



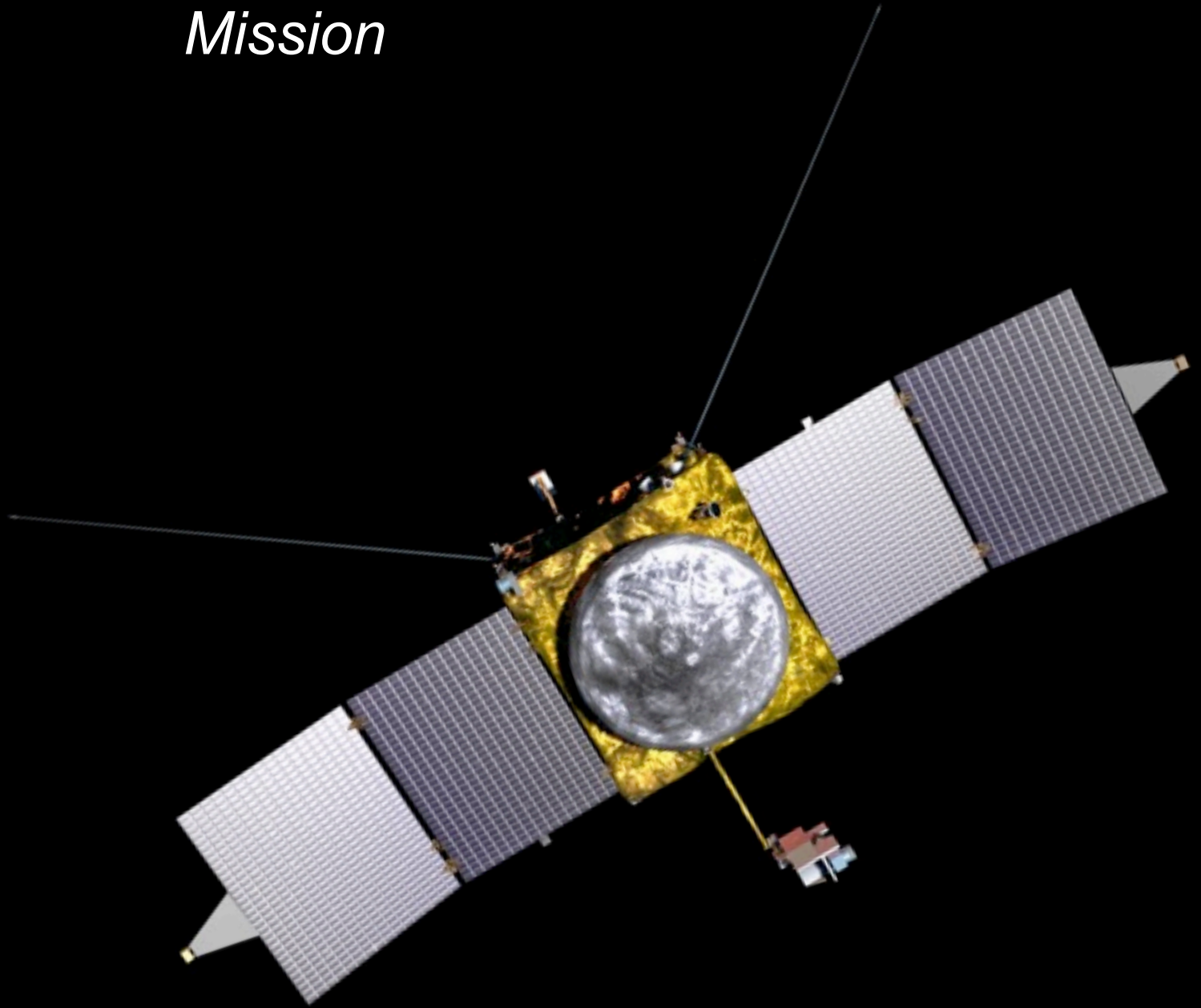
The 2013 MAVEN Mission To Mars



Bruce Jakosky
MAVEN Principal Investigator
University of Colorado



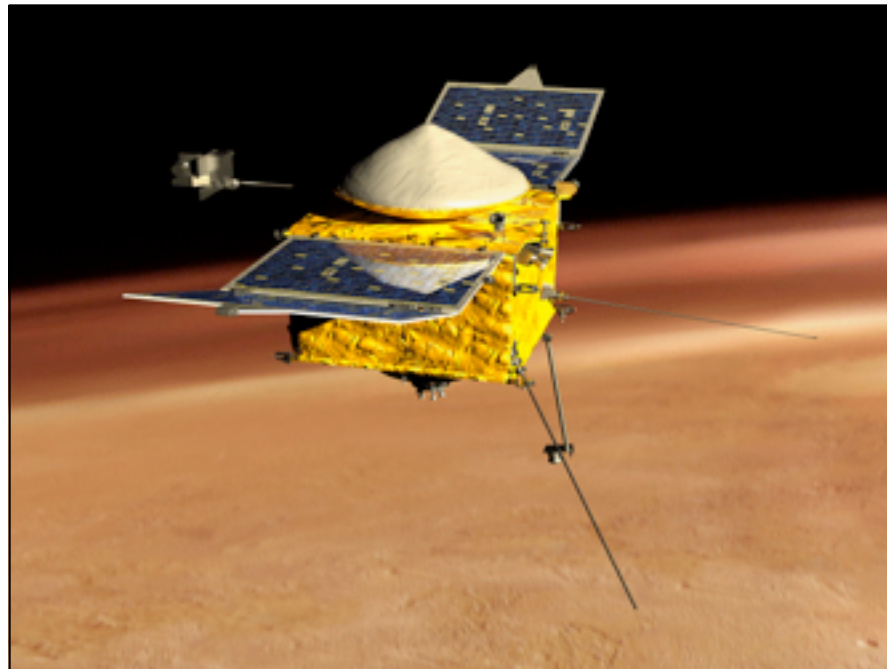
“Mars Atmosphere and Volatile EvolutionN” Mission



Summary of MAVEN Status

- We've been developing MAVEN since 2003; now 165 days to launch!
- All eight science instruments are on the spacecraft
- Spacecraft assembly is complete and its in final stages of environmental testing
- Launch period is 18 November – 7 December, 2013
- Arrival at Mars in September, 2014
- One-Earth-year primary science mission

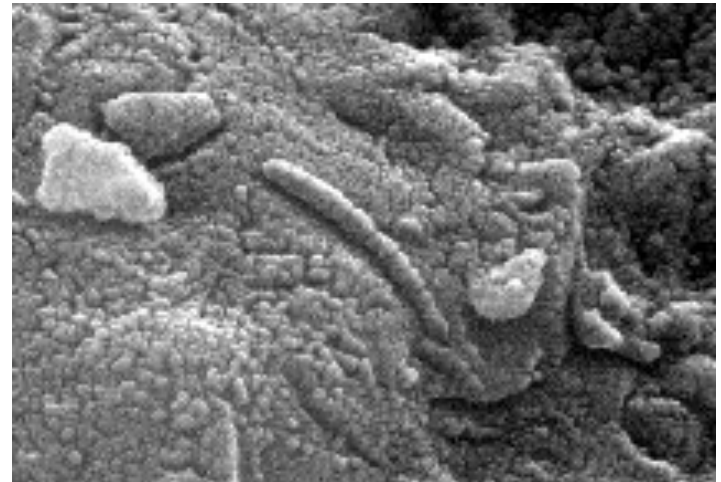
Technical development is on track, we are on schedule and on budget!



Overarching Question: Did Mars Ever Have Life?

