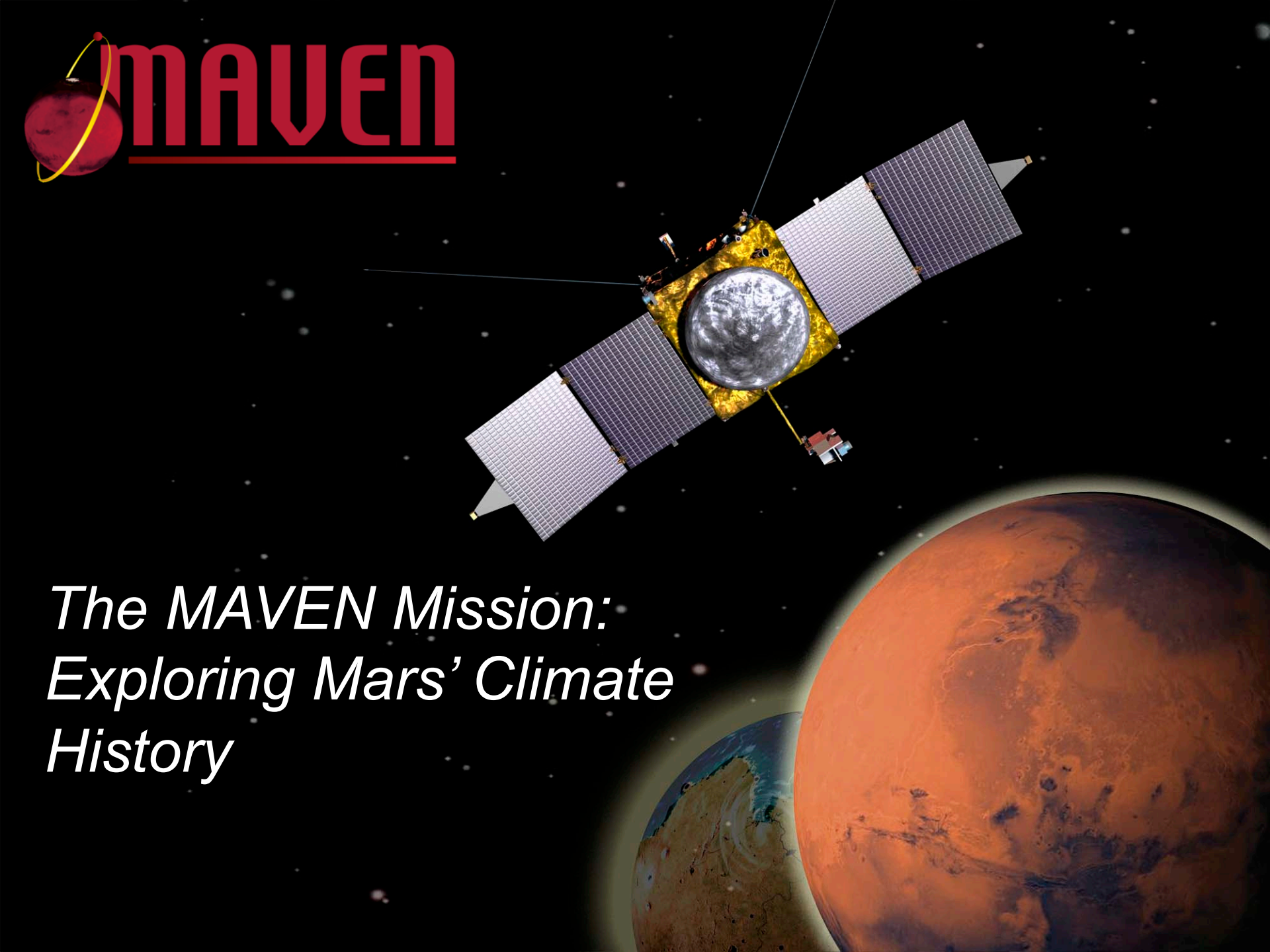
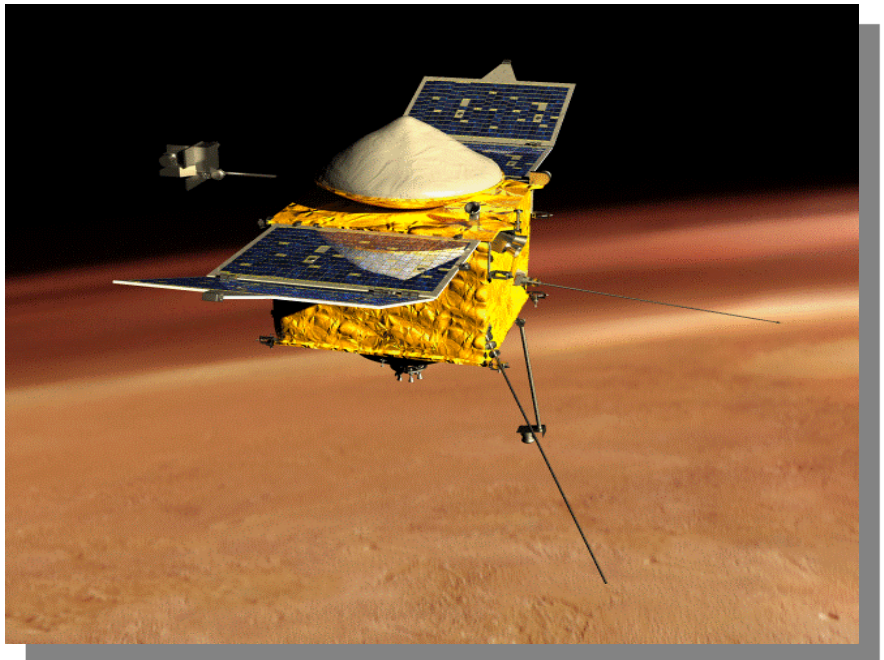

MAVEN
The MAVEN Mission:
Exploring Mars' Climate
History

MAVEN Launches, 18 November 2013

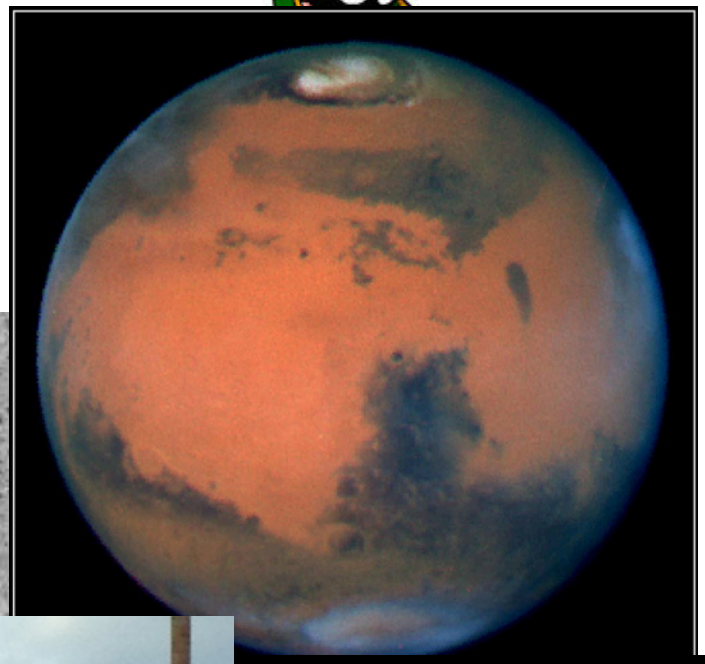
Today's Status

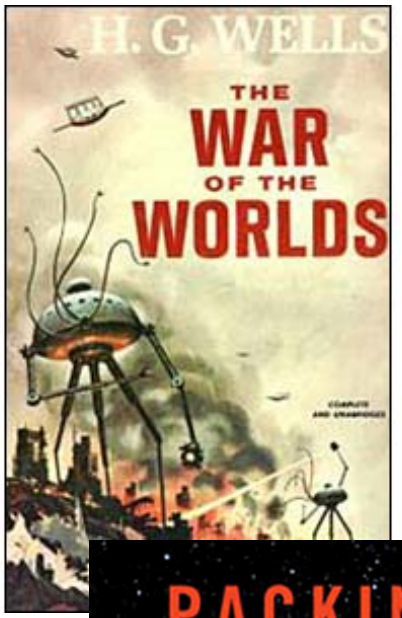
- 16 days until arrival at Mars, as of today (5 September 2014)
- Cruise phase to Mars is 10 months total, from launch on 18 November 2013
- Initial check-out of spacecraft and instruments is complete; all systems are operating nominally
- Two Trajectory Correction Maneuvers carried out; TCM-3 canceled as unnecessary, TCM-4 scheduled for 12 September but may be canceled
- There are lots of activities that still need to occur successfully, but…

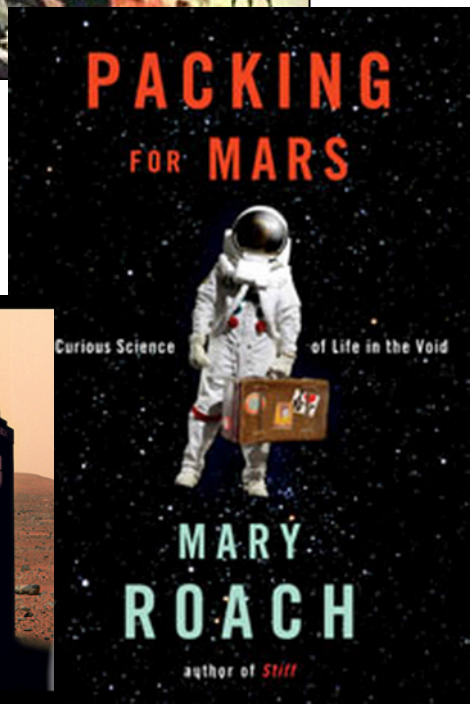
We are on track to carry out our science mission as planned!

