National Aeronautics and
Space Administration

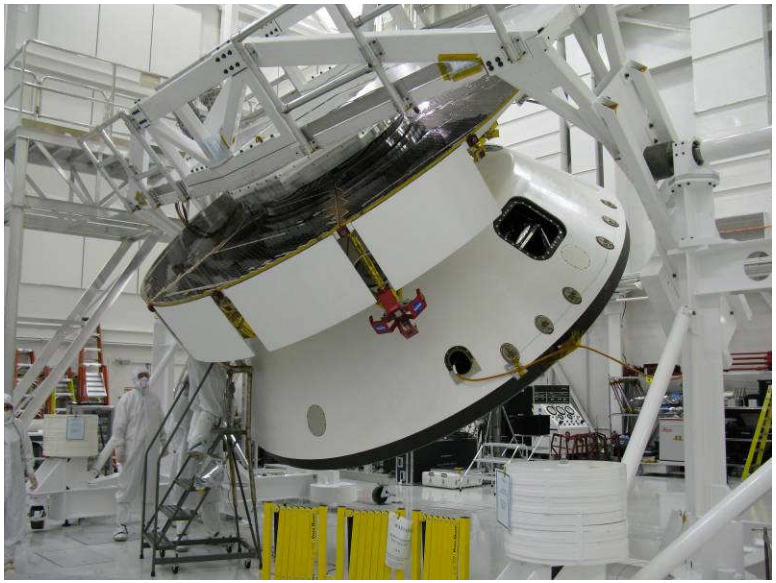
Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Mars Exploration Program Analysis Group (MEPAG)

