



1
00:00:00,506 --> 00:00:20,566
[Music]

2
00:00:21,066 --> 00:00:22,406
>> So this is our mission brief.

3
00:00:22,406 --> 00:00:29,056
Engines start at ten after.
Takeoff at 7:50. And landing at 5:25.

4
00:00:29,056 --> 00:00:31,016
Telescope status?

5
00:00:31,286 --> 00:00:32,400
>> It's ready to go.

6
00:00:32,400 --> 00:00:33,490
>> Mission systems?

7
00:00:33,496 --> 00:00:34,156
Good to go.

8
00:00:38,086 --> 00:00:42,926
>> FIFI-LS also measured this source,
but obviously cannot resolve the structure and velocity.

9
00:00:42,926 --> 00:00:44,416
And this is a profile

10
00:00:44,526 --> 00:00:48,526
as straight measures towards
the center of this nebula,

11
00:00:48,900 --> 00:00:53,780
and you see the complex
dynamics that is going on as different shells and bluffs

12
00:00:53,780 --> 00:00:56,980

expanding from the central white dwarf.

13

00:00:57,516 --> 00:01:07,876

[Music]

14

00:01:08,060 --> 00:01:10,100

>> For tonight, your safety techs:

15

00:01:10,100 --> 00:01:12,640

Myself, John, and Juan.

16

00:01:12,640 --> 00:01:14,700

Our mission director

tonight is Nancy.

17

00:01:14,700 --> 00:01:16,490

The doors are all

closed and armed.

18

00:01:17,200 --> 00:01:18,720

If there's an emergency

or whatever,

19

00:01:18,720 --> 00:01:20,550

and we have to open the

doors, the safety techs

20

00:01:20,550 --> 00:01:22,490

and mission director are

responsible for them.

21

00:01:22,490 --> 00:01:26,970

[Aircraft taking off]

22

00:01:26,970 --> 00:01:33,330

[Music]

23

00:01:33,960 --> 00:01:34,460

>> Here we are.

24

00:01:34,460 --> 00:01:39,360

We're on this incredible
flying telescope right now,

25

00:01:39,360 --> 00:01:42,600

and about fifty feet behind
me is an instrument that's

26

00:01:42,600 --> 00:01:46,620

cryogenically frozen at four
degrees above absolute zero,

27

00:01:46,620 --> 00:01:51,100

which is blowing my mind at the
moment, and right behind that,

28

00:01:51,100 --> 00:01:53,800

the back half of this
airplane is wide open,

29

00:01:53,800 --> 00:01:55,520

and we've got this
incredible device looking

30

00:01:55,520 --> 00:02:00,120

out into the middle of
a galaxy far, far away.

31

00:02:00,120 --> 00:02:00,910

That's pretty cool.

32

00:02:02,160 --> 00:02:17,720

[Music]

33

00:02:17,720 --> 00:02:21,920

>>This is the view as if you were behind the telescope looking out the door.

34

00:02:21,920 --> 00:02:25,720

The green thing in the center, that's the secondary mirror.

35
00:02:25,720 --> 00:02:28,480
There's three mains holding up the secondary,

36
00:02:28,480 --> 00:02:30,480
The large circle is the primary,

37
00:02:30,480 --> 00:02:32,800
that's the secondary in the middle of the primary.

38
00:02:32,800 --> 00:02:36,060
>> We're observing this one part
of the galaxy and this one part

39
00:02:36,140 --> 00:02:37,660
of the galaxy is
where stars are born.

40
00:02:37,660 --> 00:02:40,650
Just like you're born
and have a life cycle,

41
00:02:40,650 --> 00:02:43,710
stars do that as well, and
it's happening all the time

42
00:02:43,860 --> 00:02:45,100
in the universe,

43
00:02:45,380 --> 00:02:48,020
and it tells us different
things about the universe based

44
00:02:48,020 --> 00:02:49,740
on where they're forming
and why they're forming.

45
00:02:49,740 --> 00:02:53,010

>> We look for signatures of certain elements like carbon

46

00:02:53,010 --> 00:02:55,320
or nitrogen or oxygen,
and it tells us something.

47

00:02:55,320 --> 00:02:58,720
So we may not actually be
able to see the stars forming,

48

00:02:58,720 --> 00:03:01,440
but we can detect
that they're forming

49

00:03:01,440 --> 00:03:03,800
by looking for these signatures.

50

00:03:03,800 --> 00:03:07,980
[Music]

51

00:03:09,300 --> 00:03:11,020
On this mission, we're
looking for oxygen lines.

52

00:03:11,020 --> 00:03:13,770
Just the mere fact that we're
breathing oxygen on land

53

00:03:13,770 --> 00:03:16,370
that should be enough
of a compelling story

54

00:03:16,370 --> 00:03:17,860
to help feel a connection
to space.

55

00:03:17,880 --> 00:03:23,320
[Music]

56

00:03:23,320 --> 00:03:28,760

>>Even in land navigation, you're used to navigating your way from point to point

57

00:03:28,760 --> 00:03:30,760

to point over the surface of the Earth.

