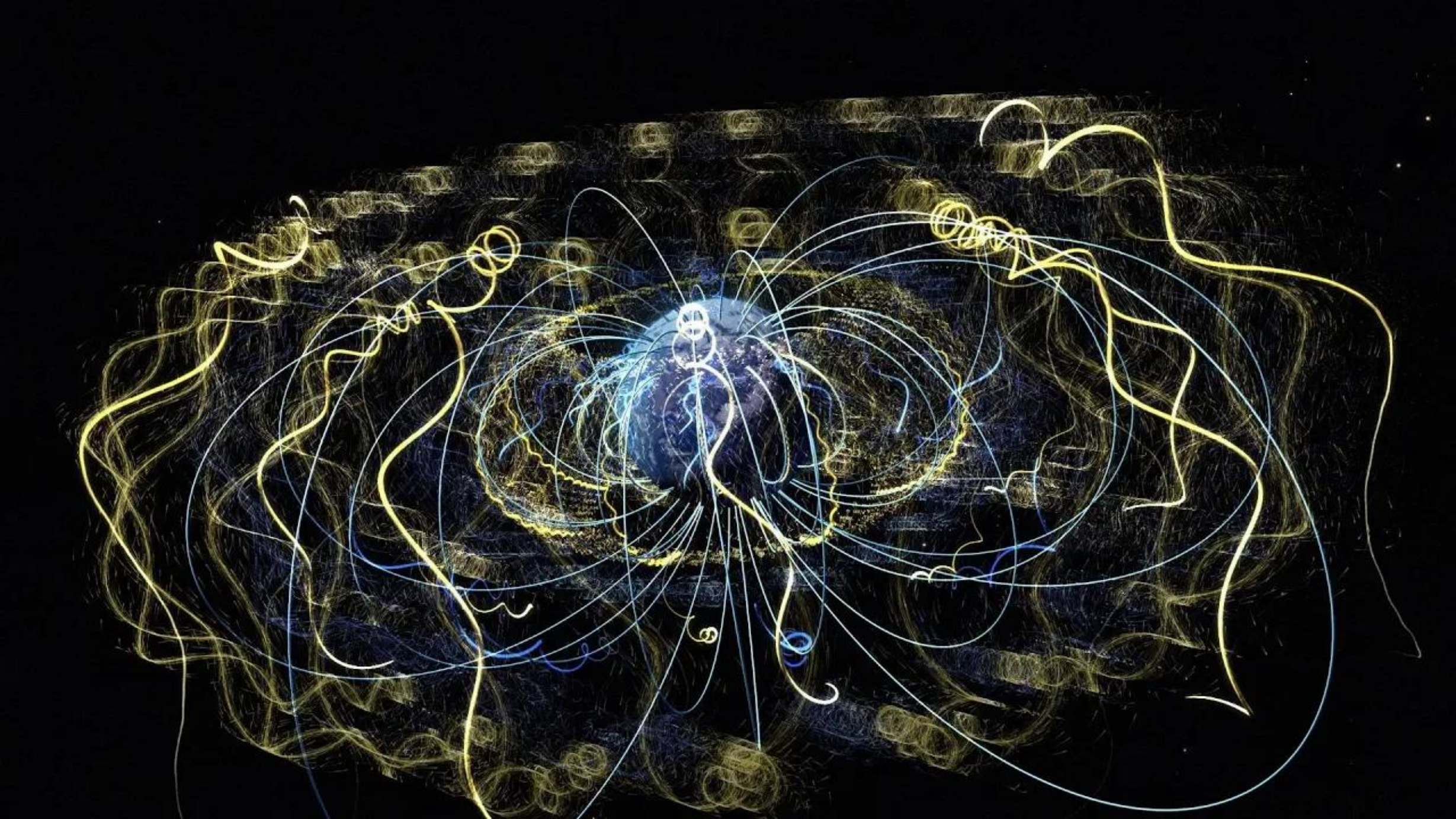

1
00:00:00,000 --> 00:00:05,950
Throughout the universe there are forces fundamental to how things move.

2
00:00:05,970 --> 00:00:08,890
Just as gravity is key to how things move on Earth,

3
00:00:08,910 --> 00:00:11,660
a process called magnetic reconnection

4
00:00:11,680 --> 00:00:15,870
is key to how charged particles speed through space.

