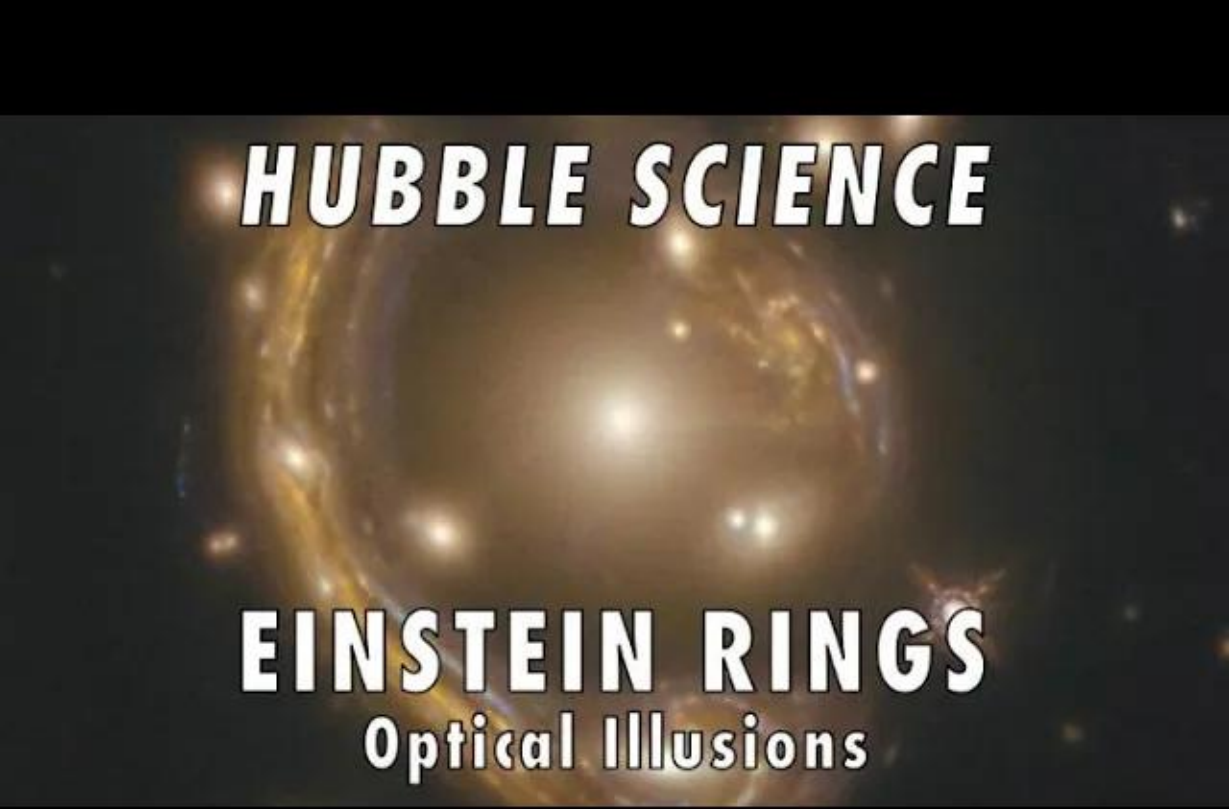
HUBBLE SCIENCE
EINSTEIN RINGS
Optical Illusions

1
00:00:00,050 --> 00:00:09,110
[Music]

