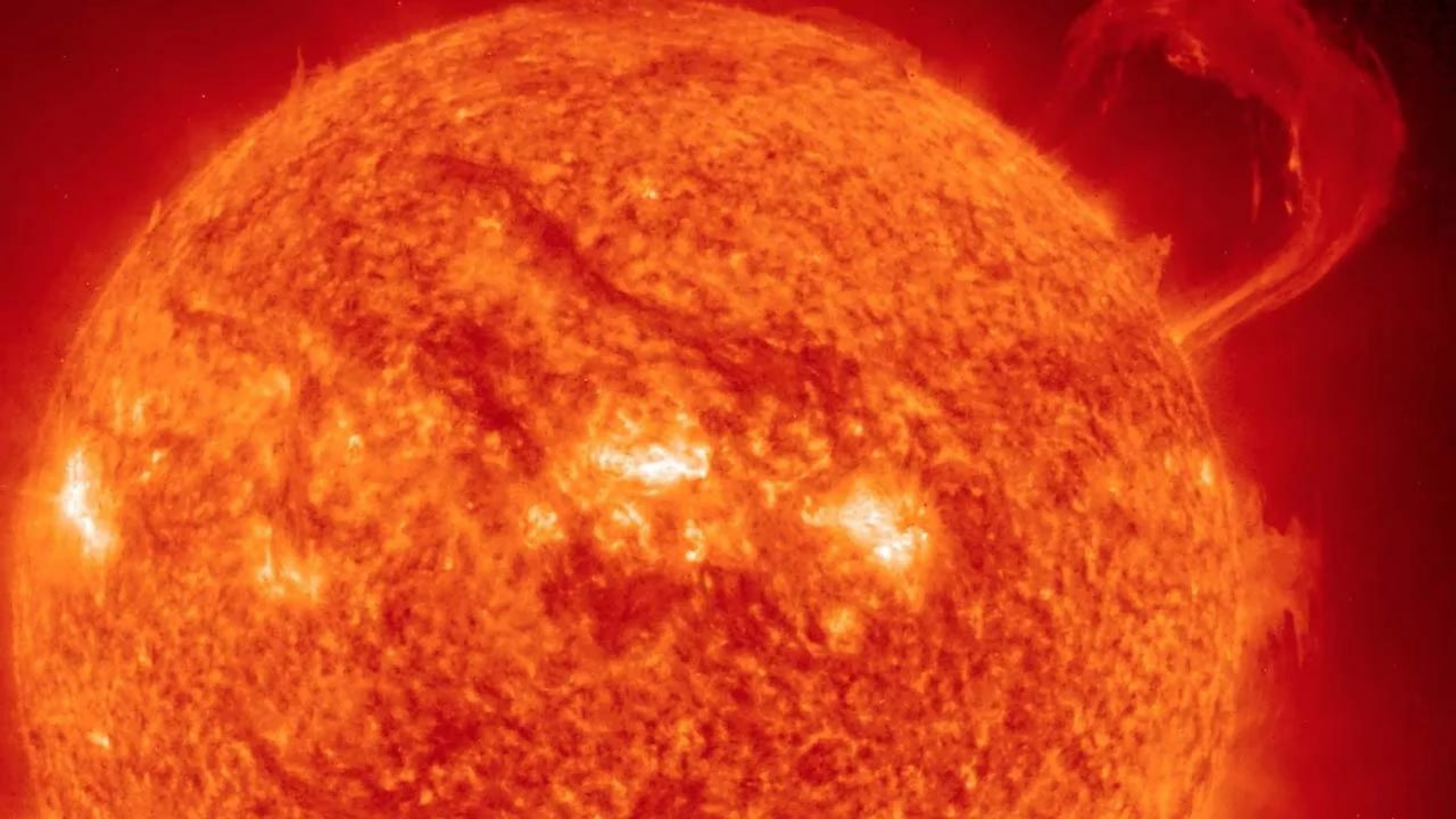

1
00:00:00,020 --> 00:00:04,210
Hi, I'm Joe Gurman, I'm a solar physicist in

2
00:00:04,210 --> 00:00:08,380
the heliophysics division at NASA's Goddard Space Flight Center.

