
Ames Research Center
NASA

1
00:00:01,000 --> 00:00:07,000
[music playing]

2
00:00:15,666 --> 00:00:17,966
- SO WELCOME
TO THE 75TH ANNIVERSARY

3
00:00:17,966 --> 00:00:20,700
OF NASA AMES RESEARCH CENTER

4
00:00:20,700 --> 00:00:24,233
DIRECTOR'S COLLOQUIUM
SUMMER SERIES.

5
00:00:24,233 --> 00:00:28,233
TODAY'S SEMINAR
IS BY ROBERT CARVALHO

6
00:00:28,233 --> 00:00:29,566
AND IS ENTITLED

7
00:00:29,566 --> 00:00:34,200
PURSUING THE MYSTERIES
OF THE SUN: THE IRIS MISSION.

8
00:00:34,200 --> 00:00:38,833
THE SUN IS AT THE CORE
OF OUR HABITABLE ZONE.

9
00:00:38,833 --> 00:00:42,600
THE INTERFACE REGION
IMAGING SPECTROGRAPH MISSION,

10
00:00:42,600 --> 00:00:46,233
OR "IRIS" FOR SHORT,
STUDIES HOW ENERGY TRAVELS

11
00:00:46,233 --> 00:00:50,433
THROUGH THE SOLAR ATMOSPHERE

INTERFACE REGION.

12
00:00:50,433 --> 00:00:56,200
IRIS WAS LAUNCHED
ON JUNE 26, 2013,

13
00:00:56,200 --> 00:01:00,600
AND HAS ALREADY PRODUCED NOVEL
DATA ON THE WORKINGS OF THE SUN.

14
00:01:02,866 --> 00:01:05,733
THERE ARE MANY COMPONENTS
THAT ARE CRITICAL

15
00:01:05,733 --> 00:01:09,366
TO THE OVERALL SUCCESS
OF SPACE-BASED SCIENCE MISSIONS.

16
00:01:09,366 --> 00:01:13,333
ONE SUCH COMPONENT
IS SPACECRAFT OPERATIONS.

17
00:01:13,333 --> 00:01:17,200
ROBERT IS A FLIGHT CONTROLLER
AND GROUND DATA SYSTEMS ENGINEER

18
00:01:17,200 --> 00:01:22,433
AT NASA AMES RESEARCH CENTER
FOR THE IRIS MISSION.

19
00:01:22,433 --> 00:01:26,100
HIS CAREER
AT AMES SPANS 21 YEARS

20
00:01:26,100 --> 00:01:29,600
AND STARTED AS AN INTERN HERE
AT THE CENTER,

21
00:01:29,600 --> 00:01:34,100
FOR THOSE INTERNS HERE

IN THE AUDIENCE.

22
00:01:34,100 --> 00:01:36,866
HE RECEIVED A BACHELOR'S DEGREE
IN COMPUTER ENGINEERING

23
00:01:36,866 --> 00:01:38,600
FROM SANTA CLARA UNIVERSITY

24
00:01:38,600 --> 00:01:41,300
AND A GRADUATE CERTIFICATE
IN SPACE SYSTEM ENGINEERING

25
00:01:41,300 --> 00:01:44,066
FROM STEVENS INSTITUTE
OF TECHNOLOGY.

26
00:01:44,066 --> 00:01:47,466
PLEASE JOIN ME IN WELCOMING
ROBERT CARVALHO.

27
00:01:47,466 --> 00:01:49,466
[applause]

28
00:01:53,500 --> 00:01:55,600
- THANK YOU.
GOOD AFTERNOON.

29
00:01:55,600 --> 00:01:58,200
SO I'M HERE TO TALK
ABOUT THE IRIS MISSION.

30
00:01:58,200 --> 00:01:59,600
THERE WILL BE
PLENTY OF OPPORTUNITY

31
00:01:59,600 --> 00:02:02,066
FOR QUESTIONS AT THE END.

32

00:02:02,066 --> 00:02:05,066
SO I'M GONNA START WITH
A BRIEF INTRODUCTION OF MYSELF.

33
00:02:05,066 --> 00:02:08,933
AS WAS MENTIONED, I GOT MY
DEGREE IN COMPUTER ENGINEERING

34
00:02:08,933 --> 00:02:11,700
FROM SANTA CLARA HERE IN 1995.

35
00:02:11,700 --> 00:02:16,033
BUT I HAD STARTED AS AN INTERN
HERE AT AMES ACTUALLY IN 1993,

36
00:02:16,033 --> 00:02:18,566
AND I'VE BEEN WORKING HERE
EVER SINCE.

37
00:02:18,566 --> 00:02:21,900
I WORKED WITH THE APEX PROGRAM
HERE AT AMES

38
00:02:21,900 --> 00:02:23,933
TO GET
THAT GRADUATE CERTIFICATE

39
00:02:23,933 --> 00:02:27,233
IN SPACECRAFT SYSTEMS
ENGINEERING IN 2009.

40
00:02:27,233 --> 00:02:29,333
SOME OF THE OTHER INTERESTING
THINGS I'VE DONE HERE

41
00:02:29,333 --> 00:02:33,266
HAVE BEEN WORKING
ON THE CONSTELLATION PROGRAM,

42
00:02:33,266 --> 00:02:35,466

FOR THOSE OF YOU
THAT REMEMBER THAT,

43
00:02:35,466 --> 00:02:37,800
WORKING ON A NUMBER
OF INTERESTING MISSION PROPOSALS

44
00:02:37,800 --> 00:02:40,200
FOR OTHER MISSIONS
THAT WE MIGHT DO HERE

45
00:02:40,200 --> 00:02:42,800
IN THE FUTURE AT AMES.

46
00:02:42,800 --> 00:02:46,000
I HAVE WORKED ON ASTRONAUT
TRAINING MANAGEMENT SYSTEMS,

47
00:02:46,000 --> 00:02:47,533
AND I DID DO SOME WORK

48
00:02:47,533 --> 00:02:51,200
SUPPORTING THE COLUMBIA
ACCIDENT INVESTIGATION BOARD.

49
00:02:51,200 --> 00:02:53,966
I'M ALSO WORKING NOW
ON A SIMILAR ROLE

50
00:02:53,966 --> 00:02:55,666
TO WHAT I'VE BEEN
DOING FOR IRIS

51
00:02:55,666 --> 00:02:57,433
ON THE RESOURCE
PROSPECTOR MISSION,

52
00:02:57,433 --> 00:02:58,833
WHICH IS AN UPCOMING MISSION

53
00:02:58,833 --> 00:03:02,433
THAT AMES IS WORKING ON
TO GO BACK TO THE MOON.

54
00:03:02,433 --> 00:03:05,433
AND I'VE ENJOYED SPACE
EVER SINCE I WAS A KID.

55
00:03:05,433 --> 00:03:07,866
ACTUALLY, MY FATHER WORKED
ON THE SPACE SHUTTLE

56
00:03:07,866 --> 00:03:10,600
AND THE SPACE STATION PROGRAMS
WHEN I WAS IN SCHOOL,

57
00:03:10,600 --> 00:03:14,266
AND SO I JUST KIND OF
FOLLOWED RIGHT ALONG.

58
00:03:14,266 --> 00:03:17,733
SO THE IRIS MISSION
IS A SMALL EXPLORER MISSION,

59
00:03:17,733 --> 00:03:20,233
AND WE'RE DESIGNED TO STUDY

60
00:03:20,233 --> 00:03:22,800
THE LAYER
BETWEEN THE PHOTOSPHERE,

61
00:03:22,800 --> 00:03:25,600
THAT IS, THE SURFACE OF THE SUN
AND THE CORONA.

62
00:03:25,600 --> 00:03:28,900
FOR SOME REASON,
AND THEY'RE NOT SURE WHY,

63

00:03:28,900 --> 00:03:31,166
THE FUSION HAPPENS
IN THE CENTER OF THE SUN,

64
00:03:31,166 --> 00:03:33,733
AND THEN AS THINGS MOVE OUT,
THEY GET COOLER.

65
00:03:33,733 --> 00:03:35,033
HOWEVER, ONCE YOU GO

66
00:03:35,033 --> 00:03:37,733
FROM THE SURFACE
OF THE SUN TO THE CORONA,

67
00:03:37,733 --> 00:03:40,600
THEN THINGS SUDDENLY
GET SIGNIFICANTLY HOTTER,

68
00:03:40,600 --> 00:03:42,266
AND SCIENTISTS
ARE NOT SURE WHY.

69
00:03:42,266 --> 00:03:44,400
AND THAT'S THE INTENT
OF THE IRIS MISSION,

70
00:03:44,400 --> 00:03:46,733
IS TO TRY AND UNDERSTAND
WHAT GOES ON RIGHT THERE

71
00:03:46,733 --> 00:03:48,233
AT THAT INTERFACE REGION,

72
00:03:48,233 --> 00:03:51,800
TO UNDERSTAND,
WHY DOES IT JUMP IN TEMPERATURE?

73
00:03:51,800 --> 00:03:54,333
AND WHAT ARE ALL THE ACTIVITIES

THAT GO ON RIGHT THERE

74
00:03:54,333 --> 00:03:57,933
AT THAT BOUNDARY LAYER?

75
00:03:57,933 --> 00:04:00,666
SO HERE'S AN IMAGE OF THE SUN.

76
00:04:00,666 --> 00:04:03,400
YOU CAN SEE THERE'S THE CORE
WHERE THE FUSION HAPPENS

77
00:04:03,400 --> 00:04:08,700
AND THE PHOTOSPHERE
AND THE CORONA OUT TO THE RIGHT.

78
00:04:08,700 --> 00:04:13,566
SO YOU CAN SEE WHERE IT GOES OUT
TO THE ATMOSPHERE OF THE SUN.

79
00:04:13,566 --> 00:04:15,133
AND AS I MENTIONED, YOU KNOW,

80
00:04:15,133 --> 00:04:17,633
IT'S THOUSANDS OF DEGREES KELVIN
ON THE SURFACE,

81
00:04:17,633 --> 00:04:19,733
BUT THEN IT'S MILLIONS
OF DEGREES KELVIN

82
00:04:19,733 --> 00:04:23,033
OUT IN THE CORONA,
AND THEY DON'T KNOW WHY.

83
00:04:23,033 --> 00:04:26,733
THIS GIVES YOU ANOTHER VIEW
OF THE CORONA OF THE SUN

84

00:04:26,733 --> 00:04:28,233
AS RELATED
TO THE CHROMOSPHERE.

85
00:04:28,233 --> 00:04:30,166
SO THE CHROMOSPHERE
IS LIKE THE SURFACE,

86
00:04:30,166 --> 00:04:32,866
AND THE CORONA IS THE OUTER
ATMOSPHERE OF THE SUN.

87
00:04:32,866 --> 00:04:34,433
AND THE CORONA
ACTUALLY EXTENDS

88
00:04:34,433 --> 00:04:37,933
ALL THE WAY OUT
ACROSS THE PLANETS AS WELL.

89
00:04:37,933 --> 00:04:43,466
IRIS IS ONE OF MANY, MANY NASA
MISSIONS STUDYING THE SUN.

90
00:04:43,466 --> 00:04:46,366
THIS SHOWS YOU
QUITE A FEW OF THEM.

91
00:04:46,366 --> 00:04:48,666
WE ACTUALLY WORK
IN PARTNERSHIP.

92
00:04:48,666 --> 00:04:51,933
OUR SCIENCE TEAMS
COLLABORATE ACROSS THE MISSIONS

93
00:04:51,933 --> 00:04:54,400
SO THAT THEY CAN WORK TOGETHER

94
00:04:54,400 --> 00:04:57,533

TO OBSERVE THE SAME ASPECTS
OF THE SUN AT THE SAME TIME

95
00:04:57,533 --> 00:05:00,566
TO TRY AND UNDERSTAND
MORE ABOUT WHAT'S GOING ON

96
00:05:00,566 --> 00:05:04,233
WITH VARIOUS ASPECTS
OF THE SUN.

97
00:05:04,233 --> 00:05:06,866
SO HOW DOES IRIS
DO WHAT IT DOES?

98
00:05:06,866 --> 00:05:10,066
IT LOOKS AT THE SUN
IN THE ULTRAVIOLET.

99
00:05:10,066 --> 00:05:12,333
IT LOOKS AT THE SUN BOTH
IN THE NEAR ULTRAVIOLET,

100
00:05:12,333 --> 00:05:15,333
WHICH YOU SEE ON THE LEFT,
AS WELL AS THE FAR ULTRAVIOLET,

101
00:05:15,333 --> 00:05:16,866
WHICH IS WHAT YOU SEE
ON THE RIGHT.

102
00:05:16,866 --> 00:05:19,166
AND THAT HELPS IT
TO UNDERSTAND WHAT'S GOING ON

103
00:05:19,166 --> 00:05:22,500
AT THE DIFFERENT LAYERS
BASED ON THE TEMPERATURE

104
00:05:22,500 --> 00:05:25,366

AND THE CHEMISTRY
THAT'S GOING ON WITHIN THOSE.

105
00:05:25,366 --> 00:05:30,333
IT TAKES IMAGES
AS WELL AS SPECTRAL DATA,

106
00:05:30,333 --> 00:05:35,300
SO THESE IMAGES SHOW
AN AREA OF THE SUN,

107
00:05:35,300 --> 00:05:36,900
AND THEN IF YOU SEE
THAT BLACK LINE

108
00:05:36,900 --> 00:05:38,566
DOWN THE MIDDLE OF EACH
OF THOSE PICTURES--

109
00:05:38,566 --> 00:05:41,566
IT'S MOST PROMINENT
ON THE ONE ON THE LEFT THERE--

110
00:05:41,566 --> 00:05:44,666
THAT'S WHERE THE SLIT IS
FOR THE SPECTROGRAPH,

111
00:05:44,666 --> 00:05:47,766
WHICH THEN GENERATES THE
SPECTRAL DATA THAT YOU SEE HERE.

112
00:05:47,766 --> 00:05:53,566
SO YOU CAN SEE THE SPATIAL
LAYOUT IS IN THE VERTICAL,

113
00:05:53,566 --> 00:05:56,000
AND THEN THE HORIZONTAL
IS THE SPECTRAL LAYOUT.