Mars appears to meet or have met all of the environmental requirements for the occurrence of life:

- Liquid water
- Access to the biogenic elements
- Source of energy to drive metabolism



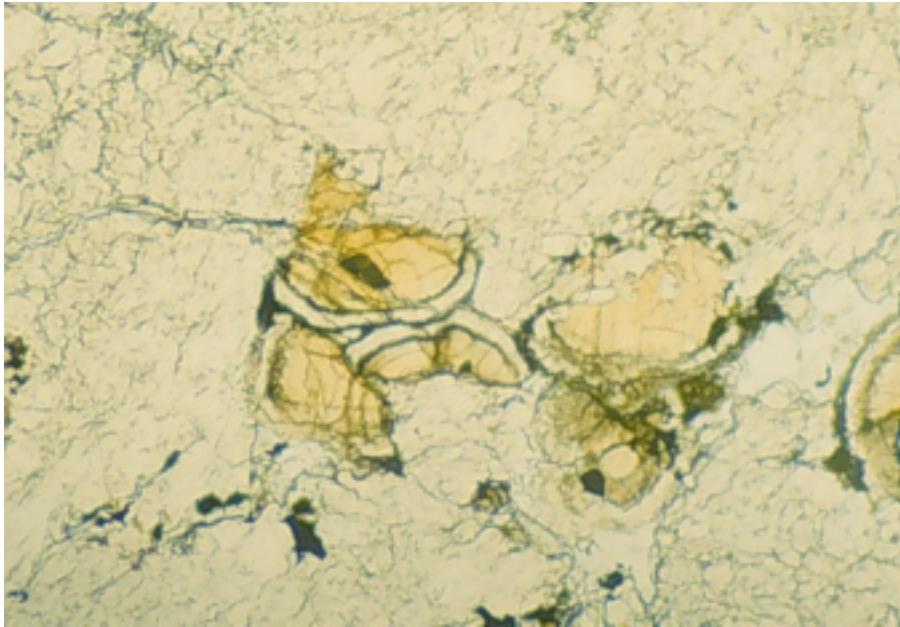
Did Mars ever have life?

How did any life interact with its planetary environment?

How has the habitability of Mars changed over time?

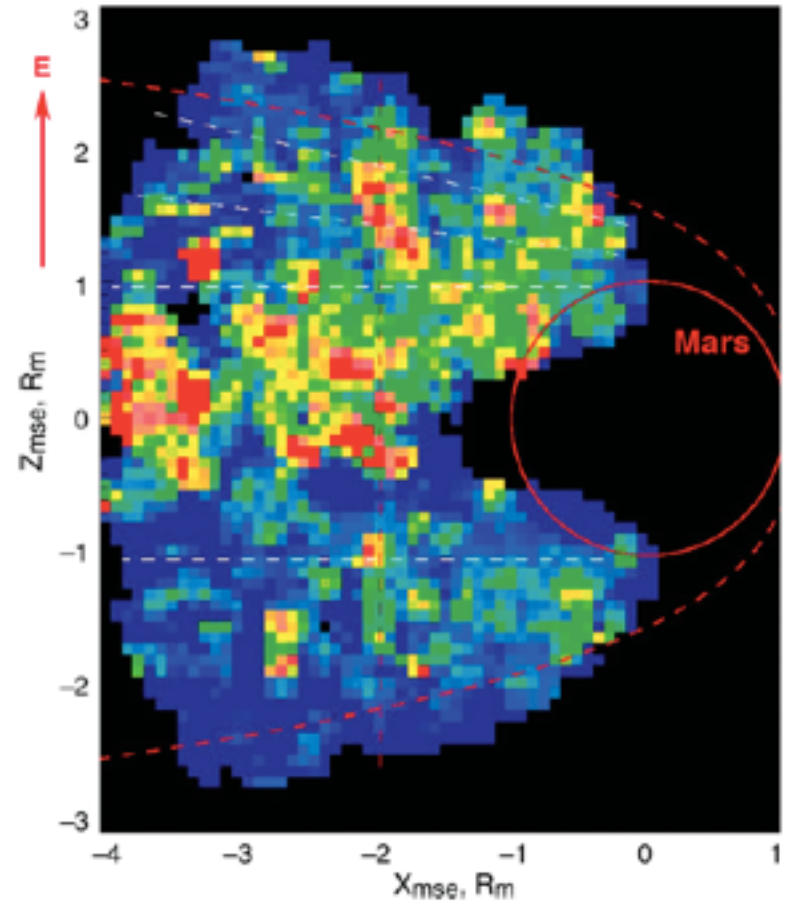
Where Did The Water Go? Where Did The CO₂ Go?

Into the crust



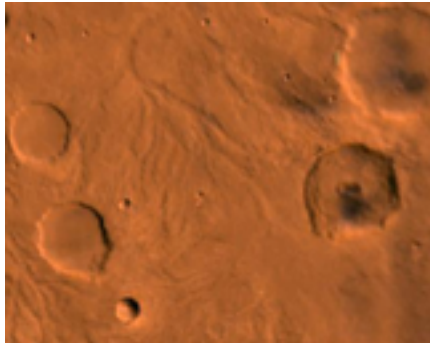
Carbonate deposits in a Martian meteorite

Lost to space



Escaping ions detected from *Mars Express*

What Will MAVEN Do? (1 of 2)

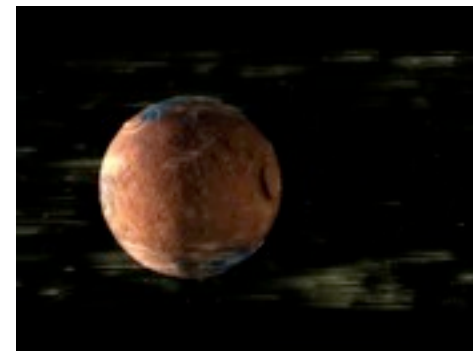
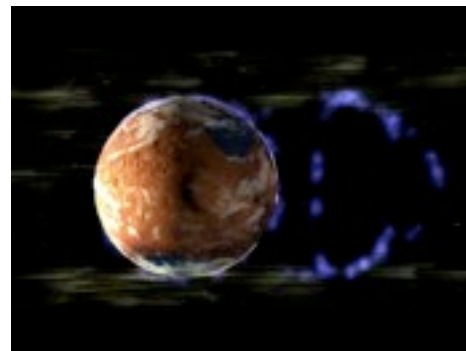
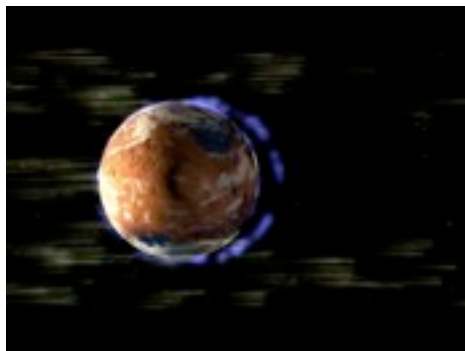
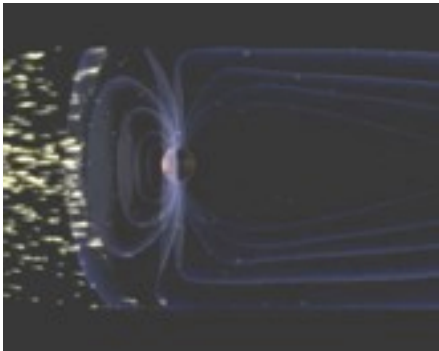


Ancient Valleys

Mars' atmosphere is cold and dry today, but there was once liquid water flowing over the surface.

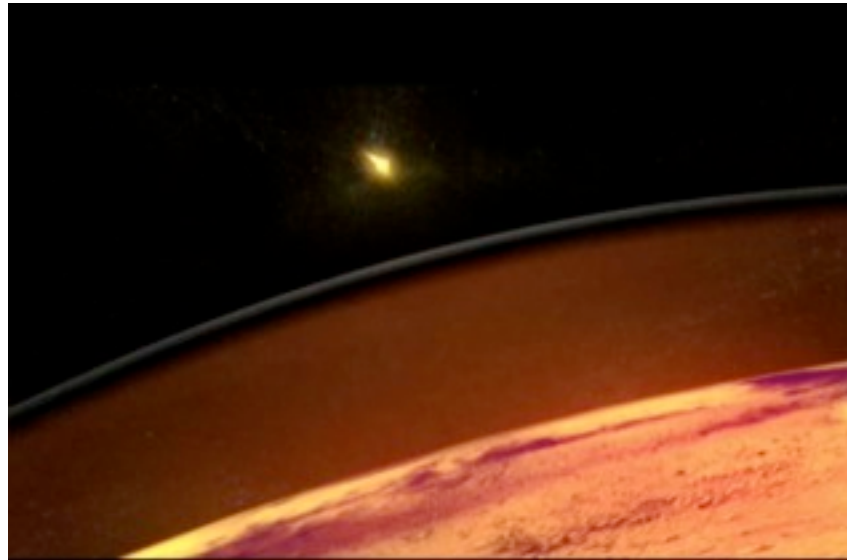
Where did the water and early atmosphere go?

