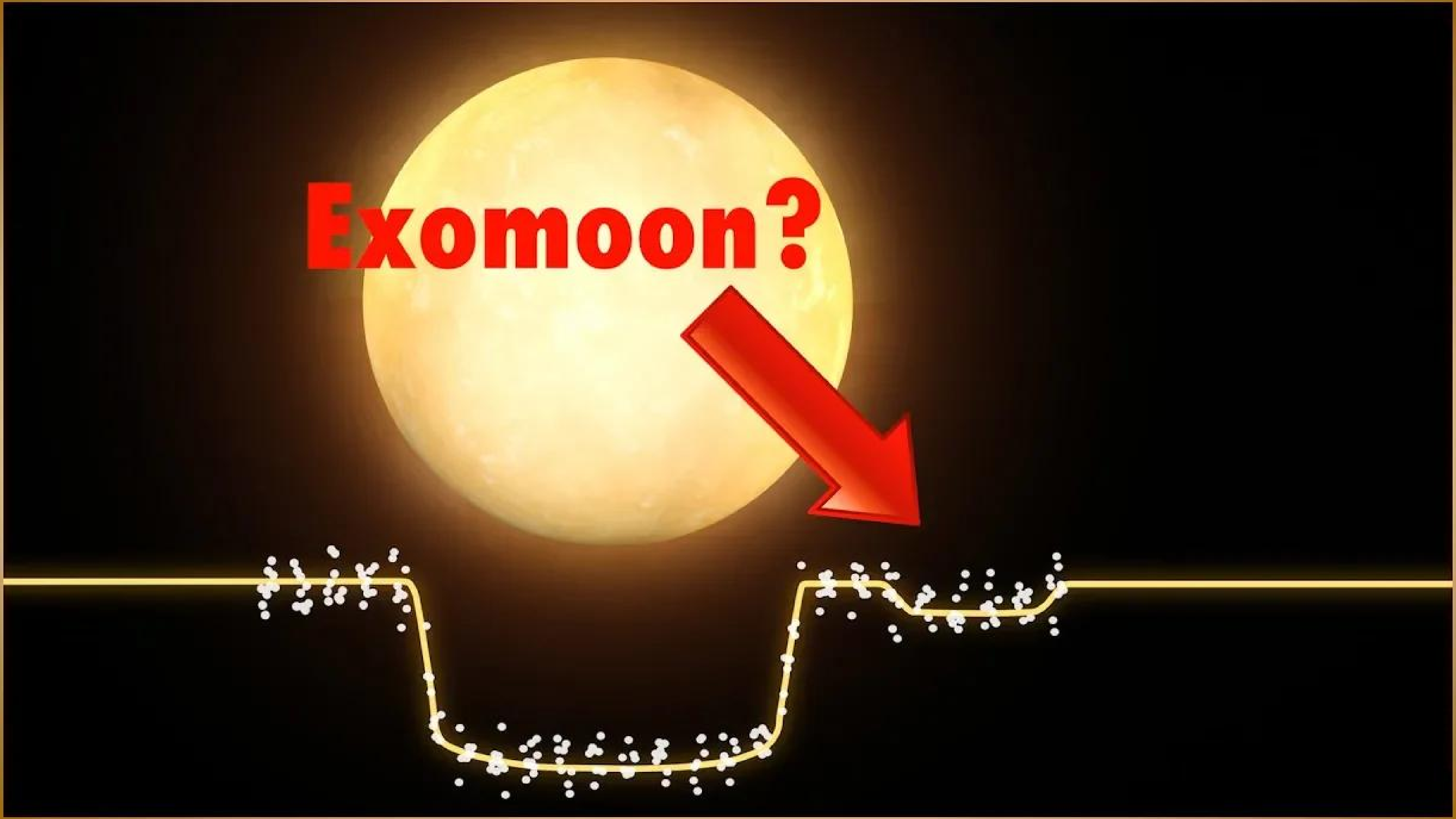
Exomoon?