114
00:05:56,000 --> 00:05:57,433

SO THAT YOU--

115
00:05:57,433 --> 00:06:00,366
SO THAT THE SCIENTISTS CAN
UNDERSTAND WHAT'S GOING ON,

116
00:06:00,366 --> 00:06:02,466
THE CHEMISTRY,
THE TEMPERATURES,

117
00:06:02,466 --> 00:06:03,700
THE DIFFERENT ACTIVITIES

118
00:06:03,700 --> 00:06:08,366
AT THE DIFFERENT LOCATIONS
ON THE SUN.

119
00:06:08,366 --> 00:06:11,100
COMPARED
TO OTHER NASA MISSIONS,

120
00:06:11,100 --> 00:06:13,133
MOST OF THE OTHER NASA MISSIONS
LOOKING AT THE SUN

121
00:06:13,133 --> 00:06:16,066
LOOK AT THE ENTIRE SUN,
SO THIS BIG PICTURE HERE

122
00:06:16,066 --> 00:06:20,566
IS ACTUALLY AN SDO IMAGE,
WHEREAS THAT LITTLE SQUARE THERE

123
00:06:20,566 --> 00:06:23,066
IS THE TYPICAL AREA
OF AN IRIS IMAGE.

124
00:06:23,066 --> 00:06:25,200
WE ARE MUCH MORE OF A ZOOM.

125
00:06:25,200 --> 00:06:30,333
WE'RE MUCH MORE FOCUSED IN
ON THE DETAILS.

126
00:06:30,333 --> 00:06:33,366
WE INTEND TO FOCUS IN
ON THE DETAILS OF THE SUN

127
00:06:33,366 --> 00:06:36,066
SO THAT WE CAN UNDERSTAND
MORE OF THE MINUTE ASPECTS

128
00:06:36,066 --> 00:06:37,200
OF WHAT'S GOING ON.

129
00:06:37,200 --> 00:06:38,733
SDO LOOKS AT THE BIG PICTURE

130
00:06:38,733 --> 00:06:40,633
AND TRIES TO UNDERSTAND
THE BIG FLOWS,

131
00:06:40,633 --> 00:06:43,600
WHEREAS IRIS LOOKS DOWN
AT THE VERY LITTLE STUFF

132
00:06:43,600 --> 00:06:45,600
AND TRIES TO UNDERSTAND
THE DETAILS.

133
00:06:45,600 --> 00:06:48,100
IRIS ALSO WORKS
AT A MUCH FASTER RATE.

134
00:06:48,100 --> 00:06:50,400
IT TAKES IMAGES
ABOUT EVERY SECOND

135
00:06:50,400 --> 00:06:52,900

OR EVERY TWO SECONDS
DEPENDING ON THE SITUATION,

136
00:06:52,900 --> 00:06:54,866
AND SO THAT THEN THE SCIENTISTS

137
00:06:54,866 --> 00:06:57,100
TO UNDERSTAND
MORE OF WHAT'S GOING ON,

138
00:06:57,100 --> 00:06:58,700
BECAUSE THINGS ARE SO DYNAMIC

139
00:06:58,700 --> 00:07:01,166
RIGHT THERE
ON THE SURFACE OF THE SUN.

140
00:07:01,166 --> 00:07:04,233
SOME OF THE OTHER MISSIONS
WE COLLABORATE WITH.

141
00:07:04,233 --> 00:07:05,433
MOST OFTEN, WE COLLABORATE

142
00:07:05,433 --> 00:07:07,400
WITH THE SOLAR DYNAMICS
OBSERVATORY.

143
00:07:07,400 --> 00:07:09,900
MANY OF OUR SCIENTISTS ARE
ACTUALLY THE SAME SCIENTISTS

144
00:07:09,900 --> 00:07:11,533
THAT WORK ON THE SDO MISSION.

145
00:07:11,533 --> 00:07:13,133
WE ALSO WORK A LOT

146
00:07:13,133 --> 00:07:16,366

WITH THE HINODE SCIENCE TEAM
OUT OF JAPAN,

147
00:07:16,366 --> 00:07:18,433
AND THEN THERE ARE
SOME EARTHBOUND TELESCOPES

148
00:07:18,433 --> 00:07:21,166
THAT ARE STUDYING THE SUN
AS WELL THAT WE WORK WITH.

149
00:07:21,166 --> 00:07:22,833
IRIS IS DIFFERENT FROM THOSE

150
00:07:22,833 --> 00:07:24,833
IN THAT WE CAN LOOK
AT THE ULTRAVIOLET.

151
00:07:24,833 --> 00:07:27,700
THOSE ARE SPECTRA THAT ARE
FILTERED BY THE OZONE LAYER,

152
00:07:27,700 --> 00:07:32,900
WHICH IS GOOD FOR US
BUT BAD FOR SCIENCE.

153
00:07:32,900 --> 00:07:36,733
SO NASA ALSO--
AMES HERE ALSO PLAYS A ROLE

154
00:07:36,733 --> 00:07:40,066
ON THIS MISSION
IN HIGH-END COMPUTING.

155
00:07:40,066 --> 00:07:41,666
SO THERE'S
THE PLEIADES CLUSTER,

156
00:07:41,666 --> 00:07:44,266
WHICH IS BACK UP

IN BUILDING 258,

157
00:07:44,266 --> 00:07:46,800
AND THEY DO
A LOT OF THE MODELING

158
00:07:46,800 --> 00:07:48,533
THAT'S ASSOCIATED
WITH THIS DATA.

159
00:07:48,533 --> 00:07:51,666
SINCE THERE'S A LOT OF DATA
TO BE PROCESSED FROM IRIS,

160
00:07:51,666 --> 00:07:55,000
AND THERE'S VARIOUS MODELS
SCIENTISTS HAVE DEVELOPED,

161
00:07:55,000 --> 00:07:56,800
AND THEY'RE TRYING TO NOW
CHECK THOSE MODELS

162
00:07:56,800 --> 00:07:59,466
AGAINST THE DATA
GATHERED FROM IRIS.

163
00:07:59,466 --> 00:08:02,433
AND SO THE SUPERCOMPUTING
FACILITIES HERE AT AMES

164
00:08:02,433 --> 00:08:06,733
ARE PARTICIPATING IN THAT.

165
00:08:06,733 --> 00:08:09,066
SO THIS IS
THE IRIS SPACECRAFT,

166
00:08:09,066 --> 00:08:12,700
AND I'VE GOT A MODEL ACTUALLY
HERE ON THE TABLE AS WELL.

167
00:08:12,700 --> 00:08:14,800
YOU CAN SEE
MOST OF THE SPACECRAFT

168
00:08:14,800 --> 00:08:18,100
IS ACTUALLY THE TELESCOPE
AND THE SPECTROGRAPH.

169
00:08:18,100 --> 00:08:19,533
SO THAT'S THIS.

170
00:08:19,533 --> 00:08:22,100
THE ACTUAL--WHAT THEY CALL
THE SPACECRAFT BUS,

171
00:08:22,100 --> 00:08:23,700
INDEPENDENT OF THE PAYLOAD,

172
00:08:23,700 --> 00:08:26,700
IS JUST THIS A RING
AROUND THE BOTTOM HERE.

173
00:08:29,633 --> 00:08:33,566
SO TO LOOK IN MORE DETAIL IN
WHAT'S INSIDE THAT RING THERE,

174
00:08:33,566 --> 00:08:37,933
YOU'VE GOT THE REACTION WHEELS
AND THE STAR TRACKERS

175
00:08:37,933 --> 00:08:39,633
THAT HELP KEEP
THE SPACECRAFT POINTED

176
00:08:39,633 --> 00:08:41,400
WHERE IT NEEDS TO BE POINTED.

177
00:08:41,400 --> 00:08:44,366

THERE'S THE VARIOUS COMPUTERS
AND BATTERIES AND SO ON

178
00:08:44,366 --> 00:08:47,366
FOR THE SPACECRAFT ITSELF
AS OPPOSED TO THE COMPUTER

179
00:08:47,366 --> 00:08:50,700
FOR THE INSTRUMENT,
WHICH IS THIS BOX HERE.

180
00:08:52,866 --> 00:08:54,366
WHERE DOES IRIS GO?

181
00:08:54,366 --> 00:08:56,466
SO WHEN I'VE TALKED
TO PEOPLE IN THE PAST,

182
00:08:56,466 --> 00:08:59,033
SOMETIMES THEY WONDER,
HOW ARE WE GETTING TO THE SUN?

183
00:08:59,033 --> 00:09:01,966
WELL, WE'RE NOT ACTUALLY
GOING TO THE SUN.

184
00:09:01,966 --> 00:09:03,366
WE STAY IN A LOW EARTH ORBIT.

185
00:09:03,366 --> 00:09:05,466
IT'S A POLAR
SUN-SYNCHRONOUS ORBIT

186
00:09:05,466 --> 00:09:08,000
SO THAT WE CAN ALWAYS
LOOK AT THE SUN.

187
00:09:08,000 --> 00:09:10,933
SO IMAGINE IF YOU ALL OUT THERE
WERE THE SUN,

188
00:09:10,933 --> 00:09:12,200
AND THIS WAS THE EARTH,

189
00:09:12,200 --> 00:09:14,100
WE'RE GOING
AROUND THE EARTH LIKE THIS.

190
00:09:14,100 --> 00:09:16,600
SO IT'S
AT THE SUNRISE-SUNSET LINE

191
00:09:16,600 --> 00:09:19,200
SO THAT WE CAN ALWAYS
SEE THE SUN.

192
00:09:19,200 --> 00:09:21,033
IT MAXIMIZES OUR DATA TIME

193
00:09:21,033 --> 00:09:23,666
AS WELL AS MAKES IT EASY
FROM A POWER PERSPECTIVE

194
00:09:23,666 --> 00:09:26,266
AND A THERMAL PERSPECTIVE
TO BE VERY CONSISTENTLY

195
00:09:26,266 --> 00:09:28,533
IN THE SUN AT ALL TIMES.

196
00:09:28,533 --> 00:09:31,800
WE USE FOUR DIFFERENT GROUND
STATIONS AROUND THE EARTH.

197
00:09:31,800 --> 00:09:33,633
SINCE WE'RE IN A POLAR ORBIT,

198
00:09:33,633 --> 00:09:36,133
IT MAKES MOST SENSE

TO USE POLAR GROUND STATIONS.

199
00:09:36,133 --> 00:09:38,666
SO THAT'S
THE ALASKA GROUND STATION,

200
00:09:38,666 --> 00:09:40,900
AND THE MCMURDO
GROUND STATION,

201
00:09:40,900 --> 00:09:42,333
AND THE SVALBARD
GROUND STATION.

202
00:09:42,333 --> 00:09:43,500
THE SVALBARD GROUND STATION

203
00:09:43,500 --> 00:09:45,533
IS ACTUALLY PROVIDED
FOR THIS MISSION

204
00:09:45,533 --> 00:09:47,366
BY THE NORWEGIAN SPACE AGENCY

205
00:09:47,366 --> 00:09:49,800
AS THEIR CONTRIBUTION
TO THIS MISSION.

206
00:09:49,800 --> 00:09:52,933
THEY GIVE US TIME ON THEIR
ANTENNAS UP THERE ON SVALBARD.

207
00:09:52,933 --> 00:09:57,833
AND THEN WE ALSO USE THE WALLOPS
FACILITY IN VIRGINIA.

208
00:09:57,833 --> 00:10:01,366
MOST OF OUR GROUND CONTACTS
ARE COMPLETELY AUTOMATED,

209
00:10:01,366 --> 00:10:04,000
AND I'LL BE TALKING
MORE ABOUT THAT IN A BIT,

210
00:10:04,000 --> 00:10:06,700
BUT WE ESSENTIALLY TALK
TO ONE GROUND STATION

211
00:10:06,700 --> 00:10:12,666
OR ANOTHER EVERY ORBIT, AND
OUR ORBIT IS ABOUT 90 MINUTES.

212
00:10:12,666 --> 00:10:14,933
SO WHAT DID AMES DO
ON THIS MISSION?

213
00:10:14,933 --> 00:10:16,966
THIS IS
A LOCKHEED-LED MISSION.

214
00:10:16,966 --> 00:10:21,466
IT'S PRIMARILY MANAGED BY THE
LOCKHEED FACILITY IN PALO ALTO.

215
00:10:21,466 --> 00:10:23,966
THEY BUILT THE TELESCOPE
AND THE SPECTROGRAPH.

216
00:10:23,966 --> 00:10:25,833
THEY PUT TOGETHER
THE INSTRUMENT PACKAGE.

217
00:10:25,833 --> 00:10:28,233
THEY ALSO HAVE THE SCIENCE TEAM,
THE SCIENCE--

218
00:10:28,233 --> 00:10:33,000
BOTH THE P.I.s AND MANY
OF THE SCIENTISTS WORK THERE.

219
00:10:33,000 --> 00:10:36,333
THE SPACECRAFT BUS WAS PUT
TOGETHER BY LOCKHEED SUNNYVALE

220
00:10:36,333 --> 00:10:39,266
JUST ON THE OTHER SIDE
OF THE RUNWAY HERE.

221
00:10:39,266 --> 00:10:43,433
AND THEN AMES HAD A NUMBER
OF SMALL ROLES IN THIS MISSION

222
00:10:43,433 --> 00:10:45,400
BUT KEY ROLES IN THIS MISSION.

223
00:10:45,400 --> 00:10:48,400
SO WE HAD THE ASSISTANT
PROJECT MANAGER, JOHN MARMIE.

224
00:10:48,400 --> 00:10:51,833
HE WAS THE NUMBER TWO OVERALL
ON THE MISSION.

225
00:10:51,833 --> 00:10:54,400
WE ARE RESPONSIBLE HERE
FOR MISSION OPERATIONS

226
00:10:54,400 --> 00:10:56,000
AND GROUND SYSTEMS.

227
00:10:56,000 --> 00:10:58,100
WE'VE ALSO HAD
A NUMBER OF EDUCATION

228
00:10:58,100 --> 00:11:00,100
AND PUBLIC OUTREACH
ACTIVITIES.

229
00:11:00,100 --> 00:11:02,533

WE DO HAVE
SOME SCIENCE PARTICIPATION,

230
00:11:02,533 --> 00:11:05,366
SO OUR CENTER DIRECTOR AND
A COUPLE OF FOLKS ON HIS TEAM

231
00:11:05,366 --> 00:11:07,633
ARE ACTUALLY PART
OF THE SCIENCE TEAM HERE

232
00:11:07,633 --> 00:11:10,100
AS WELL
AS THE SUPERCOMPUTER FACILITY

233
00:11:10,100 --> 00:11:12,266
THAT I MENTIONED EARLIER.