- *H_2O and CO_2 can go into the crust or be lost to space.*
- *MAVEN will focus on volatile loss to space.*



Turn-off of the Martian magnetic field allowed turn-on of solar-EUV and solar-wind stripping of the atmosphere approximately 3.7 billion years ago, resulting in the present thin, cold atmosphere.

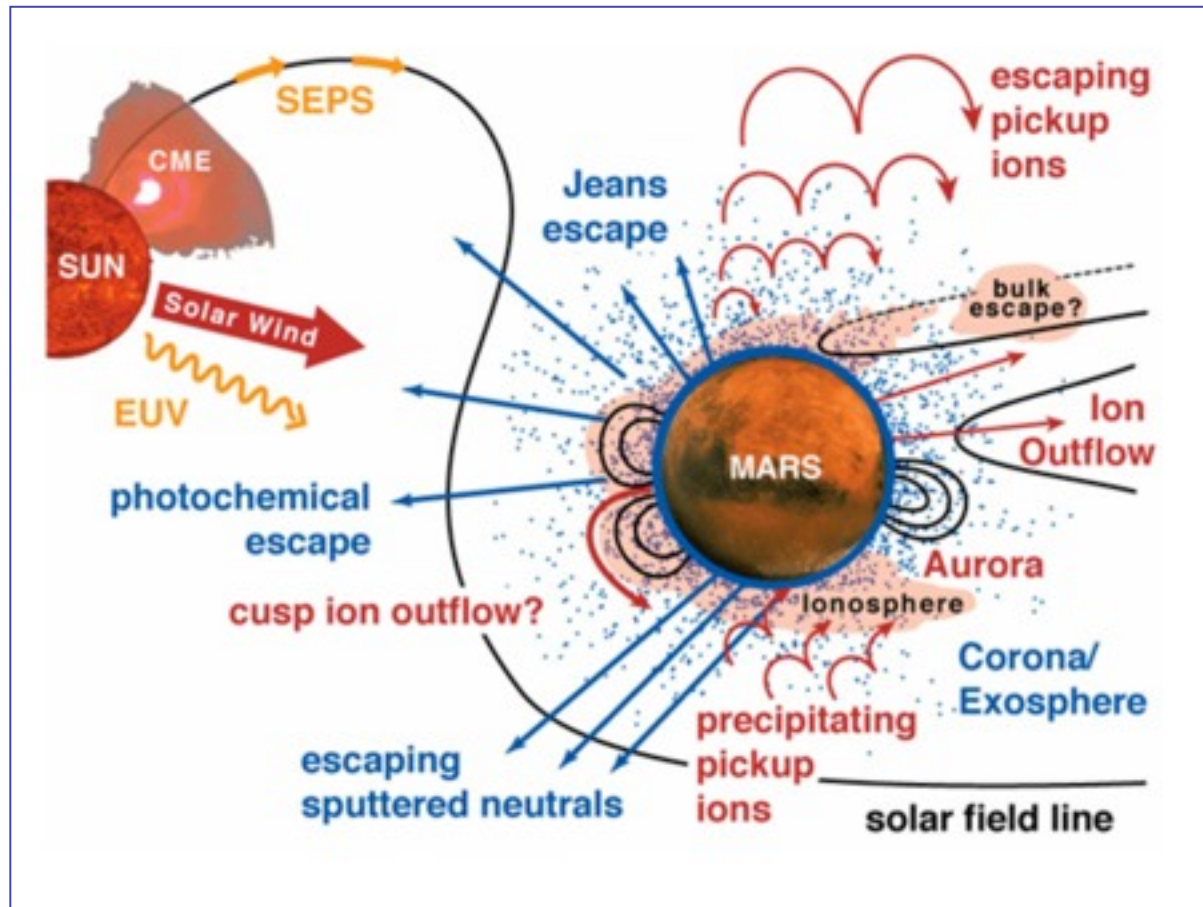
What Will MAVEN Do? (2 of 2)



- Determine the structure and composition of the Martian upper atmosphere today
- Determine rates of loss of gas to space today
- Measure properties and processes that will allow us to determine the integrated loss to space through time

MAVEN will answer questions about the history of Martian volatiles and atmosphere and help us to understand the nature of planetary habitability.

MAVEN Will Measure the Energetic Drivers, Reservoirs, and Escape Rates

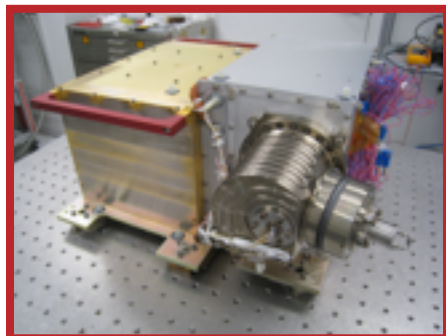


- MAVEN will determine the present state of the upper atmosphere and today's rates of loss to space.

- Measurements will allow determination of the net integrated loss to space through time.

The MAVEN Science Instruments

Mass Spectrometry Instrument



*Neutral Gas and Ion
Mass Spectrometer;
Paul Mahaffy, GSFC*

Particles and Fields Package

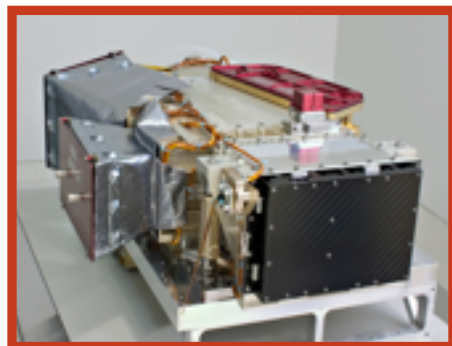


*Solar Energetic Particles;
Davin Larson, SSL*



*SupraThermal and Thermal
Ion Composition; Jim
McFadden, SSL*

Remote-Sensing Package



*Imaging Ultraviolet
Spectrometer; Nick
Schneider, LASP*



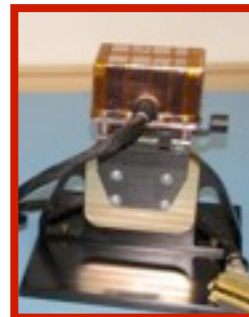
*Solar Wind Electron Analyzer;
David Mitchell, SSL*



