imagine the moment...

[Image:NASA/DSCOVR EPIC]

Future Assembly/Servicing Study Team (FASST)

A Community-Based Assessment of Future Astronaut and Robotic Capabilities
To Achieve Major Scientific Goals in Space Astrophysics
https://asd.gsfc.nasa.gov/fasst/

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For the FASST

Presentation to the NASA Advisory Committee
Human Exploration and Science Committees
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FASST Core and Affiliated Members

(Does not Include TIM Planning Team)

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Challenges

- Science in the future will require even larger telescopes for which no existing launch vehicles will enable autonomous deployment. Regardless of the specific science goals, the signal-to-noise ratio of astronomical observations increases as a high power of the aperture: from D^2 to D^4, depending upon target.
- These flagship observatories are capable of returning spectacular science for their entire lifetime. We need to develop capabilities to upgrade and service them, thus permitting lifetimes comparable to those of ground-based facilities: 50 to 100+ years. For example, HST is entering its 28th year of operation and still providing exceptional science return.
- These large telescopes may occasionally need repairs during their planned primary mission, as was the case with HST.
- Autonomously deployed, post-JWST large space telescopes are being designed to specifically use the payload capabilities of the SLS Block II. There is no back-up if the SLS becomes unavailable or suffers failure.

Solution: Develop the capabilities and technologies to service and assemble future generations of large space telescopes in space.

Why Now?

- The 2020 Decadal Survey. SMD missions that use Exploration infrastructure as "pull technology" should have Survey endorsement, which will require much-improved engineering designs and trade studies of space assembly over the next two years.
- Technology development. The process of identifying, developing, and maturing the technologies to enable servicing and assembly will take time. We need to begin creating a technology roadmap and implementing early development efforts in the very near future, for example using ISS as a testbed prior to its termination.
- Risk reduction for the mission selected by the 2020 Survey. Having an assembly/servicing capability using medium-lift vehicles and a Gateway-like facility may offer an option to the 2020 Survey in the event that the SLS heavy-lift is unavailable.

and…

A Disruptive Opportunity

Four disruptive technologies or capabilities may be developed and either demonstrated or sufficiently matured for flight infusion during the 2020s:

a) *Industry-provided low-cost launch vehicles with frequent launch windows*

b) *In-space robotic technologies for servicing and assembly developed by industry and government*

c) *Science instrument technologies are advancing at a rapidly increasing pace, allowing for instrument upgrades and advances in science return at rates far faster than in the past.*

d) *A deep-space Gateway with capabilities that would enable assembly and servicing of large science systems*

We can take advantage of these developments now to shape the joint future of space science and exploration by assessing their impacts in advance of the 2020 Decadal Survey.

FASST Terms of Reference
March 2017

In a partnership among government organizations, industry, and academia and in time for consideration by the 2020 astrophysics Decadal Survey:

- Develop preliminary scenarios and trade studies for on-orbit servicing and assembly of truly large astronomical space telescopes and other scientific systems (e.g., starshades) using astronauts and/or robots.
- A starting point for a more comprehensive assessment led by NASA to establish a strategy to enable routine and cost-effective servicing and assembly of science missions in deep space, including:
  - *Two or three top-level system architectures with various starting conditions and/or capability assumptions*
  - *A technology development roadmap*
  - *Opportunities for public/private partnerships facilitated by a regular series of workshops, technical interchange meetings, etc.*

FASST Planned Activities

1. Release an RFI to query industry/academia (international?) on current/near-future capabilities for in-space servicing/assembly, which will be input to the technology roadmap for the priority investments
2. Working with scientists and engineers from the NASA mission directorates and academia we will deliver a report that: (1) lists the potential missions that would be enabled if a cis-lunar capability for servicing and assembly existed, and (2) summarizes the current and expected industry/government capability for servicing and assembly.
3. Establish collaboration/partnership on joint assessments with HEOMD, STMD, industry, DoD and academia
4. Perform a design study of in-space assembly, using robots and/or astronauts, of two independent candidate SMD payloads that are consistent with Decadal Survey and other SMD priorities: [1] a large-aperture telescope and/or [2] a large starshade.
5. Perform a design study of astronaut- and/or telerobotic assembly and servicing from a Gateway-type facility (versus ISS).
6. Establish recurring technical interchange meetings to develop coordinated community (industry+NASA+academia) assessments of use of a Gateway-type facility for assembly/servicing
   [Scheduled for early November (GSFC) with follow up in June 2018 (JPL)]

Community Technical Interchange Meeting (TIM) on Future Priorities in Astrophysics Enabled by In-Space Servicing and Assembly

NASA GSFC, November 1 – 3, 2017

Major developments in space exploration will take place in the coming decade that have the potential to significantly enhance cost-effective science return from major space astrophysics missions:

- Significant reduction in cost of medium-lift launch vehicles
- Continued advances in robotic/telerobotic capabilities: refueling, upgrading, assembly
- Deployment in cis-lunar space of a long-duration human-occupied "Gateway" ops site

First in a series of three-day technical interchange meetings that will bring together ~60 professionals to assess current and near-future capabilities and investments, technology gaps, mission requirements, and opportunities for collaborative work that will take advantage of these developments. Attendees will be SMEs invited from NASA and other government agencies, industry, and academia.