234
00:11:12,266 --> 00:11:15,166
WE HAVE ALSO
DONE SOME ACTIVITIES

235
00:11:15,166 --> 00:11:17,700
TO SUPPORT THE REST
OF THE MISSION AS WELL.

236
00:11:17,700 --> 00:11:22,666
SO EDDY, WHO WAS GONNA BE
COPRESENTING HERE WITH ME,

237
00:11:22,666 --> 00:11:24,366
HE HELPED A LOT
WITH THE FLIGHT SOFTWARE

238
00:11:24,366 --> 00:11:25,833
DEVELOPMENT AND TESTING,

239
00:11:25,833 --> 00:11:28,800
AS WELL AS THE ACS
DEVELOPMENT AND TESTING.

240
00:11:28,800 --> 00:11:30,366
WE'VE ALSO DONE SOME SUPPORT

241
00:11:30,366 --> 00:11:33,400
IN TESTING AND EVALUATING
THE SIMULATORS

242
00:11:33,400 --> 00:11:38,266
AND DOING SOME THERMAL
ENGINEERING AS WELL HERE.

243
00:11:38,266 --> 00:11:40,133
SO TO TALK A LITTLE BIT MORE

244
00:11:40,133 --> 00:11:42,166
ABOUT THE ATTITUDE
CONTROL SYSTEM--

245
00:11:42,166 --> 00:11:44,766
THE ATTITUDE CONTROL SYSTEM
IS WHAT KEEPS THE SPACECRAFT

246
00:11:44,766 --> 00:11:46,300
POINTING AT THE SUN.

247
00:11:46,300 --> 00:11:48,466
SO IN THE CASE OF IRIS,
WE HAVE NO THRUSTERS.

248
00:11:48,466 --> 00:11:49,933
WE HAVE NO PROPULSION,

249
00:11:49,933 --> 00:11:52,633
WHICH IS KIND OF NICE FOR ME
AS A FLIGHT CONTROLLER

250
00:11:52,633 --> 00:11:55,600
BECAUSE THEN I NEVER HAVE TO

WORRY ABOUT RUNNING OUT OF GAS.

251
00:11:55,600 --> 00:11:58,900
BUT WE HAVE REACTION WHEELS,
WHICH DO THE MAIN JOB

252
00:11:58,900 --> 00:12:01,733
OF KEEPING THE SPACECRAFT
STABLE AND POINTED.

253
00:12:01,733 --> 00:12:03,466
AND THEN THEY USE
THE TORQUE RODS

254
00:12:03,466 --> 00:12:06,333
TO DUMP THE MOMENTUM
FROM THE REACTION WHEELS

255
00:12:06,333 --> 00:12:08,466
TO KEEP THEM SPINNING
AT A NICE RATE,

256
00:12:08,466 --> 00:12:11,433
AND THEY USE THAT BY PULLING
ON THE EARTH'S MAGNETIC FIELD

257
00:12:11,433 --> 00:12:15,500
AS WE GO
AROUND THE POLES.

258
00:12:15,500 --> 00:12:19,266
THERE ARE--WHEN WE FIRST
DROPPED OFF THE ROCKET,

259
00:12:19,266 --> 00:12:21,100
THERE WERE A NUMBER
OF SUN SENSORS,

260
00:12:21,100 --> 00:12:23,833
THE CORE SUN SENSORS

YOU CAN SEE ON THE SOLAR PANELS

261
00:12:23,833 --> 00:12:25,400
AS WELL AS THE DIGITAL ONE
THAT YOU SEE

262
00:12:25,400 --> 00:12:27,400
ON THE FRONT END
OF THE TELESCOPE THERE.

263
00:12:27,400 --> 00:12:28,866
AND THOSE HELP THE SPACECRAFT

264
00:12:28,866 --> 00:12:30,800
TO KNOW WHERE THE SUN
WAS INITIALLY

265
00:12:30,800 --> 00:12:34,300
SO THAT WE COULD TURN AND FACE
THE SUN AS QUICKLY AS POSSIBLE

266
00:12:34,300 --> 00:12:37,200
TO GET OUR POWER OPERATING
ON THE SOLAR PANELS

267
00:12:37,200 --> 00:12:39,600
AND THEN GET
THE SPACECRAFT GOING.

268
00:12:41,700 --> 00:12:44,533
SO THAT WAS THE FIRST MODE
THERE THAT I TALKED ABOUT,

269
00:12:44,533 --> 00:12:46,100
THE DE-TUMBLE
AND THE SUN SEARCH.

270
00:12:46,100 --> 00:12:48,666
THAT'S THE EARLY--THE VERY EARLY
PHASES OF THE MISSION.

271
00:12:48,666 --> 00:12:50,733
WE DON'T ANTICIPATE
EVER USING THOSE AGAIN,

272
00:12:50,733 --> 00:12:53,566
BUT THEY ARE AVAILABLE
SHOULD WE GET HIT BY SOME,

273
00:12:53,566 --> 00:12:56,433
YOU KNOW, SCREW THAT FALLS OFF
OF THE SPACE STATION

274
00:12:56,433 --> 00:12:58,866
OR SOMETHING LIKE THAT
THAT WOULD KNOCK US SPINNING.

275
00:12:58,866 --> 00:13:00,666
YOU KNOW,
WE HAVE THE CAPABILITY

276
00:13:00,666 --> 00:13:03,100
TO ONCE AGAIN FIND
WHERE THE SUN IS

277
00:13:03,100 --> 00:13:05,900
AND GET THINGS POINTED
BACK AT THE SUN.

278
00:13:05,900 --> 00:13:08,966
COURSE CONTROL IS WHAT WE USE
WHEN WE'RE DOING MAINTENANCE

279
00:13:08,966 --> 00:13:10,233
OF THE SPACECRAFT.

280
00:13:10,233 --> 00:13:12,933
IT JUST KEEPS US GENERALLY
POINTING AT THE SUN

281
00:13:12,933 --> 00:13:16,066
AND IN A POWER-POSITIVE
DIRECTION.

282
00:13:16,066 --> 00:13:17,800
THE INERTIAL SUNPOINT
AND THE FINE SUNPOINT

283
00:13:17,800 --> 00:13:19,666
ARE WHAT WE USE
FOR THE SCIENCE MODES,

284
00:13:19,666 --> 00:13:23,333
AND THAT KEEPS US
VERY FINELY POINTED ON THE SUN.

285
00:13:23,333 --> 00:13:25,800
SO WE TRY TO STAY
WITHIN AN ARC SECOND

286
00:13:25,800 --> 00:13:28,300
OF WHERE WE WANT TO BE
ON THE SUN.

287
00:13:28,300 --> 00:13:32,666
FOR THOSE OF YOU WHO DON'T KNOW,
A CIRCLE IS 360 DEGREES.

288
00:13:32,666 --> 00:13:35,633
A DEGREE IS BROKEN DOWN
INTO 60 ARC MINUTES.

289
00:13:35,633 --> 00:13:38,533
AN ARC MINUTE IS BROKEN DOWN
INTO 60 ARC SECONDS.

290
00:13:38,533 --> 00:13:41,700
SO WE STAY
WITHIN AN ARC SECOND POINTING

291
00:13:41,700 --> 00:13:44,166
OF WHERE WE WANT TO
ON THE SUN.

292
00:13:44,166 --> 00:13:45,866
IT'S SO STABLE ACTUALLY,

293
00:13:45,866 --> 00:13:50,766
WE CAN ACTUALLY SEE THE SHUTTER
ON THE CAMERA AS IT CLOSES.

294
00:13:50,766 --> 00:13:52,233
IT SHAKES THE SPACECRAFT,

295
00:13:52,233 --> 00:13:54,933
AND THAT'S
THE PRIMARY DISTURBER

296
00:13:54,933 --> 00:13:56,800
OF THE SPACECRAFT
ATTITUDE POINTING,

297
00:13:56,800 --> 00:14:00,800
IS THE SHUTTER ON THE CAMERA
SHAKES IT JUST A LITTLE BIT.

298
00:14:00,800 --> 00:14:03,000
SO WE CAN WATCH THAT
AS IT HAPPENS.

299
00:14:03,000 --> 00:14:05,166
SO THIS IS
A LITTLE BIT BETTER VIEW

300
00:14:05,166 --> 00:14:08,033
OF THE INSTRUMENT HERE
ON THE SPACECRAFT.

301
00:14:08,033 --> 00:14:12,200

THE GUIDE TELESCOPE, WHICH IS
THIS SMALLER TELESCOPE HERE,

302
00:14:12,200 --> 00:14:14,633
HELPS US KNOW
WHERE WE'RE AT ON THE SUN.

303
00:14:14,633 --> 00:14:17,566
SO IT HAS
A COUPLE OF PRISMS IN IT

304
00:14:17,566 --> 00:14:19,333
THAT GET ADJUSTED
BY THOSE WEDGE MOTORS

305
00:14:19,333 --> 00:14:21,133
THAT ARE MENTIONED UP THERE,

306
00:14:21,133 --> 00:14:23,633
AND THOSE HELP
KEEP THE SPACECRAFT--

307
00:14:23,633 --> 00:14:27,566
HELP KEEP THE SUN CENTERED
IN THE GUIDE TELESCOPE.

308
00:14:27,566 --> 00:14:29,600
AND THEN THAT
TELLS THE SPACECRAFT

309
00:14:29,600 --> 00:14:31,333
WHERE TO POINT
THE BIG TELESCOPE

310
00:14:31,333 --> 00:14:33,933
SO THAT WE'RE LOOKING AT THE
APPROPRIATE SECTION OF THE SUN

311
00:14:33,933 --> 00:14:37,700
'CAUSE WE LIKE TO MOVE

AROUND THE SUN AS WE GO.

312
00:14:37,700 --> 00:14:40,733
AND THEN YOU CAN SEE
THE SPECTROGRAPH

313
00:14:40,733 --> 00:14:42,733
IS THIS MAIN BOX DOWN HERE

314
00:14:42,733 --> 00:14:45,600
INSIDE THE BODY
OF THE SPACECRAFT.

315
00:14:45,600 --> 00:14:47,133
NOT BEING
A SCIENTIST MYSELF,

316
00:14:47,133 --> 00:14:49,666
I'M NOT GONNA GET TOO MUCH
INTO THE DETAILS OF THAT.

317
00:14:49,666 --> 00:14:52,166
THOUGH I CAN IF PEOPLE
HAVE SOME QUESTIONS ON THAT.

318
00:14:52,166 --> 00:14:53,800
I CAN TRY.

319
00:14:53,800 --> 00:14:55,666
SO THE FLIGHT SOFTWARE--

320
00:14:55,666 --> 00:14:56,900
THE FLIGHT SOFTWARE,

321
00:14:56,900 --> 00:14:58,566
THERE'S TWO SETS
OF FLIGHT SOFTWARE.

322
00:14:58,566 --> 00:15:00,700

THERE'S THE FLIGHT SOFTWARE
FOR THE SPACECRAFT,

323
00:15:00,700 --> 00:15:03,000
WHICH MAINTAINS THE HEALTH
OF THE SPACECRAFT,

324
00:15:03,000 --> 00:15:05,666
AND IT INCLUDES
THINGS LIKE FAULT MANAGEMENT

325
00:15:05,666 --> 00:15:07,066
AND THE ATTITUDE CONTROL

326
00:15:07,066 --> 00:15:09,800
AS WELL AS THE CUES
THAT WE LOAD

327
00:15:09,800 --> 00:15:11,366
TO MAKE SURE
THAT THE SPACECRAFT

328
00:15:11,366 --> 00:15:14,533
IS DOING WHAT IT'S SUPPOSED
TO BE DOING EVERY DAY.

329
00:15:14,533 --> 00:15:17,033
AND THEN THERE'S ALSO THE FLIGHT
SOFTWARE FOR THE INSTRUMENT,

330
00:15:17,033 --> 00:15:19,366
WHICH IS VERY SPECIFIC
FOR THIS INSTRUMENT.

331
00:15:19,366 --> 00:15:22,166
AND IT MANAGES THINGS
LIKE SHUTTER SPEEDS

332
00:15:22,166 --> 00:15:24,566
AND CADENCE RATES OF IMAGERY

333
00:15:24,566 --> 00:15:26,266
AND POINTING OF THE MIRRORS

334
00:15:26,266 --> 00:15:29,900
AND LOTS OF OTHER FINE DETAILS
LIKE THAT.

335
00:15:29,900 --> 00:15:32,566
WE HAVE HAD,
OVER THE COURSE OF THIS MISSION,

336
00:15:32,566 --> 00:15:35,400
TO UPDATE THE FLIGHT SOFTWARE
A COUPLE OF TIMES,

337
00:15:35,400 --> 00:15:37,633
BOTH THE SPACECRAFT
FLIGHT SOFTWARE

338
00:15:37,633 --> 00:15:39,366
AS WELL AS
THE INSTRUMENT FLIGHT SOFTWARE.

339
00:15:39,366 --> 00:15:42,200
AND WE'VE EVEN TRIED UPDATING
THE FLIGHT SOFTWARE

340
00:15:42,200 --> 00:15:44,600
FOR THE STAR TRACKERS BECAUSE
WE WERE HAVING SOME ISSUES

341
00:15:44,600 --> 00:15:46,500
WITH THOSE
SHORTLY AFTER LAUNCH.

342
00:15:46,500 --> 00:15:47,866
AND SO WE WORKED
WITH THE VENDOR,

343
00:15:47,866 --> 00:15:49,500
AND THEY GAVE US
SOME UPDATES

344
00:15:49,500 --> 00:15:50,966
FOR THE FLIGHT SOFTWARE THERE
AS WELL.

345
00:15:50,966 --> 00:15:53,100
SO WE'VE UPDATED THE FLIGHT
SOFTWARE ON ALL THREE.

346
00:15:53,100 --> 00:15:54,600
IT'S BEEN SUCCESSFUL.

347
00:15:54,600 --> 00:15:56,133
WE ACTUALLY DID THE FLIGHT--

348
00:15:56,133 --> 00:15:58,166
THE SPACECRAFT FLIGHT
SOFTWARE UPDATE

349
00:15:58,166 --> 00:16:03,533
JUST A COUPLE OF WEEKS AGO,
AND IT'S RUNNING FINE NOW.

350
00:16:03,533 --> 00:16:05,500
SO THE GROUND DATA SYSTEM,

351
00:16:05,500 --> 00:16:07,533
THIS IS THE AREA
I WORKED MORE ON.