1
00:00:00,000 --> 00:00:04,238
In 2017, astronomers using
NASA’s Kepler telescope found

2
00:00:04,238 --> 00:00:07,307
hints of evidence of what they
thought could be the first

3
00:00:07,307 --> 00:00:11,411
exomoon ever detected– a moon
orbiting a planet outside our

4
00:00:11,411 --> 00:00:14,748
solar system. A lot of people
were very excited about the

5
00:00:14,748 --> 00:00:17,718
potential discovery, and the
research team requested time on

6
00:00:17,718 --> 00:00:21,822
NASA’s Hubble Space Telescope to
see if there was truly a moon.

7
00:00:21,822 --> 00:00:25,826
Now, the data from Hubble is in
and processed. Have scientists

8
00:00:25,826 --> 00:00:29,363
found our first exomoon? Looks
like they still need more

9
00:00:29,363 --> 00:00:33,133
observations to be a hundred
percent sure. The moons in our

10
00:00:33,133 --> 00:00:36,703
solar system are very diverse –
some with liquid water, some

11
00:00:36,703 --> 00:00:39,907
that are potentially habitable –
so being able to observe moons

12
00:00:39,907 --> 00:00:42,876
in different solar systems would
give us a whole new treasure

13
00:00:42,876 --> 00:00:46,613
trove of interesting worlds to
study. The team of astronomers

14
00:00:46,613 --> 00:00:50,751
from Columbia University sifted
through data from 284 Kepler

15
00:00:50,751 --> 00:00:54,221
measurements of transiting
exoplanets. A transit happens

16
00:00:54,221 --> 00:00:57,257
when a planet passes directly
between us and its star and

17
00:00:57,257 --> 00:01:00,460
blocks out a small portion of
the star’s light, which produces

18
00:01:00,460 --> 00:01:03,363
a dip in the amount of light
coming from that star over time,

19
00:01:03,363 --> 00:01:07,067
called a light curve. If there’s
a moon on either side of the

20
00:01:07,067 --> 00:01:10,537
planet, we may be able to see a
second, smaller dip in the light

21
00:01:10,537 --> 00:01:13,574
curve. Making transit
measurements and processing the

22
00:01:13,574 --> 00:01:16,543
data into a light curve can be
very tricky though, so

23
00:01:16,543 --> 00:01:19,313
scientists need to observe
multiple transits in order to

24
00:01:19,313 --> 00:01:23,917
get convincing evidence of an
exoplanet or an exomoon. Out of

25
00:01:23,917 --> 00:01:28,021
the 284 planets the team looked
at, they found one planet with

26
00:01:28,021 --> 00:01:32,225
an extra wobble in its light
curve that might be a moon. This

27
00:01:32,225 --> 00:01:36,196
planet, Kepler-1625b, orbits its
star once every nine and a half

28
00:01:36,196 --> 00:01:40,634
months, so it takes years to
observe multiple transits. The

29
00:01:40,634 --> 00:01:43,170
team only had Kepler data from
three transits of this

30
00:01:43,170 --> 00:01:46,206
exoplanet, so they sent a
proposal to the Hubble Space

31
00:01:46,206 --> 00:01:50,677
Telescope to capture more data
of this possible exomoon. Hubble

32
00:01:50,677 --> 00:01:53,680
can measure light curves much
more precisely than Kepler, so

33
00:01:53,680 --> 00:01:56,350
Hubble can more definitively
confirm or disprove the

34
00:01:56,350 --> 00:02:00,587
existence of this exomoon once
it gets multiple transits. So

35
00:02:00,587 --> 00:02:03,690
far, the team of astronomers has
collected Hubble observations of

36
00:02:03,690 --> 00:02:08,295
one transit of exoplanet
Kepler-1625b. Hubble measured

37
00:02:08,295 --> 00:02:12,232
the light coming from the star
over a period of 40 hours. About

38
00:02:12,232 --> 00:02:15,669
7 hours into the observation,
the planet started its transit,

39
00:02:15,669 --> 00:02:19,373
which was about an hour earlier
than predicted – a tantalizing

40
00:02:19,373 --> 00:02:22,442
piece of evidence that the
planet has a large moon, because

41
00:02:22,442 --> 00:02:26,813
a moon would cause the planet to
wobble in its orbit. The planet

42
00:02:26,813 --> 00:02:31,218
transited across the face of its
star for 19 hours, as expected.