TIM organizing team consists of a representative from each "decadal survey" study, NASA SMD & STMD, the industry "Gateway" studies, DoD, SMEs from NASA Centers, and other experienced industry leaders.

Community TIM Products and Deliverables

Findings and Observations

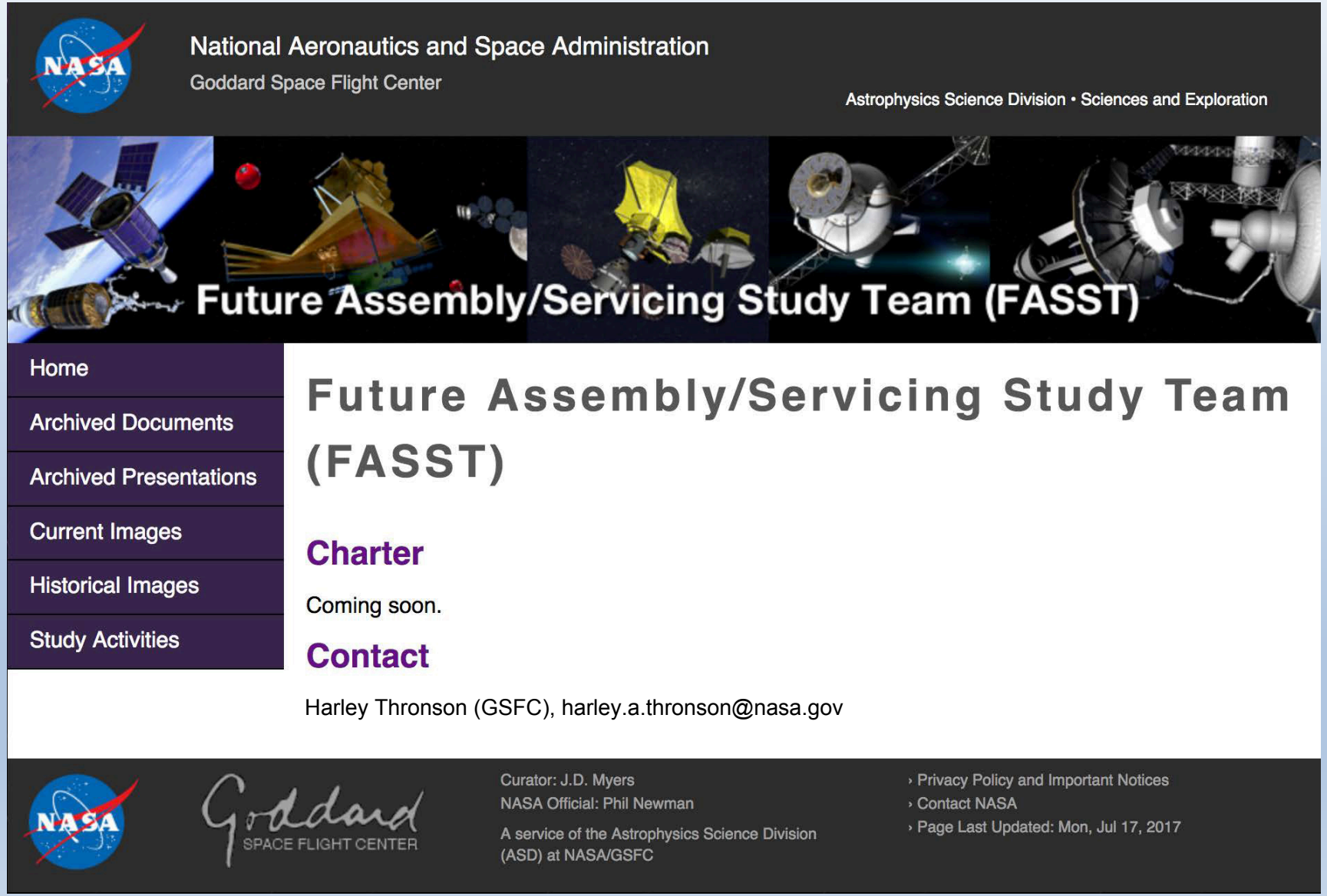
- *Identification of the science enabled from a cis-lunar facility in addition to observatory support: e.g., telerobotic ops of lunar rover, sample return, far-side meter-wave array*
- *Potential precursor or demonstration activities: e.g., initial (pre-Gateway) Orion rendezvous with observatory, LEO demonstration . . .*
- *Production of an initial list of technology gaps bridging current capabilities to future needs*
- *A top-level concept for an "initial Gateway" able to service, assemble, upgrade science facilities; upgraded over time*
- *Development and comparison of schedules, milestones . . .*

