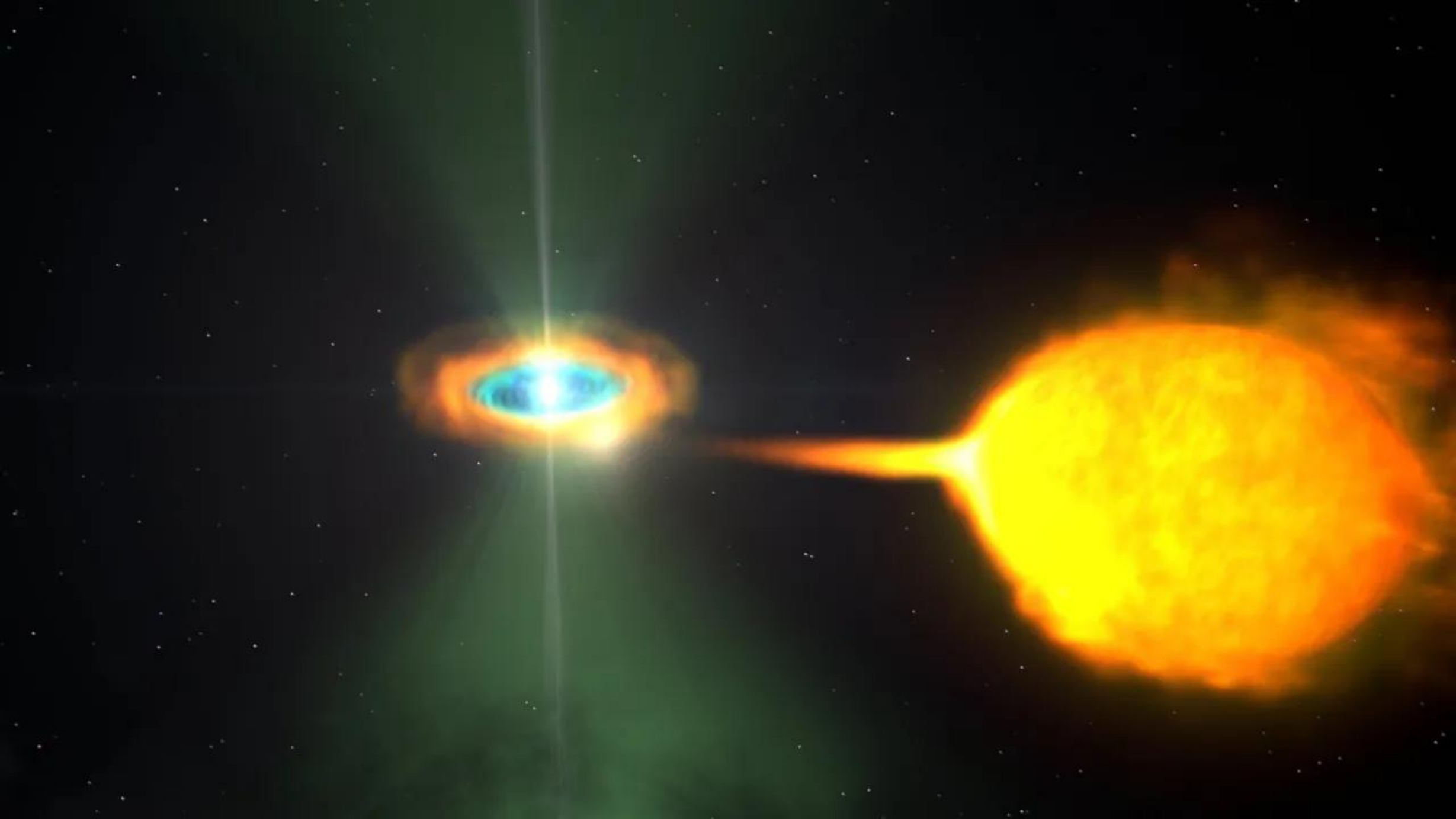

1
00:00:08,150 --> 00:00:04,080
[Music]