*Solar Wind Ion Analyzer;
Jasper Halekas, SSL*



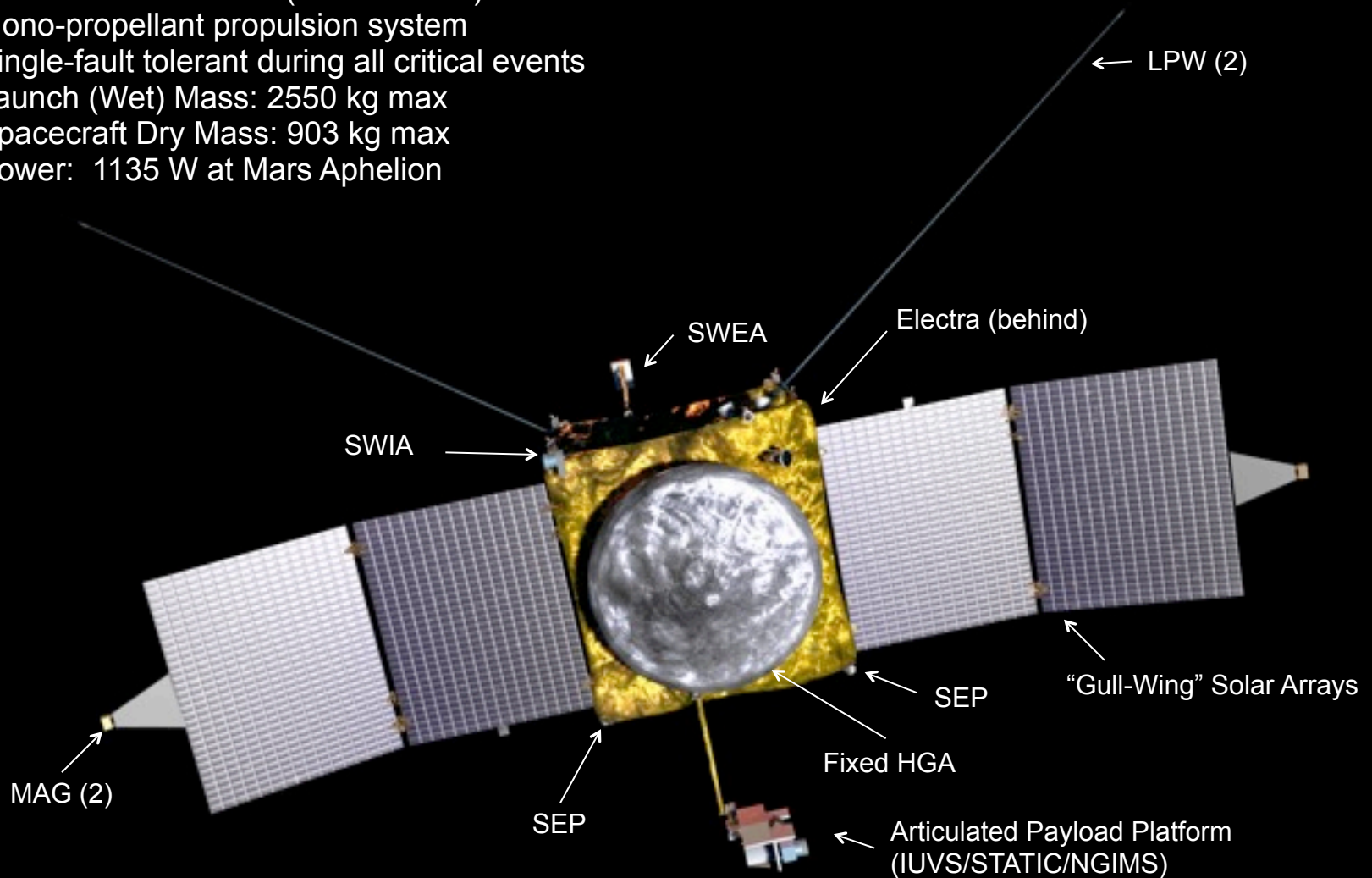
*Langmuir Probe and Waves;
Bob Ergun, LASP*



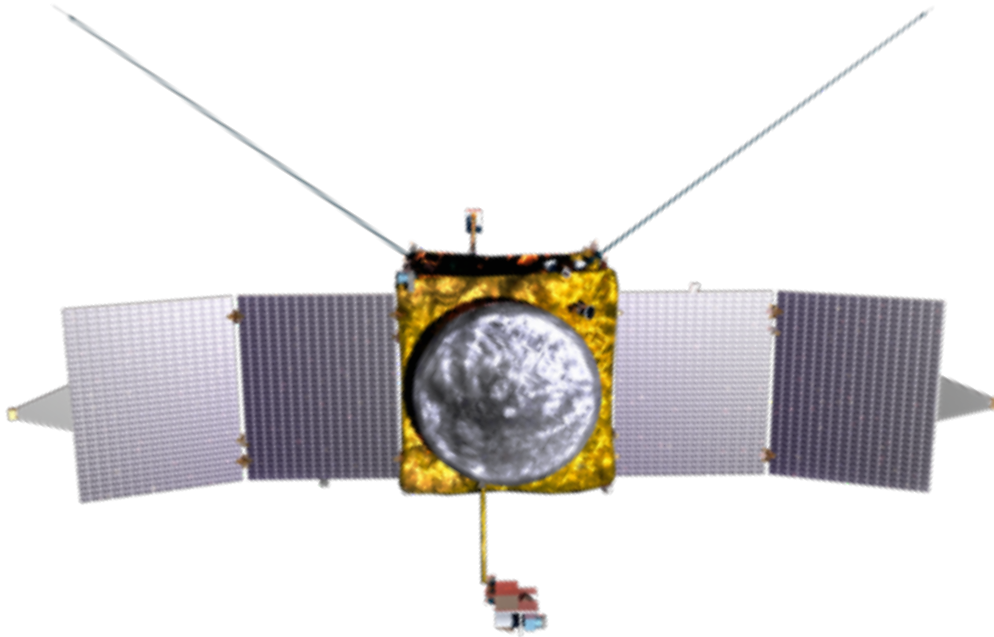
*Magnetometer;
Jack Connerney, GSFC*

The MAVEN Spacecraft

- 3-axis attitude control (wheel based)
- Mono-propellant propulsion system
- Single-fault tolerant during all critical events
- Launch (Wet) Mass: 2550 kg max
- Spacecraft Dry Mass: 903 kg max
- Power: 1135 W at Mars Aphelion



The MAVEN Spacecraft



Same weight fully loaded as a
GMC Yukon – 2550 kg.



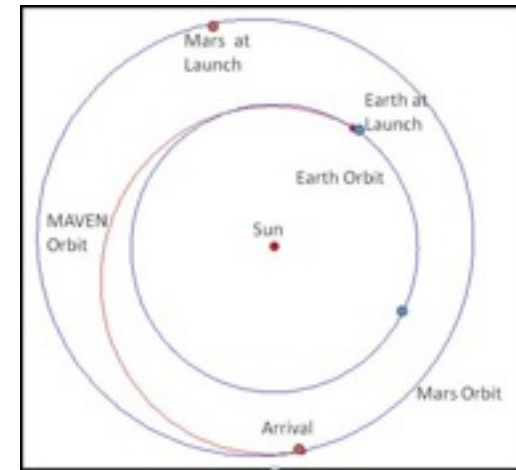
Same length as a school bus –
wingtip-to-wingtip length of 37ft.