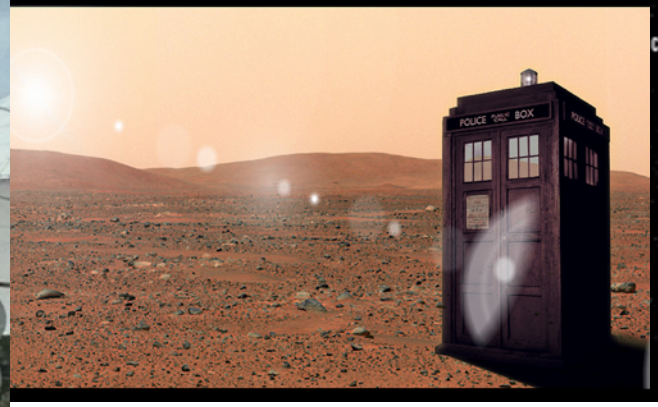


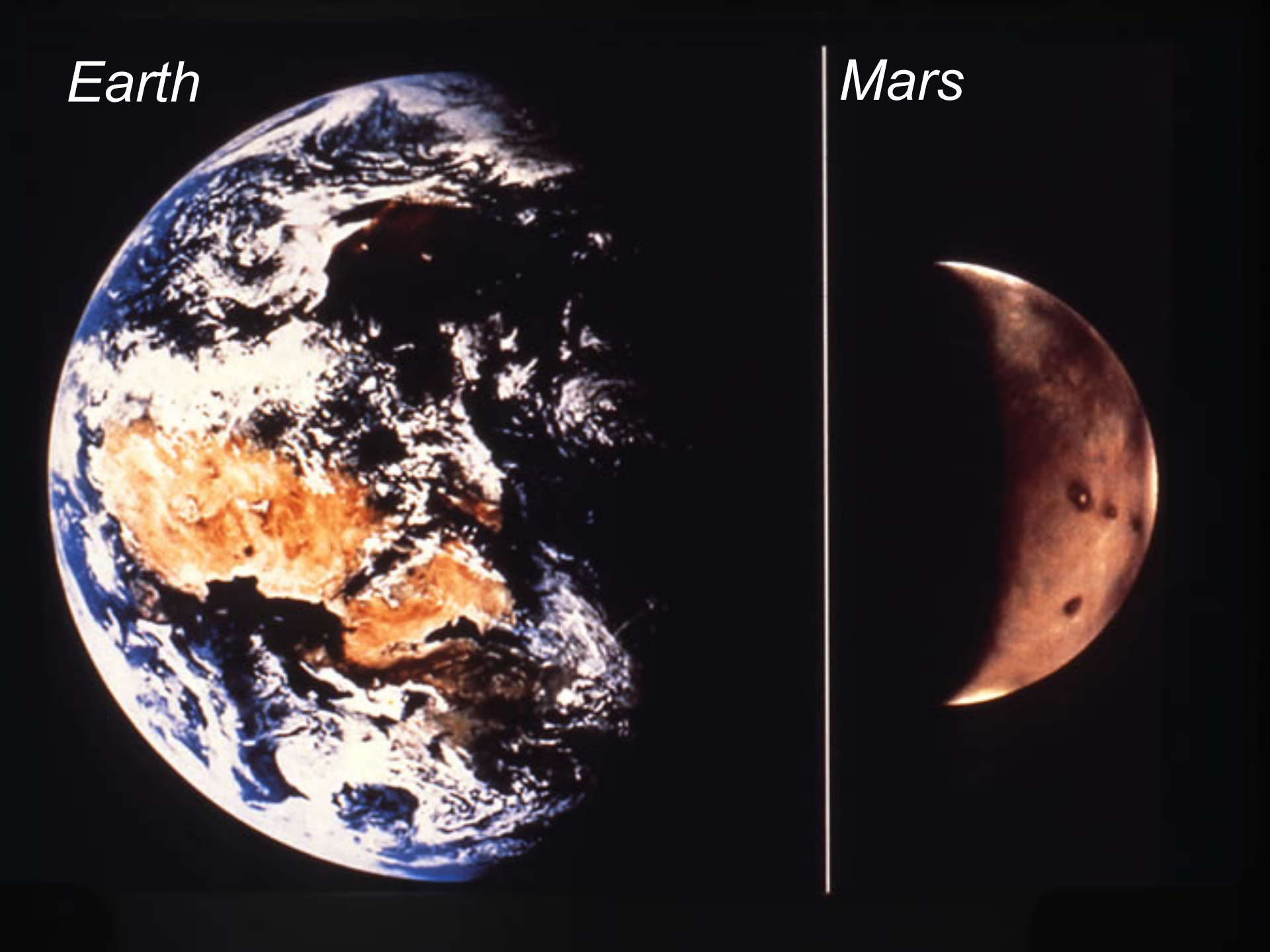
The Public's Fascination With Mars







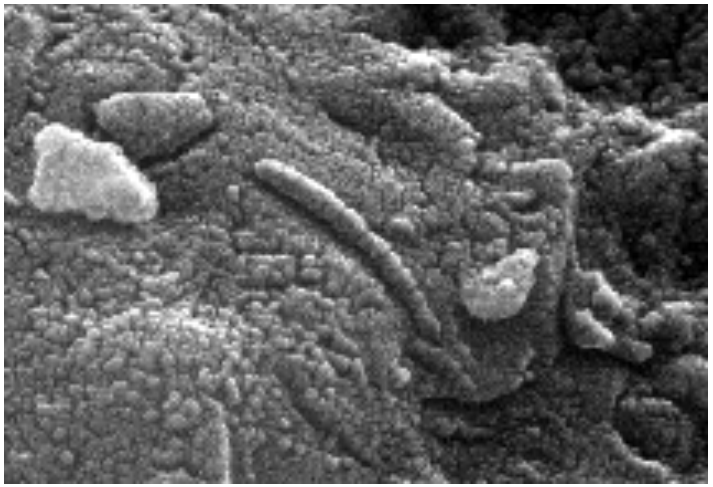



Earth
Mars

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



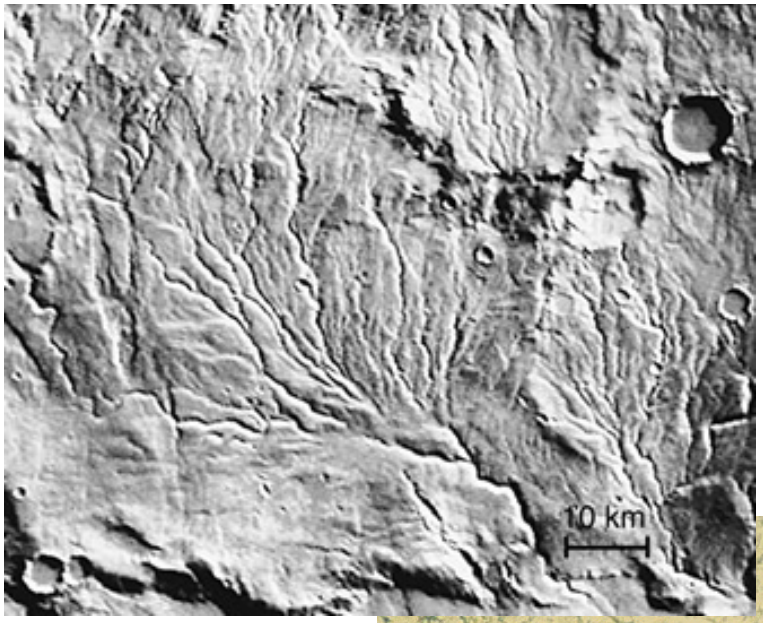
Did Mars ever have life?

How did any life interact with its planetary environment?

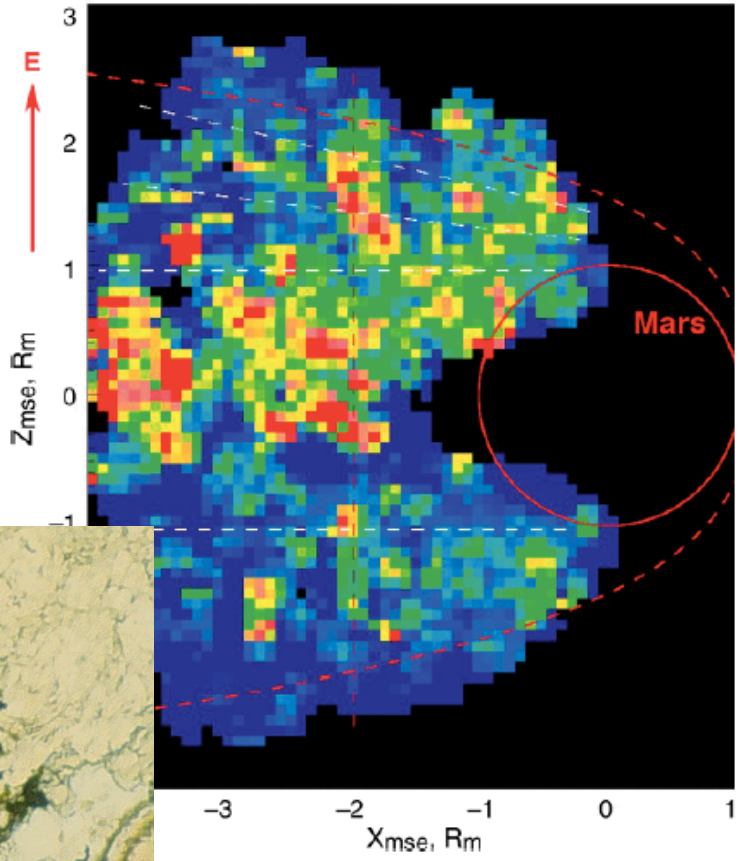
How has the habitability of Mars changed over time?

Evidence for Surface Water on Ancient Mars
Where Did the Water Go? Where Did the CO_2 Go?

