Path Forward: Study Office Schedule and Resources

Marshall Space Flight Center

Smithsonian Astrophysical Observatory

STDT Support Structure

Science and Technology Definition Team
A. Vikhlinin (Co-Chair)
F. Özel (Co-Chair)

Study Office (MSFC + SAO)
J. Gaskin (Study Scientist)
D. Swartz (Deputy Study Scientist)
M. King (Study Manager)
M. Weisskopf (MSFC Senior Science Advisor)
A. Vikhlinin (SAO Lead)
H. Tanenbaum (SAO Senior Science Advisor)
L. Cohen (Chief Telescope Engineer)

NASA HQ
D. Evans (Program Scientist)
J. Davis (Program Executive, Overall Study Coordination)

PCOS
M. Ahmed (Program Manager)
A. Hornschemeier (Chief Scientist)
H. Thronson (Chief Technologist)
T. Pham (Technology Development Manager)
G. Karpati (Chief Engineer)
R. Sambruna (HQ Program Scientist, Overall Study Coordination)
S. Habib (HQ Program Executive)

- When STDT members have questions:
  - First point of contact will be the STDT Community Chairs
  - Next POC will be the Center Study Scientist and the Center Study Manager
  - After that, questions should go to Program Scientist who will bring the question to the Decadal Survey Management Team (DSMT) for guidance and consistency of direction.

Note: Programmatic questions (cost, schedule, governance per this Management Plan) should be directed to the DSMT via the Program Scientist Dan Evans

Management Plan For Large Mission Concept Studies – Rev B: http://science.nasa.gov/astrophysics/2020-decadal-survey-planning/