MAVEN Mission Architecture

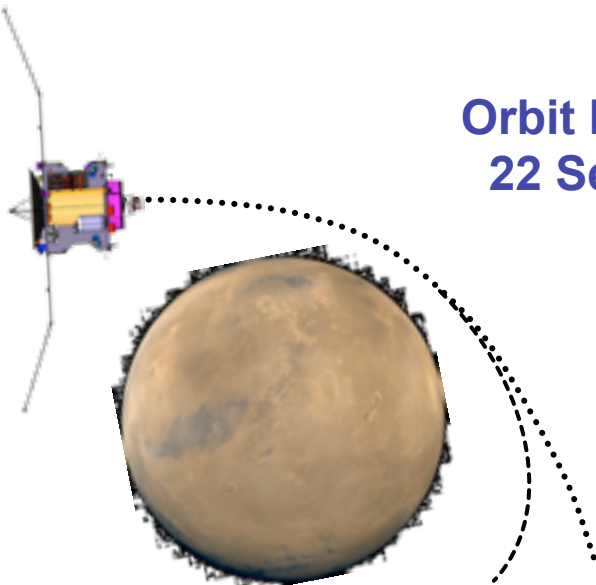


**20-Day Launch Period:
November 18 –
December 7, 2013**

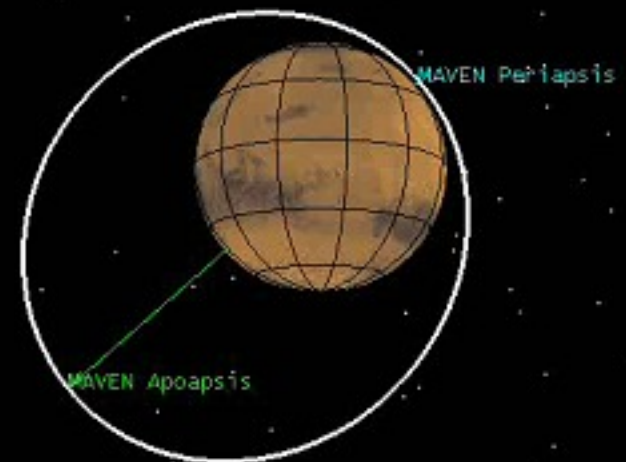
Ten-Month Ballistic Cruise to Mars



**Orbit Insertion:
22 Sept 2014**

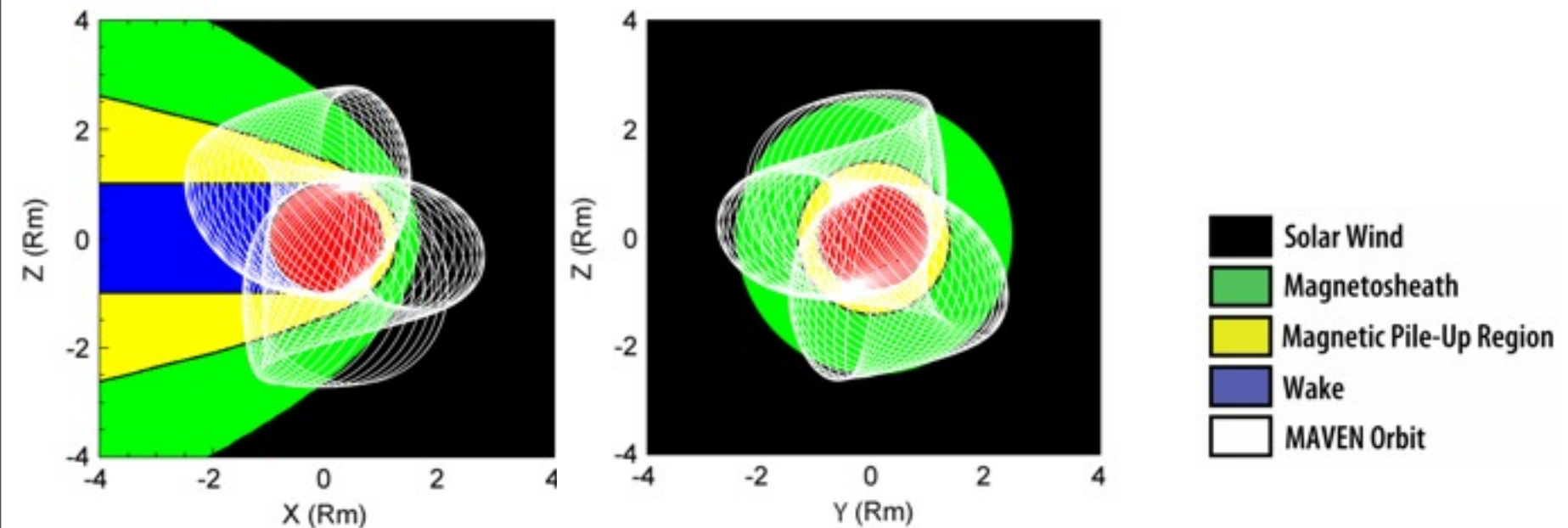


One Year of Science Operations

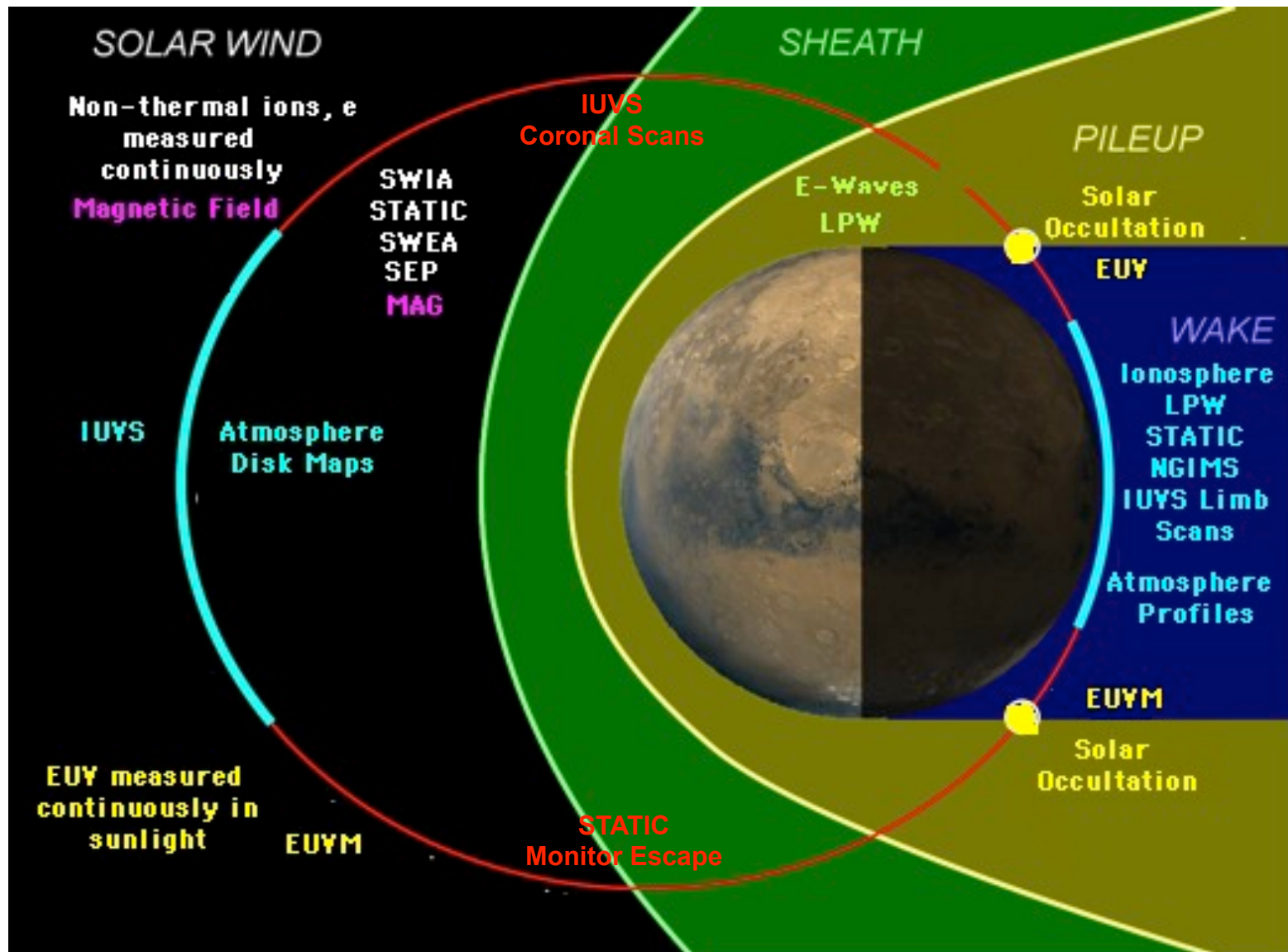


MAVEN Orbit and Primary Science Mission

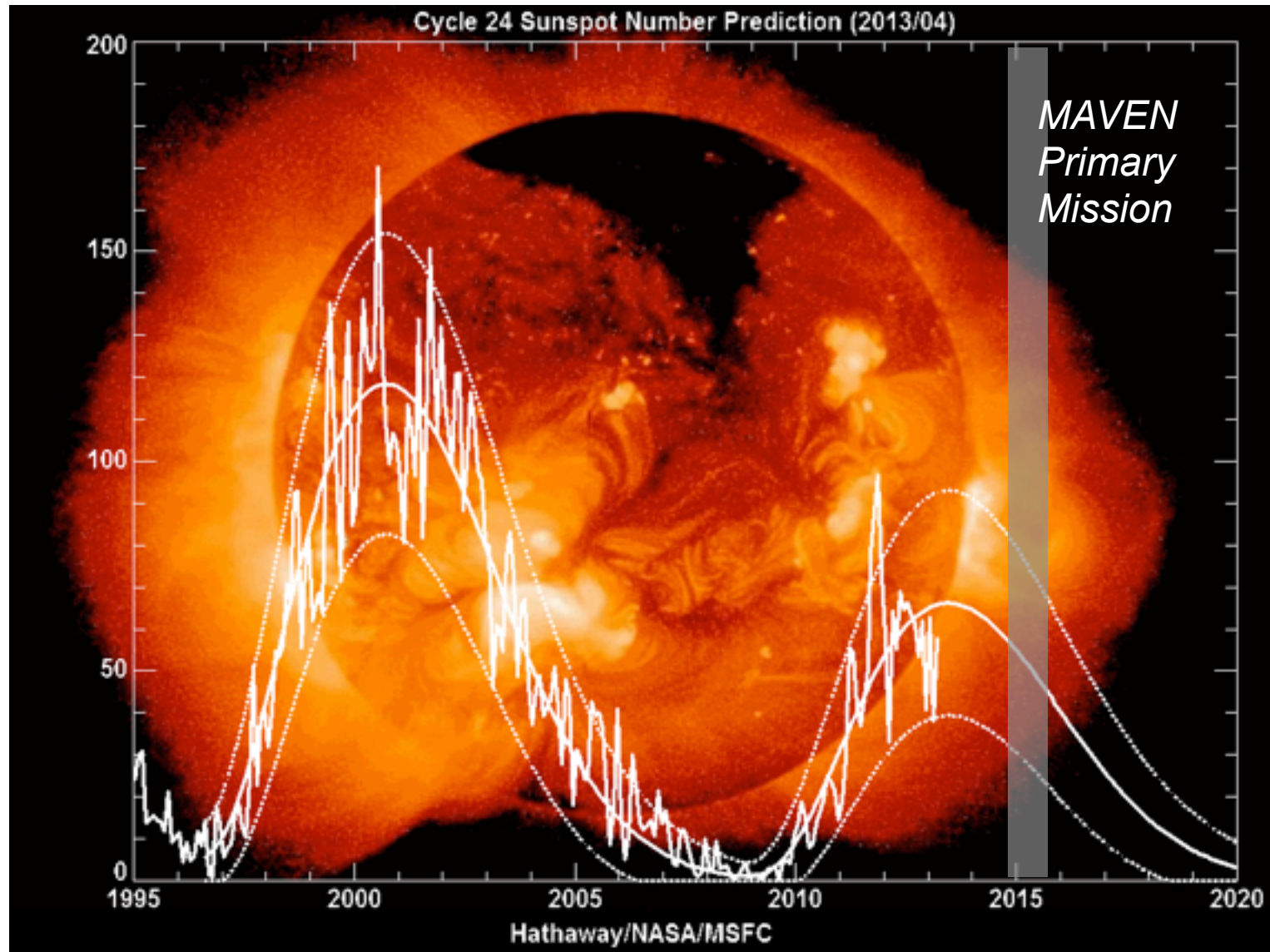