352
00:16:07,533 --> 00:16:10,433
EDDY WAS MORE ON THE ACS
AND THE FLIGHT SOFTWARE.

353
00:16:10,433 --> 00:16:13,533
THE GROUND DATA SYSTEM IS

ALL THE TOOLS THAT HELP ME,

354
00:16:13,533 --> 00:16:15,766
AS THE FLIGHT CONTROLLER,
DO WHAT I DO.

355
00:16:15,766 --> 00:16:19,266
IT BUILDS THE COMMAND PACKAGES,
WHICH I SEND TO THE SPACECRAFT.

356
00:16:19,266 --> 00:16:21,600
IT RECEIVES AND IT PROCESSES
THE TELEMETRY,

357
00:16:21,600 --> 00:16:24,033
AND IT ALSO HELPS ME
IN SCHEDULING THOSE CONTACTS

358
00:16:24,033 --> 00:16:26,266
WITH THE GROUND STATIONS.

359
00:16:26,266 --> 00:16:28,433
MY PRIMARY ROLE
FOR THE GROUND DATA SYSTEM

360
00:16:28,433 --> 00:16:30,066
WAS IN THE SYSTEMS
ENGINEERING,

361
00:16:30,066 --> 00:16:33,033
SO I WAS LOOKING
AT ALL OF THOSE ASPECTS OF IT.

362
00:16:33,033 --> 00:16:35,166
I DID ALSO WIND UP
DOING SOME CODING

363
00:16:35,166 --> 00:16:37,033
JUST BECAUSE WE WERE
A VERY SMALL TEAM,

364
00:16:37,033 --> 00:16:39,166
AND WE COULDN'T AFFORD
TO HAVE, YOU KNOW,

365
00:16:39,166 --> 00:16:41,400
ANYBODY DO TOO SPECIALIZED
OF A JOB.

366
00:16:41,400 --> 00:16:43,033
SO WE ALL KIND OF
WORKED TOGETHER.

367
00:16:43,033 --> 00:16:44,733
ALTHOUGH PETER
DOWN HERE IN THE FRONT

368
00:16:44,733 --> 00:16:46,966
IS OUR LEAD
GDS SOFTWARE DEVELOPER,

369
00:16:46,966 --> 00:16:49,566
AND HE'S DONE A LOT MORE
OF THE DEVELOPMENT THAN I HAVE.

370
00:16:49,566 --> 00:16:52,266
AND HE'S A LOT BETTER AT IT
THAN I AM.

371
00:16:54,566 --> 00:16:56,133
ONE OF THE OTHER
MAIN RESPONSIBILITIES

372
00:16:56,133 --> 00:16:58,733
I HAD PRIOR TO LAUNCH WAS
THE TESTING AND THE TRAINING.

373
00:16:58,733 --> 00:17:01,500
SO THERE WERE LOTS OF DIFFERENT
PIECES THAT HAD TO BE TESTED,

374
00:17:01,500 --> 00:17:02,966
BOTH WITHIN THE GDS

375
00:17:02,966 --> 00:17:05,600
AND HOW THE GDS WORKED
WITH THE OTHER SYSTEMS,

376
00:17:05,600 --> 00:17:07,000
AND THEN THERE WAS
A LOT OF TRAINING

377
00:17:07,000 --> 00:17:09,500
THAT WE HAD TO DO
AS FLIGHT CONTROLLERS.

378
00:17:09,500 --> 00:17:11,333
AND WE RECENTLY
HAD TO GO THROUGH A ROUND

379
00:17:11,333 --> 00:17:12,833
OF ALL THAT TRAINING AGAIN

380
00:17:12,833 --> 00:17:15,066
AS WE'VE ADDED A COUPLE
OF NEW FLIGHT CONTROLLERS

381
00:17:15,066 --> 00:17:20,033
TO THE MISSION
SINCE WE LAUNCHED.

382
00:17:20,033 --> 00:17:21,100
ALL RIGHT.

383
00:17:21,100 --> 00:17:22,400
SO AT THIS POINT,

384
00:17:22,400 --> 00:17:27,633
I'M GONNA SWITCH OVER

JUST BRIEFLY HERE TO...

385
00:17:27,633 --> 00:17:31,166
SO I'M GONNA SHOW WHAT
THE LAUNCH OF THE SPACECRAFT

386
00:17:31,166 --> 00:17:33,733
LOOKED LIKE.

387
00:17:39,666 --> 00:17:42,066
SO WE WERE LAUNCHED
ON A PEGASUS ROCKET,

388
00:17:42,066 --> 00:17:44,166
WHICH IS DROPPED
FROM AN L-1011.

389
00:17:44,166 --> 00:17:47,233
THE PLANE LAUNCHED
FROM VANDENBERG AIR FORCE BASE

390
00:17:47,233 --> 00:17:48,966
JUST DOWN THE COAST HERE,

391
00:17:48,966 --> 00:17:52,033
FLEW OUT OVER THE OCEAN
JUST OFF OF MONTEREY,

392
00:17:52,033 --> 00:17:54,366
AND THEN DROPPED
THE ROCKET OUT THERE,

393
00:17:54,366 --> 00:17:56,233
AT WHICH POINT,
THEN THE ROCKET TOOK OFF,

394
00:17:56,233 --> 00:17:59,266
FLEW DOWN TO THE SOUTH,
AND PUT US UP IN OUR ORBIT.

395
00:17:59,266 --> 00:18:02,200
NOW THIS IS SHOWING
SOME OF THE FIRST LIGHT DATA.

396
00:18:02,200 --> 00:18:05,833
SO IT TOOK US ABOUT A MONTH
BETWEEN WHEN WE LAUNCHED

397
00:18:05,833 --> 00:18:08,066
AND WHEN WE OPENED
THE TELESCOPE DOOR.

398
00:18:08,066 --> 00:18:09,533
WE HAD A DOOR ON THE TELESCOPE

399
00:18:09,533 --> 00:18:13,566
TO HELP KEEP DIRT OUT
OF THE CAMERA AND DEBRIS,

400
00:18:13,566 --> 00:18:16,966
AND WE THEN DID SOME BAKE-OUT
OF THE ELECTRONICS

401
00:18:16,966 --> 00:18:18,733
AND OF THE VARIOUS COMPONENTS,

402
00:18:18,733 --> 00:18:21,566
WHICH IS AN ESSENTIAL PART
OF MOST SPACE MISSIONS,

403
00:18:21,566 --> 00:18:23,866
BEFORE WE FINALLY
OPENED THE DOOR IN JULY.

404
00:18:23,866 --> 00:18:25,866
AND THEN THESE ARE
THE FIRST IMAGES HERE

405
00:18:25,866 --> 00:18:30,366

THAT WERE TAKEN
WITH THE CAMERA

406
00:18:30,366 --> 00:18:34,166
FROM THAT DOOR OPENING.

407
00:18:34,166 --> 00:18:38,466
SO WE'RE GONNA
GO BACK NOW TO...

408
00:18:38,466 --> 00:18:40,600
THIS IS THE IRIS CONTROL ROOM.

409
00:18:40,600 --> 00:18:42,900
THIS IS WHAT IT LOOKED LIKE
THE DAY OF LAUNCH.

410
00:18:42,900 --> 00:18:45,733
THIS IS JUST
AFTER WE HAD SUCCESSFUL CONTACT

411
00:18:45,733 --> 00:18:47,133
WITH THE SPACECRAFT.

412
00:18:47,133 --> 00:18:49,833
YOU'LL SEE EDDY SITTING THERE
IN THE FRONT AND CENTER.

413
00:18:49,833 --> 00:18:52,233
THAT'S
THE FLIGHT CONTROLLER'S SEAT.

414
00:18:52,233 --> 00:18:54,366
EDDY AND I WERE
THE PRIMARY FLIGHT CONTROLLERS

415
00:18:54,366 --> 00:18:56,066
FOR THE FIRST SEVERAL MONTHS.

416

00:18:56,066 --> 00:18:57,833
NOW AS I MENTIONED,
WE'VE ADDED A COUPLE MORE,

417
00:18:57,833 --> 00:18:59,233
SO IT'S KIND OF NICE.

418
00:18:59,233 --> 00:19:01,433
WE GET
A LITTLE BIT MORE ROTATION.

419
00:19:01,433 --> 00:19:03,166
THE ROOM WAS VERY FULL.

420
00:19:03,166 --> 00:19:04,866
THIS IS OVER IN 240.

421
00:19:04,866 --> 00:19:06,900
THE ROOM WAS VERY FULL
ON LAUNCH DAY

422
00:19:06,900 --> 00:19:09,066
AND ON THE WEEK OR SO
AFTER THAT.

423
00:19:09,066 --> 00:19:11,633
AND THEN AFTER THAT,
PEOPLE STARTED DRIFTING AWAY.

424
00:19:11,633 --> 00:19:14,100
MOST DAYS NOW,
YOU GO BY THAT ROOM,

425
00:19:14,100 --> 00:19:16,166
YOU'LL SEE PETER IN THERE,

426
00:19:16,166 --> 00:19:18,400
AND YOU'LL SEE ONE OF US
FLIGHT CONTROLLERS IN THERE,

427
00:19:18,400 --> 00:19:19,966
MAYBE TWO IF YOU'RE LUCKY.

428
00:19:19,966 --> 00:19:21,966
JIM COMES BY FOR A COUPLE HOURS
IN THE AFTERNOON,

429
00:19:21,966 --> 00:19:23,200
BUT THAT'S ABOUT IT.

430
00:19:23,200 --> 00:19:24,633
YOU KNOW, IT'S A LOT--

431
00:19:24,633 --> 00:19:28,033
IT'S A LOT MORE EMPTY NOW
THAN IT WAS AT THAT POINT.

432
00:19:28,033 --> 00:19:30,266
SO THIS IS THAT FIRST
LIGHT IMAGE I TALKED ABOUT.

433
00:19:30,266 --> 00:19:33,033
THIS IS THE FIRST IMAGE
WE TOOK WITH IRIS OF THE SUN.

434
00:19:33,033 --> 00:19:36,600
IT SHOWS A LOT MORE DETAIL
OF THAT SUNSPOT

435
00:19:36,600 --> 00:19:41,533
THAN WHAT YOU SEE WITH THE OTHER
SUN-OBSERVING SPACECRAFT.

436
00:19:41,533 --> 00:19:43,933
SO AS I MENTIONED,

437
00:19:43,933 --> 00:19:48,333
NOW IT'S A PRETTY LIGHT STAFFING
FOR THE IRIS MISSION,

438
00:19:48,333 --> 00:19:51,000
AND PART OF HOW
WE'VE ACHIEVED THAT--

439
00:19:51,000 --> 00:19:53,500
WE'VE ACHIEVED THAT
IN ORDER TO HAVE A LOW BUDGET

440
00:19:53,500 --> 00:19:55,400
BECAUSE IT IS
A VERY LONG MISSION.

441
00:19:55,400 --> 00:19:57,000
IT'S AT LEAST
A TWO-YEAR MISSION.

442
00:19:57,000 --> 00:19:58,600
IT MAY BE A FOUR-YEAR MISSION.

443
00:19:58,600 --> 00:20:01,033
WE MAY GET EXTENDED
BEYOND THAT AS WELL.

444
00:20:01,033 --> 00:20:03,866
BUT WE CAN'T AFFORD
TO HAVE A LOT OF OPERATORS

445
00:20:03,866 --> 00:20:05,566
IN THE CONTROL ROOM
AT ALL TIMES,

446
00:20:05,566 --> 00:20:08,166
SO WHAT WE DO IS
WE'VE GOT A LOT OF SOFTWARE

447
00:20:08,166 --> 00:20:09,766
THAT HANDLES IT
AUTOMATICALLY FOR US.

448
00:20:09,766 --> 00:20:11,766
SO AS THE SPACECRAFT--

449
00:20:11,766 --> 00:20:13,566
AND I'M GONNA START DOWN
ON THE LOWER RIGHT.

450
00:20:13,566 --> 00:20:15,533
AS THE SPACECRAFT
EXECUTES THE PLAN

451
00:20:15,533 --> 00:20:18,333
AND IT'S TAKING THE IMAGERY
AND IT'S GATHERING DATA

452
00:20:18,333 --> 00:20:19,933
AND IT'S MONITORING
ITS OWN HEALTH,

453
00:20:19,933 --> 00:20:24,200
IT DUMPS THAT DATA AT A GROUND
STATION ONCE EVERY ORBIT.

454
00:20:24,200 --> 00:20:26,000
IT CONTACTS THE GROUND
FOR ABOUT 10 MINUTES

455
00:20:26,000 --> 00:20:27,966
OUT OF EVERY 90-MINUTE ORBIT,

456
00:20:27,966 --> 00:20:31,666
AND IT DUMPS THE DATA
IN A BIG FILE DUMP.

457
00:20:31,666 --> 00:20:35,066
THAT THEN GETS FTP'D
OVER HERE TO THE CENTER,

458
00:20:35,066 --> 00:20:37,733

AND THEN OUR SOFTWARE
PROCESSES THAT DATA.

459
00:20:37,733 --> 00:20:41,100
IT SENDS THE SCIENCE DATA
ON TO STANFORD

460
00:20:41,100 --> 00:20:42,833
WHERE THE SCIENCE TEAM
THEN HAS ACCESS TO IT,

461
00:20:42,833 --> 00:20:44,266
AND THEY CAN LOOK AT IT.

462
00:20:44,266 --> 00:20:46,366
AND IT'S ALSO PUBLISHED
ON THE WEB.

463
00:20:46,366 --> 00:20:47,866
THERE'S A WEBSITE
WHERE YOU CAN GO

464
00:20:47,866 --> 00:20:51,500
AND LOOK AT IRIS PICTURES
FROM TODAY EVERY DAY.

465
00:20:51,500 --> 00:20:55,066
AND THEN THE HOUSEKEEPING DATA
IS RUN THROUGH OUR SYSTEMS HERE.

466
00:20:55,066 --> 00:20:57,400
AND GENERALLY
THROUGHOUT THE DAY,

467
00:20:57,400 --> 00:21:00,833
THAT SYSTEM MONITORS THE HEALTH
OF THE SPACECRAFT FOR US.