3
00:00:08,380 --> 00:00:12,570
All of the eight large planets in the solar system orbit the Sun

4
00:00:12,570 --> 00:00:16,750
in a plane that lies within a few degrees of the Earth's

5
00:00:16,750 --> 00:00:20,930
orbital plane, the so-called ecliptic. So when we observe the Sun with a coronagraph,

6
00:00:20,930 --> 00:00:24,990
that blocks the much brighter light from the Sun itself so we can see the faint

7
00:00:24,990 --> 00:00:29,170
corona, the Sun's hot, outermost atmosphere, we get occasional

8
00:00:29,170 --> 00:00:33,300
glimpses of planets. And in this remarkable series of

9
00:00:33,300 --> 00:00:37,480
images, we actually get to see several different planets. And also in the upper-left

10
00:00:37,480 --> 00:00:41,670
of the image, you can see the Pleiades, the star cluster. The images of the

11
00:00:41,670 --> 00:00:45,850
planets come out here looking as though they have horizontal streaks,

12
00:00:45,850 --> 00:00:50,030
because they're so bright that they overwhelm the

13
00:00:50,030 --> 00:00:54,210

electronics in the detector that's taking this image. SOHO's

14
00:00:54,210 --> 00:00:58,370
Extreme Ultraviolet Telescope allows us to see a variety of solar activity

15
00:00:58,370 --> 00:01:02,560
and some of the most intense activity we saw was in the fall of 2003.

16
00:01:02,560 --> 00:01:06,740
It was a bit of a surprise because it was a couple of years after the maximum, the 11-year

17
00:01:06,740 --> 00:01:10,930
solar activity cycle. It's a beautiful clip, and it shows what SOHO's Extreme

18
00:01:10,930 --> 00:01:15,110
Ultraviolet Telescope can do. So what we're seeing here is those same

19
00:01:15,110 --> 00:01:19,300
periods of activity in the fall of 2003, only this

20
00:01:19,300 --> 00:01:23,320
time from SOHO's coronagraph. And you can see a sequence of events,

21
00:01:23,320 --> 00:01:27,500
so-called coronal mass ejections, launching off in all directions

22
00:01:27,500 --> 00:01:31,690
as the active region rotates across the solar

23
00:01:31,690 --> 00:01:35,860
surface. And you also see what looks like snow on the windshield

24
00:01:35,860 --> 00:01:40,040
of a car driving through a blizzard, and that's energetic particles

25
00:01:40,040 --> 00:01:44,090
accelerated by the solar activity hitting the detectors

26
00:01:44,090 --> 00:01:48,120
on the SOHO spacecraft.

27
00:01:48,120 --> 00:01:52,300
Prominences are cooler gas that flows along magnetic fields

28
00:01:52,300 --> 00:01:56,370
in the much hotter solar corona. And this image from 1999

29
00:01:56,370 --> 00:02:00,570
you can see the eruption of a huge prominence from a fairly high latitude

30
00:02:00,570 --> 00:02:04,760
in the Sun, and that tells us that it's associated with new cycle

31
00:02:04,760 --> 00:02:08,920
magnetic fields and with the expulsion of twists in

32
00:02:08,920 --> 00:02:13,110
magnetic fields from the old solar cycle.

33
00:02:13,110 --> 00:02:17,140
Each of those approximately 11-year halves of the magnetic cycle

34
00:02:17,140 --> 00:02:21,320
displays its own cycle of first increasing and then decreasing

35
00:02:21,320 --> 00:02:25,350
magnetic activity, and that's reflected in the intensity

36
00:02:25,350 --> 00:02:29,540
of extreme ultraviolet emission from gas that's trapped in

37
00:02:29,540 --> 00:02:33,740
the magnetic field. So in this image you can see a series

38
00:02:33,740 --> 00:02:37,940

of snapshots taken one a year over

39
00:02:37,940 --> 00:02:42,120
a solar cycle.

