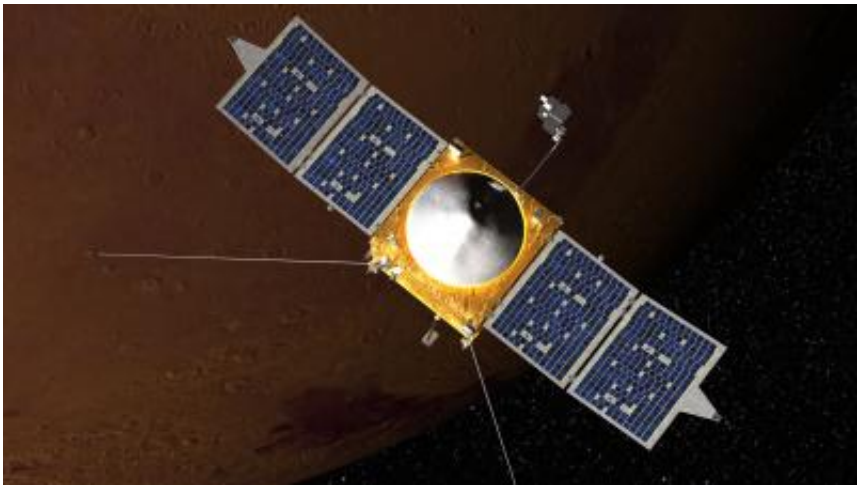
MAVEN spectrometer opens window to Red Planet's past

July 18 2013



This is an artist's concept of the MAVEN spacecraft. Credit: NASA's Goddard Space Flight Center

When NASA's MAVEN mission begins its journey to the Red Planet later this year, it will be equipped with a special instrument to take the planet back in time.

That instrument is the Neutral Gas and Ion Mass Spectrometer, a network of electrically charged rods that will measure the charged gas particles—or ions—making up Mars' upper atmosphere.

Designed and developed at NASA's Goddard Space Flight Center in Greenbelt, Md., the state-of-the-art instrument will launch aboard

MAVEN, short for Mars Atmosphere and Volatile Evolution, in November. Once at Mars, the spectrometer will collect data on the ions above the Red Planet.

"The data could be used to build models showing how Mars has lost the majority of its atmosphere, a phenomenon that continues to be one of the planet's greatest mysteries," said Paul Mahaffy, the spectrometer's principal investigator from Goddard.

Once the MAVEN spacecraft launches, the team would apply radio frequency and electrical voltages to the instrument's four metal cylinders, or quadrupole rods.

Each specific voltage isolates ions based on their specific mass. This allows the instrument to build a profile, known as a mass spectrum, of all the different gas particles present in the Martian atmosphere.

"We're basically sorting ions by mass," Mahaffy said.

Besides measuring the ions already present in the atmosphere, the instrument could also create ions from neutral gas molecules. An electron gun will fire a beam of electrons, breaking the gas molecules into smaller, charged particles. By doing this, the instrument can collect information on all of the gas particles, both neutral and charged, in the upper atmosphere.

"Our part of the overall mission is to measure the neutral and ion composition of the atmosphere," Mahaffy said. "We're measuring ions that are already there and those that are created."

The instrument will measure the composition of the current atmosphere and how variables like time of day change the gas particles over time. This critical information can then be used to build simulations of both

the current Martian atmosphere and the atmosphere billions of years ago.

"What we're doing is measuring the composition of the atmosphere as a measure of latitude, longitude, time of day and solar activities," Mahaffy said. "We're trying to understand over billions of years how the atmosphere has been lost."

While it's unknown why Mars has lost most of its atmosphere, scientists point to solar wind for stripping it. The planet itself lacks a global magnetic field, which typically protects planets like Earth from solar wind, maintaining the atmosphere.

If the models can accurately portray the Martian atmosphere billions of years ago, scientists might be able to answer critical questions like whether the atmosphere was once substantial enough to sustain liquid water on its surface and support life. Currently, the planet is barren and below freezing, with much of its water seen near the surface as ice.

"The big question is can the models help us understand the atmosphere back in time," Mahaffy said. "This is another part of the puzzle in understanding what [the] atmosphere is like that's intended to be solved by the MAVEN mission."

The spectrometer instrument, known by the acronym "NGIMS," will be located on a platform below the spacecraft, keeping it away from its own gases and allowing it to face different directions. It will collect data when MAVEN is between about 93 and 311 miles (150 and 500 kilometers) above the planet, storing it in the spacecraft's memory bank for several days before it's transmitted to NASA's Deep Space Network satellites around the globe.

In addition to providing important information on its own, NGIMS would complement other instruments aboard, specifically the Imaging

Ultraviolet Spectrometer, which would also measure gas composition.

"Both instruments get composition of the atmosphere and how it changes based on variables," Mahaffy said. "Not only do the different instruments get different species, but we measure at different locations, and that's really helpful for understanding what the atmosphere is doing."

NGIMS electrical lead Florence Tan said the information the instrument is trying to find supports mankind's desire to determine if Earth is the only planet supporting life.

"The question of why only Earth to me is the big science question," Tan said. "Mars is a close neighbor, so we look at it from the point of view of finding organisms on Earth living in extreme conditions."

The instrument promises to collect a lot of exciting data.

"It is one step in getting to a really big question, which is, 'Are we alone in the universe?" Mahaffy said. "MAVEN is one step in that program for understanding life on early Mars, and we'll try to do everything we can to understand it."

Provided by NASA's Goddard Space Flight Center