1
00:00:01,090 --> 00:00:18,630
[Music]

2
00:00:24,390 --> 00:00:21,830
hello everyone i am marina jurica and

3
00:00:27,269 --> 00:00:24,400
welcome to nasa's jet propulsion

4
00:00:29,269 --> 00:00:27,279
laboratory today is a very special day

5
00:00:32,150 --> 00:00:29,279
as we celebrate the legacy of the

6
00:00:34,229 --> 00:00:32,160
spitzer space telescope spitzer is a

7
00:00:36,950 --> 00:00:34,239
telescope that has observed things in

8
00:00:39,430 --> 00:00:36,960
our own solar system and far beyond

9
00:00:42,150 --> 00:00:39,440
after over 16 years of incredible

10
00:00:44,790 --> 00:00:42,160
discoveries which impacted how we see

11
00:00:47,670 --> 00:00:44,800
the universe the world will continue to

12
00:00:50,709 --> 00:00:47,680
benefit from its monumental impact for

13
00:00:52,470 --> 00:00:50,719

many years to come to grasp the wonders

14
00:00:55,029 --> 00:00:52,480
of the cosmos and understand their

15
00:00:58,869 --> 00:00:55,039
variety and beauty nasa launched its

16
00:01:01,590 --> 00:00:58,879
four great observatories hubble chandra

17
00:01:04,229 --> 00:01:01,600
compton and spitzer who apart and

18
00:01:06,870 --> 00:01:04,239
together gave us an extensive look into

19
00:01:08,950 --> 00:01:06,880
places we only dreamed of spitzer

20
00:01:11,109 --> 00:01:08,960
observes in the infrared wavelength

21
00:01:13,590 --> 00:01:11,119
giving it no shortage of things to look

22
00:01:15,670 --> 00:01:13,600
at while a whole new universe was

23
00:01:17,749 --> 00:01:15,680
unveiled throughout the program we are

24
00:01:19,830 --> 00:01:17,759
inviting everyone to ask questions of

25
00:01:22,149 --> 00:01:19,840
our panelists if you are a member of the

26
00:01:25,030 --> 00:01:22,159
media on our phone lines just make sure

27
00:01:27,510 --> 00:01:25,040
that you press star one and if you are a

28
00:01:29,830 --> 00:01:27,520
member of social media make sure you use

29
00:01:31,350 --> 00:01:29,840
the hashtag ask

30
00:01:36,069 --> 00:01:31,360
nasa

31
00:01:38,149 --> 00:01:36,079
the head of astrophysics paul hertz

32
00:01:40,390 --> 00:01:38,159
welcome paul and thank you so much for

33
00:01:44,469 --> 00:01:40,400
helping us celebrate the legacy

34
00:01:46,389 --> 00:01:44,479
of this amazing telescope

35
00:01:48,310 --> 00:01:46,399
well marina it's my pleasure to be here

36
00:01:50,389 --> 00:01:48,320
today

37
00:01:52,550 --> 00:01:50,399
paul tell us why we are celebrating here

38
00:01:55,270 --> 00:01:52,560

today and what spitzer has meant to the

39
00:01:58,310 --> 00:01:55,280
world

40
00:02:00,069 --> 00:01:58,320
well at nasa we're interested in asking

41
00:02:02,709 --> 00:02:00,079
answering the big questions in

42
00:02:03,990 --> 00:02:02,719
astrophysics how did the universe begin

43
00:02:06,310 --> 00:02:04,000
and evolve

44
00:02:09,190 --> 00:02:06,320
how did the familiar night sky full of

45
00:02:11,510 --> 00:02:09,200
galaxies stars and planets come to be

46
00:02:15,030 --> 00:02:11,520
where did the elements of life and life

47
00:02:17,670 --> 00:02:15,040
itself come from and are we alone

48
00:02:19,670 --> 00:02:17,680
now these are hard questions so we need

49
00:02:21,910 --> 00:02:19,680
to use all the evidence that the

50
00:02:23,830 --> 00:02:21,920
universe provides us to help us answer

51
00:02:27,430 --> 00:02:23,840
them and that means observing the

52
00:02:29,990 --> 00:02:27,440
universe in every kind of light there is

53
00:02:32,309 --> 00:02:30,000
