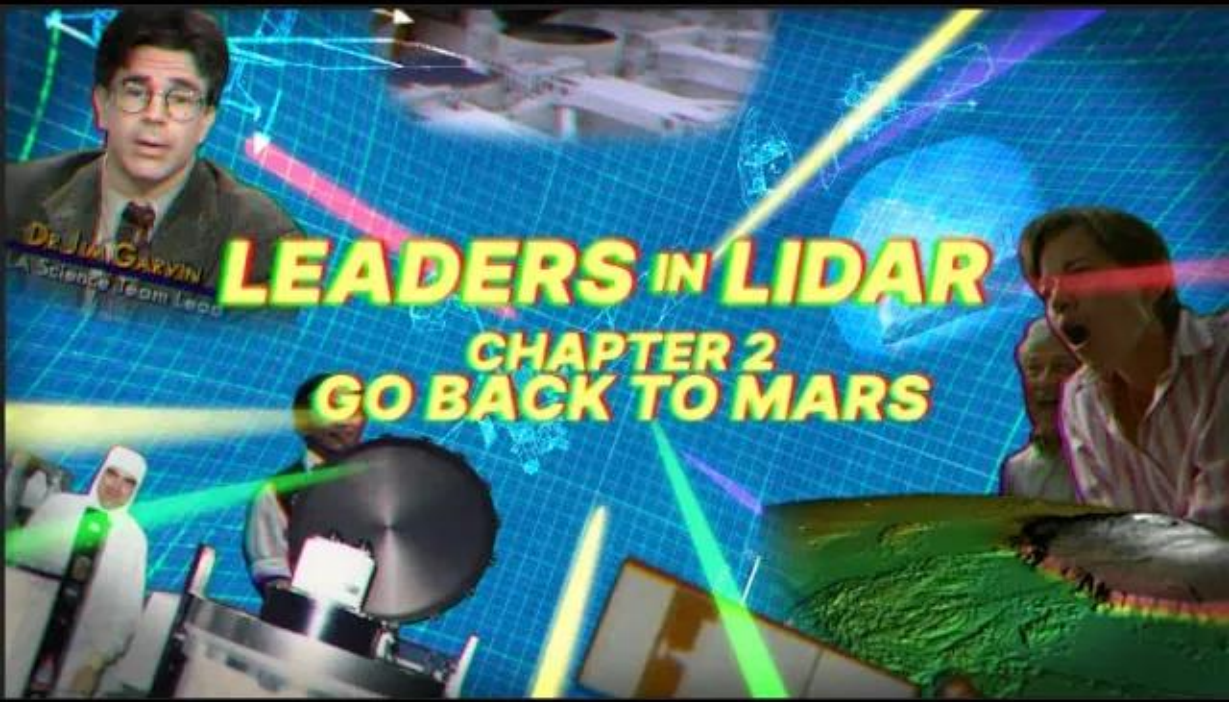
Dr. Jim Garvin
LA Science Team Lead
LEADERS IN LIDAR
CHAPTER 2
GO BACK TO MARS

1
00:00:00,133 --> 00:00:10,600
[somber music]

2
00:00:10,633 --> 00:00:15,233
On 21 August, 1993, a tragic event occurred.

3
00:00:15,233 --> 00:00:19,433
Communications with the Mars Observer
spacecraft were lost

4
00:00:19,433 --> 00:00:23,433
during a sequence referred to as the pressurization sequence.

5
00:00:23,700 --> 00:00:25,700
This was a sequence in preparation

6
00:00:26,700 --> 00:00:29,400
for insertion to orbit about Mars.

7
00:00:29,633 --> 00:00:32,100
Once again, I mean, we are always trying things

8
00:00:32,100 --> 00:00:35,833
because they're hard,
not not because they're easy.

9
00:00:36,200 --> 00:00:39,900
And so once in a while,
we're going to have a failure

10
00:00:40,033 --> 00:00:42,733
because we are trying hard things.

11
00:00:42,733 --> 00:00:46,700
But I had been fully anticipating that we
could have problems with this instrument.

12
00:00:46,700 --> 00:00:49,033

This was a new ballgame completely, okay.

13
00:00:49,300 --> 00:00:51,833
But I was not concerned
about the spacecraft.

14
00:00:51,833 --> 00:00:54,500
It never crossed my mind
that the spacecraft would let us down.

15
00:00:54,666 --> 00:00:57,466
So this was a blow in the sense of, wow,

16
00:00:57,800 --> 00:01:00,000
something I completely didn't expect.

17
00:01:00,000 --> 00:01:04,533
[music]

18
00:01:04,533 --> 00:01:06,333
You know, we held out hope for a while,

19
00:01:06,333 --> 00:01:08,066
that maybe it would come back,

20
00:01:08,433 --> 00:01:11,233
maybe they'd find it or recover it
or something, and then

21
00:01:11,533 --> 00:01:15,300
eventually that settles down
and you realize the mission was lost.

