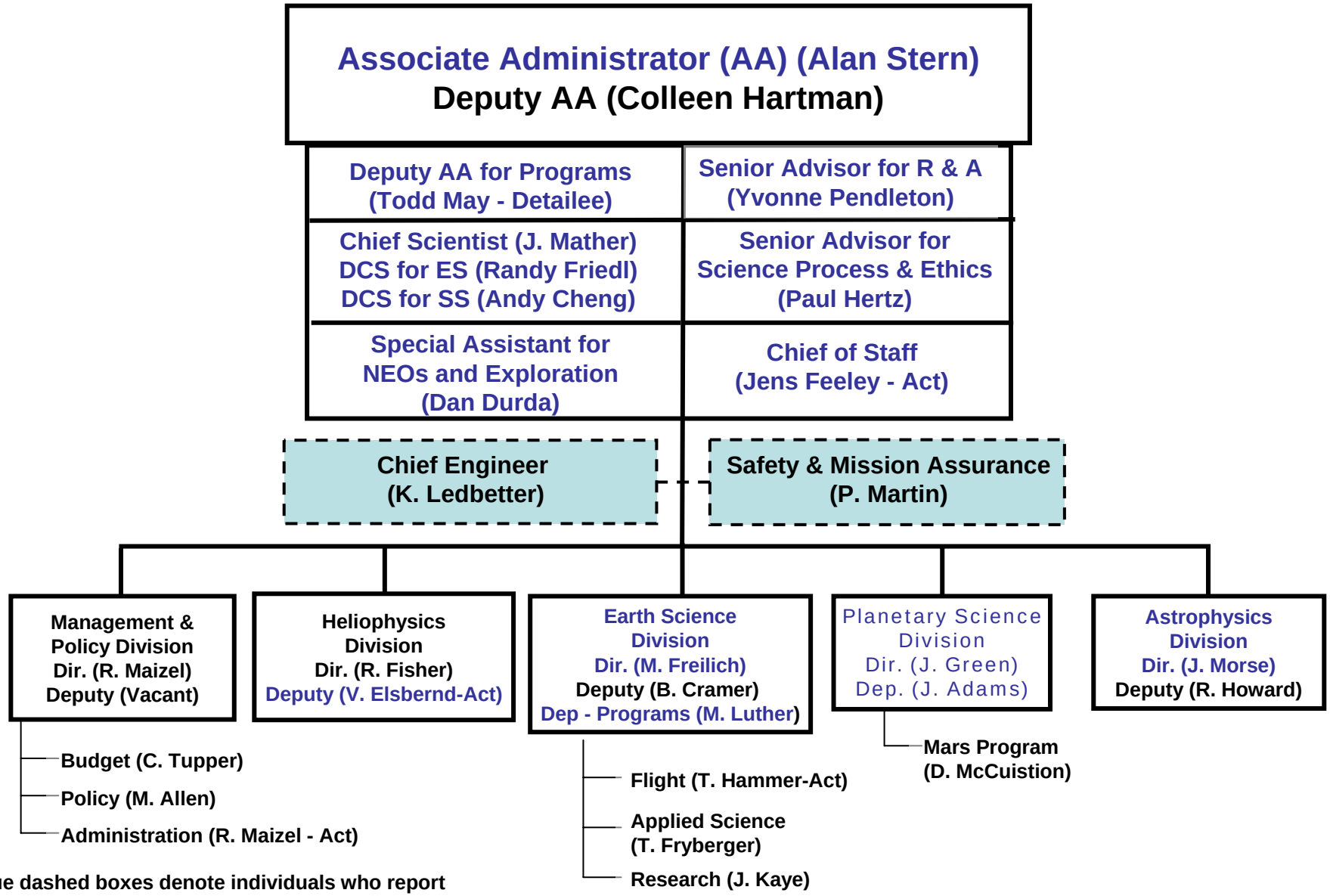
Alan Stern

NASA Associate Administrator
Science Mission Directorate

SMD's New Team

