



1  
00:00:10,150 --> 00:00:05,910  
hidden magnetic portals around earth

2  
00:00:13,589 --> 00:00:12,310  
a favorite theme of science fiction is

3  
00:00:15,910 --> 00:00:13,599  
the portal

4  
00:00:18,310 --> 00:00:15,920  
an extraordinary opening in space or

5  
00:00:19,830 --> 00:00:18,320  
time that connects travelers to distant

6  
00:00:22,870 --> 00:00:19,840  
realms

7  
00:00:24,870 --> 00:00:22,880  
a good portal is a shortcut a guide

8  
00:00:27,509 --> 00:00:24,880  
a door into the unknown

9  
00:00:30,310 --> 00:00:27,519  
if only they actually existed

10  
00:00:32,310 --> 00:00:30,320  
it turns out that they do sort of and a

11  
00:00:35,510 --> 00:00:32,320  
nasa-funded researcher at the university

12  
00:00:37,750 --> 00:00:35,520  
of iowa has figured out how to find them

13  
00:00:40,150 --> 00:00:37,760

we call them x points or electron

14

00:00:42,549 --> 00:00:40,160

diffusion regions explains plasma

15

00:00:44,389 --> 00:00:42,559

physicist jack scudder of the university

16

00:00:46,069 --> 00:00:44,399

of iowa

17

00:00:48,310 --> 00:00:46,079

they're places where the magnetic field

18

00:00:49,590 --> 00:00:48,320

of earth connects to the magnetic field

19

00:00:51,670 --> 00:00:49,600

of the sun

20

00:00:53,270 --> 00:00:51,680

creating an uninterrupted path leading

21

00:00:56,709 --> 00:00:53,280

from our own planet to the sun's

22

00:00:59,270 --> 00:00:56,719

atmosphere 93 million miles away

23

00:01:01,670 --> 00:00:59,280

observations by nasa's themis spacecraft

24

00:01:03,990 --> 00:01:01,680

and europe's cluster probes suggest that

25

00:01:06,789 --> 00:01:04,000

these magnetic portals open and close

26

00:01:08,870 --> 00:01:06,799

dozens of times each day

27

00:01:11,030 --> 00:01:08,880

they're typically located a few tens of

28

00:01:12,950 --> 00:01:11,040

thousands of kilometers from earth where

29

00:01:15,429 --> 00:01:12,960

the geomagnetic field meets the

30

00:01:18,390 --> 00:01:15,439

onrushing solar wind

31

00:01:21,670 --> 00:01:18,400

most portals are small and short-lived

32

00:01:23,590 --> 00:01:21,680

others are yawning vast and sustained

33

00:01:25,429 --> 00:01:23,600

energetic particles can flow through the

34

00:01:26,550 --> 00:01:25,439

openings heating earth's upper

35

00:01:29,350 --> 00:01:26,560

atmosphere

36

00:01:32,069 --> 00:01:29,360

sparking geomagnetic storms and igniting

37

00:01:34,950 --> 00:01:32,079

bright polar auroras

38

00:01:37,030 --> 00:01:34,960

nasa is planning a mission called mms

39

00:01:40,069 --> 00:01:37,040

short for magnetospheric multi-scale

40

00:01:41,910 --> 00:01:40,079

mission due to launch in 2014 to study

41

00:01:43,670 --> 00:01:41,920

the phenomenon

42

00:01:46,310 --> 00:01:43,680

bristling with energetic particle

43

00:01:48,469 --> 00:01:46,320

detectors and magnetic sensors the four

44

00:01:50,389 --> 00:01:48,479

spacecraft of mms will spread out in

45

00:01:53,109 --> 00:01:50,399

earth's magnetosphere and surround the

46

00:01:54,870 --> 00:01:53,119

portals to observe how they work

47

00:01:56,950 --> 00:01:54,880

just one problem

48

00:01:59,270 --> 00:01:56,960

finding them

49

00:02:01,510 --> 00:01:59,280

magnetic portals are invisible

50

00:02:03,990 --> 00:02:01,520

unstable and elusive

51  
00:02:05,990 --> 00:02:04,000  
they open and close without warning and

