1
00:00:06,789 --> 00:00:04,309
traveling through the sun's blazing hot

2
00:00:09,190 --> 00:00:06,799
atmosphere nasa's parker solar probe has

3
00:00:11,589 --> 00:00:09,200
sent back a complex close-up view of our

4
00:00:13,270 --> 00:00:11,599
star the spacecraft confirmed that our

5
00:00:14,950 --> 00:00:13,280
picture of the sun from earth is

6
00:00:16,790 --> 00:00:14,960
deceptively simple

7
00:00:18,950 --> 00:00:16,800
parker is the closest spacecraft to the

8
00:00:21,109 --> 00:00:18,960
sun meaning we now have never before

9
00:00:23,590 --> 00:00:21,119
seen details about the solar wind and

10
00:00:27,269 --> 00:00:23,600
solar energetic particles

11
00:00:30,310 --> 00:00:27,279
energy particles that can endanger both

12
00:00:32,549 --> 00:00:30,320
astronauts and satellites in space the

13
00:00:34,389 --> 00:00:32,559

solar wind is the continuous outflow of

14
00:00:35,190 --> 00:00:34,399
particles and magnetic field from the

15
00:00:37,510 --> 00:00:35,200
sun

16
00:00:39,110 --> 00:00:37,520
both speed out filling up space and

17
00:00:41,110 --> 00:00:39,120
affecting space weather throughout our

18
00:00:42,869 --> 00:00:41,120
solar system

19
00:00:44,549 --> 00:00:42,879
for the first time ever we were able to

20
00:00:47,110 --> 00:00:44,559
go to the source of the solar wind and

21
00:00:49,590 --> 00:00:47,120
solar particles here are five features

22
00:00:51,510 --> 00:00:49,600
parker saw

23
00:00:52,950 --> 00:00:51,520
we've long known that space is full of

24
00:00:54,709 --> 00:00:52,960
cosmic dust

25
00:00:57,189 --> 00:00:54,719
we can even see the dust from earth

26
00:00:58,869 --> 00:00:57,199
because it reflects sunlight parker saw

27
00:01:00,950 --> 00:00:58,879
evidence that the dust stops at an

28
00:01:03,349 --> 00:01:00,960
estimated three and a half million miles

29
00:01:05,750 --> 00:01:03,359
from the sun as the dust gets closer the

30
00:01:08,950 --> 00:01:05,760
sun vaporizes it creating a dust-free

31
00:01:10,630 --> 00:01:08,960
zone surrounding the star

32
00:01:12,710 --> 00:01:10,640
at earth it appears that the magnetic

33
00:01:14,230 --> 00:01:12,720
field lines flow evenly out from the sun

34
00:01:16,390 --> 00:01:14,240
but parker saw them behave in a

35
00:01:18,149 --> 00:01:16,400
surprising way

36
00:01:20,789 --> 00:01:18,159
the magnetic field lines flip in a

37
00:01:23,190 --> 00:01:20,799
whip-like motion turning 180 degrees

38
00:01:25,270 --> 00:01:23,200

around in a matter of seconds

39
00:01:27,030 --> 00:01:25,280
these switchbacks came in clusters and

40
00:01:28,830 --> 00:01:27,040
were timed with fast-moving clumps of

41
00:01:31,030 --> 00:01:28,840
plasma in the solar wind

42
00:01:32,789 --> 00:01:31,040
[Music]

43
00:01:34,950 --> 00:01:32,799
scientists have long wondered if the

44
00:01:37,990 --> 00:01:34,960
solar wind is generated as a continuous

45
00:01:40,149 --> 00:01:38,000
flow or in spurts we now see evidence

46
00:01:41,270 --> 00:01:40,159
that the solar wind has rough irregular

47
00:01:43,350 --> 00:01:41,280
texture

48
00:01:45,429 --> 00:01:43,360
the plasma within it also seems to lack

49
00:01:47,350 --> 00:01:45,439
an orderly sense of direction

50
00:01:49,590 --> 00:01:47,360
some clumps of solar material fire out

51
00:01:50,630 --> 00:01:49,600
into space while others fall back toward

52
00:01:52,149 --> 00:01:50,640
the sun

53
00:01:55,109 --> 00:01:52,159
these clumps may be distorting the

54
00:01:56,789 --> 00:01:55,119
magnetic field causing the switchbacks

55
00:01:58,469 --> 00:01:56,799
they may also be an indicator of what

56
00:02:02,389 --> 00:01:58,479
the solar wind looks like in its early

57
00:02:04,149 --> 00:02:02,399
stages after its birth on the sun

58
00:02:05,749 --> 00:02:04,159
parker found a transition point in the

59
00:02:08,070 --> 00:02:05,759
solar wind

60
00:02:11,910 --> 00:02:08,080
the corona is the sun's faint outermost

61
00:02:13,990 --> 00:02:11,920
layer that transitions to the solar wind

62
00:02:15,910 --> 00:02:14,000
before parker scientists knew that the

63
00:02:18,470 --> 00:02:15,920

corona rotates with the visible surface

64
00:02:20,790 --> 00:02:18,480
below it but they didn't know how or

65
00:02:23,670 --> 00:02:20,800
where the solar wind switched to flowing

66
00:02:25,589 --> 00:02:23,680
straight by the time it reaches earth

67
00:02:27,750 --> 00:02:25,599
parker has finally spotted signs of this

68
00:02:31,990 --> 00:02:27,760
transition and the changeover happened

69
00:02:35,910 --> 00:02:33,750
although the sun has been very quiet

70
00:02:37,910 --> 00:02:35,920
over the first two orbits parker

71
00:02:40,309 --> 00:02:37,920
observed several tiny bursts of solar

72
00:02:42,550 --> 00:02:40,319
energetic particles

73
00:02:44,390 --> 00:02:42,560
while these events have been seen before

74
00:02:46,070 --> 00:02:44,400
never ones this small

75
00:02:47,990 --> 00:02:46,080
the fast-moving particles from these

76
00:02:49,110 --> 00:02:48,000
modest bursts spread out as they move

77
00:02:52,710 --> 00:02:49,120
from the sun

78
00:02:54,869 --> 00:02:52,720
making them undetectable from earth

79
00:02:56,470 --> 00:02:54,879
without parker's front row seat we would

80
00:02:59,910 --> 00:02:56,480
never know that the sun is regularly

81
00:03:01,670 --> 00:02:59,920
producing these small scale events

82
00:03:03,350 --> 00:03:01,680
fast moving particles are a source of

83
00:03:05,190 --> 00:03:03,360
dangerous radiation

84
00:03:07,190 --> 00:03:05,200
the more we learn about these eruptions

85
00:03:09,430 --> 00:03:07,200
the better we can protect our technology

86
00:03:11,509 --> 00:03:09,440
and astronauts

87
00:03:13,830 --> 00:03:11,519
parker still has more work to do

88
00:03:18,610 --> 00:03:13,840

but it's already helping us see our star