



1
00:00:00,506 --> 00:00:10,956
[Music]

2
00:00:11,456 --> 00:00:14,306
>> Welcome to the mission
brief for Flight 168.

3
00:00:15,056 --> 00:00:16,906
>> We'll taxi into position
at Runway 25.

4
00:00:16,906 --> 00:00:19,966
We'll go out and make a right
down on the departure towards Daggett VOR.

5
00:00:20,400 --> 00:00:22,160
>> Going to be taking
off almost on the hour.

6
00:00:22,216 --> 00:00:24,926
It's 2 minutes prior,
and you're going

7
00:00:24,926 --> 00:00:26,936
to be making a right hand
turn proceeding to the first

8
00:00:26,936 --> 00:00:27,956
science point.

9
00:00:27,960 --> 00:00:29,720
>> What we're looking at is
a galaxy which is known

10
00:00:29,726 --> 00:00:32,256
to have a super massive
black hole at its center.

11
00:00:32,256 --> 00:00:34,006

>>What we need to do is to
point the telescope

12

00:00:34,006 --> 00:00:35,520
at 45 degrees elevation.

13

00:00:35,520 --> 00:00:38,596
>> If we see this, it'll only be
I think the 3rd time a supernova

14

00:00:38,596 --> 00:00:40,896
like this has ever
been seen in the mid-infrared.

15

00:00:41,516 --> 00:00:54,586
[Music]

16

00:00:55,086 --> 00:00:57,306
>> The doors have
been all armed.

17

00:00:57,656 --> 00:01:00,946
Everyone has been trained
on how to open them.

18

00:01:00,946 --> 00:01:02,496
As you push the door, make
sure you let it go

19

00:01:03,076 --> 00:01:06,496
or you will exit a lot
quicker than you wanted to.

20

00:01:06,516 --> 00:01:12,516
[Music]

21

00:01:25,260 --> 00:01:20,836
[Radio chatter]

22

00:01:25,416 --> 00:01:26,756
>> I was born in the generation

23

00:01:26,756 --> 00:01:29,786
where the Apollo astronauts
started to walk on the moon.

24

00:01:29,786 --> 00:01:31,916
That got me very
excited about wanting

25

00:01:31,916 --> 00:01:33,436
to be an astronaut myself.

26

00:01:36,160 --> 00:01:38,860
I think a lot of kids really
wanted to be an astronaut

27

00:01:38,866 --> 00:01:40,446
when they were younger.

28

00:01:41,160 --> 00:01:42,720
>> I grew up with the
space shuttle program.

29

00:01:42,906 --> 00:01:46,236
One of my dreams as a kid
was to become an astronaut.

30

00:01:46,356 --> 00:01:49,136
>> From 6th grade, when I went to
space camp for the first time.

31

00:01:49,196 --> 00:01:52,896
I kind of always had this
dream of something with NASA.

32

00:01:53,580 --> 00:01:55,000
>> When I was young,
I always dreamed

33

00:01:55,000 --> 00:01:56,720
about being an astronaut,
getting into space.

34

00:01:56,726 --> 00:01:59,746
It's so exciting that NASA
has given me this opportunity

35

00:01:59,746 --> 00:02:01,096
to participate in this program.

36

00:02:01,096 --> 00:02:03,206
>> Now I have an actual
chance to fly.

37

00:02:03,206 --> 00:02:04,280
On SOFIA.

38

00:02:04,436 --> 00:02:08,446
>> This is fulfilling that
one...one of my lifelong dreams.

39

00:02:08,556 --> 00:02:09,716
>> This gives me my chance

40

00:02:09,716 --> 00:02:11,256
to actually be part
of a NASA mission.

41

00:02:11,256 --> 00:02:13,046
>> Now, Pamela, are
these nodding

42

00:02:13,046 --> 00:02:15,736
and chopping things
normal functions?

43

00:02:15,736 --> 00:02:17,046

>> Yes. Nod, chop, and dither.

44

00:02:17,396 --> 00:02:18,836

Chop is a secondary mirror.

45

00:02:18,836 --> 00:02:20,616

Nod is the primary mirror.

46

00:02:20,896 --> 00:02:23,146

Dither has to do
with the light coming

47

00:02:23,146 --> 00:02:25,136

down the bore sight to the instrument.

48

00:02:25,556 --> 00:02:26,906

And they'll move it around so

49

00:02:26,996 --> 00:02:29,946

where there's a bad
pixel or channel.

50

00:02:30,026 --> 00:02:33,106

You don't have a
hole in your data.

51

00:02:33,720 --> 00:02:34,760

>> We have 2 cameras.