2
00:00:08,170 --> 00:00:12,180
Narrator: About

3
00:00:12,200 --> 00:00:16,240
4,400 light-years away, in the constellation Sextans,

4
00:00:16,260 --> 00:00:20,270
there is an extraordinary binary system that pairs a rapidly spinning neutron

5
00:00:20,290 --> 00:00:24,290
star, or pulsar, with a star about one-fifth the mass of the

6
00:00:24,310 --> 00:00:28,360
sun. Thanks to its rapid rotation and intense magnetic field,

7
00:00:28,380 --> 00:00:32,430
the pulsar produces a strong radio signal, which is how astronomers first

8
00:00:32,450 --> 00:00:36,500
discovered it. Many similar binaries are known, what's strange

9
00:00:36,520 --> 00:00:40,520
about this one is that sometimes the radio beacon just disappears.

10
00:00:40,540 --> 00:00:44,560
Then the system lights up in X-rays and gamma rays.

11
00:00:44,580 --> 00:00:48,580
Here's what researchers think may be happening. The two

12
00:00:48,600 --> 00:00:52,600
stars orbit so closely that gas from the sun-like star overflows and

13
00:00:52,620 --> 00:00:56,630

a stream falls toward the pulsar. But the pulsar produces an outflow of its own,

14
00:00:56,650 --> 00:01:00,650
Its spin and magnetic field accelerate charged particles to near

15
00:01:00,670 --> 00:01:04,710
the speed of light, creating a high-energy wind. During the radio

16
00:01:04,730 --> 00:01:08,740
phase, this pulsar wind easily holds back the gas stream.

17
00:01:08,760 --> 00:01:12,770
Now and then, and for reasons as yet unknown, the companion's

18
00:01:12,790 --> 00:01:16,800
stream surges, pushing close enough to the pulsar that it collects into a disk.

19
00:01:16,820 --> 00:01:20,890
Once in the disk, the gas gradually spirals toward the neutron star.

20
00:01:20,910 --> 00:01:24,910
At an altitude of about 50 miles, the gas chokes off the pulsar

21
00:01:24,930 --> 00:01:29,000
wind, unleashing the full torrent of the companion's gas stream.

22
00:01:29,020 --> 00:01:33,030
Gas reaching closest to the neutron star becomes transformed into dual

23
00:01:33,050 --> 00:01:37,060
particle jets, which fire out of the disk in opposite directions at nearly light-speed.

24
00:01:37,080 --> 00:01:41,100
Gamma rays observed by NASA's Fermi satellite may arise along the edge

25
00:01:41,120 --> 00:01:45,120
of the jet, while enhanced X-ray emission observed by other spacecraft

26
00:01:45,140 --> 00:01:49,160
may come from shock waves rocking the inner accretion disk.

27
00:01:49,180 --> 00:01:53,190
Eventually, and for reasons not understood, the companion's flow ebbs.

28
00:01:53,210 --> 00:01:57,230
The pulsar wind again becomes dominant, choking off the flow and blowing

29
00:01:57,250 --> 00:02:01,270
away the accretion disk. The pulsar flips back to its radio-emitting

30
00:02:01,290 --> 00:02:05,310
mode. Astronomers think this system represents a rare

31
00:02:05,330 --> 00:02:09,350
glimpse of a relatively brief phase. Mass transfer from a companion can

32
00:02:09,370 --> 00:02:13,400
rejuvenate an old, slow pulsar, spinning it up to tens of thousands of rpm.

33
00:02:13,420 --> 00:02:17,450
We may be seeing a system where this phase is on the verge of ending.

34
00:02:17,470 --> 00:02:21,490
When it does, the pulsar's wind will erode what's left of its companion

35
00:02:21,510 --> 00:02:25,550
until only the pulsar remains. Although astronomers have

36
00:02:25,570 --> 00:02:29,600
studied the system in both low- and high-energy states, they haven't yet observed

37
00:02:29,620 --> 00:02:33,610
this transformation in progress. Now, they are watching

38
00:02:33,630 --> 00:02:37,660

closely, waiting to document the next dramatic change of this exceptional

39
00:02:37,680 --> 00:02:41,720
binary. [Beeping]