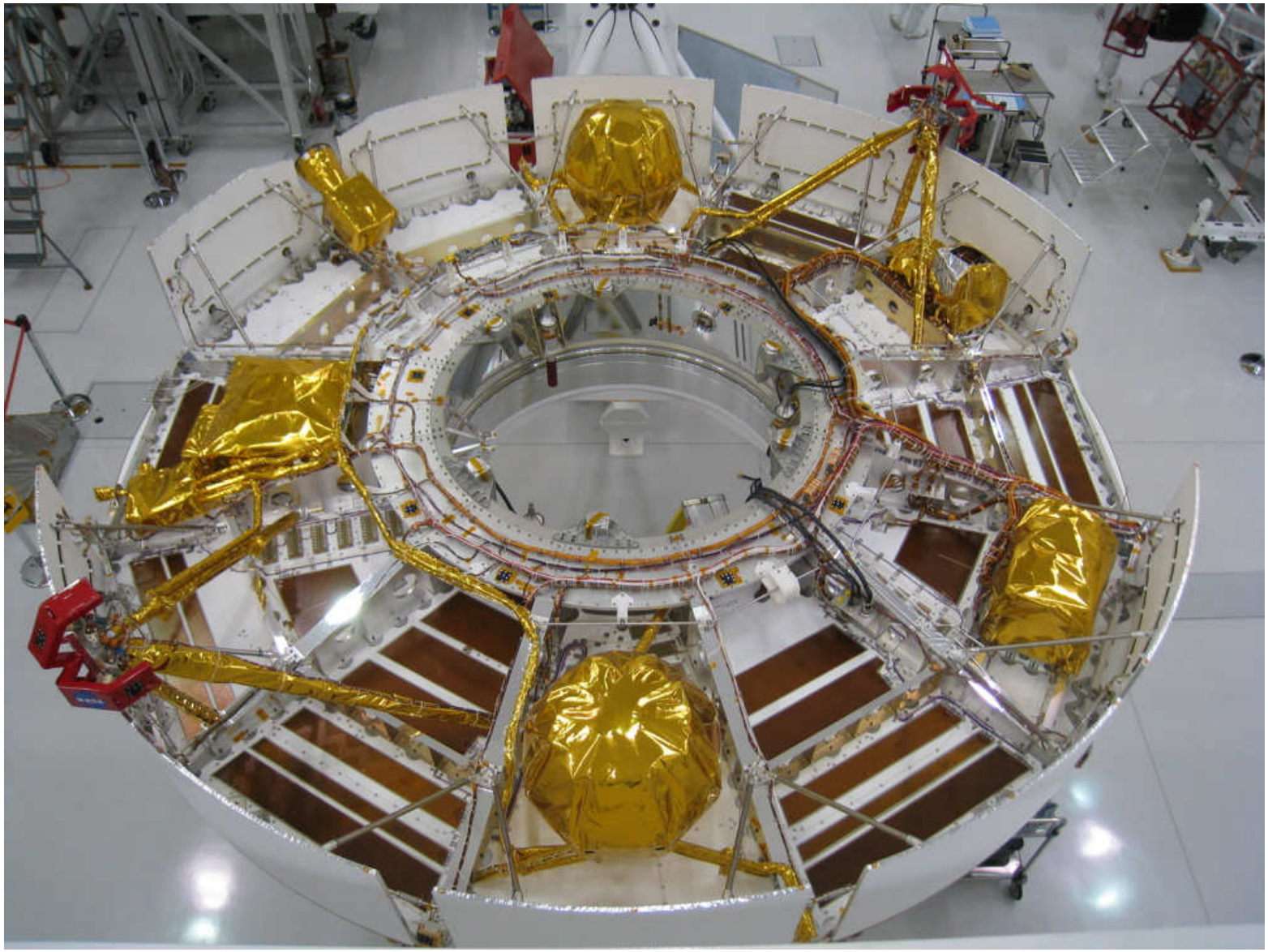
Dr. Fuk Li

March 3-4, 2009

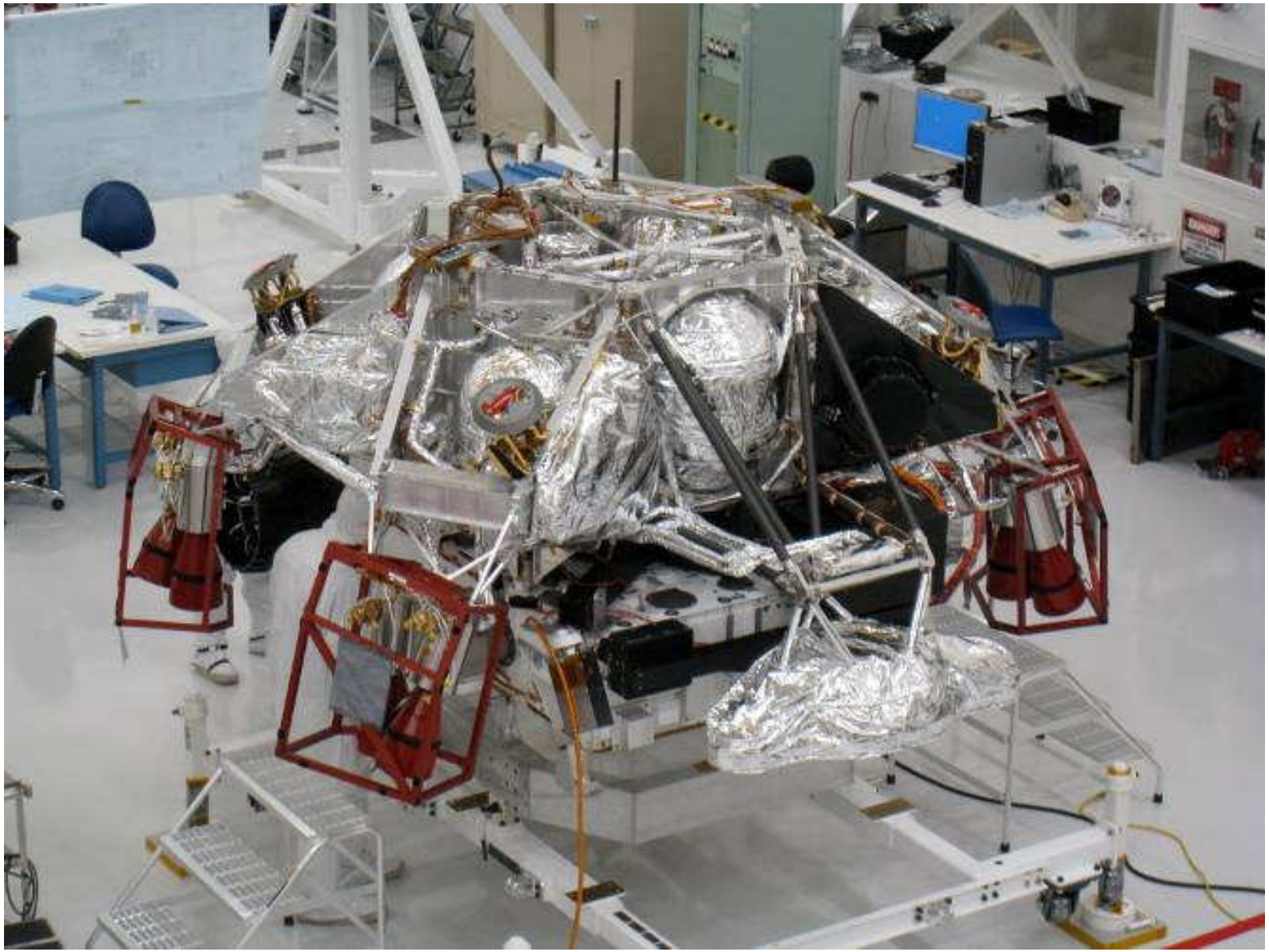
Integrated Spacecraft



Cruise Stage

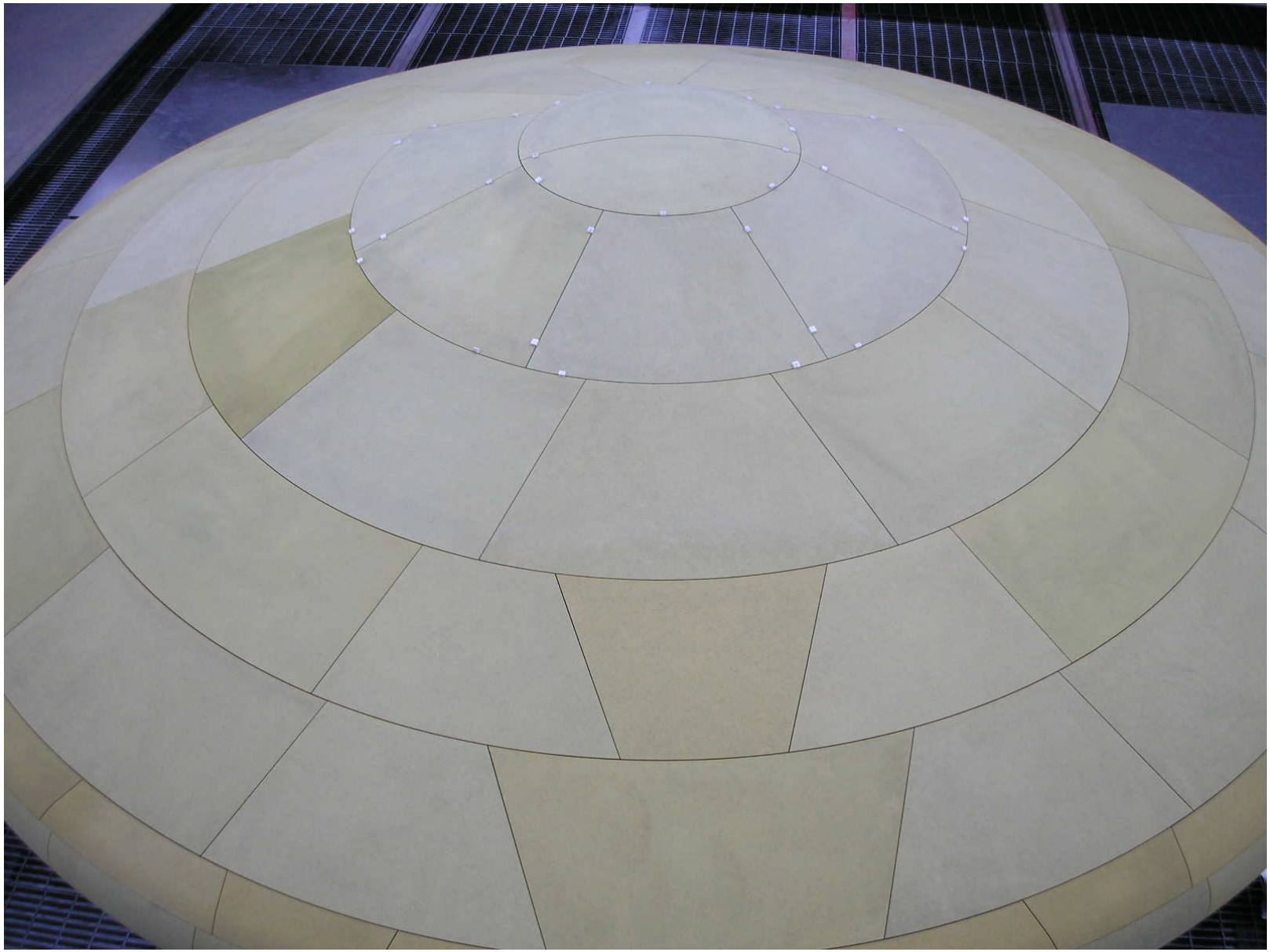


Descent Stage



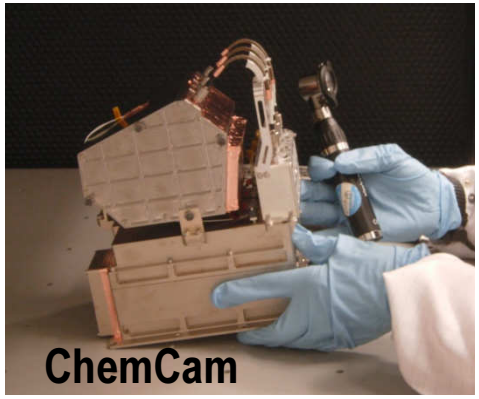
Backshell

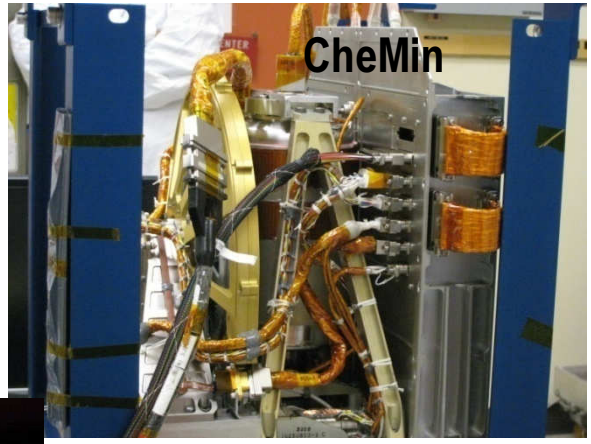
PICA Heatshield

