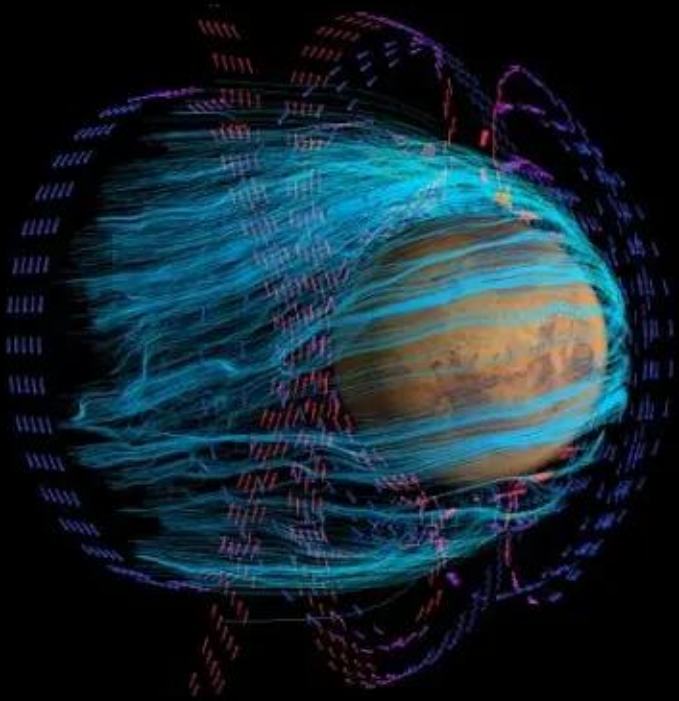

1
00:00:06,590 --> 00:00:03,050
maven is a spacecraft that's orbiting

2
00:00:08,480 --> 00:00:06,600
Mars it's been there since 2014 maven in

3
00:00:10,900 --> 00:00:08,490
this case is an acronym that stands for

4
00:00:13,910 --> 00:00:10,910
Mars atmosphere and volatile evolution

5
00:00:16,640 --> 00:00:13,920
and this gives a clue as to what mavens

6
00:00:19,279 --> 00:00:16,650
real goal is it's to study the top of

7
00:00:21,650 --> 00:00:19,289
the atmosphere and how the gases in the

8
00:00:24,529 --> 00:00:21,660
top of the atmosphere might escape from

9
00:00:26,330 --> 00:00:24,539
Mars away to space so the atmosphere of

10
00:00:28,189 --> 00:00:26,340
Mars must have been a lot thicker but

11
00:00:30,140 --> 00:00:28,199
four billion years ago and today is very

12
00:00:32,179 --> 00:00:30,150
cold and dry and maven is meant to

13
00:00:34,819 --> 00:00:32,189

understand the atmosphere as it is today

14
00:00:37,010 --> 00:00:34,829
and how it has evolved into this current

15
00:00:38,930 --> 00:00:37,020
cold dry state one of the things we're

16
00:00:41,150 --> 00:00:38,940
trying to understand with maven is

17
00:00:43,459 --> 00:00:41,160
whether a magnetic field for a planet is

18
00:00:45,260 --> 00:00:43,469
important for regulating the climate or

19
00:00:47,450 --> 00:00:45,270
allowing the planet to keep an

20
00:00:50,900 --> 00:00:47,460
atmosphere earth has a global dynamo

21
00:00:53,240 --> 00:00:50,910
magnetic field Mars does not but Mars

22
00:00:55,400 --> 00:00:53,250
has an induced magnetosphere it has an

23
00:00:57,439 --> 00:00:55,410
induced magnetic field the upper

24
00:01:00,139 --> 00:00:57,449
atmosphere of Mars being ionized by

25
00:01:01,400 --> 00:01:00,149
solar radiation and so the electrons are

26
00:01:03,170 --> 00:01:01,410
being stripped from the atoms in the

27
00:01:04,670 --> 00:01:03,180
atmosphere when that happens it turns

28
00:01:06,410 --> 00:01:04,680
into what we call the state of plasma

29
00:01:08,000 --> 00:01:06,420
this plasma in the upper atmosphere is

30
00:01:09,859 --> 00:01:08,010
very conductive it leads electric

31
00:01:11,750 --> 00:01:09,869
currents to flow through it electric

32
00:01:13,310 --> 00:01:11,760
currents they shape the magnetic fields

33
00:01:15,140 --> 00:01:13,320
that are around them and that's actually

34
00:01:16,940 --> 00:01:15,150
how we see them with maven we take mean

35
00:01:18,890 --> 00:01:16,950
etic field data and we map it around the

36
00:01:21,440 --> 00:01:18,900
planet and from that the currents emerge

37
00:01:23,390 --> 00:01:21,450
we've known how the currents flow in the

38
00:01:24,950 --> 00:01:23,400

earth may need a sphere for decades but

39
00:01:26,899 --> 00:01:24,960
we don't know how that works around Mars

40
00:01:28,789 --> 00:01:26,909
we don't know how it influences the

41
00:01:30,469 --> 00:01:28,799
interaction with the solar wind because

42
00:01:33,109 --> 00:01:30,479
it determines how energy is flowing into

43
00:01:34,789 --> 00:01:33,119
the atmosphere it's transferred from the

44
00:01:36,490 --> 00:01:34,799
solar wind into the system and that's

45
00:01:38,899 --> 00:01:36,500
what we're trying to do with maven

46
00:01:40,550 --> 00:01:38,909
when you just look at the data as it

47
00:01:42,740 --> 00:01:40,560
comes down you're just seeing a little

48
00:01:44,330 --> 00:01:42,750
squiggly line essentially you're seeing

49
00:01:46,010 --> 00:01:44,340
the magnetic field strength in its

50
00:01:47,870 --> 00:01:46,020
direction vary as the spacecraft's

51
00:01:49,190 --> 00:01:47,880
flying through different regions and so

52
00:01:51,469 --> 00:01:49,200
what you have to do is you have to

53
00:01:53,059 --> 00:01:51,479
actually map it to the planets and to

54
00:01:54,919 --> 00:01:53,069
this interaction with the solar wind and

55
00:01:57,020 --> 00:01:54,929
then it starts to merge that the you

56