Abundant evidence for ancient water

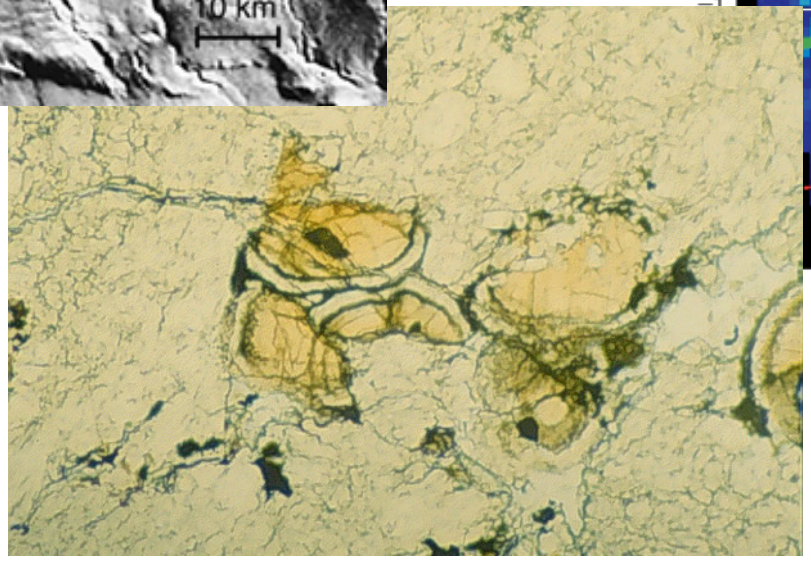


Volatiles can be lost to space



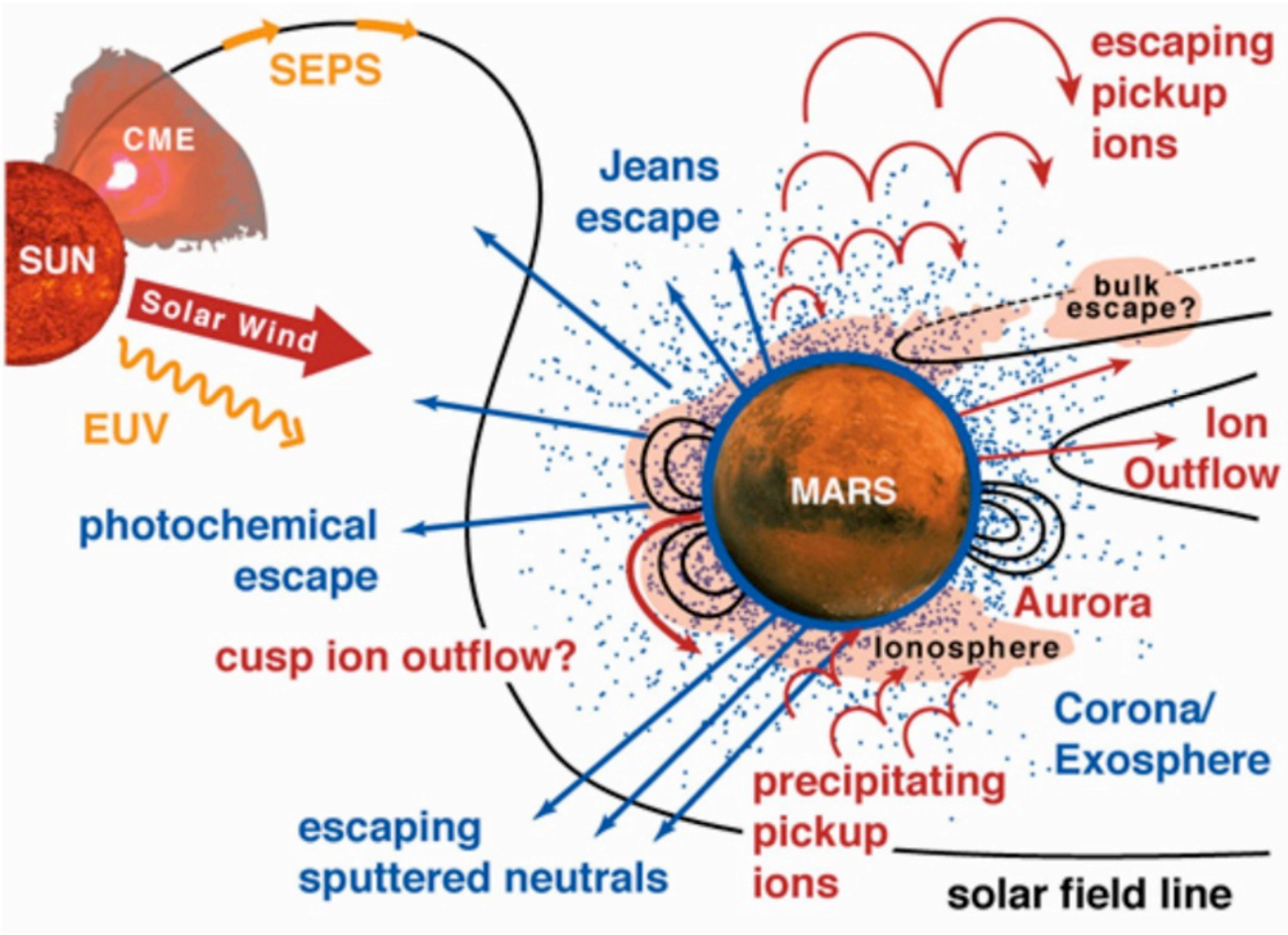
Escaping ions detected from Mars Express

Volatiles can go into the crust



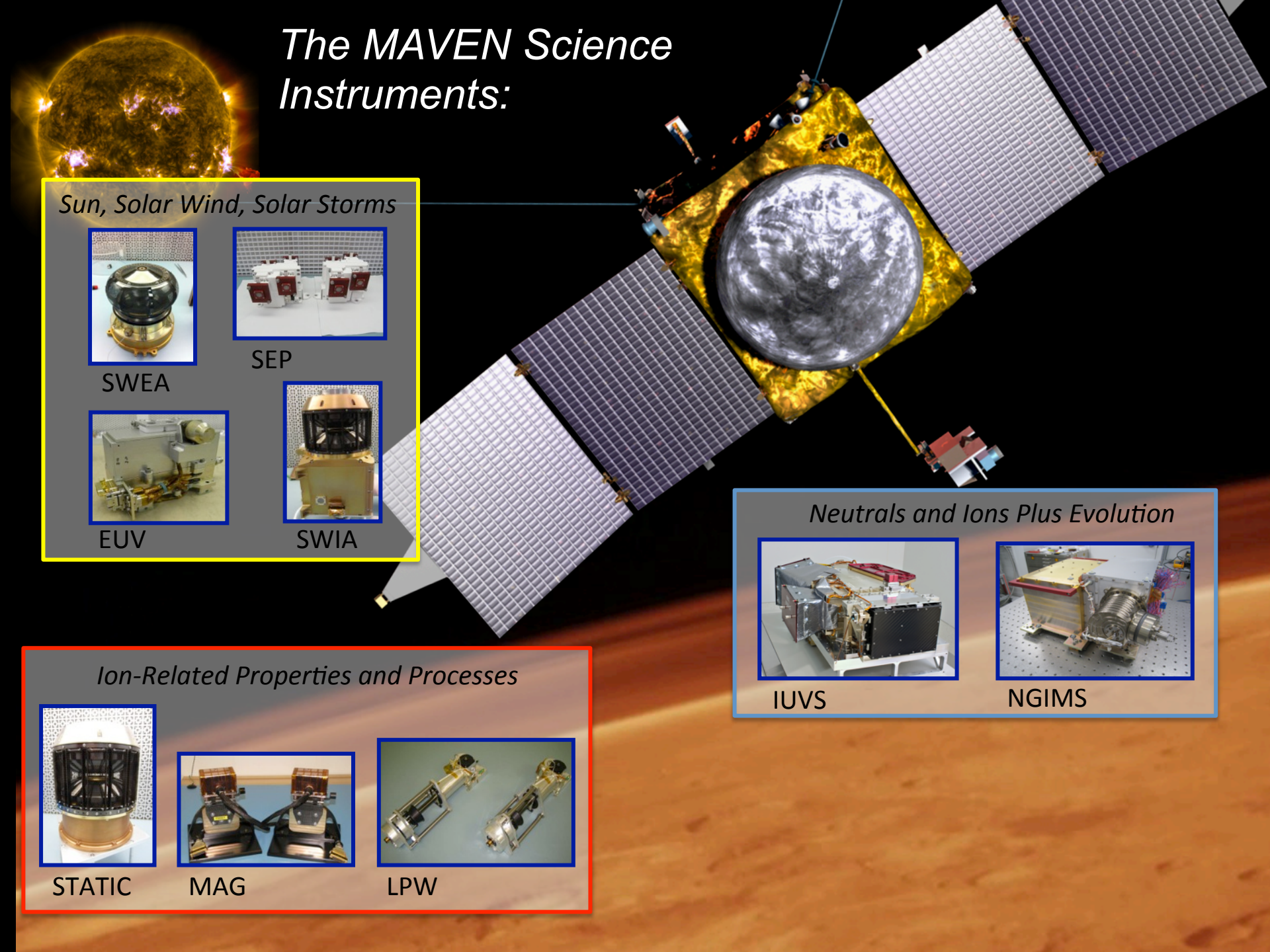
Carbonate deposits in a Martian meteorite

MAVEN Will Allow Us to Understand Escape of Atmospheric Gases to Space



The Solar Wind is Able to Strip Off Gas from the Top of the Atmosphere

The MAVEN Science Instruments:



