
NASA LIVE
DART
IMPACT

1
00:00:16,680 --> 00:00:00,950
[Music]

2
00:00:44,950 --> 00:00:16,690
[Applause]

3
00:01:20,950 --> 00:00:44,960
[Music]

4
00:01:26,210 --> 00:01:24,530
live from Laurel Maryland this is NASA's

5
00:01:28,850 --> 00:01:26,220
coverage of the double asteroid

6
00:01:31,609 --> 00:01:28,860
redirection test planned impact with

7
00:01:34,550 --> 00:01:31,619
asteroid dimorphos

8
00:01:38,090 --> 00:01:34,560
in a Galaxy where asteroids have humbled

9
00:01:40,030 --> 00:01:38,100
planets for billions of years now one

10
00:01:42,830 --> 00:01:40,040
planet strikes back

11
00:01:45,050 --> 00:01:42,840
for the first time in our planet's

12
00:01:47,149 --> 00:01:45,060
history NASA will test an asteroid

13
00:01:50,270 --> 00:01:47,159

deflection technique

14
00:01:52,910 --> 00:01:50,280
it's the first planetary defense method

15
00:01:55,670 --> 00:01:52,920
of its kind

16
00:01:58,190 --> 00:01:55,680
NASA's double asteroid redirection test

17
00:02:03,410 --> 00:01:58,200
will intentionally Ram itself into an

18
00:02:08,630 --> 00:02:05,870
at the crossroads of Science Fiction and

19
00:02:10,790 --> 00:02:08,640
reality Dart is part of our plan to

20
00:02:12,770 --> 00:02:10,800
defend planet Earth against potential

21
00:02:15,350 --> 00:02:12,780
future impacts

22
00:02:26,690 --> 00:02:15,360
the test to protect the future of our

23
00:02:31,010 --> 00:02:28,850
welcome and thank you for joining us

24
00:02:33,229 --> 00:02:31,020
from Johns Hopkins Applied Physics

25
00:02:36,350 --> 00:02:33,239
laboratory home to the dart Mission

26
00:02:38,690 --> 00:02:36,360
operations center I'm your host Tahira

27
00:02:40,670 --> 00:02:38,700
Allen with NASA Communications and

28
00:02:43,309 --> 00:02:40,680
tonight we're following the real-time

29
00:02:45,170 --> 00:02:43,319
journey of the dart spacecraft and its

30
00:02:47,630 --> 00:02:45,180
planned collision with asteroid

31
00:02:50,570 --> 00:02:47,640
dimorphos the double asteroid

32
00:02:53,150 --> 00:02:50,580
redirection test also known as Dart is

33
00:02:56,869 --> 00:02:53,160
the world's first planetary defense test

34
00:02:58,610 --> 00:02:56,879
mission of its kind at 7 14 PM Eastern

35
00:03:01,190 --> 00:02:58,620
it will demonstrate an asteroid

36
00:03:04,550 --> 00:03:01,200
deflection technique known as kinetic

37
00:03:07,490 --> 00:03:04,560
impact rest assured this is only a test

38
00:03:10,070 --> 00:03:07,500

the asteroid Dart intends to impact is

39
00:03:13,430 --> 00:03:10,080
not a threat to earth now nor will it be

40
00:03:15,530 --> 00:03:13,440
after the Collision we have live views

41
00:03:17,509 --> 00:03:15,540
of the action from space so keep an eye

42
00:03:19,850 --> 00:03:17,519
on the dart cam in the lower left hand

43
00:03:22,009 --> 00:03:19,860
corner of your screen right now you're

44
00:03:24,830 --> 00:03:22,019
only seeing a black screen with a single

45
00:03:27,589 --> 00:03:24,840
point of light that point contains two

46
00:03:29,809 --> 00:03:27,599
asteroids in it didimos with a smaller

47
00:03:32,270 --> 00:03:29,819
asteroid named dimorphos orbiting around

48
00:03:34,190 --> 00:03:32,280
it as long as we continue to receive

49
00:03:36,589 --> 00:03:34,200
these live views from Dart we're going

50
00:03:38,809 --> 00:03:36,599
to keep that feed up on your screen as

51
00:03:41,149 --> 00:03:38,819
we get closer to impact the asteroid

52
00:03:43,690 --> 00:03:41,159
will begin to take shape and eventually

53
00:03:46,009 --> 00:03:43,700
dimorphos will fill your entire screen

54
00:03:48,170 --> 00:03:46,019
you'll also notice a countdown clock

55
00:03:50,270 --> 00:03:48,180
indicating how close we are to impact

56
00:03:52,550 --> 00:03:50,280
and a progress bar that will check off

57
00:03:54,949 --> 00:03:52,560
key Milestones along the way

58
00:03:57,410 --> 00:03:54,959
now as we follow pre-impact operations

59
00:03:59,690 --> 00:03:57,420
we invite you to join us as we check in

60
00:04:02,509 --> 00:03:59,700
with mission control for live updates

61
00:04:04,670 --> 00:04:02,519
and track dart's final Milestones we'll

62
00:04:07,309 --> 00:04:04,680
see two astronauts demonstrate what

63
00:04:09,530 --> 00:04:07,319

kinetic impact looks like in space and

64
00:04:11,509 --> 00:04:09,540
will go behind the scenes at one of the

65
00:04:12,830 --> 00:04:11,519
observatory's following dart's impact

66
00:04:14,869 --> 00:04:12,840
from Earth

67
00:04:16,969 --> 00:04:14,879
you can participate in today's show

68
00:04:19,789 --> 00:04:16,979
tonight by submitting questions for our

69
00:04:21,530 --> 00:04:19,799
experts to answer live on air drop them

70
00:04:24,590 --> 00:04:21,540
into the stream wherever you're watching

71
00:04:27,110 --> 00:04:24,600
or use the hashtag planetarydefender on

72
00:04:30,590 --> 00:04:27,120
social media now we're a little over 70

73
00:04:32,810 --> 00:04:30,600
minutes out from Impact at 7 14 PM let's

74
00:04:34,310 --> 00:04:32,820
now meet your co-host Samson Rainey

75
00:04:37,189 --> 00:04:34,320
joining us live from the mission

76
00:04:39,350 --> 00:04:37,199
operations center Samson it's good to

77
00:04:41,749 --> 00:04:39,360
see you how does it feel to be in the

78
00:04:44,210 --> 00:04:41,759
middle of the action tonight hey Tahira

79
00:04:46,310 --> 00:04:44,220
I am feeling great it is awesome to be

80
00:04:48,830 --> 00:04:46,320
backer after co-hosting darts launched

81
00:04:51,110 --> 00:04:48,840
just tens short months ago how's the

82
00:04:52,430 --> 00:04:51,120
energy over there wow that's amazing

83
00:04:54,409 --> 00:04:52,440
Samson you know everybody's super

84
00:04:56,090 --> 00:04:54,419
excited I've been talking to some

85
00:04:58,670 --> 00:04:56,100
scientists and Engineers before the show

86
00:05:01,129 --> 00:04:58,680
and it's really just anticipation about

87
00:05:02,930 --> 00:05:01,139
what's going to happen tonight so with

88
00:05:04,550 --> 00:05:02,940

that could you give us an update on how

89
00:05:06,350 --> 00:05:04,560
things are going with Mission operations

90
00:05:08,510 --> 00:05:06,360
I'm glad you're enjoying it there this

91
00:05:10,909 --> 00:05:08,520
is going to be fun so I mentioned launch

92
00:05:12,909 --> 00:05:10,919
right it was a huge event NASA launches

93
00:05:15,409 --> 00:05:12,919
have become a staple of life for space

94
00:05:17,210 --> 00:05:15,419
aficionados but there's never been

95
00:05:19,370 --> 00:05:17,220
anything like what we're about to see

96
00:05:22,189 --> 00:05:19,380
tonight an attempt to impact an asteroid

97
00:05:23,810 --> 00:05:22,199
in near real time be first attempt to

98
00:05:27,469 --> 00:05:23,820
change the motion of a Celestial body

99
00:05:29,029 --> 00:05:27,479
just wow if we hit that asteroid to Hero

100
00:05:31,070 --> 00:05:29,039
I think we're going to see a whole new

101
00:05:33,350 --> 00:05:31,080
side of this team that we've never seen

102
00:05:35,029 --> 00:05:33,360
before because let me tell you since

103
00:05:37,310 --> 00:05:35,039
launch these engineers and scientists

104
00:05:39,590 --> 00:05:37,320
have been eating sleeping and breathing

105
00:05:41,390 --> 00:05:39,600
this Mission this Center has been like a

106
00:05:43,430 --> 00:05:41,400
second home for them as they've been

107
00:05:45,350 --> 00:05:43,440
monitoring the spacecraft's health and

108
00:05:47,270 --> 00:05:45,360
managing everything from propulsion to

109
00:05:50,450 --> 00:05:47,280
the power supply guidance and navigation

110
00:05:52,370 --> 00:05:50,460
the list goes on and on they've run

111
00:05:54,650 --> 00:05:52,380
countless simulations and have rehearsed

112
00:05:56,870 --> 00:05:54,660
for this moment time and time again

113
00:05:59,810 --> 00:05:56,880

preparing for anything and I mean

114
00:06:01,969 --> 00:05:59,820
anything that could possibly happen a

115
00:06:04,430 --> 00:06:01,979
quick recap of the last 24 hours no

116
00:06:05,990 --> 00:06:04,440
surprise here they've been busy last

117
00:06:07,850 --> 00:06:06,000
night they performed the sixth and last

118
00:06:10,670 --> 00:06:07,860
of what are called trajectory correction

119
00:06:12,890 --> 00:06:10,680
Maneuvers to aim darts within 200 meters

120
00:06:14,330 --> 00:06:12,900
of didimos then they work straight

121
00:06:16,670 --> 00:06:14,340
through to this morning to make sure

122
00:06:18,770 --> 00:06:16,680
that all went smoothly then they

123
00:06:21,050 --> 00:06:18,780
soldiered on to get us ready for tonight

124
00:06:23,270 --> 00:06:21,060
and here we are about an hour and 10

125
00:06:25,189 --> 00:06:23,280
minutes from Impact and we're now in

126
00:06:27,350 --> 00:06:25,199
What's called the terminal phase meaning

127
00:06:29,090 --> 00:06:27,360
that smart now the autonomous navigation

128
00:06:31,309 --> 00:06:29,100
system is actively guiding the

129
00:06:33,950 --> 00:06:31,319
spacecraft as it was designed to do for

130
00:06:35,689 --> 00:06:33,960
its final four hours I also received

131
00:06:38,210 --> 00:06:35,699
word minutes ago that Dart has reached

132
00:06:40,070 --> 00:06:38,220
another critical Milestone Draco the

133
00:06:42,890 --> 00:06:40,080
eyes of smartnav is able to detect

134
00:06:44,629 --> 00:06:42,900
dimorphos this is a major goal post I

135
00:06:46,309 --> 00:06:44,639
have to remind you because up until now

136
00:06:49,550 --> 00:06:46,319
Draco has only been able to detect

137
00:06:51,290 --> 00:06:49,560
dynamos the much larger asteroid orbits

138
00:06:53,029 --> 00:06:51,300

the next major Milestone we're waiting

139
00:06:55,790 --> 00:06:53,039
for is for smart enough to be locked on

140
00:06:58,010 --> 00:06:55,800
or targeting dimorphos we'll get more

141
00:07:00,710 --> 00:06:58,020
into what that means later lots more to

142
00:07:02,090 --> 00:07:00,720
come as we draw closer to impact back to

143
00:07:05,090 --> 00:07:02,100
you Tahira

144
00:07:07,430 --> 00:07:05,100
all right thank you Samson it feels good

145
00:07:10,370 --> 00:07:07,440
to know that we are detecting dimorphos

146
00:07:12,770 --> 00:07:10,380
now before we get any closer to impact

147
00:07:13,550 --> 00:07:12,780
let's get to know our spacecraft and its

148
00:07:16,129 --> 00:07:13,560
mission

149
00:07:19,189 --> 00:07:16,139
after a beautiful launch from bindenburg

150
00:07:23,029 --> 00:07:19,199
space force base on November 24 2021

151
00:07:26,029 --> 00:07:23,039
Dart has traveled over 400 million miles

152
00:07:28,010 --> 00:07:26,039
and now in just over an hour we'll

153
00:07:30,290 --> 00:07:28,020
witness the spacecraft collide with

154
00:07:32,629 --> 00:07:30,300
asteroid dimorphos in an attempt to

155
00:07:34,490 --> 00:07:32,639
change its orbit forever the dart

156
00:07:36,589 --> 00:07:34,500
spacecraft is about the size of a

157
00:07:38,870 --> 00:07:36,599
vending machine and uses hydrazine

158
00:07:41,689 --> 00:07:38,880
thrusters for propulsion and roll out

159
00:07:44,570 --> 00:07:41,699
solar arrays for power it's traveling at

160
00:07:46,790 --> 00:07:44,580
about 14 000 miles per hour and will

161
00:07:48,830 --> 00:07:46,800
complete the last four miles of its

162
00:07:50,870 --> 00:07:48,840
journey in just one second

163
00:07:53,029 --> 00:07:50,880

Dart is on a collision course with

164
00:07:55,189 --> 00:07:53,039
asteroid dimorphos which is about the

165
00:07:57,650 --> 00:07:55,199
height of the Washington Monument and

166
00:07:58,370 --> 00:07:57,660
more importantly poses no threat to

167
00:08:00,890 --> 00:07:58,380
Earth

168
00:08:02,570 --> 00:08:00,900
dimorphos sits within a double asteroid

169
00:08:04,790 --> 00:08:02,580
system and as the smaller moonlit

170
00:08:07,969 --> 00:08:04,800
asteroid orbiting its larger companion

171
00:08:10,129 --> 00:08:07,979
didimos Dart has just one instrument on

172
00:08:11,870 --> 00:08:10,139
board and that's a draco camera which is

173
00:08:14,629 --> 00:08:11,880
feeding images to its autonomous

174
00:08:16,189 --> 00:08:14,639
navigation system steering it straight

175
00:08:19,010 --> 00:08:16,199
into the asteroid

176
00:08:21,350 --> 00:08:19,020
Now teams from around the world have

177
00:08:23,749 --> 00:08:21,360
worked hard to get us to this moment

178
00:08:26,510 --> 00:08:23,759
Samson is standing by with NASA's head

179
00:08:29,210 --> 00:08:26,520
of Science and Johns Hopkins apl's head

180
00:08:31,249 --> 00:08:29,220
of space exploration let's check in to

181
00:08:33,469 --> 00:08:31,259
hear more about the journey

182
00:08:35,089 --> 00:08:33,479
thanks to Hera to help give us some

183
00:08:37,250 --> 00:08:35,099
insight into what it takes to imagine

184
00:08:39,589 --> 00:08:37,260
much less attempt a mission this

185
00:08:41,389 --> 00:08:39,599
ambitious add with me Thomas rhuben

186
00:08:43,610 --> 00:08:41,399
associate administrator for NASA science

187
00:08:45,530 --> 00:08:43,620
Mission directorate and Bobby Brown's

188
00:08:47,630 --> 00:08:45,540

space exploration sector head at Johns

189
00:08:49,490 --> 00:08:47,640
Hopkins ETL gentlemen thanks so much for

190
00:08:50,990 --> 00:08:49,500
being here thank you Thomas I'll start

191
00:08:52,610 --> 00:08:51,000
with you the mission this team has been

192
00:08:54,230 --> 00:08:52,620
through an intense Journey years in the

193
00:08:57,230 --> 00:08:54,240
making and they're now on the cusp of

194
00:08:59,389 --> 00:08:57,240
doing a seemingly impossible

195
00:09:01,430 --> 00:08:59,399
um impacting a tiny asteroid 7 million

196
00:09:04,970 --> 00:09:01,440
miles away from Earth with a spacecraft

197
00:09:06,290 --> 00:09:04,980
traveling 14 000 miles per hour why is

198
00:09:07,970 --> 00:09:06,300
it important for us to continue to push

199
00:09:10,550 --> 00:09:07,980
the boundaries up as possible in space

200
00:09:13,190 --> 00:09:10,560
you know what I always think is the

201
00:09:16,310 --> 00:09:13,200
world is made out of a box those are

202
00:09:18,470 --> 00:09:16,320
things we know we can use and a large

203
00:09:20,389 --> 00:09:18,480
space of things that are unknown in that

204
00:09:23,210 --> 00:09:20,399
large space are solutions for problems

205
00:09:25,730 --> 00:09:23,220
of the future there's new research new

206
00:09:27,650 --> 00:09:25,740
understanding of Nature and we at Nasa

207
00:09:29,570 --> 00:09:27,660
were all about moving that boundary back

208
00:09:32,090 --> 00:09:29,580
moving it back to make more things

209
00:09:34,009 --> 00:09:32,100
useful for us like Dart but also

210
00:09:36,710 --> 00:09:34,019
understanding nature in a new fashion

211
00:09:38,810 --> 00:09:36,720
it's incredible Thomas well based on

212
00:09:41,150 --> 00:09:38,820
what we know tonight heading into this

213
00:09:43,190 --> 00:09:41,160

Main Event you know what uh what are you

214
00:09:44,870 --> 00:09:43,200
thinking about our chances of impact wow

215
00:09:46,250 --> 00:09:44,880
I'm betting on the team betting on the

216
00:09:47,810 --> 00:09:46,260
team is always the right thing to do

217
00:09:49,910 --> 00:09:47,820
when it comes to NASA missions whether

218
00:09:51,769 --> 00:09:49,920
it's this one or other teams we've had

219
00:09:53,810 --> 00:09:51,779
the thing you just announced you know

220
00:09:56,449 --> 00:09:53,820
that kind of seeing that little bump

221
00:09:59,090 --> 00:09:56,459
there in uh in the image of that new

222
00:10:01,250 --> 00:09:59,100
kind of celestial body we knew was there

223
00:10:02,870 --> 00:10:01,260
but now we've uh have it on the camera

224
00:10:04,610 --> 00:10:02,880
it's just uh just a step in that

225
00:10:06,350 --> 00:10:04,620
direction I'm very optimistic that's

226
00:10:08,150 --> 00:10:06,360
awesome what the team has planned for

227
00:10:10,430 --> 00:10:08,160
months years ago is coming to fruition

228
00:10:12,590 --> 00:10:10,440
and we're watching it live absolutely

229
00:10:14,630 --> 00:10:12,600
just exciting awesome thank you Thomas

230
00:10:16,670 --> 00:10:14,640
Bobby you've been through so many White

231
00:10:18,889 --> 00:10:16,680
Knuckle experiences

232
00:10:20,269 --> 00:10:18,899
um with space missions most recently

233
00:10:23,509 --> 00:10:20,279
with the landing of the Mars

234
00:10:26,030 --> 00:10:23,519
perseverance Rover just last year

235
00:10:28,130 --> 00:10:26,040
um what is the mindset of the team

236
00:10:30,470 --> 00:10:28,140
coming to such a major moment in their

237
00:10:32,870 --> 00:10:30,480
career with the stakes being so high

238
00:10:35,150 --> 00:10:32,880

well teams like this prepare for the

239
00:10:36,350 --> 00:10:35,160
worst but celebrate the best and I think

240
00:10:38,750 --> 00:10:36,360
we're going to have one of those best

241
00:10:40,130 --> 00:10:38,760
nights tonight there are of course many

242
00:10:42,290 --> 00:10:40,140
things that could go wrong in space

243
00:10:44,030 --> 00:10:42,300
flight but so far this team's been on

244
00:10:45,590 --> 00:10:44,040
top of every possible problem they've

245
00:10:48,170 --> 00:10:45,600
been ahead of it and they just need to

246
00:10:49,910 --> 00:10:48,180
focus and and push through and go for

247
00:10:51,410 --> 00:10:49,920
success that's awesome I think from what

248
00:10:53,210 --> 00:10:51,420
we're hearing the cheers coming out of

249
00:10:54,769 --> 00:10:53,220
the mock on the for this broadcast I

250
00:10:58,730 --> 00:10:54,779
feel like we're on the right track oh

251
00:11:00,290 --> 00:10:58,740
yeah absolutely any pep talk or advice

252
00:11:01,970 --> 00:11:00,300
for the team heading into tonight that

253
00:11:03,470 --> 00:11:01,980
you gave them well I've been in the mock

254
00:11:05,990 --> 00:11:03,480
several times today talking with the

255
00:11:08,329 --> 00:11:06,000
team they're calm they're cool they're

256
00:11:10,250 --> 00:11:08,339
collected I basically told them just

257
00:11:12,230 --> 00:11:10,260
follow the Data Trust in each other

258
00:11:14,810 --> 00:11:12,240
trust in themselves you know they've

259
00:11:16,310 --> 00:11:14,820
prepared for this moment for years and

260
00:11:18,110 --> 00:11:16,320
so they know this better than anybody

261
00:11:20,030 --> 00:11:18,120
and as a team they're going to get

262
00:11:21,889 --> 00:11:20,040
through this successfully so awesome

263
00:11:24,590 --> 00:11:21,899

thank you both that's great words of

264
00:11:26,449 --> 00:11:24,600
wisdom for moving forward in space and

265
00:11:27,590 --> 00:11:26,459
seems like the team is in good hands

266
00:11:29,210 --> 00:11:27,600
with themselves

267
00:11:30,889 --> 00:11:29,220
all right Tahira we're attempting the

268
00:11:33,170 --> 00:11:30,899
once Unthinkable but the team has

269
00:11:34,790 --> 00:11:33,180
prepared for this moment now to keep a

270
00:11:38,449 --> 00:11:34,800
steady course on this last mission

271
00:11:40,790 --> 00:11:38,459
defining leg back to you

272
00:11:43,009 --> 00:11:40,800
all right thanks Samson I mean it is

273
00:11:45,769 --> 00:11:43,019
incredible what the teams are pulling

274
00:11:48,769 --> 00:11:45,779
off tonight this is a first of its kind

275
00:11:51,530 --> 00:11:48,779
Mission testing a way to one day save

276
00:11:53,389 --> 00:11:51,540
our planet from a hazardous asteroid now

277
00:11:55,310 --> 00:11:53,399
we asked astronauts aboard the

278
00:11:57,949 --> 00:11:55,320
International Space Station to show us

279
00:12:00,949 --> 00:11:57,959
how this technique Works in microgravity

280
00:12:03,350 --> 00:12:00,959
and they had some fun with it now before

281
00:12:05,329 --> 00:12:03,360
we get to the video I urge you to keep a

282
00:12:07,130 --> 00:12:05,339
close eye on Shane he's going to be in

283
00:12:10,069 --> 00:12:07,140
the blue shirt and standing in for

284
00:12:12,230 --> 00:12:10,079
asteroid dimorphos a white object is

285
00:12:14,509 --> 00:12:12,240
about to come crashing into him that's

286
00:12:17,210 --> 00:12:14,519
our spacecraft you'll notice how the

287
00:12:20,090 --> 00:12:17,220
impact of the crash moves Shane's

288
00:12:22,310 --> 00:12:20,100

position in space this demo much like

289
00:12:25,009 --> 00:12:22,320
dart's test relies on the energy

290
00:12:27,650 --> 00:12:25,019
transfer from a collision to change the

291
00:12:30,230 --> 00:12:27,660
motion of an object the method which is

292
00:12:33,110 --> 00:12:30,240
called kinetics impact deflection is the

293
00:12:36,050 --> 00:12:33,120
technique Dart will test at 7 14 PM

294
00:12:38,740 --> 00:12:36,060
Eastern let's take a look

295
00:12:42,430 --> 00:12:38,750
foreign

296
00:12:47,210 --> 00:12:44,690
and I'm going to be the NASA dark

297
00:12:49,550 --> 00:12:47,220
Mission while this CTV more exactly is

298
00:12:51,590 --> 00:12:49,560
going to be a spacecraft I'm going to

299
00:12:54,350 --> 00:12:51,600
try to throw it and we look at the

300
00:12:57,889 --> 00:12:54,360
effect of that mask coming at him and

301
00:13:00,410 --> 00:12:57,899
the kinetic energy transfer from the CTB

302
00:13:02,590 --> 00:13:00,420
to Shane to Shane will be perfectly

303
00:13:05,750 --> 00:13:02,600
stable

304
00:13:08,140 --> 00:13:05,760
it's not an easy test you ready

305
00:13:17,090 --> 00:13:08,150
all right here it comes

306
00:13:25,009 --> 00:13:21,069
I've redirected Shane successfully

307
00:13:30,290 --> 00:13:28,190
all right now back on Earth we're taking

308
00:13:32,650 --> 00:13:30,300
your questions live in just a few

309
00:13:35,930 --> 00:13:32,660
minutes send them in using the hashtag

310
00:13:38,329 --> 00:13:35,940
planetarydefender and stand by it's time

311
00:13:40,550 --> 00:13:38,339
now for our first status poll update

312
00:13:42,889 --> 00:13:40,560
let's head to Samson to check in on

313
00:13:44,210 --> 00:13:42,899

dart's progress Samson how are we

314
00:13:46,370 --> 00:13:44,220
looking

315
00:13:48,530 --> 00:13:46,380
hey it's a hero we are entering the

316
00:13:50,569 --> 00:13:48,540
60-minute mark until impact and as you

317
00:13:52,129 --> 00:13:50,579
noted the team is about to conduct a

318
00:13:54,290 --> 00:13:52,139
poll which is essentially a status

319
00:13:56,569 --> 00:13:54,300
update to check that key systems are in

320
00:13:58,370 --> 00:13:56,579
working order we're talking Draco image

321
00:14:00,350 --> 00:13:58,380
quality smart nav guidance and

322
00:14:02,629 --> 00:14:00,360
navigation ground systems performance

323
00:14:05,150 --> 00:14:02,639
everything that's anything to do with

324
00:14:07,550 --> 00:14:05,160
getting us to impact

325
00:14:37,069 --> 00:14:07,560
all right I think the poll is about to

326
00:15:05,990 --> 00:14:40,430
we are waiting for that poll to begin

327
00:15:11,689 --> 00:15:09,230
waiting on that first poll of the

328
00:15:13,730 --> 00:15:11,699
evening there will be two polls when

329
00:15:29,269 --> 00:15:13,740
it's 60 minutes which is now and one at

330
00:15:34,910 --> 00:15:31,009
afterward we should be hearing from

331
00:15:37,009 --> 00:15:34,920
Elena Adams the mission systems engineer

332
00:15:49,370 --> 00:15:37,019
to give us a summary of what we'll have

333
00:15:55,070 --> 00:15:52,370
all right folks we're an hour prior to

334
00:16:01,069 --> 00:15:58,370
[Applause]

335
00:16:04,129 --> 00:16:01,079
we're seeing dimorphous so wonderful

336
00:16:05,090 --> 00:16:04,139
wonderful all right let's do our poll

337
00:16:07,970 --> 00:16:05,100
um

338
00:16:11,090 --> 00:16:07,980

image quality let's start with you

339
00:16:13,850 --> 00:16:11,100
images are looking great uh tamorphos is

340
00:16:16,370 --> 00:16:13,860
coming in at about the same relative

341
00:16:18,710 --> 00:16:16,380
dimness as didamouse

342
00:16:20,030 --> 00:16:18,720
so very consistent brightness between

343
00:16:22,790 --> 00:16:20,040
the two

344
00:16:24,000 --> 00:16:22,800
and it's a stable track

345
00:16:29,689 --> 00:16:24,010
that's awesome

346
00:16:32,389 --> 00:16:29,699
[Applause]

347
00:16:34,189 --> 00:16:32,399
all right uh smart nav

348
00:16:37,310 --> 00:16:34,199
smart nav is looking good we're sitting

349
00:16:39,889 --> 00:16:37,320
at about 30 meters of uh projected Miss

350
00:16:41,870 --> 00:16:39,899
distance there is no movement right now

351
00:16:44,629 --> 00:16:41,880
on the bars for doing a maneuver but we

352
00:16:46,069 --> 00:16:44,639
do expect that when we transition uh in

353
00:16:47,569 --> 00:16:46,079
about 10 minutes that we'll see a

354
00:16:49,249 --> 00:16:47,579
maneuver at that point

355
00:16:50,990 --> 00:16:49,259
yeah that's great and at this point

356
00:16:53,749 --> 00:16:51,000
because we have a stable track we do

357
00:16:56,110 --> 00:16:53,759
expect to transition over at that time

358
00:17:01,129 --> 00:16:56,120
so that's really good

359
00:17:07,370 --> 00:17:04,150
GNC is nominal we're we're ready to burn

360
00:17:12,829 --> 00:17:07,380
[Laughter]