5
00:00:15,890 --> 00:00:19,500
The more we understand how those particles are accelerated,

6
00:00:19,520 --> 00:00:25,340
the better we can protect our spacecraft and astronauts as we explore deeper into the solar system.

7
00:00:25,360 --> 00:00:29,570
And now, NASA’s Magnetospheric Multiscale spacecraft, or MMS,

8
00:00:29,590 --> 00:00:35,310
has discovered magnetic reconnection occurring in a new and surprising way near Earth.

9
00:00:35,330 --> 00:00:42,320
Typically, images of our planet from space show a blue-green sphere engulfed by the darkness of space.

10
00:00:42,340 --> 00:00:48,650
But -- invisible to the eye -- a vast network of magnetic energy and particles surround our planet.

11
00:00:48,670 --> 00:00:54,630
Earth’s magnetic field creates a protective bubble that shields us from highly energetic particles

12
00:00:54,650 --> 00:00:58,000
that stream in both from the Sun and interstellar space.

13
00:00:58,020 --> 00:01:00,090

As this solar wind bathes our planet,

14
00:01:00,110 --> 00:01:05,020
Earth’s magnetic field lines absorbs this energy and get stretched.

15
00:01:05,040 --> 00:01:09,390
And like elastic bands they eventually release energy by snapping.

16
00:01:09,410 --> 00:01:14,290
As a result, particles in the region are flung at supersonic speeds.

17
00:01:14,310 --> 00:01:17,650
That burst of energy is magnetic reconnection.

18
00:01:17,670 --> 00:01:22,220
It’s pervasive in the universe - it happens on the Sun, around Earth,

19
00:01:22,240 --> 00:01:25,190
and flings particles across the solar system.

20
00:01:25,210 --> 00:01:31,520
Scientists have observed this phenomenon many times in the magnetosphere, Earth’s vast magnetic environm

21
00:01:31,540 --> 00:01:36,000
Now, in a new study, MMS caught the process occurring in a new region.

22
00:01:36,020 --> 00:01:41,440
For the first time, magnetic reconnection was detected in the turbulent magnetosheath -

23
00:01:41,460 --> 00:01:44,690
the boundary between the magnetosphere and solar wind.

24
00:01:44,710 --> 00:01:47,720
This region is made up of turbulent plasma.

25
00:01:47,740 --> 00:01:51,750
It’s one of the most chaotic regions in the near-Earth space.

26
00:01:51,770 --> 00:01:58,120
MMS captured 3-D observations by flying four identical spacecraft in a tight pyramid formation

27
00:01:58,140 --> 00:01:59,560
through the magnetosheath.

28
00:01:59,580 --> 00:02:02,900
These arrows show the hundreds of observations MMS took

29
00:02:02,920 --> 00:02:06,300
to measure the changes in particles and the magnetic field.

30
00:02:06,320 --> 00:02:10,960
This is the moment MMS sees bursts of energy from magnetic reconnection.

31
00:02:10,980 --> 00:02:15,300
But these signatures don’t look like standard reconnection.

32
00:02:15,320 --> 00:02:19,480
Compared to standard reconnection that occurs over tens of thousands of miles,

33
00:02:19,500 --> 00:02:24,450
this new magnetic reconnection spans only a couple of miles within turbulent plasma.

34
00:02:24,470 --> 00:02:29,600
These reactions are essentially much smaller but more stretchy elastic bands

35
00:02:29,620 --> 00:02:32,360
that accelerate particles 40 times faster.

36
00:02:32,380 --> 00:02:38,830
In short, MMS spotted a completely new magnetic mechanism that’s much quicker than what we’ve seen befor

37
00:02:38,850 --> 00:02:41,170
Just like when you mix milk into coffee,

38
00:02:41,190 --> 00:02:45,670

turbulent plasma in space moves randomly and creates vortices.

39
00:02:45,690 --> 00:02:52,280
It can transport particles and energy, but a lot is unknown about how these particles move through these regio

40
00:02:52,300 --> 00:02:56,860
Showing that this new magnetic reconnection plays a role in turbulent plasma

41
00:02:56,880 --> 00:03:02,210
gives scientists insights into how turbulence influences particles moving through space.

42
00:03:02,230 --> 00:03:07,340
By looking at such fundamental processes in space at both large and small scales,