Sun, Solar Wind, Solar Storms

SWEA

SEP

EUV

SWIA

Neutrals and Ions Plus Evolution

IUVS

NGIMS

Ion-Related Properties and Processes

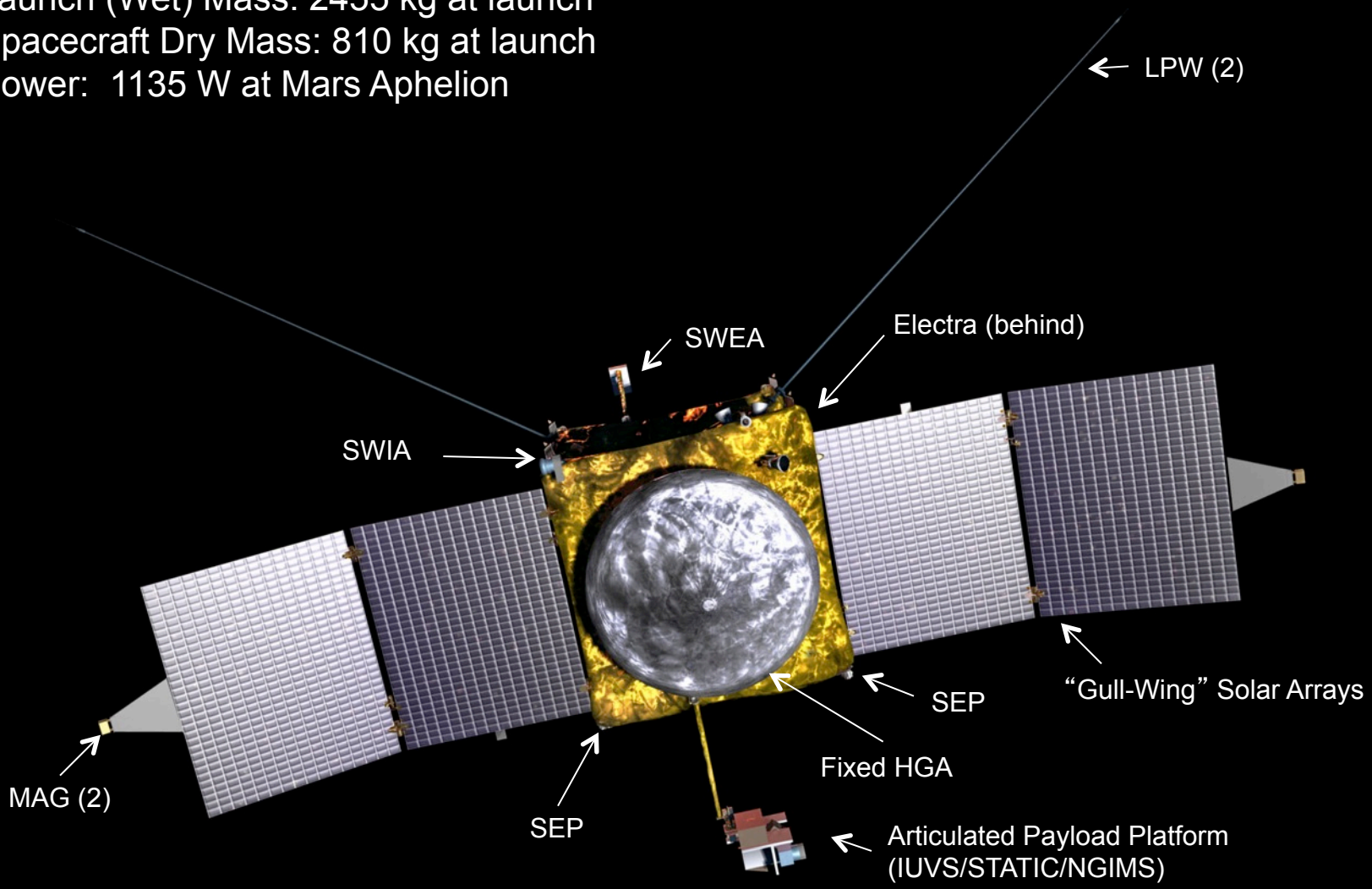
STATIC

MAG

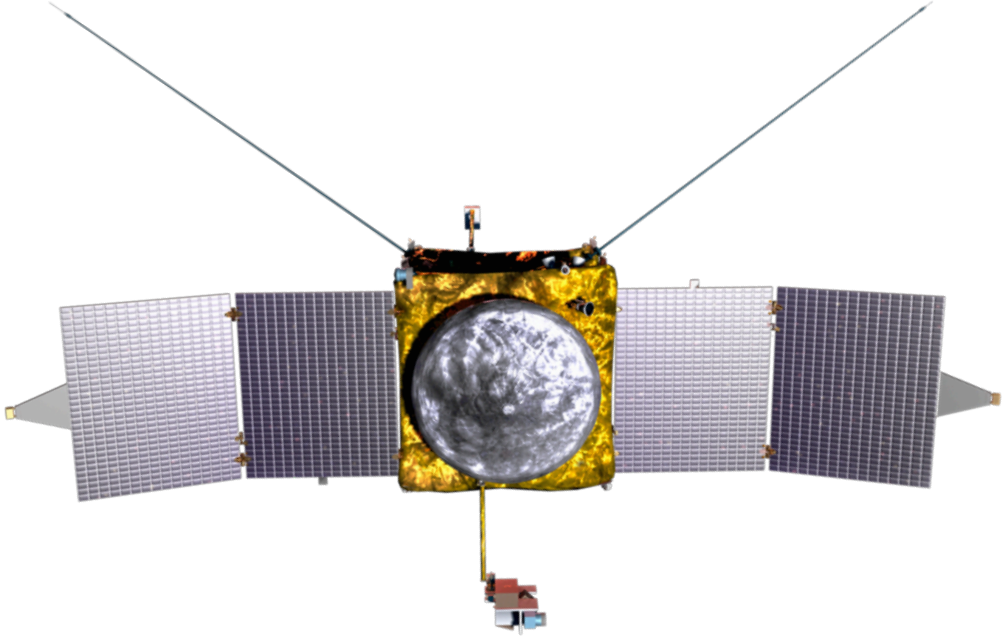
LPW

The MAVEN Spacecraft

- Launch (Wet) Mass: 2455 kg at launch
- Spacecraft Dry Mass: 810 kg at launch
- Power: 1135 W at Mars Aphelion



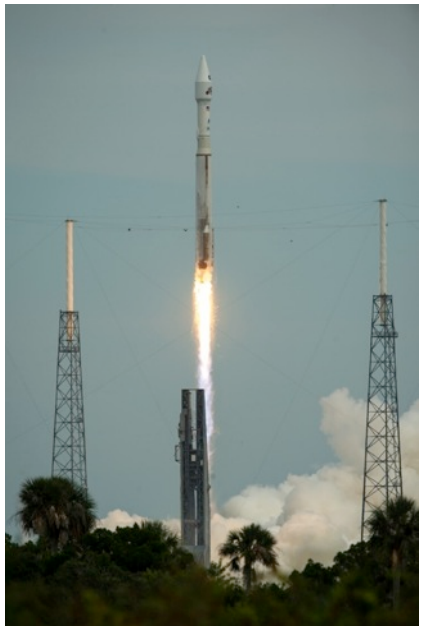
The MAVEN Spacecraft



Same weight fully loaded as a GMC Yukon – 2455 kg.

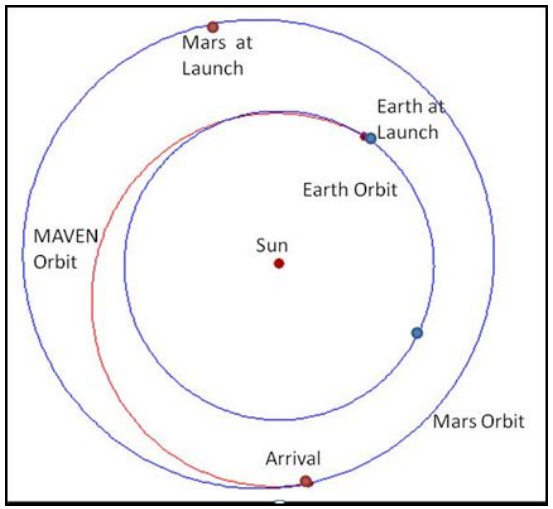
Same length as a school bus – wingtip-to-wingtip length of 37ft.

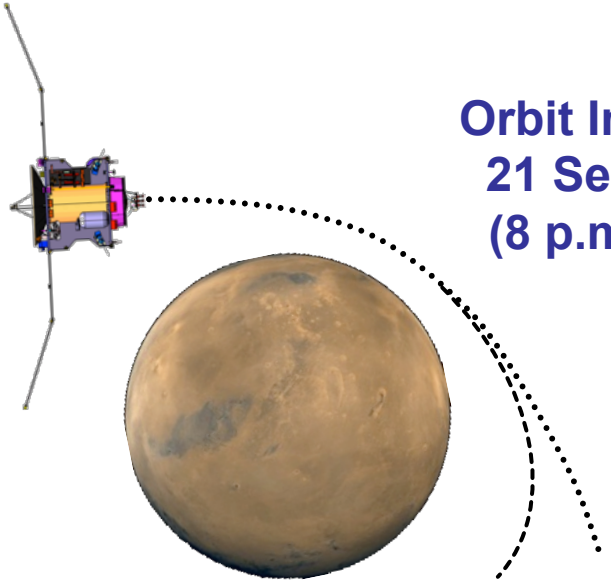
MAVEN Mission Architecture



Launched on 18 Nov. 2013, first day of its 20-day launch period

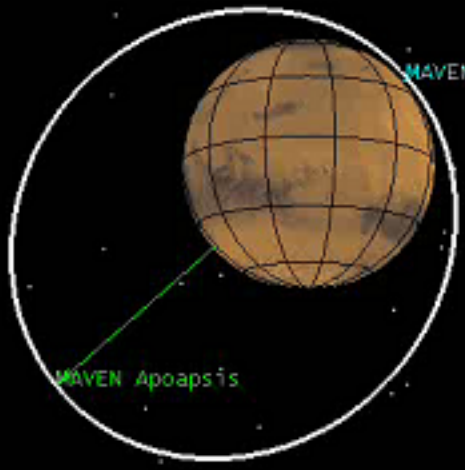
Ten-Month Ballistic Cruise to Mars





Orbit Insertion: 21 Sept 2014 (8 p.m. MDT)

