated because of input errors.

Milestones

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<td>ETA October 23, 2002</td>
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<tr>
<td>Final report</td>
<td>(November 30, 2002)</td>
<td>ETA November 15, 2002</td>
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G. Science Requirements for the OTE Simulator

STScI Lead: Ed Nelan and Margaret Meixner

Originator: JWST Project

Description:
The OTE Simulator will be built by the Prime contractor for use during ISIM integration and test (I&T). The simulator will contain a variety of light sources, and it will provide simulated light cones and images to the ISIM as if the light were coming through the OTE itself. The OTE Simulator will be a key tool for aligning and focusing the instruments in the ISIM and verifying mechanical and thermal stability. A ground rule for ISIM I&T is that it will not be used for verification of instrument science performance. This is supposed to be done by the instrument teams before instrument delivery. Thus, there should not be any science requirement levied on the OTE simulator involving absolute photometric accuracy in the light sources, nor a high density of sharp spectral lines spread across the instruments’ spectral range to be used for wavelength calibrations.

Products:
A brief Technical Memorandum to be delivered to Matt Greenhouse establishing the requirements. This will also be published on the STScI Document Library.

Cost to completion:
Preparatory meetings and conversations: 2 FTE days
Draft of memo: 3 FTE days
Revise draft & publish final memo: 2 FTE days
TOTAL: 7 FTE days

Status:
Some initial meetings and conversations have taken place.

Milestones:
11/27/02 Circulate first draft
12/14/02 Publish final memo
H. Activity: Draft the MIRI Operations Concept

STScI Lead:
Bernie Rauscher

Origin:
The MIRI Science Lead, George Rieke, asked us to lead this.

Description:
STScI will draft the MIRI Operations Concept Document. This will become a JPL Configuration Managed document with an STScI Document Custodian.

Products:
- A presentation to be made to the MIRI team.
- A draft document to be submitted to the JPL MIRI team.

This is a significant document. The corresponding document for SIRTF/MIPS, which George supplied as an example, is 65 pages long. The MIRI Operations Concept will discuss the major instrument functional elements, and the observing modes that will be used to operate them. The document may include state/transition diagrams as well as examples of command sequences.

STScI will work closely with JPL and the Science Team to write this document. It can be expected to evolve as the MIRI’s design matures.

Cost to Completion:

Status:
An outline document exists and this outline has been circulated within the JPL/MIRI team and STScI. Bernie and Margaret are working on an advanced draft that will be presented at MIRI meetings at Rutherford Appleton Labs (RAL) in late November.

Milestones:
9/2/02, Bernie sent a draft to JPL. This met the Due Date called out in the Monthly Reports.
11/25-26/02 Advanced draft presented (verbally) at RAL. Written draft sent to JPL.
I. Activity: Reducing Back-Scattered Light with Black Spots

STScI Lead:
Bernie Rauscher

Origin:
Requested by Matthew Greenhouse

Description:
Study the effectiveness of reducing back-scattered calibration lamp light by painting portions of the secondary mirror black. The aim of this study was to evaluate and quantify any impact on MIRI’s sensitivity due to black body emission from the spot.

Scope:
The product of this study is a short (few pages) STScI document on the STScI document server.

Status:
The document is written, and has been in essentially final form for several weeks. Once it is signed by Peter, it will be posted to the STScI server.

Milestones:
Due, 7/1/02
Finish, 11/01/02
J.   Activity: Reach Convergence on the MEMS Requirements

STScI Lead:
M. Regan

Origin:
Original request to configuration manage the requirements was rejected by the CCB.

Description:
The MEMS requirements document is not configuration managed. The current official version still reflects many requirements left over from the reflective MEMS options. The STScI and GSFC CCBs rejected the first attempt at a new document.

Products:
STScI’s role is to act as a facilitator between GSFC and ESA on the requirements. We are not the lead on this and can just help GSFC. But it would be helpful to put our views in writing in a short memo.

Status:
Discussions with Peter Jakobsen in June reached agreement on the issues between ESA and STScI.

Milestones:
11/15/02  Draft memo summarizing our views and circulate internally
11/25/02  Send memo to Jakobsen for comment
12/6/02   Publish final memo
K. Activity: Update the Draft FGS Operations Concept

STScI Lead: Ed Nelan

Origin: GSFC/STScI

Description:
During the initial FGS pre-phase A studies, STScI drafted an operations concept for the FGS that served as a guide to requirements development and the design of the system architecture. The resulting FGS design concept and architecture produced by CSA is somewhat different from our initial assumptions. The draft operations concept should be revised and updated in a way that is consistent with the current CSA design concept.

Products:
The updated FGS Operations Concept document.

Cost to Completion:
- Update the document: 10 FTE days
- Incorporate comments: 5 FTE days
- TOTAL: 15 FTE days

Status:
STScI has reviewed the CSA FGS Concept document and has provided comments to CSA. No work has yet been done on updating the Ops Concept document.