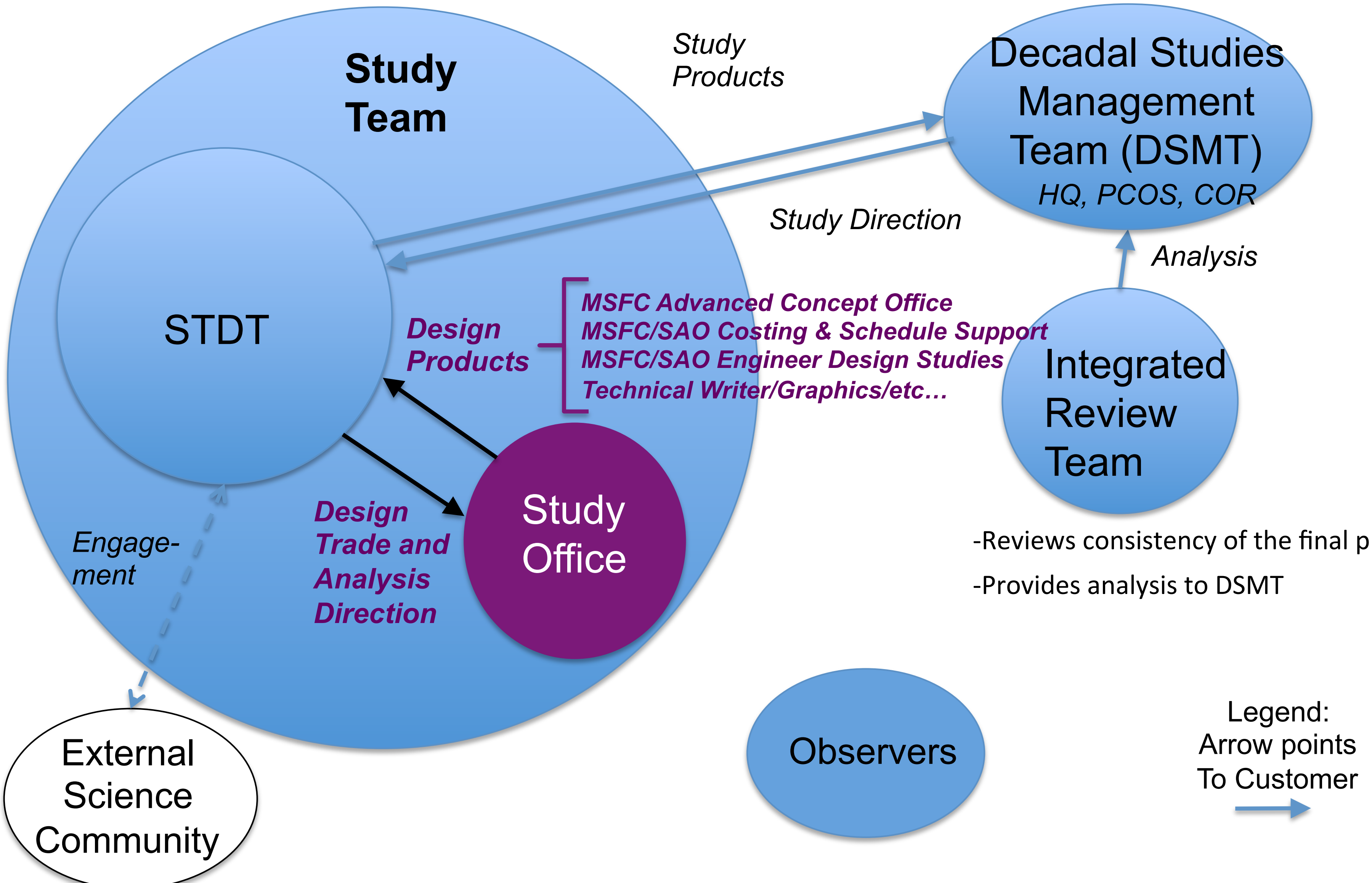
Study Office Primary Role

- Support the STDT in achieving and preparing Study Deliverables by providing:
  - Guidance and resources, as requested, related to technical and programmatic issues
  - Oversight on maintaining schedule and cost for delivering products on-time and on-budget
  - Logistical support for meetings and teleconferences
  - Suggestions and support for outreach activities

The final study deliverable shall include:

- ***Science case*** *for the mission*
- ***Mission and observatory performance requirements*** *that deliver these science capabilities*
- ***Design reference mission****, including straw-man payload trade studies conducted to arrive at the final mission concept*
- ***Technology assessment****:*
  - *Current status, at the time of submittal of the final report*
  - *Roadmap for maturation to both TRL-5 by the start of Phase-A and TRL-6 by the mission PDR*
  - *Phased resources needed to achieve TRL by the start of Phase A and by mission PDR*
- ***Cost assessment****, major technical, and risk burn-down plans as a function of science capability.*
- ***Top-level schedule*** *for major phases of development including a notional launch date (assuming entering phase-A as a post-WFIRST budget wedge opens) and top schedule risks.*

Roles and Responsibilities: A Team and Customer View



-Reviews consistency of the final product

-Provides analysis to DSMT

Center Study Scientist

- Appointed member of STDT
- Represents STDT to the engineering team in its day to day activities
- Provides guidance to the STDT regarding NASA processes
- Provides guidance to the STDT regarding the practicality of implementing science objectives
- Accountable to the STDT chairs (technical direction)
- Does not act autonomously from the STDT chairs

Center Study Manager (CSM)

- Supports the STDT; the STDT is the customer of the Study Office.
- Accountable to the STDT chair (technical direction)
- Along with Study Scientist, Responsible for developing an implementable Design Reference Mission (DRM) meeting the science objectives
- Obtains the necessary technical & administrative resources from the NASA Center
- Obtains Center approval/reviews of the deliverable milestones prior to delivery
- Responsible for cost estimates and inputs to independent cost estimates
- Through Study Office staff, is responsible for Study Team logistics: websites, document postings, mailing lists, processing affiliate travel, contracts, export compliance guidelines, budget, schedule, etc.
- Does not act autonomously from the STDT chairs

NASA Success Criteria

NASA Astrophysics Division Decadal Success Criteria:

"full success" is the delivery to the Decadal Survey Committee of compelling and **executable concepts** for all four large missions so that **science *can* be adequately prioritized by the Decadal Committee**.

Executable is defined as *feasible* with respect to technical, cost, and risk resources outlined in the Study Report

X-Ray Surveyor Success Criteria

The delivery to the Decadal Survey Committee a compelling and **executable concept** for the X-Ray Surveyor mission so that **science *will* be prioritized by the Decadal Committee**.

1. **Define a strong science case that has support from the entire community**
   -Must result in a payload that is executable (strong risk/cost assessment)
   -Must be significantly improved/different from Chandra, Athena & Others

2. **Define a solid path towards achieving the required optics**
   -This must include the optics *and* all tasks that support or relate to the optics
   -Only a design study (Roadmap) is required. This is not enough!

