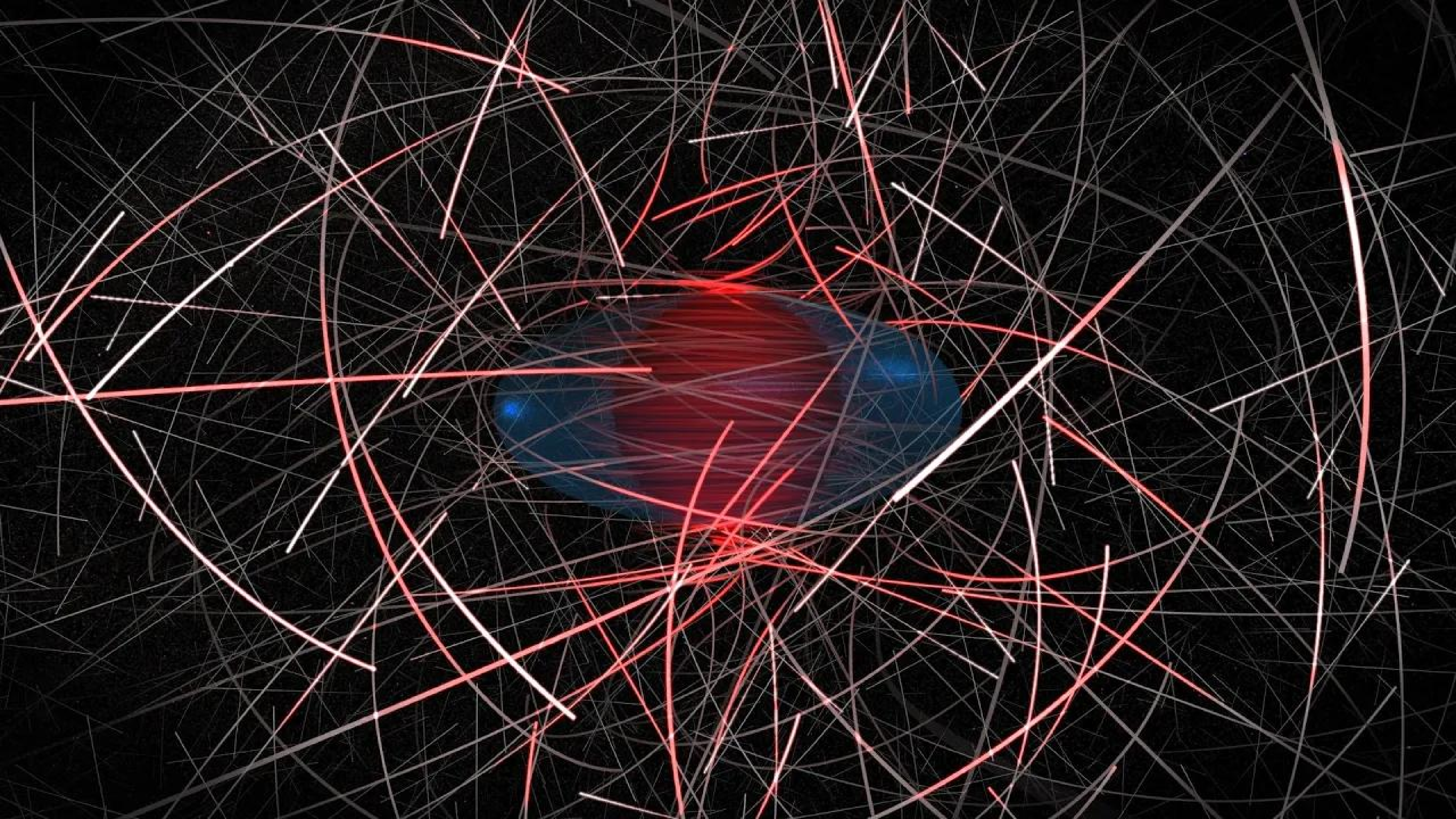

1
00:00:12,110 --> 00:00:04,040
[Music]

2
00:00:12,130 --> 00:00:16,160
Narrator: Dark matter makes up about 27 percent

3
00:00:16,180 --> 00:00:20,170
of the cosmos, but so far no one knows what it is.