with the but the uh with in every kind

54
00:02:33,910 --> 00:02:32,319
of light there is not just the light

55
00:02:36,630 --> 00:02:33,920
that gets through the earth's atmosphere

56
00:02:39,589 --> 00:02:36,640
and can be perceived by our eyes

57
00:02:42,150 --> 00:02:39,599
and with since nasa goes into space we

58
00:02:44,229 --> 00:02:42,160
can put space telescopes above the

59
00:02:45,589 --> 00:02:44,239
blurring and obscuring of the earth's

60
00:02:48,710 --> 00:02:45,599
atmosphere

61
00:02:50,949 --> 00:02:48,720
back in the 1970s nasa began a program

62
00:02:53,190 --> 00:02:50,959
of great observatories

63
00:02:55,270 --> 00:02:53,200

the first of the great observatories was

64
00:02:57,270 --> 00:02:55,280
the hubble space telescope which

65
00:02:58,550 --> 00:02:57,280
observes the universe in the optical and

66
00:03:00,630 --> 00:02:58,560
ultraviolet

67
00:03:03,190 --> 00:03:00,640
hubble will be celebrating its 30th

68
00:03:05,350 --> 00:03:03,200
anniversary later this year

69
00:03:08,070 --> 00:03:05,360
the next great observatory was the

70
00:03:10,309 --> 00:03:08,080
compton gamma-ray observatory compton

71
00:03:12,070 --> 00:03:10,319
observed the universe in gamma rays and

72
00:03:14,229 --> 00:03:12,080
it completed its science mission in the

73
00:03:17,750 --> 00:03:14,239
year 2000

74
00:03:19,670 --> 00:03:17,760
the chandra x-ray observatory is nasa's

75
00:03:21,750 --> 00:03:19,680
third great observatory observing the

76
00:03:23,990 --> 00:03:21,760
universe in x-rays

77
00:03:26,149 --> 00:03:24,000
chandra celebrated its 20th anniversary

78
00:03:28,630 --> 00:03:26,159
in orbit last year

79
00:03:31,750 --> 00:03:28,640
nasa's fourth great observatory is the

80
00:03:33,430 --> 00:03:31,760
spitzer space telescope our infrared

81
00:03:35,430 --> 00:03:33,440
great observatory

82
00:03:39,270 --> 00:03:35,440
the spitzer space telescope will be

83
00:03:40,470 --> 00:03:39,280
completing its 16-year mission next week

84
00:03:43,750 --> 00:03:40,480
and we're here

85
00:03:46,149 --> 00:03:43,760
to celebrate and discuss the legacy that

86
00:03:48,710 --> 00:03:46,159
spitzer has left for us how it has

87
00:03:52,869 --> 00:03:48,720
changed our views of our solar system of

88
00:03:55,270 --> 00:03:52,879

our galaxy and of the universe itself

89
00:03:57,589 --> 00:03:55,280
thank you so much paul and what a legacy

90
00:03:59,270 --> 00:03:57,599
it does leave behind we will bring paul

91
00:04:00,789 --> 00:03:59,280
back a little later in the program to

92
00:04:03,190 --> 00:04:00,799
talk about how spitzer will be a

93
00:04:05,670 --> 00:04:03,200
pathfinder for both scientists and

94
00:04:12,229 --> 00:04:05,680
future missions but for now let's take a

95
00:04:15,670 --> 00:04:13,509
we have ignition

96
00:04:18,789 --> 00:04:15,680
the rocket launches

97
00:04:21,670 --> 00:04:18,799
it's thrusting out flames and you're

98
00:04:23,430 --> 00:04:21,680
watching and you have all those emotions

99
00:04:28,390 --> 00:04:23,440
and the rocket goes along on this

100
00:04:35,830 --> 00:04:31,430
the spitzer space telescope is a member

101
00:04:38,469 --> 00:04:35,840
of nasa's family of great observatories

102
00:04:42,629 --> 00:04:38,479
spitzer is the infrared member of this

103
00:04:47,270 --> 00:04:44,390
spitzer has unveiled the infrared

104
00:04:49,370 --> 00:04:47,280
universe it has enabled humans to see

105
00:04:50,629 --> 00:04:49,380
what our eyes could not see

106
00:04:52,629 --> 00:04:50,639
[Music]