3. **Define a solid path towards achieving the science instruments**
   -Must relate each closely to the science requirements and optics performance

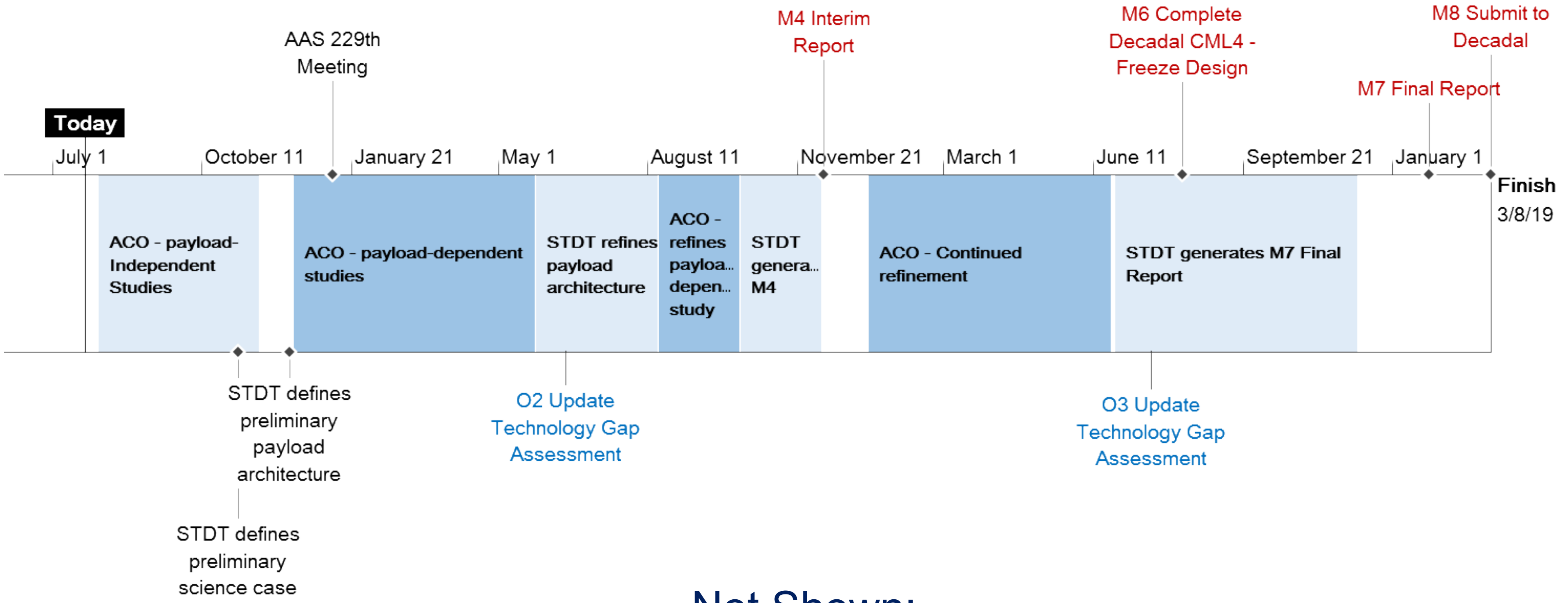
- ***What other criteria should we be considering to achieve the goal of highest prioritization in the Decadal?***
- ***What is our approach to accomplishing this goal within the time and Study budget?***

Study Deliverables

✓	**M1**	**Comments on Study Requirements and Deliverables** – Accept the study requirements/deliverables and submit plan--- or – Provide rationale for modifying requirements/deliverables	**April 29 2016**
✓	***O1***	***Optional: Initial Technology Gap Assessment*** – *To impact PCOS/COR/ExEP 2016 technology cycle*	**June 30 2016**
	O2	***Optional: Update Technology Gap Assessments***	**June 2017**
	M4	**Interim Report** – Provide science case and mission concept (use CML 3 as a guide) – Deliver initial technology roadmaps; estimate technology development cost/schedule – CML 4 tailored approach (optional)	Early **Dec 2017**
	O3	**Update Technology Gap Assessments** – In support of 2018 technology cycle	**June 2018**
	M6	**Complete Decadal Concept Maturity Level 4 Audit and Freeze Point Design** – Provide science case and mission concept (use CML4 as a guide) – Support independent cost estimation/validation process	**August 2018**
	M7	**Final Report** – As described in study success criteria chart 15	**January 2019**
	M8	**Submit to Decadal**	**March 2019**

All products delivered to NASA Astrophysics Deputy Division Director, Andrea Razzaghi

Notional Schedule (TBC by STDT)



Not Shown:

- Optics proof-of-concept tasks
- Technology Roadmap development tasks
- Concept costing and top-level schedule development
- Workshops and Conferences
- Working Group Meetings
- Future STDT F2F Meetings

Defining a Mission Architecture

- To determine and plan resources and schedule for the next 2.5 years, the Study Office needs a preliminary architecture.

- The STDT recommendation for a basic mission architecture should be given no later than the end of 2016 (early December).

