1
00:00:14,470 --> 00:00:12,789
cause is the most sensitive

2
00:00:22,070 --> 00:00:14,480
spectroscope

3
00:00:24,390 --> 00:00:22,080
are

4
00:00:27,109 --> 00:00:24,400
so important for research

5
00:00:27,990 --> 00:00:27,119
they produce ugly pictures

6
00:00:31,029 --> 00:00:28,000
but

7
00:00:32,389 --> 00:00:31,039
they are the nuts and bolts of physical

8
00:00:35,910 --> 00:00:32,399
science

9
00:00:38,869 --> 00:00:35,920
they put the physics in astrophysics

10
00:00:40,389 --> 00:00:38,879
cos was conceived in the mid-1990s by dr

11
00:00:43,270 --> 00:00:40,399
jim green and his colleagues at the

12
00:00:45,670 --> 00:00:43,280
university of colorado primarily to

13
00:00:47,270 --> 00:00:45,680

study the cosmic web

14
00:00:48,869 --> 00:00:47,280
which is made up of the largest scale

15
00:00:52,709 --> 00:00:48,879
structures of matter in the entire

16
00:00:57,590 --> 00:00:54,310
if you want to know what something is

17
00:00:59,830 --> 00:00:57,600
made of how hot it is how dense it is

18
00:01:02,150 --> 00:00:59,840
how fast it's moving in space how fast

19
00:01:04,229 --> 00:01:02,160
it's rotating for example a spectrograph

20
00:01:06,630 --> 00:01:04,239
will give you all that information with

21
00:01:07,590 --> 00:01:06,640
cost we can acquire information like

22
00:01:09,109 --> 00:01:07,600
that

23
00:01:17,429 --> 00:01:09,119
farther out across the universe than

24
00:01:21,830 --> 00:01:19,749
spectroscopy is

25
00:01:24,950 --> 00:01:21,840
taking light from an object

26
00:01:27,030 --> 00:01:24,960
and breaking it up into

27
00:01:29,030 --> 00:01:27,040
the different colors that that light

28
00:01:30,550 --> 00:01:29,040
consists of

29
00:01:32,230 --> 00:01:30,560
each of the elements each of the

30
00:01:34,230 --> 00:01:32,240
chemical elements has

31
00:01:37,109 --> 00:01:34,240
characteristic wavelengths

32
00:01:39,429 --> 00:01:37,119
characteristic colors at which it emits

33
00:01:40,789 --> 00:01:39,439
light when you heat it up or absorbs

34
00:01:43,749 --> 00:01:40,799
light

35
00:01:46,630 --> 00:01:43,759
for example if i have a

36
00:01:48,950 --> 00:01:46,640
tube full of hydrogen between

37
00:01:50,550 --> 00:01:48,960
me and that light instead of seeing the

38
00:01:52,230 --> 00:01:50,560

normal spectrum of that light when i

39
00:01:54,310 --> 00:01:52,240
look at it with the spectrograph i'll

40
00:01:56,469 --> 00:01:54,320
see that spectrum but with some of the

41
00:01:58,789 --> 00:01:56,479
light taken away at the wavelengths

42
00:02:00,149 --> 00:01:58,799
where hydrogen has its characteristic

43
00:02:02,389 --> 00:02:00,159
absorptions

44
00:02:04,550 --> 00:02:02,399
and so by measuring that the depth of

45
00:02:06,709 --> 00:02:04,560
those notches and the velocities and the

46
00:02:08,229 --> 00:02:06,719
width of them and so on you can infer

47
00:02:10,389 --> 00:02:08,239
all kinds of things about the physical

48
00:02:12,869 --> 00:02:10,399
state of that cloud

49
00:02:15,270 --> 00:02:12,879
kos has taken a really key part of

50
00:02:18,070 --> 00:02:15,280
spectroscopic science and said how can

51
00:02:20,070 --> 00:02:18,080
we do that in the absolutely best most

52
00:02:21,270 --> 00:02:20,080