- Elliptical orbit to provide coverage of all altitudes
- The orbit precesses in both latitude and local solar time
- One-Earth-year mission allows thorough coverage of near-Mars space



MAVEN Makes Measurements Throughout The Orbit



MAVEN's Timing in the Solar Cycle



Proposal, Site Visit, and Presentation at NASA HQ



Monday, June 17, 2013

Reviews Are Held Only On Days That Contain The Word “Day”

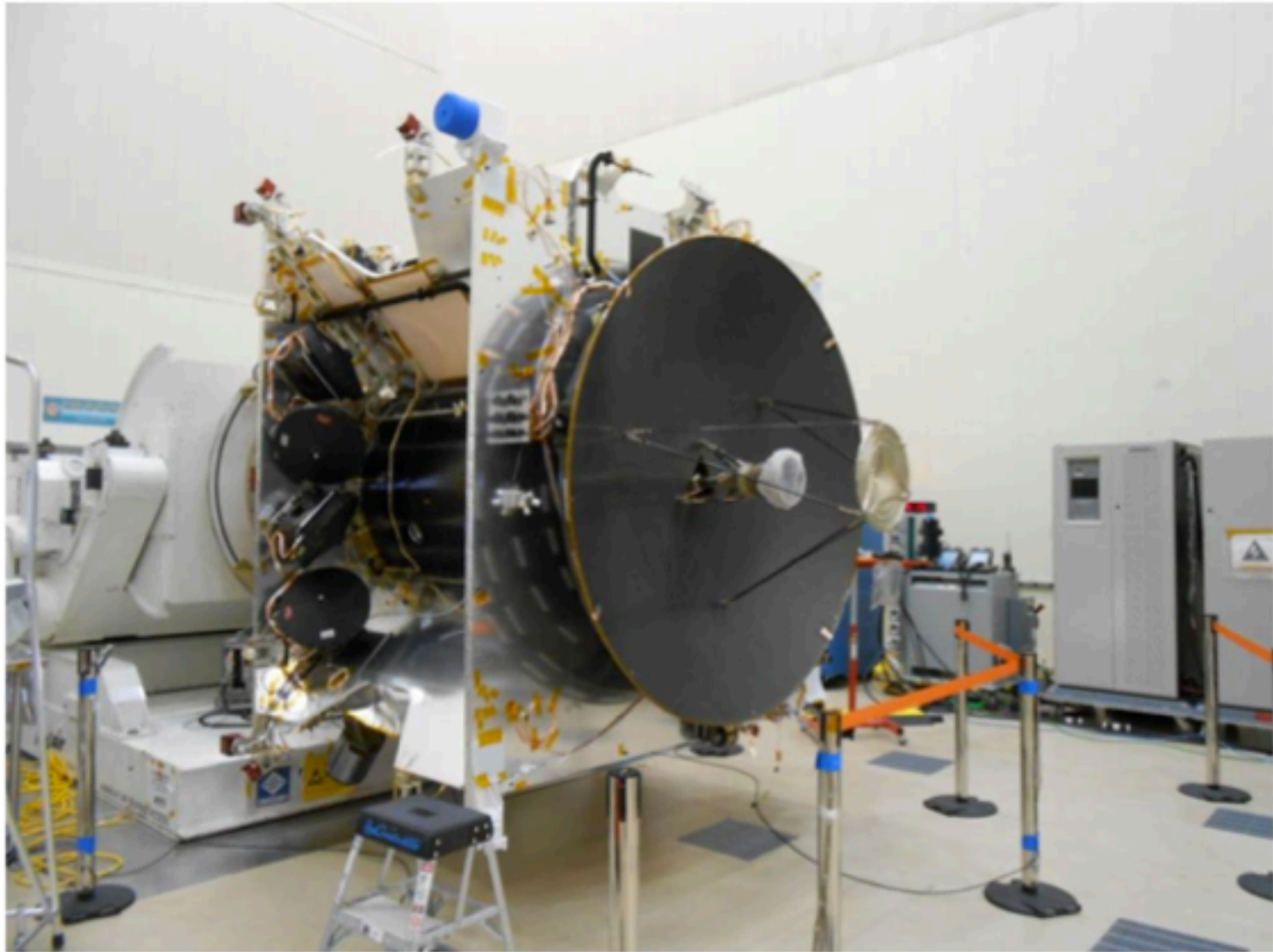


MAVEN Spacecraft Early In “ATLO”