22
00:01:15,300 --> 00:01:16,900
I was devastated.

23
00:01:16,900 --> 00:01:18,400
I think we all were.

24
00:01:18,400 --> 00:01:21,100
And it was--it really wasn't clear at the time

25
00:01:22,300 --> 00:01:24,533
whether we were going to have a

26
00:01:25,366 --> 00:01:27,533
follow on to actually

27
00:01:27,533 --> 00:01:29,933
do what the mission was supposed to do.

28
00:01:30,800 --> 00:01:33,800
So that was extremely hard to take.

29
00:01:33,800 --> 00:01:37,666
What made it easier
is the amount of time we had for grieving

30
00:01:37,666 --> 00:01:39,133
was actually pretty short.

31
00:01:39,133 --> 00:01:42,933
NASA decided that we want to continue
this and go back to Mars,

32
00:01:42,966 --> 00:01:48,200
and so we had to snap out of it
literally and get back to thinking about

33
00:01:48,200 --> 00:01:52,566
and fighting for the next mission, which was Mars Global Surveyor.

34
00:01:53,000 --> 00:01:54,566
It was a difficult time, and

35
00:01:54,566 --> 00:01:56,500
it was the first time I think I really felt

36
00:01:56,500 --> 00:02:00,433
I had to get in there and argue with my colleagues.

37
00:02:00,433 --> 00:02:03,366
But as the PI, particularly for me,

38
00:02:03,866 --> 00:02:07,100
that we needed to get to back to Mars
and we needed to get back

39
00:02:07,100 --> 00:02:08,366
with this instrument,

40
00:02:08,366 --> 00:02:12,333
knowing that they couldn't carry all six
or seven instruments, only four would go.

41
00:02:12,333 --> 00:02:14,233
The laser altimeter had to be one of them.

42
00:02:14,233 --> 00:02:15,266
Okay.

43
00:02:16,033 --> 00:02:18,233
The engineers had a chance to kind of

44
00:02:18,233 --> 00:02:23,266
just, not change it, but, you know, do
certain things a little bit better.

45
00:02:23,266 --> 00:02:26,033
That's what engineers like to do is

46
00:02:26,466 --> 00:02:28,966
fix all the first round mistakes

47
00:02:28,966 --> 00:02:31,500

in the second round and make new ones.

48
00:02:32,233 --> 00:02:34,600
We were asked immediately, how long will it take

49
00:02:34,600 --> 00:02:38,000
you to rebuild another copy of MOLA?

50
00:02:38,700 --> 00:02:41,100
How much is it going to cost?

51
00:02:41,100 --> 00:02:43,433
Can you get your team back together in time?

52
00:02:43,433 --> 00:02:44,833
Do you have the parts?

53
00:02:44,833 --> 00:02:47,733
So there was immediately
a flood of things we had to do.

54
00:02:49,366 --> 00:02:52,633
Jim Abshire brought me in
for the detector engineer

55
00:02:52,633 --> 00:02:55,833
who would just left
Goddard at the time.

56
00:02:55,833 --> 00:02:59,666
So I was lucky to join the team
working on the detectors.

57
00:03:00,133 --> 00:03:05,366
We were only given, I think, three years
to rebuild it, which is shorter than usual.

58
00:03:05,366 --> 00:03:06,433
And everyone,

59
00:03:06,433 --> 00:03:10,466
all the management knew that means there's
no wiggle room in your schedule.

60
00:03:10,500 --> 00:03:14,533
But the team was largely still there
and everyone's

61
00:03:14,533 --> 00:03:17,800
geared up to redo it
since the first one didn't make it.

62
00:03:17,800 --> 00:03:20,566
So everyone really want to do it again,

63
00:03:20,566 --> 00:03:21,900
and do it right.

64
00:03:22,233 --> 00:03:25,433
While the Goddard team was building
MOLA-2 for the Mars

65
00:03:25,433 --> 00:03:28,566
Global Surveyor mission,
a small team seized

66
00:03:28,566 --> 00:03:32,533
a long awaited opportunity
to hitch a ride on the Space Shuttle

67
00:03:32,533 --> 00:03:35,966
with an experiment
known as the Shuttle Laser Altimeter.

68
00:03:36,133 --> 00:03:39,266
I think confidence
comes from demonstration.

69

00:03:39,266 --> 00:03:40,866
Sometimes you have to do more.

70
00:03:40,866 --> 00:03:42,233
Sometimes you have to do less.

71
00:03:42,233 --> 00:03:45,233
Working personally to build that instrument.

72
00:03:45,233 --> 00:03:48,466
We built it at Goddard in our lab down the hall

73
00:03:48,466 --> 00:03:52,900
without any fancy paperwork
or flight procedures or anything.

