MAVEN: NASA's Next Mission to Mars

MAVEN Presentation at the Smithsonian National Air and Space Museum

Transcript

(Music) (Music) Bruce Jakosky: I want to start my story with this picture not of the Earth but of an early Mars. We know that Mars had a thicker atmosphere, was warmer, a much wetter environment than we see today. Because we see crater lakes on the surface, ancient lakes, valley networks that were carved by by liquid water. Over time though, the environment changed. Today, we see a much colder, dryer desert and we have to ask, "What's responsible for that change?" On early Mars we think that there was a lot more water. We think that the atmosphere was a thick CO2, carbon dioxide atmosphere that somehow changed over time, that Mars has undergone significant climate change. Where did the water go? Where did the carbon dioxide go? It might have gone down into the crust where it can be locked up as minerals or as ice, or it might have gone up to the top of the atmosphere and been lost to space. That latter option is the one that MAVEN is going to be exploring. Looking at the role that loss to space may have played in the changing Mars climate. We think that this loss to space was driven by the sun, by the solar wind hitting the planet by solar storms that eject out from the sun, hitting the planet, and stripping the atmosphere of. So we have to start with the sun. When we look here at the quiet sun we don't see the solar winds streaming out, out beyond that corona though it's going out at 500-1000 kilometers per second. And when it hits Mars it has the possibility of stripping some of the gas off. The more energetic sun is much more interesting though, the solar wind is more intense, the solar storms that you can see here, are more intense, and the ability to strip off the gas is more significant. We're going to measure the properties of the sunlight hitting the planet, the solar wind, and the response of the atmosphere. When these solar storms eject from the sun and head out through the solar system, seen here in this artist's representation, we want to know what effects they can have when they get to Mars. And when they do, we can see here in a representation from observations from spacecrafts spread throughout the solar system that they can hit Mars, they can have a significant effect. We know these storms happen, we need to see what happens when they get to Mars. So we're going to study the upper atmosphere which is the place form which gas is removed. And this image shows a representation of the upper atmosphere and what might happen when the solar wind hits it. The arrows represent streamlines; the colors represent the top of the atmosphere being stripped off by the solar wind when it hits the planet. That was to my mind was such a cool video I want to show this again, because I had to talk through the first time. When we see the atmosphere and the solar wind hitting it, it strips the gas off, and over geologic time that may have been responsible for changing the atmosphere, for driving the climate change that we see evidence for at Mars. We're going to do this now with the MAVEN spacecraft. It's a solar powered spacecraft. That bus in the middle, that almost cube like thing is about 7 feet across, to give you a sense of the scale. Most of the instruments are mounted around the edge of the high gain antenna seen in the middle, because they want to look at the sun in order to capture the solar wind, the solar particles that hit it. And then at the bottom and the top are the instruments that measure the properties of the upper atmosphere. The ones at the bottom measure it in situ, at the location of the spacecraft. The ones at the top measure it both in situ and remotely, so we can get a global picture of what's happening with the Mars upper atmosphere today and how escape to space occurs. We've just

finished building the spacecraft, unfortunately we're not really flying 4 of them, this just shows it at different steps. And fortunately they were more careful in building it than moving as fast as they are here. The spacecraft was built by Lockheed Martin in Denver, and I have to say they've provided us with what looks like it's going to be a honey of a spacecraft. Once it was built it goes into testing. Here we're seeing the deployment test of the solar arrays. We want to make sure that everything that the spacecraft is going to experience and do, it does on Earth. It experiences on Earth first, because we want to make sure it works. One of the most exciting tests is what's called thermal vacuum testing. We put it in a large chamber, you'll see it going in in just a minute, and pump it down to vacuum and put it through its paces. MAVEN spent 3 weeks in thermal vacuum testing, going through everything it's going to do once it's in orbit at Mars. The science instruments were cycled. The platform that holds them was moved. The spacecraft thought it was in orbit around Mars, again they didn't really move it this fast. They took a lot of care with it. You can imagine dropping it would not be a good thing. Once the testing was complete at the beginning of August, just a month and a half ago we shipped the whole thing down to Cape Canaveral, in Florida, that's where we're going to launch it from. We started off by driving it in a truck, in this big shipping container out to Buckley Air Force Base. Put it on a C-17, Air Force cargo jet and flew it down to Florida. Here in the C-17, it was so cool to me to ride along with it and just accompany it on the start of its trip to Mars. The launch vehicle, an Atlas V, is now at the Cape. It was delivered at the end of August and now we're in the process of integrating it all together. This isn't ours on the pad, but ours is going to look a lot like this. On November 18, we're going to launch into space, we have a 10-month cruise phase to get to Mars. We go into orbit with a rocket motor burn for 38 minutes. It takes us about a month then to commission the spacecraft; deploy the booms, test all the instruments, make sure everything is working right, and then we can begin our 1 Earth year science mission. In that year, we anticipate seeing enough variability of the solar input, of the solar wind input, of the solar energetic storms, to really understand what effects they have on the atmosphere. What this is going to do is going to tell us, coming back to the science now, "Where did that water go?" Where did the carbon dioxide go, from that early thick, warm wet environment? And this really isn't just about Mars, it's telling us about the evolution of the habitability of a planet by microbes. What is it that causes a planet to be habitable? And what is it that makes it not habitable? That's what MAVEN is going to be exploring. I hope you guys are going to see this with us. Thank you. (clapping) (music) (beeping) (beeping)