52

00:02:34,766 --> 00:02:37,086

One operates from
5 to 25 microns,

53

00:02:37,146 --> 00:02:39,106

the other from 25 to 40 microns.

54

00:02:39,336 --> 00:02:41,516

And with a dichroic beam
splitter, you can image

55

00:02:41,516 --> 00:02:42,936
in both wave lengths at once.

56

00:02:43,236 --> 00:02:46,036
>> I like supernovae in
particular because everything

57

00:02:46,036 --> 00:02:49,116
that we're made of, all the
atoms that you see around us.

58

00:02:49,216 --> 00:02:50,706
All that was made
inside of a star.

59

00:02:50,856 --> 00:02:53,006
The universe would be a
boring place without stars.

60

00:02:53,516 --> 00:02:55,206
So supernovae are
actually responsible

61

00:02:55,306 --> 00:02:58,446
for everything that's
interesting

62

00:02:58,520 --> 00:03:00,440
in the universe including
planets

63

00:03:00,516 --> 00:03:01,916
and people and things like that.

64

00:03:02,860 --> 00:03:06,520
The way these supernova happen
is these are very massive stars.

65

00:03:06,556 --> 00:03:07,796
Much more massive than the sun.

66
00:03:07,796 --> 00:03:10,436
Massive stars just tend to be
very violent, very short lived.

67
00:03:10,726 --> 00:03:11,986
They throw off a
lot of material.

68
00:03:11,986 --> 00:03:14,726
And then the shock wave from
the supernova goes out and runs

69
00:03:14,726 --> 00:03:17,066
into that and heats
all that material up to

70
00:03:17,066 --> 00:03:18,006
where we can see it again.

71
00:03:18,436 --> 00:03:19,716
We had detected this

72
00:03:19,746 --> 00:03:21,566
with another telescope
called Spitzer,

73
00:03:21,926 --> 00:03:23,306
which is a space telescope.

74
00:03:23,506 --> 00:03:27,316
But Spitzer doesn't go out as
far in wave length as SOFIA.

75
00:03:27,456 --> 00:03:30,316
So that's kind of what
we're trying to do here.

76

00:03:30,316 --> 00:03:32,076

Is get this longer wave
length observation.

77

00:03:32,336 --> 00:03:35,016

It'll look just like a star if
we end up seeing anything.

78

00:03:35,226 --> 00:03:37,460

They didn't see anything
last night either.

79

00:03:37,460 --> 00:03:39,480

>> The scientist who is
investigating the supernova,

80

00:03:39,816 --> 00:03:41,816

they actually haven't
found any data.

81

00:03:41,816 --> 00:03:43,726

This is an important
part of science I'm going

82

00:03:43,786 --> 00:03:45,406

to bring back to the students.

83

00:03:45,476 --> 00:03:48,056

Is that sometimes
hypotheses are not supported.

84

00:03:48,056 --> 00:03:50,816

And this is just as important
as if they were supported.

85

00:03:52,046 --> 00:03:53,356

>> We can turn all
of these things

86

00:03:53,466 --> 00:03:55,296
into teachable moments
in our classroom.

87
00:03:55,716 --> 00:03:58,326
Teaching about measurements,
conversions, and units,

88
00:03:58,486 --> 00:04:01,666
and then real life application
of engineer design process.

89
00:04:01,666 --> 00:04:03,896
How in the world is this
plane even up in the air

90
00:04:03,896 --> 00:04:04,916
with the side of it open?

91
00:04:05,276 --> 00:04:08,226
>> The telescope is actually
run by some gyroscopes.

92
00:04:08,606 --> 00:04:10,756
The gyroscopes actually
help to keep the pointing

93
00:04:11,396 --> 00:04:14,096
of the telescope aimed
at the right spot.

94
00:04:14,096 --> 00:04:16,716
I have a little demonstration
here I'd like to show

95
00:04:16,716 --> 00:04:19,976
with a toy gyroscope
and my toy airplane.

96
00:04:20,436 --> 00:04:22,326

By the law of conservation

97

00:04:22,326 --> 00:04:26,666
of angular momentum, when
the telescope moves one way,

98

00:04:26,666 --> 00:04:29,236
the gyroscope is going
to move the other way

99

00:04:29,236 --> 00:04:30,546
to keep everything in balance.

100

00:04:34,760 --> 00:04:35,400
There we go.

101

00:04:35,846 --> 00:04:37,096
So now we've got it.

102

00:04:37,776 --> 00:04:39,826
And I'm going to be jiggling
the airplane a little bit

103

00:04:39,926 --> 00:04:41,886
to keep it on the board.

