1
00:00:11,010 --> 00:00:06,970
Music

2
00:00:11,030 --> 00:00:15,050
For the past 40 years, astronomers have known that something about the

3
00:00:15,070 --> 00:00:19,090
cosmos doesn't add up. First in galaxy clusters

4
00:00:19,110 --> 00:00:23,130
and then within individual galaxies, they found that visible matter

5
00:00:23,150 --> 00:00:27,180
--stars, gas and dust--cannot account for motions they observe.

6
00:00:27,200 --> 00:00:31,260
No one knows what this missing mass, now

7
00:00:31,280 --> 00:00:35,280
called "dark matter," actually is, but studies by NASA's

8
00:00:35,300 --> 00:00:39,290
WMPA spacecraft of the cosmic microwave background--the oldest

9
00:00:39,310 --> 00:00:43,370
light in the universe--show how much is out there. Dark

10
00:00:43,390 --> 00:00:47,380
matter outnumbers ordinary matter by 4 to 1.

11
00:00:47,400 --> 00:00:51,410
The WMAP results also hint that dark matter likely takes the form on an

12
00:00:51,430 --> 00:00:55,420
as-yet-undiscovered subatomic particle. WIMPs

13
00:00:55,440 --> 00:00:59,440

represent one hypothesized class of these particles. They

14
00:00:59,460 --> 00:01:03,470
neither absorb nor emit light, and don't interact strongly with other particles.

15
00:01:03,490 --> 00:01:07,500
But when they encounter each other, they annihilate and make gamma rays.

16
00:01:07,520 --> 00:01:11,540
That's where NASA's Fermi Gamma-ray Space

17
00:01:11,560 --> 00:01:15,560
Telescope comes in. Two years of scanning the sky with Fermi's

18
00:01:15,580 --> 00:01:19,600
Large Area Telescope have set the strongest limits yet for WIMP dark

19
00:01:19,620 --> 00:01:23,630
matter. The best place to look for gamma rays from dark matter annihilation?

20
00:01:23,650 --> 00:01:27,660
The most boring galaxies around, called dwarf spheroidals.

21
00:01:27,680 --> 00:01:31,690
These faint, tiny galaxies possess impressive

22
00:01:31,710 --> 00:01:35,770
amounts of dark matter, but they contain no gamma-ray-emitting objects,

23
00:01:35,790 --> 00:01:39,820
and little gas or star formation. In the currently accepted

24
00:01:39,840 --> 00:01:43,890
cosmology, the first structures formed as the gravitation of dark matter

25
00:01:43,910 --> 00:01:47,970
corralled normal matter. Simulations show that the largest structures

26
00:01:47,990 --> 00:01:52,090
formed in this way were comparable to the dwarf spheroidal galaxies we see

27
00:01:52,110 --> 00:01:56,120
today. It's thought that large galaxies like our own were

28
00:01:56,140 --> 00:02:00,150
built-up from collisions among these dwarfs.

29
00:02:00,170 --> 00:02:04,170
Using two years of data, Fermi scientists explored ten dwarf

30
00:02:04,190 --> 00:02:08,250
galaxies for an sign of gamma rays from WIMP annihilation. In

31
00:02:08,270 --> 00:02:12,330
this graph, the dashed line marks the sweet spot where conventional expectations

32
00:02:12,350 --> 00:02:16,360
for WIMP dark matter align with what we know about our universe.

33
00:02:16,380 --> 00:02:20,390
Even when scientists combine all of the Fermi data from all ten of the

34
00:02:20,410 --> 00:02:24,440
dwarfs, they see no sign of gamma rays. This limit shrinks

35
00:02:24,460 --> 00:02:28,460
the box where WIMP-based dark matter may be found, and for the

36
00:02:28,480 --> 00:02:32,500
first time, shows that the cosmology we know essentially eliminates some

37
00:02:32,520 --> 00:02:36,600
WIMP types. The longer Fermi operates, the better

38
00:02:36,620 --> 00:02:40,650

its ability either to box in the nature of dark matter, or to find actual

39
00:02:40,670 --> 00:02:44,690
evidence of what it is. And the discovery new dwarf galaxies will

40
00:02:44,710 --> 00:02:48,760
make this search even more sensitive. Although

41
00:02:48,780 --> 00:02:52,840
nondescript, dwarf spheroidal galaxies may have been the first large

42
00:02:52,860 --> 00:02:56,910
structures to form in the universe. Now, they've taken

43
00:02:56,930 --> 00:03:00,930
center stage in the drama to solve one of astronomy's greatest mysteries.

44
00:03:00,950 --> 00:03:04,960
Humm and beep