1
00:00:00,280 --> 00:00:02,520
>>This is flight number 223.

2
00:00:02,520 --> 00:00:03,650
A special flight.

3
00:00:03,650 --> 00:00:10,080
>>Ok, we're gonna take off, and Pluto is right
here, we're gonna make sure we're on time

4
00:00:10,080 --> 00:00:11,599
straight to this point.

5
00:00:11,599 --> 00:00:13,950
>>Basically, we have
three objectives.

6
00:00:13,950 --> 00:00:17,010
The first is to observe Pluto occulting a
star.

7
00:00:17,010 --> 00:00:19,570
We should be able
to get a pressure and temperature profile

8
00:00:19,570 --> 00:00:23,680
for Pluto's atmosphere, which is particularly
interesting right now because we can directly

9
00:00:23,680 --> 00:00:27,580
compare it to the one derived from New Horizons
and that will let us to calibrate all the

10
00:00:27,580 --> 00:00:30,050
observations we've been making for 20 years.

11
00:00:30,050 --> 00:00:34,780
And secondly, if we can do this occultation
in multiple wavelengths simultaneously, we

12
00:00:34,780 --> 00:00:39,859
will be sensitive to particle dust haze in
the atmosphere, in a way that we're not in

13
00:00:39,859 --> 00:00:41,149
any single wavelength.

14
00:00:41,149 --> 00:00:45,719
And, finally, the biggest objective is, if
we can hit the center point

15
00:00:45,719 --> 00:00:50,790
of the shadow, within say 75 kilometers, then
we can get an actual global view around the

16
00:00:50,790 --> 00:00:52,329
entire planet.

17
00:00:52,329 --> 00:00:56,690
>>Tonight we're planning on observing the
Pluto occultation over the South Pacific.

18
00:00:56,690 --> 00:01:01,730
We have a very finite amount of time to catch
the shadow as it streaks across the Earth.

19
00:01:01,730 --> 00:01:03,510
>>Let's go do it.

20
00:01:03,510 --> 00:01:04,510
>>Let's go.

21
00:01:04,510 --> 00:01:05,770
[SOFIA taking off]

22
00:01:05,770 --> 00:01:10,469
>>We started this process at MIT for this
particular event about

23
00:01:10,469 --> 00:01:11,469
three years ago.

24
00:01:11,469 --> 00:01:15,009
Basically, you just have to spend a lot of
time observing both Pluto

25
00:01:15,009 --> 00:01:16,369
and the star.

26
00:01:16,369 --> 00:01:20,259
As Pluto moves across the sky, we're constantly
updating its ephemeris.

27
00:01:20,259 --> 00:01:22,810
Each
night, we measure it, we measure its position,

28
00:01:22,810 --> 00:01:27,520
see which direction it's moving, and project
that ahead until it intersects with the star.

29
00:01:27,520 --> 00:01:31,310
Simultaneously, we're measuring where the
star is, trying to firm up the coordinate

30
00:01:31,310 --> 00:01:36,280
system of the other stars around it, so we
can get a very careful measurement of how

31
00:01:36,280 --> 00:01:40,600
closely they will intersect, and more importantly,
from where on the earth we'll be able to see

32
00:01:40,600 --> 00:01:41,600
that occultation.

33
00:01:41,600 --> 00:01:44,710

SOFIA is the only observatory
that can actually get to the center of the

34
00:01:44,710 --> 00:01:47,630
shadow, as the center line is going to be
over the ocean.

35
00:01:47,630 --> 00:01:50,759
And now we're here to actually observe the
occultation and see what we can

36
00:01:50,759 --> 00:01:53,060
learn about Pluto's atmosphere.

37
00:01:53,060 --> 00:01:56,590
>>And, coming up on 5 minutes, pilots- it's
gonna be a left-hand

38
00:01:56,590 --> 00:01:59,240
turn to 253.

39
00:01:59,240 --> 00:02:01,530
[Music/Radio Chatter]

40
00:02:01,530 --> 00:02:04,969
>>Update dot txt.

41
00:02:04,969 --> 00:02:11,150
Print that one-
This particular mission looms large in importance

42
00:02:11,150 --> 00:02:13,180
because of the synergy with New Horizons.