74
00:03:52,900 --> 00:03:54,100
We just built it.

75
00:03:54,100 --> 00:03:56,200
I was hired then

76
00:03:56,200 --> 00:03:59,533
to come on board working on the Shuttle Laser Altimeter,

77
00:03:59,766 --> 00:04:04,466
and I was brought in specifically
to work on precise positioning,

78
00:04:04,466 --> 00:04:09,666
precise pointing and precise geolocation
of the surface footprints.

79
00:04:09,666 --> 00:04:15,066
And we tested it on the roof,
shined it over to a bank building

80
00:04:15,066 --> 00:04:19,433
eleven kilometers away, lined it up,

and it was ready for the Shuttle.

81
00:04:19,800 --> 00:04:22,666
It was a Hitchhiker Special
that we flew with

82
00:04:22,666 --> 00:04:25,633
help from NASA Headquarters on the Space
Shuttle Endeavour.

83
00:04:25,633 --> 00:04:28,700
Booster ignition
and liftoff of Endeavour in pursuit

84
00:04:28,700 --> 00:04:34,733
of a Japanese satellite. [radio chatter]

85
00:04:34,733 --> 00:04:39,200
They turned it on for us and
the first time they turned it on,

86
00:04:39,200 --> 00:04:42,966
the Shuttle's upside down with the laser
pointing at Earth.

87
00:04:42,966 --> 00:04:45,133
We were over the Middle Pacific.

88
00:04:45,133 --> 00:04:49,100
First light showed all this fuzz
over the surface of the Earth.

89
00:04:49,100 --> 00:04:50,333
We're all looking.

90
00:04:50,333 --> 00:04:51,533
We thought we got something wrong.

91
00:04:51,533 --> 00:04:55,300

We realized later we were seeing
the boundary layer clouds over the ocean.

92
00:04:55,300 --> 00:04:58,400
When we came over land,
the fuzz was the height of the trees.

93
00:04:58,633 --> 00:05:01,200
All of a sudden the laser pulses

94
00:05:01,200 --> 00:05:04,300
got shorter and shorter distances.

95
00:05:04,300 --> 00:05:07,500
The first landfall of the Shuttle Laser
Altimeter and the first orbit

96
00:05:07,500 --> 00:05:10,633
went right over the summit of the Mauna
Kea volcano in Hawaii.

97
00:05:10,633 --> 00:05:14,666
Well, we're extraordinarily delighted
to report that the Shuttle Laser

98
00:05:14,666 --> 00:05:16,733
Altimeter experiment--it's a Hitchhiker

99
00:05:16,733 --> 00:05:21,133
experiment on STS-72--has performed absolutely nominally.

100
00:05:21,133 --> 00:05:24,133
In fact, everything has worked even beyond our expectation--

101
00:05:24,133 --> 00:05:27,766
And that was a genuine first light

102
00:05:27,766 --> 00:05:31,033
experience with MOLA technology,

103
00:05:31,033 --> 00:05:31,966
but on Earth.

104
00:05:31,966 --> 00:05:34,033
Really had to get those datasets out there

105
00:05:34,033 --> 00:05:37,700
and you had to get a couple people
that really bought into it

106
00:05:37,700 --> 00:05:41,633
and built on it
and convinced others that this worked.

107
00:05:41,633 --> 00:05:46,133
As the data from the Shuttle Laser
Altimeter began to convince some skeptics.

108
00:05:46,133 --> 00:05:48,800
The Goddard team finished the MOLA instrument.

109
00:05:49,266 --> 00:05:49,966
Again.

110
00:05:49,966 --> 00:05:53,300
Our MOLA team
really came through, was just really

111
00:05:53,900 --> 00:05:57,166
another great experience for many of us,
including me.

112
00:05:57,333 --> 00:06:02,166
We're able to deliver to the Mars Global
Surveyor project and it got launched.

113
00:06:02,166 --> 00:06:05,866
And we have liftoff of NASA's

Mars Global Surveyor

114
00:06:05,866 --> 00:06:09,866
as America begins
its journey back to the Red Planet.

115
00:06:09,866 --> 00:06:12,433
[radio chatter]

116
00:06:12,433 --> 00:06:16,033
When Mars Global Surveyor
started getting closer to Mars,

117
00:06:16,033 --> 00:06:18,700
we were going to go into this
aerobraking phase.

118
00:06:19,566 --> 00:06:21,166
That was an opportunity that we had

119
00:06:21,166 --> 00:06:24,666
to go ahead and turn on the lasers
and see if we could track the surface.

120
00:06:24,666 --> 00:06:26,733
[room chatter]

121
00:06:26,733 --> 00:06:31,933
In Station 45 was having problems
locking up to the two tape data.