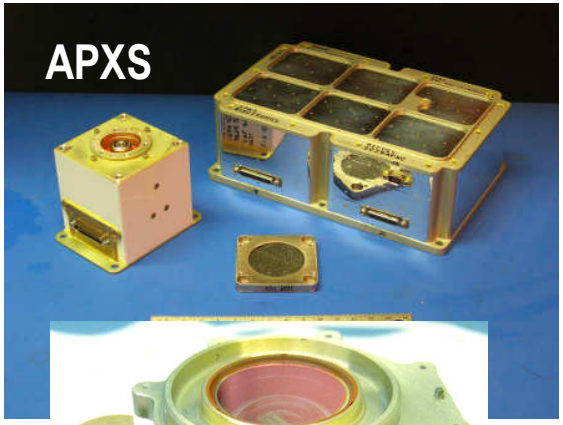


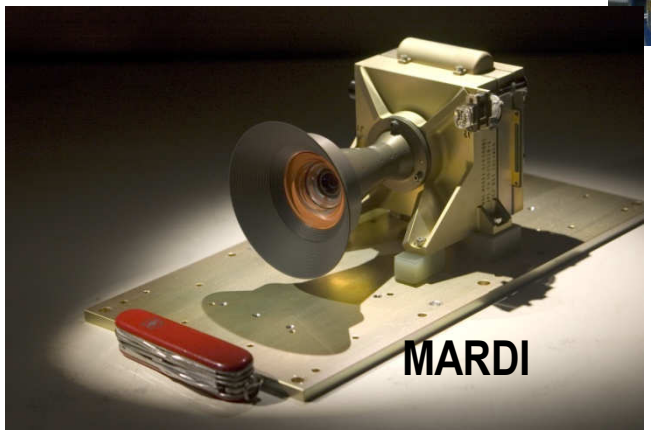
Rover Chassis

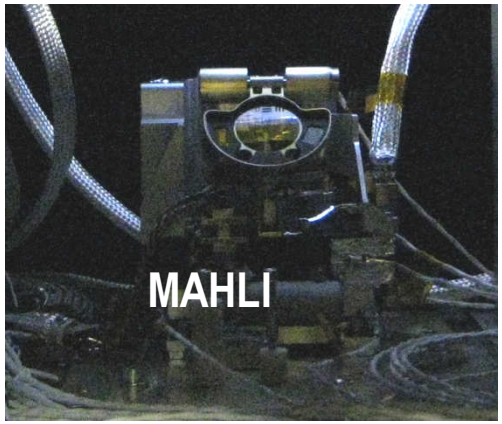
Payload

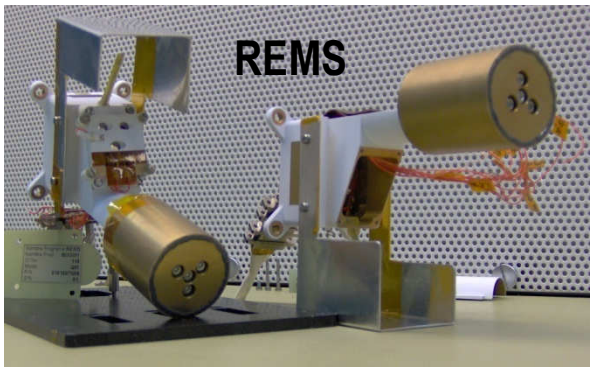


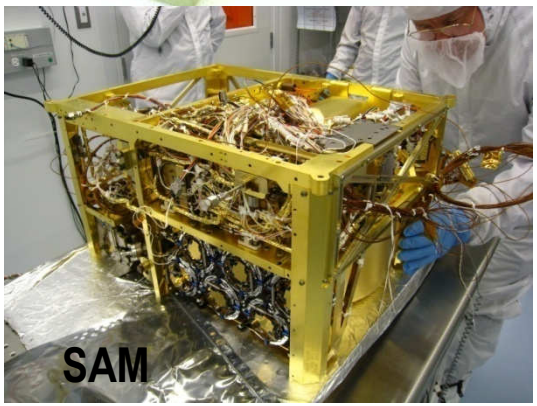






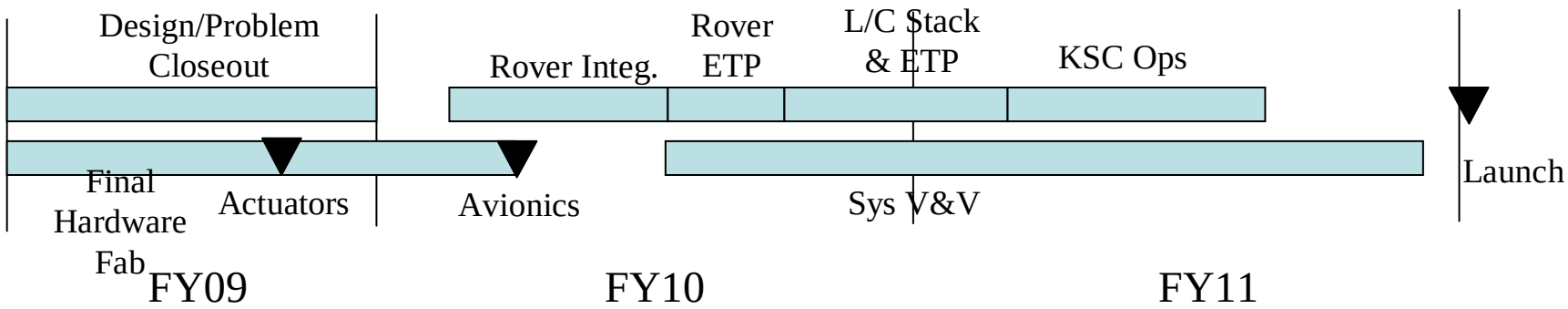






Top-Level Schedule Strategy

- F09 - Risk Reduction/Design Completion
  - Retire high risk development issues
  - Finish hardware builds where feasible
- FY10 - Delivery & Test
  - Complete remaining hardware builds
  - Conduct Rover System Environmental Test Program
- FY11 - Test & Margin
  - Launch/Cruise ETP & KSC Operations
  - Complete ATLO ~ 4 months prior to earliest launch date