468
00:21:00,833 --> 00:21:02,933
SO IF THERE ARE ALERTS

FROM THE SPACECRAFT,

469
00:21:02,933 --> 00:21:04,333
IF THERE ARE PROBLEMS,

470
00:21:04,333 --> 00:21:05,700
IF THINGS ARE
GETTING OUT OF LIMITS

471
00:21:05,700 --> 00:21:08,566
OR THINGS ARE HAPPENING
THAT ARE NOT EXPECTED,

472
00:21:08,566 --> 00:21:11,833
THEN WE GET EMAILS
AND WE GET TEXT MESSAGES

473
00:21:11,833 --> 00:21:15,700
THROUGHOUT THE DAY THAT ALERT US
TO ISSUES ON THE SPACECRAFT.

474
00:21:15,700 --> 00:21:18,200
SO I ACTUALLY--I HAD TO PUT
MY PHONE OVER THERE ON QUIET

475
00:21:18,200 --> 00:21:20,100
BECAUSE SOME OF THE GUYS
OVER IN THE MOCK TODAY

476
00:21:20,100 --> 00:21:21,633
ARE RUNNING SOME TESTS,

477
00:21:21,633 --> 00:21:23,833
AND SO I'VE BEEN GETTING TEXTS
ALL DAY LONG THAT, YOU KNOW,

478
00:21:23,833 --> 00:21:25,000
"HEY, THIS IS BROKEN,

479

00:21:25,000 --> 00:21:26,466
THIS IS BROKEN,
THIS IS BROKEN."

480
00:21:26,466 --> 00:21:27,833
IT'S NOT REALLY
THE SPACECRAFT.

481
00:21:27,833 --> 00:21:28,900
THIS TIME IT'S TESTS.

482
00:21:28,900 --> 00:21:30,266
I KNOW THESE GUYS
ARE RUNNING TESTS,

483
00:21:30,266 --> 00:21:32,266
BUT I HAD TO PUT IT
OVER THERE ON QUIET,

484
00:21:32,266 --> 00:21:35,566
SO IT'S NOT GONNA DISRUPT
THE TALK HERE.

485
00:21:35,566 --> 00:21:39,300
SO THEN THE SCIENCE PLANNERS
DO THEIR PLANNING ACTIVITIES

486
00:21:39,300 --> 00:21:41,400
IN THE MORNING
OF EACH BUSINESS DAY.

487
00:21:41,400 --> 00:21:43,000
AND AT THE SAME TIME
IN THE MORNING,

488
00:21:43,000 --> 00:21:44,300
WE AS THE FLIGHT CONTROLLERS

489
00:21:44,300 --> 00:21:47,000
LOOK AT WHATEVER

SPACECRAFT MAINTENANCE--

490
00:21:47,000 --> 00:21:49,300
THERE'S SOME ROUTINE
ACTIVITIES THAT NEED TO BE DONE

491
00:21:49,300 --> 00:21:51,866
AS WELL
AS OCCASIONAL SPECIAL ACTIVITIES

492
00:21:51,866 --> 00:21:53,400
THAT NEED TO BE PERFORMED.

493
00:21:53,400 --> 00:21:56,166
WE ALSO DO SOME SCHEDULING
OF THE GROUND STATIONS,

494
00:21:56,166 --> 00:21:58,300
SO ALL THAT HAPPENS
IN THE MORNINGS.

495
00:21:58,300 --> 00:22:00,200
AND THEN IN THE AFTERNOON,

496
00:22:00,200 --> 00:22:03,833
WE RUN A PROGRAM TO INTEGRATE
THE INPUTS FROM THE SCIENCE TEAM

497
00:22:03,833 --> 00:22:05,866
WITH THE SPACECRAFT
MAINTENANCE ACTIVITIES.

498
00:22:05,866 --> 00:22:08,600
THAT BUILDS IT
INTO ONE PROGRAM THAT THEN,

499
00:22:08,600 --> 00:22:10,933
DURING THE ONE COMMAND PASS
A DAY

500
00:22:10,933 --> 00:22:13,400
THAT WE HAVE EACH DAY
IN THE AFTERNOON,

501
00:22:13,400 --> 00:22:15,166
WE THEN UPLOAD THAT PROGRAM.

502
00:22:15,166 --> 00:22:16,833
AND THE SPACECRAFT
RUNS THAT PROGRAM

503
00:22:16,833 --> 00:22:19,233
FOR THE NEXT 24 HOURS,
OR IN THE CASE OF A WEEKEND,

504
00:22:19,233 --> 00:22:21,100
IT'LL RUN IT
FOR THE WHOLE WEEKEND,

505
00:22:21,100 --> 00:22:22,900
EVEN AN EXTENDED WEEKEND.

506
00:22:22,900 --> 00:22:27,533
WE'VE RUN AS MANY AS FIVE DAYS
OFF OF ONE COMMAND LOAD,

507
00:22:27,533 --> 00:22:30,633
SO IT'S A VERY LOW ACTIVITY.

508
00:22:30,633 --> 00:22:32,966
WE DON'T--WE'RE NOT
CONSTANTLY IN COMMUNICATION

509
00:22:32,966 --> 00:22:34,466
WITH THE SPACECRAFT.

510
00:22:34,466 --> 00:22:37,366
REALLY, WE'RE ONLY TALKING
TO THE SPACECRAFT ONCE A DAY

511
00:22:37,366 --> 00:22:42,566
FOR ABOUT 10 MINUTES,
12 MINUTES AT THE MOST.

512
00:22:42,566 --> 00:22:45,700
AND THAT'S IT
FOR MY PRIMARY PRESENTATION.

513
00:22:45,700 --> 00:22:49,300
SO AT THIS POINT, I'M GONNA
OPEN IT UP FOR QUESTIONS.

514
00:22:49,300 --> 00:22:54,900
AND THERE'S FELLOWS
WITH MICROPHONES WALKING AROUND.

515
00:22:54,900 --> 00:22:57,900
[applause]

516
00:23:11,366 --> 00:23:13,833
THERE HAVE GOT TO BE
SOME QUESTIONS OUT THERE.

517
00:23:13,833 --> 00:23:17,666
I'M NOT THAT GOOD
OF A PRESENTER.

518
00:23:17,666 --> 00:23:19,100
- HEY, ROBERT,
THANK YOU.

519
00:23:19,100 --> 00:23:21,400
I HAPPENED TO ACTUALLY
SEE THE TAKEOFF TOO

520
00:23:21,400 --> 00:23:24,500
AS I WAS CYCLING HOME,
SO THAT WAS A LOT OF FUN.

521
00:23:24,500 --> 00:23:25,933
ANYWAY,
BUT QUESTION FOR YOU IS,

522
00:23:25,933 --> 00:23:27,700
IF YOU'RE ONLY TALKING TO 'EM
TEN MINUTES A DAY,

523
00:23:27,700 --> 00:23:29,633
IS THAT ENOUGH
TO DOWNLOAD THE DATA

524
00:23:29,633 --> 00:23:31,166
THAT YOU TOOK DURING THAT DAY,

525
00:23:31,166 --> 00:23:35,333
OR DO YOU HAVE A LONGER DOWNLINK
ONCE A WEEK OR SO?

526
00:23:35,333 --> 00:23:37,166
- SO WE DOWNLINK
FROM THE SPACECRAFT

527
00:23:37,166 --> 00:23:40,700
TEN MINUTES OUT OF EVERY ORBIT,
BUT THAT'S ALL AUTOMATED.

528
00:23:40,700 --> 00:23:43,866
THE SPACECRAFT JUST DUMPS
THE DATA FOR TEN MINUTES

529
00:23:43,866 --> 00:23:46,600
OVER A GROUND STATION,
AND THEN THEY FTP IT TO US,

530
00:23:46,600 --> 00:23:48,833
AND OUR SOFTWARE PROCESSES IT
IN THE BACKGROUND.

531

00:23:48,833 --> 00:23:51,066
SO THAT'S ALL AUTOMATED.
WE DON'T TOUCH IT.

532
00:23:51,066 --> 00:23:52,900
THE ONLY PART WE'RE ACTUALLY

533
00:23:52,900 --> 00:23:54,866
DIRECTLY TALKING
TO THE SPACECRAFT

534
00:23:54,866 --> 00:23:56,766
IS THAT ONE COMMAND PASS
IN THE AFTERNOON.

535
00:23:56,766 --> 00:23:59,866
BUT THERE IS CONTACT WITH
THE SPACECRAFT EVERY 90 MINUTES,

536
00:23:59,866 --> 00:24:03,766
SO WE DO GET UPDATES FROM
THE SPACECRAFT EVERY 90 MINUTES.

537
00:24:03,766 --> 00:24:07,433
- ROBERT, WHAT HAPPENS
IF THE DATA CAN'T COME DOWN?

538
00:24:07,433 --> 00:24:09,933
DO YOU STORE IT ON BOARD?

539
00:24:09,933 --> 00:24:12,300
YOU KNOW, WEATHER,
WHATEVER GETS IN THE WAY,

540
00:24:12,300 --> 00:24:14,433
AND DOES IT
AUTOMATICALLY DUMP DATA?

541
00:24:14,433 --> 00:24:16,833
DO YOU HAVE TO PRIORITIZE DATA

YOU'RE NEVER GOING TO GET,

542
00:24:16,833 --> 00:24:18,633
OR DO YOU HAVE CAPACITY
ON THE SPACECRAFT,

543
00:24:18,633 --> 00:24:22,866
SO YOU NEVER HAVE AN ISSUE,
THAT IT CAN CATCH UP LATER?

544
00:24:22,866 --> 00:24:25,433
- SO THERE IS
AN ONBOARD DATA RECORDER,

545
00:24:25,433 --> 00:24:28,600
WHICH IS USED
THROUGHOUT THE ORBIT, AND THEN--

546
00:24:28,600 --> 00:24:30,766
IT RECORDS DATA
ON A CONSTANT BASIS,

547
00:24:30,766 --> 00:24:32,100
AND THEN IT DUMPS THE DATA

548
00:24:32,100 --> 00:24:34,466
WHEN IT'S IN CONTACT
WITH THE GROUND STATION.

549
00:24:34,466 --> 00:24:38,533
THERE HAVE BEEN SITUATIONS WHERE
THAT DATA RECORDER GETS FULL,

550
00:24:38,533 --> 00:24:41,200
AND BASICALLY, THE WAY WE'VE
SET IT UP WITH THE SCIENCE TEAM

551
00:24:41,200 --> 00:24:43,700
IS THAT THEY ACKNOWLEDGE
THAT EVERY ONCE IN A WHILE,

552
00:24:43,700 --> 00:24:45,233
THERE'S GONNA BE DATA LOSS.

553
00:24:45,233 --> 00:24:46,733
IT'S A TWO-YEAR MISSION

554
00:24:46,733 --> 00:24:49,000
WITH POTENTIALLY
A TWO-YEAR EXTENDED MISSION,

555
00:24:49,000 --> 00:24:51,133
SO IF WE MISS DATA
OCCASIONALLY

556
00:24:51,133 --> 00:24:52,566
BECAUSE IT GETS OVERWRITTEN

557
00:24:52,566 --> 00:24:55,600
BECAUSE THE BUFFER
GETS TOO FULL, THAT HAPPENS.

558
00:24:55,600 --> 00:24:57,000
IT HAS HAPPENED,

559
00:24:57,000 --> 00:24:59,800
AND THAT'S JUST
ONE OF THE RISKS THAT YOU TAKE

560
00:24:59,800 --> 00:25:01,966
WITH A LOW-BUDGET MISSION
LIKE THIS.

561
00:25:01,966 --> 00:25:04,933
WE COULD GET FANCY
AND TRY AND DO THINGS

562
00:25:04,933 --> 00:25:08,400
ABOUT GOING BACK AND TRYING

TO REPLAY DATA THAT WAS MISSED.

563
00:25:08,400 --> 00:25:10,333
WE DID SOME OF THAT
IN THE EARLY MISSION,

564
00:25:10,333 --> 00:25:12,000
THE VERY FIRST WEEKS
OF THE MISSION,

565
00:25:12,000 --> 00:25:14,866
IN ORDER TO GET SOME
CRITICAL DATA FROM EARLY ON,

566
00:25:14,866 --> 00:25:18,366
BUT SINCE THEN, NO, WE JUST--
IT'S A CIRCULAR BUFFER.

567
00:25:18,366 --> 00:25:20,333
IT WRITES DATA,
AND IT PLAYS DATA,

568
00:25:20,333 --> 00:25:21,833
AND IT WRITES DATA,
AND IT PLAYS DATA.

569
00:25:21,833 --> 00:25:24,766
AND IF IT WINDS UP CATCHING UP
AND OVERWRITING SOME DATA,

570
00:25:24,766 --> 00:25:29,133
THEN THE DATA IS LOST.

571
00:25:29,133 --> 00:25:32,533
- SO WE'RE COMING UP TO
ABOUT THE FIRST YEAR ANNIVERSARY

572
00:25:32,533 --> 00:25:34,400
SINCE THE LAUNCH,
AND I WAS CURIOUS TO HEAR,

573
00:25:34,400 --> 00:25:37,666
WHAT ARE SOME
OF THE BIGGEST SCIENCE FINDINGS

574
00:25:37,666 --> 00:25:40,200
THAT HAVE COME OUT OF ALL
THE DATA THAT YOU'VE DOWNLOADED?

575
00:25:40,200 --> 00:25:42,066
- OKAY, GREAT.
THANK YOU.

576
00:25:42,066 --> 00:25:44,000
I HAD FORGOTTEN THAT
I'VE GOT A NUMBER OF VIDEOS HERE

577
00:25:44,000 --> 00:25:46,866
I WAS GONNA SHOW YOU
BEYOND THAT FIRST ONE.

578
00:25:46,866 --> 00:25:49,566
SO LET'S SEE HERE.

579
00:25:49,566 --> 00:25:52,766
WE'LL GO BACK HERE.

580
00:25:54,766 --> 00:25:58,433
ALL RIGHT, SO THIS WAS
ONE OF THE FIRST VIDEOS

581
00:25:58,433 --> 00:26:00,600
THAT WE GOT
FROM THE SCIENCE TEAM.

582
00:26:00,600 --> 00:26:05,566
AND THIS IS AGAIN
OFF OF THAT FIRST COUPLE OF DAYS

583

00:26:05,566 --> 00:26:07,500
WHEN WE FIRST OPENED
THE TELESCOPE.

584
00:26:07,500 --> 00:26:09,866
IT'S LOOKING
AT THAT SAME SUNSPOT,

585
00:26:09,866 --> 00:26:11,633
AND I'M GONNA PLAY THAT AGAIN.