One Year of Science Operations



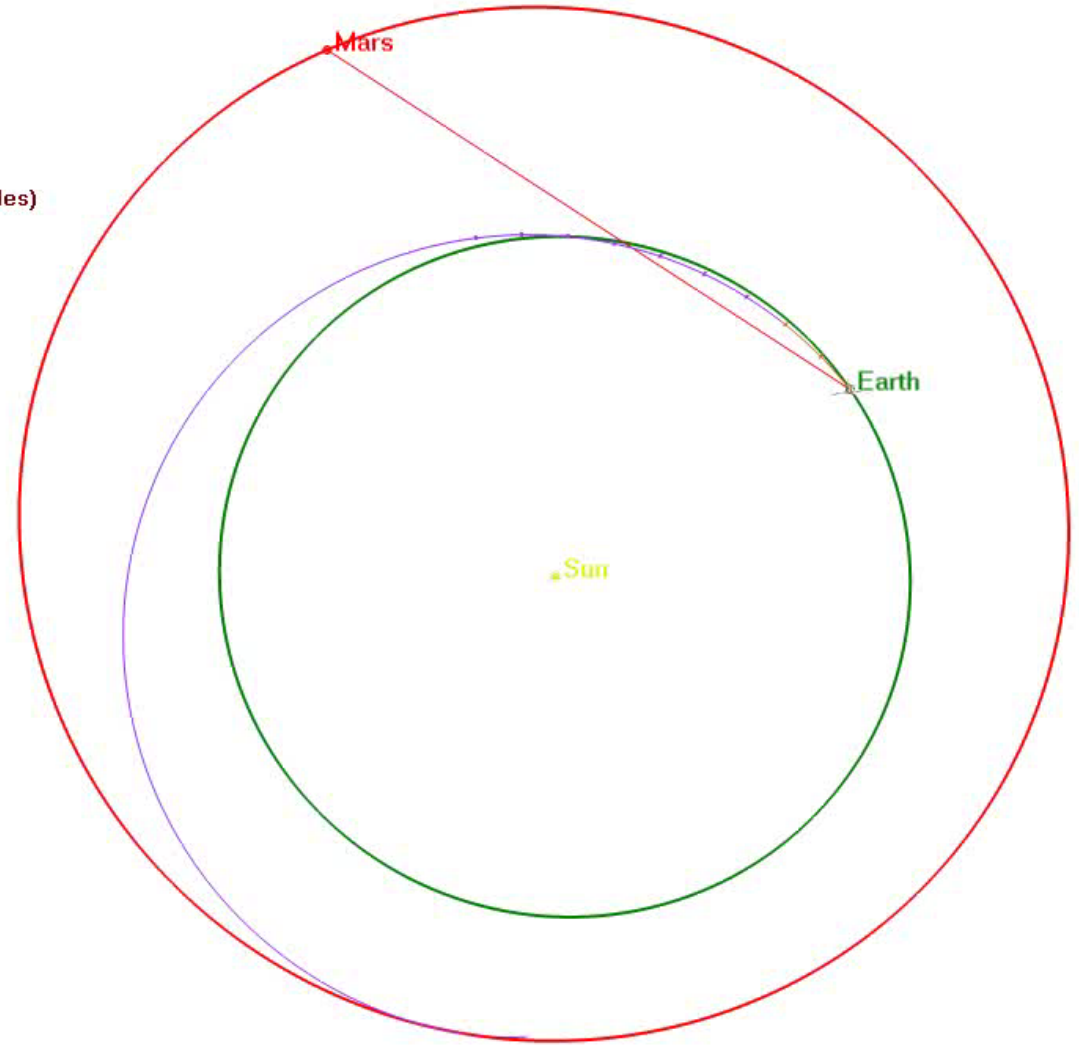
Orbit shown to scale

MAVEN's Path To Mars

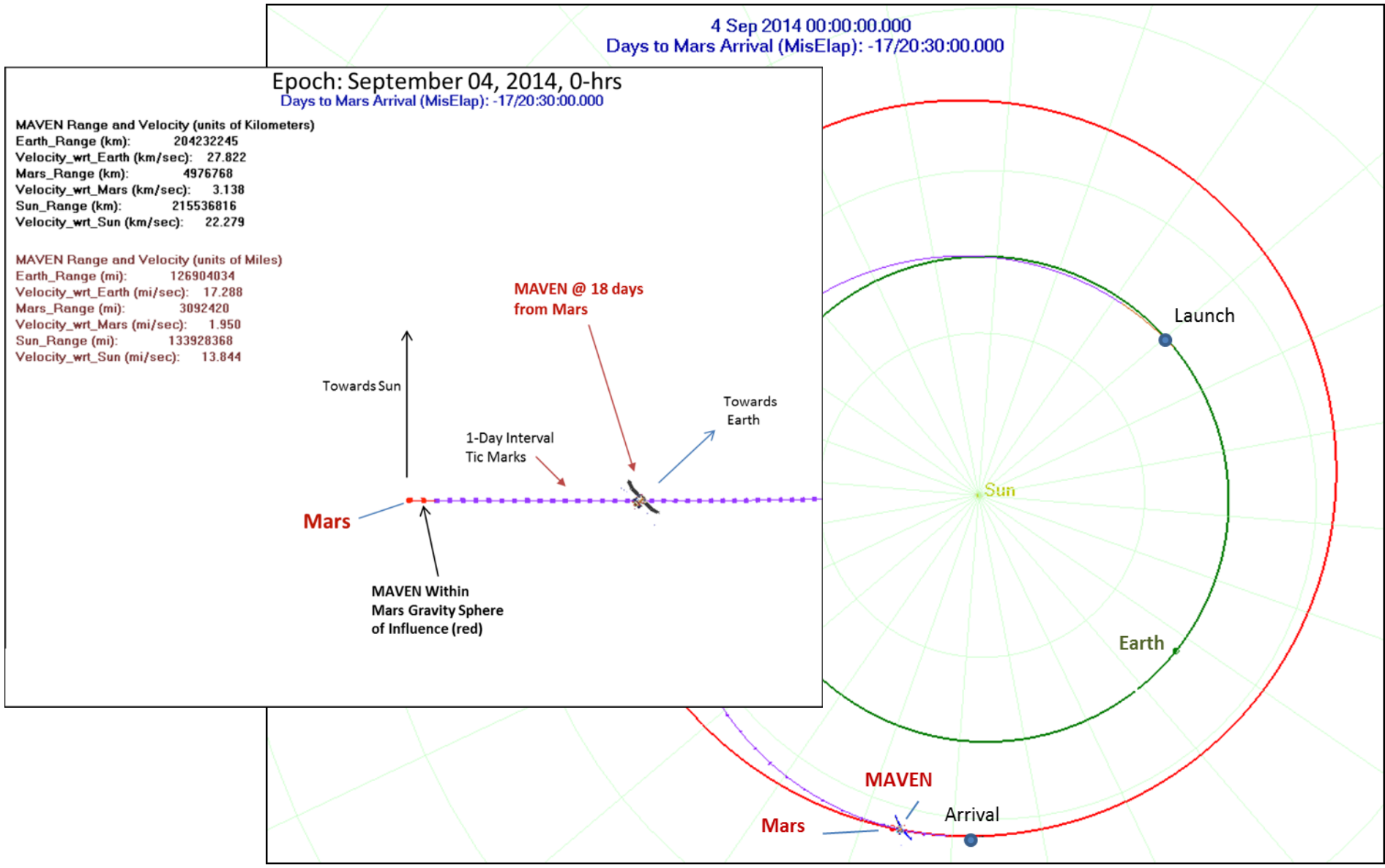
19 Nov 2013 06:30:00.000
Days to Mars Arrival (MisElap): -306/14:00:00.000

MAVEN Range and Velocity (units of Kilometers)
Earth_Range (km): 192293
Velocity_wrt_Earth (km/sec): 4.045
Mars_Range (km): 264525423
Velocity_wrt_Mars (km/sec): 33.724
Sun_Range (km): 147718010
Velocity_wrt_Sun (km/sec): 33.019

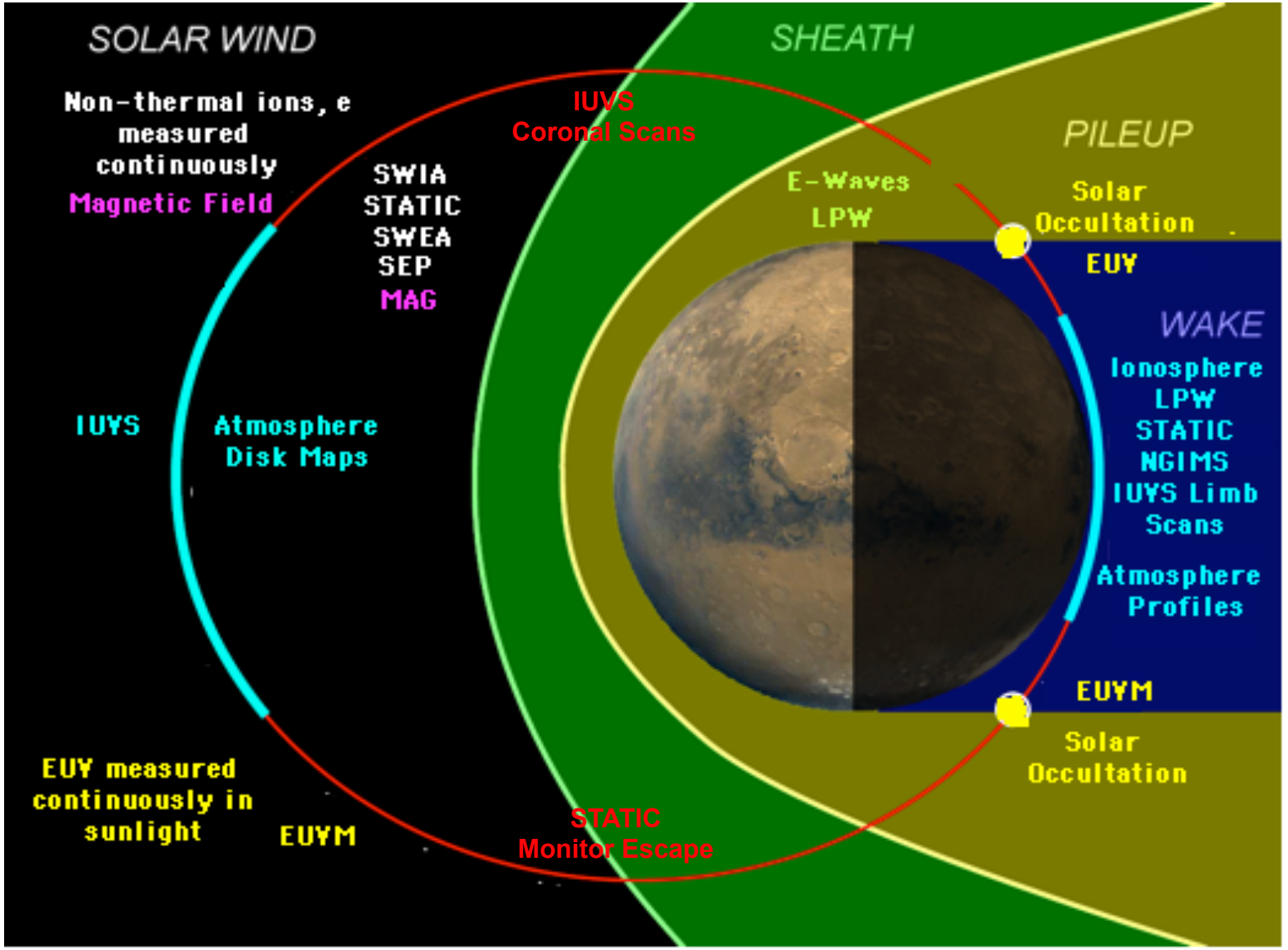
MAVEN Range and Velocity (units of Miles)
Earth_Range (mi): 119485
Velocity_wrt_Earth (mi/sec): 2.513
Mars_Range (mi): 164368478
Velocity_wrt_Mars (mi/sec): 20.955
Sun_Range (mi): 91787716
Velocity_wrt_Sun (mi/sec): 20.517