2
00:00:13,490 --> 00:00:11,450
an Einstein ring is a very cool feature

3
00:00:15,110 --> 00:00:13,500
of gravitational lensing where a

4
00:00:17,870 --> 00:00:15,120
background Galaxy gets stretched out

5
00:00:18,950 --> 00:00:17,880
into a full ring around the foreground

6
00:00:21,470 --> 00:00:18,960
lens

7
00:00:23,750 --> 00:00:21,480
molten ring is a really interesting case

8
00:00:26,509 --> 00:00:23,760
where it's one of the largest galaxies

9
00:00:28,250 --> 00:00:26,519
that forms a near complete Einstein ring

10
00:00:30,170 --> 00:00:28,260
the molten ring you have a very large

11
00:00:33,229 --> 00:00:30,180
cluster of galaxies that has magnified

12
00:00:37,610 --> 00:00:35,270
Einstein's theory of general relativity

13
00:00:39,889 --> 00:00:37,620

is really sort of what predicted these

14
00:00:42,590 --> 00:00:39,899
Einstein rings in the first place he

15
00:00:44,569 --> 00:00:42,600
created this whole machinery for how

16
00:00:46,430 --> 00:00:44,579
gravity is supposed to work matter would

17
00:00:48,350 --> 00:00:46,440
tell space-time how to curve and

18
00:00:50,330 --> 00:00:48,360
space-time would tell matter how to move

19
00:00:52,250 --> 00:00:50,340
and then as you have light moving

20
00:00:54,049 --> 00:00:52,260
through this curved space time that

21
00:00:56,270 --> 00:00:54,059
those equations led to the prediction

22
00:00:58,790 --> 00:00:56,280
that this light would almost move on

23
00:01:00,650 --> 00:00:58,800
what seems like curved paths and caused

24
00:01:02,750 --> 00:01:00,660
the phenomenon of gravitational lensing

25
00:01:04,910 --> 00:01:02,760
which is where this light gets

26
00:01:07,130 --> 00:01:04,920
essentially bent and distorted by a

27
00:01:09,289 --> 00:01:07,140
foreground lens like your Galaxy cluster

28
00:01:11,149 --> 00:01:09,299
and creates these these stretched out

29
00:01:13,190 --> 00:01:11,159
images that are magnified of these

30
00:01:15,350 --> 00:01:13,200
distant galaxies that we see

31
00:01:18,050 --> 00:01:15,360
it's definitely a bit of an optical

32
00:01:20,929 --> 00:01:18,060
illusion so if you were to take the

33
00:01:22,429 --> 00:01:20,939
gravitational lens completely away then

34
00:01:23,990 --> 00:01:22,439
these background galaxies would just

35
00:01:25,910 --> 00:01:24,000
look like you know the normal everyday

36
00:01:28,190 --> 00:01:25,920
galaxies that we see at these distances

37
00:01:30,170 --> 00:01:28,200
and it'd be a lot harder to to pick

38
00:01:32,870 --> 00:01:30,180

apart what's going on in their their

39
00:01:34,249 --> 00:01:32,880
inner workings so the the gravitational

40
00:01:35,990 --> 00:01:34,259
lensing effect it is kind of like

41
00:01:37,730 --> 00:01:36,000
looking you know at a fun house mirror

42
00:01:40,010 --> 00:01:37,740
it makes the the background object

43
00:01:42,050 --> 00:01:40,020
appear a little bit bigger a little bit

44
00:01:44,330 --> 00:01:42,060
distorted you know just like you go to a

45
00:01:46,730 --> 00:01:44,340
fun house and you see you know your head

46
00:01:48,710 --> 00:01:46,740
looks gigantic your body looks tiny it's

47
00:01:50,450 --> 00:01:48,720
a similar effect but we can use it for

48
00:01:51,950 --> 00:01:50,460
science as opposed to just you know

49
00:01:53,510 --> 00:01:51,960
looking at ourselves and saying oh wow

50
00:01:55,010 --> 00:01:53,520
that's kind of funny

51
00:01:57,170 --> 00:01:55,020
the Hubble Space Telescope has

52
00:01:59,090 --> 00:01:57,180
definitely taken the clearest images of

53
00:02:00,770 --> 00:01:59,100
the Einstein rings and they've really

54
00:02:02,149 --> 00:02:00,780
you know verified this part of

55
00:02:04,249 --> 00:02:02,159
Einstein's theories of general

56
00:02:05,990 --> 00:02:04,259
relativity they've really you know shown

57
00:02:08,270 --> 00:02:06,000
us a lot more about how gravitational

58
00:02:09,889 --> 00:02:08,280
lensing works and really sort of push

59
00:02:11,150 --> 00:02:09,899
the limits of what we can learn about