40
00:02:42,120 --> 00:02:46,180
Over the course of the SOHO

41
00:02:46,180 --> 00:02:50,360
mission, we've observed over 3,000 sun-grazing comets, comets that come

42
00:02:50,360 --> 00:02:54,520
so close to the Sun that you can't see them from the Earth because the Sun basically

43
00:02:54,520 --> 00:02:58,700
blinds Earth-bound telescopes. With SOHO's coronagraphs, we're able to track

44
00:02:58,700 --> 00:03:02,890
the comets all the way into their evaporation near the Sun.

45
00:03:02,890 --> 00:03:07,070
In late 2012, astronomers discovered

46
00:03:07,070 --> 00:03:11,140
a comet inbound, we didn't know if it would survive its passage with the Sun or not,

47
00:03:11,140 --> 00:03:15,230
and we were able to get these measurements with SOHO's C3 coronagraph.

48
00:03:15,230 --> 00:03:19,290
of the comet as it passed

49
00:03:19,290 --> 00:03:23,470
in towards the Sun, and then the ghostly image of the comet continued

50
00:03:23,470 --> 00:03:27,660
past the Sun, but it was already evaporating.

51
00:03:27,660 --> 00:03:31,760
If you're able to catch it, and if you blink you'll miss it, you see a wave

52
00:03:31,760 --> 00:03:35,810
traveling outwards from the flare in the lower solar corona

53
00:03:35,810 --> 00:03:39,990
EIT was really good at, and in fact discovered, these waves in the very

54
00:03:39,990 --> 00:03:44,170
lowest part of the corona that corresponded to coronal mass ejections, and we literally

55
00:03:44,170 --> 00:03:48,200
hadn't known about that before. In a coronagraph, you don't know if an event

56
00:03:48,200 --> 00:03:52,240
is heading towards you or away from you, the geometry is the same. And

57
00:03:52,240 --> 00:03:56,430
with the addition of an extreme ultraviolet image,

58
00:03:56,430 --> 00:04:00,610
that shows a wave like this, then you know that the event has occurred on

59
00:04:00,610 --> 00:04:04,680
the Earthward side of the Sun, and we may very well have some space weather in store

60
00:04:04,680 --> 00:04:08,860
in one to three days. This clip shows Comet Machholz

61
00:04:08,860 --> 00:04:13,040
which SOHO observed in 2002 as it was passing near the Sun. And

62
00:04:13,040 --> 00:04:17,130
as the clip shows, the direction of the comet's tail, which

63
00:04:17,130 --> 00:04:21,320

is made up of electrically charged particles, changes as it passes the Sun,

64
00:04:21,320 --> 00:04:25,490
that's because the Sun's solar wind, a continual emission of plasma

65
00:04:25,490 --> 00:04:29,550
from the Sun, is pushing it outwards.

66
00:04:29,550 --> 00:04:33,740
This shows an entire solar rotation of about 28 days.

67
00:04:33,740 --> 00:04:37,820
In 2001, as we were ascending up to solar maximum,

68
00:04:37,820 --> 00:04:42,000
and you'll see several events in here, and the interesting

69
00:04:42,000 --> 00:04:46,050
thing about these is how they're distributed in latitude, they're not all

70
00:04:46,050 --> 00:04:50,110
just along the horizontal axis in this series of images.

71
00:04:50,110 --> 00:04:54,290
And that's an indication that you are reaching solar maximum.

72
00:04:54,290 --> 00:04:58,360
During solar minimum, the much smaller number of events that happen

73
00:04:58,360 --> 00:05:02,530
all seem to come off the east or west edges of the Sun. But as you get toward

74
00:05:02,530 --> 00:05:06,720
solar maximum, the active regions are distributed all over in latitude.

75
00:05:06,720 --> 00:05:10,880
And you get this much more active appearance.