THE 2013 *Mars Atmosphere and Volatile EvolutioN* (*MAVEN*) MISSION TO MARS

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Introduction:

The MAVEN mission will explore the Mars upper atmosphere and ionosphere and its interactions with solar-wind, solar storms, and solar-EUV energy drivers. The goals of the mission are to understand the current structure of the upper atmosphere and ionosphere, the loss rates at the present epoch and the processes that control them, and the integrated loss to space through time. These will allow us to understand the habitability of Mars and how it has changed through time and the history of water. Launch will occur during a three-week launch window beginning November 18, 2013. The primary mission runs for one Earth year beginning in October, 2014. The elliptical orbit will allow measurements to be made at altitudes from the homopause to deep into the hot-atom corona, at various combinations of latitude and local solar time, thereby mapping out the behavior in three-dimensional near-Mars space. The payload includes (i) a Particles and Fields package that measures the magnetic field, solar energetic particles, ionosphere properties, solar-wind properties, energetic ions, and incoming solar EUV, (ii) a Remote-Sensing package that contains an imaging ultraviolet spectrometer that can map ion and neutral properties, measure D/H, and determine H and D escape, and (iii) a mass spectrometer package to look at thermal neutrals and ions. The project currently has just completed its preliminary design phase.

Science Drivers:

There is clear and compelling evidence of climate change having occurred on Mars. Early Mars had more, and more stable, liquid water, and there was a transition to the colder and drier atmosphere that we see today. The best explanation for the early atmosphere is warmer temperatures resulting from greenhouse warming, and the best explanation for the transition is loss of a thick CO_2 atmosphere. The CO_2 could have been lost to the ground, where it would have formed carbonate minerals. Although carbonates have been identified, there does not appear to be enough to account for an early thick atmosphere. CO_2 also could have been lost to space. There is compelling evidence for loss to space having occurred, including isotopic evidence for loss and direct observation of gas being lost at the present epoch. Theoretical models of the loss process suggest that loss to space may have been the dominant mechanism for loss of the early atmosphere. However, the models are very poorly constrained due to the lack of measurements.

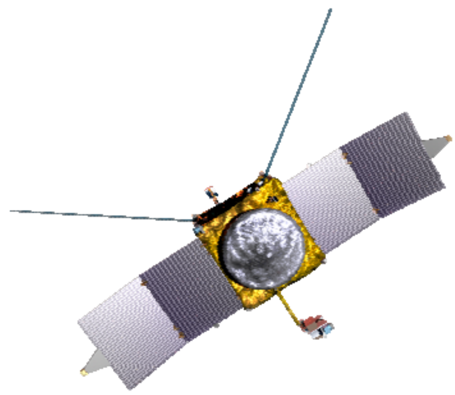
The upper atmosphere can act as a conduit through which the gases flow as they are lost to space. The loss processes themselves act instantaneously, on diurnal timescales, on seasonal timescales, and on longer timescales. Thus, it is important to understand the behavior of the upper atmosphere and how it connects to the lower atmosphere.

In this context, the MAVEN mission is designed to understand the nature of the upper atmosphere as the conduit through which gases move as they are lost to space and to understand the nature of the processes by which gases are lost at the present. By measuring the response of these to changing solar inputs over the course of the mission, and by measuring key aspects of the atmosphere today, we can extrapolate the loss to billion-year timescales and determine the role that loss to space has played through time.

Understanding the relationship between the lower and upper atmospheres, on timescales of a day, a year, and longer, is necessary in order to understand the Mars atmosphere as a whole.

Current Status:

The MAVEN mission has recently been confirmed, has started into Phases C/D, and as of this writing is just under three years from launch. The Critical Design Review (CDR) will take place in July 2011, and will be followed by the building, assembly, and test of the individual instruments and spacecraft components, and the final assembly, test, and launch operations.



Artist's rendition of the MAVEN spacecraft in its on-orbit configuration. Instruments are mounted on the body, on the extensions at the end of the solar arrays, on three booms on the top of the spacecraft, and on an articulated payload platform on the bottom. The body-mounted high-gain antenna, seen in the middle, is 2 m across.