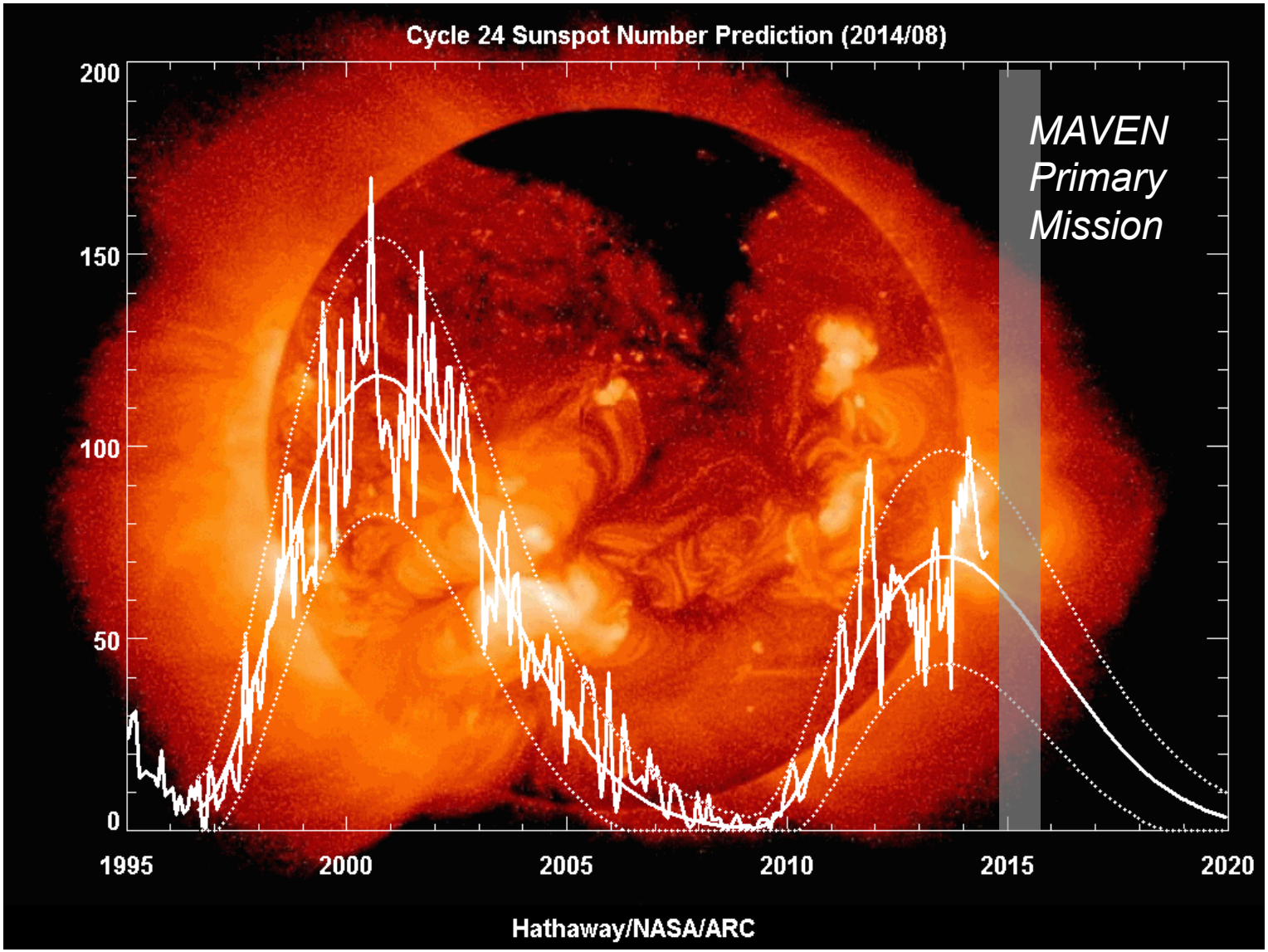
Where Is MAVEN Today?



MAVEN Observes All Regions Of Near-Mars Space Throughout The Orbit



MAVEN's Timing in the Solar Cycle

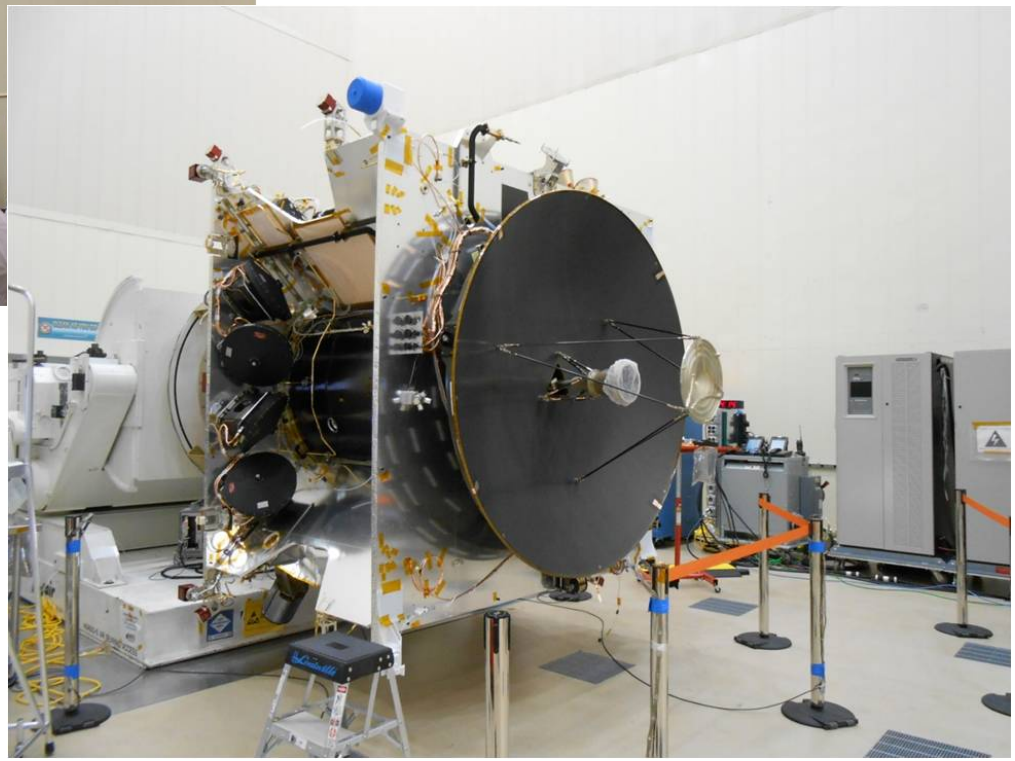


MAVEN's primary mission occurs on the declining phase of the solar cycle, when solar storms are most intense and most abundant.

Proposal, Site Visit, and Presentation at NASA HQ

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

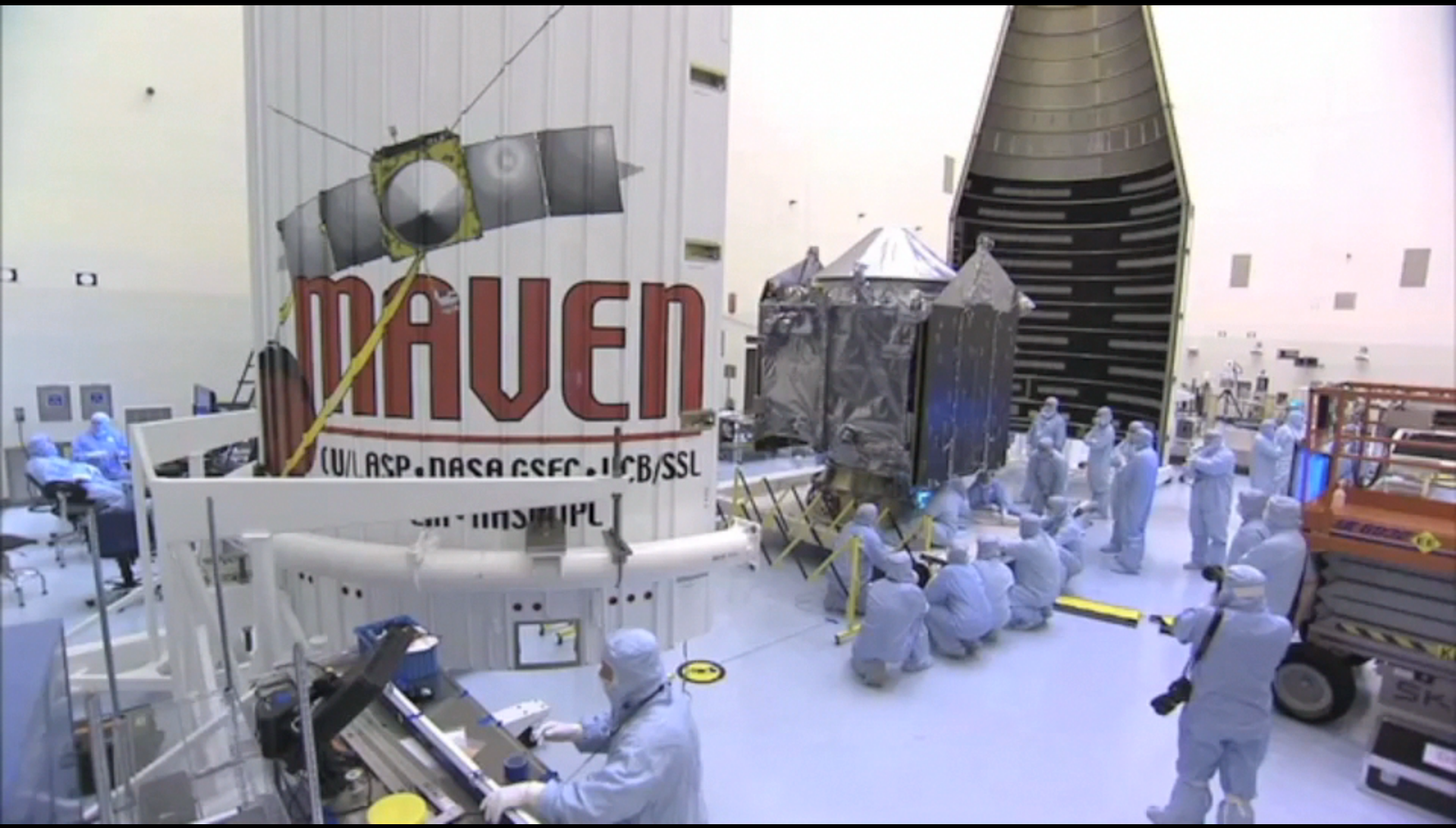
MAVEN Spacecraft Early and Late in Assembly