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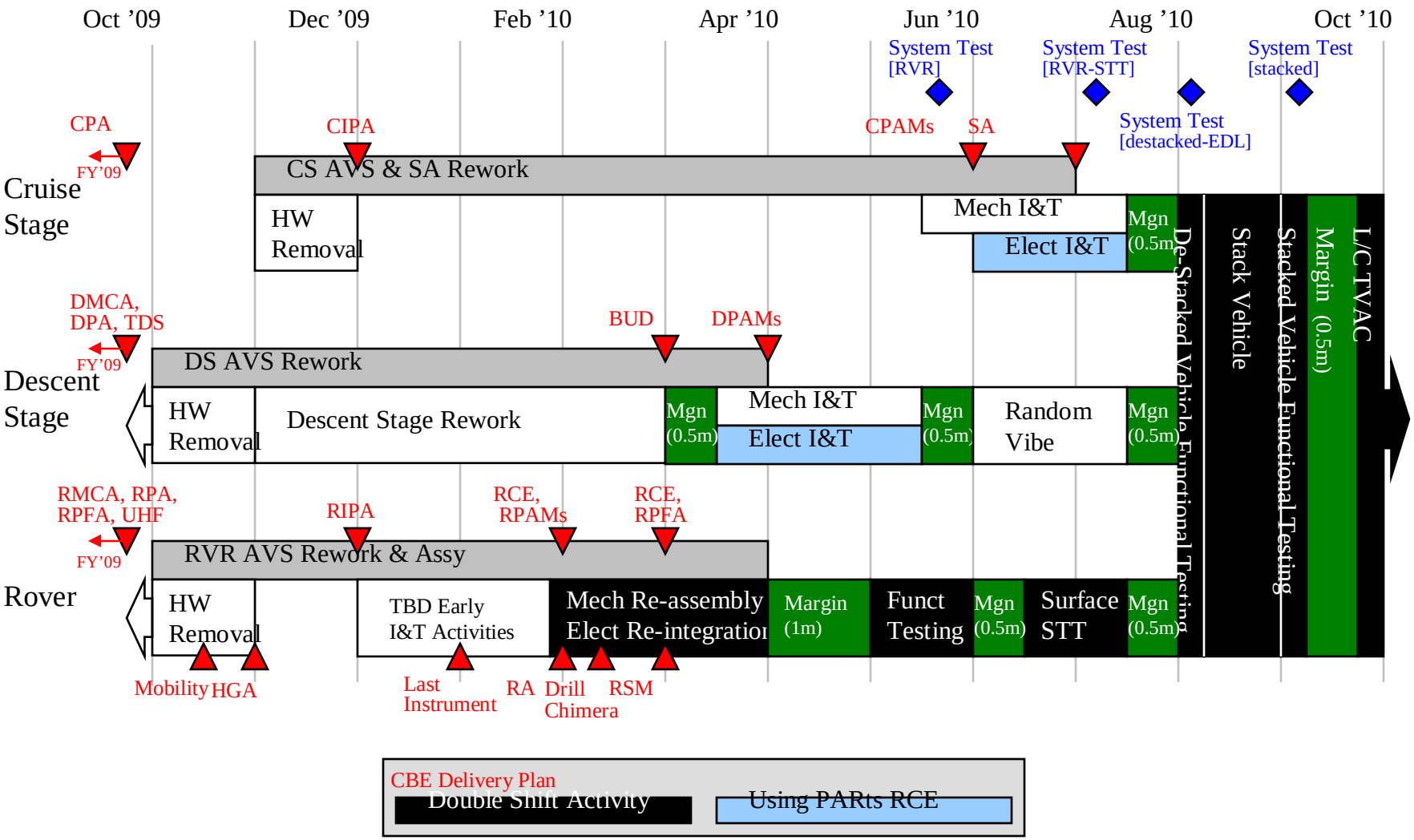
ATLO Schedule Overview: FY'10



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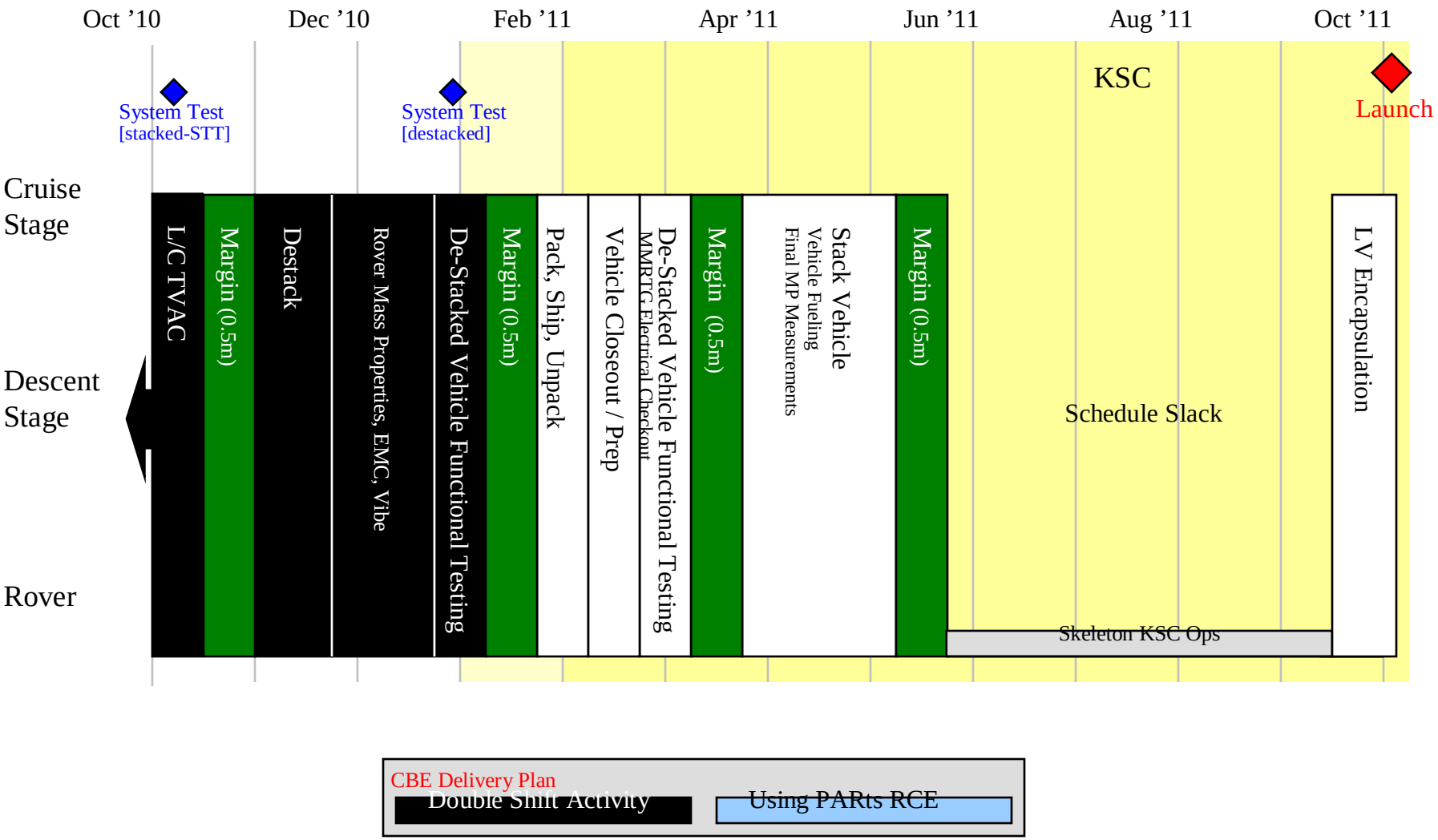
ATLO Schedule Overview: FY'11