Key questions to be addressed by the TIM

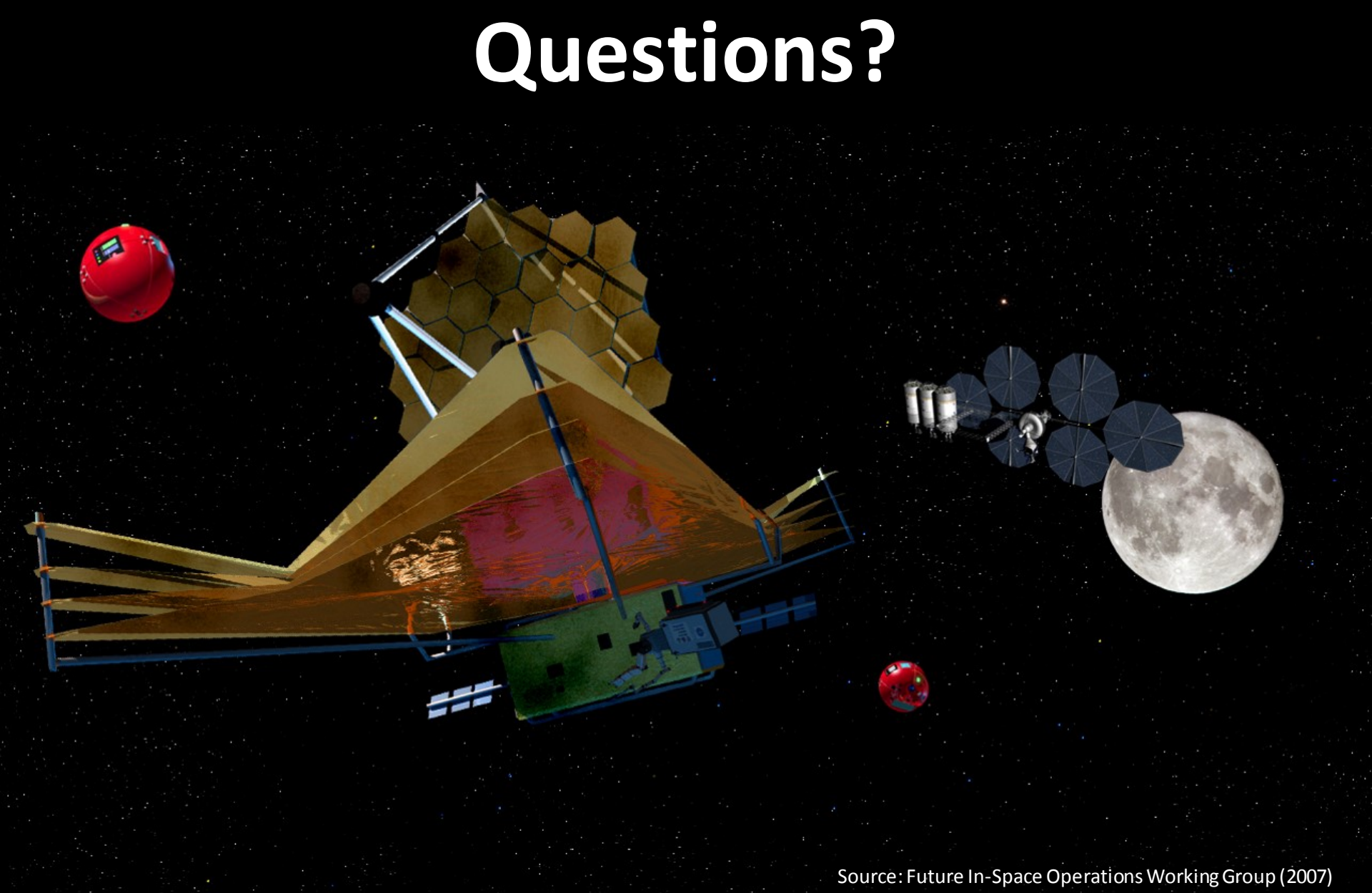
- *Priority engineering design activities to enhance Gateway-type designs: i.e., coordination with observatory and robotics designs*
- *Assessment of capabilities: astronaut EVA and telerobotics*
- *Technology capability development plan and priorities, esp. near-term*
- *Future coordination among scientists, Gateway designers: next steps*

Heritage of Space Servicing and Assembly

See archived studies and presentations at https://asd.gsfc.nasa.gov/fasst/



Questions?



Source: Future In-Space Operations Working Group (2007)

A post-JWST “flagship” observatory, accompanied by inspection robots, approaches a Gateway-type cis-lunar operations facility for upgrade