1
00:00:16,110 --> 00:00:04,010
[Music]

2
00:00:16,130 --> 00:00:20,190
Narrator: The large Magellanic Cloud is among the closest galaxies to our own Milky Way,

3
00:00:20,210 --> 00:00:24,210
offering astronomers a detailed look at what makes a galaxy tick.

4
00:00:24,230 --> 00:00:28,230
One of its most striking features is the Tarantula Nebula,

5
00:00:28,250 --> 00:00:32,320
a star-forming region than any in ours or other

6
00:00:32,340 --> 00:00:36,350
neighboring galaxies. This is the source of most of the gamma rays

7
00:00:36,370 --> 00:00:40,410
we see from the LMC. Astronomers had thought the emission was a byproduct of

8
00:00:40,430 --> 00:00:44,480
star formation, which includes short-lived massive stars whose explosions

9
00:00:44,500 --> 00:00:48,510
produce shockwaves that can accelerate particles. Interactions by these

10
00:00:48,530 --> 00:00:52,530
particles, called cosmic rays, can produce gamma rays, the highest-energy

11
00:00:52,550 --> 00:00:56,620
form of light. But a discovery by NASA's Fermi Gamma-ray

12
00:00:56,640 --> 00:01:00,640
Space Telescope has turned this thinking on its head. Most of the

13
00:01:00,660 --> 00:01:04,660

emission arises from a single gamma-ray pulsar--the first ever detected in

14
00:01:04,680 --> 00:01:08,710
another galaxy. Pulsar J0540-6919

15
00:01:08,730 --> 00:01:12,790
turns out to be the most luminous gamma-ray

16
00:01:12,810 --> 00:01:16,820
pulsar yet observed, beating the previous record holder, the famous Crab

17
00:01:16,840 --> 00:01:20,870
Neubula pulsar in the Milky Way by 20 times.

18
00:01:20,890 --> 00:01:24,940
Discovered in X-rays using NASA's Einstein satellite in 1984,

19
00:01:24,960 --> 00:01:28,950
J0540 looked like a twin of the Crab until Fermi's Large Area

20
00:01:28,970 --> 00:01:33,020
Telescope unveiled its gamma-ray power. While Fermi is the most

21
00:01:33,040 --> 00:01:37,100
sensitive gamma-ray telescope ever launched, its vision is not as sharp as

22
00:01:37,120 --> 00:01:41,120
telescopes using other wavelengths. In 1998,

23
00:01:41,140 --> 00:01:47,140
NASA's RXTE satellite detected X-ray pulses from J0537-6910,

24
00:01:47,160 --> 00:01:51,180
a pulsar located just 16 arcminutes from J0540,

25
00:01:51,200 --> 00:01:55,240
or about half the apparent width of the Moon. In the early years of Fermi's

26
00:01:55,260 --> 00:01:59,280
mission, the two pulsars were seen only as a single steady gamma-ray source.

27
00:01:59,300 --> 00:02:03,360
But the vision of Fermi's Large Area Telescope

28
00:02:03,380 --> 00:02:07,400
improves over time for two reasons. First, it collects more

29
00:02:07,420 --> 00:02:11,460
gamma rays, and each one adds to the story of cosmic sources.

30
00:02:11,480 --> 00:02:15,550
Second, Fermi scientists improve their knowledge of the instrument, allowing them to

31
00:02:15,570 --> 00:02:19,560
reanalyze existing data to tease out more detail.

32
00:02:19,580 --> 00:02:23,630
Thanks to new data, and a reprocessing of old, Fermi scientists

33
00:02:23,650 --> 00:02:27,720
were finally able to detect gamma-ray pulses from J0540,

34
00:02:27,740 --> 00:02:31,760
revealing its incredible luminosity. The object is responsible for

35
00:02:31,780 --> 00:02:35,820
perhaps 60 percent of the gamma rays from the Tarantula Nebula.

36
00:02:35,840 --> 00:02:39,910
The surprise that it's the pulsar, not the nebula, suggests astronomers need to

37
00:02:39,930 --> 00:02:43,910
revisit their understanding of how cosmic rays are produced and move through

38
00:02:43,930 --> 00:02:47,980

star-forming regions. And the best way to do that, of course, is to

39
00:02:48,000 --> 00:02:52,000
keep watching the sky.