



1

00:00:00,320 --> 00:00:05,180

>>This is flight number 223. A special flight.

2

00:00:05,180 --> 00:00:07,150

>>Ok, we're gonna take off, and Pluto is right

3

00:00:07,150 --> 00:00:11,290

here, we're gonna make sure we're on time
straight to this point.

4

00:00:11,290 --> 00:00:12,400

>>Basically, we have

5

00:00:12,400 --> 00:00:17,539

three objectives. The first is to observe
Pluto occulting a star. We should be able

6

00:00:17,539 --> 00:00:21,960

to get a pressure and temperature profile
for Pluto's atmosphere, which is particularly

7

00:00:21,960 --> 00:00:26,220

interesting right now because we can directly
compare it to the one derived from New Horizons

8

00:00:26,220 --> 00:00:30,089

and that will let us to calibrate all the
observations we've been making for 20 years.

9

00:00:30,089 --> 00:00:34,829

And secondly, if we can do this occultation
in multiple wavelengths simultaneously, we

10

00:00:34,829 --> 00:00:39,910

will be sensitive to particle dust haze in
the atmosphere, in a way that we're not in

11

00:00:39,910 --> 00:00:45,760

any single wavelength. And, finally, the biggest

objective is, if we can hit the center point

12
00:00:45,760 --> 00:00:50,930
of the shadow, within say 75 kilometers, then
we can get an actual global view around the

13
00:00:50,930 --> 00:00:53,190
entire planet.

14
00:00:53,190 --> 00:00:56,680
>>Tonight we're planning on observing
the Pluto occultation over the South Pacific.

15
00:00:56,680 --> 00:01:02,559
We have a very finite amount of time to catch
the shadow as it streaks across the Earth.

16
00:01:02,559 --> 00:01:03,319
>>Let's go do it.

17
00:01:03,319 --> 00:01:04,879
>>Let's go.

18
00:01:04,879 --> 00:01:07,399
[SOFIA taking off]

19
00:01:07,399 --> 00:01:10,559
>>We started this
process at MIT for this particular event about

20
00:01:10,560 --> 00:01:15,100
three years ago. Basically, you just have
to spend a lot of time observing both Pluto

21
00:01:15,100 --> 00:01:20,720
and the star. As Pluto moves across the sky,
we're constantly updating its ephemeris. Each

22
00:01:20,720 --> 00:01:24,920

night, we measure it, we measure its position,
see which direction it's moving, and project

23

00:01:24,920 --> 00:01:29,399

that ahead until it intersects with the star.
Simultaneously, we're measuring where the

24

00:01:29,399 --> 00:01:33,720

star is, trying to firm up the coordinate
system of the other stars around it, so we

25

00:01:33,720 --> 00:01:38,930

can get a very careful measurement of how
closely they will intersect, and more importantly,

26

00:01:38,930 --> 00:01:43,229

from where on the earth we'll be able to see
that occultation. SOFIA is the only observatory

27

00:01:43,229 --> 00:01:46,380

that can actually get to the center of the
shadow, as the center line is going to be

28

00:01:46,380 --> 00:01:50,829

over the ocean. And now we're here to actually
observe the occultation and see what we can

29

00:01:50,829 --> 00:01:53,349

learn about Pluto's atmosphere.

30

00:01:53,349 --> 00:01:56,629

>>And, coming
up on 5 minutes, pilots- it's gonna be a left-hand

31

00:01:56,630 --> 00:01:59,310

turn to 253.

32

00:01:59,310 --> 00:02:03,950

[Music/Radio Chatter]

33

00:02:03,950 --> 00:02:07,790

>>Update dot txt. Print that one-

34

00:02:07,790 --> 00:02:11,190

This particular mission looms large in importance

35

00:02:11,200 --> 00:02:17,440

because of the synergy with New Horizons.

What I've been doing tonight is receiving

36

00:02:17,440 --> 00:02:23,940

updates on Pluto's position relative to the

stars. I received that update first as a very

37

00:02:23,940 --> 00:02:32,360

simple text message. That the center line

of the shadow had moved north by 227 kilometers.

38

00:02:32,360 --> 00:02:39,200

The good people upstairs were able to adjust

these legs going back and forth, kind of like

39

00:02:39,200 --> 00:02:42,440

a trombone, so we wound up at the right place

at the right time.

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00:02:42,440 --> 00:02:49,160

>>Each stays the same...but now they're just shifted up and over.

41

00:02:49,160 --> 00:02:53,560

Headed in there, there, then up here, then down...

42

00:02:53,560 --> 00:02:54,920

All right?

43

00:02:54,920 --> 00:02:56,280

>> Yeah, that's good.

44

00:02:56,280 --> 00:02:57,320

>>There it is.

45

00:02:57,320 --> 00:02:59,640

>>My colleague Karina

46

00:02:59,640 --> 00:03:05,630

at the other console, is closely monitoring where the plane is compared to where it's

47

00:03:05,630 --> 00:03:08,470

supposed to be crossing this shadow path.

48

00:03:08,470 --> 00:03:10,470

>>Two minutes, crew.

49

00:03:10,470 --> 00:03:14,390

[Music]

50

00:03:14,400 --> 00:03:15,760

>>One degree left.

51

00:03:15,760 --> 00:03:17,360

>>One left.

52

00:03:17,360 --> 00:03:19,280

>>How's our cross elevation looking?

53

00:03:19,280 --> 00:03:21,280

>>Good, right in the center.

54

00:03:21,280 --> 00:03:25,080

>>Ah! Did it just? It's going down!

55

00:03:25,080 --> 00:03:27,600

Woohoo!

56

00:03:27,600 --> 00:03:29,000

>>Nice.

57

00:03:29,000 --> 00:03:30,240

>>That's so cool!

58

00:03:30,240 --> 00:03:33,200

>>They're right on top
of each other.

59

00:03:33,200 --> 00:03:35,200

>>It's just about right on.

60

00:03:35,200 --> 00:03:37,200

>>Wow!

61

00:03:37,200 --> 00:03:39,200

>>Congratulations! That's so cool!

62

00:03:39,200 --> 00:03:41,800

>>Oh, it's coming back.

63

00:03:41,800 --> 00:03:44,360

>>Oh, yep I see it.

64

00:03:44,360 --> 00:03:46,640

>>That is so bizarre.

65

00:03:46,640 --> 00:03:49,960

>>That's probably close to 90 seconds...

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00:03:49,960 --> 00:03:52,880

>>So they may have really gotten
right in the middle.

67

00:03:52,880 --> 00:03:54,880

>>So this graph is signal

68

00:03:54,880 --> 00:04:03,000

over time plot. We see the signal of the occulting star before Pluto is moving right in front

69

00:04:03,010 --> 00:04:07,570

of it. At this point, Pluto is moving in front of the star and the signal drops down. And,

70

00:04:07,570 --> 00:04:14,530

here at the bottom of the curve, we see this central flash, which means that we were very

71

00:04:14,530 --> 00:04:18,050

close to the center line of the shadow.

72

00:04:18,050 --> 00:04:21,560

>>Everyone just jumped for joy when we actually saw that

73

00:04:21,560 --> 00:04:28,730

star occulted by Pluto. I think of Pluto as being kind of a small body, but we saw it

74

00:04:28,730 --> 00:04:32,960

and it was just amazing. One of the highlights of my career, I gotta say, working on this