efficient way

53
00:02:22,869 --> 00:02:21,280
and that is

54
00:02:25,750 --> 00:02:22,879
to measure

55
00:02:28,390 --> 00:02:25,760
the properties of the material between

56
00:02:29,589 --> 00:02:28,400
the galaxies looking back into the

57
00:02:31,830 --> 00:02:29,599
universe

58
00:02:34,229 --> 00:02:31,840
as the galaxies form there's a lot of

59
00:02:36,390 --> 00:02:34,239
material that does not collapse into the

60
00:02:38,869 --> 00:02:36,400
galaxies and there's other

61
00:02:41,270 --> 00:02:38,879
material that is ejected from galaxies

62
00:02:43,110 --> 00:02:41,280
by supernova explosions and so on and so

63
00:02:45,110 --> 00:02:43,120

that intergalactic gas the so-called

64
00:02:46,790 --> 00:02:45,120
intergalactic medium

65
00:02:48,390 --> 00:02:46,800
carries a lot of information about the

66
00:02:50,390 --> 00:02:48,400
history of the universe

67
00:02:53,350 --> 00:02:50,400
when you couple that story

68
00:02:55,670 --> 00:02:53,360
sort of the global cosmic process of how

69
00:02:57,190 --> 00:02:55,680
you form the large scale structure of

70
00:02:59,270 --> 00:02:57,200
how material is distributed in the

71
00:03:01,509 --> 00:02:59,280
universe and what role that played in

72
00:03:04,390 --> 00:03:01,519
forming new galaxies and then you use

73
00:03:06,710 --> 00:03:04,400
wifi camera three to investigate

74
00:03:09,190 --> 00:03:06,720
how did the galaxies themselves change

75
00:03:11,270 --> 00:03:09,200
internally with time

76
00:03:13,190 --> 00:03:11,280
and over space you know looking back

77
00:03:16,630 --> 00:03:13,200
through the history of the universe all

78
00:03:17,670 --> 00:03:16,640
that kind of ties together into the full

79
00:03:21,670 --> 00:03:17,680
story

80
00:03:25,750 --> 00:03:24,550
it's going into the costar

81
00:03:28,390 --> 00:03:25,760
slot

82
00:03:30,229 --> 00:03:28,400
and so there is nothing whatsoever lost

83
00:03:33,110 --> 00:03:30,239
in doing that because costar is not

84
00:03:35,910 --> 00:03:33,120
needed anymore costar was put up in the

85
00:03:38,710 --> 00:03:35,920
first servicing mission and it was used

86
00:03:40,710 --> 00:03:38,720
to deploy correcting optics in front of

87
00:03:42,390 --> 00:03:40,720
some of the first generation instruments

88
00:03:44,869 --> 00:03:42,400

the the first generation spectrographs

89
00:03:46,309 --> 00:03:44,879
for example correcting optics to correct

90
00:03:48,789 --> 00:03:46,319
for the spherical aberration that had

91
00:03:50,550 --> 00:03:48,799
been inadvertently built into the hst

92
00:03:52,630 --> 00:03:50,560
primary mirror

93
00:03:55,030 --> 00:03:52,640
all the more recent instruments

94
00:03:57,190 --> 00:03:55,040
include that correction within the new

95
00:03:59,030 --> 00:03:57,200
instrument itself so right now costar

96
00:04:01,110 --> 00:03:59,040
doesn't have anything to do all the

97
00:04:03,350 --> 00:04:01,120
other instruments in the so-called axial

98
00:04:05,990 --> 00:04:03,360
bays of hst have their own internal

99
00:04:08,470 --> 00:04:06,000
correction and so the costar space is

100
00:04:10,710 --> 00:04:08,480
freely available and they'll pull that

101
00:04:12,630 --> 00:04:10,720
out at no loss of science to hst