586
00:26:11,633 --> 00:26:13,733
AND WATCH THE MIDDLE
OF THE SUNSPOT,

587
00:26:13,733 --> 00:26:16,166
AND YOU'LL SEE
THIS CHAIN OF PEARLS

588
00:26:16,166 --> 00:26:17,900
COME OUT THE MIDDLE
RIGHT THERE.

589
00:26:17,900 --> 00:26:19,333
DID YOU SEE THAT?

590
00:26:19,333 --> 00:26:24,600
THAT--WHEN THE SCIENTISTS
ACTUALLY PRESENTED THIS TO US

591
00:26:24,600 --> 00:26:26,800
SHORTLY AFTER WE HAD OPENED
THE TELESCOPE DOOR,

592
00:26:26,800 --> 00:26:29,466
THE SCIENTIST WHO WAS
SHOWING THIS TO US SAID,

593
00:26:29,466 --> 00:26:32,700
"I HAVE NO IDEA WHAT THAT IS.

I DON'T KNOW."

594
00:26:32,700 --> 00:26:35,966
SO EVEN IN THE FIRST DAYS
OF THE MISSION,

595
00:26:35,966 --> 00:26:38,433
WE HAD FOUND
SOME INTERESTING NEW DATA

596
00:26:38,433 --> 00:26:41,433
THAT THE SCIENCE TEAM
HAD NOT EXPECTED TO SEE

597
00:26:41,433 --> 00:26:44,600
AND WAS VERY SURPRISED TO SEE.

598
00:26:44,600 --> 00:26:46,233
HERE'S ANOTHER ONE.

599
00:26:46,233 --> 00:26:49,566
THIS ONE SHOWS CORONAL RAIN
OVER THE SUN.

600
00:26:49,566 --> 00:26:53,866
SO IF YOU SEE OUT TO THE RIGHT,
YOU CAN SEE SOME STUFF

601
00:26:53,866 --> 00:26:58,700
FALLING BACK TO THE SUN
FROM THESE PROMINENCES HERE.

602
00:26:58,700 --> 00:27:00,933
AND THIS ALSO SHOWS
A LOT OF THE DETAIL,

603
00:27:00,933 --> 00:27:03,433
THE FINE DETAIL
ON THE SURFACE OF THE SUN,

604
00:27:03,433 --> 00:27:05,566
WHICH IS WHAT IRIS IS
REALLY INTENDED TO LOOK AT,

605
00:27:05,566 --> 00:27:08,966
IS ALL OF THAT FINE DETAIL
THERE.

606
00:27:08,966 --> 00:27:11,433
ONE OF THE OTHER
INTERESTING FEATURES OF THIS

607
00:27:11,433 --> 00:27:14,700
IS THIS IS A GOOD EXAMPLE
OF ONE OF THE ISSUES

608
00:27:14,700 --> 00:27:16,700
THAT WAS FOUND
IN THE IRIS MISSION.

609
00:27:16,700 --> 00:27:17,933
SO I DON'T KNOW IF YOU SEE

610
00:27:17,933 --> 00:27:22,933
THOSE DARK SPOTS
SITTING OVER THE SUN.

611
00:27:22,933 --> 00:27:25,433
FOR EXAMPLE,
THAT ONE THERE

612
00:27:25,433 --> 00:27:28,200
AND THIS ONE HERE
AND THAT ONE THERE.

613
00:27:28,200 --> 00:27:31,133
THOSE ARE DIRT ON THE CCDs,

614
00:27:31,133 --> 00:27:33,433

ON THE CAMERAS
INSIDE THE SPACECRAFT.

615
00:27:33,433 --> 00:27:36,233
WHEN THEY HAD GOTTEN THE ENTIRE
SPACECRAFT ALL TOGETHER,

616
00:27:36,233 --> 00:27:37,700
AND THEY TURNED IT ON,

617
00:27:37,700 --> 00:27:40,366
AND THEY STARTED TESTING
THE IMAGING FOR THE FIRST TIME,

618
00:27:40,366 --> 00:27:42,133
THEY FOUND THE DIRT
ON THE CAMERAS.

619
00:27:42,133 --> 00:27:43,800
AND THEY SAID,
"IT'S TOO EXPENSIVE,

620
00:27:43,800 --> 00:27:46,200
"AND IT'S GONNA TAKE TOO LONG
TO TAKE IT ALL APART

621
00:27:46,200 --> 00:27:48,900
"AND GET THOSE OUT
AND CLEAN THAT DIRT OFF OF THERE

622
00:27:48,900 --> 00:27:50,233
AND THEN PUT IT ALL
BACK TOGETHER AGAIN."

623
00:27:50,233 --> 00:27:51,666
SO THEY SAID,

624
00:27:51,666 --> 00:27:55,000
"WE'RE JUST GONNA FLY
WITH THE DIRT ON THE CAMERAS."

625
00:27:58,300 --> 00:28:00,333
YEAH, YOU CAN ACTUALLY
SMOOTH THAT OUT

626
00:28:00,333 --> 00:28:01,766
BECAUSE WE TAKE
SO MANY IMAGES,

627
00:28:01,766 --> 00:28:03,666
AND WE DO SCANNING
WITH THE IMAGES.

628
00:28:03,666 --> 00:28:07,200
SO YOU CAN ACTUALLY START
TO EDIT THOSE OUT A LITTLE BIT.

629
00:28:07,200 --> 00:28:11,433
SO THIS IMAGE HERE SHOWS

630
00:28:11,433 --> 00:28:13,433
A SCAN OF THE SUN THAT WE DID

631
00:28:13,433 --> 00:28:16,800
AND SHOWS SOME
OF THE DIFFERENT FREQUENCIES.

632
00:28:16,800 --> 00:28:18,800
SO IF YOU SEE
IN THE UPPER LEFT,

633
00:28:18,800 --> 00:28:21,800
YOU'LL SEE HOW IRIS IS
KIND OF SCANNING BACK AND FORTH

634
00:28:21,800 --> 00:28:25,033
ACROSS THE ULTRAVIOLET
WAVELENGTHS THERE

635

00:28:25,033 --> 00:28:28,000
AS THE COLOR
OF THE SUN CHANGES.

636
00:28:28,000 --> 00:28:29,900
THIS WAS A NUMBER OF IMAGES

637
00:28:29,900 --> 00:28:32,000
THAT WERE PUT TOGETHER
OVER A COUPLE OF DAYS,

638
00:28:32,000 --> 00:28:35,566
AND THE BLACK LINES
ARE WHERE WE DIDN'T QUITE GET

639
00:28:35,566 --> 00:28:37,500
ALL THE PIECES
COVERED ADEQUATELY.

640
00:28:37,500 --> 00:28:41,433
BUT THAT IS
A SURVEY OF THE SUN

641
00:28:41,433 --> 00:28:47,333
THAT WAS TAKEN
BY THE INSTRUMENT THERE.

642
00:28:47,333 --> 00:28:49,400
OKAY.

643
00:28:49,400 --> 00:28:51,566
LET'S SEE.

644
00:28:53,566 --> 00:28:57,666
SO...

645
00:28:57,666 --> 00:28:59,666
AS I MENTIONED EARLIER,

646

00:28:59,666 --> 00:29:03,900
IRIS NOT ONLY TAKES
THE IMAGES OF THE SUN,

647
00:29:03,900 --> 00:29:06,266
WHICH YOU SEE THERE
ON THE RIGHT.

648
00:29:06,266 --> 00:29:08,800
THAT'S WHAT'S CALLED
OUR SLIT-JAW IMAGER

649
00:29:08,800 --> 00:29:11,000
THAT GIVES
THE SCIENTISTS CONTEXT

650
00:29:11,000 --> 00:29:12,966
FOR WHAT'S GOING ON
ON THE SURFACE OF THE SUN.

651
00:29:12,966 --> 00:29:14,833
BUT WE ALSO THEN
TAKE THE SPECTRA,

652
00:29:14,833 --> 00:29:17,700
AND THAT'S WHAT YOU SEE
ON THE LEFT HERE.

653
00:29:17,700 --> 00:29:20,900
SO THIS IS AN EXAMPLE
OF SPECTRAL DATA BEING TAKEN

654
00:29:20,900 --> 00:29:24,633
AT THE SAME TIME
AS THE SLIT-JAW IMAGER THERE.

655
00:29:24,633 --> 00:29:27,600
SO YOU CAN ACTUALLY
WATCH THE ACTIVITY

656

00:29:27,600 --> 00:29:30,300
OF THOSE FLARES THERE,

657
00:29:30,300 --> 00:29:32,466
NOT ONLY IN THE IMAGE
ON THE RIGHT,

658
00:29:32,466 --> 00:29:33,800
BUT YOU CAN ALSO THEN SEE

659
00:29:33,800 --> 00:29:36,466
THE SPECTRA
RELATED TO THAT

660
00:29:36,466 --> 00:29:39,900
ON THE LEFT THERE.

661
00:29:39,900 --> 00:29:42,600
ALL RIGHT,
NOW LET'S SEE.

662
00:29:42,600 --> 00:29:44,966
WHICH ONE WAS THE ONE--

663
00:29:50,500 --> 00:29:52,733
OKAY.

664
00:29:57,566 --> 00:29:59,800
HERE'S ANOTHER EXAMPLE
OF THAT.

665
00:29:59,800 --> 00:30:04,133
SO YOU CAN SEE IN THE SLIT-JAW
IMAGER IMAGE ON THE RIGHT,

666
00:30:04,133 --> 00:30:06,966
YOU CAN SEE THAT LINE AGAIN
DOWN THE MIDDLE

667

00:30:06,966 --> 00:30:09,766
WHERE IT SHOWS
WHERE THE SPECTRAL DATA

668
00:30:09,766 --> 00:30:11,233
IS ACTUALLY BEING TAKEN.

669
00:30:11,233 --> 00:30:16,200
AND THEN YOU SEE THE SPECTRAL
DATA ON THE LEFT THERE.

670
00:30:16,200 --> 00:30:19,700
AND THIS IS LOOKING AT ACTIVITY
OFF OF THE SIDE OF THE SUN.

671
00:30:19,700 --> 00:30:22,100
SO YOU CAN SEE THE VERY EDGE
OF THE SURFACE OF THE SUN

672
00:30:22,100 --> 00:30:24,333
DOWN THERE ON THE LEFT--
ON THE BOTTOM LEFT,

673
00:30:24,333 --> 00:30:28,166
AND THIS IS LOOKING
AT ACTIVITY OUT IN THE CORONA.

674
00:30:31,066 --> 00:30:32,400
ALL RIGHT.

675
00:30:32,400 --> 00:30:36,366
AND THEN I'VE GOT
ONE MORE MOVIE TO SHOW YOU.

676
00:30:38,600 --> 00:30:42,300
AND THAT'S...

677
00:30:42,300 --> 00:30:45,266
THIS ONE HERE.

678
00:30:45,266 --> 00:30:48,033
AND SO RECENTLY IN MAY,

679
00:30:48,033 --> 00:30:50,233
IRIS WAS LUCKY ENOUGH
TO WORK TOGETHER

680
00:30:50,233 --> 00:30:52,833
WITH OUR SISTER
SOLAR SPACECRAFT

681
00:30:52,833 --> 00:30:56,600
TO LOOK AT A CORONAL MASS
EJECTION ON THE SUN.

682
00:30:56,600 --> 00:30:58,633
SO THIS IS
WHEN THE SUN SPITS OUT

683
00:30:58,633 --> 00:31:03,466
LARGE AMOUNTS OF MATTER
AS WELL AS RADIATION.

684
00:31:03,466 --> 00:31:05,033
AND SO YOU'LL SEE--

685
00:31:05,033 --> 00:31:07,833
THERE'S SDO TAKING IMAGERY
OF THIS AT THE SAME TIME

686
00:31:07,833 --> 00:31:10,000
THAT IRIS IS TAKING IMAGERY
OF IT.

687
00:31:10,000 --> 00:31:11,900
AND YOU CAN SEE THE DATA--

688
00:31:11,900 --> 00:31:14,966
THE PARTICLES JUST

BLASTING OUT OF THE SUN.

689
00:31:14,966 --> 00:31:17,600
WHEN THAT HAPPENS,
AND IT'S POINTED AT THE EARTH,

690
00:31:17,600 --> 00:31:19,300
IT CAN BE BAD FOR SPACECRAFT.

691
00:31:19,300 --> 00:31:22,266
IT CAN BE BAD FOR, YOU KNOW,
ASTRONAUTS OUT IN SPACE.

692
00:31:22,266 --> 00:31:25,866
IT CAN ALSO BE BAD FOR THE POWER
SYSTEM HERE ON THE EARTH.

693
00:31:25,866 --> 00:31:28,200
SO THAT'S PART OF WHAT IRIS
IS TRYING TO UNDERSTAND

694
00:31:28,200 --> 00:31:33,366
IS MORE ABOUT THAT SPACE WEATHER
STUFF THAT'S GOING ON THERE.

695
00:31:33,366 --> 00:31:36,166
WE'LL WATCH THAT ONE
ONE MORE TIME.

696
00:31:41,400 --> 00:31:46,533
WE'VE ALSO MANAGED TO CAPTURE
SOME SOLAR FLARES WITH IRIS.

697
00:31:46,533 --> 00:31:48,333
IT'S A LITTLE BIT TRICKY
TO CAPTURE THINGS LIKE THAT

698
00:31:48,333 --> 00:31:51,766
BECAUSE WE'RE NOT COMMANDING
THE SPACECRAFT IN REAL TIME,

699
00:31:51,766 --> 00:31:55,833
SO WE HAVE TO MONITOR
ACTIVE REGIONS ON THE SUN

700
00:31:55,833 --> 00:31:58,233
AND HOPE WE CATCH THE FLARES,

701
00:31:58,233 --> 00:32:00,066
WHEREAS SPACECRAFT LIKE SDO

702
00:32:00,066 --> 00:32:01,766
THAT ARE WATCHING
THE WHOLE SUN ALL THE TIME,

703
00:32:01,766 --> 00:32:04,333
THEY JUST GET THEM
AS A MATTER OF COURSE.

704
00:32:04,333 --> 00:32:05,700
BUT WE HAVE MANAGED TO CATCH

705
00:32:05,700 --> 00:32:07,800
SOME PRETTY BIG SOLAR FLARES
AS WELL,

706
00:32:07,800 --> 00:32:10,033
AND THERE ARE SOME VIDEOS
OUT ON THE WEB

707
00:32:10,033 --> 00:32:14,233
THAT SHOW THAT AS WELL.

708
00:32:14,233 --> 00:32:17,933
SO ARE THERE OTHER QUESTIONS?