43
00:02:13,180 --> 00:02:21,099
What I've been doing tonight is receiving
updates on Pluto's position relative to the

44
00:02:21,099 --> 00:02:22,099

stars.

45
00:02:22,099 --> 00:02:26,459
I received that update first as a very
simple text message.

46
00:02:26,459 --> 00:02:31,540
That the center line of the shadow had moved
north by 227 kilometers.

47
00:02:31,540 --> 00:02:38,180
The good people upstairs were able to adjust
these legs going back and forth, kind of like

48
00:02:38,180 --> 00:02:42,209
a trombone, so we wound up at the right place
at the right time.

49
00:02:42,209 --> 00:02:48,270
>>Each stays the same...but now they're just
shifted up and over.

50
00:02:48,270 --> 00:02:53,240
Headed in there, there, then up here, then
down...

51
00:02:53,240 --> 00:02:54,340
All right?

52
00:02:54,340 --> 00:02:56,000
>> Yeah, that's good.

53
00:02:56,000 --> 00:02:57,650
>>There it is.

54
00:02:57,650 --> 00:03:02,569
>>My collegue Karina
at the other console, is closely monitoring

55

00:03:02,569 --> 00:03:09,090
where the plane is compared to where it's
supposed to be crossing this shadow path.

56
00:03:09,090 --> 00:03:12,590
>>Two minutes, crew.

57
00:03:12,590 --> 00:03:13,760
[Music]

58
00:03:13,760 --> 00:03:17,260
>>One degree left.

59
00:03:17,260 --> 00:03:19,590
>>One left.

60
00:03:19,590 --> 00:03:25,430
>>How's our cross elevation looking?

61
00:03:25,430 --> 00:03:31,370
>>Good, right in the center.

62
00:03:31,370 --> 00:03:33,120
>>Ah!

63
00:03:33,120 --> 00:03:38,370
Did it just?

64
00:03:38,370 --> 00:03:40,879
It's going down!

65
00:03:40,879 --> 00:03:41,879
Woohoo!

66
00:03:41,879 --> 00:03:42,879
>>Nice.

67
00:03:42,879 --> 00:03:43,879

>>That's so cool!

68
00:03:43,879 --> 00:03:45,990
>>They're right on top of each other.

69
00:03:45,990 --> 00:03:47,650
>>It's just about right on.

70
00:03:47,650 --> 00:03:48,650
>>Wow!

71
00:03:48,650 --> 00:03:49,650
>>Congratulations!

72
00:03:49,650 --> 00:03:50,650
That's so cool!

73
00:03:50,650 --> 00:03:51,650
>>Oh, it's coming back.

74
00:03:51,650 --> 00:03:52,650
>>Oh, yep I see it.

75
00:03:52,650 --> 00:03:53,650
>>That is so bizarre.

76
00:03:53,650 --> 00:03:54,650
>>That's probably close to 90 seconds...

77
00:03:54,650 --> 00:03:55,650
>>So they may have really gotten right in
the middle.

78
00:03:55,650 --> 00:03:56,650
>>So this graph is signal
over time plot.

79
00:03:56,650 --> 00:04:02,830

We see the signal of the occulting star before
Pluto is moving right in front

80
00:04:02,830 --> 00:04:03,830
of it.

81
00:04:03,830 --> 00:04:07,209
At this point, Pluto is moving in front of
the star and the signal drops down.

82
00:04:07,209 --> 00:04:11,500
And,
here at the bottom of the curve, we see this

83
00:04:11,500 --> 00:04:16,720
central flash, which means that we were very
close to the center line of the shadow.

84
00:04:16,720 --> 00:04:21,500
>>Everyone just jumped for joy when we actually
saw that

85
00:04:21,500 --> 00:04:22,889
star occulted by Pluto.

86
00:04:22,889 --> 00:04:27,580
I think of Pluto as being kind of a small
body, but we saw it

87
00:04:27,580 --> 00:04:29,289
and it was just amazing.

88
00:04:29,289 --> 00:04:30,992
One of the highlights of my career, I gotta
say, working on this