361
00:17:19,010 --> 00:17:16,850
all right um let's see autonomy

362
00:17:20,990 --> 00:17:19,020
autonomy is nominal here's our cycling

363
00:17:23,169 --> 00:17:21,000

and no more fault rules

364
00:17:25,549 --> 00:17:23,179
all right DSN

365
00:17:28,610 --> 00:17:25,559
looks good and we don't see any sign of

366
00:17:31,310 --> 00:17:28,620
rain and Esa looks good as well

367
00:17:34,909 --> 00:17:31,320
that's good and then ground system

368
00:17:37,310 --> 00:17:34,919
ground system is nominal and we have a

369
00:17:38,630 --> 00:17:37,320
clear vision of dimorphous on the image

370
00:17:42,289 --> 00:17:38,640
display now

371
00:17:43,549 --> 00:17:42,299
yes it looks great thank you guys

372
00:17:46,190 --> 00:17:43,559
all right

373
00:17:47,930 --> 00:17:46,200
um one more poll after this but in the

374
00:17:50,990 --> 00:17:47,940
meantime we're going to hopefully

375
00:17:57,110 --> 00:17:51,000
transition at 50 minutes to locking so

376
00:18:02,150 --> 00:17:58,730
all right we're going to hear from Lena

377
00:18:04,190 --> 00:18:02,160
ourselves to give us a update

378
00:18:06,169 --> 00:18:04,200
hey Elena

379
00:18:08,450 --> 00:18:06,179
how's it going

380
00:18:10,970 --> 00:18:08,460
how are you good that sounded like a

381
00:18:14,690 --> 00:18:10,980
great poll any words about what we just

382
00:18:16,669 --> 00:18:14,700
heard oh um we're very excited uh we are

383
00:18:19,970 --> 00:18:16,679
starting to see dimorphous for the first

384
00:18:22,190 --> 00:18:19,980
time it is uh looking great

385
00:18:26,510 --> 00:18:22,200
um it is um just about the same dimness

386
00:18:28,130 --> 00:18:26,520
as didimos as we expected and so we are

387
00:18:30,770 --> 00:18:28,140
getting ready to transition we have a

388
00:18:34,850 --> 00:18:30,780

stable track at this point it's about

389
00:18:36,470 --> 00:18:34,860
um seven pixels in size and uh yeah

390
00:18:38,630 --> 00:18:36,480
we're ready to go

391
00:18:42,049 --> 00:18:38,640
great news Elena thanks so much I'll let

392
00:18:47,450 --> 00:18:45,289
wow that that was

393
00:18:49,490 --> 00:18:47,460
that's a great update joining me in

394
00:18:51,830 --> 00:18:49,500
reacting to that bit of news is Angela

395
00:18:53,810 --> 00:18:51,840
stickle planetary geologist and a dart

396
00:18:57,409 --> 00:18:53,820
investigation team lead

397
00:19:01,250 --> 00:18:59,390
they're going really well what are you

398
00:19:03,529 --> 00:19:01,260
feeling what are you thinking I'm so

399
00:19:05,029 --> 00:19:03,539
excited this is fantastic we can see

400
00:19:06,830 --> 00:19:05,039
dimorphos and

401
00:19:08,930 --> 00:19:06,840
we're on our way

402
00:19:11,450 --> 00:19:08,940
okay second we just gotta keep humming

403
00:19:13,789 --> 00:19:11,460
along right right that's awesome heading

404
00:19:16,010 --> 00:19:13,799
in gosh well let's quickly talk about

405
00:19:18,350 --> 00:19:16,020
the next major Milestone that's ahead of

406
00:19:20,750 --> 00:19:18,360
us Walking On Target with dimorphos

407
00:19:22,789 --> 00:19:20,760
which could happen as early as 10 or so

408
00:19:25,190 --> 00:19:22,799
minutes from now right now smart nav is

409
00:19:27,289 --> 00:19:25,200
still targeting dynamos right but

410
00:19:29,390 --> 00:19:27,299
locking onto dimorphous means all right

411
00:19:30,950 --> 00:19:29,400
dimorphous you are bright you are

412
00:19:33,770 --> 00:19:30,960
consistently bright enough and ready to

413
00:19:35,870 --> 00:19:33,780

start targeting you dive into what that

414
00:19:38,690 --> 00:19:35,880
means a little bit more yeah exactly so

415
00:19:40,669 --> 00:19:38,700
smart nav is looking for bright parts of

416
00:19:43,029 --> 00:19:40,679
the image and so as dimorphous gets

417
00:19:45,770 --> 00:19:43,039
closer and it's brighter and bigger

418
00:19:47,210 --> 00:19:45,780
smartnav will just Target onto it as

419
00:19:48,230 --> 00:19:47,220
opposed to dynamos and we'll be on our

420
00:19:51,230 --> 00:19:48,240
way

421
00:19:53,270 --> 00:19:51,240
um to impact that is awesome

422
00:19:54,590 --> 00:19:53,280
thank you Angela has very cool stuff

423
00:19:56,450 --> 00:19:54,600
good luck with the rest of the evening

424
00:19:58,549 --> 00:19:56,460
thank you great

425
00:20:00,230 --> 00:19:58,559
and while we wait we want to invite you

426
00:20:02,570 --> 00:20:00,240
to celebrate the life of an important

427
00:20:04,310 --> 00:20:02,580
member of our dart team pulling off

428
00:20:07,010 --> 00:20:04,320
extraordinary events requires

429
00:20:09,770 --> 00:20:07,020
extraordinary people and Ray Harvey was

430
00:20:12,110 --> 00:20:09,780
just that a leader an engineer a friend

431
00:20:14,630 --> 00:20:12,120
Ray devoted his life to making the

432
00:20:16,010 --> 00:20:14,640
impossible possible tonight we pay

433
00:20:19,150 --> 00:20:16,020
tribute to dart's former Mission

434
00:20:21,770 --> 00:20:19,160
operations manager

435
00:20:24,110 --> 00:20:21,780
Ray Harvey was our mission operations

436
00:20:25,549 --> 00:20:24,120
manager for Dart but I've known Rave

437
00:20:28,010 --> 00:20:25,559
since I've been at the lab which is

438
00:20:29,990 --> 00:20:28,020

about 14 years as a young engineer

439
00:20:31,789 --> 00:20:30,000
having people like Ray was actually

440
00:20:34,250 --> 00:20:31,799
extremely important because he could go

441
00:20:35,930 --> 00:20:34,260
ask for a question he would tell you a

442
00:20:38,210 --> 00:20:35,940
joke but he would also give you an

443
00:20:39,890 --> 00:20:38,220
answer so you didn't feel awkward asking

444
00:20:42,169 --> 00:20:39,900
questions you would just feel good

445
00:20:44,930 --> 00:20:42,179
coming out with more knowledge but also

446
00:20:47,510 --> 00:20:44,940
you had fun in the process

447
00:20:49,970 --> 00:20:47,520
I've known Ray probably since I started

448
00:20:52,669 --> 00:20:49,980
working here almost 25 years ago and he

449
00:20:54,049 --> 00:20:52,679
was always like a good Mentor and a

450
00:20:55,730 --> 00:20:54,059
sounding board for anything we were

451
00:20:58,010 --> 00:20:55,740
doing I think everybody learned

452
00:21:00,529 --> 00:20:58,020
something from Rey his leadership skills

453
00:21:01,970 --> 00:21:00,539
how to treat people how to work as a

454
00:21:04,909 --> 00:21:01,980
team

455
00:21:07,190 --> 00:21:04,919
Ray was a pretty amazing person even

456
00:21:08,570 --> 00:21:07,200
though he was fighting this terrible

457
00:21:12,710 --> 00:21:08,580
disease

458
00:21:15,409 --> 00:21:12,720
he made it a point to be involved in all

459
00:21:18,350 --> 00:21:15,419
the rehearsals and all the activities

460
00:21:21,529 --> 00:21:18,360
going on on Dart he led the mission

461
00:21:22,750 --> 00:21:21,539
operations team to the last few days of

462
00:21:25,730 --> 00:21:22,760
his life

463
00:21:27,590 --> 00:21:25,740

he was really hoping to make it to the

464
00:21:29,090 --> 00:21:27,600
end of this Mission he meant so much to

465
00:21:30,470 --> 00:21:29,100
this team and to getting us to this

466
00:21:33,409 --> 00:21:30,480
point

467
00:21:36,350 --> 00:21:33,419
it represents so many years of hard work

468
00:21:39,710 --> 00:21:36,360
of him and also the team but him leading

469
00:21:41,870 --> 00:21:39,720
that team and so the dart spacecraft is

470
00:21:44,870 --> 00:21:41,880
a tribute to Rey

471
00:21:46,730 --> 00:21:44,880
we are hoping that this experience it

472
00:21:47,690 --> 00:21:46,740
kind of goes out to write and to his

473
00:21:50,510 --> 00:21:47,700
family

474
00:21:59,710 --> 00:21:50,520
we will we will really miss him and we

475
00:22:05,570 --> 00:22:03,230
Ray has touched so many lives even in

476
00:22:07,370 --> 00:22:05,580
the short time that I knew him he was so

477
00:22:10,190 --> 00:22:07,380
generous with his knowledge and he made

478
00:22:12,409 --> 00:22:10,200
you feel like you belonged Ray you will

479
00:22:14,810 --> 00:22:12,419
be greatly missed this one's for you

480
00:22:16,789 --> 00:22:14,820
Tahira

481
00:22:19,490 --> 00:22:16,799
thank you Samson for that beautiful

482
00:22:21,830 --> 00:22:19,500
dedication now if you're just joining us

483
00:22:24,169 --> 00:22:21,840
we're under an hour away from the dart

484
00:22:27,110 --> 00:22:24,179
spacecraft's head-on collision with

485
00:22:29,090 --> 00:22:27,120
asteroid dimorphos dart's mission is a

486
00:22:32,090 --> 00:22:29,100
test of a planetary defense technique

487
00:22:35,149 --> 00:22:32,100
that could one day save Humanity rest

488
00:22:37,970 --> 00:22:35,159

assured the test poses no threat to

489
00:22:40,250 --> 00:22:37,980
Earth the spacecraft is almost 7 million

490
00:22:42,529 --> 00:22:40,260
miles away from us right now and you're

491
00:22:45,289 --> 00:22:42,539
watching a live stream of its approach

492
00:22:47,210 --> 00:22:45,299
to dimorphos it takes about 45 seconds

493
00:22:50,270 --> 00:22:47,220
for the images you're seeing in the dark

494
00:22:52,549 --> 00:22:50,280
cam to make their way back to Earth any

495
00:22:55,130 --> 00:22:52,559
moment now we should learn if Dart is

496
00:22:57,470 --> 00:22:55,140
ready to commit to impact while we wait

497
00:23:00,169 --> 00:22:57,480
I'm here with Andy Rifkin Dart science

498
00:23:04,010 --> 00:23:00,179
investigation lead and Mallory decoster

499
00:23:05,870 --> 00:23:04,020
Dart impact modeler Andy Mallory while

500
00:23:08,029 --> 00:23:05,880
we wait to learn if Dart is ready to

501
00:23:11,090 --> 00:23:08,039
commit to dimorphos I can't help but

502
00:23:13,190 --> 00:23:11,100
wonder why this asteroid that's a great

503
00:23:15,590 --> 00:23:13,200
question the way that the double

504
00:23:18,350 --> 00:23:15,600
asteroid redirection test was designed

505
00:23:21,110 --> 00:23:18,360
it was uh to to measure the period

506
00:23:22,370 --> 00:23:21,120
change in a binary asteroid system so we

507
00:23:24,169 --> 00:23:22,380
needed a binary asteroid so that

508
00:23:25,850 --> 00:23:24,179
eliminates some number of objects we

509
00:23:28,549 --> 00:23:25,860
needed something uh with a moon that was

510
00:23:32,330 --> 00:23:28,559
small enough that we could move it with

511
00:23:34,549 --> 00:23:32,340
a strike from a from a spacecraft

512
00:23:36,710 --> 00:23:34,559
um but not so small that we wrecked the

513
00:23:38,870 --> 00:23:36,720

uh the moon so when you kind of tick off

514
00:23:40,789 --> 00:23:38,880
all the possibilities dynamos really

515
00:23:42,830 --> 00:23:40,799
ended up as the best choice and really

516
00:23:44,930 --> 00:23:42,840
the only choice that would provide a

517
00:23:46,730 --> 00:23:44,940
mission in this time period

518
00:23:48,770 --> 00:23:46,740
see I want to go back to that you

519
00:23:51,590 --> 00:23:48,780
mentioned having a moon that we could

520
00:23:53,870 --> 00:23:51,600
push but not destroy could you now in

521
00:23:56,330 --> 00:23:53,880
pop culture a lot we see that you know

522
00:23:59,029 --> 00:23:56,340
oftentimes the idea is to just totally

523
00:24:01,610 --> 00:23:59,039
try to demolish the asteroid why have we

524
00:24:03,830 --> 00:24:01,620
chosen to not test that technique this

525
00:24:06,169 --> 00:24:03,840
time yeah the conventional wisdom for

526
00:24:09,169 --> 00:24:06,179
planetary defense is that you don't want

527
00:24:10,730 --> 00:24:09,179
to disrupt an object and blow it into a

528
00:24:12,470 --> 00:24:10,740
zillion pieces but you want to keep it

529
00:24:14,029 --> 00:24:12,480
intact and just move it all as one piece

530
00:24:15,890 --> 00:24:14,039
because if you move it all in one piece

531
00:24:17,630 --> 00:24:15,900
then you can keep track of it a lot

532
00:24:18,950 --> 00:24:17,640
easier if you blow it into a million

533
00:24:20,690 --> 00:24:18,960
pieces then some of them might still

534
00:24:23,270 --> 00:24:20,700
Earth and you don't want to miss a thing

535
00:24:25,549 --> 00:24:23,280
yeah we might have more issues then so

536
00:24:27,890 --> 00:24:25,559
we know that we have the perfect test

537
00:24:31,070 --> 00:24:27,900
subject Mallory now can you help us

538
00:24:33,049 --> 00:24:31,080

understand how if Mission success

539
00:24:35,750 --> 00:24:33,059
um dart's mission tonight can help

540
00:24:37,909 --> 00:24:35,760
improve models for mitigating hazardous

541
00:24:40,549 --> 00:24:37,919
asteroids in the future that's exactly

542
00:24:43,370 --> 00:24:40,559
right so we stand to learn a lot from

543
00:24:45,770 --> 00:24:43,380
this dark impact Dart is both a

544
00:24:48,470 --> 00:24:45,780
technology demonstration as well as a

545
00:24:50,570 --> 00:24:48,480
really big science experiment so from a

546
00:24:53,149 --> 00:24:50,580
technology standpoint we're going to see

547
00:24:56,510 --> 00:24:53,159
if we have what it takes to autonomously

548
00:24:58,669 --> 00:24:56,520
navigate a spacecraft into a relatively

549
00:25:02,210 --> 00:24:58,679
small Celestial body something the size

550
00:25:04,850 --> 00:25:02,220
of a football stadium that's pretty far

551
00:25:08,029 --> 00:25:04,860
away from Earth from a science

552
00:25:10,549 --> 00:25:08,039
perspective we get to perform one of the

553
00:25:13,310 --> 00:25:10,559
largest and fastest impact experiments

554
00:25:14,750 --> 00:25:13,320
that man has done ever something that

555
00:25:17,149 --> 00:25:14,760
could never be accomplished in a

556
00:25:20,149 --> 00:25:17,159
laboratory here on Earth so we're going

557
00:25:22,730 --> 00:25:20,159
to learn how these large sizes these

558
00:25:24,950 --> 00:25:22,740
fast impact velocities and also these

559
00:25:28,190 --> 00:25:24,960
sort of extraterrestrial asteroid

560
00:25:30,110 --> 00:25:28,200
materials respond to deflection wow I

561
00:25:31,430 --> 00:25:30,120
mean there's so much about tonight that

562
00:25:33,890 --> 00:25:31,440
we don't know and it seems like you're

563
00:25:37,130 --> 00:25:33,900

fun is just getting started right until

564
00:25:39,830 --> 00:25:37,140
after impact so Mallory Andy thank you

565
00:25:41,990 --> 00:25:39,840
so much and tonight ground-based

566
00:25:44,450 --> 00:25:42,000
telescopes aren't the only one watching

567
00:25:46,490 --> 00:25:44,460
the action a small cube satellite built

568
00:25:49,130 --> 00:25:46,500
by the attack Italian space agency was

569
00:25:51,169 --> 00:25:49,140
deployed by Dart 15 days ago and has

570
00:25:53,990 --> 00:25:51,179
been in the area to give us a bird's eye

571
00:25:55,370 --> 00:25:54,000
view of impact here's more on lychia

572
00:25:57,649 --> 00:25:55,380
Cube

573
00:25:59,930 --> 00:25:57,659
is a six year cubesat of the Italian

574
00:26:02,390 --> 00:25:59,940
space agency participating in the dark

575
00:26:05,510 --> 00:26:02,400
Mission and it's also the first Italian

576
00:26:07,850 --> 00:26:05,520
satellite operating in deep space it is

577
00:26:10,130 --> 00:26:07,860
mission objectives is to support the

578
00:26:12,890 --> 00:26:10,140
dart in the documentation of the impact

579
00:26:14,810 --> 00:26:12,900
effects in particular in terms of the

580
00:26:17,390 --> 00:26:14,820
objective of materials that will be

581
00:26:19,970 --> 00:26:17,400
released from the asteroid Surface after

582
00:26:22,490 --> 00:26:19,980
the impact and also Imaging the

583
00:26:26,149 --> 00:26:22,500
non-visible side of the asteroid during

584
00:26:30,970 --> 00:26:26,159
its flyby Bishop will acquire images

585
00:26:36,590 --> 00:26:34,070
RGB camera therefore we can better

586
00:26:39,529 --> 00:26:36,600
understand the nature of the asteroid

587
00:26:42,830 --> 00:26:39,539
dimorphous impacted by dark by means of

588
00:26:46,070 --> 00:26:42,840

our scientific Operation Center in ssdc

589
00:26:49,490 --> 00:26:46,080
RC we will distribute and process the

590
00:26:52,310 --> 00:26:49,500
images in order to make the them

591
00:26:54,350 --> 00:26:52,320
available to the entire team we are here

592
00:26:56,450 --> 00:26:54,360
in agrotech's Mission Control Center in

593
00:26:58,490 --> 00:26:56,460
Turin from where together with us he

594
00:27:00,710 --> 00:26:58,500
will monitor the status of leisure Cube

595
00:27:01,970 --> 00:27:00,720
the batteries of charge radio is

596
00:27:03,409 --> 00:27:01,980
communicating correctly and the

597
00:27:05,570 --> 00:27:03,419
navigation aptitude is on the right

598
00:27:07,430 --> 00:27:05,580
trajectory everything is ready for the

599
00:27:12,230 --> 00:27:07,440
most important part of the dark Mission

600
00:27:17,630 --> 00:27:14,630
Dart is a global effort to prepare

601
00:27:19,909 --> 00:27:17,640
Humanity for the unthinkable before the

602
00:27:21,950 --> 00:27:19,919
spacecraft can complete its Mission the

603
00:27:24,950 --> 00:27:21,960
autonomous navigation system must first

604
00:27:26,690 --> 00:27:24,960
confirm a lock on Target this is a key

605
00:27:29,029 --> 00:27:26,700
Milestone that we should be hearing

606
00:27:32,930 --> 00:27:29,039
about soon so let's go back to Samson

607
00:27:39,590 --> 00:27:35,510