52  
00:02:07,510 --> 00:02:06,000  
there are no signposts to guide us in

53  
00:02:10,070 --> 00:02:07,520  
note scatter

54  
00:02:12,070 --> 00:02:10,080  
actually there are signposts and scudder

55  
00:02:14,390 --> 00:02:12,080  
has found them

56  
00:02:16,070 --> 00:02:14,400  
portals form via the process of magnetic

57  
00:02:17,990 --> 00:02:16,080  
reconnection

58  
00:02:20,550 --> 00:02:18,000  
mingling lines of magnetic force from

59  
00:02:22,630 --> 00:02:20,560  
the sun and earth criss-cross and joined

60  
00:02:24,470 --> 00:02:22,640  
to create the openings

61  
00:02:25,670 --> 00:02:24,480  
x points are where the crisscross takes

62  
00:02:27,589 --> 00:02:25,680  
place

63  
00:02:29,750 --> 00:02:27,599

the sudden joining of magnetic fields

64

00:02:31,830 --> 00:02:29,760

can propel jets of charged particles

65

00:02:33,990 --> 00:02:31,840

from the x point creating an electron

66

00:02:36,070 --> 00:02:34,000

diffusion region

67

00:02:37,750 --> 00:02:36,080

to learn how to pinpoint these events

68

00:02:39,509 --> 00:02:37,760

scudder looked at data from a space

69

00:02:41,190 --> 00:02:39,519

probe that orbited earth more than 10

70

00:02:43,670 --> 00:02:41,200

years ago

71

00:02:45,350 --> 00:02:43,680

in the late 1990s nasa's polar

72

00:02:47,750 --> 00:02:45,360

spacecraft spent years in earth's

73

00:02:49,509 --> 00:02:47,760

magnetosphere explained scudder and it

74

00:02:50,949 --> 00:02:49,519

encountered many x-points during its

75

00:02:52,949 --> 00:02:50,959

mission

76  
00:02:54,470 --> 00:02:52,959  
because polar carried sensors similar to

77  
00:02:56,470 --> 00:02:54,480  
those of mms

78  
00:02:58,790 --> 00:02:56,480  
scudder decided to see how an x-point

79  
00:03:01,190 --> 00:02:58,800  
looked to polar

80  
00:03:03,350 --> 00:03:01,200  
using polar data we have found five

81  
00:03:05,270 --> 00:03:03,360  
simple combinations of magnetic field

82  
00:03:06,949 --> 00:03:05,280  
and energetic particle measurements that

83  
00:03:10,070 --> 00:03:06,959  
tell us when we've come across an x

84  
00:03:11,990 --> 00:03:10,080  
point or an electron diffusion region

85  
00:03:15,509 --> 00:03:12,000  
a single spacecraft properly

86  
00:03:17,430 --> 00:03:15,519  
instrumented can make these measurements

87  
00:03:20,390 --> 00:03:17,440  
this means that a single member of the

88  
00:03:22,149 --> 00:03:20,400



mms constellation using the diagnostics

89

00:03:24,390 --> 00:03:22,159

can find a portal and alert other

90

00:03:26,789 --> 00:03:24,400

members of the constellation

91

00:03:28,390 --> 00:03:26,799

mission planners long thought that mms

92

00:03:30,229 --> 00:03:28,400

might have to spend a year or so

93

00:03:33,190 --> 00:03:30,239

learning to find portals before it could

94

00:03:34,149 --> 00:03:33,200

study them scudder's work shortcuts the

95

00:03:35,990 --> 00:03:34,159

process

96

00:03:37,509 --> 00:03:36,000

allowing mms to get to work without

97

00:03:39,110 --> 00:03:37,519

delay

98

00:03:40,630 --> 00:03:39,120

it's a shortcut worthy of the best

99

00:03:43,350 --> 00:03:40,640

portals of fiction

100

00:03:45,430 --> 00:03:43,360

only this time the portals are real

101

00:03:47,270 --> 00:03:45,440

and with the new signposts we know how

102

00:03:49,990 --> 00:03:47,280

to find them