43
00:02:31,218 --> 00:02:34,521
Then, about three and a half
hours later, a second smaller

44
00:02:34,521 --> 00:02:38,759
dip in the light curve started.
That right there is intriguing

45
00:02:38,759 --> 00:02:42,562
evidence of an exomoon. The
Hubble observation unfortunately

46
00:02:42,562 --> 00:02:46,199
concluded before the possible
moon finished its transit, so

47
00:02:46,199 --> 00:02:50,070
Hubble hasn’t yet observed a
full transit. This light curve

48
00:02:50,070 --> 00:02:52,072
appears like it shows an
exomoon, but

49
00:02:52,072 --> 00:02:54,241
we can’t say
it’s a definitive detection

50
00:02:54,241 --> 00:02:58,245
until Hubble observes at least
one more transit. If this is

51
00:02:58,245 --> 00:03:01,581
actually a moon, what do we know
about it? The planet

52
00:03:01,581 --> 00:03:05,752
Kepler-1625b is likely several
times the mass of Jupiter. Its

53
00:03:05,752 --> 00:03:08,722
possible moon appears to be
about the mass and radius of

54
00:03:08,722 --> 00:03:11,558
Neptune. The ratio between the
mass of this planet and its moon

55
00:03:11,558 --> 00:03:15,395
is about the same as between the
Earth and our Moon, but scaled

56
00:03:15,395 --> 00:03:19,032
way up. Neptune-sized moons are
obviously not something that

57
00:03:19,032 --> 00:03:23,470
exist in our own solar system,
and we’re not sure exactly how

58
00:03:23,470 --> 00:03:27,174
such a moon would form. When
scientists first started

59
00:03:27,174 --> 00:03:29,743
discovering exoplanets, a lot of
them were several times the mass

60
00:03:29,743 --> 00:03:33,880
of Jupiter because big planets
are easier to detect, so a

61
00:03:33,880 --> 00:03:37,451
similar thing may happen when
discovering the first exomoons.

62
00:03:37,451 --> 00:03:40,620
Finding planets and moons so
different from the ones in our

63
00:03:40,620 --> 00:03:43,223
own solar system gives us a lot
more knowledge of the many

64
00:03:43,223 --> 00:03:47,461
diverse ways planetary systems
can exist. In the near future,

65
00:03:47,461 --> 00:03:50,497
scientists hope to use the
Hubble Space Telescope to try to

66
00:03:50,497 --> 00:03:53,733
confirm the discovery of this
exomoon, and they’ll use Hubble

67
00:03:53,733 --> 00:03:56,570
for follow-up observations of
other planetary systems

68
00:03:56,570 --> 00:03:59,372
discovered by observatories like
Kepler and the recently launched

69
00:03:59,372 --> 00:04:03,043
Transiting Exoplanet Survey
Satellite, TESS. And then the

70
00:04:03,043 --> 00:04:05,846
upcoming James Webb Space
Telescope will be able to take

71
00:04:05,846 --> 00:04:08,482
high-precision measurements in
infrared wavelengths, which

72
00:04:08,482 --> 00:04:11,518
combined with Hubble will allow
for detailed characterizations

73
00:04:11,518 --> 00:04:14,621
of a whole bunch of really
interesting exoplanets and

74
00:04:14,621 --> 00:04:20,460
exomoons. So if you like planets
– and honestly, who doesn’t –

75
00:04:20,460 --> 00:04:23,330
stay tuned to learn more about
all sorts of fascinating new

76
00:04:23,330 --> 00:04:25,632
worlds.

77
00:04:25,632 --> 00:04:29,903
[music fades out]