hey Tahira we are less than 50 minutes

608
00:27:42,409 --> 00:27:39,600
out and we just heard big news we have

609
00:27:45,710 --> 00:27:42,419
reached the point where smartnav is now

610
00:27:47,390 --> 00:27:45,720
Target locked onto dimorphos uh that

611
00:27:51,169 --> 00:27:47,400
progress bar should move to your right

612
00:27:53,450 --> 00:27:51,179
that much further closer to impact very

613
00:27:55,070 --> 00:27:53,460

exciting uh in the meantime joining me

614
00:27:57,470 --> 00:27:55,080
is someone who worked on the instrument

615
00:27:59,690 --> 00:27:57,480
playing a starring role with this major

616
00:28:02,090 --> 00:27:59,700
Milestone and basically all the way up

617
00:28:04,130 --> 00:28:02,100
to impact Lisa Wu mechanical engineer

618
00:28:06,289 --> 00:28:04,140
who helped install the Draco camera and

619
00:28:08,810 --> 00:28:06,299
built its cover Lisa thank you for

620
00:28:11,510 --> 00:28:08,820
joining me thank you for having me so we

621
00:28:13,909 --> 00:28:11,520
just heard big news we hit this target

622
00:28:16,970 --> 00:28:13,919
lock it could have come fairly later

623
00:28:18,830 --> 00:28:16,980
than this yeah it is very it is we are

624
00:28:21,470 --> 00:28:18,840
we're in a good spot exactly how are you

625
00:28:24,289 --> 00:28:21,480
feeling I am so excited I'm sure the

626
00:28:26,630 --> 00:28:24,299
entire team is ecstatic this is what

627
00:28:28,669 --> 00:28:26,640
we've been working so hard for in these

628
00:28:31,310 --> 00:28:28,679
very last moments and we just heard we

629
00:28:34,610 --> 00:28:31,320
got Target lock so could not be feeling

630
00:28:37,130 --> 00:28:34,620
any better very exciting I mean we are

631
00:28:38,690 --> 00:28:37,140
we are humming along so a quick recap

632
00:28:40,490 --> 00:28:38,700
smart and have this darts autonomous

633
00:28:42,590 --> 00:28:40,500
navigation system it's been called the

634
00:28:44,029 --> 00:28:42,600
brains of the spacecraft and right now

635
00:28:46,250 --> 00:28:44,039
it's essentially maneuvering that

636
00:28:49,789 --> 00:28:46,260
spacecraft on its own as it will be for

637
00:28:51,049 --> 00:28:49,799
the last four hours a draco imager is

638
00:28:53,690 --> 00:28:51,059

providing smartness with that

639
00:28:55,970 --> 00:28:53,700
unflinching view of the morphos about an

640
00:28:58,130 --> 00:28:55,980
image per second it is the eyes of the

641
00:29:00,769 --> 00:28:58,140
spacecraft based on what makes this

642
00:29:03,529 --> 00:29:00,779
camera perfect for this Mission yeah of

643
00:29:06,110 --> 00:29:03,539
course so the Draco instrument is a very

644
00:29:08,149 --> 00:29:06,120
very high resolution narrow field of

645
00:29:11,630 --> 00:29:08,159
view telescope

646
00:29:14,029 --> 00:29:11,640
um the image quality let's go back at

647
00:29:15,710 --> 00:29:14,039
Draco is a descendant of the Lorry color

648
00:29:18,830 --> 00:29:15,720
self which might sound familiar because

649
00:29:21,169 --> 00:29:18,840
it took the very first pictures of Pluto

650
00:29:22,789 --> 00:29:21,179
on the New Horizons Mission which also

651
00:29:25,370 --> 00:29:22,799
might sound very familiar because that

652
00:29:27,950 --> 00:29:25,380
is an APL LED Mission so if you've ever

653
00:29:31,070 --> 00:29:27,960
seen the first pictures of Pluto that is

654
00:29:33,049 --> 00:29:31,080
the amazing quality that we have on Dart

655
00:29:34,909 --> 00:29:33,059
that's incredible Heritage and yeah

656
00:29:37,010 --> 00:29:34,919
anyone who saw those images of Pluto

657
00:29:38,389 --> 00:29:37,020
those were made amazing and they're kind

658
00:29:39,769 --> 00:29:38,399
of upstanding for what we're going to

659
00:29:40,970 --> 00:29:39,779
see with these pictures of the muscles

660
00:29:43,549 --> 00:29:40,980
right oh yeah

661
00:29:45,710 --> 00:29:43,559
so we all know about a lot of us have

662
00:29:48,110 --> 00:29:45,720
smartphones with you know cameras we

663
00:29:49,669 --> 00:29:48,120

have practice smudges how do your team

664
00:29:51,289 --> 00:29:49,679
make sure that this camera made it in

665
00:29:54,789 --> 00:29:51,299
pristine condition to get to this point

666
00:29:57,710 --> 00:29:54,799
of course so our flight Hardware

667
00:30:00,350 --> 00:29:57,720
including this instrument was made in

668
00:30:03,649 --> 00:30:00,360
the clean room very very high clean

669
00:30:05,630 --> 00:30:03,659
facility in order to make sure that the

670
00:30:07,610 --> 00:30:05,640
telescope works we had to put it through

671
00:30:10,490 --> 00:30:07,620
a lot of electrical testing Optical

672
00:30:13,070 --> 00:30:10,500
testing alignment testing we have to

673
00:30:14,990 --> 00:30:13,080
make sure it performs as we intended and

674
00:30:17,330 --> 00:30:15,000
then not only that you have to take this

675
00:30:18,950 --> 00:30:17,340
instrument and put it through all the

676
00:30:20,630 --> 00:30:18,960
environments that it will see through

677
00:30:23,149 --> 00:30:20,640
space so we put it through vibration

678
00:30:26,149 --> 00:30:23,159
testing thermal vacuum chamber testing

679
00:30:27,889 --> 00:30:26,159
all to make sure that it performs and it

680
00:30:31,130 --> 00:30:27,899
will survive through space

681
00:30:33,049 --> 00:30:31,140
amazing test test and test again right

682
00:30:35,330 --> 00:30:33,059
yes this is how we get to a stage like

683
00:30:37,970 --> 00:30:35,340
this that is exactly that is great

684
00:30:40,130 --> 00:30:37,980
thanks so much Lisa the number of

685
00:30:42,409 --> 00:30:40,140
astounding technologies that are on

686
00:30:44,510 --> 00:30:42,419
board this spacecraft is amazing but

687
00:30:47,029 --> 00:30:44,520
doing the impossible requires nothing

688
00:30:48,830 --> 00:30:47,039

less than the astounding right all right

689
00:30:50,810 --> 00:30:48,840
so here we have the technology clearly

690
00:30:53,570 --> 00:30:50,820
we have the talent now we wait for

691
00:30:55,909 --> 00:30:53,580
history back to you

692
00:30:58,010 --> 00:30:55,919
all right thanks Samson it feels good to

693
00:31:00,830 --> 00:30:58,020
know that we have locked on target

694
00:31:02,690 --> 00:31:00,840
dimorphos now earlier we asked you to

695
00:31:05,149 --> 00:31:02,700
send in your questions by using the

696
00:31:08,090 --> 00:31:05,159
hashtag planetarydefender and I am

697
00:31:11,210 --> 00:31:08,100
joined Now by two real life planetary

698
00:31:13,549 --> 00:31:11,220
Defenders we have Kelly fast and Lucas

699
00:31:15,830 --> 00:31:13,559
Paganini both from NASA's planetary

700
00:31:18,230 --> 00:31:15,840
defense coordination office let's dive

701
00:31:20,510 --> 00:31:18,240
into what you want to know so Kelly

702
00:31:22,490 --> 00:31:20,520
Lucas before I get to social media

703
00:31:25,070 --> 00:31:22,500
questions we actually have a special

704
00:31:27,409 --> 00:31:25,080
question from a familiar face especially

705
00:31:29,029 --> 00:31:27,419
if you're into football so let's take a

706
00:31:31,250 --> 00:31:29,039
moment and hear from him

707
00:31:32,870 --> 00:31:31,260
what's up I'm Joshua Dobbs quarterback

708
00:31:35,269 --> 00:31:32,880
for the Cleveland Browns now the

709
00:31:37,549 --> 00:31:35,279
question for NASA's dart team on the

710
00:31:38,810 --> 00:31:37,559
field I have to use Precision passing in

711
00:31:41,269 --> 00:31:38,820
order to get the football in the hands

712
00:31:44,029 --> 00:31:41,279
of my teammates and at least I can see

713
00:31:46,490 --> 00:31:44,039

where they are for NASA Star Team how

714
00:31:49,789 --> 00:31:46,500
are you able to aim a spacecraft at an

715
00:31:53,389 --> 00:31:51,529
but that's a really good question Kelly

716
00:31:57,350 --> 00:31:53,399
and I mean we haven't really done this

717
00:31:59,450 --> 00:31:57,360
before how can we aim right but I have

718
00:32:02,330 --> 00:31:59,460
to say Joshua does in a few seconds what

719
00:32:03,950 --> 00:32:02,340
we've taken you know years to do

720
00:32:06,110 --> 00:32:03,960
um just because he has to throw it where

721
00:32:07,430 --> 00:32:06,120
he knows that the player will be throw

722
00:32:09,950 --> 00:32:07,440
his football where the player will be

723
00:32:11,870 --> 00:32:09,960
Dart needs to end up where uh dynamos

724
00:32:14,149 --> 00:32:11,880
and dimorphos will be and so that that

725
00:32:15,830 --> 00:32:14,159
was learned from astronomy looking at

726
00:32:18,590 --> 00:32:15,840
through telescopes calculating the orbit

727
00:32:21,529 --> 00:32:18,600
and then the people who launched uh Dart

728
00:32:22,970 --> 00:32:21,539
his destination navigated there so it's

729
00:32:24,889 --> 00:32:22,980
there's just a lot more calculations

730
00:32:26,930 --> 00:32:24,899
involved which Joshua does in his head

731
00:32:28,789 --> 00:32:26,940
yeah and then there's this autonomous

732
00:32:31,130 --> 00:32:28,799
navigation it would be like he had a

733
00:32:34,070 --> 00:32:31,140
football that could navigate itself so

734
00:32:37,130 --> 00:32:34,080
so we we have that to lean on that that

735
00:32:39,529 --> 00:32:37,140
he doesn't and so that's what helps get

736
00:32:42,289 --> 00:32:39,539
to that destination all right nice I

737
00:32:44,690 --> 00:32:42,299
mean it's very impressive and so we have

738
00:32:47,750 --> 00:32:44,700

another question from it from Jonathan

739
00:32:49,669 --> 00:32:47,760
on Facebook who wants to know how can a

740
00:32:52,549 --> 00:32:49,679
small satellite like Dart be able to

741
00:32:55,190 --> 00:32:52,559
impact something as big and heavy as an

742
00:32:57,230 --> 00:32:55,200
asteroid and actually move it right and

743
00:33:01,190 --> 00:32:57,240
it's all about momentum right we have

744
00:33:04,130 --> 00:33:01,200
these tiny uh well asteroid of about 160

745
00:33:05,990 --> 00:33:04,140
meters the size of a football field and

746
00:33:08,630 --> 00:33:06,000
then you have this spacecraft which is

747
00:33:11,690 --> 00:33:08,640
about 500 Kilograms so it's all about

748
00:33:14,990 --> 00:33:11,700
momentum right we have this massive

749
00:33:17,509 --> 00:33:15,000
Astrid and this tiny spacecraft and how

750
00:33:19,730 --> 00:33:17,519
do you move it it's all about mass and

751
00:33:22,009 --> 00:33:19,740
velocity since we don't have enough mass

752
00:33:23,810 --> 00:33:22,019
in that spacecraft we have to really

753
00:33:26,090 --> 00:33:23,820
impact it hard and that's why we're

754
00:33:28,909 --> 00:33:26,100
impacting it at four miles a second

755
00:33:31,130 --> 00:33:28,919
which is outstanding which is amazing

756
00:33:34,610 --> 00:33:31,140
and I mean we're actually gonna get to

757
00:33:36,590 --> 00:33:34,620
watch impact live take place and so that

758
00:33:40,070 --> 00:33:36,600
gets me to my next question we have

759
00:33:42,110 --> 00:33:40,080
metal money on Twitter who asks what is

760
00:33:43,730 --> 00:33:42,120
the size of the blast on the asteroid

761
00:33:45,710 --> 00:33:43,740
Kelly could you explain a little bit

762
00:33:47,690 --> 00:33:45,720
about that well and that's something

763
00:33:49,250 --> 00:33:47,700

that we're hoping to find out from this

764
00:33:51,950 --> 00:33:49,260
Mission because you know there's there's

765
00:33:53,149 --> 00:33:51,960
physics but and calculations but

766
00:33:54,769 --> 00:33:53,159
actually when you're dealing with a real

767
00:33:56,810 --> 00:33:54,779
asteroid that we haven't seen close up

768
00:33:59,149 --> 00:33:56,820
before and what type of material might

769
00:34:01,310 --> 00:33:59,159
be on the surface what the structure is

770
00:34:03,590 --> 00:34:01,320
this is something that like a lychia

771
00:34:05,990 --> 00:34:03,600
cube we hope to see as the two Cube

772
00:34:07,730 --> 00:34:06,000
flies by to see what that blast was how

773
00:34:09,290 --> 00:34:07,740
large it was which will help those who

774
00:34:13,369 --> 00:34:09,300
are doing the modeling of how effective

775
00:34:15,530 --> 00:34:13,379
the uh impact was and in changing the

776
00:34:17,450 --> 00:34:15,540
orbit what all figures in what Lucas

777
00:34:19,909 --> 00:34:17,460
just talked about the mass and the

778
00:34:21,409 --> 00:34:19,919
velocity but then also maybe that blast

779
00:34:23,510 --> 00:34:21,419
that is seen afterwards the plume of

780
00:34:26,030 --> 00:34:23,520
material that we're hoping to see from

781
00:34:28,790 --> 00:34:26,040
the Chia Cube so how does tonight's

782
00:34:31,790 --> 00:34:28,800
Mission play into the work that y'all do

783
00:34:33,889 --> 00:34:31,800
in NASA's planetary defense coordination

784
00:34:35,570 --> 00:34:33,899
office Lucas yeah I would start by

785
00:34:38,210 --> 00:34:35,580
saying that this is a very important

786
00:34:40,669 --> 00:34:38,220
test we're going to know if this kinetic

787
00:34:42,669 --> 00:34:40,679
impact is an effective technique to use

788
00:34:46,190 --> 00:34:42,679

in the case that there will be any

789
00:34:47,869 --> 00:34:46,200
potential asteroid on road to Earth so

790
00:34:50,210 --> 00:34:47,879
definitely for me that's the most

791
00:34:53,030 --> 00:34:50,220
important thing about this test

792
00:34:55,550 --> 00:34:53,040
but then on top of that there's finding

793
00:34:57,410 --> 00:34:55,560
the asteroids because you can't go out

794
00:34:59,150 --> 00:34:57,420
and mitigate a possible threat if you

795
00:35:02,089 --> 00:34:59,160
don't even know it's there and so NASA

796
00:35:04,130 --> 00:35:02,099
is very focused also on finding nearest

797
00:35:06,410 --> 00:35:04,140
asteroids with telescopes that survey

798
00:35:08,329 --> 00:35:06,420
the skies every night looking for near

799
00:35:09,589 --> 00:35:08,339
thasteroids getting the orbits

800
00:35:10,849 --> 00:35:09,599
calculated figuring out where they're

801
00:35:12,710 --> 00:35:10,859
going to be in the future to see if we

802
00:35:14,750 --> 00:35:12,720
even need something by Dart and then

803
00:35:16,790 --> 00:35:14,760
working to speed that up NASA's working

804
00:35:18,470 --> 00:35:16,800
on the near-earth object surveyor Space

805
00:35:19,490 --> 00:35:18,480
Telescope that would look in the

806
00:35:21,470 --> 00:35:19,500
infrared and have a different

807
00:35:23,510 --> 00:35:21,480
perspective complement the ground-based

808
00:35:25,190 --> 00:35:23,520
telescopes to accelerate things just so

809
00:35:26,630 --> 00:35:25,200
that we know is there a threat out there

810
00:35:28,849 --> 00:35:26,640
that we're facing that we do not yet

811
00:35:30,770 --> 00:35:28,859
know about wow I mean it's incredible

812
00:35:32,150 --> 00:35:30,780
just to know the work that is already

813
00:35:34,430 --> 00:35:32,160

being done it's good to know that we're

814
00:35:36,109 --> 00:35:34,440
building off of it but it's good to know

815
00:35:37,609 --> 00:35:36,119
we've already got some people watching

816
00:35:39,530 --> 00:35:37,619
this guys

817
00:35:42,530 --> 00:35:39,540
um and so I have our next question from

818
00:35:45,710 --> 00:35:42,540
Alan on Twitter who asks how long does

819
00:35:47,750 --> 00:35:45,720
it take for pictures to reach Earth well

820
00:35:49,730 --> 00:35:47,760
the uh the light the time it takes light

821
00:35:52,430 --> 00:35:49,740
and then a radio signal from the

822
00:35:53,990 --> 00:35:52,440
spacecraft uh to come to Earth is 38

823
00:35:56,270 --> 00:35:54,000
seconds but then there's also the time

824
00:35:58,550 --> 00:35:56,280
needed to process the images so a few

825
00:36:01,370 --> 00:35:58,560
more seconds on on top of that so under

826
00:36:03,349 --> 00:36:01,380
a minute but still it's uh it's not

827
00:36:05,270 --> 00:36:03,359
instantaneous because it's it's a ways

828
00:36:07,069 --> 00:36:05,280
out there well that makes sense I mean

829
00:36:08,750 --> 00:36:07,079
but under a minute to get something back

830
00:36:12,050 --> 00:36:08,760
from space I'd say we're doing pretty

831
00:36:13,970 --> 00:36:12,060
good right there so Lucas Kelly thank

832
00:36:16,310 --> 00:36:13,980
you so much for everything that y'all

833
00:36:19,430 --> 00:36:16,320
are doing to keep our planet safe thanks

834
00:36:20,810 --> 00:36:19,440
and so it's important to note that

835
00:36:23,089 --> 00:36:20,820
tonight we're attempting something

836
00:36:25,550 --> 00:36:23,099
that's never been done and what that

837
00:36:28,130 --> 00:36:25,560
presents many challenges to overcome

838
00:36:29,690 --> 00:36:28,140

here's what makes Dart a first of its

839
00:36:31,750 --> 00:36:29,700
kind mission

840
00:36:33,890 --> 00:36:31,760
foreign

841
00:36:36,710 --> 00:36:33,900
mission is a very difficult Mission

842
00:36:38,630 --> 00:36:36,720
because we are trying to do something

843
00:36:40,430 --> 00:36:38,640
that hasn't been done before this is the

844
00:36:43,430 --> 00:36:40,440
first time we're going to an asteroid

845
00:36:46,490 --> 00:36:43,440
that is this small this dark and we're

846
00:36:48,170 --> 00:36:46,500
actually going to attempt an impact the