The Spacecraft Undergoes Final Testing

Starting Its Journey To Mars: From Lockheed Martin To Kennedy Space Center

Getting Ready To Launch



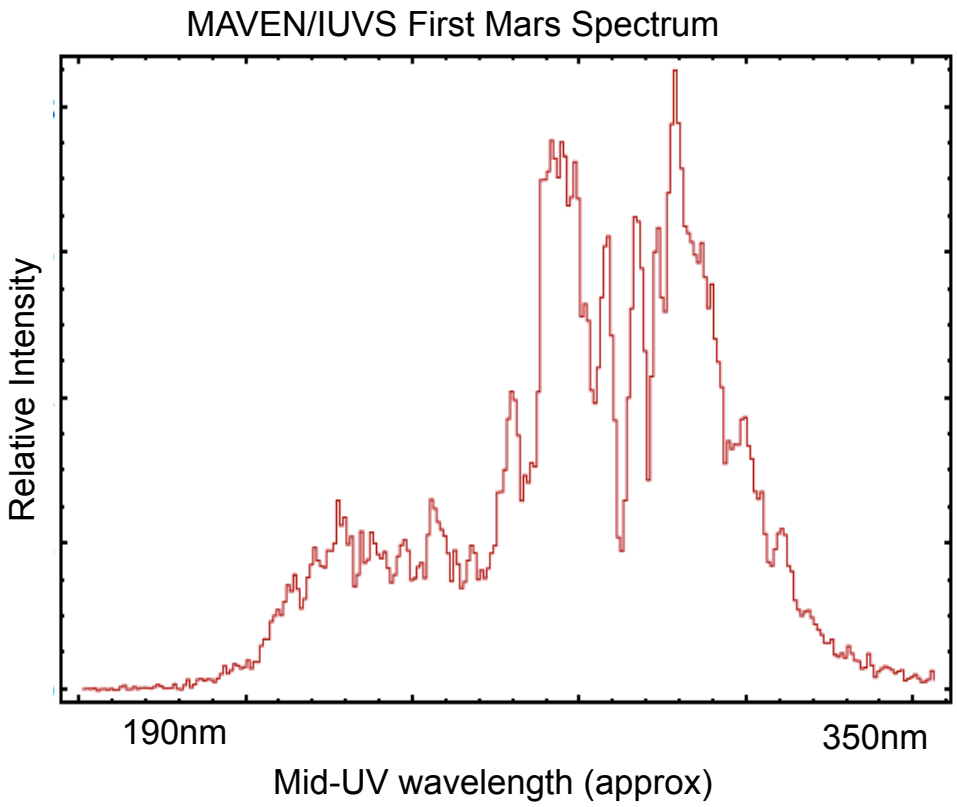
MAVEN Team During Launch Week

Go Atlas, Go Centaur, Go MAVEN!

MAVEN's UltraViolet Imaging Spectrograph (IUVS) Gets Its First View Of Mars

MAVEN
Mars Atmosphere and Volatile Evolution Mission
CU/LASP • GSFC • UCB/SSL • LM • JPL

- IUVS made calibration observations of Mars on 21 May 2014, four months before MOI
- Despite Mars' great distance, IUVS detected the planet and obtained a spectrum of Mars' sunlit disk in the mid-UV range (figure at right).
- Since Mars still appears smaller than a pixel, the spectrum does not yet reveal information about the atmosphere; essentially all spectral features are due to the Sun.

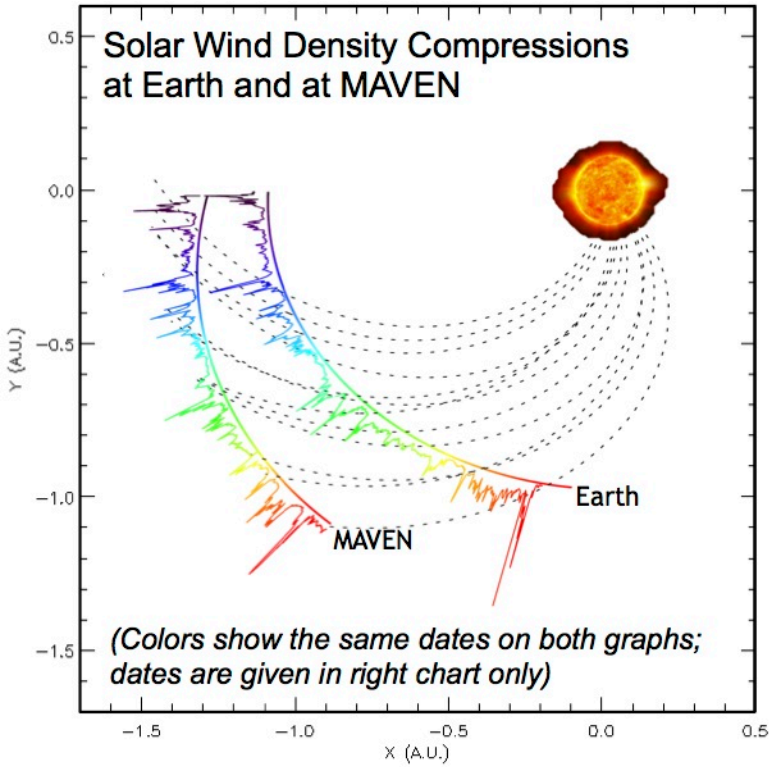


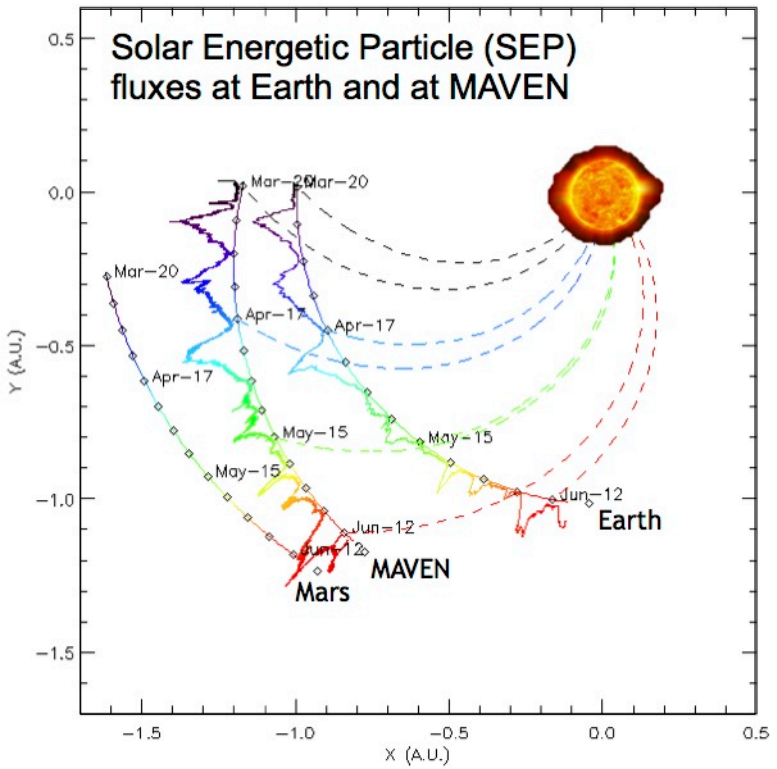
- IUVS' next Mars observations are planned for shortly after MOI; these will be the first data with useful atmospheric information.
- IUVS and spacecraft teams worked very well together to plan and carry out these observations

MAVEN Particles and Fields: Exploring the Solar Wind Beyond 1 A.U.

- MAVEN is exploring propagation of the solar wind and SEPs beyond 1 A.U. during its cruise to Mars.
- Solar wind density compressions from stream interactions and ICMEs (left) and Solar Energetic Particle (SEP) events (right) are seen at the orbits of Earth and MAVEN
- They show the combined effects of radial propagation and solar rotation, and features can be followed along the solar-wind spirals
- MAVEN observations are complementary to near-Earth assets, providing a valuable perspective on the structure of the solar wind.

MAVEN Particles and Fields package has demonstrated its ability to monitor space weather at Mars!





Solar wind data from MAVEN SWIA (J.S. Halekas) and OMNIWeb (N. Papitashvili), SEP fluxes from MAVEN SEP (D. Larson) and ACE EPAM (R. Gold)

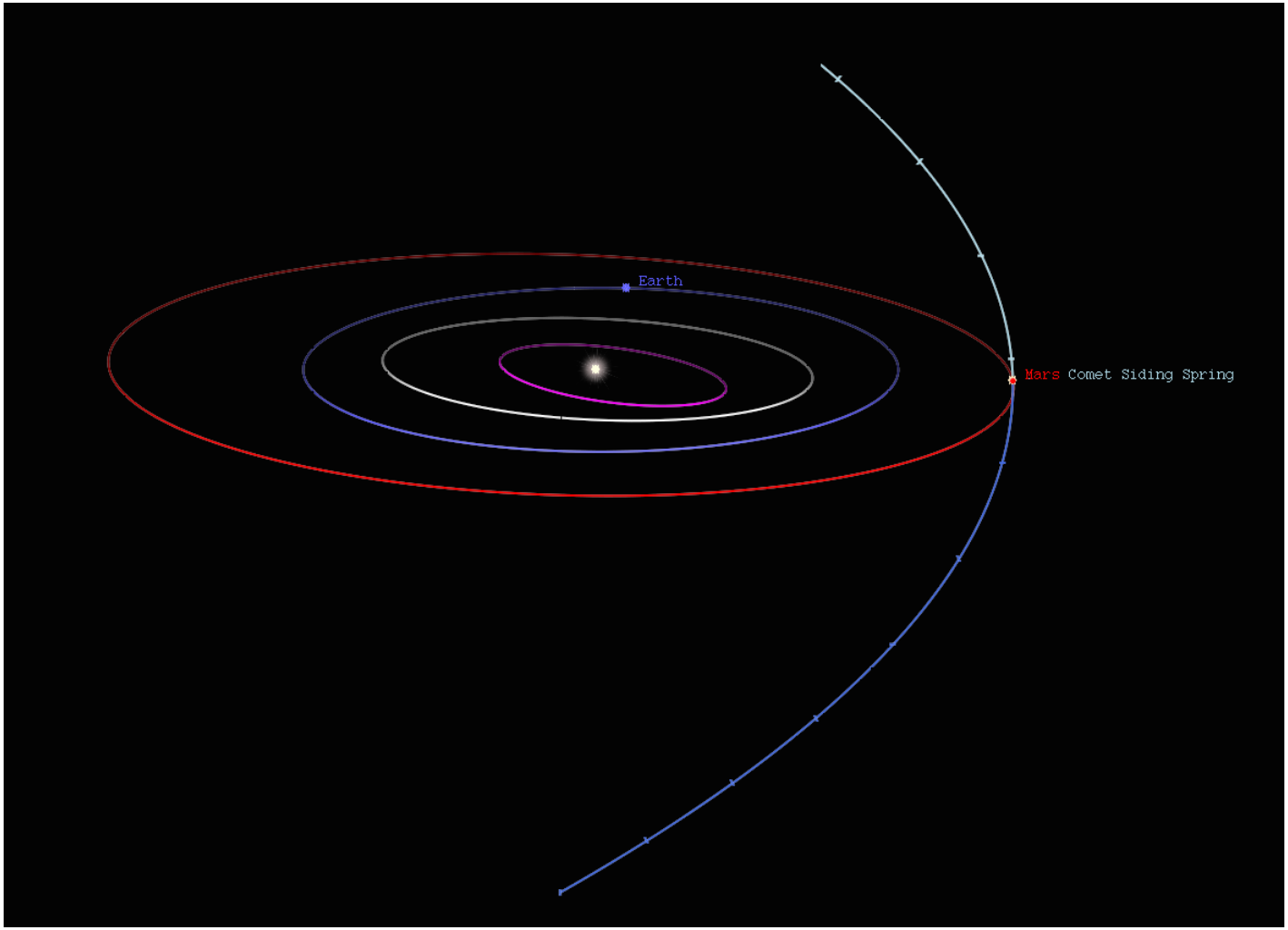
A Bizarre Twist: Comet Siding Spring Encounters Mars