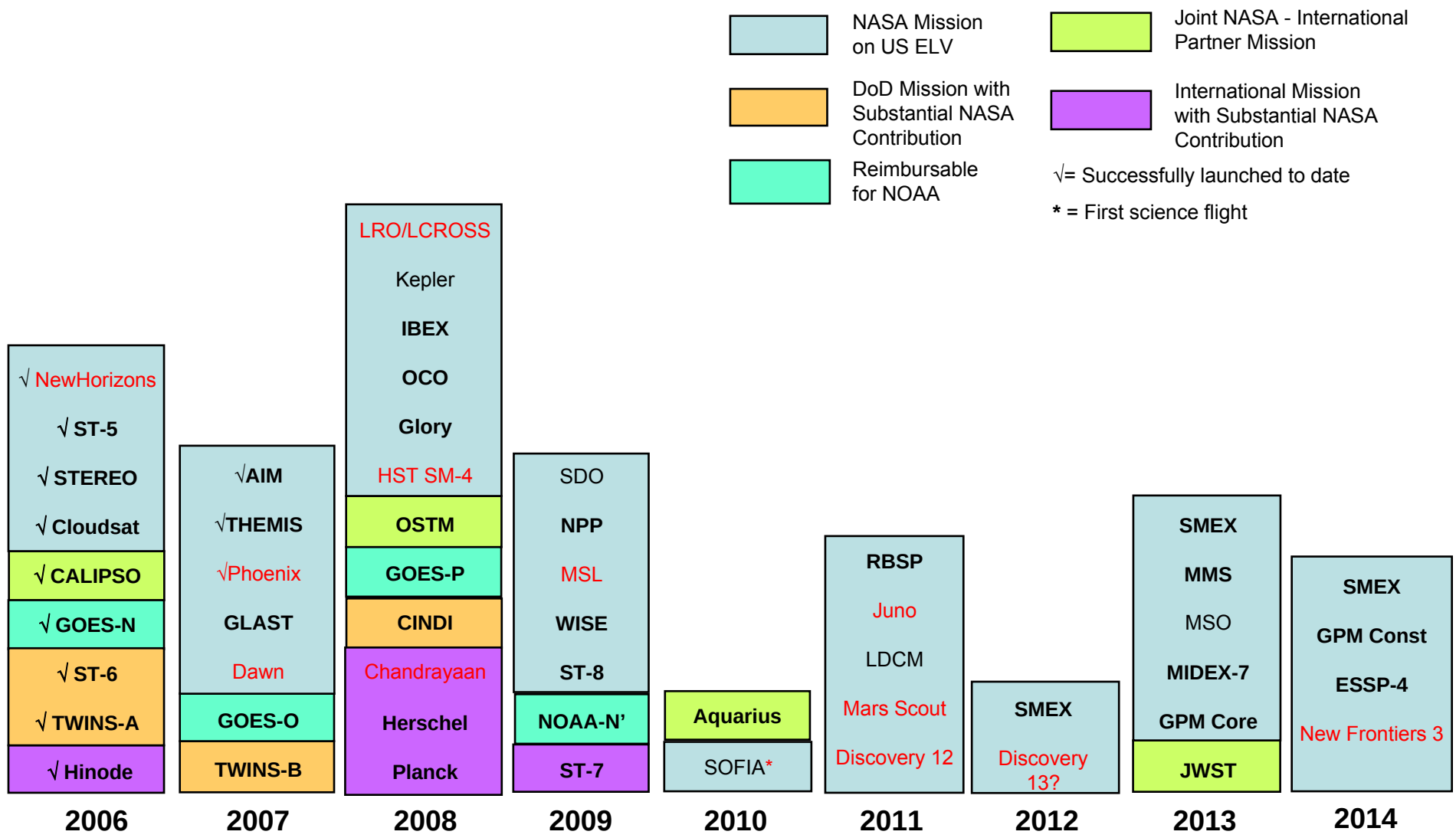


Blue dashed boxes denote individuals who report to other organizations, but support SMD