847
00:36:55,370 --> 00:36:48,180
dart mission is really something that

848
00:37:01,550 --> 00:36:58,910
we're doing this mission to prove that

849
00:37:04,430 --> 00:37:01,560
we can deflect an asteroid if we find

850
00:37:07,089 --> 00:37:04,440
one that is on an impact course for

851
00:37:09,650 --> 00:37:07,099
Earth we are trying to hit an asteroid

852
00:37:12,349 --> 00:37:09,660
163 meters wide which is about the size

853
00:37:14,030 --> 00:37:12,359
of the Washington Monument while flying

854
00:37:16,130 --> 00:37:14,040
at six kilometers per second which is

855
00:37:18,710 --> 00:37:16,140
like going from New York to DC in about

856
00:37:21,109 --> 00:37:18,720
a minute there is no chance that this

857
00:37:23,510 --> 00:37:21,119
asteroid could ever hit earth it's a

858
00:37:25,609 --> 00:37:23,520
very small asteroid it's only about the

859
00:37:28,010 --> 00:37:25,619
size of a small football stadium and

860
00:37:30,770 --> 00:37:28,020
it's almost 7 million miles away from

861
00:37:32,390 --> 00:37:30,780
the earth that's uh 28 times the

862
00:37:35,329 --> 00:37:32,400
distance between the Earth and the moon

863
00:37:38,569 --> 00:37:35,339

there's kind of a limit on how much mass

864
00:37:39,710 --> 00:37:38,579
you can launch in space Rockets are only

865
00:37:42,950 --> 00:37:39,720
so big

866
00:37:45,950 --> 00:37:42,960
so our spacecraft is only the size of a

867
00:37:48,349 --> 00:37:45,960
golf cart Draco is the primary

868
00:37:50,390 --> 00:37:48,359
instrument on the dart spacecraft it is

869
00:37:53,569 --> 00:37:50,400
the camera that is going to be Imaging

870
00:37:55,630 --> 00:37:53,579
the dirimo system as we approach when we

871
00:37:57,950 --> 00:37:55,640
first see the asteroid through Draco

872
00:38:00,290 --> 00:37:57,960
it's just gonna look like a pixel

873
00:38:02,870 --> 00:38:00,300
there's a star tracker on board that

874
00:38:05,510 --> 00:38:02,880
takes images of the stars and Compares

875
00:38:07,310 --> 00:38:05,520
them to a known catalog to determine

876
00:38:09,890 --> 00:38:07,320
which way it's pointing in space it

877
00:38:11,930 --> 00:38:09,900
poses the biggest risk because very very

878
00:38:13,730 --> 00:38:11,940
small errors in this measurement can

879
00:38:15,950 --> 00:38:13,740
spell the difference between success and

880
00:38:17,810 --> 00:38:15,960
failure and those measurements are going

881
00:38:19,490 --> 00:38:17,820
to be fed into the smart nav algorithm

882
00:38:22,310 --> 00:38:19,500
that's going to be making the autonomous

883
00:38:25,250 --> 00:38:22,320
course correction uh commands that will

884
00:38:26,870 --> 00:38:25,260
put us on an intercept course there is a

885
00:38:28,670 --> 00:38:26,880
very small probability that we don't hit

886
00:38:30,130 --> 00:38:28,680
the asteroid even if we do everything

887
00:38:33,349 --> 00:38:30,140
right

888
00:38:36,290 --> 00:38:33,359

our sensors work well our spacecraft is

889
00:38:38,750 --> 00:38:36,300
doing well we are looking we're finding

890
00:38:40,910 --> 00:38:38,760
the asteroid even then we might still

891
00:38:43,849 --> 00:38:40,920
miss we're trying to teach a computer

892
00:38:46,670 --> 00:38:43,859
how to recognize an object we've never

893
00:38:49,550 --> 00:38:46,680
seen before and the way it does that is

894
00:38:51,710 --> 00:38:49,560
by taking pictures of the asteroid and

895
00:38:53,990 --> 00:38:51,720
then interpreting where it is in space

896
00:38:56,510 --> 00:38:54,000
and guiding itself to it the spacecraft

897
00:38:59,870 --> 00:38:56,520
is controlling itself smart enough is

898
00:39:02,510 --> 00:38:59,880
guiding spacecraft and we have very

899
00:39:05,870 --> 00:39:02,520
limited ability to respond in that time

900
00:39:08,810 --> 00:39:05,880
so it has to do it all by itself and at

901
00:39:14,390 --> 00:39:08,820
about two and a half minutes out

902
00:39:20,270 --> 00:39:16,670
until we hit the asteroid

903
00:39:22,370 --> 00:39:20,280
it is going very very fast towards the

904
00:39:25,490 --> 00:39:22,380
asteroid traveling at six kilometers per

905
00:39:26,690 --> 00:39:25,500
second 200 times faster than a car on

906
00:39:29,329 --> 00:39:26,700
the freeway

907
00:39:31,730 --> 00:39:29,339
so when we hit

908
00:39:34,609 --> 00:39:31,740
all of that mass all of that momentum

909
00:39:37,910 --> 00:39:34,619
pushes the asteroid even giving it a

910
00:39:40,370 --> 00:39:37,920
small nudge will allow it to change its

911
00:39:42,589 --> 00:39:40,380
course but if we did see an asteroid on

912
00:39:44,870 --> 00:39:42,599
track for Earth this would be enough of

913
00:39:47,150 --> 00:39:44,880

a deflection it's like a Bittersweet

914
00:39:49,250 --> 00:39:47,160
moment yeah all this hard work just got

915
00:39:51,470 --> 00:39:49,260
destroyed but that was exactly why we

916
00:39:54,770 --> 00:39:51,480
put it all together of all the Endeavors

917
00:39:57,410 --> 00:39:54,780
that we do for space and in space this

918
00:39:59,150 --> 00:39:57,420
is probably one of the ones that one day

919
00:40:00,650 --> 00:39:59,160
will be the most important thing that

920
00:40:04,069 --> 00:40:00,660
we've ever done

921
00:40:06,290 --> 00:40:04,079
in the future I hope that Dart can teach

922
00:40:09,890 --> 00:40:06,300
us what ways work and what ways don't

923
00:40:12,050 --> 00:40:09,900
work for planetary defense because it is

924
00:40:14,810 --> 00:40:12,060
humankind's first

925
00:40:17,270 --> 00:40:14,820
demonstration that we have gained the

926
00:40:19,970 --> 00:40:17,280
knowledge and the technology to be able

927
00:40:28,310 --> 00:40:19,980
to protect the Earth from an asteroid

928
00:40:34,430 --> 00:40:30,829
pushing past boundaries remember tonight

929
00:40:35,750 --> 00:40:34,440
is a test and we hope to make impact now

930
00:40:38,150 --> 00:40:35,760
that you've learned of the challenges

931
00:40:40,430 --> 00:40:38,160
today's test let's head back to Mission

932
00:40:43,130 --> 00:40:40,440
operations and get a status update on

933
00:40:45,010 --> 00:40:43,140
dart's real-time progress Samson how are

934
00:40:47,630 --> 00:40:45,020
we looking

935
00:40:50,690 --> 00:40:47,640
hero we have 30 minutes to go until

936
00:40:52,310 --> 00:40:50,700
impact as we heard earlier so far so

937
00:40:54,230 --> 00:40:52,320
good smart nav is now targeting

938
00:40:56,930 --> 00:40:54,240

dimorphos thrusters are firing

939
00:40:58,849 --> 00:40:56,940
maneuvering the spacecraft Draco dar's

940
00:41:00,950 --> 00:40:58,859
eye playing Paparazzi with dimorphos

941
00:41:02,930 --> 00:41:00,960
providing smart enough of about an image

942
00:41:04,550 --> 00:41:02,940
per second and this is a good time to

943
00:41:06,349 --> 00:41:04,560
remind you that what we're seeing on the

944
00:41:09,230 --> 00:41:06,359
Draco feed is delayed by about 45

945
00:41:11,690 --> 00:41:09,240
seconds on a ton of signal delay and

946
00:41:13,430 --> 00:41:11,700
image processing and coming up we're

947
00:41:16,130 --> 00:41:13,440
about to see the team conduct a final

948
00:41:18,829 --> 00:41:16,140
poll one last scheduled confab to make

949
00:41:20,210 --> 00:41:18,839
sure that all systems are go and as we

950
00:41:22,130 --> 00:41:20,220
head to that I have someone with me who

951
00:41:24,890 --> 00:41:22,140
knows a thing or two about ensuring

952
00:41:27,170 --> 00:41:24,900
spacecraft Readiness and integrity Betsy

953
00:41:29,030 --> 00:41:27,180
Congdon darts mechanical systems

954
00:41:31,910 --> 00:41:29,040
engineer Betsy thank you so much for

955
00:41:34,190 --> 00:41:31,920
joining me thank you so you led the team

956
00:41:36,650 --> 00:41:34,200
that literally put Dart together is that

957
00:41:38,329 --> 00:41:36,660
right let's see yeah so the my job is to

958
00:41:40,310 --> 00:41:38,339
make sure that engineers and the

959
00:41:42,170 --> 00:41:40,320
technicians all physically put all these

960
00:41:44,870 --> 00:41:42,180
boxes that you've been hearing bolts and

961
00:41:47,810 --> 00:41:44,880
all all onto a spacecraft altogether I

962
00:41:50,329 --> 00:41:47,820
gotta ask with uh Mission so ambitious

963
00:41:52,130 --> 00:41:50,339

how many hours how many years how many

964
00:41:54,530 --> 00:41:52,140
people do you have any idea at this

965
00:41:55,970 --> 00:41:54,540
point oh man so I mean Dart has been

966
00:41:57,650 --> 00:41:55,980
thought about for a long time but really

967
00:41:59,210 --> 00:41:57,660
started in Earnest about five years ago

968
00:42:01,190 --> 00:41:59,220
we started building up the spacecraft

969
00:42:03,290 --> 00:42:01,200
and you know in that assembly that I was

970
00:42:04,370 --> 00:42:03,300
talking about about two two and a half

971
00:42:05,870 --> 00:42:04,380
years ago

972
00:42:07,310 --> 00:42:05,880
um and so it's been hundreds of hours

973
00:42:09,170 --> 00:42:07,320
you know to make something like this

974
00:42:10,730 --> 00:42:09,180
possible people with all sorts of

975
00:42:11,510 --> 00:42:10,740
talents you've seen a lot of them uh

976
00:42:13,730 --> 00:42:11,520
today

977
00:42:16,250 --> 00:42:13,740
that's incredible and so we're heading

978
00:42:18,829 --> 00:42:16,260
up toward another feed as I said earlier

979
00:42:20,810 --> 00:42:18,839
and as we all know space is a unique and

980
00:42:22,550 --> 00:42:20,820
challenging environment when you're

981
00:42:24,410 --> 00:42:22,560
ascending Dart what were the key boxes

982
00:42:26,089 --> 00:42:24,420
you're checking off of that very long

983
00:42:27,829 --> 00:42:26,099
quality assurance list to get the

984
00:42:30,710 --> 00:42:27,839
spacecraft to where it is right now and

985
00:42:32,210 --> 00:42:30,720
hopefully till impact so space is very

986
00:42:33,650 --> 00:42:32,220
hard and so what we do is each

987
00:42:35,210 --> 00:42:33,660
individual component Lisa was talking

988
00:42:36,950 --> 00:42:35,220

about this earlier goes through its own

989
00:42:38,690 --> 00:42:36,960
individual testing and then we put the

990
00:42:40,490 --> 00:42:38,700
whole spacecraft together and we will

991
00:42:42,050 --> 00:42:40,500
check out the electrical systems making

992
00:42:43,849 --> 00:42:42,060
sure all the boxes are working and

993
00:42:45,109 --> 00:42:43,859
talking to each other we put it into a

994
00:42:46,730 --> 00:42:45,119
vacuum chamber make sure it's going to

995
00:42:47,870 --> 00:42:46,740
work in space put it through all the

996
00:42:49,609 --> 00:42:47,880
different temperatures it's going to see

997
00:42:51,770 --> 00:42:49,619
and then put it on a Shaker table and

998
00:42:53,089 --> 00:42:51,780
actually mimic launch and so it actually

999
00:42:54,410 --> 00:42:53,099
goes through all of that as a full

1000
00:42:56,270 --> 00:42:54,420
spacecraft as well as individual

1001
00:42:58,790 --> 00:42:56,280
components so we go through a lot of

1002
00:43:01,430 --> 00:42:58,800
testing Mission operations uh mission

1003
00:43:03,230 --> 00:43:01,440
simulations to get to this point that's

1004
00:43:05,089 --> 00:43:03,240
incredible I mean I don't know if you

1005
00:43:06,710 --> 00:43:05,099
included you mentioned so much Ray is

1006
00:43:08,630 --> 00:43:06,720
that also accounting for the temperature

1007
00:43:11,990 --> 00:43:08,640
fluctuations in space or some other

1008
00:43:13,910 --> 00:43:12,000
people yeah so the we have Chambers here

1009
00:43:15,410 --> 00:43:13,920
at APL they're specially built to take

1010
00:43:17,030 --> 00:43:15,420
these spacecraft put them into the

1011
00:43:18,290 --> 00:43:17,040
vacuum space and run them through the

1012
00:43:19,910 --> 00:43:18,300
temperature spaces that we're going to

1013
00:43:21,829 --> 00:43:19,920

actually see it's incredible how many

1014
00:43:23,750 --> 00:43:21,839
times do you check is it like one test

1015
00:43:26,030 --> 00:43:23,760
number done or are you sometimes testing

1016
00:43:27,710 --> 00:43:26,040
and testing lots and lots of testing and

1017
00:43:29,450 --> 00:43:27,720
that's what makes it you know so perfect

1018
00:43:31,910 --> 00:43:29,460
we're seeing these great images coming

1019
00:43:33,410 --> 00:43:31,920
in uh because of all that testing and

1020
00:43:34,970 --> 00:43:33,420
all that work so you know you don't do

1021
00:43:37,190 --> 00:43:34,980
anything once you're doing it many times

1022
00:43:39,829 --> 00:43:37,200
because once it's in space there's not a

1023
00:43:41,870 --> 00:43:39,839
lot of ways to fix it right well do you

1024
00:43:44,270 --> 00:43:41,880
ever you know think about that one panel

1025
00:43:45,470 --> 00:43:44,280
that one component that gave you a

1026
00:43:47,270 --> 00:43:45,480
little bit of heartburn in the clean

1027
00:43:49,609 --> 00:43:47,280
room and you're up and I thinking I

1028
00:43:52,430 --> 00:43:49,619
think that thing is gonna hold true Up

1029
00:43:53,990 --> 00:43:52,440
Until the End everything everything is

1030
00:43:55,430 --> 00:43:54,000
looking really good I will say you know

1031
00:43:57,410 --> 00:43:55,440
we had a lot of new technologies which

1032
00:43:58,730 --> 00:43:57,420
are really exciting the Rosa solar rays

1033
00:44:00,950 --> 00:43:58,740
had never been integrated onto a

1034
00:44:02,390 --> 00:44:00,960
spacecraft before and so that was like a

1035
00:44:03,950 --> 00:44:02,400
challenge but one the team was up for

1036
00:44:06,230 --> 00:44:03,960
and now it's all ready and working

1037
00:44:07,849 --> 00:44:06,240
perfectly all these new technology

1038
00:44:09,650 --> 00:44:07,859

demonstrations I mean it only adds to

1039
00:44:12,109 --> 00:44:09,660
the complexity of this Mission and to

1040
00:44:14,030 --> 00:44:12,119
you know testing things I want to say

1041
00:44:15,710 --> 00:44:14,040
even more so but it's it's just as

1042
00:44:19,190 --> 00:44:15,720
critical the new technology everything

1043
00:44:20,809 --> 00:44:19,200
has to be so to make sure it comes yeah

1044
00:44:22,670 --> 00:44:20,819
I mean all of this new technologies

1045
00:44:24,170 --> 00:44:22,680
requires extra testing but that just

1046
00:44:25,910 --> 00:44:24,180
gains confidence you know you're seeing

1047
00:44:28,069 --> 00:44:25,920
the team working through that working

1048
00:44:29,450 --> 00:44:28,079
through all these Mission Sims so

1049
00:44:30,950 --> 00:44:29,460
um that's really what makes it exciting

1050
00:44:32,990 --> 00:44:30,960
you don't want to just do the same thing

1051
00:44:34,670 --> 00:44:33,000
over and over this is what makes the APL

1052
00:44:36,470 --> 00:44:34,680
a special place we build these special

1053
00:44:38,329 --> 00:44:36,480
spacecraft that you know have never been

1054
00:44:40,130 --> 00:44:38,339
done before the last quick question for

1055
00:44:41,990 --> 00:44:40,140
you it's got to be a little Bittersweet

1056
00:44:44,089 --> 00:44:42,000
that a spacecraft you poured heart and

1057
00:44:45,829 --> 00:44:44,099
soul into is about to careen into an

1058
00:44:47,510 --> 00:44:45,839
asteroid how are you feeling about that

1059
00:44:49,190 --> 00:44:47,520
I'm feeling great about it you know it

1060
00:44:50,930 --> 00:44:49,200
was designed to create an industry it's

1061
00:44:52,609 --> 00:44:50,940
meeting its Destiny so it's really

1062
00:44:55,550 --> 00:44:52,619
exciting to see

1063
00:44:57,170 --> 00:44:55,560

um and I can't wait for impact well it

1064
00:44:59,569 --> 00:44:57,180
is serving a purpose I guess that's why

1065
00:45:01,490 --> 00:44:59,579
it's easier to let it go exactly very

1066
00:45:03,770 --> 00:45:01,500
much so that is awesome

1067
00:45:07,130 --> 00:45:03,780
well I think we are about to get into

1068
00:45:08,390 --> 00:45:07,140
that final poll in the mock very shortly

1069
00:45:10,609 --> 00:45:08,400
so we're gonna

1070
00:45:12,410 --> 00:45:10,619
hear that final 30

1071
00:45:14,329 --> 00:45:12,420
minute poll and then we're going to hear

1072
00:45:16,430 --> 00:45:14,339
from Lena Adams again darts mission

1073
00:45:18,109 --> 00:45:16,440
systems engineer to give us that summary

1074
00:45:20,329 --> 00:45:18,119
of what we just heard how she's feeling

1075
00:45:22,190 --> 00:45:20,339
how they're feeling in their uh very

1076
00:46:10,130 --> 00:45:22,200
exciting stuff this will be the final

1077
00:46:10,140 --> 00:46:16,970
we are awaiting that final poll

1078
00:46:26,410 --> 00:46:21,230
this is dark MSC on DT mock it is time

1079
00:46:34,730 --> 00:46:31,510
we're about what 7 000 miles from

1080
00:46:35,510 --> 00:46:34,740
dimorphous at this point so yay all

1081
00:46:37,069 --> 00:46:35,520
right

1082
00:46:38,630 --> 00:46:37,079
um image quality

1083
00:46:41,990 --> 00:46:38,640
how are we doing

1084
00:46:43,550 --> 00:46:42,000
still looking very good uh dimorphos

1085
00:46:47,150 --> 00:46:43,560
still tracking along that same

1086
00:46:49,360 --> 00:46:47,160
brightness predict as didimos

1087
00:46:54,700 --> 00:46:49,370
that's great all right

1088
00:47:01,550 --> 00:46:59,770

[Applause]