Integration of core structure with fuel tank

Nearly Complete Spacecraft In Lockheed Martin High-Bay Cleanroom



Attaching the Solar Panels

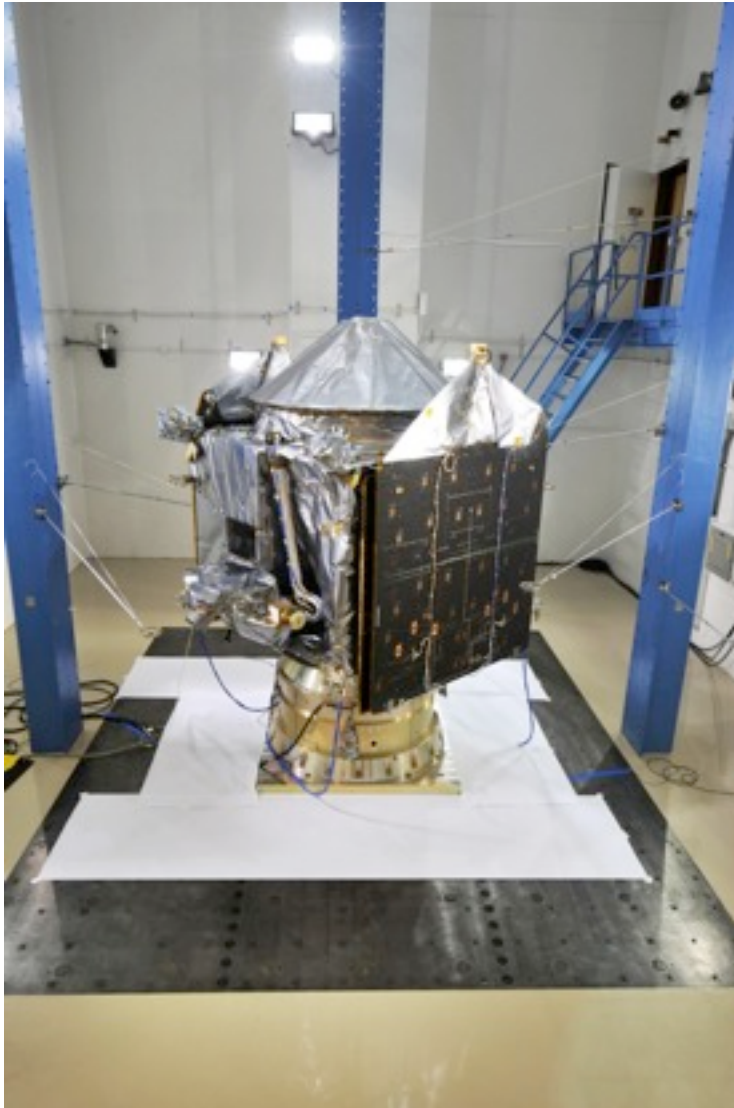


Observatory in ATLO



MAVEN spacecraft with solar arrays deployed

Observatory in Environmental Testing

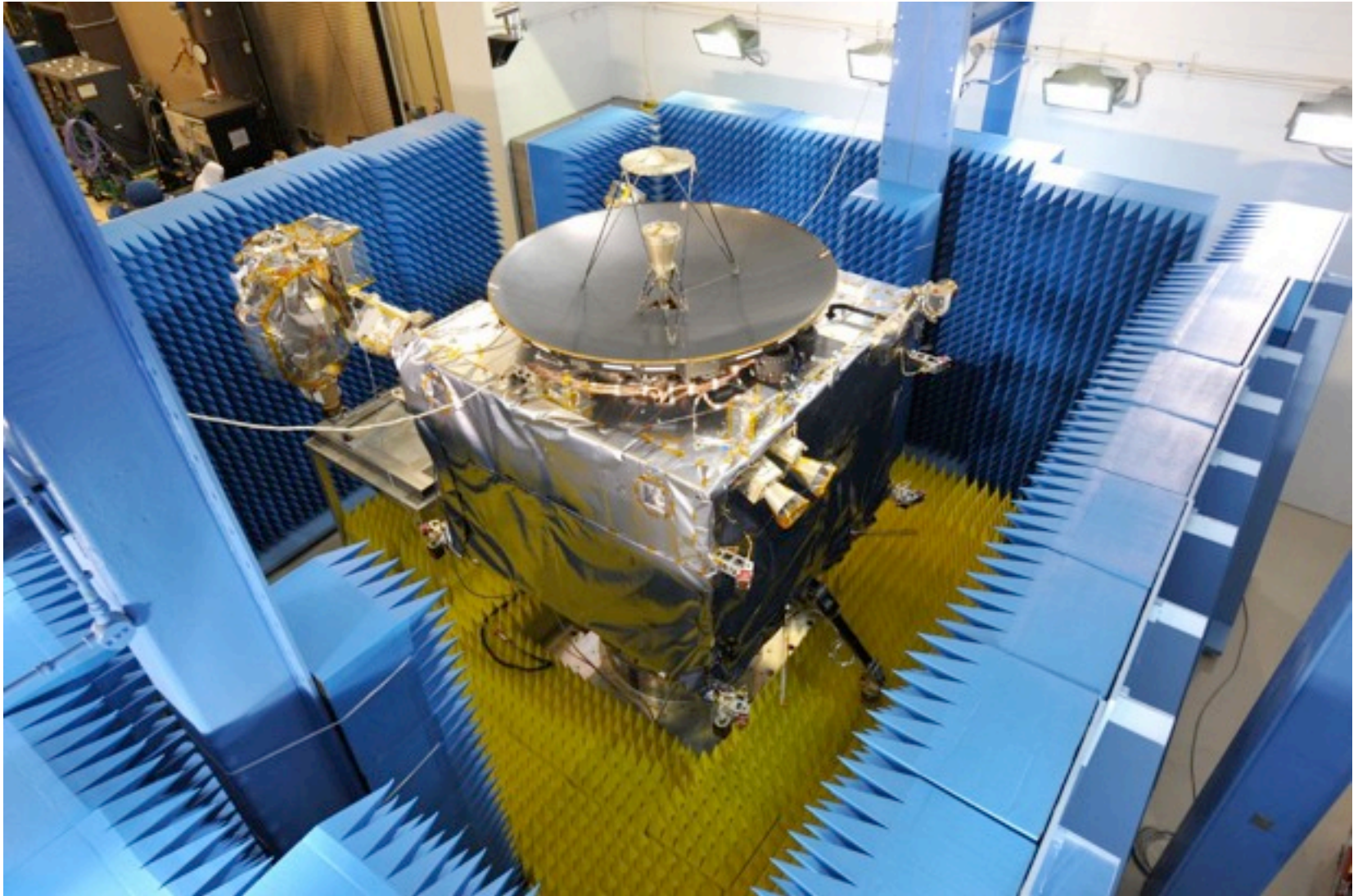


MAVEN in Acoustics



MAVEN on Shaker – Sine Vibration

Observatory in Environmental Testing



MAVEN in EMI/EMC Test Configuration

The MAVEN Team Tours The Launch Facilities

Atlas V Horizontal Processing Facility



Launch Pad

MAVEN's Atlas V - 401 in Fabrication



Atlas 1st Stage



Atlas Centaur 2nd Stage

Mockup of MAVEN on the Launch Pad



Monday, June 17, 2013

How Do I Spend My Time As P.I.?

How Do I Spend My Time As P.I.?



How Do I Spend My Time As P.I.?



How Do I Spend My Time As P.I.?



How Do I Spend My Time As P.I.?



How Do I Spend My Time As P.I.?



How Do I Spend My Time As P.I.?



How Do I Spend My Time As P.I.?