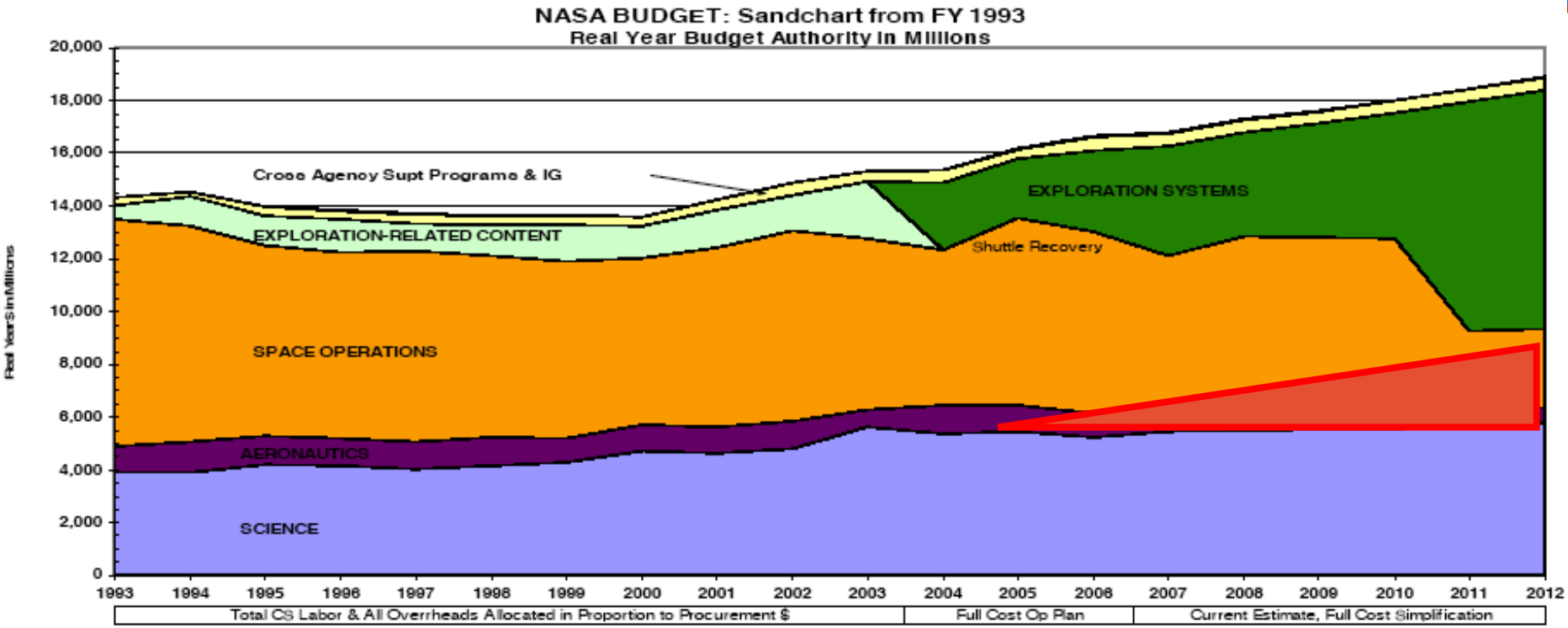
Our Four Core Objectives

- To Get More Science Done With Our Budget.
- To Ensure “The Vision” Succeeds.
- To Promote U.S. Leadership Across All of SMD’s Science Disciplines.
- To Create a Better Workplace.

SMD's Launch Program



NASA Budget Perspective



- **The retirement of the Space Shuttle in 2010 and development of new human spaceflight systems occurs once-in-a-generation. A slower rate of budget growth for Science missions is necessary to avoid a prolonged gap in strategic capability of U.S. human spaceflight.**
  - Science program budget is moderated to 1% annual growth in FY08-11, and then growing consistent with NASA's topline growth thereafter (2.4% in FY12).
  - The Science budget is 32% of the total NASA budget today. In 1992, Science was only 24% of NASA's budget.

- **The rate of growth previously planned for Science was not sustainable, given the need to complete International Space Station assembly with the Space Shuttle and need to retire the Space Shuttle by 2010.**
  - In the FY 2007 budget for FY07-11, the Science budget paid $2.44B and the Exploration budget paid $1.26B to make up the difference in the previous, placeholder estimated costs for Space Shuttle and ISS operations (additional $2.2B and $1.5B needed in FY06-10, respectively).

