1
00:00:00,020 --> 00:00:04,060
Astronomers have found thousands

2
00:00:04,080 --> 00:00:08,090
of planets orbiting distant stars, and the discoveries keep coming.

3
00:00:08,110 --> 00:00:12,160
Yet many techniques detect only the planets closest to their host stars,

4
00:00:12,180 --> 00:00:16,200
and within a few hundred light-years of Earth, leaving us to wonder what worlds

5
00:00:16,220 --> 00:00:20,260
we're missing. A technique called microlensing promises to

6
00:00:20,280 --> 00:00:24,440
clarify the picture. A recent analysis of six years of data

7
00:00:24,460 --> 00:00:28,570
from the MOA-II ground-based survey concludes that exoplanets similar

8
00:00:28,590 --> 00:00:32,690
in mass and, probably, composition, to Neptune are likely the most common

9
00:00:32,710 --> 00:00:36,860
worlds in the outer reaches of planetary systems.

10
00:00:36,880 --> 00:00:40,910
When a star passes directly between us and a more distant star,

11
00:00:40,930 --> 00:00:44,940
its gravity can act like a lens, magnifying the background star's

12
00:00:44,960 --> 00:00:49,000
brightness significantly for a few weeks. If the lensing star hosts

13
00:00:49,020 --> 00:00:53,040

a planet, the planets gravity can produce a noticeable change in brightness over

14
00:00:53,060 --> 00:00:57,100
a hours or days. This spike signals not only the planet's

15
00:00:57,120 --> 00:01:01,170
presence, but tells us its mass and distance from the star.

16
00:01:01,190 --> 00:01:05,250
Each method of finding exoplanets

17
00:01:05,270 --> 00:01:09,330
has different strengths. Radial velocity measurements reveal planets by

18
00:01:09,350 --> 00:01:13,380
detecting how they cause the star to move. Transit measurements reveal dips in

19
00:01:13,400 --> 00:01:17,580
starlight caused by planets passing in front of their stars.

20
00:01:17,600 --> 00:01:21,710
Both work best for massive planets in close orbits, and for stars up to hundreds of

21
00:01:21,730 --> 00:01:25,880
lgiht-years away. Microlensing opens a

22
00:01:25,900 --> 00:01:30,070
planetary window onto a larger part of the galaxy, reaching thousands of light-years.

23
00:01:30,090 --> 00:01:34,110
And because microlensing is more sensitive to smaller planets farther from their stars,

24
00:01:34,130 --> 00:01:38,170
it can reveal new planetary populations.

25
00:01:38,190 --> 00:01:42,220
In the MOA-II study, researchers discovered that planets beyond a certain

26
00:01:42,240 --> 00:01:46,290
distance from their star tend to be roughly 20 Earth masses, or

27
00:01:46,310 --> 00:01:50,360
about the same as Neptune. That distance is what astronomers call

28
00:01:50,380 --> 00:01:54,430
the "snow line," where water would be frozen during the formation of a

29
00:01:54,450 --> 00:01:58,510
planetary system. For our system, that location is roughly

30
00:01:58,530 --> 00:02:02,650
2.7 times farther from the sun than Earth. Beyond the snow line,

31
00:02:02,670 --> 00:02:06,680
where there is more solid material to coagulate and initiate the planet formation

32
00:02:06,700 --> 00:02:10,750
process, planetary formation is thought to be most efficient.

33
00:02:10,770 --> 00:02:14,820
In fact, worlds formed in this frozen hinterland

34
00:02:14,840 --> 00:02:18,940
may play an important role in making habitable planets closer to their star.

35
00:02:18,960 --> 00:02:23,070
The gravity of planets beyond the snow line can help send water-rich

36
00:02:23,090 --> 00:02:27,150
asteroids inward, where they can deliver water to young rocky worlds.

37
00:02:27,170 --> 00:02:31,190
WFIRST, an upcoming NASA mission,

38
00:02:31,210 --> 00:02:35,220

which combines high-resolution with a huge field of view, will watch for

39
00:02:35,240 --> 00:02:39,380
microlensing events toward the central part of our galaxy, the Milky Way.

40
00:02:39,400 --> 00:02:43,560
It will expand on the exoplanet survey started by NASA's Kepler mission,

41
00:02:43,580 --> 00:02:47,590
and should reveal exoplanets down to Mars mass in orbits around their

42
00:02:47,610 --> 00:02:51,650
stars as close as Earth's to more distant than Neptune's.

43
00:02:51,670 --> 00:02:55,690
When combined with Kepler's discoveries, WFIRST will give us a complete

44
00:02:55,710 --> 00:02:59,710
picture of exoplanetary systems. Stay tuned.

45
00:03:11,860 --> 00:03:03,760
[Music]