

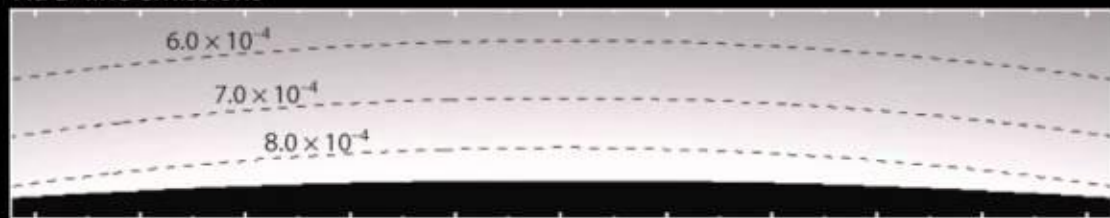


Coronal and Zodiacal Light (CZL)



Elevation Angle [°]

Na D-line emissions



1  
00:00:10,150 --> 00:00:07,269  
the mystery of the lunar ionosphere

2  
00:00:11,910 --> 00:00:10,160  
presented by science at nasa

3  
00:00:13,270 --> 00:00:11,920  
how can a world with no air have an

4  
00:00:15,669 --> 00:00:13,280  
ionosphere

5  
00:00:17,269 --> 00:00:15,679  
somehow the moon has done it

6  
00:00:19,590 --> 00:00:17,279  
lunar researchers have been struggling

7  
00:00:21,830 --> 00:00:19,600  
with this mystery for years and they may

8  
00:00:25,189 --> 00:00:21,840  
have finally found a solution

9  
00:00:26,790 --> 00:00:25,199  
but first what is an ionosphere

10  
00:00:29,109 --> 00:00:26,800  
every terrestrial planet with an

11  
00:00:30,630 --> 00:00:29,119  
atmosphere has one high above the

12  
00:00:33,030 --> 00:00:30,640  
planet's rocky surface where the

13  
00:00:34,870 --> 00:00:33,040

atmosphere meets the vacuum of space

14

00:00:36,630 --> 00:00:34,880

ultraviolet rays from the sun break

15

00:00:39,350 --> 00:00:36,640

apart atoms of air

16

00:00:41,190 --> 00:00:39,360

this creates a layer of ionized gas an

17

00:00:46,549 --> 00:00:41,200

ionosphere

18

00:00:48,790 --> 00:00:46,559

impact on communications and navigation

19

00:00:50,790 --> 00:00:48,800

for instance it reflects radio waves

20

00:00:52,709 --> 00:00:50,800

allowing shortwave radio operators to

21

00:00:55,110 --> 00:00:52,719

bounce transmissions over the horizon

22

00:00:57,270 --> 00:00:55,120

for long-range communication

23

00:00:59,910 --> 00:00:57,280

the ionosphere also bends and scatters

24

00:01:02,229 --> 00:00:59,920

signals from gps satellites sometimes

25

00:01:03,590 --> 00:01:02,239

causing your gps tracker to misread your

26

00:01:05,270 --> 00:01:03,600

position

27

00:01:06,990 --> 00:01:05,280

the first convincing evidence for an

28

00:01:10,830 --> 00:01:07,000

ionosphere around the moon came in the

29

00:01:14,149 --> 00:01:10,840

1970s from the soviet probes luna 19 and

30

00:01:16,710 --> 00:01:14,159

22. circling the moon at close range the

31

00:01:18,469 --> 00:01:16,720

orbiter sensed a layer of charged gas

32

00:01:20,870 --> 00:01:18,479

tens of kilometers above the lunar

33

00:01:23,030 --> 00:01:20,880

surface containing as many as 1 000

34

00:01:24,710 --> 00:01:23,040

electrons per cubic centimeter a

35

00:01:26,390 --> 00:01:24,720

thousand times more than any theory

36

00:01:28,550 --> 00:01:26,400

could explain

37

00:01:31,109 --> 00:01:28,560

the idea of an airless moon having an

38

00:01:33,749 --> 00:01:31,119

ionosphere didn't make much sense but

39

00:01:36,310 --> 00:01:33,759

the evidence seemed compelling

40

00:01:37,990 --> 00:01:36,320

in fact the moon isn't quite as airless

41

00:01:39,590 --> 00:01:38,000

as most people think

42

00:01:42,230 --> 00:01:39,600

small amounts of gas created by

43

00:01:43,510 --> 00:01:42,240

radioactive decay seep out of the lunar

44

00:01:46,069 --> 00:01:43,520

interior

45

00:01:48,230 --> 00:01:46,079

meteoroids and the solar wind also blast

46

00:01:50,630 --> 00:01:48,240

atoms off the moon's surface

47

00:01:52,630 --> 00:01:50,640