122
00:06:31,933 --> 00:06:32,400
What was that?

123
00:06:32,400 --> 00:06:34,100
You said 1607 or 16--

124
00:06:34,100 --> 00:06:36,466
Can you tell

125
00:06:36,466 --> 00:06:38,333
if MOLA is turned off?

126
00:06:38,333 --> 00:06:42,933
[radio and room chatter]

127
00:06:42,933 --> 00:06:44,000
Is that the nadir event?

128
00:06:44,000 --> 00:06:45,333
That must be the nadir event.

129
00:06:45,333 --> 00:06:48,166
I'm hungry. You didn't really want those sandwiches--
[room chatter]

130
00:06:48,166 --> 00:06:49,866
Look at the laser beam coming back, Rob.

131
00:06:49,866 --> 00:06:57,166
[Lots of chatter].

132
00:06:57,166 --> 00:07:00,133
It's going to be too fast,
and I've got too much data coming in.

133
00:07:01,700 --> 00:07:08,533
[cheering and applause]

134
00:07:08,533 --> 00:07:09,733
Look at that!

135
00:07:09,733 --> 00:07:11,966
Yeah, look, there's a little tiny terrace.

136
00:07:12,033 --> 00:07:15,233
This is the first profile of a crater

we've ever seen on a planet.

137
00:07:15,966 --> 00:07:17,666
Rob, nice laser!

138
00:07:18,566 --> 00:07:20,000
We have Mars finally!

139
00:07:20,000 --> 00:07:21,266
12 years!

140
00:07:21,266 --> 00:07:22,833
All right, let's take a look.

141
00:07:22,833 --> 00:07:24,200
[room chatter]

142
00:07:24,200 --> 00:07:25,700
Over a decade later

143
00:07:25,700 --> 00:07:27,800
the Goddard team had proof:

144
00:07:27,933 --> 00:07:31,166
planet-scale laser altimetry worked.

145
00:07:31,466 --> 00:07:35,133
It could map distant craters and valleys and mountains.

146
00:07:35,766 --> 00:07:37,000
It changed the game.

147
00:07:37,000 --> 00:07:40,300
Today, we've ushered in a new era
in the remote sensing of Mars.

148
00:07:40,733 --> 00:07:44,300
And this particular dataset

that we've acquired has in fact enabled us

149
00:07:44,300 --> 00:07:45,700
to generate what we consider

150
00:07:45,700 --> 00:07:49,733
a very detailed description
of the shape of the planet Mars.

151
00:07:50,100 --> 00:07:55,433
This has significant implications
for the flow of water early on Mars.

152
00:07:55,433 --> 00:07:56,633
We believe this is one of the

153
00:07:56,633 --> 00:07:58,500
youngest features on the planet.

154
00:07:58,500 --> 00:08:00,566
We're seeing a planet
is very different from Earth,

155
00:08:00,733 --> 00:08:04,300
and is telling us something
about the Earth in an indirect way

156
00:08:04,300 --> 00:08:09,066
that says that not everything works
in the way that we originally had in mind.

157
00:08:09,266 --> 00:08:13,000
The kind of measurements that we're making
now are allowing us to,

158
00:08:13,000 --> 00:08:17,733
you know, characterize Mars
on timescales of days to years now,

159

00:08:17,733 --> 00:08:21,166
and then the next step
is to try to go back eons and

160
00:08:21,166 --> 00:08:23,400
try to figure out what changed on Mars.

161
00:08:23,400 --> 00:08:27,700
I mean, at that time, we used to brag that
Mars was mapped better than the Earth.

162
00:08:28,100 --> 00:08:30,633
The accuracy of MOLA was so good,

163
00:08:31,166 --> 00:08:33,500
and and after a couple of years,
the coverage was so good,

164
00:08:33,500 --> 00:08:37,600
it was definitely a more accurate map
of a planet than any planet.

165
00:08:37,600 --> 00:08:41,300
And this came out of
"it can't be done" in the mid eighties

166
00:08:41,300 --> 00:08:44,033
to a tool that we now accept as the standard.

167
00:08:44,133 --> 00:08:47,000
For those of us that worked on MOLA,

168
00:08:47,000 --> 00:08:49,500
it was transformative.

169
00:08:49,500 --> 00:08:52,566
It wasn't a destination or a place

170
00:08:52,566 --> 00:08:57,333

that we were as much as a place that we would become.

171
00:08:58,900 --> 00:09:00,700
In some ways, we were in demand

172
00:09:00,700 --> 00:09:02,500
to consider whether we could

173
00:09:02,500 --> 00:09:04,133
provide a laser altimeter

174
00:09:04,133 --> 00:09:06,233
to another mission.

175
00:09:06,233 --> 00:09:09,966
Things were not working
the way we expected them to,