- This concept will be developed and refined as the Study progresses.
    - STDT and WGs will need to contribute

- This concept will be developed by the STDT and supported by the Study Office
    - Advanced Concept Office (mission design support)
    - Optics engineering design studies (for tasks not supported by the SAT & APRA)
    - Contributions outside of the Study Office in support of Concept development are encouraged (including industry and international)

Working version of Consensus (yes, NASA has a policy)

How do we come to a consensus about the mission architecture and payload performance in near-term (by the next Face-to-Face meeting or just after)?

- **In general, consensus decisions can produce stronger and more durable decisions than those by votes or decree.**
- **However, convergence time can be a factor in consensus decisions – they take too long or do not converge.**
- **Instead, we suggest (but do not require) a Constrained Consensus method: defined as preferring and striving for consensus in the reasonable time available, else, the leaders make a decision, dissent (if any) is captured and the groups moves on with full support of the decision.**

- **Will follow 7120.5E, Ch 3.4, "Process for Handling Dissenting Opinion"**
    - Three options: (1) Agree, (2) Disagree but fully support the decision, (3) Disagree and raise a dissenting opinion
- **Treat (1) and (2) as consensus for STDT**
- **Dissents (3) will be documented and delivered to senior NASA management (APD DD) per 7120.5E**

Start Now!

- The Study Office encourages the Science Working Groups to develop a preliminary science case (**November, 2016**)
- We also encourage the Science Instrument WG to develop a charter and solicit participation (**August 12th**).
- We suggest starting payload-independent Study tasks related to the spacecraft and mission in the MSFC Advanced Concept Office (**August 1st**)
- We recommend that the Study Office (along with the OWG leadership) develop a detailed plan/schedule for carrying out (optics) substrate-independent engineering analysis tasks that will take into account potential outside resources (**August 12th**)
- Planning for a large Conference in 2017 should begin soon. We recommend that the STDT formulate a team to work this along with the Study Office (**July 26th**).

Study Office Resources – MSFC ACO

Mission design topics independent of payload might include:

1. Orbit trades

Consider nominal orbits at L2, a nominal high earth orbit (e.g., Chandra-like), and lunar resonant orbits. Can a sun-trailing orbit be dismissed? Considerations should include the following:

(a) **Trajectory and time to final orbit**. Launch window opportunities. What are re-entry or disposal requirements, if any?
(b) **Radiation environment**. Evaluate the lifetime of critical electronics and systems and shielding requirement assumptions
(c) **Define the mass that can be placed in such orbit**, and possible launch vehicles to deliver to orbit
(d) **Expendables required** to maintain the orbit, and the orbit lifetime and evolution
(e) **Telemetry rates available vs. power** required for uplink/downlink in the orbit. Consider the average ground station availability, maximum outage times, telemetry rates as a function of orbital phase if relevant
(f) **Thermal environment** including eclipses
(g) **Micro-meteoroid environment**

2. Thermal insulation and thermal control

(a) Define one or more **thermal control concepts** applicable to the optics, focal plane, and spacecraft
E.g., cold bias, isolation philosophy, hardwire feedback from sensors vs. software control
(b) **Consider insulator materials**, thermal blanket requirements, etc.
(c) **Thermal isolation for the mirror, reduction of radiation to space**
(e) Total **thermal control power requirements**

3. Rapid Response Capability
4. Define Attitude Control Equipment
5. Avionics Studies
6. Optical Bench Studies
7. Mechanisms

Topics to be discussed with STDT in discussion session.

Study Office Resources – SAO/MSFC

These are *some* of the recommended risk reduction optics-related topics common to most x-ray optics that SAO and MSFC can support as requested by the STDT.

We also recommend soliciting outside resources that include industry and international partners, and welcome support from the OWG members and community.

- developing a detailed optical prescription
- considering trades between angular resolution, effective area, and vignetting in different energy bands
- developing a conceptual design for the stray light baffles
- conceptualizing an approach to a module mount design
- conceptualizing an approach to full module design
- developing a model incorporating the mechanical design and the notional assembly and alignment process
- performing structural, thermal, and optical analyses and check consistency with expected launch load
- determining placement of thermal pre- and post-collimators, heaters and temperature sensors
- developing an independent and consistent error budget to assess allocations for reflector figure quality, mounting, and aligning
- evaluating the type of metrology required, its accuracy and its volume
- developing a set of calibration requirements and use these to formulate a calibration plan
- designing a strawman module support structure, including: structural / thermal / optical analysis
- developing a preliminary workflow for the assembly and alignment
- developing notional requirements and design of the aspect system, fiducial lights, and inertial reference unit

Questions?

Let's Get Started!