00:01:59,029 --> 00:01:57,030
have a drape situation where the the

57
00:02:00,260 --> 00:01:59,039
magnetic field the solar wind encounters

58
00:02:02,600 --> 00:02:00,270
the planet and it starts to wrap around

59
00:02:04,370 --> 00:02:02,610
it and the reason it wraps around the

60
00:02:06,770 --> 00:02:04,380
planet is those electric currents that

61
00:02:08,960 --> 00:02:06,780
we were seeing the magnetic field in the

62
00:02:10,789 --> 00:02:08,970
solar wind is straight lines you can

63
00:02:13,070 --> 00:02:10,799

think of straight spaghetti noodles and

64
00:02:15,680 --> 00:02:13,080
it's flowing towards the planet and

65
00:02:18,020 --> 00:02:15,690
those spaghetti noodles wrap around this

66
00:02:19,670 --> 00:02:18,030
basket ball shaped planet and that's

67
00:02:22,250 --> 00:02:19,680
indeed what we saw in the data the

68
00:02:24,500 --> 00:02:22,260
magnetic field lines draping around Mars

69
00:02:27,229 --> 00:02:24,510
as a planet one thing that wasn't so

70
00:02:29,420 --> 00:02:27,239
expected was the specific configuration

71
00:02:31,759 --> 00:02:29,430
of the electric currents that we derived

72
00:02:34,100 --> 00:02:31,769
from the magnetic field data if Mars is

73
00:02:35,780 --> 00:02:34,110
a ball here it's sort of this cup shape

74
00:02:38,059 --> 00:02:35,790
on the day side that loops back on

75
00:02:38,630 --> 00:02:38,069
itself maybe something that looks like

76
00:02:40,910 --> 00:02:38,640
this

77
00:02:42,920 --> 00:02:40,920
what wasn't so intuitive to me was the

78
00:02:45,740 --> 00:02:42,930
directions of those currents and the

79
00:02:48,080 --> 00:02:45,750
fact that it wraps continuously around

80
00:02:50,930 --> 00:02:48,090
to the night side and it makes this

81
00:02:53,960 --> 00:02:50,940
marvelously complex current system on

82
00:02:55,849 --> 00:02:53,970
the night side as well this is the first

83
00:02:57,860 --> 00:02:55,859
time that we've been able to actually

84
00:02:59,210 --> 00:02:57,870
map out the currents so we can see where

85
00:03:01,430 --> 00:02:59,220
the energy is being transferred we can

86
00:03:03,770 --> 00:03:01,440
see what actually forms the underlying

87
00:03:05,660 --> 00:03:03,780
mechanisms creating these induced

88
00:03:07,370 --> 00:03:05,670

magnetosphere that are not just common

89
00:03:08,690 --> 00:03:07,380
here in the solar system they're 50% of

90
00:03:10,160 --> 00:03:08,700
the planets that have them of the

91
00:03:12,080 --> 00:03:10,170
terrestrial planets and if you want to

92
00:03:14,569 --> 00:03:12,090
understand how the atmosphere of Mars

93
00:03:16,550 --> 00:03:14,579
and Venus why they're so different from

94
00:03:18,410 --> 00:03:16,560
the earth and why they're so different

95
00:03:20,150 --> 00:03:18,420
from each other despite both being non

96
00:03:23,629 --> 00:03:20,160
magnetized we need to understand they're

97
00:03:25,490 --> 00:03:23,639
induced many others first so knowing how

98
00:03:27,920 --> 00:03:25,500
these global current systems are

99
00:03:30,199 --> 00:03:27,930
configured teaches us about how charged

100
00:03:32,120 --> 00:03:30,209
particles near the planet are going to

101
00:03:34,339 --> 00:03:32,130
move both charged particles in the solar

102
00:03:36,530 --> 00:03:34,349
wind and charged particles from the

103
00:03:39,170 --> 00:03:36,540
atmosphere itself that are in the

104
00:03:40,729 --> 00:03:39,180
process of escaping to space so now we

105
00:03:43,099 --> 00:03:40,739
can understand better where those

106
00:03:45,500 --> 00:03:43,109
particles came from how they move near

107
00:03:47,149 --> 00:03:45,510
Mars and where they're going to go next

108
00:03:49,309 --> 00:03:47,159
that in turn teaches us about

109
00:03:51,440 --> 00:03:49,319
atmospheric escape from the planet and

110
00:03:53,509 --> 00:03:51,450
the history of the atmosphere over time

111
00:03:58,080 --> 00:03:53,519
how thick has it been how much has been