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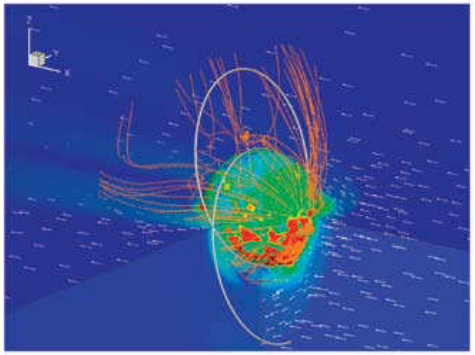
MAVEN Status and Plans



Mission Objectives

- Determine the role that loss of volatiles from the Mars atmosphere to space has played through time, allowing us to understand the histories of Mars' atmosphere and climate, liquid water, and planetary habitability
- Determine the current state of the upper atmosphere, ionosphere, and interactions with the solar wind
- Determine the current rates of escape of neutrals and ions to space and the processes controlling them
- Determine the ratios of stable isotopes that will tell Mars' history of loss through time

Mission Overview

- Obtain detailed measurements of the upper atmosphere, ionosphere, planetary corona, solar wind, solar EUV and SEPs over a 1-Earth-year period, to define the interactions between the Sun and Mars
- Operate 8 instruments for previously unobtainable science results:

  Particles and Fields Package (6 instruments):

  SWEA - Solar Wind Electron Analyzer
  SWIA - Solar Wind Ion Analyzer
  STATIC - Suprathermal and Thermal Ion Composition
  SEP - Solar Energetic Particle
  LPW - Langmuir Probe and Waves (with EUV detectors)
  MAG - Magnetometer

  IUVS - Imaging Ultraviolet Spectrometer

  NGIMS - Neutral Gas and Ion Mass Spectrometer
- Fly 75°-inclination, 4.5-hour-period, 150-km-periapsis-altitude science orbit
- Perform five 5-day "deep dip" campaigns to altitudes near 125 km during the 1-year mission

Status and Plans

- Oct 2008 – Risk Reduction Phase start
  - Implementing several risk-reduction activities, including:
    - STATIC Engineering Test Unit
    - Periapsis Timing Estimator using MRO test bed
    - C&DH software &instrument hardware interface and function verification using MRO test env
  - Preparing for System Requirements Review
  - Conducting program-directed relay-comm studies
- Aug 2009 – System Requirements Review
- Oct 2009 – Phase B start

Launch

- To be launched from KSC on an EELV between November 18 and December 7, 2013
- Mars Orbit Insertion on September 16, 2014 (for 11/18 launch)

Website

http://lasp.colorado.edu/MAVEN

Mars Exploration Program Analysis Group (MEPAG)

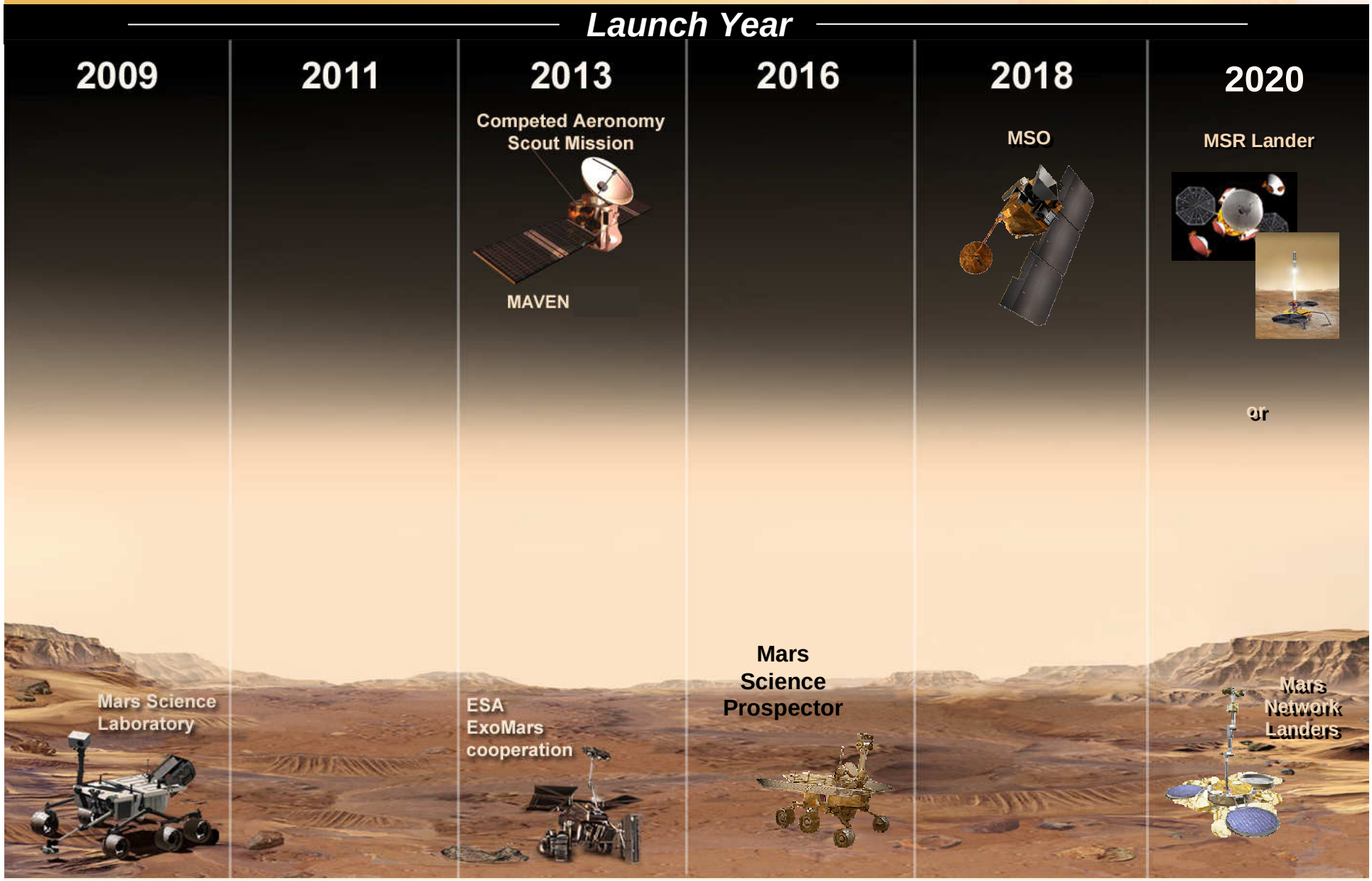
chartered by NASA HQ to assist in planning the scientific exploration of Mars