709
00:32:17,933 --> 00:32:20,900
WE'VE GOT
A COUPLE OF QUESTIONS DOWN HERE.

710
00:32:20,900 --> 00:32:22,900
- HI.
YEAH, HI.

711
00:32:22,900 --> 00:32:24,566
SO YOU SORT OF
STARTED TO ALLUDE TO IT

712
00:32:24,566 --> 00:32:25,733
RIGHT THERE A LITTLE BIT.

713
00:32:25,733 --> 00:32:28,066
CAN YOU GIVE
A LITTLE MORE CONTEXT AS TO--

714
00:32:28,066 --> 00:32:30,033
SO IRIS LOOKS AT--
SPENDS A LOT OF TIME

715
00:32:30,033 --> 00:32:33,066
LOOKING AT FLARES AND CMEs
AND THAT SORT OF THING.

716
00:32:33,066 --> 00:32:34,600
WHAT'S THE CONNECTION
WITH SPACE WEATHER

717
00:32:34,600 --> 00:32:37,400
AND PREDICTION
AND SORT OF OUR FUTURE?

718
00:32:37,400 --> 00:32:39,333
- WELL, SO I'M NOT
A SCIENCE EXPERT,

719
00:32:39,333 --> 00:32:41,333
SO I CAN'T SPEAK TO THAT
AT GREAT LENGTH,

720
00:32:41,333 --> 00:32:44,633
BUT IT'S TRYING TO UNDERSTAND
WHAT'S GOING ON THERE.

721
00:32:44,633 --> 00:32:48,066
SO THESE CORONAL MASS EJECTIONS,
THESE SOLAR FLARES,

722
00:32:48,066 --> 00:32:50,900
THEY PROVIDE A LOT OF RADIATION,
A LOT OF CHARGED PARTICLES

723
00:32:50,900 --> 00:32:53,300
THAT GET BLASTED OUT
INTO THE SOLAR SYSTEM.

724
00:32:53,300 --> 00:32:56,166
IF THE EARTH IS IN THE WAY,
WE CATCH SOME OF THAT,

725
00:32:56,166 --> 00:32:59,166
AND SO THIS IS TRYING
TO UNDERSTAND HOW THOSE OPERATE.

726
00:32:59,166 --> 00:33:01,000
WHERE DO THEY COME FROM?

727
00:33:01,000 --> 00:33:02,466
THAT'S REALLY
WHAT IRIS IS ABOUT,

728
00:33:02,466 --> 00:33:04,766
IS TRYING TO UNDERSTAND THE
DETAILS OF HOW DO THOSE HAPPEN?

729
00:33:04,766 --> 00:33:07,166
WHEN DO THOSE HAPPEN?
WHY DO THOSE HAPPEN?

730

00:33:07,166 --> 00:33:09,466
SO THAT WE CAN TRY AND THEN
BETTER AND PREDICT THEM

731
00:33:09,466 --> 00:33:13,766
TO BE ABLE TO BETTER UNDERSTAND
SPACE WEATHER IN THE FUTURE.

732
00:33:13,766 --> 00:33:15,033
WE GOT ANOTHER QUESTION
OVER HERE.

733
00:33:15,033 --> 00:33:16,800
- IF YOU HAD THE CHANCE
TO BE INVOLVED

734
00:33:16,800 --> 00:33:18,433
IN A SIMILAR MISSION
IN THE FUTURE,

735
00:33:18,433 --> 00:33:19,900
WHAT THINGS
WOULD YOU DO DIFFERENT

736
00:33:19,900 --> 00:33:21,666
TO ENHANCE THIS MISSION,

737
00:33:21,666 --> 00:33:23,366
LIKE, IN TERMS
OF HARDWARE DESIGN?

738
00:33:23,366 --> 00:33:24,600
LESSONS LEARNED
FROM THIS ONE

739
00:33:24,600 --> 00:33:26,866
THAT YOU WOULD DO
FOR THE NEXT MISSION?

740
00:33:26,866 --> 00:33:31,366

- SO ONE INTERESTING CASE
THAT WE HAD HERE ON THIS MISSION

741
00:33:31,366 --> 00:33:36,533
WAS WE ACTUALLY HAD A CHALLENGE
WITH THE X-BAND ANTENNA.

742
00:33:36,533 --> 00:33:39,433
SO THE X-BAND ANTENNA
IS WHAT WE USE PRIMARILY

743
00:33:39,433 --> 00:33:43,233
TO DOWNLINK THOSE LARGE FILES
ON EVERY ORBIT,

744
00:33:43,233 --> 00:33:45,966
AND WE WERE HAVING
SOME UNUSUAL ACTIVITIES.

745
00:33:45,966 --> 00:33:49,366
THE X-BAND ANTENNA IS DESIGNED
TO HAVE BROAD COVERAGE

746
00:33:49,366 --> 00:33:52,300
SO THAT AS WE GO
ACROSS A GROUND STATION,

747
00:33:52,300 --> 00:33:54,900
WE CAN GET DATA DOWN
FOR MOST OF THE PASS.

748
00:33:54,900 --> 00:33:57,733
UNFORTUNATELY,
THE WAY THE DESIGN WORKED OUT

749
00:33:57,733 --> 00:34:00,866
IS WE WOUND UP HAVING
THESE LARGE HOLES

750
00:34:00,866 --> 00:34:04,433

IN THE MIDDLE
OF THE X-BAND ANTENNA PATTERN.

751
00:34:04,433 --> 00:34:07,333
SO YOU CAN SEE DOWN HERE
ON THE PLOT ON THE BOTTOM,

752
00:34:07,333 --> 00:34:09,800
YOU SEE WE'RE GETTING
VERY GOOD SIGNAL FOR A WHILE,

753
00:34:09,800 --> 00:34:11,666
AND THEN WE GET
THESE BIG DROPOUTS

754
00:34:11,666 --> 00:34:13,333
AND A REALLY BIG DROPOUT HERE

755
00:34:13,333 --> 00:34:15,533
BEFORE THE SIGNAL
COMES BACK AGAIN.

756
00:34:15,533 --> 00:34:17,200
SO EARLY IN THE MISSION,

757
00:34:17,200 --> 00:34:21,433
WE WERE ACTUALLY LOSING QUITE
A BIT OF DATA IN THOSE HOLES,

758
00:34:21,433 --> 00:34:24,766
SO WE HAD TO DO
A SCIENCE EXPERIMENT

759
00:34:24,766 --> 00:34:28,500
DURING THE MISSION
TO TRY AND UNDERSTAND.

760
00:34:28,500 --> 00:34:31,300
AND WHAT WE HAVE DOWN HERE
AT THE BOTTOM ON THIS CHART

761
00:34:31,300 --> 00:34:36,033
IS AN X-BAND ANTENNA
GOODNESS MAP, IF YOU WILL.

762
00:34:36,033 --> 00:34:38,233
SO THE BRIGHTER
THE COLOR DOWN THERE,

763
00:34:38,233 --> 00:34:41,600
THE BETTER IT IS
AT GIVING US DATA

764
00:34:41,600 --> 00:34:43,833
AS THE GROUND STATION
GOES THROUGH.

765
00:34:43,833 --> 00:34:47,666
SO THAT WHITE LINE YOU SEE
IS ONE ANTENNA PASS,

766
00:34:47,666 --> 00:34:50,800
ONE STATION PASS FROM
THE SPACECRAFT'S PERSPECTIVE.

767
00:34:50,800 --> 00:34:52,833
THAT'S HOW
THE GROUND STATION MOVES

768
00:34:52,833 --> 00:34:57,366
ACROSS THE SPACECRAFT'S FIELD
OF VIEW LOOKING OUT THE ANTENNA.

769
00:34:57,366 --> 00:34:59,166
SO WE HAD TO DO
SOME SCIENCE EXPERIMENTS

770
00:34:59,166 --> 00:35:02,500
TO FIGURE OUT EXACTLY
WHERE IS THAT HOLE,

771
00:35:02,500 --> 00:35:06,666
THAT VERY DARK SPOT HERE IN THE
MIDDLE OF THE ANTENNA PATTERN

772
00:35:06,666 --> 00:35:09,333
TO MAKE SURE THAT WE WERE NOT
DUMPING DATA.

773
00:35:09,333 --> 00:35:12,000
SO NOW WE'VE GOT IT SET UP
SO THAT,

774
00:35:12,000 --> 00:35:13,333
WHILE WE HAVE
THE TRANSMITTER ON

775
00:35:13,333 --> 00:35:15,466
FOR THE ENTIRE DURATION
OF THE PASS,

776
00:35:15,466 --> 00:35:19,700
WE ACTUALLY STOP DUMPING DATA
BEFORE WE GET TO THAT HOLE,

777
00:35:19,700 --> 00:35:22,166
SO WE DON'T LOSE ANY DATA
IN THE HOLE THERE

778
00:35:22,166 --> 00:35:26,033
BEFORE WE THEN TURN
THE DATA BACK ON AGAIN.

779
00:35:26,033 --> 00:35:28,000
- YOU MENTIONED
THERE WAS A BIG DIFFERENCE

780
00:35:28,000 --> 00:35:29,733
BETWEEN THE TEMPERATURE
OF THE CORONA

781
00:35:29,733 --> 00:35:31,766
AND THE SURFACE OF THE SUN.

782
00:35:31,766 --> 00:35:34,700
COULD YOU EXPLAIN SOME
OF THE HYPOTHESES BETWEEN THAT?

783
00:35:34,700 --> 00:35:38,033
AND HAS THIS MISSION
UNVEILED ANYTHING

784
00:35:38,033 --> 00:35:40,600
OR SUPPORTED OR REJECTED
ANY OF THE HYPOTHESES?

785
00:35:40,600 --> 00:35:44,266
- UNFORTUNATELY, I DON'T KNOW
ANYTHING MORE ABOUT THAT.

786
00:35:44,266 --> 00:35:46,100
I'M NOT A MEMBER
OF THE SCIENCE TEAM,

787
00:35:46,100 --> 00:35:49,400
SO I CAN'T REALLY EXPLAIN
WHAT THEIR THEORIES ARE

788
00:35:49,400 --> 00:35:51,833
AS TO WHY THAT HAPPENS.

789
00:35:51,833 --> 00:35:54,433
I DO KNOW THAT THAT'S PART
OF WHAT IRIS IS TRYING TO DO

790
00:35:54,433 --> 00:35:56,566
IS TO UNDERSTAND
WHY THAT'S HAPPENING.

791

00:35:56,566 --> 00:35:59,666
I ALSO KNOW THE SCIENCE TEAM
HAS A BIG PAPER

792
00:35:59,666 --> 00:36:02,466
THAT THEY'RE PLANNING ON
PUBLISHING IN "SCIENCE" MAGAZINE

793
00:36:02,466 --> 00:36:04,066
VERY SOON HERE.

794
00:36:04,066 --> 00:36:07,500
I DON'T REALLY KNOW ANYTHING
MORE ABOUT THAT.

795
00:36:07,500 --> 00:36:10,300
I LOOK FORWARD TO READING THE
PAPER THAT THEY'RE PUBLISHING

796
00:36:10,300 --> 00:36:13,433
JUST AS MUCH
AS THE REST OF THE PUBLIC.

797
00:36:13,433 --> 00:36:15,766
- I'M GONNA ASK--OH.

798
00:36:15,766 --> 00:36:17,666
I'M GONNA ASK
LESSONS LEARNED AGAIN.

799
00:36:17,666 --> 00:36:20,066
I KNOW THESE ARE DELICATE
QUESTIONS, LESSONS LEARNED,

800
00:36:20,066 --> 00:36:22,700
BUT IN TERMS OF OPERATIONS,
GROUND SYSTEMS,

801
00:36:22,700 --> 00:36:24,866
AND STUFF THAT YOU WERE

DEALING WITH IN PARTICULAR,

802
00:36:24,866 --> 00:36:28,166
SYSTEMS ENGINEERING,
WHAT THINGS DO YOU--

803
00:36:28,166 --> 00:36:33,200
WHAT LESSONS DO YOU THINK SHOULD
BE APPLIED TO OTHER MISSIONS?

804
00:36:33,200 --> 00:36:37,633
- SO ANOTHER THING
THAT WE HAD THE ADVANTAGE OF

805
00:36:37,633 --> 00:36:39,066
ON THIS PARTICULAR MISSION

806
00:36:39,066 --> 00:36:42,533
IS WE WERE ABLE TO DO
A LOT OF THE DESIGN

807
00:36:42,533 --> 00:36:44,733
AND THE DEVELOPMENT
OF THE GROUND DATA SYSTEMS

808
00:36:44,733 --> 00:36:46,233
FAIRLY EARLY ON.

809
00:36:46,233 --> 00:36:49,733
A LOT OF MISSIONS LEAVE THAT
UNTIL VERY LATE IN THE MISSION,

810
00:36:49,733 --> 00:36:52,833
AND SO YOU WIND UP
THEN GETTING VERY COMPRESSED

811
00:36:52,833 --> 00:36:55,133
AND VERY STRESSED
ON THE GROUND SYSTEM.

812
00:36:55,133 --> 00:36:57,166
SO IT'S NICE TO HAVE THE TIME

813
00:36:57,166 --> 00:37:01,233
TO ACTUALLY WORK
ALONGSIDE THE SPACECRAFT FOLKS.

814
00:37:01,233 --> 00:37:03,866
AND THAT'S ANOTHER THING
AS WELL IS THAT EDDY,

815
00:37:03,866 --> 00:37:06,166
WHO'S THE OTHER
FLIGHT CONTROLLER WITH ME,

816
00:37:06,166 --> 00:37:08,233
HE WORKED AS MUCH
ON THE FLIGHT SOFTWARE

817
00:37:08,233 --> 00:37:09,600
AS HE DID
ON THE GROUND SOFTWARE--

818
00:37:09,600 --> 00:37:11,300
PROBABLY MORE
ON THE FLIGHT SOFTWARE.

819
00:37:11,300 --> 00:37:14,866
AND I WAS OVER THERE AT LOCKHEED
AT LEAST ONCE A WEEK.

820
00:37:14,866 --> 00:37:17,933
I SAT THROUGH
THE INSTRUMENT THERMAL VAC.

821
00:37:17,933 --> 00:37:20,300
I ACTUALLY TOOK
SOME SHIFTS IN THERE

822

00:37:20,300 --> 00:37:22,633
IN ORDER TO LEARN MORE
ABOUT THE INSTRUMENT,

823
00:37:22,633 --> 00:37:24,500
TO LEARN MORE
ABOUT HOW IT BEHAVED

824
00:37:24,500 --> 00:37:26,333
IN A THERMAL ENVIRONMENT.

