

A satellite is shown in orbit above the Earth's horizon. The satellite has a white parabolic dish antenna and solar panels. The text 'MMVV EN' is overlaid in a stylized, red-to-black gradient font.

MMVV EN

11.18.13

1
00:00:08,360 --> 00:00:04,170
(Music)

2
00:00:08,380 --> 00:00:12,540
Bruce Jakosky: I want to start my story with this picture not

3
00:00:12,560 --> 00:00:16,710
of the Earth but of an early Mars. We know that

4
00:00:16,730 --> 00:00:20,890
Mars had a thicker atmosphere, was warmer, a much wetter environment

5
00:00:20,910 --> 00:00:25,040
than we see today. Because we see crater lakes

6
00:00:25,060 --> 00:00:29,060
on the surface, ancient lakes, valley networks that were carved by

7
00:00:29,080 --> 00:00:33,100
by liquid water. Over time though, the environment

8
00:00:33,120 --> 00:00:37,220
changed. Today, we see a much colder, dryer desert

9
00:00:37,240 --> 00:00:41,330
and we have to ask, "What's responsible for that change?" On early Mars

10
00:00:41,350 --> 00:00:45,400
we think that there was a lot more water. We think that the atmosphere was

11
00:00:45,420 --> 00:00:49,460
a thick CO₂, carbon dioxide atmosphere that

12
00:00:49,480 --> 00:00:53,490
somehow changed over time, that Mars has undergone significant climate change.

13
00:00:53,510 --> 00:00:57,670

Where did the water go? Where did the carbon dioxide go?

14

00:00:57,690 --> 00:01:01,850

It might have gone down into the crust where it can be locked up as

15

00:01:01,870 --> 00:01:06,020

minerals or as ice, or it might have gone up to the top of the atmosphere and been

16

00:01:06,040 --> 00:01:10,200

lost to space. That latter option is the one that MAVEN is going to be

17

00:01:10,220 --> 00:01:14,210

exploring. Looking at the role that loss to space may have

18

00:01:14,230 --> 00:01:18,370

played in the changing Mars climate. We think that this loss to space was

19

00:01:18,390 --> 00:01:22,510

driven by the Sun, by the solar wind hitting the planet

20

00:01:22,530 --> 00:01:26,630

by solar storms that eject out from the Sun hitting

21

00:01:26,650 --> 00:01:30,640

the planet, and stripping the atmosphere off. So we have to start with

22

00:01:30,660 --> 00:01:34,720

the Sun. When we look here at the quiet Sun we don't see the

23

00:01:34,740 --> 00:01:38,780

solar winds streaming out, out beyond that corona though it's going out

24

00:01:38,800 --> 00:01:42,820

at 500-1000 kilometers per second. And when it hits Mars

25

00:01:42,840 --> 00:01:46,850

it has the possibility of stripping some of the gas off.

26

00:01:46,870 --> 00:01:51,020

The more energetic Sun is much more interesting though, the

27

00:01:51,040 --> 00:01:55,210

solar wind is more intense, the solar storms that you can see here,

28

00:01:55,230 --> 00:01:59,260

are more intense, and the ability to strip off the gas is more

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00:01:59,280 --> 00:02:03,430

significant. We're going to measure the properties of the sunlight

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00:02:03,450 --> 00:02:07,450

hitting the planet, the solar wind, and the response of the atmosphere.

31

00:02:07,470 --> 00:02:11,600

When these solar storms eject from the Sun and head out

32

00:02:11,620 --> 00:02:15,730

through the solar system, seen here in this artist's representation,

33

00:02:15,750 --> 00:02:19,780

we want to know what effects they can have when they get to Mars. And when they

34

00:02:19,800 --> 00:02:23,840

do, we can see here in a representation from

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00:02:23,860 --> 00:02:27,890

observations from spacecrafts spread throughout the solar system

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00:02:27,910 --> 00:02:31,910

that they can hit Mars, they can have a significant effect.

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00:02:31,930 --> 00:02:35,960

We know these storms happen, we need to see what happens when they get to

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00:02:35,980 --> 00:02:40,140

Mars. So we're going to study the upper atmosphere which is the place from which

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00:02:40,160 --> 00:02:44,170

gas is removed. And this image shows a representation

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00:02:44,190 --> 00:02:48,370

of the upper atmosphere and what might happen when the solar wind hits it.

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00:02:48,390 --> 00:02:52,540

The arrows represent streamlines; the colors represent the top of the

42

00:02:52,560 --> 00:02:56,700

atmosphere being stripped off by the solar wind when it hits the planet.

43

00:02:56,720 --> 00:03:00,840

That was to my mind was such a cool video I want to show this

44

00:03:00,860 --> 00:03:04,950

again, because I had to talk through the first time. When we

45

00:03:04,970 --> 00:03:09,000

see the atmosphere and the solar wind hitting it,

46

00:03:09,020 --> 00:03:13,090

it strips the gas off, and over geologic time that may have been

47

00:03:13,110 --> 00:03:17,140

responsible for changing the atmosphere, for

48

00:03:17,160 --> 00:03:21,180

driving the climate change that we see evidence for at Mars.

49

00:03:21,200 --> 00:03:25,210

We're going to do this now with the MAVEN spacecraft. It's a solar powered

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00:03:25,230 --> 00:03:29,380

spacecraft. That bus in the middle, that almost cube like thing

51

00:03:29,400 --> 00:03:33,530

is about 7 feet across, to give you a sense of the scale. Most of the instruments

52

00:03:33,550 --> 00:03:37,670

are mounted around the edge of the high gain antenna

53

00:03:37,690 --> 00:03:41,800

seen in the middle, because they want to look at the Sun in order to capture the solar

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00:03:41,820 --> 00:03:45,840

wind, the solar particles that hit it. And then at the

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00:03:45,860 --> 00:03:49,990

bottom and the top are the instruments that measure the properties of the upper atmosphere.