1089
00:47:04,069 --> 00:47:01,560
smartness

1090
00:47:06,230 --> 00:47:04,079
smart nav is looking nominal we are at

1091
00:47:07,849 --> 00:47:06,240
under 30 meters of projected Miss

1092
00:47:10,430 --> 00:47:07,859
distance right yeah it's looking really

1093
00:47:12,349 --> 00:47:10,440
good look at that that's that's looking

1094
00:47:15,230 --> 00:47:12,359
fantastic

1095
00:47:18,650 --> 00:47:15,240
very excited

1096
00:47:21,470 --> 00:47:18,660
all right uh GNC

1097
00:47:23,870 --> 00:47:21,480
yeah GNC also looking good we've been

1098
00:47:26,089 --> 00:47:23,880
very excited to do those Burns so we've

1099
00:47:28,190 --> 00:47:26,099
been waiting a long time

1100
00:47:30,290 --> 00:47:28,200
oh this is great

1101
00:47:34,970 --> 00:47:30,300
autonomy

1102
00:47:42,290 --> 00:47:34,980
cycling nominally and we've had no new

1103
00:47:48,890 --> 00:47:46,309
is green and Issa is green got plenty of

1104
00:47:52,490 --> 00:47:48,900
margin looks good all right ground

1105
00:47:55,130 --> 00:47:52,500
systems ground system has been helping a

1106
00:47:57,230 --> 00:47:55,140
few users manage clients but everything

1107
00:48:00,349 --> 00:47:57,240
is going fine there and we are green

1108
00:48:00,950 --> 00:48:00,359
yes wonderful thank you guys completes

1109
00:48:02,270 --> 00:48:00,960
the poll

1110
00:48:05,809 --> 00:48:02,280
[Applause]

1111
00:48:10,910 --> 00:48:09,230
last one last one all right so dynamos

1112
00:48:13,790 --> 00:48:10,920
is looking like itself let's see what

1113
00:48:15,170 --> 00:48:13,800

dimorphous is looking like soon uh in

1114
00:48:17,089 --> 00:48:15,180
the meantime we're going to transition

1115
00:48:25,910 --> 00:48:17,099
to Precision lock at 20 minutes that's

1116
00:48:32,930 --> 00:48:29,450
all right robots here from Lena Adams

1117
00:48:36,230 --> 00:48:32,940
from the mission operations center

1118
00:48:38,510 --> 00:48:36,240
hi Samson hi Elena that sounded very

1119
00:48:40,250 --> 00:48:38,520
positive how's it going in there oh it's

1120
00:48:42,770 --> 00:48:40,260
going great it's going great we've

1121
00:48:44,870 --> 00:48:42,780
locked on uh dimorphous we're when

1122
00:48:47,510 --> 00:48:44,880
you're wearing towards it and uh yeah

1123
00:48:49,370 --> 00:48:47,520
everything is looking really good we are

1124
00:48:52,190 --> 00:48:49,380
um we were at the time of the poll

1125
00:48:53,870 --> 00:48:52,200
within just a few meters of projected

1126
00:48:56,210 --> 00:48:53,880
Miss distance which means we were

1127
00:48:57,890 --> 00:48:56,220
hitting uh towards the center and at

1128
00:49:00,710 --> 00:48:57,900
this point we're you know coming back

1129
00:49:02,569 --> 00:49:00,720
there about 30 meters off the center of

1130
00:49:05,870 --> 00:49:02,579
the lit portion of dimorphous as of

1131
00:49:07,550 --> 00:49:05,880
right now we've executed two Burns and

1132
00:49:09,829 --> 00:49:07,560
everything's looking on track

1133
00:49:11,390 --> 00:49:09,839
oh that sounds wonderful Anna thanks so

1134
00:49:13,609 --> 00:49:11,400
much for that and good luck on the final

1135
00:49:15,890 --> 00:49:13,619
stretch thank you thank you have a good

1136
00:49:20,630 --> 00:49:18,410
all right Betsy we had that very

1137
00:49:22,790 --> 00:49:20,640
positive poll lots of fantastic lots of

1138
00:49:25,670 --> 00:49:22,800

clapping we heard Lena in a very

1139
00:49:27,770 --> 00:49:25,680
positive mode how are you feeling I'm

1140
00:49:29,450 --> 00:49:27,780
feeling great it's amazing to see like

1141
00:49:31,190 --> 00:49:29,460
the actual dots on the screen for real

1142
00:49:33,050 --> 00:49:31,200
coming down from the spacecraft very

1143
00:49:35,030 --> 00:49:33,060
exciting any any words of encouragement

1144
00:49:36,890 --> 00:49:35,040
for the team I mean obviously they're

1145
00:49:39,470 --> 00:49:36,900
doing a great job they practice a ton

1146
00:49:41,089 --> 00:49:39,480
and uh we're ready go dark

1147
00:49:43,849 --> 00:49:41,099
you've heard it all loud and clear

1148
00:49:45,890 --> 00:49:43,859
Tahira all systems are gone we remain on

1149
00:49:50,210 --> 00:49:45,900
track for impact and like Betsy just

1150
00:49:52,730 --> 00:49:50,220
said go Dart back to you all right what

1151
00:49:56,329 --> 00:49:52,740
an exciting update Samson you just heard

1152
00:49:59,210 --> 00:49:56,339
it all systems are go Mission operations

1153
00:50:02,569 --> 00:49:59,220
confirm the spacecraft is on track for

1154
00:50:05,390 --> 00:50:02,579
impact but in order to hit the mark the

1155
00:50:07,910 --> 00:50:05,400
test must first locate its Target that's

1156
00:50:10,609 --> 00:50:07,920
why Johns Hopkins APL engineer Michelle

1157
00:50:13,190 --> 00:50:10,619
Chen helped develop new autonomous

1158
00:50:15,470 --> 00:50:13,200
navigation techniques that will ensure a

1159
00:50:19,010 --> 00:50:15,480
bullseye let's take a look

1160
00:50:20,690 --> 00:50:19,020
foreign my life would I have thought I

1161
00:50:22,730 --> 00:50:20,700
would take a couple hundred million

1162
00:50:26,210 --> 00:50:22,740
dollars spacecraft and crash that into

1163
00:50:28,670 --> 00:50:26,220

an asteroid my name is Michelle Chen and

1164
00:50:30,710 --> 00:50:28,680
I lead the team that is responsible for

1165
00:50:33,650 --> 00:50:30,720
the autonomous navigation of dark

1166
00:50:36,109 --> 00:50:33,660
spacecraft to his and asteroid the dart

1167
00:50:38,270 --> 00:50:36,119
mission is the first planetary defense

1168
00:50:40,730 --> 00:50:38,280
test mission our goal is to hit an

1169
00:50:43,430 --> 00:50:40,740
impact an asteroid to understand and

1170
00:50:45,470 --> 00:50:43,440
study the momentum transfer so that we

1171
00:50:47,690 --> 00:50:45,480
could potentially later down the road if

1172
00:50:49,549 --> 00:50:47,700
we need to deflect an ashtray on its way

1173
00:50:51,349 --> 00:50:49,559
to Earth I am the smart nav lead

1174
00:50:53,510 --> 00:50:51,359
smartness stands for small body

1175
00:50:55,309 --> 00:50:53,520
maneuvering autonomous real-time

1176
00:50:57,770 --> 00:50:55,319
navigation so right now I always

1177
00:51:00,290 --> 00:50:57,780
consider it sort of like the brains and

1178
00:51:03,829 --> 00:51:00,300
so the camera Draco is essentially the

1179
00:51:06,349 --> 00:51:03,839
eyes the algorithm has to identify and

1180
00:51:08,750 --> 00:51:06,359
hit the target in the field of view of

1181
00:51:10,670 --> 00:51:08,760
the camera we're flying at over six

1182
00:51:13,790 --> 00:51:10,680
kilometers a second it essentially

1183
00:51:15,770 --> 00:51:13,800
occupies a pixel up until possibly 30

1184
00:51:17,750 --> 00:51:15,780
minutes prior to impact and then that's

1185
00:51:19,309 --> 00:51:17,760
where everything it's really exciting

1186
00:51:21,650 --> 00:51:19,319
and so you could just imagine if it was

1187
00:51:23,569 --> 00:51:21,660
a human being joysticking this because

1188
00:51:26,030 --> 00:51:23,579

we don't know for sure what the

1189
00:51:28,510 --> 00:51:26,040
asteroids look like our simulation gives

1190
00:51:31,609 --> 00:51:28,520
us the capability to use different

1191
00:51:34,010 --> 00:51:31,619
asteroid shapes and asteroid objects to

1192
00:51:36,290 --> 00:51:34,020
see that our smart nav algorithm

1193
00:51:39,049 --> 00:51:36,300
performs against all these unknowns

1194
00:51:41,450 --> 00:51:39,059
we're super excited and nervous as well

1195
00:51:43,910 --> 00:51:41,460
I love pushing the boundaries and I love

1196
00:51:45,829 --> 00:51:43,920
the application of math into real world

1197
00:51:48,170 --> 00:51:45,839
problems you know and then seeing it

1198
00:51:51,170 --> 00:51:48,180
actually doing its thing to me there's

1199
00:51:53,329 --> 00:51:51,180
nothing cooler than that

1200
00:51:55,490 --> 00:51:53,339
if you're just joining us we're about 24

1201
00:51:57,890 --> 00:51:55,500
minutes away from dart's Impact with

1202
00:52:00,470 --> 00:51:57,900
asteroid dimorphos the spacecraft is

1203
00:52:02,870 --> 00:52:00,480
flying at four miles per second guidance

1204
00:52:05,750 --> 00:52:02,880
only by its autonomous navigation system

1205
00:52:08,150 --> 00:52:05,760
I'm here now with Tom Statler DART

1206
00:52:11,270 --> 00:52:08,160
program scientist and

1207
00:52:13,130 --> 00:52:11,280
Don graninger Dart impact modeler Tom

1208
00:52:15,710 --> 00:52:13,140
Dunn thank you for being here with us

1209
00:52:17,329 --> 00:52:15,720
tonight we have some good news happening

1210
00:52:19,190 --> 00:52:17,339
but we did just hear about the

1211
00:52:20,870 --> 00:52:19,200
challenges that Dart is facing tonight

1212
00:52:23,089 --> 00:52:20,880
so don could you tell us a little bit

1213
00:52:25,069 --> 00:52:23,099

about what kind of uncertainty exists

1214
00:52:26,870 --> 00:52:25,079
with a mission like this yeah sure so

1215
00:52:28,670 --> 00:52:26,880
what's really interesting is that until

1216
00:52:29,809 --> 00:52:28,680
just you know even a few minutes ago I

1217
00:52:31,910 --> 00:52:29,819
feel like we're just getting our first

1218
00:52:33,290 --> 00:52:31,920
looks at dimorphos and so we have

1219
00:52:35,270 --> 00:52:33,300
absolutely no idea what we're going to

1220
00:52:37,069 --> 00:52:35,280
be impacting into it could be covered in

1221
00:52:38,390 --> 00:52:37,079
rubble pile it could be just a

1222
00:52:40,309 --> 00:52:38,400
completely different shape we don't know

1223
00:52:41,270 --> 00:52:40,319
until we really right up on that impact

1224
00:52:43,549 --> 00:52:41,280
and that's probably one of our biggest

1225
00:52:46,309 --> 00:52:43,559
uncertainties on this I mean but that's

1226
00:52:49,970 --> 00:52:46,319
what really makes tonight so exciting

1227
00:52:51,770 --> 00:52:49,980
and so Tom could you expand a little bit

1228
00:52:54,290 --> 00:52:51,780
more on how we will use this information

1229
00:52:56,450 --> 00:52:54,300
in the future if all goes successfully

1230
00:52:58,190 --> 00:52:56,460
well this test is really important to

1231
00:53:00,230 --> 00:52:58,200
understand how we might be able to

1232
00:53:02,329 --> 00:53:00,240
deflect asteroids in the future and when

1233
00:53:05,089 --> 00:53:02,339
we when we measure the change in the

1234
00:53:07,670 --> 00:53:05,099
binary period of dimorphos and we will

1235
00:53:09,890 --> 00:53:07,680
understand how the asteroid reacted to

1236
00:53:12,290 --> 00:53:09,900
our kinetic impact and then as we get

1237
00:53:14,990 --> 00:53:12,300
deeper understanding into exactly what

1238
00:53:16,609 --> 00:53:15,000

the geology was of that asteroid that's

1239
00:53:19,309 --> 00:53:16,619
the basic information that's going to

1240
00:53:21,650 --> 00:53:19,319
help us refine our physics understanding

1241
00:53:24,230 --> 00:53:21,660
of asteroids and our ability to compute

1242
00:53:26,150 --> 00:53:24,240
and predict like Don does runs these

1243
00:53:29,210 --> 00:53:26,160
fantastic codes and extend this

1244
00:53:31,250 --> 00:53:29,220
knowledge to really have a good plan for

1245
00:53:33,410 --> 00:53:31,260
how we might react if we ever do

1246
00:53:35,690 --> 00:53:33,420
discover a dangerous asteroid that is

1247
00:53:38,870 --> 00:53:35,700
different from dimorphos well hey I mean

1248
00:53:40,910 --> 00:53:38,880
it's better to be safe than sorry so it

1249
00:53:42,890 --> 00:53:40,920
sounds like y'all's party is really just

1250
00:53:45,290 --> 00:53:42,900
getting started after impact so

1251
00:53:48,530 --> 00:53:45,300
congratulations on your success so far

1252
00:53:51,230 --> 00:53:48,540
it has been a pleasure thank you so much

1253
00:53:53,809 --> 00:53:51,240
now any second we should be learning if

1254
00:53:56,089 --> 00:53:53,819
Dart has a Precision lock on its Target

1255
00:53:59,030 --> 00:53:56,099
dimorphos this is a key Milestone

1256
00:54:01,910 --> 00:53:59,040
critical to ignite success Samson

1257
00:54:03,770 --> 00:54:01,920
Mission operations must be buzzing how

1258
00:54:06,589 --> 00:54:03,780
are things going

1259
00:54:09,349 --> 00:54:06,599
hey Tahira the energy is indeed electric

1260
00:54:10,790 --> 00:54:09,359
and the team is hyper focused you could

1261
00:54:12,890 --> 00:54:10,800
hear a pin drop right now as we're

1262
00:54:15,049 --> 00:54:12,900
coming up on the critical 20-minute mark

1263
00:54:16,970 --> 00:54:15,059

from Impact and expecting to hear from

1264
00:54:19,549 --> 00:54:16,980
the team that smartnav is now Precision

1265
00:54:21,049 --> 00:54:19,559
locked onto the amorphos which means

1266
00:54:23,690 --> 00:54:21,059
that smart nav will be tracking only

1267
00:54:25,670 --> 00:54:23,700
dimorphos from here on out why smart

1268
00:54:27,470 --> 00:54:25,680
have a smart nap has full confidence

1269
00:54:29,750 --> 00:54:27,480
that we're in fact tracking dimorphos

1270
00:54:32,329 --> 00:54:29,760
and so we want to remove any confusion

1271
00:54:34,010 --> 00:54:32,339
by continuing to track didimos because

1272
00:54:35,569 --> 00:54:34,020
what could happen with ditamos is that

1273
00:54:37,370 --> 00:54:35,579
its shape could be such that there's a

1274
00:54:39,109 --> 00:54:37,380
lot of shadowing which could make it

1275
00:54:42,170 --> 00:54:39,119
seem in the Draco imagery like multiple

1276
00:54:44,030 --> 00:54:42,180
blobs as the team likes to call them and

1277
00:54:46,370 --> 00:54:44,040
we don't want smart and optimistic any

1278
00:54:48,170 --> 00:54:46,380
of those blobs for dimorphos so we're

1279
00:54:49,549 --> 00:54:48,180
doing away with tracking did almost all

1280
00:54:52,549 --> 00:54:49,559
together we are waiting for that

1281
00:54:53,990 --> 00:54:52,559
announcement as of precision lock

1282
00:54:56,030 --> 00:54:54,000
um all right we're about to hear from

1283
00:54:58,790 --> 00:54:56,040
the team

1284
00:55:24,710 --> 00:54:58,800
actually we have some time

1285
00:55:29,690 --> 00:55:26,630
and now let's listen in for that

1286
00:55:31,790 --> 00:55:29,700
confirmation of precision block

1287
00:56:10,910 --> 00:55:31,800
all right we expect to be in Precision

1288
00:56:24,109 --> 00:56:13,069

we are waiting for a confirmation of

1289
00:56:30,290 --> 00:56:26,809
MSC this is sn5

1290
00:56:32,590 --> 00:56:30,300
go ahead sn5 we are Precision locked and

1291
00:56:43,670 --> 00:56:32,600
still tracking dimorphous yes

1292
00:56:46,130 --> 00:56:43,680
[Applause]

1293
00:56:50,630 --> 00:56:46,140
we are soon gonna hear again from Elena

1294
00:56:56,630 --> 00:56:53,750
DT Mark so this was our last Milestone

1295
00:56:58,609 --> 00:56:56,640
at this point we're going to be uh

1296
00:57:00,530 --> 00:56:58,619
working towards dimorphous I expect

1297
00:57:04,549 --> 00:57:00,540
we're going to do some Burns we're about

1298
00:57:12,530 --> 00:57:04,559
4 500 miles away from dinamos and

1299
00:57:17,150 --> 00:57:15,470
ground stuff for one of C2 price joining

1300
00:57:19,910 --> 00:57:17,160
me now to react to that bit of good news

1301
00:57:22,130 --> 00:57:19,920
is Lindley Johnson NASA's planetary

1302
00:57:24,170 --> 00:57:22,140
defense officer Lindley you heard Lena

1303
00:57:26,390 --> 00:57:24,180
we are now Precision locked a lot of

1304
00:57:28,609 --> 00:57:26,400
Applause things are looking good

1305
00:57:31,130 --> 00:57:28,619
and we are now headed for the moment of

1306
00:57:33,109 --> 00:57:31,140
truth how are you holding up oh I'm

1307
00:57:35,510 --> 00:57:33,119
doing great uh you know the team's been

1308
00:57:38,510 --> 00:57:35,520
doing great the spacecraft's doing great

1309
00:57:42,470 --> 00:57:38,520
uh it's uh this Precision lock you know

1310
00:57:43,910 --> 00:57:42,480
is is absolute uh milestone for the

1311
00:57:46,849 --> 00:57:43,920
terminal phase here we've got a good

1312
00:57:48,829 --> 00:57:46,859
signature on dimorphous uh so the

1313
00:57:52,010 --> 00:57:48,839

spacecraft has what it needs to guide

1314
00:57:54,950 --> 00:57:52,020
itself in uh for the impact uh here in

1315
00:57:58,190 --> 00:57:54,960
uh 17 almost 18 18 minutes so we're

1316
00:58:01,010 --> 00:57:58,200
doing great yep so close

1317
00:58:02,870 --> 00:58:01,020
um very exciting moments ahead now we

1318
00:58:04,910 --> 00:58:02,880
can't say this enough and I know you've

1319
00:58:09,049 --> 00:58:04,920
said it so many times but it's worth

1320
00:58:10,849 --> 00:58:09,059
repeating for viewers that dimorphos is

1321
00:58:13,430 --> 00:58:10,859
not a threat to Earth

1322
00:58:16,910 --> 00:58:13,440
nor will it be after impact right no

1323
00:58:19,130 --> 00:58:16,920
that's right uh this uh asteroid system

1324
00:58:21,410 --> 00:58:19,140
is still almost seven million miles away

1325
00:58:23,930 --> 00:58:21,420
from the earth uh it's at its closest

1326
00:58:25,730 --> 00:58:23,940
point in the order right now too or so

1327
00:58:27,950 --> 00:58:25,740
from this point forward is going to be

1328
00:58:31,309 --> 00:58:27,960
moving away uh from Earth so there's no

1329
00:58:33,290 --> 00:58:31,319
chance of uh anything uh anything here

1330
00:58:35,870 --> 00:58:33,300
we've got to look for all the other

1331
00:58:38,150 --> 00:58:35,880
unknown asteroids out there still that's

1332
00:58:40,670 --> 00:58:38,160
not to find what the uh Hazard really is

1333
00:58:43,490 --> 00:58:40,680
thanks so much Lindley I'll catch you on

1334
00:58:44,770 --> 00:58:43,500
the other side of impact oh okay yeah if

1335
00:58:47,030 --> 00:58:44,780
you can

1336
00:58:49,609 --> 00:58:47,040
back to you tiara

1337
00:58:51,770 --> 00:58:49,619
all right thanks Samson it is amazing to

1338
00:58:54,349 --> 00:58:51,780

know that we have a Precision lock on

1339
00:58:56,630 --> 00:58:54,359
Target dimorphos now we have a fun way

1340
00:58:59,030 --> 00:58:56,640
for you to join our mission and it is by

1341
00:59:01,390 --> 00:58:59,040
signing up to be a planetary Defender

1342
00:59:03,950 --> 00:59:01,400
visit

1343
00:59:07,549 --> 00:59:03,960
bity.com forward slash planetary

1344
00:59:10,490 --> 00:59:07,559
Defender take the quiz and receive a

1345
00:59:12,950 --> 00:59:10,500
certificate like this one now once it's

1346
00:59:15,470 --> 00:59:12,960
official show us on social media using

1347
00:59:18,289 --> 00:59:15,480
the hashtag planetarydefender

1348
00:59:20,569 --> 00:59:18,299
now telescopes from around the world are

1349
00:59:23,390 --> 00:59:20,579
observing tonight's impact to ensure

1350
00:59:25,190 --> 00:59:23,400
that how successful we are at changing

1351
00:59:27,470 --> 00:59:25,200
the asteroids orbit they'll be measuring

1352
00:59:30,230 --> 00:59:27,480
this success and you may be wondering

1353
00:59:32,690 --> 00:59:30,240
how does that happen let's go behind the

1354
00:59:35,089 --> 00:59:32,700
scenes with astronomer Nick moskovitz at

1355
00:59:37,609 --> 00:59:35,099
Lowell Observatory home to the telescope

1356
00:59:39,410 --> 00:59:37,619
that discovered Pluto to see what's in

1357
00:59:44,630 --> 00:59:39,420
store for Dart

1358
00:59:49,190 --> 00:59:47,630
this is Lowell Observatory Lowell is one

1359
00:59:50,990 --> 00:59:49,200
of many observatories around the world

1360
00:59:53,450 --> 00:59:51,000
that will be observing the dark impact

1361
00:59:55,730 --> 00:59:53,460
NASA's first ever planetary defense test

1362
00:59:57,950 --> 00:59:55,740
mission to see how much a spacecraft

1363
00:59:59,990 --> 00:59:57,960

impact can deflect an asteroid in its

1364
01:00:02,270 --> 01:00:00,000
orbit this is where Pluto was discovered

1365
01:00:04,490 --> 01:00:02,280
and we are still doing research in all

1366
01:00:06,770 --> 01:00:04,500
areas of astronomy today so let's go

1367
01:00:10,370 --> 01:00:06,780
check it out

1368
01:00:13,490 --> 01:00:12,230
this is the Pluto telescope the

1369
01:00:16,490 --> 01:00:13,500
telescope that was used to discover

1370
01:00:17,930 --> 01:00:16,500
Pluto almost 100 years ago so here we

1371
01:00:21,549 --> 01:00:17,940
are at the Clark telescope this is

1372
01:00:23,450 --> 01:00:21,559
reversible is at to observe Mars

1373
01:00:25,010 --> 01:00:23,460
let's head on over to the Lowell

1374
01:00:26,690 --> 01:00:25,020
Discovery telescope about an hour south

1375
01:00:28,190 --> 01:00:26,700
of Flagstaff which is where we are going

1376
01:00:30,049 --> 01:00:28,200
to be collecting data for the dart

1377
01:00:30,890 --> 01:00:30,059
Mission the reason we're all the way out

1378
01:00:32,809 --> 01:00:30,900
here

1379
01:00:38,580 --> 01:00:32,819
in the middle of this Forest is that we

1380
01:00:38,590 --> 01:00:43,250
[Music]