the resulting shroud of gas is so thin

48

00:01:54,870 --> 00:01:52,640

however that many researchers refused to

49

00:01:56,870 --> 00:01:54,880

call it an atmosphere preferring instead

50

00:01:58,709 --> 00:01:56,880

the term exosphere

51  
00:02:01,190 --> 00:01:58,719  
the density of the lunar exosphere is

52  
00:02:03,190 --> 00:02:01,200  
about a hundred million billion times

53  
00:02:05,030 --> 00:02:03,200  
less than that of air on earth

54  
00:02:07,670 --> 00:02:05,040  
not nearly enough to support the kind of

55  
00:02:09,669 --> 00:02:07,680  
ionosphere the luna probes saw

56  
00:02:12,229 --> 00:02:09,679  
for 40 years the moon's ionosphere

57  
00:02:13,589 --> 00:02:12,239  
remained a mystery until tim stubbs of

58  
00:02:16,550 --> 00:02:13,599  
the goddard space flight center

59  
00:02:19,990 --> 00:02:16,560  
published a solution in 2011.

60  
00:02:22,150 --> 00:02:20,000  
the answer he proposes is moon dust

61  
00:02:23,510 --> 00:02:22,160  
stubbs a 30-something scientist who

62  
00:02:25,670 --> 00:02:23,520  
wasn't even born when the moon's

63  
00:02:27,910 --> 00:02:25,680

ionosphere was discovered read the

64

00:02:29,750 --> 00:02:27,920

accounts of apollo 15 astronauts who

65

00:02:31,270 --> 00:02:29,760

reported seeing a strange glow over the

66

00:02:33,190 --> 00:02:31,280

moon's horizon

67

00:02:34,710 --> 00:02:33,200

many researchers believe the astronauts

68

00:02:37,110 --> 00:02:34,720

were seeing dust

69

00:02:38,869 --> 00:02:37,120

the moon is an extremely dusty place

70

00:02:41,190 --> 00:02:38,879

naturally surrounded by a swarm of

71

00:02:42,470 --> 00:02:41,200

particles think pig pen in the charlie

72

00:02:44,150 --> 00:02:42,480

brown comets

73

00:02:46,309 --> 00:02:44,160

when these floating dust grains catch

74

00:02:49,110 --> 00:02:46,319

the light of the rising or setting sun

75

00:02:51,110 --> 00:02:49,120

they create a glow along the horizon

76  
00:02:52,550 --> 00:02:51,120  
stubs and colleagues realized that dust

77  
00:02:54,550 --> 00:02:52,560  
could be the key

78  
00:02:56,309 --> 00:02:54,560  
uv rays from the sun hit the floating

79  
00:02:58,630 --> 00:02:56,319  
grains and ionized them

80  
00:03:00,869 --> 00:02:58,640  
according to their calculations this

81  
00:03:03,270 --> 00:03:00,879  
process can produce enough charge

82  
00:03:04,790 --> 00:03:03,280  
that is positively charged grains

83  
00:03:07,030 --> 00:03:04,800  
surrounded by negatively charged

84  
00:03:08,710 --> 00:03:07,040  
electrons to create the moon's

85  
00:03:13,270 --> 00:03:08,720  
ionosphere

86  
00:03:14,790 --> 00:03:13,280  
gas is new to planetary science no one

87  
00:03:17,350 --> 00:03:14,800  
knows how it will behave at different

88  
00:03:19,509 --> 00:03:17,360

times of night and day or how it might

89

00:03:20,790 --> 00:03:19,519

affect communications and navigation on

90

00:03:23,030 --> 00:03:20,800

the moon

91

00:03:25,270 --> 00:03:23,040

with nasa's artemis probes orbiting the

92

00:03:27,589 --> 00:03:25,280

moon now and the lady spacecraft

93

00:03:30,149 --> 00:03:27,599

scheduled to launch in 2013 to study the

94

00:03:33,350 --> 00:03:30,159

moon's exosphere more information should