Mission Operations at Lockheed Martin, Science Operations at LASP



Lockheed Martin Mission Support Area

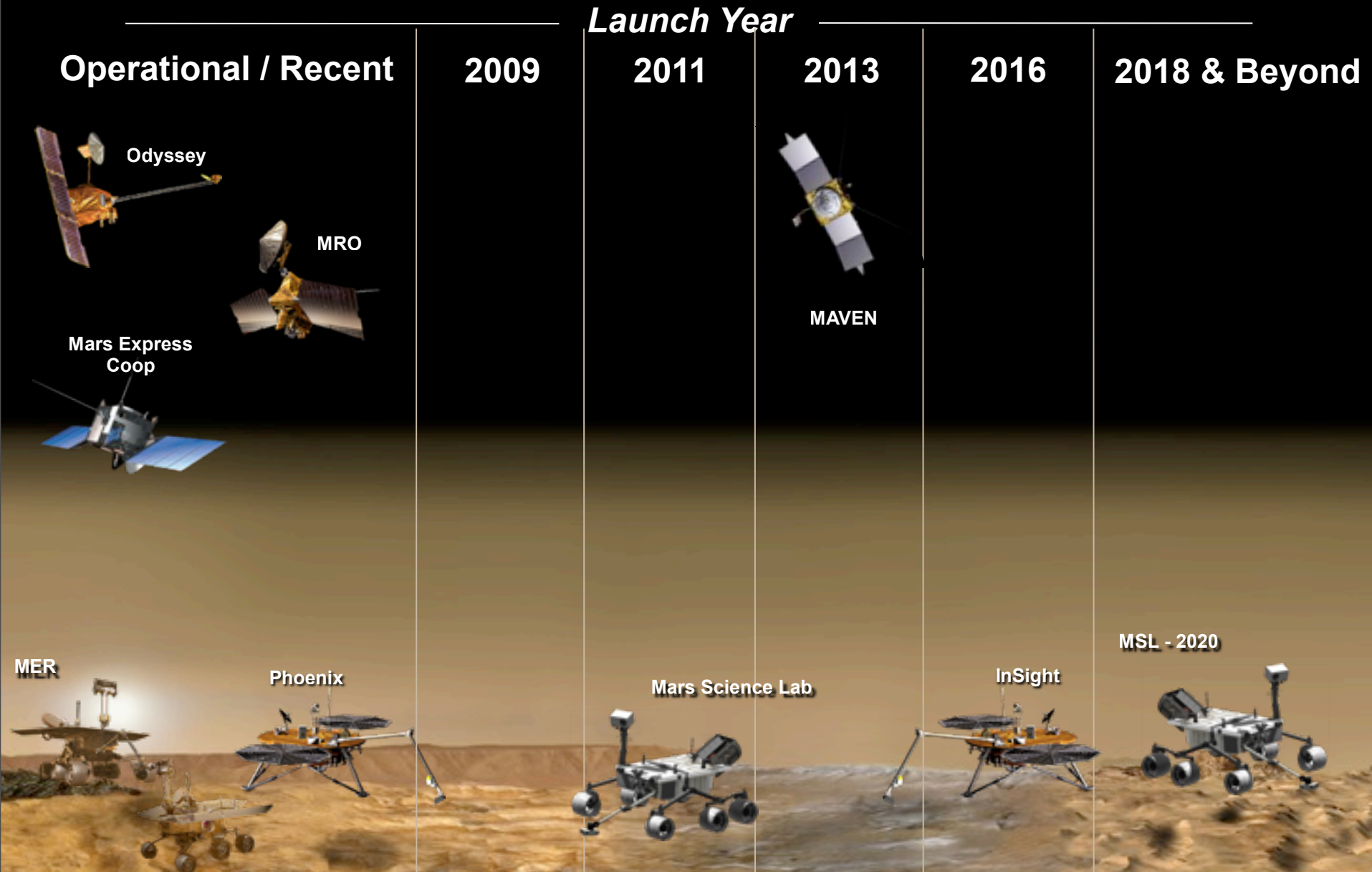
- All operational phases of the MAVEN mission have been carried out at Mars on previous missions by the MAVEN operations team.

- MAVEN utilizes extensive operational facilities at LM (MOC) and LASP (SOC).
- Both LM and LASP have very experienced operations teams and well-developed procedures.

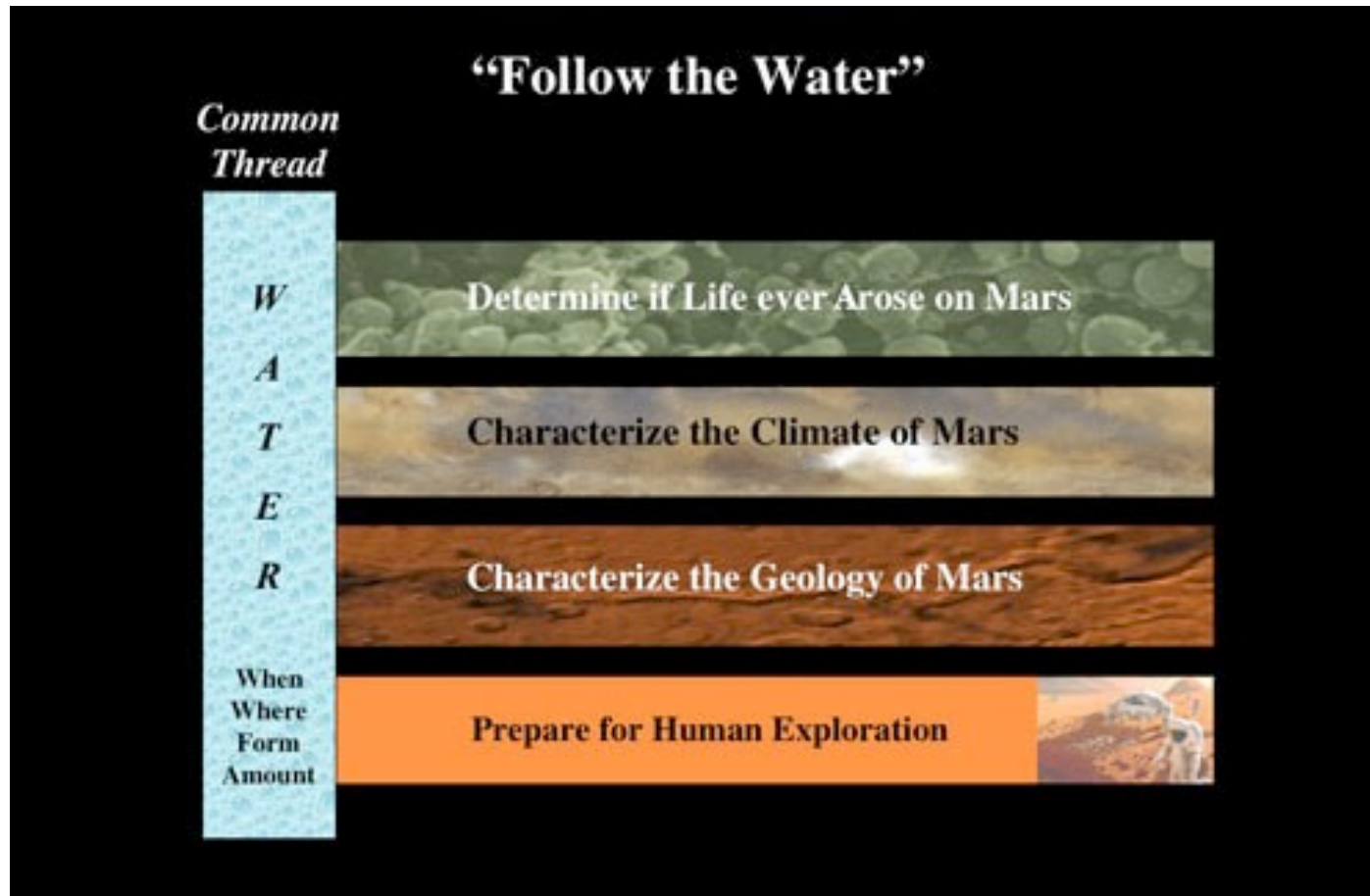


LASP Mission Operations Center

NASA's Mars Exploration Program



MAVEN Will Continue The Successful “Follow The Water” Theme.



MGS, MPF, ODY, MER, MRO, MEx, PHX, upcoming MSL, are focused largely on the history of the surface. MAVEN's comprehensive approach will provide the history of the atmosphere as the necessary other half of the story.

MAVEN Schedule



6 June 2013

- MAVEN concept developed starting in late 2003
- Proposal submitted for Mars Scout program in 2006
- Selected for competitive Phase A, early 2007
- Selected for development for flight, Sept. 2008
- MAVEN Confirmed for development, October 2010
- As of today, launch is 5 months 12 days away!



MAVEN is on track in its development, on schedule, and on budget.

Follow us at:

MAVEN web sites: [*http://nasa.gov/MAVEN*](http://nasa.gov/MAVEN)

[*http://lasp.colorado.edu/maven*](http://lasp.colorado.edu/maven)

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