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00:03:50,010 --> 00:03:54,120

The ones at the bottom measure it in situ, at the location of

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00:03:54,140 --> 00:03:58,220

the spacecraft. The ones at the top measure it both in situ and

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00:03:58,240 --> 00:04:02,320

remotely, so we can get a global picture of what's happening with the

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00:04:02,340 --> 00:04:06,400

Mars upper atmosphere today and how escape to space occurs.

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00:04:06,420 --> 00:04:10,470

We've just finished building the spacecraft, unfortunately we're not

61

00:04:10,490 --> 00:04:14,490

really flying 4 of them, this just shows it at different steps.

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00:04:14,510 --> 00:04:18,520

And fortunately they were more careful in building it than moving as fast

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00:04:18,540 --> 00:04:22,700

as they are here. The spacecraft was built by Lockheed Martin

64

00:04:22,720 --> 00:04:26,880

in Denver, and I have to say they've provided us with what looks like it's going to be a honey

65

00:04:26,900 --> 00:04:31,060

of a spacecraft. Once it was built it goes into testing. Here we're seeing

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00:04:31,080 --> 00:04:35,240

the deployment test of the solar arrays. We want to

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00:04:35,260 --> 00:04:39,440

make sure that everything that the spacecraft is going to

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00:04:39,460 --> 00:04:43,620

experience and do, it does on Earth. It experiences on

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00:04:43,640 --> 00:04:47,650

Earth first, because we want to make sure it works. One of the

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00:04:47,670 --> 00:04:51,820

most exciting tests is what's called thermal vacuum testing. We

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00:04:51,840 --> 00:04:55,990

put it in a large chamber, you'll see it going in in just a minute,

72

00:04:56,010 --> 00:05:00,030

and pump it down to vacuum and put it through its paces.

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00:05:00,050 --> 00:05:04,140

MAVEN spent 3 weeks in thermal vacuum testing, going

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00:05:04,160 --> 00:05:08,240

through everything it's going to do once it's in orbit at Mars.

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00:05:08,260 --> 00:05:12,310

The science instruments were cycled. The platform that holds

76

00:05:12,330 --> 00:05:16,350

them was moved. The spacecraft thought it was in orbit around Mars, again

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00:05:16,370 --> 00:05:20,390

they didn't really move it this fast. They took a lot of care with it.

78

00:05:20,410 --> 00:05:24,570

You can imagine dropping it would not be a good thing. Once

79

00:05:24,590 --> 00:05:28,750

the testing was complete at the beginning of August,

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00:05:28,770 --> 00:05:32,770

just a month and a half ago we shipped the whole thing down to Cape Canaveral,

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00:05:32,790 --> 00:05:36,800

in Florida, that's where we're going to launch it from. We started off

82

00:05:36,820 --> 00:05:40,950

by driving it in a truck, in this big shipping

83

00:05:40,970 --> 00:05:45,100

container out to Buckley Air Force Base. Put it on a C-17,

84

00:05:45,120 --> 00:05:49,200

Air Force cargo jet and flew it down to Florida.

85

00:05:49,220 --> 00:05:53,320

Here in the C-17, it was so cool to me

86

00:05:53,340 --> 00:05:57,350

to ride along with it and just accompany it on the start of

87

00:05:57,370 --> 00:06:01,410

its trip to Mars. The launch vehicle, an Atlas V,

88

00:06:01,430 --> 00:06:05,460

is now at the Cape. It was delivered at the end of

89

00:06:05,480 --> 00:06:09,500

August and now we're in the process of integrating it all together.

90

00:06:09,520 --> 00:06:13,670

This isn't ours on the pad, but ours is going to look a lot like this.

91

00:06:13,690 --> 00:06:17,730

On November 18, we're going to launch into space,

92

00:06:17,750 --> 00:06:21,780

we have a 10-month cruise phase to get to Mars. We go into orbit with a

93

00:06:21,800 --> 00:06:25,950

rocket motor burn for 38 minutes. It takes us about a month

94

00:06:25,970 --> 00:06:30,120

then to commission the spacecraft; deploy the booms, test all the

95

00:06:30,140 --> 00:06:34,260

instruments, make sure everything is working right, and then we can begin

96

00:06:34,280 --> 00:06:38,330

our 1 Earth year science mission. In that year,

97

00:06:38,350 --> 00:06:42,390

we anticipate seeing enough variability of the solar input,

98

00:06:42,410 --> 00:06:46,440

of the solar wind input, of the solar energetic

99

00:06:46,460 --> 00:06:50,470

storms, to really understand what effects they have on the atmosphere.

100

00:06:50,490 --> 00:06:54,510

What this is going to do is going to tell us, coming back to the science now,

101
00:06:54,530 --> 00:06:58,540
"Where did that water go?" Where did the carbon dioxide go,

102
00:06:58,560 --> 00:07:02,720
from that early thick, warm wet environment? And this really isn't just

103
00:07:02,740 --> 00:07:06,900
about Mars, it's telling us about the evolution of the

104
00:07:06,920 --> 00:07:11,080
habitability of a planet by microbes. What is it that causes a planet to be

105
00:07:11,100 --> 00:07:15,240
habitable? And what is it that makes it not habitable?

106
00:07:15,260 --> 00:07:19,410
That's what MAVEN is going to be exploring. I hope you guys are going to see this with us.

107
00:07:19,430 --> 00:07:23,580
Thank you.

108
00:07:23,600 --> 00:07:27,700
(clapping)

109
00:07:27,720 --> 00:07:31,830
(music)