104

00:04:42,956 --> 00:04:46,506
And this motion is very similar
to the motion of the telescope

105

00:04:46,876 --> 00:04:50,596
and trying to maintain pointing
as the airplane is moving.

106

00:04:50,956 --> 00:04:52,916
This is a magnetometer
in a bottle.

107

00:04:53,076 --> 00:04:55,516

And it's a real simple device.

108

00:04:55,516 --> 00:04:57,466

Anybody can build it.

109

00:04:57,466 --> 00:04:59,576

It's basically inside the
bottle I have a mirror

110

00:04:59,576 --> 00:05:02,416

and I have a magnet
hooked on to that mirror.

111

00:05:02,416 --> 00:05:04,126

And it's hanging by a string.

112

00:05:04,366 --> 00:05:08,426

Over here on this side,
I have a laser pointer.

113

00:05:08,456 --> 00:05:12,696

And that laser pointer is
pointing right at that mirror.

114

00:05:12,956 --> 00:05:16,906

And it's reflecting over to
the card on the back here

115

00:05:16,906 --> 00:05:18,740

where we have it scaled.

116

00:05:18,740 --> 00:05:22,500

And so as we travel through the
various latitudes and longitudes

117

00:05:22,506 --> 00:05:25,556

of the Earth's magnetic field
while we're on the airplane,

118

00:05:25,556 --> 00:05:28,406

this is going to
move back and forth.

119

00:05:28,616 --> 00:05:30,996

This is important to
SOFIA because a lot

120

00:05:30,996 --> 00:05:32,956

of the instruments
are very sensitive

121

00:05:33,086 --> 00:05:35,976

with the Earth's magnetic field.

122

00:05:36,516 --> 00:05:39,666

>> So the grism, it splits the light,

123

00:05:40,166 --> 00:05:42,886

and then it diffracts it.

So does it actually take

124

00:05:43,116 --> 00:05:47,076

and make a finer set of spectra?

125

00:05:47,080 --> 00:05:50,080

>> The prism itself will
produce the dispersion.

126

00:05:50,556 --> 00:05:53,306

What the grating does is it
selects the order of how

127

00:05:53,306 --> 00:05:55,466

that dispersion falls
on the detector.

128

00:05:55,466 --> 00:05:58,880

The advantage of a
grism is the grism,

129

00:05:58,880 --> 00:06:00,500

you can use a smaller
optical component

130

00:06:00,646 --> 00:06:02,206

to get the same dispersion.

131

00:06:02,336 --> 00:06:04,576

And we can put those grisms
right in the filter wheels.

132

00:06:04,846 --> 00:06:07,026

Basically, it allows you
to switch back and forth

133

00:06:07,096 --> 00:06:09,306

between imaging and
spectroscopy on the fly.

134

00:06:09,306 --> 00:06:10,926

>> In talking to the astronomers

135

00:06:10,926 --> 00:06:12,326

and astrophysicists
here tonight,

136

00:06:12,326 --> 00:06:14,856

provided great background
and great context

137

00:06:15,326 --> 00:06:19,176

for when I integrate a lot
of the engineering challenges

138

00:06:19,176 --> 00:06:21,946

that go along with
SOFIA into my curriculum.

139

00:06:22,196 --> 00:06:23,876

>> So there's this
ring of dust and gas

140

00:06:24,436 --> 00:06:28,156

about 3 light years' radius
around the central cluster,

141

00:06:28,156 --> 00:06:29,196

that super massive black hole.

142

00:06:29,456 --> 00:06:30,336

If you look more closely,

143

00:06:30,336 --> 00:06:32,236

you'll see that there's
these dark bands

144

00:06:32,546 --> 00:06:35,366

at some fixed distance away
from that central cluster.

145

00:06:35,446 --> 00:06:38,636

These are some of the contours
from what we took from FORCAST.

146

00:06:38,636 --> 00:06:41,656

So this is at 37 microns and you
can see that the contours line

147

00:06:41,656 --> 00:06:43,896

up pretty well with where
those dark bands are located.

148

00:06:43,896 --> 00:06:45,296

There's no other
observatory that's capable

149

00:06:45,296 --> 00:06:47,236

of looking at 37 microns.

150

00:06:47,236 --> 00:06:49,036

But SOFIA is the only
observatory capable

151

00:06:49,036 --> 00:06:50,696

of getting this information
right now.

152

00:06:50,746 --> 00:06:53,416

>> This is very exciting to
see the actual data being taken

153

00:06:53,626 --> 00:06:55,396

and then eventually
being able to be used

154

00:06:55,516 --> 00:06:56,816

in research papers and research.

155

00:06:56,966 --> 00:06:58,186

>> We've looked at supernova.