1381
01:00:47,750 --> 01:00:45,530
and this is the lull Discovery telescope

1382
01:00:49,730 --> 01:00:47,760
this is what a 4.3 meter telescope looks

1383
01:00:52,370 --> 01:00:49,740
like this is what we will be using to

1384
01:00:54,829 --> 01:00:52,380
study didimos and dimorphos in the days

1385
01:00:56,870 --> 01:00:54,839
and weeks after dark impact the dark

1386
01:00:58,849 --> 01:00:56,880
spacecraft will be hitting an asteroid

1387
01:01:00,950 --> 01:00:58,859
called dimorphos a special because it's

1388
01:01:02,569 --> 01:01:00,960

a binary asteroid which means a

1389
01:01:04,609 --> 01:01:02,579
satellite around a larger asteroid

1390
01:01:06,770 --> 01:01:04,619
called dinimos and dart will actually be

1391
01:01:09,890 --> 01:01:06,780
hitting dimorphos and what we will be

1392
01:01:12,589 --> 01:01:09,900
measuring is how much Dart changes the

1393
01:01:15,049 --> 01:01:12,599
orbit of dimorphos around didimos so

1394
01:01:17,510 --> 01:01:15,059
this is an important test for planetary

1395
01:01:19,490 --> 01:01:17,520
defense mitigation strategies in case we

1396
01:01:20,750 --> 01:01:19,500
ever have to do this for real the Lowell

1397
01:01:22,430 --> 01:01:20,760
Discovery telescope is one of many

1398
01:01:25,069 --> 01:01:22,440
telescopes around the world which will

1399
01:01:27,289 --> 01:01:25,079
be used to study didimos and dimorphos

1400
01:01:28,970 --> 01:01:27,299
it's really a global coordinated effort

1401
01:01:31,370 --> 01:01:28,980
and what we're looking at here is a

1402
01:01:33,530 --> 01:01:31,380
large 4.3 meter primary mirror that's in

1403
01:01:35,450 --> 01:01:33,540
the middle of the telescope tube here up

1404
01:01:37,130 --> 01:01:35,460
at the top is a secondary mirror the

1405
01:01:38,569 --> 01:01:37,140
secondary mirror up top there is what is

1406
01:01:40,069 --> 01:01:38,579
focusing the light down onto the

1407
01:01:42,349 --> 01:01:40,079
instruments and allows us to take images

1408
01:01:43,190 --> 01:01:42,359
with the camera that's located down at

1409
01:01:45,289 --> 01:01:43,200
the bottom

1410
01:01:47,270 --> 01:01:45,299
this is maybe one of my favorite hidden

1411
01:01:49,910 --> 01:01:47,280
rooms at the telescope we're like

1412
01:01:52,250 --> 01:01:49,920
standing inside the telescope underneath

1413
01:01:55,549 --> 01:01:52,260

the telescope 100 times above your head

1414
01:01:57,049 --> 01:01:55,559
held up by this let's just go

1415
01:01:59,329 --> 01:01:57,059
is this sort of as you can see the

1416
01:02:01,609 --> 01:01:59,339
highest peak around here it's just over

1417
01:02:03,289 --> 01:02:01,619
8 000 feet come up here for Sunset

1418
01:02:07,309 --> 01:02:03,299
because we have sun setting right there

1419
01:02:09,349 --> 01:02:07,319
it's perfect for Dart we're going to be

1420
01:02:10,670 --> 01:02:09,359
collecting images of the night sky and

1421
01:02:11,690 --> 01:02:10,680
typically an observer would be here in

1422
01:02:12,770 --> 01:02:11,700
front of one of these consoles

1423
01:02:14,569 --> 01:02:12,780
controlling the instrument and taking

1424
01:02:16,670 --> 01:02:14,579
images like these as they're coming in

1425
01:02:18,890 --> 01:02:16,680
off the telescope Dart is really a sort

1426
01:02:20,450 --> 01:02:18,900
of before and after experiment we need

1427
01:02:22,190 --> 01:02:20,460
to understand the system before the

1428
01:02:23,750 --> 01:02:22,200
spacecraft intentionally impacts and

1429
01:02:25,910 --> 01:02:23,760
then we have to understand what the

1430
01:02:27,289 --> 01:02:25,920
outcome of that impact event is as we

1431
01:02:29,690 --> 01:02:27,299
watch from the Earth

1432
01:02:32,210 --> 01:02:29,700
dimorphos will pass in front of dinimos

1433
01:02:33,890 --> 01:02:32,220
and behind what we will be doing with

1434
01:02:36,230 --> 01:02:33,900
those images is measuring the brightness

1435
01:02:37,970 --> 01:02:36,240
of didimosa in those images and looking

1436
01:02:40,130 --> 01:02:37,980
at how that brightness changes and those

1437
01:02:42,829 --> 01:02:40,140
dips in brightness allow us to measure

1438
01:02:45,289 --> 01:02:42,839

when these eclipse happen and measure

1439
01:02:47,089 --> 01:02:45,299
the orbit period of dimorphos and so you

1440
01:02:49,190 --> 01:02:47,099
have essentially a fixed star field here

1441
01:02:50,809 --> 01:02:49,200
all the white dots or stars of different

1442
01:02:52,970 --> 01:02:50,819
brightness and moving through this field

1443
01:02:54,710 --> 01:02:52,980
is did emotion dimorphos which again we

1444
01:02:57,230 --> 01:02:54,720
can't distinguish them as discrete

1445
01:02:59,630 --> 01:02:57,240
points of light but we have a small

1446
01:03:02,510 --> 01:02:59,640
object moving through the field of view

1447
01:03:05,030 --> 01:03:02,520
so after impact we will then be able to

1448
01:03:07,250 --> 01:03:05,040
go back and start observing intensely

1449
01:03:09,170 --> 01:03:07,260
looking for those neutral events in

1450
01:03:11,270 --> 01:03:09,180
those Eclipse events of dimorphos

1451
01:03:13,430 --> 01:03:11,280
passing in front of and behind didimos

1452
01:03:15,170 --> 01:03:13,440
and on each one of these frames we're

1453
01:03:16,910 --> 01:03:15,180
measuring the brightness to assess

1454
01:03:19,069 --> 01:03:16,920
whether or not it's undergoing one of

1455
01:03:21,410 --> 01:03:19,079
these events where dimorphosis is

1456
01:03:23,870 --> 01:03:21,420
passing in front of or behind and using

1457
01:03:26,750 --> 01:03:23,880
those to determine the orbit period of

1458
01:03:28,190 --> 01:03:26,760
dimorphous around the demos this is such

1459
01:03:29,569 --> 01:03:28,200
a cool experience government of such a

1460
01:03:31,250 --> 01:03:29,579
singular experiment using the

1461
01:03:33,650 --> 01:03:31,260
ground-based telescopes like this one

1462
01:03:35,630 --> 01:03:33,660
and others around the world to to watch

1463
01:03:38,270 --> 01:03:35,640

the systems and see how it's affected by

1464
01:03:39,890 --> 01:03:38,280
this impact event because that's really

1465
01:03:42,650 --> 01:03:39,900
what's going to give us the answer to

1466
01:03:44,630 --> 01:03:42,660
what did Dart do at the time of impact

1467
01:03:46,130 --> 01:03:44,640
and that will be exciting to see how

1468
01:03:50,510 --> 01:03:46,140
that evolves over the days and weeks

1469
01:03:57,049 --> 01:03:53,530
all right after a 10-month

1470
01:04:01,010 --> 01:03:57,059
470 million mile Journey Dart is just

1471
01:04:03,049 --> 01:04:01,020
minutes away from making history a truly

1472
01:04:04,970 --> 01:04:03,059
Global effort this Mission has brought

1473
01:04:08,630 --> 01:04:04,980
together people from around the world

1474
01:04:10,430 --> 01:04:08,640
United under one goal to find a way to

1475
01:04:13,549 --> 01:04:10,440
protect Humanity from a hazardous

1476
01:04:16,069 --> 01:04:13,559
asteroid if one were ever discovered now

1477
01:04:18,710 --> 01:04:16,079
usually NASA spacecraft are intended to

1478
01:04:21,530 --> 01:04:18,720
operate for many years or even decades

1479
01:04:24,470 --> 01:04:21,540
but not Dart Dart was built to be

1480
01:04:26,390 --> 01:04:24,480
destroyed Dart is a mission of Firsts

1481
01:04:29,750 --> 01:04:26,400
proving that a spacecraft can

1482
01:04:32,569 --> 01:04:29,760
autonomously seek find and approach a

1483
01:04:34,849 --> 01:04:32,579
Target in space that's so far away we

1484
01:04:37,549 --> 01:04:34,859
don't even know what it looks like it

1485
01:04:40,010 --> 01:04:37,559
also marks the first time humanity will

1486
01:04:43,309 --> 01:04:40,020
have moved a planetary body in the

1487
01:04:45,710 --> 01:04:43,319
universe I said that correctly now at

1488
01:04:48,349 --> 01:04:45,720

this point the spacecraft is controlling

1489
01:04:50,569 --> 01:04:48,359
itself making small Maneuvers to ensure

1490
01:04:53,030 --> 01:04:50,579
it's lined up with its Target

1491
01:04:55,190 --> 01:04:53,040
Dart is speeding through space and we'll

1492
01:04:58,370 --> 01:04:55,200
cover the last four miles of its journey

1493
01:05:00,470 --> 01:04:58,380
in just one second coming up we'll hear

1494
01:05:03,349 --> 01:05:00,480
the final updates from Mission operators

1495
01:05:06,829 --> 01:05:03,359
and witness the big moment Live from

1496
01:05:09,289 --> 01:05:06,839
Space Samson you have the best seat in

1497
01:05:11,870 --> 01:05:09,299
the house how are we looking

1498
01:05:14,809 --> 01:05:11,880
you're right Sahara front row tickets to

1499
01:05:17,450 --> 01:05:14,819
the biggest event in town and things are

1500
01:05:19,910 --> 01:05:17,460
looking good we are T minus 10 minutes

1501
01:05:22,370 --> 01:05:19,920
to impact and dart is precision locked

1502
01:05:24,589 --> 01:05:22,380
onto dimorphos and zooming down the home

1503
01:05:26,569 --> 01:05:24,599
stretch now we have a lot to cover in

1504
01:05:29,089 --> 01:05:26,579
the time we have left and I'm thrilled

1505
01:05:31,609 --> 01:05:29,099
to have with me Lori glaze director of

1506
01:05:34,130 --> 01:05:31,619
NASA's planetary science division with

1507
01:05:36,589 --> 01:05:34,140
me for the ride Lori such a pleasure to

1508
01:05:38,710 --> 01:05:36,599
have you oh my gosh I am so excited to

1509
01:05:42,650 --> 01:05:38,720
be here and really happy that we are

1510
01:05:45,470 --> 01:05:42,660
here in this final 10 minutes we are

1511
01:05:48,170 --> 01:05:45,480
almost there while you are just in the

1512
01:05:50,210 --> 01:05:48,180
thick of it with the team up until a few

1513
01:05:53,030 --> 01:05:50,220

minutes ago what is the atmosphere like

1514
01:05:55,309 --> 01:05:53,040
in there I can only imagine

1515
01:05:58,370 --> 01:05:55,319
it's really it's great I mean they're

1516
01:06:00,289 --> 01:05:58,380
excited every time there's a marker that

1517
01:06:02,569 --> 01:06:00,299
we we meet a milestone everyone is

1518
01:06:05,750 --> 01:06:02,579
cheering and very excited but there's

1519
01:06:09,049 --> 01:06:05,760
also almost a sense of a calm confidence

1520
01:06:12,410 --> 01:06:09,059
that with every Milestone everything's

1521
01:06:14,809 --> 01:06:12,420
going you know as planned uh We've we're

1522
01:06:16,609 --> 01:06:14,819
found and we locked on the the target as

1523
01:06:18,530 --> 01:06:16,619
planned pretty much at the right time

1524
01:06:20,809 --> 01:06:18,540
they're looking at the brightness and

1525
01:06:23,210 --> 01:06:20,819
the reflectivity of the object and and

1526
01:06:25,250 --> 01:06:23,220
it's more or less what they expected

1527
01:06:26,990 --> 01:06:25,260
um everything is performing as expected

1528
01:06:29,329 --> 01:06:27,000
and so there's a lot of cheering and

1529
01:06:31,130 --> 01:06:29,339
happiness but just kind of a sense hey

1530
01:06:33,170 --> 01:06:31,140
you know we've been planning for this a

1531
01:06:35,150 --> 01:06:33,180
long time and we've got it we've got

1532
01:06:37,370 --> 01:06:35,160
this we've been planning for this we can

1533
01:06:39,950 --> 01:06:37,380
hear Applause left and right throughout

1534
01:06:41,809 --> 01:06:39,960
this evening all good signs

1535
01:06:44,270 --> 01:06:41,819
what are they focused on at this

1536
01:06:46,849 --> 01:06:44,280
critical juncture Lori it is basically

1537
01:06:48,529 --> 01:06:46,859
years of planning 10 months on making

1538
01:06:51,230 --> 01:06:48,539

sure we get to this point after launch

1539
01:06:52,910 --> 01:06:51,240
and they've been juggling a lot is there

1540
01:06:55,849 --> 01:06:52,920
anything in particular that they are

1541
01:06:57,710 --> 01:06:55,859
glued on as we enter this moment as Ruth

1542
01:06:59,990 --> 01:06:57,720
yeah so the main thing they've been

1543
01:07:01,309 --> 01:07:00,000
watching is you know getting to that

1544
01:07:04,010 --> 01:07:01,319
point where we could do the Precision

1545
01:07:06,589 --> 01:07:04,020
lock where we had good enough signal

1546
01:07:08,870 --> 01:07:06,599
coming back and enough confidence in

1547
01:07:11,450 --> 01:07:08,880
where we are relative to dimorphous that

1548
01:07:13,670 --> 01:07:11,460
we could really do that Precision lock

1549
01:07:15,829 --> 01:07:13,680
onto the Target and we it's hands off

1550
01:07:18,230 --> 01:07:15,839
now right we're not you know the the

1551
01:07:20,809 --> 01:07:18,240
spacecraft is going to drive itself and

1552
01:07:22,549 --> 01:07:20,819
really focused on that uh you know that

1553
01:07:24,710 --> 01:07:22,559
point where they could be Precision

1554
01:07:27,430 --> 01:07:24,720
locked and they're also thinking about

1555
01:07:30,410 --> 01:07:27,440
looking at and reassessing continuously

1556
01:07:31,970 --> 01:07:30,420
what's the probability of Miss right as

1557
01:07:34,010 --> 01:07:31,980
you get closer and closer that probably

1558
01:07:37,010 --> 01:07:34,020
should get smaller and smaller and it is

1559
01:07:39,410 --> 01:07:37,020
it's getting it looks really really good

1560
01:07:41,029 --> 01:07:39,420
right now wow it sounds like the game of

1561
01:07:43,730 --> 01:07:41,039
thinking of what wondering really

1562
01:07:46,130 --> 01:07:43,740
doesn't end until that last second comes

1563
01:07:47,750 --> 01:07:46,140

to pass so they can do a lot of great up

1564
01:07:50,029 --> 01:07:47,760
into this point we just have to see this

1565
01:07:52,190 --> 01:07:50,039
through to these last few minutes

1566
01:07:54,170 --> 01:07:52,200
well in a few minutes speaking of that

1567
01:07:56,690 --> 01:07:54,180
all the years of thinking of doing

1568
01:07:57,710 --> 01:07:56,700
planning reacting is finally coming to

1569
01:07:59,329 --> 01:07:57,720
an end

1570
01:08:01,250 --> 01:07:59,339
from five minutes to impact there will

1571
01:08:02,930 --> 01:08:01,260
be no more opportunity to send any

1572
01:08:05,089 --> 01:08:02,940
commands to Smart nav in the mission

1573
01:08:08,089 --> 01:08:05,099
operations center the team will be

1574
01:08:09,890 --> 01:08:08,099
purely Spectators the data coming in and

1575
01:08:12,890 --> 01:08:09,900
they are just wetting it out like the

1576
01:08:14,690 --> 01:08:12,900
rest of us for the first time

1577
01:08:16,490 --> 01:08:14,700
Lori this is huge both from an

1578
01:08:18,349 --> 01:08:16,500
operational perspective and also an

1579
01:08:21,050 --> 01:08:18,359
emotional one isn't it

1580
01:08:23,030 --> 01:08:21,060
yeah it is I mean you can imagine

1581
01:08:24,650 --> 01:08:23,040
um you know I've you've been I'm really

1582
01:08:26,570 --> 01:08:24,660
excited about it and I've been engaged

1583
01:08:28,130 --> 01:08:26,580
with this mission for you know the last

1584
01:08:30,709 --> 01:08:28,140
four and a half years that I've been in

1585
01:08:33,950 --> 01:08:30,719
my current role but this team has been

1586
01:08:36,470 --> 01:08:33,960
working so hard on this for so many

1587
01:08:39,470 --> 01:08:36,480
years and they've put so much of their

1588
01:08:41,990 --> 01:08:39,480

energy and their time into this and so

1589
01:08:44,689 --> 01:08:42,000
much planning and rehearsing and you

1590
01:08:47,269 --> 01:08:44,699
know it's uh it's a it's a really big

1591