Milestones:
- 12/07/02 Produce a revised draft for internal circulation
- 12/14/02 Send revised document to GSFC and CSA for review
- 12/31/02 Publish final FGS ops concept
L. Activity: Requirements for Target Acquisitions

STScI Lead: G. Kriss, with assistance from S. Casertano, M. Regan, & B. Rauscher

Origin: JWST Project/Matt Greenhouse

Description:
Working closely with the instrument teams, establish the science requirements for doing target acquisitions and peak-ups, and make any relevant recommendations for updating the JWST Level 2 requirements.

Products:
- Memo giving recommendations for how target acquisition and peak-up requirements should be handled in the project’s requirements structure. (Completed 4/4/02.)
- Memo summarizing science requirements for target acquisitions

Cost to Completion:
Investigate NIRCam requirements: 5 FTE days
Draft memo: 1 FTE days
Incorporate comments into final memo: 1 FTE days
TOTAL: 7 FTE days

Milestones:
11/22/02 Circulate draft memo internally
12/07/02 Circulate draft to instrument teams
12/21/02 Publish final memo
M. Activity: Study Tracking of Moving Targets

**STScI Lead:** Ed Nelan

**Origin:** GSFC/STScI

**Description:**
The ability of JWST to track moving targets is highly desired by solar system astronomers. Observations of moving targets has implications for the processing and scheduling of such exposures. We are evaluating the costs associated with these implications.

**Scope:**
We are identifying the requirements and their costs associated with the observations of moving targets. Our study assumes that the FGS will have the ability to track guide stars with the needed NEA as JWST is slewed to track a moving target. We will consider the various rates to be encountered, and the operational implications as a function of rate. For example, the fast moving targets will have shorter intervals over which a particular guide star can be used. We are also considering the impact on observatory efficiency for moving target observations which need to execute at a particular time or over a particular time interval.

**Status:**
A draft document has been produced that outlines how moving target observations with HST are to be similar and different with JWST. This study has recently become the highest priority as it needs to be completed by Nov 2, 2002.

**Milestones:**
- 10/25/02 Draft for internal review.
- 11/02/02 Completed study is due.
N. Activity: Science Requirements for Detector Read-out Modes
Provide a science rationale for each of the planned read-out modes to be implemented in the detector read-out electronics for JWST.

STScI Lead:
Jerry Kriss

Origin:
Requested by Matthew Greenhouse

Description:
This resulted from an RFA submitted at the detector electronics system requirements review on 6/21/02 that requested better traceability for the requirements.

Scope:
The product of this study is a short (few pages) STScI document on the STScI document server.

Status:
The thoughts are in Jerry’s head, and will be transformed into electronic bits when he returns from research leave.

Milestones:
10/25/02 Draft for internal STScI review.
10/31/02 Send to Goddard and post on web site.
O. Activity: Provide Simulated Data for Testing Data Compression Schemes

STScI Lead: A. Sivaramakrishnan, with assistance from S. Casertano

Origin: RFA from Detector Electronics Peer Review

Description:
To test various data compression schemes being considered for implementation, the electronics group would like to have realistic simulated data frames. We had said that the simulators we were developing could provide these. The simulated data should contain a variety of astronomical scenes as well as include cosmic rays with a morphology and rate consistent with what is expected on orbit.

Products:
• Simulated data frames in FITS format

Cost to Completion:
Generate astronomical scenes: 1 FTE days
Software for cosmic ray inclusion: 5 FTE days
Prepare data frames: 4 FTE days
TOTAL: 10 FTE days

Status:
The simulated astronomical scene (an extragalactic field with galaxies) has been generated.

Milestones:
10/11/02 Prepare simulated astronomical scene with noise (Done)
10/25/02 Verify that cosmic-ray simulation can be done
10/31/02 Deliver simulated data frames to Goddard
P. Activity: Re-evaluate Science Data Volume and Rates

STScI Lead: G. Kriss

Origin: Action from ISIM Kickoff/Detector Splinter on 11/15/02

Description:
A driver for developing hardware and algorithms for on-board data processing with cosmic-ray rejection on JWST is the inability to downlink all the raw data so that this processing could be done on the ground. The original data volume study assumed that science data would be downlinked every 1000 s. This is not frequent enough to avoid substantial impacts due to cosmic ray contamination, which is nominally expected to affect ~5% of the pixels in an image in 1000 s. However, downlinking intermediate accumulations in a MultiAccum integration every 100 s would be frequent enough to enable effective ground-based processing of the data. If this were possible, it might eliminate the perceived need to develop an on-board CR-processing capability. Through consultation with TRW and the SI teams, STScI is to re-evaluate the capability for downlinking science data.

Products:
- Short technical memo summarizing science data volumes and rates for typical observing configurations using the proposed TRW spacecraft design and currently envisioned downlink capabilities.

Cost to Completion:
- Gather information: 1 FTE days
- Draft initial report: 2 FTE days
- Revise draft and publish final report: 2 FTE days
- TOTAL: 5 FTE days

Status:
11/15/02 Task assigned.

Milestones:
- 12/06/02 Contact all parties and gather input information
- 12/13/02 Distribute draft report for review
- 12/20/02 Publish and distribute final report