
HUBBLE SCIENCE
GRAVITATIONAL LENSING
Nature's Boost

1
00:00:19,830 --> 00:00:17,349
as hubble looks out into these

2
00:00:21,990 --> 00:00:19,840
fields of galaxies we sometimes see

3
00:00:23,830 --> 00:00:22,000
clusters of galaxies these are galaxies

4
00:00:26,310 --> 00:00:23,840
that are held nearby each other by their

5
00:00:28,790 --> 00:00:26,320
mutual gravity

6
00:00:31,830 --> 00:00:28,800
these clusters are

7
00:00:34,310 --> 00:00:31,840
massive conglomerations

8
00:00:37,910 --> 00:00:34,320
there's so much mass that they have an

9
00:00:39,430 --> 00:00:37,920
actual observable impact on space time

10
00:00:42,709 --> 00:00:39,440
itself

11
00:00:44,470 --> 00:00:42,719
einstein predicted that mass distorts

12
00:00:46,470 --> 00:00:44,480
space but we didn't realize we could

13
00:00:49,110 --> 00:00:46,480

actually see the effects of that but

14
00:00:51,670 --> 00:00:49,120
with hubble we have been able to see

15
00:00:54,389 --> 00:00:51,680
distortions in space around clusters of

16
00:00:57,270 --> 00:00:54,399
galaxies the way we see that is when

17
00:00:59,510 --> 00:00:57,280
light from a background galaxy travels

18
00:01:01,830 --> 00:00:59,520
through that cluster of galaxies or

19
00:01:04,229 --> 00:01:01,840
around it due to this gravitational

20
00:01:07,270 --> 00:01:04,239
lensing effect the lensing also

21
00:01:09,429 --> 00:01:07,280
magnifies that background galaxy so if

22
00:01:11,350 --> 00:01:09,439
we look in some of these distorted arcs

23
00:01:13,990 --> 00:01:11,360
we can see more detail than we would

24
00:01:17,190 --> 00:01:14,000
ever have been able to see without

25
00:01:19,510 --> 00:01:17,200
gravitational lensing nature's boost

26
00:01:21,830 --> 00:01:19,520
so hubble has been used in an unexpected

27
00:01:23,990 --> 00:01:21,840
way for us to look at nature's

28
00:01:24,950 --> 00:01:24,000
magnifying glasses these gravitational

29
00:01:27,350 --> 00:01:24,960
lenses

30
00:01:29,590 --> 00:01:27,360
and using those to tell us about much

31
00:01:31,749 --> 00:01:29,600
more distant galaxies in detail we could

32
00:01:33,830 --> 00:01:31,759
never have seen without the lensing and

33
00:01:36,069 --> 00:01:33,840
also to tell us how dark matter is

34
00:01:38,310 --> 00:01:36,079
distributed in those clusters because it

35
00:01:40,230 --> 00:01:38,320
turns out that most of the mass that's

36
00:01:41,590 --> 00:01:40,240
distorting space and these clusters of

37
00:01:44,149 --> 00:01:41,600
galaxies

38
00:01:46,550 --> 00:01:44,159

is made of this unseen dark matter not

39
00:01:48,230 --> 00:01:46,560
the visible stars and the galaxies and

40
00:01:49,990 --> 00:01:48,240
we can't see the dark matter but by

41
00:01:52,069 --> 00:01:50,000
seeing how this background light is

42
00:01:54,789 --> 00:01:52,079
distorted we can kind of map out where

43
00:01:57,350 --> 00:01:54,799
that dark matter is through this effect

44
00:01:58,870 --> 00:01:57,360
we call gravitational lensing

45
00:02:01,429 --> 00:01:58,880
so we're learning a lot about dark

46
00:02:03,270 --> 00:02:01,439
matter this mystery of matter we don't

47
00:02:05,270 --> 00:02:03,280
really know what it is but we know where

48
00:02:07,030 --> 00:02:05,280
it is in these clusters because of this

49
00:02:10,969 --> 00:02:07,040
innovative use of the hubble space