4
00:00:20,190 --> 00:00:24,170
Dark matter neither emits nor absorbs light and it

5
00:00:24,190 --> 00:00:28,180
interacts with the rest of the universe primarily through gravity.

6
00:00:28,200 --> 00:00:32,240
In fact, it's thought dark matter traced the initial framework of the

7
00:00:32,260 --> 00:00:36,260
cosmos, attracting normal matter that formed stars and galaxies.

8
00:00:36,280 --> 00:00:40,320
Black holes are astronomical objects famed for their

9
00:00:40,340 --> 00:00:44,330
extreme gravity. Jeremy Schnittman, an astrophysicist at

10
00:00:44,350 --> 00:00:48,370
NASA's Goddard Space Flight Center, wondered if they could serve as a kind of

11
00:00:48,390 --> 00:00:52,440
laboratory for exploring different dark matter models. [Dr. Schnittman]: The leading

12
00:00:52,460 --> 00:00:56,540
particle physics model for dark matter is called weakly

13
00:00:56,560 --> 00:01:00,630

interacting massive particles, or also known as WIMPS. These guys just

14
00:01:00,650 --> 00:01:04,650
fly through the universe without even bumping into anything

15
00:01:04,670 --> 00:01:08,690
or each other. The idea of two WIMPS coming together,

16
00:01:08,710 --> 00:01:12,720
annihilating, and forming gamma rays, is kind of like two bullets hitting

17
00:01:12,740 --> 00:01:16,740
head-on in a crossfire--it's very rare. But when you

18
00:01:16,760 --> 00:01:20,810
go to the area around a supermassive black hole, we expect the

19
00:01:20,830 --> 00:01:24,830
density to be much higher so the probability of annihilation is much higher

20
00:01:24,850 --> 00:01:28,950
and thus detection with a gamma-ray telescope.

21
00:01:28,970 --> 00:01:33,040
Narrator: In Schnittman's computer simulation, a population

22
00:01:33,060 --> 00:01:37,070
of dark matter particles orbits a rapidly spinning black hole.

23
00:01:37,090 --> 00:01:41,170
Close in, at the brink of the black hole's event horizon, the particles

24
00:01:41,190 --> 00:01:45,190
are orbiting at nearly the speed of light. The lightly shaded region

25
00:01:45,210 --> 00:01:49,210
farther out is the ergosphere, a zone where all particles are forced

26
00:01:49,230 --> 00:01:53,280
to move in the same direction as the black hole's spin.

27
00:01:53,300 --> 00:01:57,350
The concentrated dark matter collides and makes gamma rays,

28
00:01:57,370 --> 00:02:01,370
but not all of this light can escape the ergosphere. The gamma rays

29
00:02:01,390 --> 00:02:05,410
most likely to make it out come from the left side, where the black hole spins

30
00:02:05,430 --> 00:02:09,440
toward us. The result is an asymmetric glow.

31
00:02:09,460 --> 00:02:13,490
The highest energy gamma rays come from the center of this region,

32
00:02:13,510 --> 00:02:17,560
corresponding to the black hole's equator. Schnittman's work has

33
00:02:17,580 --> 00:02:21,610
uncovered previously overlooked orbits that can produced extremely energetic

34
00:02:21,630 --> 00:02:25,670
gamma rays, and has shown that the peak energy attainable for this escaping light

35
00:02:25,690 --> 00:02:29,750
is a strong function of the black hole's rotation.

36
00:02:29,770 --> 00:02:33,850
So far, the initial work is focusing on setting upper limits on dark matter

37
00:02:33,870 --> 00:02:37,900
annihilation rates by looking at otherwise quiescent galaxies. But Schnittman's

38
00:02:37,920 --> 00:02:41,950

ultimate ambition is nothing short of an unambiguous detection of dark matter

39
00:02:41,970 --> 00:02:45,990
annihilation around supermassive black holes. [Dr. Schnittman]: To me,

40
00:02:46,010 --> 00:02:50,130
dark matter, black holes, two of the most elusive things in the

41
00:02:50,150 --> 00:02:54,190
universe coming together to help explain each other

42
00:02:54,210 --> 00:02:58,240
is quite poetic. [Music]