Siding Spring Observatory

NEOWISE Image of C/SS

- Comet C/ 2013 A1 Siding Spring (C/SS) discovered in January 2013
- Long-period comet on first passage from Oort Cloud
- Siding Spring will pass ~132,000 km from Mars on October 19

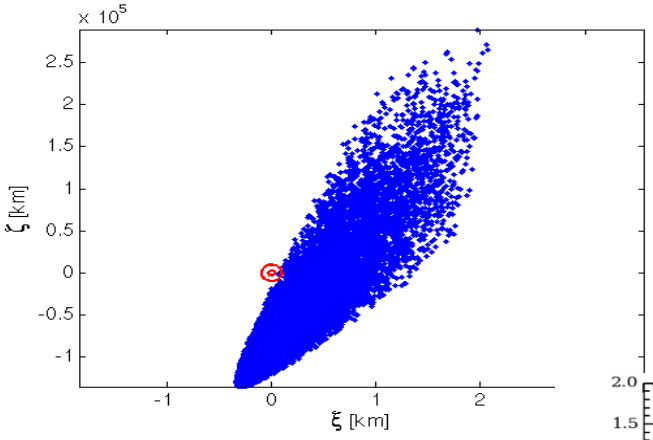
Geometry Of Encounter With Mars



- CSS is in a highly inclined, slightly retrograde orbit
- Any dust from CSS will hit MAVEN and Mars at 56 km/s

Modeling The Dust Environment At MAVEN And Mars

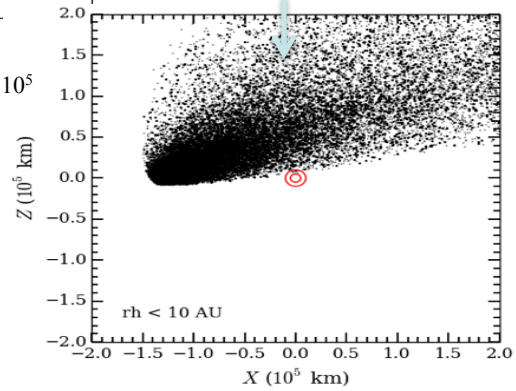
- Dust release from comet and subsequent trajectories can be modeled
- Three groups independently modeled the distribution of dust particles from comet C/ 2013 A1 Siding Spring during its close approach to Mars.

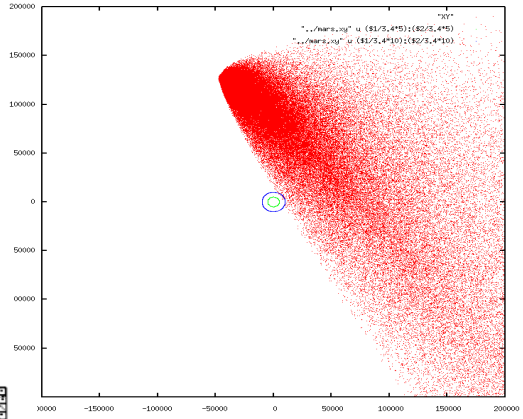


Solar System Dynamics Group
Farnocchia et al.

Note: Calculations are for dust particles > 100 µm diameter

Univ. of Maryland
*T. Farnham, M. Kelley, et al.





PSI
*P. Tricarico et al.

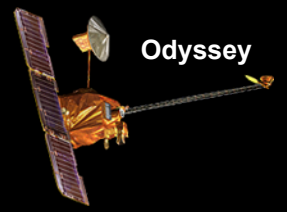
**Supported by the MPO Critical Data Products Program (CDP); report available at* http://mepag.nasa.gov/cdp.cfm

- Mars is at edge of dust cloud – dust may not actually impact spacecraft
- Risk is thought to be relatively small today – comparable to background dust
- MAVEN will take steps to mitigate risk

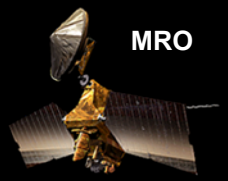
NASA's Mars Exploration Program

Launch Year

Operational / Recent	2009	2011	2013	2016	2018 & Beyond



Odyssey



MRO

Mars Express
Coop

MAVEN

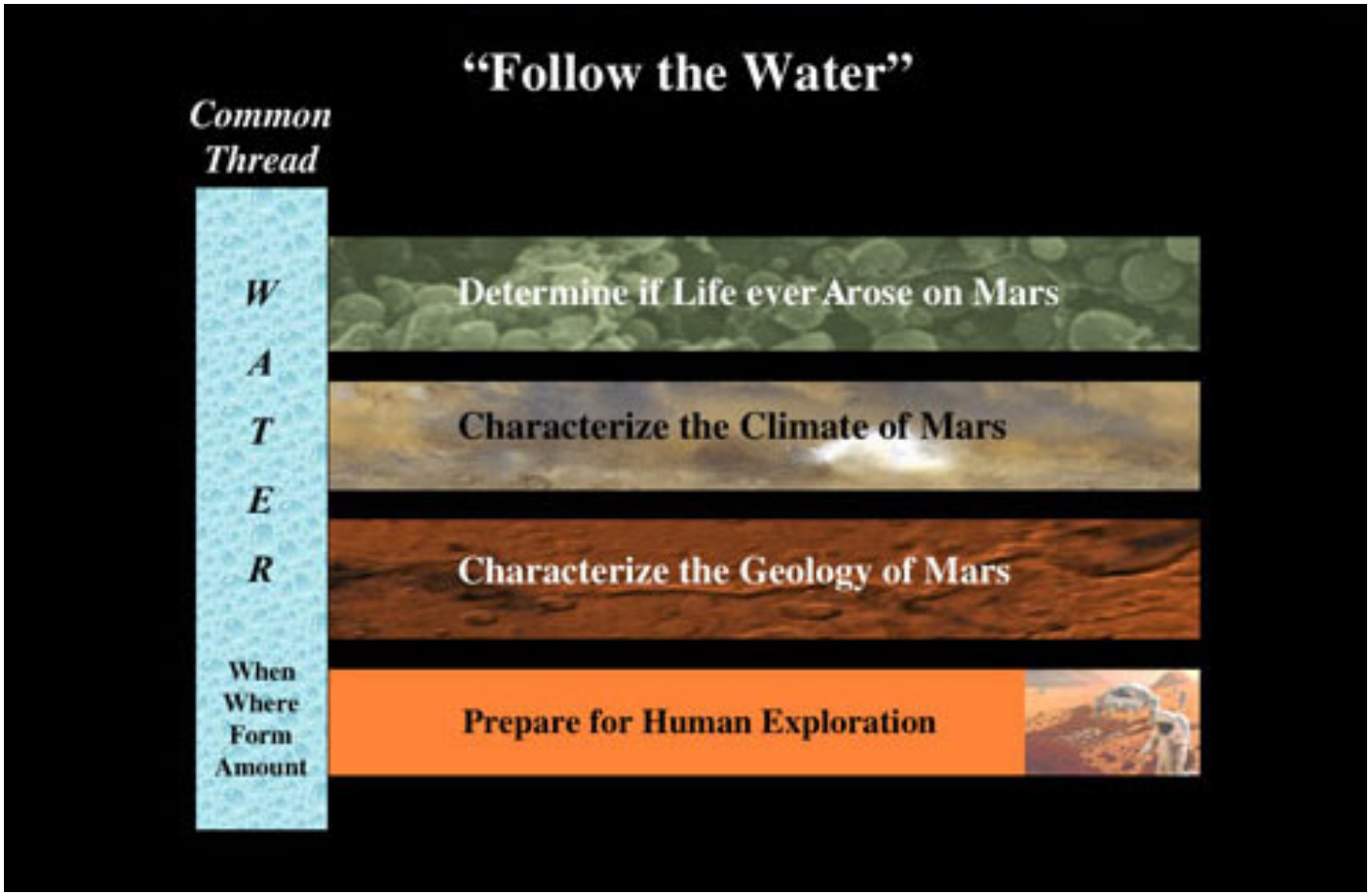
MER

Mars Science Lab

InSight

Mars 2020

MAVEN Will Continue The Successful "Follow The Water" Theme



The MAVEN Team Got Us Here: We Are Ready to Carry Science Operations at Mars!

MAVEN
Mars Atmosphere and Volatile Evolution Mission
CU/LASP • GSFC • UCB/SSL • LM • JPL

- *MAVEN launched on schedule and under budget!*
- *It arrives at Mars this month!*
- *Science mission begins in November!*

Next stop – Mars!

Go MAVEN!

[Continue to follow us on Facebook and Twitter: MAVEN2MARS]