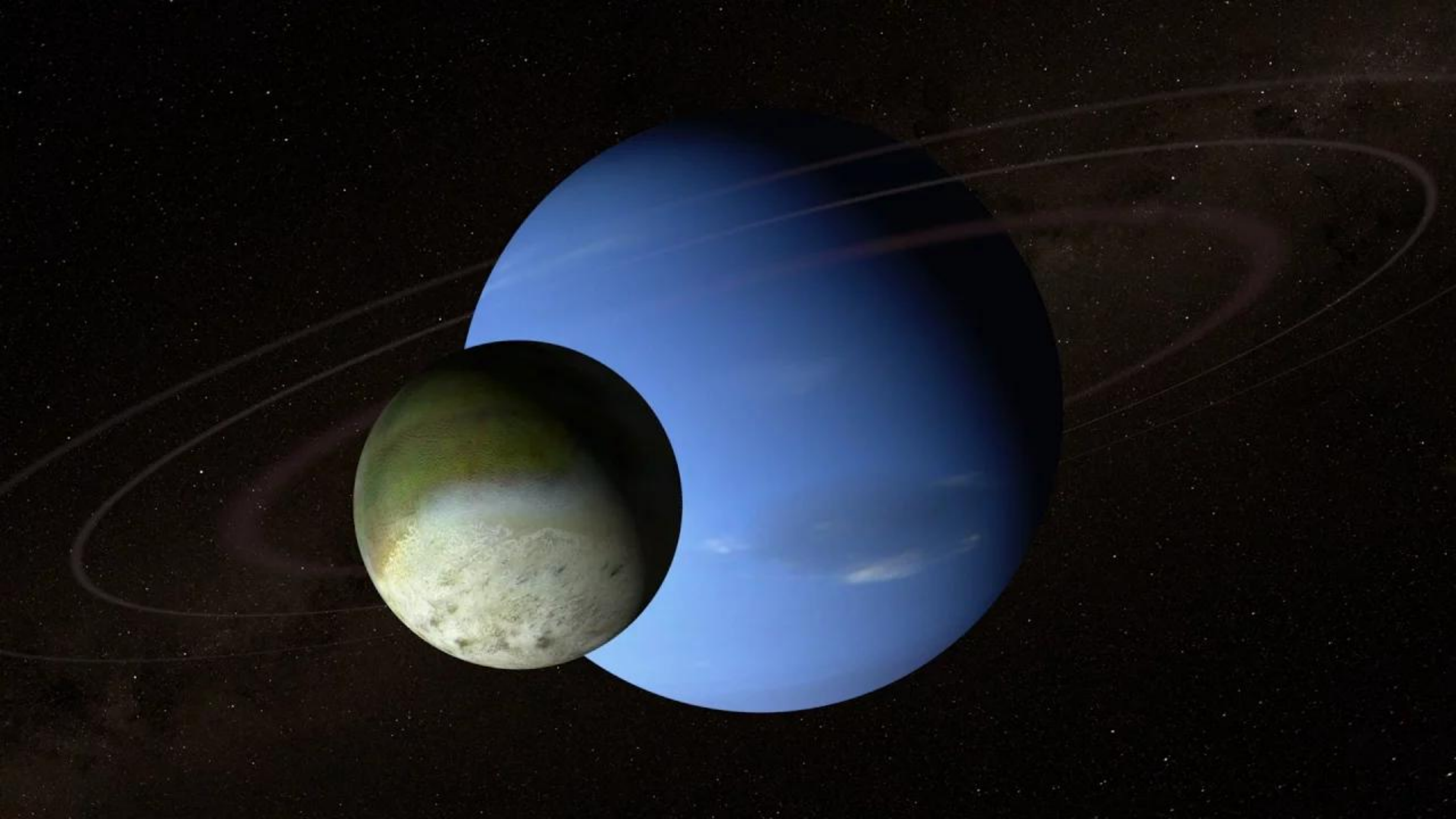

1
00:00:00,834 --> 00:00:04,838
NASA's Kepler telescope trails
behind Earth in its orbit.

2
00:00:04,838 --> 00:00:08,041
Since 2014, Kepler has been
looking outward along the

3
00:00:08,041 --> 00:00:10,911
ecliptic, the plane
of our solar system.

4
00:00:10,911 --> 00:00:13,513
In this orientation, the
telescope can observe the

5
00:00:13,513 --> 00:00:16,617
superior planets like Neptune,
which passed through its field

6
00:00:16,617 --> 00:00:20,921
of view in late 2014
through early 2015.

7
00:00:20,921 --> 00:00:24,558
As we zoom into Kepler's array
of detectors, we see the images

8
00:00:24,558 --> 00:00:27,628
taken by the telescope during
this period, sped up from over

9
00:00:27,628 --> 00:00:31,164
two months of observations
into a matter of seconds.

10
00:00:31,164 --> 00:00:34,601
The dot orbiting Neptune is its
largest moon, Triton, while the

11
00:00:34,601 --> 00:00:38,205
smaller moon Nereid
trails faintly to the east.

12
00:00:38,205 --> 00:00:41,074
About halfway through the
observation, Neptune appears to

13
00:00:41,074 --> 00:00:44,044
stop its westward
march and reverse course.

14
00:00:44,044 --> 00:00:46,380
In reality, Neptune always moves
east,

15
00:00:46,380 --> 00:00:48,181
but at a slower rate than
Kepler.

16
00:00:48,181 --> 00:00:51,551
This causes an apparent
retrograde motion, or backwards

17
00:00:51,551 --> 00:00:55,656
step, each time that the
telescope laps the planet.

18
00:00:55,656 --> 00:00:58,492
The Kepler Telescope was
originally designed to search

19
00:00:58,492 --> 00:01:00,594
for planets in other solar
systems

20
00:01:00,594 --> 00:01:02,763
using the transit method.

21

00:01:02,763 --> 00:01:05,866
When a planet passes in front of
its star, it causes a small dip

22
00:01:05,866 --> 00:01:08,302
in starlight that can be
measured by Kepler's sensitive

23
00:01:08,302 --> 00:01:12,406
detector, revealing the
presence and size of the planet.

24
00:01:12,406 --> 00:01:15,008
During the Neptune observations,
Kepler instead looked

25
00:01:15,008 --> 00:01:17,344
at changes in reflected
sunlight.

26
00:01:17,344 --> 00:01:20,314
It measured fluctuations in
Neptune's brightness of less

27
00:01:20,314 --> 00:01:23,717
than a single percent, caused by
factors including the planet's

28
00:01:23,717 --> 00:01:27,788
daily rotation, the movement of
clouds, and even seismic waves

29
00:01:27,788 --> 00:01:30,324
within the Sun itself.

30
00:01:30,324 --> 00:01:33,627
By measuring tiny variations
in Neptune's brightness, Kepler

31
00:01:33,627 --> 00:01:36,863

teased out clues to the planet's
hidden dynamics, pushing the

32
00:01:36,863 --> 00:01:39,733
limits of its detector, and
laying the groundwork for more

33
00:01:39,733 --> 00:01:43,303
detailed studies of
exoplanets in the years ahead.