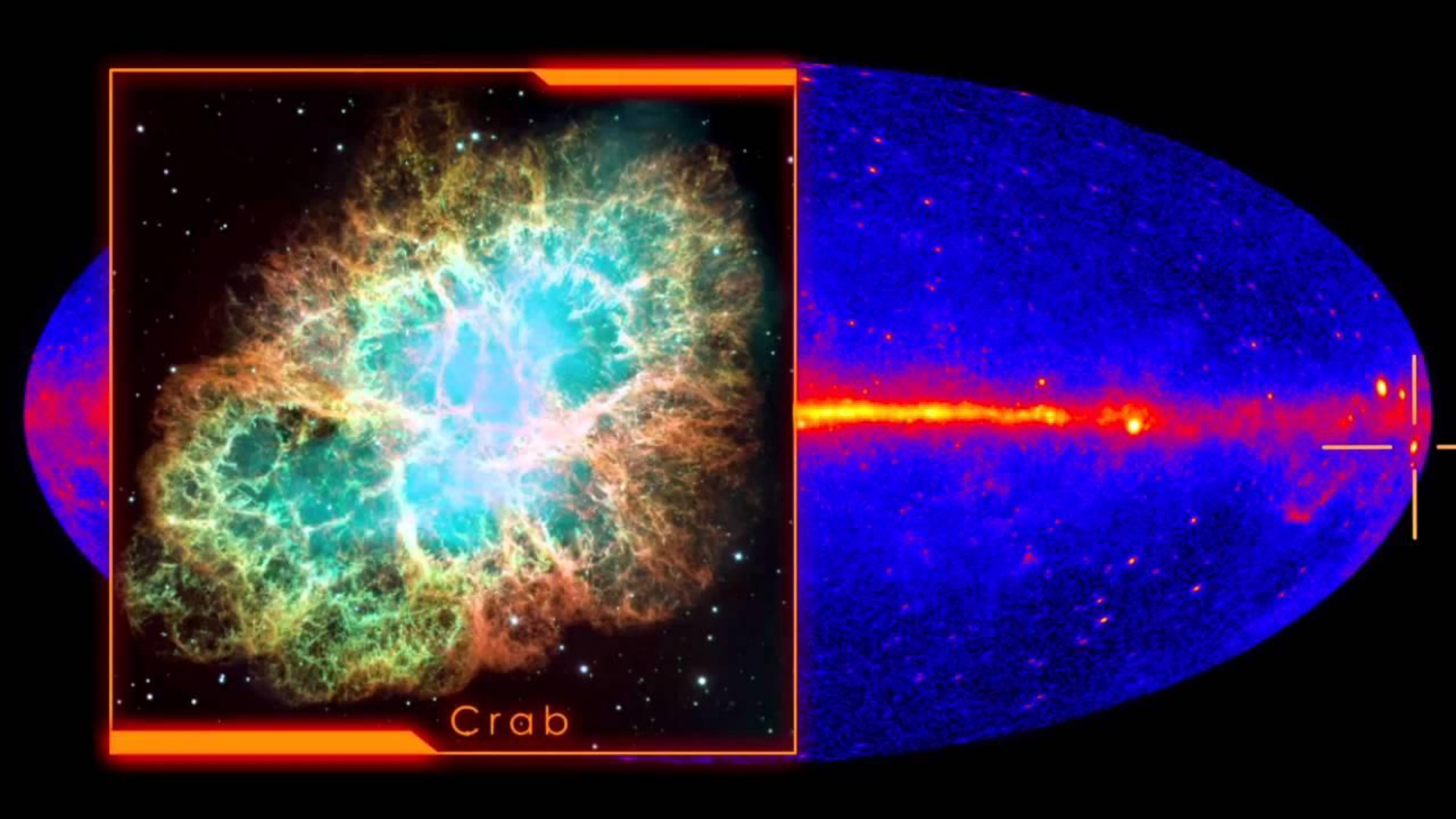
Crab

1
00:00:03,510 --> 00:00:11,550
Music

2
00:00:11,570 --> 00:00:15,570
Narrator: The Crab Nebula is one of the brightest sources of high-energy radiation in the sky.

3
00:00:15,590 --> 00:00:19,630
Little wonder, it's the expanding remains of an exploded star,

4
00:00:19,650 --> 00:00:23,710
a supernova seen in the year 1054.

5
00:00:23,730 --> 00:00:27,750
Recently, astronomers using satellites sensitive to the highest energy form of

6
00:00:27,770 --> 00:00:31,800
light -- gamma rays -- have observed incredible flares in the nebula that theorists

7
00:00:31,820 --> 00:00:35,900
are hard-pressed to explain. The supernova left behind a

8
00:00:35,920 --> 00:00:40,000
magnetized neutron star -- a pulsar. It's about the size

9
00:00:40,020 --> 00:00:44,140
of Washington D.C., but it spins 30 times a second. Each

10
00:00:44,160 --> 00:00:48,180
rotation sweeps a lighthouse-like beam past us, creating a pulse of electromagnetic

11
00:00:48,200 --> 00:00:52,220
energy detectable across the spectrum. Here's what the

12
00:00:52,240 --> 00:00:56,300
sky looks like in high-energy gamma rays. The pulsar in the Crab Nebula

13
00:00:56,320 --> 00:01:00,310

is among the brightest sources. As the pulsar spins, its powerful

14
00:01:00,330 --> 00:01:04,350
magnetic field causes particles to flow. These currents ultimately light up the

15
00:01:04,370 --> 00:01:08,410
nebula. But as bright as the pulsar is in gamma rays, it isn't the source

16
00:01:08,430 --> 00:01:12,440
of the flares. NASA's Fermi Gamma-ray Space Telescope can look in

17
00:01:12,460 --> 00:01:16,480
between the pulsar's brilliant pulses to reveal the faint gamma rays from the underlying

18
00:01:16,500 --> 00:01:20,570
nebula. Yet several times since 2009 enormous

19
00:01:20,590 --> 00:01:24,600
flares have erupted somewhere within the nebula. The most powerful one to date

20
00:01:24,620 --> 00:01:28,650
lasted six days and made the nebula 30 times brighter than normal and five times

21
00:01:28,670 --> 00:01:32,760
brighter than previous flares. During the huge flare,

22
00:01:32,780 --> 00:01:36,790
astronomers also studied the Crab with NASA's Chandra X-ray Observatory. Chandra's

23
00:01:36,810 --> 00:01:40,860
keen X-ray eye saw lots of activity, but none of it seems correlated to the

24
00:01:40,880 --> 00:01:44,960
superflare. This hints that whatever's causing the flare is happening

25
00:01:44,980 --> 00:01:49,000
within about a third of a light-year from the pulsar. And rapid changes in the rise

26
00:01:49,020 --> 00:01:53,130
and fall of gamma rays imply that the emission region is very small, comparable

27
00:01:53,150 --> 00:01:57,160
in size to our solar system. Scientists say the gamma

28
00:01:57,180 --> 00:02:01,180
rays most likely arise from electrons moving near the speed of light, which emit gamma

29
00:02:01,200 --> 00:02:05,240
rays as they interact with magnetic fields. But to account for these flares,

30
00:02:05,260 --> 00:02:09,260
the electrons must have the highest energies ever seen in cosmic sources--

31
00:02:09,280 --> 00:02:13,300
100 times higher than can be achieved in the most powerful particle accelerators on Earth.

32
00:02:13,320 --> 00:02:17,430
Even after a thousand years, the heart of this shattered star still

33
00:02:17,450 --> 00:02:21,450
offers scientists glimpses of staggering energies and cutting-edge science.