825
00:37:26,333 --> 00:37:28,166
SO THAT ABILITY TO WORK

826
00:37:28,166 --> 00:37:30,600
THROUGH THE DEVELOPMENT
OF THE SPACECRAFT

827
00:37:30,600 --> 00:37:33,700
AND TO REALLY SIT SIDE BY SIDE
WITH THE SPACECRAFT TEAM

828
00:37:33,700 --> 00:37:38,733
WAS A VERY BENEFICIAL THING
FOR THIS--FOR THIS MISSION.

829
00:37:38,733 --> 00:37:40,833
- I HAVE A QUESTION UP HERE.
- OKAY.

830
00:37:40,833 --> 00:37:43,800
- CAN YOU SAY A LITTLE BIT MORE
ABOUT THE FINE POINTING SYSTEM?

831
00:37:43,800 --> 00:37:46,133
ARE YOU POINTING
AT ONE PARTICULAR SPOT?

832
00:37:46,133 --> 00:37:47,833
HOW DO YOU DEFINE THAT SPOT?

833
00:37:47,833 --> 00:37:50,966
AND IS THAT A PARTICULARLY NEW
TECHNOLOGY THAT YOU'RE USING?

834
00:37:50,966 --> 00:37:53,866
- SO WE'LL GO BACK.

835
00:37:56,200 --> 00:38:02,100
SO YES, WE DO--THE SCIENTISTS
MOVE US AROUND ON THE SUN.

836
00:38:02,100 --> 00:38:04,366
SO IF YOU SEE THAT RED BOX,

837
00:38:04,366 --> 00:38:06,300
IT WILL TAKE SOME IMAGES THERE
FOR A WHILE,

838
00:38:06,300 --> 00:38:08,433
AND THEN WE WILL
MOVE THE SPACECRAFT,

839
00:38:08,433 --> 00:38:10,933
AND WE'LL TAKE
SOME IMAGES ELSEWHERE.

840
00:38:10,933 --> 00:38:13,966
THE WAY THE SCIENTISTS DO THAT
IS THEY HAVE A PROGRAM

841
00:38:13,966 --> 00:38:18,200
THAT BASICALLY TRANSLATES
COORDINATES ON THE SUN

842
00:38:18,200 --> 00:38:19,633
AS YOU'RE LOOKING AT IT.

843
00:38:19,633 --> 00:38:22,333

SO, LIKE, YOU KNOW, IF YOU DO
X AND Y KIND OF COORDINATES

844
00:38:22,333 --> 00:38:26,033
ON THE SUN LIKE THAT INTO
COMMANDS FOR THE WEDGE MOTORS,

845
00:38:26,033 --> 00:38:28,333
WHICH ARE HERE
IN THE GUIDE TELESCOPE,

846
00:38:28,333 --> 00:38:30,200
THAT ESSENTIALLY THEN BENDS

847
00:38:30,200 --> 00:38:32,466
THE LIGHT
FOR THE GUIDE TELESCOPE.

848
00:38:32,466 --> 00:38:35,200
THE SPACECRAFT TRIES
TO KEEP THE SUN CENTERED

849
00:38:35,200 --> 00:38:36,533
IN THE GUIDE TELESCOPE,

850
00:38:36,533 --> 00:38:39,133
SO IF THEY BEND THE LIGHT
TO GO THAT WAY,

851
00:38:39,133 --> 00:38:42,333
THEN THE SPACECRAFT STEERS IT
UNTIL IT'S BACK CENTERED AGAIN,

852
00:38:42,333 --> 00:38:45,200
WHICH IS THEN
HOW THE BIG TELESCOPE FOCUSES

853
00:38:45,200 --> 00:38:47,133
ON THOSE PARTICULAR PARTS
OF THE SUN

854
00:38:47,133 --> 00:38:50,300
DEPENDING ON WHERE
THEY WANT TO LOOK.

855
00:38:50,300 --> 00:38:52,400
DOES THAT ANSWER THE QUESTION?

856
00:38:52,400 --> 00:38:55,566
OKAY.

857
00:38:55,566 --> 00:38:57,133
- OKAY, ONE MORE.

858
00:38:57,133 --> 00:39:00,366
SO THE EXPECTED LIFETIME
OF THE SPACECRAFT,

859
00:39:00,366 --> 00:39:03,433
YOU MENTIONED YOU DIDN'T
HAVE ANY HYDRAZINE ON BOARD,

860
00:39:03,433 --> 00:39:06,433
SO THAT'S GONNA BE
A LIMITING FACTOR.

861
00:39:06,433 --> 00:39:08,366
BUT IF YOU USE
THE SAME REACTION WHEELS

862
00:39:08,366 --> 00:39:10,433
AS WE DID ON KEPLER,
THAT MIGHT.

863
00:39:10,433 --> 00:39:12,233
WHAT IS THE LIMITING FACTORS

864
00:39:12,233 --> 00:39:13,766
IN THE LIFETIME

OF THIS SPACECRAFT,

865
00:39:13,766 --> 00:39:15,366
AND HOW LONG
IS THAT GONNA BE?

866
00:39:15,366 --> 00:39:16,900
- SO THERE'S
TWO LIMITING FACTORS.

867
00:39:16,900 --> 00:39:19,033
FIRST OF ALL,
OUR REACTION WHEELS,

868
00:39:19,033 --> 00:39:22,466
WHILE THEY ARE NOT THE SAME
AS KEPLER'S, THEY ARE SIMILAR.

869
00:39:22,466 --> 00:39:25,533
AND SO THAT IS LIKELY
TO BE ONE OF THE FIRST THINGS

870
00:39:25,533 --> 00:39:27,200
THAT WILL GO OUT
ON THIS SPACECRAFT.

871
00:39:27,200 --> 00:39:29,966
WE DO HAVE FOUR REACTION WHEELS,
AS MOST SPACECRAFT DO,

872
00:39:29,966 --> 00:39:32,933
SO WHEN ONE FAILS,
WE CAN RUN ON THREE.

873
00:39:32,933 --> 00:39:34,333
WHEN THE SECOND ONE GOES,

874
00:39:34,333 --> 00:39:36,066
AS YOU KNOW
VERY WELL FROM KEPLER,

875
00:39:36,066 --> 00:39:38,600
THEN THINGS GET
MORE INTERESTING.

876
00:39:38,600 --> 00:39:40,833
SO WHEN THAT HAPPENS,

877
00:39:40,833 --> 00:39:42,900
THAT WILL LIKELY BE
THE END OF THE MISSION.

878
00:39:42,900 --> 00:39:44,800
THE OTHER THING
IS THAT NASA REQUIRES

879
00:39:44,800 --> 00:39:47,300
THAT SPACECRAFT IN EARTH ORBIT

880
00:39:47,300 --> 00:39:49,500
BE DE-ORBITED
ONE WAY OR ANOTHER,

881
00:39:49,500 --> 00:39:53,200
MOVED OUT OF THE WAY
WITHIN 25 YEARS OF LAUNCH.

882
00:39:53,200 --> 00:39:55,366
AND SO WE ARE
IN A LOW ENOUGH ORBIT

883
00:39:55,366 --> 00:39:57,733
THAT THE DRAG
OF EARTH'S ATMOSPHERE

884
00:39:57,733 --> 00:40:00,400
ON THE SOLAR PANELS
WILL BRING THE SPACECRAFT DOWN

885

00:40:00,400 --> 00:40:02,233
WITHIN 25 YEARS.

886
00:40:02,233 --> 00:40:05,166
AND SO THAT'S HOW
WE WILL BE DE-ORBITED,

887
00:40:05,166 --> 00:40:09,033
IS SOMEWHERE IN
THE 20- TO 25-YEAR TIME FRAME,

888
00:40:09,033 --> 00:40:10,366
DEPENDING ON, YOU KNOW,

889
00:40:10,366 --> 00:40:12,400
HOW MUCH THE EARTH'S
ATMOSPHERE FLUCTUATES,

890
00:40:12,400 --> 00:40:15,100
BECAUSE IT DOES--
IT EXPANDS AND IT CONTRACTS--

891
00:40:15,100 --> 00:40:18,500
IT WILL BRING US DOWN
STRICTLY THROUGH DRAG.

892
00:40:23,733 --> 00:40:27,833
- DO YOU ANTICIPATE
THE TELESCOPE BURNING UP

893
00:40:27,833 --> 00:40:29,066
DURING REENTRY,

894
00:40:29,066 --> 00:40:32,733
OR IS THE GOAL TO HAVE IT LAND
IN THE OCEAN

895
00:40:32,733 --> 00:40:34,766
AND NOT REALLY HIT ANYTHING?

896
00:40:34,766 --> 00:40:37,200
- NO, IT'S A--
IT'S A VERY SMALL SPACECRAFT.

897
00:40:37,200 --> 00:40:41,933
SO IT'S ONLY ABOUT 7 FEET
FROM HERE TO THERE,

898
00:40:41,933 --> 00:40:44,700
SO IT WILL BURN UP COMPLETELY
WHEN IT COMES DOWN

899
00:40:44,700 --> 00:40:46,333
IN THE EARTH'S ATMOSPHERE.

900
00:40:46,333 --> 00:40:49,466
THERE WON'T BE ANYTHING LEFT.

901
00:40:53,100 --> 00:40:55,133
JUST SO YOU'RE AWARE,
IT IS--

902
00:40:55,133 --> 00:40:56,800
AS I'VE MENTIONED,
IT'S A TWO-YEAR MISSION

903
00:40:56,800 --> 00:40:59,366
THAT WE'RE JUST COMING UP
ON THE END OF THE FIRST YEAR

904
00:40:59,366 --> 00:41:00,866
OF THE MISSION.

905
00:41:00,866 --> 00:41:03,233
THE SCIENCE TEAM IS ALREADY
IN NEGOTIATION WITH HEADQUARTERS

906
00:41:03,233 --> 00:41:05,933
TO GET

THE TWO-YEAR EXTENDED MISSION

907
00:41:05,933 --> 00:41:08,033
TO MAKE US
A FOUR-YEAR MISSION.

908
00:41:08,033 --> 00:41:11,966
AND THEN DEPENDING ON HOW WELL
THINGS CONTINUE TO PERFORM,

909
00:41:11,966 --> 00:41:13,900
BOTH THE INSTRUMENT
AS WELL AS THE REACTION WHEELS

910
00:41:13,900 --> 00:41:15,300
AND OTHER THINGS,

911
00:41:15,300 --> 00:41:18,133
WE COULD CONTINUE TO GET
EXTENDED MISSIONS BEYOND THAT.

912
00:41:18,133 --> 00:41:21,200
SOME OF THE OTHER MISSIONS THAT
HAVE BEEN LOOKING AT THE SUN

913
00:41:21,200 --> 00:41:23,333
WERE ORIGINALLY DESIGNED
FOR A TWO-YEAR MISSION,

914
00:41:23,333 --> 00:41:26,733
AND THEY WOUND UP BEING,
YOU KNOW, 12-, 14-YEAR MISSIONS.

915
00:41:26,733 --> 00:41:28,666
IT JUST DEPENDS ON FUNDING

916
00:41:28,666 --> 00:41:31,966
AND WHAT HEADQUARTERS'
PRIORITIES ARE.

917
00:41:35,066 --> 00:41:40,066
ONE LAST QUESTION
DOWN HERE IN THE FRONT.

918
00:41:40,066 --> 00:41:42,233
- YEAH, COULD YOU GIVE US
A QUICK RENDITION

919
00:41:42,233 --> 00:41:45,766
OF AVOIDANCE OF SPACE JUNK?

920
00:41:45,766 --> 00:41:47,200
- THERE ISN'T ANY.

921
00:41:47,200 --> 00:41:49,900
WE JUST HAVE TO GET LUCKY.

922
00:41:49,900 --> 00:41:52,566
WE HAVE NO THRUSTERS.
WE HAVE NO PROPULSION.

923
00:41:52,566 --> 00:41:56,566
WE DO GET UPDATES TWICE A DAY

924
00:41:56,566 --> 00:41:59,033
TELLING US WHEN SPACE JUNK,
WHEN OTHER DEBRIS,

925
00:41:59,033 --> 00:42:01,600
WHEN OTHER SPACECRAFT
ARE COMING CLOSE TO US,

926
00:42:01,600 --> 00:42:04,466
AND THEY'RE
WEEK-LONG PREDICTIONS.

927
00:42:04,466 --> 00:42:06,500
AND THERE WAS
ONE PREDICTION WE HAD

928
00:42:06,500 --> 00:42:08,800
WHERE IT SAID THAT A PIECE
OF SPACE JUNK WAS, AT ONE POINT,

929
00:42:08,800 --> 00:42:11,766
GONNA PASS
WITHIN 7 METERS OF US.

930
00:42:11,766 --> 00:42:14,533
AND WE GOT A LITTLE NERVOUS
ABOUT THAT ONE,

931
00:42:14,533 --> 00:42:16,833
BUT THERE'S REALLY NOTHING
WE CAN DO.

932
00:42:16,833 --> 00:42:20,200
I MEAN, WE DID TALK AT THAT
POINT WITH THE SCIENCE TEAM

933
00:42:20,200 --> 00:42:22,033
ABOUT, WELL, IS IT BETTER--

934
00:42:22,033 --> 00:42:24,366
IF WE THINK THE SPACE JUNK
IS COMING THIS WAY,

935
00:42:24,366 --> 00:42:26,066
IS IT BETTER TO HAVE IT
HIT THE TELESCOPE?

936
00:42:26,066 --> 00:42:27,433
OR DO WE TURN THE THING

937
00:42:27,433 --> 00:42:29,900
SO THAT IT'S MORE LIKELY
TO HIT THE SOLAR PANELS?

938

00:42:29,900 --> 00:42:33,233
YOU KNOW, THERE WASN'T REALLY
ANY GOOD SOLUTION FOR THAT,

939
00:42:33,233 --> 00:42:35,266
SO BASICALLY,
THE ANSWER IS

940
00:42:35,266 --> 00:42:39,366
THAT WE HOPE WE GET LUCKY.

941
00:42:39,366 --> 00:42:42,800
- SO FAR, SO GOOD.

942
00:42:42,800 --> 00:42:45,000
- ALL RIGHT, WELL,
THANK YOU ALL FOR COMING.

943
00:42:45,000 --> 00:42:49,466
[applause]