SOME SMD OBJECTIVES

- Control Costs.
- Increase Flight Rates.
- Repair R&A: Both Processes & Budget
- Ensure Missions Fund Their Science.
- Expand Foreign Collaborations.
- Expand Suborbital Research.
- Recreate a Lunar Science Community.
- Accelerate Progress on the Earth Science Decadal Survey.

MEP 2007 EVOLUTION

- Jan: PHX $25M Build Cost Increase.
- June: MSL Sample Caching.
- May: MEP MSR Re-Focus.
- Aug: Phoenix launch.
- Sep: Phoenix $5M Mission Ops Increase.
- Sep: MSL $62M Re-baseline.
- Sep: Funded New MER Extensions Thru FY08 ($20M), With Commitment for FY09 ($20M) If Still Operating.

MSL OVERRUN 1

- **August 2006: MSL Confirmed at a development (C/D) cost of $972M.**
  - **Program added $32M to increase reserves to 35% (~60% on the S-Curve).**

- **Late ’06/early ’07: ~$20M in descopes were taken to control cost growth:**
  - **TLS, Corer, Sample Crusher, CheMin dual X-ray source, EDL latitude performance.**

- **June ’07: MSL estimated needs of approximately $75M. Sources of growth included:**
  - **Instruments; SAM, CheMin, ChemCam, Malin Space Science Systems cameras.**
  - **Mechanical Design of Rover body, Corer/drill, Sample Acquisition/Sample Processing and Handling**
  - **Actuator Design**
  - **Thermal Protection System testing**
  - **Parts Procurements**
  - **Fabrication Services/Labor**

MSL OVERRUN 2

- **Time was of the essence.**
  - **Project needs resolution and focus to go forward.**
  - **Descope effectiveness decreasing with time.**

- **Project developed recommended solutions:**
  - **Briefed to SMD AA and HQ CE.**
  - **Independent Science Team Defined the Science Floor for MSL:**
    - **SAM, CheMin, APXS, Hand Lens, brush and multiple drills.**

- **SMD's MSL Overrun Solution:**
  - **$26M in descopes to MSL; remains well above the defined science floor.**
  - **$36M from Mars Program reserves.**
  - **This is the max available funding considering other MEP liens.**

MSL OVERRUN 3

Descopes executed are in green

- Group 1 Recommended/Recommended ($19M taken)
  - Eliminate spare RTG
  - Limit to 5 landing sites by Oct '07 site selection workshop
  - Descope MASTCAM zoom capability
  - Eliminate MARDI
  - Replace Surface Removal Tool with a brush
  - Defer Participating Scientist call until Phase E
  - Descope Surface GNC capability
  - Reduce Mission System Development budget
  - Eliminate EDL Hot Swap capability
  - Replace system vibe with acoustics as in past Mars missions
  - Delete Heat Rejection System characterization test
  - Delete Stand Alone S/C Testbed

- Group 2: Recommended with programmatic implications ($6.5M taken)
  - No additional funds to ChemCam
  - Replace (i) MAHLI with MER MI spare and (ii) MASTCAM with MER PANCAM spare
  - Remove REMS and DAN

- Group 3: Not recommended due to high science or technical risk (None taken)
  - Delete redundant RCE
  - Delete second stage SDST
  - Convert MMRTG Qual unit to protoflight

- Other ($0.5M taken)
  - Descope TLS re-integration capability (follow up from early-07 descope round)
  - Cost Cap SAM and Chemin

MSL PAYLOAD RESCOPES

MSL Rescoped Payload September 2007

INSTRUMENT	SCOPE CHANGE	
Mast Camera (MastCam)	Zoom capability deleted and cost capped	After a combined 60% cost growth
Mars Hand Lens Imager (MAHLI)	Cost capped	
Mars Descent Imager (MARDI)	Instrument deleted	
Alpha Particle X-Ray Spectrometer (APXS)	No change	
Chemistry Camera (ChemCam)	No funding beyond FY'07 after a 77% cost growth	
Chemistry & Minerology Instrument (ChemMin)	Cost capped after a 160% cost growth	
Sample Analysis at Mars (SAM)	Cost capped after a 60% cost growth	
Radiation Assessment Detector (RAD)	No change	
Dynamic Albedo of Neutrons (DAN)	No change	
Rover Environmental Monitoring Station (REMS)	No change	