58

00:03:30,760 --> 00:03:33,160

Whether you're in a car or an airplane or whatever.

59

00:03:33,840 --> 00:03:35,840

That ain't the way this works at all.

60

00:03:35,840 --> 00:03:39,880

The way this works is they're looking at an object that could be literally hundreds of light years away.

61

00:03:39,880 --> 00:03:43,240

They got to take into account orbital mechanics, things of that nature.

62

00:03:43,240 --> 00:03:47,120

And they calculate their way backwards, until they get to the Earth, and then they

63

00:03:47,120 --> 00:03:51,560

got to take into account temperatures and winds and all kinds of things.

64

00:03:51,560 --> 00:03:54,120

You think about all the little details that could affect that.

65

00:03:54,120 --> 00:03:58,480

And they calculate backwards all the way down until they predict

66

00:03:58,480 --> 00:04:02,600

where that location would be over the surface of the Earth.

67

00:04:02,600 --> 00:04:05,160

>>As the Earth turns, to keep looking at one object,

68

00:04:05,160 --> 00:04:08,640

optimally, you would fly a continuous curve.

69

00:04:08,640 --> 00:04:12,760

But instead what we do is we fly little segments, so the pilot tweaks

70

00:04:12,760 --> 00:04:14,760

the heading by a degree at a time.

71

00:04:14,760 --> 00:04:18,040

Nancy says "Ok, we need another degree tweak"

72

00:04:18,040 --> 00:04:20,040

and upstairs they say "Ok".

73

00:04:20,040 --> 00:04:21,080

>>One degree left.

74

00:04:21,080 --> 00:04:23,080

>>Roger.

75

00:04:24,680 --> 00:04:26,840

The plane is in turbulence,
and you feel

76

00:04:26,840 --> 00:04:30,860

like the telescope is wobbling
up and down, but from your frame

77

00:04:30,860 --> 00:04:32,380

of reference, it's the telescope

78

00:04:32,380 --> 00:04:35,490

that is staying perfectly
stationary on this ball bearing,

79

00:04:35,490 --> 00:04:37,060

and we're the ones
that are in turbulence.

80

00:04:37,060 --> 00:04:39,690

It's just fascinating
to me that we can be

81

00:04:39,690 --> 00:04:43,380

in the air observing
an object in space,

82

00:04:43,380 --> 00:04:46,590

and we can actually keep
the telescope steady enough

83

00:04:46,600 --> 00:04:49,400

to be able to observe it
clearly and without wobble,

84

00:04:49,400 --> 00:04:52,000

and it's, like, trying to look
look through binoculars

85

00:04:52,000 --> 00:04:53,520

out the back of your car --

86

00:04:53,520 --> 00:04:57,050

>> It's great to see how this
whole SOFIA structure works.

87

00:04:57,050 --> 00:04:59,490

It's a really intricate puzzle,

88

00:04:59,490 --> 00:05:01,960

and to see the pilots
communicating

89

00:05:01,960 --> 00:05:03,700

with the mission
directors, communicating

90

00:05:03,700 --> 00:05:05,460

with the scientists, and fine
tuning this whole process

91

00:05:05,460 --> 00:05:06,180
as we go --

92

00:05:06,180 --> 00:05:07,740
>> Science isn't
taught just in a silo.

93

00:05:07,740 --> 00:05:09,620
Isn't just taught
in chemistry class

94

00:05:09,620 --> 00:05:11,910
or isn't just taught
in physics class.

95

00:05:11,920 --> 00:05:13,560
Instead, science crosses
over boundaries --

96

00:05:14,040 --> 00:05:15,950
>> That interaction
with the people

97

00:05:15,960 --> 00:05:19,580
who are doing the work
is, it's amazing --

98

00:05:19,580 --> 00:05:21,180
>> I think about my
students careerwise.

99

00:05:21,440 --> 00:05:23,190
They might not all
be scientists,

100

00:05:23,200 --> 00:05:25,750
but there might be other

careers that they can endeavor

101

00:05:25,760 --> 00:05:27,700

into because this is a
whole support system here.

102

00:05:27,700 --> 00:05:29,060

You need the engineers.

103

00:05:29,060 --> 00:05:29,970

You need the technicians.

104

00:05:29,970 --> 00:05:33,280

It's a big team effort in order
for the science to move forward.

105

00:05:34,080 --> 00:05:36,340

>> The beauty of a
program like NASA is

106

00:05:36,340 --> 00:05:37,890

that it can be very relatable.

107

00:05:37,890 --> 00:05:39,700

I hope that one of the things
that we're able to take away

108

00:05:39,700 --> 00:05:41,720

from SOFIA to bring
back to our community

109

00:05:41,720 --> 00:05:44,560

is that we can connect
really young students,

110

00:05:44,560 --> 00:05:48,330

really old students, and
everyone in between with the material.

111

00:05:48,330 --> 00:05:53,230

>> It's beyond exciting, it's beyond
fascinating, it's fantastic.