Jack Mustard, *MEPAG Chair*

Developments in Mars Exploration Since September MEPAG Meeting

- Phoenix mission completed is extended mission with great success
- Mars Science Laboratory continues development but due to technical issues the launch has been slipped to 2011
- Mars Atmosphere and Volatile Evolution Mission (MAVEN) is beginning development as the 2013 Scout mission (B. Jakosky PI)
- 3rd Mars Science Laboratory Landing Site Workshop and site evaluation concluded with identification of four landed sites for continued study
- Report on methane presence and variability published
- Architecture planning activities in response to changes in the program

Next Decade Mars Exploration Program 2008



Impacts of MSL Slip

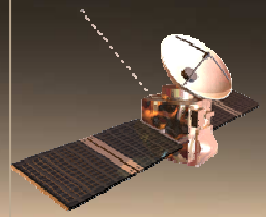
- MSL Launch slip to 2011 needed to complete critical technologies and prepare the mission for success
  - Cost for moving launch to 2011 is ≈$400 million
  - Delete MEP technology development funds for 2010-2014
  - Reduce funding for mission in 2016 launch window
  - Reduce support for EDL technical readiness and ongoing MEP missions
- May substantially alter the pace of Mars exploration and in particular development of the foundation for sample return

Mars Exploration Program Today

Launch Year

2011	2013	2016	2018	2020	2022	2024

MAVEN



Prepare the optimum program of Mars Exploration

Mars Science Laboratory

ExoMars (ESA)

Responses to MSL Slip

- **PSS has asked that the Mars Exploration Program Analysis Group (MEPAG), and the Mars community more broadly, reevaluate the MEP architecture to identify the best options currently available, including MSR, to maximize the opportunities for achieving scientific goals of the highest priority.**
- **MEP, through M. Meyer, has asked two groups to reconsider the Mars architecture in the following ways:**
  - **The Mars Science Orbiter Science Definition Team (chaired by M. Smith) was asked to reconsider the priorities of that mission in light of the recent methane report and the reduced funding for a 2016 mission**
  - **The Mars Architecture Tiger Team (MATT, chaired by P. Christensen) was asked to reconsider the Mars architecture previously endorsed by MATT-2 in light of recent changes.**
  - **These groups were tasked to give interim reports to MEPAG at this meeting and to incorporate results of the discussions in final reports**
- **MEP and SMD are in the midst of discussions on possible collaborations with ESA in Mars Exploration**

Goals for this Meeting

- Update the community on progress in the exploration of Mars including NASA, ESA, Japan, and Canada
- Update the community on outcomes of critical meetings in the past 6 months
- Develop inputs from the Mars community to the Planetary Science Decadal Survey now beginning
- Discussion and inputs to the science goals and mission objectives for the next decade of Mars exploration
- Initiate activities from MEPAG to develop positions and inputs to future MEP activities