Mars Sample Return

MSR 1

- Sample return is critical to solar system exploration:
  - Increased emphasis on returning samples from various bodies in the solar system within PSD of SMD.
  - Interest in Lunar sample missions increasing at NASA.
  - Planning to add caching to MSL.

- MSR remains a MEP and US NAS priority.
  - MEP budget cuts in '05/06 "pushed" MSR to 2020+.
  - NRC's *Astrobiology Strategy for the Exploration of Mars* reinforced importance of sample return in astrobiology as well as geology, geochemistry.
    - Aligns well with the "search for extinct/extant life" pathway in '05/06 MEP replan.

MSR 2

- International interest in 2020 mission expanding:
  - NASA dates align with ESA Aurora Program MSR plans.
  - ESA considering adding caching to 2013 ExoMars mission.
  - ESF recently identified MSR as the “recommended next mission after ExoMars” for ESA.

- The potentially paradigm-changing nature of sample return from Mars, and mission expense, lends itself to an international effort:
  - IMEWG-chartered WG critical to solidifying plans, architectures, partnerships, etc.

MSR 3

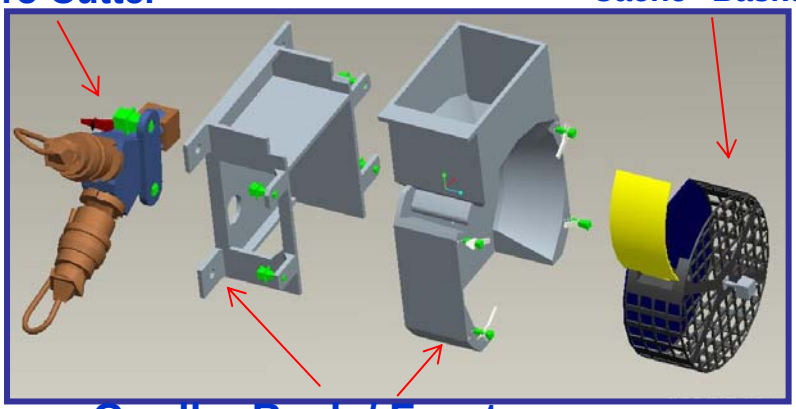
- ESA's Aurora Program contains MSR in 2018-2020:
  - Aligns with US MEP timing.
  - ESA contribution of 30-40% proposed; NASA Leadership desired. Individual countries may join the partnership as well.
- The kick-off meeting of the International Mars Architecture for Return of Samples (IMARS) WG met in Rome Sept 21.

MSL SAMPLE CACHE 1

- **A multi-center partnership between JPL and ARC:**
  - **JPL is responsible for initial concept design, integration in ATLO and V&V execution, integration into operations plans**
  - **ARC is responsible for detailed design, development, delivery and V&V support, and operations concept development with MSL science Team**
  - **SMD would fund the cache**

- **The following constraints are in effect:**
  - **The total mass impact to MSL cannot exceed 2 kg.**
  - **Cost cannot exceed $2M.**
  - **MSL's technical needs have priority.**
  - **MSL's project schedule has priority.**
  - **Cache is not part of the MSL Level I requirements or mission success criteria.**