156

00:06:58,486 --> 00:07:02,216

We looked at a donut
ring around the galaxy.

157

00:07:02,266 --> 00:07:05,186

We're looking at other
objects in the sky.

158

00:07:05,476 --> 00:07:08,256

A big red giant and
the discs around it.

159

00:07:08,466 --> 00:07:11,166

And all of these are
parts of astronomy.

160

00:07:11,166 --> 00:07:14,936
And astronomy is really amazing
because if you look at it

161
00:07:14,936 --> 00:07:17,716
in the infrared light, you're
going to see it differently

162
00:07:17,976 --> 00:07:19,816
than when you look at
it in the visible light.

163
00:07:19,876 --> 00:07:22,756
We'll be able to take some of
the content we've learned here

164
00:07:23,166 --> 00:07:25,526
and teach incoming 7th,
8th, and 9th graders.

165
00:07:25,526 --> 00:07:27,456
At Air Camp U.S.A. all

166
00:07:27,456 --> 00:07:29,716
about the infrared spectrum, different aspects

167
00:07:29,766 --> 00:07:31,776
to the engineer design
process with AFRL

168
00:07:31,776 --> 00:07:33,856
at Wright-Patt in Dayton, Ohio.

169
00:07:34,186 --> 00:07:38,016
And then also be able to show
other applications of mapping,

170
00:07:38,016 --> 00:07:40,406
of flight plans, the integration
of the total systems.

171

00:07:40,476 --> 00:07:41,146

>> One of the things

172

00:07:41,146 --> 00:07:43,956

that I always thought was
just incredible was the idea

173

00:07:43,956 --> 00:07:48,456

of just exploration for the sake
of exploration and to learn more

174

00:07:48,456 --> 00:07:51,086

about our origins or
possibly where we're going.

175

00:07:51,316 --> 00:07:52,436

If my students were
here tonight,

176

00:07:52,436 --> 00:07:55,476

I would say that this
SOFIA mission proves

177

00:07:55,476 --> 00:07:58,356

that there is a purpose
to learning.

178

00:07:58,356 --> 00:08:00,416

There are so many
applications in math, science,

179

00:08:00,416 --> 00:08:02,646

and engineering that are being
demonstrated here this evening.

180

00:08:03,416 --> 00:08:05,916

That there are practical
applications for things

181

00:08:05,916 --> 00:08:08,406

that you wouldn't ordinarily
think that you would use.

182

00:08:08,846 --> 00:08:11,396

So it's kind of nice that I can
use this as a reference point

183

00:08:11,396 --> 00:08:12,646

when my students
say, Mr. Jenkins,

184

00:08:12,646 --> 00:08:13,546

why are we learning this?

185

00:08:14,106 --> 00:08:15,986

And I can give them
a specific example

186

00:08:15,986 --> 00:08:18,136

and I could even tell them
some of the wonderful people

187

00:08:18,136 --> 00:08:19,566

that we've worked with tonight.

188

00:08:19,756 --> 00:08:23,216

To accomplish this
wonderful exploration.

189

00:08:23,396 --> 00:08:25,256

>> The kids have sent
me a lot of emails.

190

00:08:25,256 --> 00:08:26,686

And they're just really
anxious for me to get back

191

00:08:26,686 --> 00:08:28,626

and tell them all
about this opportunity.

192
00:08:28,840 --> 00:08:30,476
I would definitely want
to share to them all

193
00:08:30,476 --> 00:08:31,866
of the different
people that are involved

194
00:08:31,866 --> 00:08:33,746
in getting this flight
off the ground.

195
00:08:33,746 --> 00:08:36,216
I think it's amazing how
many paths people take

196
00:08:36,346 --> 00:08:37,516
to come work at NASA.

197
00:08:38,180 --> 00:08:39,980
How there's so many
different jobs

198
00:08:40,046 --> 00:08:41,246
and how well coordinated it is

199
00:08:41,246 --> 00:08:43,176
to get this aircraft
off the ground

200
00:08:43,176 --> 00:08:44,356
and to get the science running

201
00:08:44,516 --> 00:08:45,896
and to get the telescope
running,

202

00:08:46,086 --> 00:08:48,406

and to collect the data and
everything that's involved

203

00:08:48,476 --> 00:08:51,826

so that they realize that this
is not just a one-man operation,

204

00:08:51,826 --> 00:08:52,376

that NASA

205

00:08:52,376 --> 00:08:53,926

is a lot of different
people with a lot

206

00:08:54,206 --> 00:08:55,466

of different backgrounds
coming together

207

00:08:55,716 --> 00:08:56,916

and getting this science done.