



1
00:00:00,020 --> 00:00:08,030

Music

2
00:00:08,050 --> 00:00:12,050

Narrator: Hidden deep within a group

3
00:00:12,070 --> 00:00:16,070

of ancient stars, there lurks a young and powerful enigma.

4
00:00:16,090 --> 00:00:20,090

This is NGC 6624, a globular cluster near our

5
00:00:20,110 --> 00:00:24,140

galaxy's center thought to be about 10 billion years old. NASA's

6
00:00:24,160 --> 00:00:28,160

Fermi Gamma-ray Space Telescope detects high-energy radiation from many

7
00:00:28,180 --> 00:00:32,200

globular clusters. Usually what Fermi is seeing is the cumulative gamma

8
00:00:32,220 --> 00:00:36,240

rays from all of the old pulsars in these clusters. A pulsar

9
00:00:36,260 --> 00:00:40,260

is a rapidly spinning neutron star, which is the small, incredibly dense

10
00:00:40,280 --> 00:00:44,280

remnant of a much more massive star. A teaspoon of matter from a neutron

11
00:00:44,300 --> 00:00:48,310

star weighs as much Mount Everest, and a neutron star is so compact

12
00:00:48,330 --> 00:00:52,340

that a ball about 15 miles across contains more matter than our sun.

13
00:00:52,360 --> 00:00:56,360

Neutron stars spin between 7 and 40,000 times a minute

14

00:00:56,380 --> 00:01:00,390

and form with incredibly strong magnetic fields. Rapid spin and

15

00:01:00,410 --> 00:01:04,420

intense magnetic fields drive powerful beams of electromagnetic radiation,

16

00:01:04,440 --> 00:01:08,470

including gamma rays. As the pulsar rotates, these beams

17

00:01:08,490 --> 00:01:12,520

sweep the sky like a lighthouse. To a distant observer, the pulsar appears

18

00:01:12,540 --> 00:01:16,560

to blink on and off. Pulsars slow down as they age

19

00:01:16,580 --> 00:01:20,600

but some of the oldest pulsars spin hundreds of times a second. Each of

20

00:01:20,620 --> 00:01:24,630

these millisecond pulsars orbits a normal star. Over time, the impact

21

00:01:24,650 --> 00:01:28,670

of gas pulled from the normal star, has spun the pulsar up to incredible speeds.

22

00:01:28,690 --> 00:01:32,720

This accretion may be the cause of their weaker magnetic

23

00:01:32,740 --> 00:01:36,780

fields. Despite this, these pulsars also emit gamma rays.

24

00:01:36,800 --> 00:01:40,830

But the millisecond pulsar in NGC 6624

25

00:01:40,850 --> 00:01:44,860

doesn't fit neatly into this picture. It's so bright that Fermi

26

00:01:44,880 --> 00:01:48,880

directly detects its gamma rays, and so far it's the only one seen in a globular

27

00:01:48,900 --> 00:01:52,880

cluster with such power. It's losing energy so fast that it must be only

28

00:01:52,900 --> 00:01:56,900

around 25 million years old--the youngest millisecond pulsar ever found.

29

00:01:56,920 --> 00:02:00,920

It also possesses the strongest magnetic field yet observed in a

30

00:02:00,940 --> 00:02:04,940

millisecond pulsar. It's high energy output dooms it to fade out quickly

31

00:02:04,960 --> 00:02:08,960

on astronomical time scales and scientists wonder if this object represents

32

00:02:08,980 --> 00:02:13,000

a new way to make millisecond pulsars.

33

00:02:13,020 --> 00:02:17,020

In three years, Fermi has detected more

34

00:02:17,040 --> 00:02:21,040

than 100 gamma-ray pulsars, shown here using animated pulses

35

00:02:21,060 --> 00:02:25,050

fifty slower than actual speed. Recent advances in data

36

00:02:25,070 --> 00:02:29,070

analysis helped Fermi reach this milestone, and these techniques promise to find many more

37

00:02:29,090 --> 00:02:33,080

gamma-ray pulsars. Some of these are historical

38

00:02:33,100 --> 00:02:37,100

--the first gamma-ray pulsars ever discovered. Others,

39

00:02:37,120 --> 00:02:41,140

like the pulsar in NGC 6624, were first seen by radio

40

00:02:41,160 --> 00:02:45,150

telescopes and then observed by Fermi. Some were first spotted in

41

00:02:45,170 --> 00:02:49,170

radio after investigating unknown sources detected by Fermi. And about a

42

00:02:49,190 --> 00:02:53,190

third of gamma-ray pulsars were discovered by Fermi on the basis of their gamma-ray

43

00:02:53,210 --> 00:02:57,220

pulsations alone. Fermi's gamma-ray observations are literally showing us