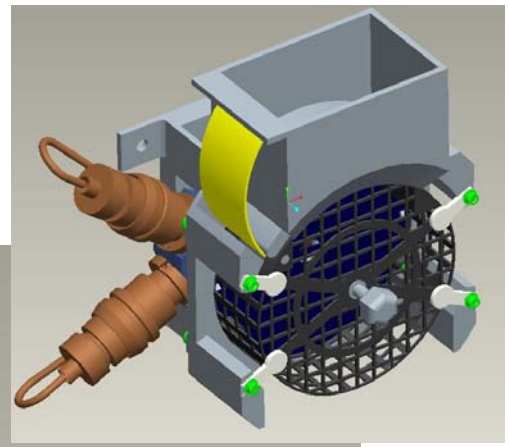
MSL SAMPLE CACHE 2

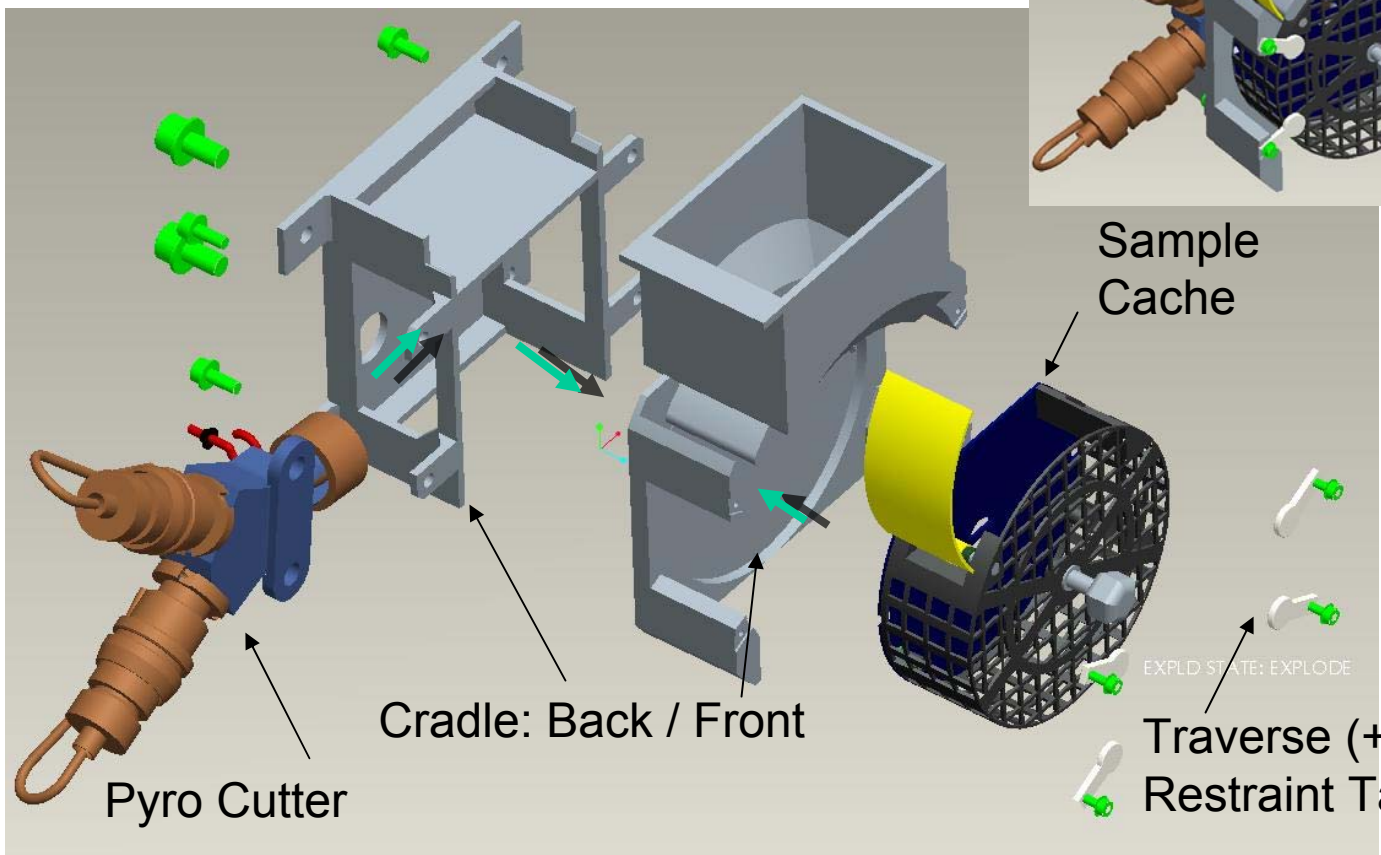


- **MSL Sample:**
  - At least 5 samples with goal of 10.
  - Materials chosen to minimize contamination.
  - Inlet supports same range of solid sample orientations as SAM and CheMin.
  - Inlet and exposed covers visible to at least one camera
  - Forward contamination satisfied by methods comparable to those used on other hardware (e.g., wheels).
  - Back contamination would be addressed by a MSR mission.