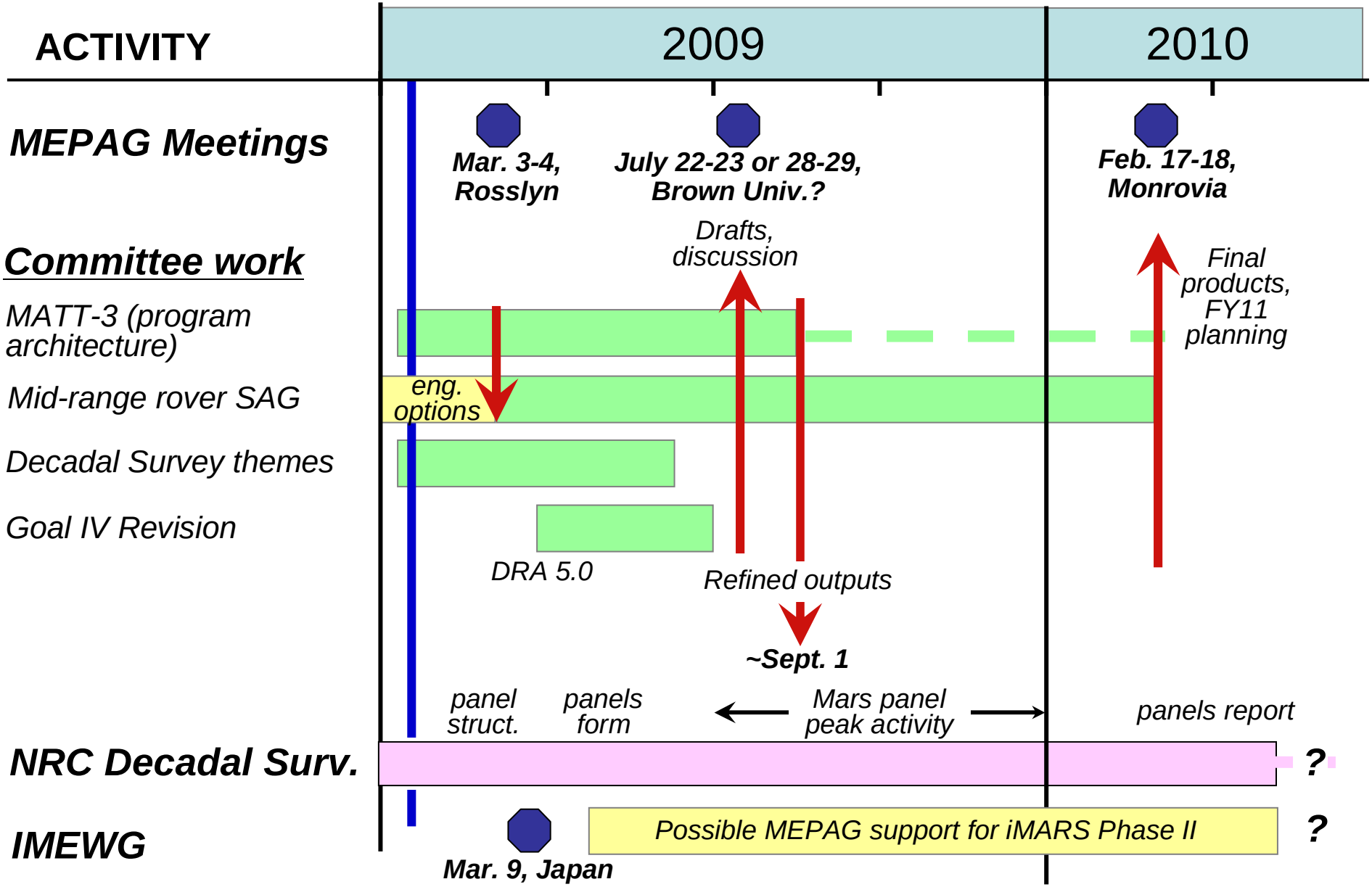
MEPAG Agenda, Day 1

Start	Time	Agenda Item	
Note: Unless otherwise indicated, all time speakers should assume that 30-50% of their time allocation is for discussion.			
Day 1 – Tuesday March 3, 2009			
08:00 AM	00:15	Welcome; MEPAG Purpose, Scope, Expected Results	J. Mustard
08:15 AM	00:30	Mars Program Director's Comments	D. McCuistion
08:45 AM	00:30	Mars Exploration Program Update	F. Li
09:15 AM	00:20	Mars Science Status	M. Meyer
09:35 AM	00:20	European Space Agency Update	J. Vago
09:55 AM	00:15	Break	
10:10 AM	00:15	Canadian Space Agency Update	Alain Berinstain
10:25 AM	00:15	Japanese Aerospace Exploration Agency Update/MELOS	S. Sasaki/T. Satoh
10:40 AM	00:20	MSL Science Status (including landing site)	J. Grotzinger
11:00 AM	00:20	ExoMars Status	J. Vago
11:20 AM	00:20	Discussion	
11:40 AM	01:30	Lunch	
01:10 PM		**MEPAG inputs to Decadal Survey**	
01:10 PM	00:20	Decadal Survey Introduction and Process	D. Smith
01:30 PM	00:30	Planning and draft MEPAG inputs to Decadal Survey with discussion	J. Johnson
02:00 PM		**Next Decade Planning--Mission Opportunities for '16, '18, '20**	
02:00 PM	00:20	Introduction	M. Meyer
02:20 PM	00:25	MSO SDT Update	Mike Smith
02:45 PM	00:15	Break	
03:00 PM	01:20	MATT-3 report and discussion: Next decade planning	P. Christensen
04:20 PM	00:30	Daily wrap-up	J. Mustard
04:50 PM		Adjourn	

MEPAG Agenda, Day 2

Start	Time	Agenda Item	
Note: Unless otherwise indicated, all time speakers should assume that 30-50% of their time allocation is for discussion.			
Day 2 – Wednesday March 4, 2009			
08:30 AM	00:30	**2016-18-20 Building Blocks--Definition, Forward Planning**	TBD
09:00 AM	00:30	Discussion	
09:30 AM		**Meeting reports**	
09:30 AM	00:30	Lunar Roadmap	J. Volosin
10:00 AM	00:10	Discussion	
10:10 AM	00:15	Break	
10:25 AM		**Meeting reports**	
10:25 AM	00:20	Mars Climate Modeling Center (MCMC)	J. Hollingsworth
10:45 AM	00:20	Mars Atmospheric Modeling Workshop	J. Levine
11:05 AM	00:20	Report on Ground Truth from Mars Workshop	C. Shearer
11:25 AM	00:20	Second Workshop on Mars Valley Networks	R. Craddock
11:45 AM	01:30	**Lunch**	
01:15 PM	00:20	Workshop on Martian Phyllosilicates	Jean-Pierre Bibring
01:35 PM	00:20	Planetary Dunes Workshop	L. Fenton
01:55 PM	00:35	**Open discussion**	
02:30 PM	00:30	Future Planning for MEPAG Activities	J. Mustard
03:00 PM		Adjourn	

MEPAG Planning, 2009



Goals Document

Active Goals Document location: http://mepag.jpl.nasa.gov/reports/index.html

Must be up to date when submitted to Decadal Survey

- At our last meeting (09-18-08) we completed a major revision process
  - Substantial changes to Goals II and III
- Major new information since then—are our priorities and descriptions of scientific objectives and investigations still current?
  - methane in martian atmosphere
  - Other?
- Goal IV: Revision process tabled until availability of Design Reference Architecture 5.0. This has not been reconsidered in ~5 years