



1
00:00:09,750 --> 00:00:06,230
voyager 1 at the final frontier

2
00:00:12,950 --> 00:00:09,760
presented by science at nasa

3
00:00:15,110 --> 00:00:12,960
for nearly 35 years nasa's voyager 1

4
00:00:17,109 --> 00:00:15,120
probe has been hurtling toward the edge

5
00:00:19,830 --> 00:00:17,119
of the solar system flying through the

6
00:00:21,590 --> 00:00:19,840
dark void on a mission unlike anything

7
00:00:24,310 --> 00:00:21,600
attempted before

8
00:00:26,870 --> 00:00:24,320
one day mission controllers hope voyager

9
00:00:29,029 --> 00:00:26,880
1 will leave the solar system behind and

10
00:00:31,349 --> 00:00:29,039
enter the realm of the stars

11
00:00:34,150 --> 00:00:31,359
interstellar space

12
00:00:36,470 --> 00:00:34,160
that day may be upon us

13
00:00:38,630 --> 00:00:36,480

the latest data from voyager 1 indicate

14

00:00:40,630 --> 00:00:38,640

that we are clearly in a new region

15

00:00:43,590 --> 00:00:40,640

where things are changing quickly says

16

00:00:45,990 --> 00:00:43,600

ed stone voyager project scientist at

17

00:00:47,670 --> 00:00:46,000

the california institute of technology

18

00:00:50,150 --> 00:00:47,680

in pasadena

19

00:00:53,110 --> 00:00:50,160

this is very exciting we are approaching

20

00:00:54,950 --> 00:00:53,120

the solar system's final frontier

21

00:00:57,750 --> 00:00:54,960

the frontier he's referring to is the

22

00:00:59,910 --> 00:00:57,760

edge of the heliosphere a great magnetic

23

00:01:01,110 --> 00:00:59,920

bubble that surrounds the sun and

24

00:01:02,950 --> 00:01:01,120

planets

25

00:01:05,750 --> 00:01:02,960

the heliosphere is the sun's own

26

00:01:08,310 --> 00:01:05,760

magnetic field inflated to gargantuan

27

00:01:10,710 --> 00:01:08,320

proportions by the solar wind

28

00:01:11,750 --> 00:01:10,720

inside lies the solar system

29

00:01:14,630 --> 00:01:11,760

home

30

00:01:17,270 --> 00:01:14,640

outside lies interstellar space where no

31

00:01:19,190 --> 00:01:17,280

spacecraft has gone before

32

00:01:21,350 --> 00:01:19,200

a tell-tale sign of the frontier's

33

00:01:23,190 --> 00:01:21,360

approach is the number of cosmic rays

34

00:01:25,109 --> 00:01:23,200

hitting voyager 1.

35

00:01:27,749 --> 00:01:25,119

cosmic rays are high-energy particles

36

00:01:30,390 --> 00:01:27,759

such as protons and helium nuclei

37

00:01:33,590 --> 00:01:30,400

accelerated to near-light speed by

38

00:01:35,350 --> 00:01:33,600

distant supernovae and black holes

39

00:01:37,350 --> 00:01:35,360

the heliosphere protects the solar

40

00:01:39,109 --> 00:01:37,360

system from these sub-atomic bullets

41

00:01:42,630 --> 00:01:39,119

deflecting and slowing many of them

42

00:01:44,710 --> 00:01:42,640

before they can reach the inner planets

43

00:01:47,350 --> 00:01:44,720

as voyager approaches the frontier the

44

00:01:51,190 --> 00:01:47,360

number of cosmic rays has gone up

45

00:01:54,230 --> 00:01:51,200

from january 2009 to january 2012 there

46

00:01:56,789 --> 00:01:54,240

had been a gradual increase of about 25

47

00:02:00,069 --> 00:01:56,799

percent in the amount of galactic cosmic

48

00:02:02,149 --> 00:02:00,079

rays voyager was encountering says stone

49

00:02:04,389 --> 00:02:02,159

more recently however we have seen a

50

00:02:06,069 --> 00:02:04,399

very rapid escalation in that part of

51

00:02:08,469 --> 00:02:06,079

the energy spectrum

52

00:02:10,389 --> 00:02:08,479

beginning on may 7 2012

53

00:02:13,110 --> 00:02:10,399

the cosmic ray hits have increased five

54

00:02:14,309 --> 00:02:13,120

percent in a week and nine percent in a

55

00:02:16,710 --> 00:02:14,319

month

56

00:02:18,790 --> 00:02:16,720

the sharp increase means that voyager 1

57

00:02:22,309 --> 00:02:18,800

could be on the verge of a breakthrough

58

00:02:25,350 --> 00:02:22,319

18 billion kilometers from earth when

59

00:02:27,510 --> 00:02:25,360

voyager 1 actually exits the heliosphere

60

00:02:28,470 --> 00:02:27,520

researchers expect to see other changes

61

00:02:30,790 --> 00:02:28,480

as well

62

00:02:32,710 --> 00:02:30,800

for one thing energetic particles from

63

00:02:36,070 --> 00:02:32,720

the sun will become scarce as the

64

00:02:38,630 --> 00:02:36,080

spacecraft leaves the heliosphere behind

65

00:02:40,790 --> 00:02:38,640

also the magnetic field around voyager 1

66

00:02:43,750 --> 00:02:40,800

will change direction from that of the

67

00:02:46,550 --> 00:02:43,760

sun's magnetic field to that of the new

68

00:02:47,910 --> 00:02:46,560

and unexplored magnetism of interstellar

69

00:02:49,589 --> 00:02:47,920

space

70

00:02:50,550 --> 00:02:49,599

so far neither of these things has

71

00:02:52,550 --> 00:02:50,560

happened

72

00:02:55,990 --> 00:02:52,560

nevertheless the sudden increase in

73

00:02:58,630 --> 00:02:56,000

cosmic rays suggests it won't be long

74

00:03:01,350 --> 00:02:58,640

meanwhile voyager 2 is making its own

75

00:03:03,910 --> 00:03:01,360

dash for the stars but because of its

76

00:03:06,550 --> 00:03:03,920

slower pace lags a few billion

77

00:03:09,750 --> 00:03:06,560

kilometers behind voyager 1.

78

00:03:12,550 --> 00:03:09,760

both spacecraft remain in good health

79

00:03:15,190 --> 00:03:12,560

when the voyagers launched in 1977 the

80

00:03:16,309 --> 00:03:15,200

space age was all of 20 years old says

81

00:03:18,149 --> 00:03:16,319

stone

82

00:03:20,710 --> 00:03:18,159

many of us on the team dreamed of

83

00:03:23,030 --> 00:03:20,720

reaching interstellar space but we

84

00:03:24,630 --> 00:03:23,040

really had no way of knowing how long a

85

00:03:26,789 --> 00:03:24,640

journey it would be

86

00:03:29,030 --> 00:03:26,799

or if these two vehicles that we

87

00:03:31,750 --> 00:03:29,040

invested so much time and energy in

88

00:03:34,710 --> 00:03:31,760

would operate long enough to reach it

89

00:03:37,430 --> 00:03:34,720

as the space age nears the 55-year mark

90

00:03:39,350 --> 00:03:37,440

there is little doubt the voyagers are

91

00:03:41,350 --> 00:03:39,360

going the distance