01:08:49,249 --> 01:08:47,279
event for them to like you say just

1592
01:08:50,809 --> 01:08:49,259
counting down and watching at this point

1593
01:08:52,309 --> 01:08:50,819
there's not much else they can do but

1594
01:08:54,590 --> 01:08:52,319
watch and see the fruits of all their

1595
01:08:56,390 --> 01:08:54,600
work yeah I've gotten to know many

1596
01:08:58,249 --> 01:08:56,400
members of this team over the past few

1597
01:09:00,829 --> 01:08:58,259
months and you know there's a lot of

1598
01:09:02,809 --> 01:09:00,839
alpha individuals on there right you

1599
01:09:04,970 --> 01:09:02,819
need a good mix of alpha people to make

1600
01:09:07,610 --> 01:09:04,980
sure we get to this point

1601
01:09:08,990 --> 01:09:07,620
I can imagine I can only imagine what

1602
01:09:10,970 --> 01:09:09,000
they're feeling perhaps like you said a

1603
01:09:12,829 --> 01:09:10,980
little bit of relief a little bit of can

1604
01:09:15,050 --> 01:09:12,839
I let this go I've worked for this one

1605
01:09:16,970 --> 01:09:15,060
so long and now we can no longer do

1606
01:09:19,130 --> 01:09:16,980
anything that moment is just coming up

1607
01:09:21,289 --> 01:09:19,140
yeah but I think they're ready I think

1608
01:09:22,849 --> 01:09:21,299
they're they're at that point you know I

1609
01:09:25,370 --> 01:09:22,859
was you're you're getting some shots of

1610
01:09:27,110 --> 01:09:25,380
Elena Adams the uh the systems engineer

1611
01:09:30,410 --> 01:09:27,120
and you can see the excitement in her

1612
01:09:33,709 --> 01:09:30,420
voice she's so ready to to show the

1613
01:09:35,870 --> 01:09:33,719

success of this Mission this is awesome

1614
01:09:38,749 --> 01:09:35,880
five minutes out which we're coming up

1615
01:09:40,910 --> 01:09:38,759
on now the team will be hands off two

1616
01:09:42,410 --> 01:09:40,920
and a half minutes from Impact smart now

1617
01:09:45,050 --> 01:09:42,420
which has been guiding the spacecraft

1618
01:09:47,870 --> 01:09:45,060
autonomously for four hours we'll also

1619
01:09:50,150 --> 01:09:47,880
step away stop any Maneuvers Dart will

1620
01:09:52,669 --> 01:09:50,160
simply be coasting to its fate this is

1621
01:09:54,950 --> 01:09:52,679
Blockbuster stuff Lorraine oh yeah oh

1622
01:09:58,850 --> 01:09:56,270
are there

1623
01:10:01,189 --> 01:09:58,860
yeah I have front row tickets and we are

1624
01:10:02,810 --> 01:10:01,199
very soon about to open up these

1625
01:10:05,150 --> 01:10:02,820
Airwaves in the mission operations

1626
01:10:07,310 --> 01:10:05,160
center we'll stay plugged in all the way

1627
01:10:09,530 --> 01:10:07,320
through impact remember at this point

1628
01:10:12,050 --> 01:10:09,540
five minutes out no more commands see

1629
01:10:14,209 --> 01:10:12,060
smart nav will be possible the team is

1630
01:10:25,729 --> 01:10:14,219
watching it just like you and me and the

1631
01:10:25,739 --> 01:10:34,910
foreign

1632
01:10:37,970 --> 01:10:36,649
all right we've reached five minutes

1633
01:10:40,189 --> 01:10:37,980
from Impact

1634
01:10:42,890 --> 01:10:40,199
the final command opportunity to

1635
01:10:45,050 --> 01:10:42,900
smartness has passed and the team is

1636
01:10:47,750 --> 01:10:45,060
simply watching that data streaming just

1637
01:10:53,750 --> 01:10:51,169
also remember there is a 30 second 38

1638
01:10:55,370 --> 01:10:53,760

second leg for the data to travel to

1639
01:10:57,890 --> 01:10:55,380
earth and also an additional few more

1640
01:11:05,570 --> 01:10:57,900
seconds for image processing important

1641
01:11:09,770 --> 01:11:07,790
you should be hearing

1642
01:11:13,850 --> 01:11:09,780
the chatter in the mission operations

1643
01:11:19,370 --> 01:11:16,610
this is Dart MSC NDT MOG five minutes

1644
01:11:21,430 --> 01:11:19,380
still impact five minutes till impact we

1645
01:11:24,770 --> 01:11:21,440
are at

1646
01:11:30,890 --> 01:11:24,780
1100 miles away

1647
01:11:37,310 --> 01:11:33,890
also our window for sending any commands

1648
01:11:45,110 --> 01:11:39,550
contingency is done

1649
01:11:49,250 --> 01:11:47,030
this is a great vibe in that machine

1650
01:11:51,229 --> 01:11:49,260
recreation center right now Lori

1651
01:11:53,750 --> 01:11:51,239
it really is

1652
01:11:55,270 --> 01:11:53,760
um they are so excited

1653
01:11:57,350 --> 01:11:55,280
and this is

1654
01:11:59,510 --> 01:11:57,360
I'm honing and looking at these images

1655
01:12:01,970 --> 01:11:59,520
as we get closer and closer and you look

1656
01:12:04,189 --> 01:12:01,980
at didimos and just you're starting to

1657
01:12:07,490 --> 01:12:04,199
see the this physical body appear there

1658
01:12:09,950 --> 01:12:07,500
it's incredible just incredible still

1659
01:12:13,070 --> 01:12:09,960
having a hard time believing this is

1660
01:12:15,410 --> 01:12:13,080
real energy coming in near real time

1661
01:12:18,229 --> 01:12:15,420
yeah yeah but you've been watching it

1662
01:12:19,850 --> 01:12:18,239
over the last you know 30 45 minutes go

1663
01:12:21,709 --> 01:12:19,860

from just being a collection of

1664
01:12:24,050 --> 01:12:21,719
individual pixels and now you can

1665
01:12:27,169 --> 01:12:24,060
actually see the shape and the the

1666
01:12:28,790 --> 01:12:27,179
shading and texture of of didimos and

1667
01:12:31,370 --> 01:12:28,800
we're going to see that same thing with

1668
01:12:33,229 --> 01:12:31,380
dimorphous as we get closer and closer

1669
01:12:35,510 --> 01:12:33,239
this is so cool

1670
01:12:40,870 --> 01:12:35,520
never before super images of the

1671
01:12:48,470 --> 01:12:43,370
it's amazing

1672
01:12:53,810 --> 01:12:50,810
the team is standing just recognizing

1673
01:12:56,630 --> 01:12:53,820
this moment years in the making

1674
01:12:58,189 --> 01:12:56,640
it is really nice to see them relax a

1675
01:12:59,689 --> 01:12:58,199
little bit get off from those computers

1676
01:13:01,490 --> 01:12:59,699
that they've been glued to and just

1677
01:13:03,709 --> 01:13:01,500
appreciate this moment that's coming

1678
01:13:07,729 --> 01:13:03,719
yeah and they've earned this

1679
01:13:13,130 --> 01:13:10,070
so cool Lori we hit another major

1680
01:13:15,110 --> 01:13:13,140
Milestone we are now two minutes and a

1681
01:13:17,630 --> 01:13:15,120
half from Impact and smart nav has

1682
01:13:19,970 --> 01:13:17,640
stopped maneuvering the spacecraft Dart

1683
01:13:22,570 --> 01:13:19,980
is now coasting toward dimorphos and we

1684
01:13:25,310 --> 01:13:22,580
hope into the history books

1685
01:13:27,770 --> 01:13:25,320
absolutely this will be I'm sure you've

1686
01:13:31,370 --> 01:13:27,780
heard it many times tonight Humanity's

1687
01:13:34,189 --> 01:13:31,380
first ever ever attempt at trying to

1688
01:13:37,189 --> 01:13:34,199

move another Celestial body and also our

1689
01:13:39,169 --> 01:13:37,199
first attempt ever to execute a mission

1690
01:13:40,729 --> 01:13:39,179
in your sole purpose of planetary

1691
01:13:43,550 --> 01:13:40,739
defense so

1692
01:13:45,350 --> 01:13:43,560
what an exciting exciting time yeah and

1693
01:13:47,030 --> 01:13:45,360
I'm starting to see dimorphous start to

1694
01:13:48,470 --> 01:13:47,040
come into view there you can see it's

1695
01:13:51,350 --> 01:13:48,480
starting to take shape I'm starting to

1696
01:13:52,930 --> 01:13:51,360
see individual Boulders on didymos

1697
01:13:56,290 --> 01:13:52,940
um unbelievable

1698
01:13:58,910 --> 01:13:56,300
unbelievable Clarity of images

1699
01:13:59,730 --> 01:13:58,920
distance is going to be about 17 meters

1700
01:14:06,709 --> 01:13:59,740
all right

1701
01:14:09,169 --> 01:14:06,719
[Applause]

1702
01:14:11,630 --> 01:14:09,179
all honors on this event space

1703
01:14:13,189 --> 01:14:11,640
telescopes ground telescopes from every

1704
01:14:17,570 --> 01:14:13,199
continent on Earth

1705
01:14:20,810 --> 01:14:19,189
two minutes out

1706
01:14:23,810 --> 01:14:20,820
does not look like one single Rock

1707
01:14:27,709 --> 01:14:23,820
tonight oh boy we're getting close

1708
01:14:31,130 --> 01:14:27,719
14 000 miles per hour Laurie 14 000

1709
01:14:33,709 --> 01:14:31,140
miles per hour and remember you know uh

1710
01:14:36,410 --> 01:14:33,719
45 minutes ago 55 minutes ago we

1711
01:14:39,770 --> 01:14:36,420
couldn't even resolve this this object

1712
01:14:42,709 --> 01:14:39,780
in space and now we are you can see us

1713
01:14:44,750 --> 01:14:42,719

zeroing in right on Target and we're now

1714
01:14:48,350 --> 01:14:44,760
dropping the clock and we'll go by loss

1715
01:14:49,610 --> 01:14:48,360
of signal to confirm impact right

1716
01:14:51,350 --> 01:14:49,620
yes

1717
01:14:53,149 --> 01:14:51,360
imagine we'll get that loss of signal

1718
01:14:54,070 --> 01:14:53,159
and then we'll hear from Lena Adams

1719
01:14:57,370 --> 01:14:54,080
again

1720
01:15:00,430 --> 01:14:57,380
letting us know

1721
01:15:04,250 --> 01:15:00,440
like I'll be a crystal clear

1722
01:15:05,810 --> 01:15:04,260
signal I think so I think we're starting

1723
01:15:08,810 --> 01:15:05,820
to see more

1724
01:15:10,669 --> 01:15:08,820
uh more resolution in fact look at that

1725
01:15:13,070 --> 01:15:10,679
didymos has even gone out of the view

1726
01:15:17,990 --> 01:15:13,080
we're now just seeing dimorphous

1727
01:15:22,430 --> 01:15:20,750
oh my goodness look at that looks like

1728
01:15:23,990 --> 01:15:22,440
control systems settling down angular

1729
01:15:24,950 --> 01:15:24,000
rates look really good

1730
01:15:29,090 --> 01:15:24,960
I think we're going to get the

1731
01:15:35,870 --> 01:15:31,370
wow

1732
01:15:39,950 --> 01:15:37,189
starting to see those individual

1733
01:15:43,250 --> 01:15:39,960
Boulders there you can see Shadows

1734
01:15:47,590 --> 01:15:46,669
it's amazing guys oh my goodness look at

1735
01:15:51,770 --> 01:15:47,600
that

1736
01:16:01,550 --> 01:15:53,510
looks to me like we're headed straight

1737
01:16:09,290 --> 01:16:04,550
oh my gosh oh wow

1738
01:16:11,390 --> 01:16:09,300

yeah oh my goodness yeah seven and six

1739
01:16:14,149 --> 01:16:11,400
wow four

1740
01:16:17,030 --> 01:16:14,159
three two

1741
01:16:21,530 --> 01:16:18,890
oh my gosh

1742
01:16:22,460 --> 01:16:21,540
oh wow you're getting visual

1743
01:16:36,790 --> 01:16:22,470
confirmation

1744
01:16:40,870 --> 01:16:36,800
[Applause]

1745
01:16:42,430 --> 01:16:40,880
in the name of planetary defense

1746
01:16:49,370 --> 01:16:42,440
fantastic

1747
01:16:53,930 --> 01:16:51,470
what a moment very few words can really

1748
01:17:04,070 --> 01:16:53,940
capture this moment this is beautiful to

1749
01:17:09,290 --> 01:17:06,950
um what a team one team and what an

1750
01:17:11,209 --> 01:17:09,300
accomplishment team a few weeks ago they

1751
01:17:12,890 --> 01:17:11,219
had their last dress rehearsal

1752
01:17:14,570 --> 01:17:12,900
they were getting emotional at the

1753
01:17:15,890 --> 01:17:14,580
dresser or something like this is this

1754
01:17:17,149 --> 01:17:15,900
is crazy we're getting emotional this is

1755
01:17:20,330 --> 01:17:17,159
not the real thing I can only imagine

1756
01:17:22,430 --> 01:17:20,340
what they are feeling right now

1757
01:17:24,169 --> 01:17:22,440
yes

1758
01:17:26,510 --> 01:17:24,179
well you can see them there on screen

1759
01:17:27,740 --> 01:17:26,520
they're all pretty excited

1760
01:17:29,689 --> 01:17:27,750
wow

1761
01:17:31,970 --> 01:17:29,699
[Applause]

1762
01:17:35,030 --> 01:17:31,980
hearing impact the curtains close on

1763
01:17:36,950 --> 01:17:35,040

Draco feed that raw Joy from the team

1764
01:17:39,050 --> 01:17:36,960
years of hard work and the weight of

1765
01:17:51,010 --> 01:17:39,060
expectation lifted off their shoulders

1766
01:17:57,590 --> 01:17:54,530
this is beautiful and Lori really this

1767
01:17:58,729 --> 01:17:57,600
is a huge moment for the mission lots

1768
01:18:01,310 --> 01:17:58,739
more work

1769
01:18:03,649 --> 01:18:01,320
needs to happen in the days absolutely

1770
01:18:05,390 --> 01:18:03,659
now you know as I always say it's one of

1771
01:18:07,910 --> 01:18:05,400
my favorite missions now is when the

1772
01:18:10,850 --> 01:18:07,920
science starts it just starts now now

1773
01:18:13,910 --> 01:18:10,860
that we've impacted now we're going to

1774
01:18:15,910 --> 01:18:13,920
see for real how effective we were we're

1775
01:18:19,430 --> 01:18:15,920
going to train all of those ground-based

1776
01:18:21,890 --> 01:18:19,440
telescopes on the Diddy most dimorphous

1777
01:18:25,490 --> 01:18:21,900
system and we're gonna make measurements

1778
01:18:27,649 --> 01:18:25,500
that will help us determine just how

1779
01:18:30,709 --> 01:18:27,659
what its orbit looks like now relative

1780
01:18:32,390 --> 01:18:30,719
to what it was before so gonna be great

1781
01:18:33,830 --> 01:18:32,400
very cool

1782
01:18:35,870 --> 01:18:33,840
all right this is when science

1783
01:18:38,450 --> 01:18:35,880
engineering and

1784
01:18:40,310 --> 01:18:38,460
a great purpose planetary defense come

1785
01:18:42,290 --> 01:18:40,320
together and

1786
01:18:43,910 --> 01:18:42,300
you know it makes a magical Moment Like

1787
01:18:45,530 --> 01:18:43,920
This yeah

1788
01:18:48,470 --> 01:18:45,540

absolutely and you can see so many

1789
01:18:52,070 --> 01:18:48,480
people there that have made this happen

1790
01:18:53,630 --> 01:18:52,080
the team of APL Engineers that have

1791
01:18:56,689 --> 01:18:53,640
really

1792
01:18:58,669 --> 01:18:56,699
poured their souls into this mission

1793
01:19:00,050 --> 01:18:58,679
Lori any last words to mark this

1794
01:19:01,550 --> 01:19:00,060
historic moment

1795
01:19:06,410 --> 01:19:01,560
oh

1796
01:19:10,490 --> 01:19:06,420
we're we're embarking on a new era of

1797
01:19:13,430 --> 01:19:10,500
humankind an Aaron which we potentially

1798
01:19:15,590 --> 01:19:13,440
have the capability to protect ourselves

1799
01:19:18,410 --> 01:19:15,600
from something like a dangerous

1800
01:19:19,729 --> 01:19:18,420
hazardous asteroid impact what an

1801
01:19:21,530 --> 01:19:19,739
amazing thing we've never had that

1802
01:19:23,709 --> 01:19:21,540
capability before thank you so much

1803
01:19:30,850 --> 01:19:23,719
Larry those are poignant Last Words

1804
01:19:38,209 --> 01:19:35,030
wow I mean what an exciting day for the

1805
01:19:42,709 --> 01:19:38,219
dart team and in in case you're keeping

1806
01:19:44,689 --> 01:19:42,719
score Humanity one asteroids zero now

1807
01:19:47,390 --> 01:19:44,699
I'm here with Nancy Chabot Dart

1808
01:19:49,910 --> 01:19:47,400
coordination lead Nancy talk about a

1809
01:19:52,189 --> 01:19:49,920
moment to catch on camera what is going

1810
01:19:54,229 --> 01:19:52,199
through your head right now I mean I'm

1811
01:19:56,149 --> 01:19:54,239
just thinking wow that was amazing

1812
01:19:58,310 --> 01:19:56,159
wasn't it I mean those images you just

1813
01:19:59,810 --> 01:19:58,320

got closer and closer and sort of we've

1814
01:20:02,510 --> 01:19:59,820
been planning for this moment we've been

1815
01:20:04,310 --> 01:20:02,520
talking about it for years at APL here

1816
01:20:06,649 --> 01:20:04,320
we've been working on this since 2015.