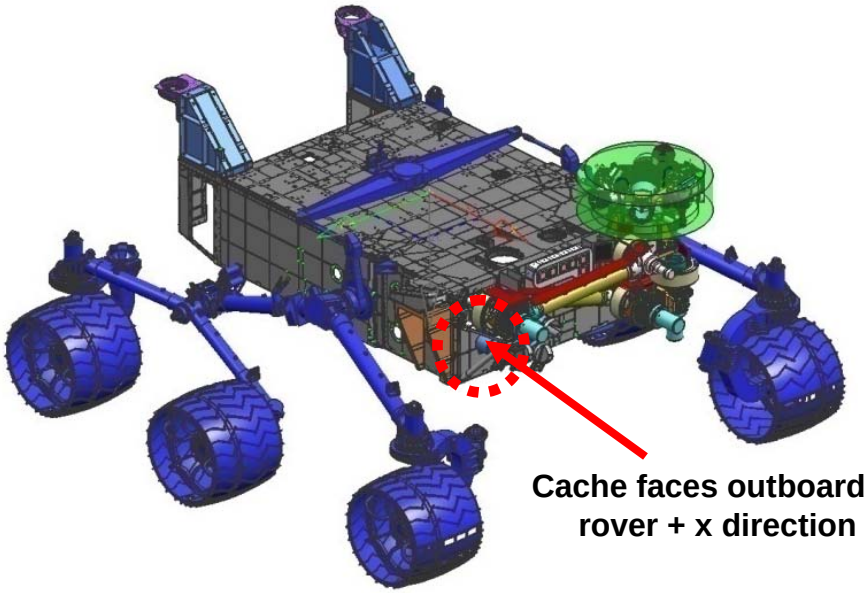
MSL SAMPLE CACHE 3

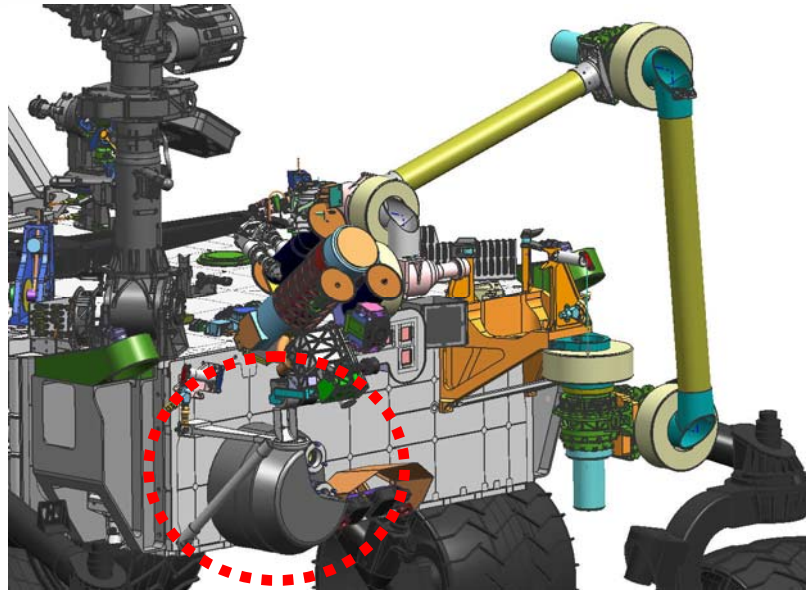
Two assemblies: Cradle and Sample Cache





MSL SAMPLE CACHE 4





- Entire assembly bolts to end of current bipod support, below robotic arm elbow.
- Located at end of robotic arm launch restraint bipod