1817
01:20:07,610 --> 01:20:06,659
and I knew I've been talking this is the

1818
01:20:09,470 --> 01:20:07,620
images that we're going to see and

1819
01:20:11,030 --> 01:20:09,480
they're going to be spectacular and I

1820
01:20:12,830 --> 01:20:11,040
think even then they exceeded my

1821
01:20:14,810 --> 01:20:12,840
expectations of just zooming in like

1822
01:20:16,850 --> 01:20:14,820
that and uh you know it really is just

1823
01:20:19,370 --> 01:20:16,860
such the team accomplishment and to get

1824
01:20:21,169 --> 01:20:19,380
to this moment over so many years

1825
01:20:23,030 --> 01:20:21,179
and I don't have to talk about it as

1826
01:20:25,189 --> 01:20:23,040
coming anymore it's happened now we

1827
01:20:28,490 --> 01:20:25,199
haven't done this it's happened and it

1828
01:20:31,490 --> 01:20:28,500
is just incredible that as humans like

1829
01:20:33,229 --> 01:20:31,500
we have done this we did this and Nancy

1830
01:20:35,270 --> 01:20:33,239
do you have anything you'd like to say

1831
01:20:36,770 --> 01:20:35,280
to the teams who made tonight possible

1832
01:20:38,090 --> 01:20:36,780
oh I mean I don't need to say anything

1833
01:20:40,669 --> 01:20:38,100
to the teams because I know everybody

1834
01:20:42,590 --> 01:20:40,679
like me is really proud to be part of

1835
01:20:44,209 --> 01:20:42,600
this right proud of this thing that

1836
01:20:46,310 --> 01:20:44,219
we've been working on for years you know

1837
01:20:48,350 --> 01:20:46,320
and even before 2015 internationally

1838
01:20:50,330 --> 01:20:48,360

people wanted to do this people wanted

1839
01:20:51,950 --> 01:20:50,340
to take this first test and then we

1840
01:20:54,709 --> 01:20:51,960
finally did Partners across the United

1841
01:20:56,510 --> 01:20:54,719
States we have actually uh 28 countries

1842
01:20:58,010 --> 01:20:56,520
represented on our investigation team of

1843
01:21:00,709 --> 01:20:58,020
scientists telescopes on all seven

1844
01:21:02,630 --> 01:21:00,719
continents everybody doing their part to

1845
01:21:05,630 --> 01:21:02,640
make this moment happen

1846
01:21:07,189 --> 01:21:05,640
um I know I'm uh I'm really honored to

1847
01:21:09,530 --> 01:21:07,199
be on this team and I know other people

1848
01:21:11,990 --> 01:21:09,540
on the team feel the same way as you

1849
01:21:14,030 --> 01:21:12,000
should Nancy and I mean there's a lot to

1850
01:21:17,149 --> 01:21:14,040
celebrate here tonight and so now that

1851
01:21:19,669 --> 01:21:17,159
we have confirmed impact can you let us

1852
01:21:21,830 --> 01:21:19,679
know what's next for this mission

1853
01:21:25,390 --> 01:21:21,840
well I mean I think um I'm still taking

1854
01:21:30,709 --> 01:21:28,669
uh and we and this was a really hard

1855
01:21:32,390 --> 01:21:30,719
technology demonstration to hit a small

1856
01:21:35,209 --> 01:21:32,400
asteroid we've never seen before and do

1857
01:21:37,250 --> 01:21:35,219
it in such spectacular fashion

1858
01:21:38,689 --> 01:21:37,260
um but I know other scientists on the

1859
01:21:40,189 --> 01:21:38,699
team like me are already pointing at

1860
01:21:42,050 --> 01:21:40,199
those images being like did you see that

1861
01:21:43,550 --> 01:21:42,060
Boulder did you see that smooth area did

1862
01:21:46,370 --> 01:21:43,560
you see the shape what does that mean

1863
01:21:48,590 --> 01:21:46,380

and lychee cube is like flying by right

1864
01:21:50,270 --> 01:21:48,600
about now they're close approach like

1865
01:21:51,729 --> 01:21:50,280
taking images and they're storing them

1866
01:21:54,229 --> 01:21:51,739
and we'll get those in the next days

1867
01:21:55,610 --> 01:21:54,239
telescopes here and in space are looking

1868
01:21:57,229 --> 01:21:55,620
they're looking at the brightening of

1869
01:21:59,270 --> 01:21:57,239
the rock that's thrown off from that

1870
01:22:01,310 --> 01:21:59,280
spectacular Collision that we saw and

1871
01:22:02,990 --> 01:22:01,320
this is going to go on for weeks and so

1872
01:22:04,669 --> 01:22:03,000
there's still a lot of excitement to

1873
01:22:06,410 --> 01:22:04,679
come but uh nothing to take away from

1874
01:22:07,850 --> 01:22:06,420
this moment yeah this is just the

1875
01:22:09,709 --> 01:22:07,860
beginning it looks like everybody is

1876
01:22:12,410 --> 01:22:09,719
celebrating here in Mission operations I

1877
01:22:15,950 --> 01:22:12,420
think I just saw Bill Nye there and so

1878
01:22:18,470 --> 01:22:15,960
it is a huge day for this team but also

1879
01:22:20,450 --> 01:22:18,480
for Humanity you know Nancy you

1880
01:22:22,729 --> 01:22:20,460
mentioned earlier about about some of

1881
01:22:23,750 --> 01:22:22,739
the international collaborations and

1882
01:22:26,689 --> 01:22:23,760
Could you

1883
01:22:29,090 --> 01:22:26,699
um give us an idea on kind of the scope

1884
01:22:31,010 --> 01:22:29,100
of dart's mission right it's not just us

1885
01:22:32,750 --> 01:22:31,020
in the United States that's focusing on

1886
01:22:34,729 --> 01:22:32,760
this so can you expand a little on that

1887
01:22:36,950 --> 01:22:34,739
yeah I mean planetary defense is really

1888
01:22:39,290 --> 01:22:36,960

an international issue we are all on

1889
01:22:40,910 --> 01:22:39,300
this planet together right yeah so and I

1890
01:22:43,130 --> 01:22:40,920
think it's been so great for this

1891
01:22:45,790 --> 01:22:43,140
mission to really support and embrace

1892
01:22:48,110 --> 01:22:45,800
that planetary planetary International

1893
01:22:50,510 --> 01:22:48,120
cooperation for planetary defense so

1894
01:22:52,850 --> 01:22:50,520
that we can maximize what we learn and

1895
01:22:54,709 --> 01:22:52,860
uh this idea came about from

1896
01:22:56,870 --> 01:22:54,719
International scientists talking to each

1897
01:22:58,850 --> 01:22:56,880
other working together you know in order

1898
01:23:00,290 --> 01:22:58,860
to make this moment happen for NASA's

1899
01:23:03,350 --> 01:23:00,300
planetary defense coordination office

1900
01:23:05,270 --> 01:23:03,360
building the spacecraft here at APL but

1901
01:23:07,970 --> 01:23:05,280
really uh scientists around the world

1902
01:23:10,070 --> 01:23:07,980
are ready to get studied what could we

1903
01:23:11,330 --> 01:23:10,080
do to dimorphos and but more importantly

1904
01:23:13,130 --> 01:23:11,340
what does that mean for potentially

1905
01:23:15,290 --> 01:23:13,140
applying this in the future I mean Dart

1906
01:23:17,630 --> 01:23:15,300
really is just the start it's just the

1907
01:23:19,130 --> 01:23:17,640
first planetary defense test mission it

1908
01:23:21,050 --> 01:23:19,140
was spectacular and it's accomplished

1909
01:23:22,370 --> 01:23:21,060
and will figure out how effective it was

1910
01:23:24,229 --> 01:23:22,380
that's really what we're going to learn

1911
01:23:26,390 --> 01:23:24,239
in the next weeks to come all right we

1912
01:23:28,010 --> 01:23:26,400
hit this asteroid now how effective was

1913
01:23:29,870 --> 01:23:28,020

that at deflecting it and what would

1914
01:23:32,750 --> 01:23:29,880
that mean for using it yeah there's

1915
01:23:35,510 --> 01:23:32,760
still so much to unpackage here and so

1916
01:23:37,610 --> 01:23:35,520
we have a special guest who is wondering

1917
01:23:41,570 --> 01:23:37,620
you know more of what's next for this

1918
01:23:47,630 --> 01:23:44,030
hey everyone I'm Danny Hanson American

1919
01:23:49,370 --> 01:23:47,640
paralympic grower and hydro athlete and

1920
01:23:51,649 --> 01:23:49,380
first I would like to congratulate the

1921
01:23:53,689 --> 01:23:51,659
entire dart team on crossing the finish

1922
01:23:56,209 --> 01:23:53,699
line so congratulations

1923
01:23:59,149 --> 01:23:56,219
and with that here's my question

1924
01:24:01,189 --> 01:23:59,159
now the dart has impacted how will you

1925
01:24:04,550 --> 01:24:01,199
know if the spacecraft has actually

1926
01:24:07,310 --> 01:24:04,560
changed the asteroid's orbit

1927
01:24:09,169 --> 01:24:07,320
it's a good question yeah I mean so this

1928
01:24:11,810 --> 01:24:09,179
is a double asteroid system so all we've

1929
01:24:13,490 --> 01:24:11,820
done here actually is uh is changed

1930
01:24:16,189 --> 01:24:13,500
slightly how dimorphos goes around

1931
01:24:17,750 --> 01:24:16,199
dynamos right and the the telescopes on

1932
01:24:20,689 --> 01:24:17,760
the earth have studied this for years so

1933
01:24:22,790 --> 01:24:20,699
we knew it used to be 11 hours and 55

1934
01:24:24,229 --> 01:24:22,800
minutes what is it going to be now and

1935
01:24:25,669 --> 01:24:24,239
so the telescopes are going to measure

1936
01:24:27,410 --> 01:24:25,679
that period change and they're so good

1937
01:24:29,390 --> 01:24:27,420
at this they've done it for decades

1938
01:24:30,770 --> 01:24:29,400

already to get us to that point and

1939
01:24:32,570 --> 01:24:30,780
they're going to work for the next weeks

1940
01:24:33,890 --> 01:24:32,580
and make that measurement and when we

1941
01:24:36,110 --> 01:24:33,900
have it we're going to be sure to share

1942
01:24:37,850 --> 01:24:36,120
it with everybody to see how much we did

1943
01:24:40,669 --> 01:24:37,860
deflect this asteroid with the dart

1944
01:24:42,169 --> 01:24:40,679
Collision wow well Nancy I mean it's

1945
01:24:44,270 --> 01:24:42,179
time for you to celebrate so

1946
01:24:46,729 --> 01:24:44,280
congratulations on everything tonight

1947
01:24:49,490 --> 01:24:46,739
and go dark oh go dark this was

1948
01:24:51,709 --> 01:24:49,500
spectacular yes and so we have Samson

1949
01:24:53,810 --> 01:24:51,719
standing by in Mission operations with

1950
01:24:55,970 --> 01:24:53,820
two very special guests let's hop over

1951
01:24:58,189 --> 01:24:55,980
there and see what's going on

1952
01:25:00,229 --> 01:24:58,199
thanks Tahira I have the pleasure of

1953
01:25:04,430 --> 01:25:00,239
introducing NASA administrator Bill

1954
01:25:07,610 --> 01:25:04,440
Nelson who has a special message for us

1955
01:25:11,510 --> 01:25:07,620
hey congratulations boy the dart team

1956
01:25:14,630 --> 01:25:11,520
you really did this one very well

1957
01:25:17,270 --> 01:25:14,640
it's been a successful completion of the

1958
01:25:19,910 --> 01:25:17,280
first part of the world's first

1959
01:25:22,610 --> 01:25:19,920
planetary defense test

1960
01:25:25,130 --> 01:25:22,620
and there were years of hard work there

1961
01:25:27,530 --> 01:25:25,140
was a lot of innovation and creativity

1962
01:25:30,470 --> 01:25:27,540
that went into this mission

1963
01:25:33,290 --> 01:25:30,480

and I believe it's going to teach us how

1964
01:25:35,750 --> 01:25:33,300
one day to protect our own planet from

1965
01:25:38,209 --> 01:25:35,760
an incoming asteroid

1966
01:25:40,790 --> 01:25:38,219
I really look forward to learning all

1967
01:25:44,510 --> 01:25:40,800
about what's happening from the

1968
01:25:48,229 --> 01:25:44,520
observatories so they can tell us about

1969
01:25:51,470 --> 01:25:48,239
the changes in this asteroid's orbit

1970
01:25:55,970 --> 01:25:51,480
so thank you to this international team

1971
01:26:00,470 --> 01:25:55,980
we are showing that planetary defense is

1972
01:26:05,169 --> 01:26:00,480
a global Endeavor and it is very

1973
01:26:09,950 --> 01:26:07,729
all right

1974
01:26:12,290 --> 01:26:09,960
that was eloquently put administrator

1975
01:26:14,570 --> 01:26:12,300
Nelson joining me right now are Deputy

1976
01:26:16,850 --> 01:26:14,580
NASA administrator Pam melroy an APL

1977
01:26:20,149 --> 01:26:16,860
director Ralph Semel thank you both for

1978
01:26:21,950 --> 01:26:20,159
being with me Pam I'll start with you

1979
01:26:25,729 --> 01:26:21,960
um how are you feeling having witnessed

1980
01:26:28,250 --> 01:26:25,739
this historic event up close oh I was

1981
01:26:29,810 --> 01:26:28,260
absolutely elated especially as we saw

1982
01:26:31,669 --> 01:26:29,820
the camera getting closer and just

1983
01:26:33,590 --> 01:26:31,679
realizing all the science that we're

1984
01:26:35,870 --> 01:26:33,600
going to learn but the best part was

1985
01:26:37,370 --> 01:26:35,880
seeing at the end that there was no

1986
01:26:40,729 --> 01:26:37,380
question there was going to be an impact

1987
01:26:42,290 --> 01:26:40,739
and to see the team Overjoyed with their

1988
01:26:45,530 --> 01:26:42,300

success

1989
01:26:48,410 --> 01:26:45,540
what does this mean for NASA what does

1990
01:26:50,750 --> 01:26:48,420
this mean for planetary defense

1991
01:26:53,209 --> 01:26:50,760
NASA works for the benefit of humanity

1992
01:26:55,189 --> 01:26:53,219
so for us it's the ultimate fulfillment

1993
01:26:57,950 --> 01:26:55,199
of our mission to do something like this

1994
01:27:01,850 --> 01:26:57,960
a technology demonstration that who

1995
01:27:04,189 --> 01:27:01,860
knows someday could save our home

1996
01:27:06,290 --> 01:27:04,199
very powerful thank you Pam

1997
01:27:08,629 --> 01:27:06,300
Ralph

1998
01:27:11,030 --> 01:27:08,639
you're in that mock for the moment of

1999
01:27:13,129 --> 01:27:11,040
impact we have seen a lot of major

2000
01:27:15,890 --> 01:27:13,139
milestones in apl's history in space

2001
01:27:17,990 --> 01:27:15,900
we're talking the first flyby of Pluto

2002
01:27:20,390 --> 01:27:18,000
the first mission to orbit Mercury and

2003
01:27:22,370 --> 01:27:20,400
now the first spacecraft to impact an

2004
01:27:23,870 --> 01:27:22,380
asteroid what was the moment like for

2005
01:27:27,890 --> 01:27:23,880
you in there

2006
01:27:31,850 --> 01:27:27,900
it it was it was incredible

2007
01:27:34,390 --> 01:27:31,860
to think to see how so many years of

2008
01:27:38,810 --> 01:27:34,400
hard work and creativity

2009
01:27:41,410 --> 01:27:38,820
resulted in a direct hit of dimorphos

2010
01:27:45,229 --> 01:27:41,420
was just an adrenaline rush

2011
01:27:46,910 --> 01:27:45,239
I'll add that I've been at the lab now

2012
01:27:48,770 --> 01:27:46,920
for quite a few years and I've been

2013
01:27:51,530 --> 01:27:48,780

involved in a lot of missions and

2014
01:27:56,750 --> 01:27:51,540
achievements and never before have I

2015
01:28:00,590 --> 01:27:56,760
been so excited to see a signal go away

2016
01:28:01,910 --> 01:28:00,600
and of image to stop Ralph I'm going to

2017
01:28:04,970 --> 01:28:01,920
give you both a tree right now we're

2018
01:28:06,890 --> 01:28:04,980
going to play that replay of impact on

2019
01:28:11,090 --> 01:28:06,900
our screens right now so we can enjoy it

2020
01:28:15,110 --> 01:28:13,370
rough what is this achina mean for Johns

2021
01:28:18,890 --> 01:28:15,120
Hopkins EPL

2022
01:28:21,649 --> 01:28:18,900
huge right oh it it is huge uh in fact

2023
01:28:24,770 --> 01:28:21,659
if you'll excuse the the pun-like

2024
01:28:28,189 --> 01:28:24,780
statement here the impact on APL as it

2025
01:28:29,570 --> 01:28:28,199
was on dimorphous is immense

2026
01:28:33,530 --> 01:28:29,580
um

2027
01:28:36,610 --> 01:28:33,540
this is exactly the kind of mission that

2028
01:28:40,370 --> 01:28:36,620
APL seeks to do a never before done

2029
01:28:42,530 --> 01:28:40,380
Mission I'd like to thank NASA for

2030
01:28:45,050 --> 01:28:42,540
entrusting us with this Mission and I'd

2031
01:28:48,169 --> 01:28:45,060
like to tell everyone how proud I am of

2032
01:28:50,270 --> 01:28:48,179
the entire dart team and APL for this

2033
01:28:52,129 --> 01:28:50,280
game-changing achievement incredible

2034
01:28:55,189 --> 01:28:52,139
thank you Ralph and we are watching that

2035
01:28:57,250 --> 01:28:55,199
replay right now on our screens and just

2036
01:29:06,910 --> 01:28:57,260
admiring that remarkable achievement

2037
01:29:12,830 --> 01:29:09,950
and now they are real objects to us

2038
01:29:19,070 --> 01:29:15,830

never before seen

2039
01:29:22,370 --> 01:29:19,080
up until today

2040
01:29:26,090 --> 01:29:24,110
you know it's just as good the second

2041
01:29:28,729 --> 01:29:26,100
and third time

2042
01:29:30,050 --> 01:29:28,739
there's that drop off knowingly made

2043
01:29:32,450 --> 01:29:30,060
impact

2044
01:29:34,970 --> 01:29:32,460
fantastic

2045
01:29:36,830 --> 01:29:34,980
well there you have it a lot of Pride

2046
01:29:39,110 --> 01:29:36,840
here tonight along with the promise of

2047
01:29:41,030 --> 01:29:39,120
big things to come and with a successful

2048
01:29:43,129 --> 01:29:41,040
Dart impact that will do it for us today

2049
01:29:45,370 --> 01:29:43,139
at the mission operations center back to

2050
01:29:49,430 --> 01:29:45,380
you Tahira

2051
01:29:52,070 --> 01:29:49,440
amazing I mean today is a fantastic day

2052
01:29:55,310 --> 01:29:52,080
and dart is just the beginning of a

2053
01:29:57,649 --> 01:29:55,320
global planetary defense effort in 2024

2054
01:30:00,110 --> 01:29:57,659
the European space agency's Hera Mission

2055
01:30:02,689 --> 01:30:00,120
will conduct follow-up observations of

2056
01:30:05,030 --> 01:30:02,699
Astro dimorphos and measure in great

2057
01:30:09,580 --> 01:30:05,040
detail dart's kinetic impactor test

2058
01:30:09,590 --> 01:30:16,510
[Music]

2059
01:30:20,629 --> 01:30:19,070
the third theme park is going to be an

2060
01:30:24,610 --> 01:30:20,639
incredible moment something we've been

2061
01:30:28,030 --> 01:30:24,620
looking for for over 17 years

2062
01:30:36,590 --> 01:30:30,709
and I'm leading the era mission for the

2063
01:30:40,250 --> 01:30:38,450

the deflection by Dart will be

2064
01:30:42,110 --> 01:30:40,260
measurable from ground with telescopes

2065
01:30:43,850 --> 01:30:42,120
however only with hair are coming up

2066
01:30:46,129 --> 01:30:43,860
close and inspecting the aster will

2067
01:30:48,169 --> 01:30:46,139
unveil although those parameters that

2068
01:30:50,629 --> 01:30:48,179
will allow us to plan for a deflection

2069
01:30:51,950 --> 01:30:50,639
Mission if one day we need one this is

2070
01:30:53,689 --> 01:30:51,960
the propulsion module of the

2071
01:30:56,149 --> 01:30:53,699
aerospacecraft that will take us to

2072
01:30:58,490 --> 01:30:56,159
Australia dimorphos and will allow us to

2073
01:31:00,770 --> 01:30:58,500
study the results of the dark impact the

2074
01:31:02,810 --> 01:31:00,780
propulsion module is being built here in

2075
01:31:04,669 --> 01:31:02,820
Italy and then will be sent to Germany

2076
01:31:06,649 --> 01:31:04,679
will be mated with the instruments and

2077
01:31:09,890 --> 01:31:06,659
the rest of the spacecraft to be ready

2078
01:31:11,689 --> 01:31:09,900
for launch in October 2024. we started

2079
01:31:13,910 --> 01:31:11,699
designing and conceiving the whole

2080
01:31:15,890 --> 01:31:13,920
mission at the spacecraft about two

2081
01:31:17,930 --> 01:31:15,900
years ago and we have a launch date to

2082
01:31:21,050 --> 01:31:17,940
meet there is a fixed date in October

2083
01:31:22,490 --> 01:31:21,060
2024 so it's challenging but we're

2084
01:31:25,070 --> 01:31:22,500
making it possible

2085
01:31:27,410 --> 01:31:25,080
you could say that Hera is really three

2086
01:31:29,090 --> 01:31:27,420
space missions in one we have one the

2087
01:31:32,390 --> 01:31:29,100
main spacecraft that we are currently

2088
01:31:34,070 --> 01:31:32,400

building at OHP in Germany but we also

2089
01:31:35,629 --> 01:31:34,080
have two smaller missions that are

2090
01:31:39,080 --> 01:31:35,639
spacecraft in their own right those are

2091
01:31:44,689 --> 01:31:39,090
the two cubesats Juventus and Milani

2092
01:31:49,189 --> 01:31:47,090
what's up I'm working on is Milani which

2093
01:31:50,750 --> 01:31:49,199
will perform spectral measurements and

2094
01:31:53,629 --> 01:31:50,760
dust detection following the dark

2095
01:31:56,450 --> 01:31:53,639
impacts my name is Margarita cardi from

2096
01:31:58,189 --> 01:31:56,460
tabac International in Italy we will

2097
01:32:00,470 --> 01:31:58,199
work alongside the other cubesat

2098
01:32:02,570 --> 01:32:00,480
Juventus which will perform kind of an

2099
01:32:04,610 --> 01:32:02,580
x-ray of the asteroid to understand the

2100
01:32:06,770 --> 01:32:04,620
internal structure this is going to be

2101
01:32:09,169 --> 01:32:06,780
the first time that we have cubesats on

2102
01:32:10,850 --> 01:32:09,179
board and Isa a spacecraft once we

2103
01:32:13,189 --> 01:32:10,860
arrive there we will be deploying the

2104
01:32:15,890 --> 01:32:13,199
cubesat in order to complement it's a

2105
01:32:18,169 --> 01:32:15,900
scientific observations taking more risk

2106
01:32:20,149 --> 01:32:18,179
while also trying to have higher rewards

2107
01:32:22,430 --> 01:32:20,159
the cube sales will be installed on two

2108
01:32:25,550 --> 01:32:22,440
panels that will be mounted on each side

2109
01:32:28,030 --> 01:32:25,560
of the structure of header

2110
01:32:30,229 --> 01:32:28,040
thank you

2111
01:32:32,510 --> 01:32:30,239
they are just the size of shoe box

2112
01:32:34,910 --> 01:32:32,520
however they contain complex technology

2113
01:32:36,950 --> 01:32:34,920

which will really allow to bring added

2114
01:32:38,270 --> 01:32:36,960
value to the header Mission here in dark

2115
01:32:40,610 --> 01:32:38,280
represents a fantastic International

2116
01:32:42,350 --> 01:32:40,620
collaboration between NASA and Isa the

2117
01:32:43,970 --> 01:32:42,360
two missions complement each other and

2118
01:32:45,649 --> 01:32:43,980
will validate illustrate deflection

2119
01:32:56,510 --> 01:32:45,659
technique that we could use in the

2120
01:33:03,169 --> 01:32:59,990
there you have it tonight we've ushered

2121
01:33:06,770 --> 01:33:03,179
in a new era in planetary defense

2122
01:33:10,330 --> 01:33:06,780
at 7 14 PM Eastern the dart spacecraft

2123
01:33:12,890 --> 01:33:10,340
targeted and collided with dimorphos

2124
01:33:15,350 --> 01:33:12,900
showcasing a technique that we could use

2125
01:33:17,629 --> 01:33:15,360
if a hazardous asteroid is ever on a

2126
01:33:20,629 --> 01:33:17,639
collision course with Earth even though

2127
01:33:22,970 --> 01:33:20,639
impact is over the process of moving the

2128
01:33:25,610 --> 01:33:22,980
asteroid is still going on as we speak

2129
01:33:28,010 --> 01:33:25,620
over the next days and weeks we'll be

2130
01:33:29,990 --> 01:33:28,020
monitoring dimorphos from all angles

2131
01:33:32,450 --> 01:33:30,000
tracking its change in orbit with

2132
01:33:34,970 --> 01:33:32,460
ground-based observatories studying the

2133
01:33:38,090 --> 01:33:34,980
impact crater and ejected materials with

2134
01:33:41,330 --> 01:33:38,100
space telescopes and we may even get

2135
01:33:44,390 --> 01:33:41,340
images from missions like Lucy Hubble

2136
01:33:46,790 --> 01:33:44,400
and Webb now don't miss a beat for

2137
01:33:49,129 --> 01:33:46,800
Mission updates follow asteroid watch on

2138
01:33:52,310 --> 01:33:49,139

Twitter NASA's solar system on Twitter

2139
01:33:54,530 --> 01:33:52,320
and Facebook remember impact was just

2140
01:33:56,870 --> 01:33:54,540
the beginning science and images will be

2141
01:34:00,229 --> 01:33:56,880
rolling in soon so stay tuned to

2142
01:34:03,110 --> 01:34:00,239
nasa.gov forward slash Dart we'll be

2143
01:34:05,390 --> 01:34:03,120
back at 8pm with members of the team to

2144
01:34:07,729 --> 01:34:05,400
capture reactions and celebrate this

2145
01:34:10,970 --> 01:34:07,739
historic event so join us soon on

2146
01:34:13,129 --> 01:34:10,980
nasa.gov forward slash live and for more

2147
01:34:15,110 --> 01:34:13,139
updates on the art of on Artemis and

2148
01:34:16,910 --> 01:34:15,120
rollback operations happening tonight at

2149
01:34:20,990 --> 01:34:16,920
the Kennedy Space Center head to

2150
01:34:23,330 --> 01:34:21,000
nasa.gov artemis-1 thank you for

2151
01:34:25,370 --> 01:34:23,340
watching NASA's coverage of Dart impact

2152
01:34:28,070 --> 01:34:25,380
from Johns Hopkins Applied Physics

2153
01:34:29,930 --> 01:34:28,080
laboratory in Maryland we want to give a

2154
01:34:32,510 --> 01:34:29,940
special thanks to all of our guests for

2155
01:34:34,370 --> 01:34:32,520
participating in today's broadcast and a

2156
01:34:36,770 --> 01:34:34,380
big shout out to my co-host Samson

2157
01:34:42,740 --> 01:34:36,780
Rainey for keeping us keyed into the

2158
01:34:52,480 --> 01:34:50,530
[Music]

2159
01:35:08,730 --> 01:34:52,490
thank you