107
00:04:56,950 --> 00:04:52,639
we see a whole new side to the universe

108
00:05:02,230 --> 00:05:00,150
you can peer inside of clouds of dust to

109
00:05:04,870 --> 00:05:02,240
see the baby stars called protostars

110
00:05:10,469 --> 00:05:07,909
it let us see into more distant galaxies

111
00:05:12,710 --> 00:05:10,479
and see how the patterns of dust tell us

112
00:05:14,629 --> 00:05:12,720
about the emotions of gas and the

113
00:05:15,909 --> 00:05:14,639

dynamics of gravity that operate in

114
00:05:18,150 --> 00:05:15,919
these objects

115
00:05:20,950 --> 00:05:18,160
all of a sudden we could create these

116
00:05:22,469 --> 00:05:20,960
vast panoramas at incredibly sharp

117
00:05:24,550 --> 00:05:22,479
resolutions that we'd never been able to

118
00:05:26,390 --> 00:05:24,560
do before and as a result

119
00:05:28,710 --> 00:05:26,400
everything that was familiar in the sky

120
00:05:30,870 --> 00:05:28,720
every nebula that we're used to seeing

121
00:05:32,629 --> 00:05:30,880
invisible light images from the ground

122
00:05:34,710 --> 00:05:32,639
things from hubble they became

123
00:05:36,870 --> 00:05:34,720
completely different when seen through

124
00:05:39,909 --> 00:05:36,880
the infrared eyes of spitzer

125
00:05:42,870 --> 00:05:39,919
it was this combination of a scientific

126
00:05:45,360 --> 00:05:42,880
insight that itself was just stunningly

127
00:05:47,189 --> 00:05:45,370
beautiful at the same time

128
00:05:49,110 --> 00:05:47,199
[Music]

129
00:05:51,430 --> 00:05:49,120
the biggest surprise in terms of what

130
00:05:53,110 --> 00:05:51,440
was revealed with spitzer is its ability

131
00:05:57,029 --> 00:05:53,120
to characterize

132
00:05:59,350 --> 00:05:57,039
exoplanets so planets around other stars

133
00:06:01,430 --> 00:05:59,360
most notably we identified a system

134
00:06:03,749 --> 00:06:01,440
called trappist-1 which has

135
00:06:06,710 --> 00:06:03,759
seven earth-sized planets sort of

136
00:06:09,430 --> 00:06:06,720
snuggling up to what's a very cool

137
00:06:10,710 --> 00:06:09,440
star and of those planets

138
00:06:13,110 --> 00:06:10,720

three of them at least are in the

139
00:06:15,590 --> 00:06:13,120
habitable zone when spitzer launched

140
00:06:19,110 --> 00:06:15,600
exoplanet science was absolutely not

141
00:06:20,870 --> 00:06:19,120
part of the science portfolio we were

142
00:06:22,390 --> 00:06:20,880
offering for spitzer because it wasn't

143
00:06:24,629 --> 00:06:22,400
considered to be sensitive enough to do

144
00:06:27,189 --> 00:06:24,639
that kind of observations but while in

145
00:06:28,790 --> 00:06:27,199
flight astronomers became clever about

146
00:06:30,629 --> 00:06:28,800
how they could use it engineers became

147
00:06:32,629 --> 00:06:30,639
very clever about how we could repurpose

148
00:06:35,110 --> 00:06:32,639
spitzer and exoplanet science has

149
00:06:36,950 --> 00:06:35,120
actually become one of the core science

150
00:06:39,430 --> 00:06:36,960
projects of spitzer since then the

151
00:06:41,350 --> 00:06:39,440
google doodle that day

152
00:06:43,189 --> 00:06:41,360
which was trappist-1

153
00:06:45,350 --> 00:06:43,199
is what kind of finished me off on a

154
00:06:48,870 --> 00:06:45,360
glorious day

155
00:06:51,189 --> 00:06:48,880
when your adult children point out that

156
00:06:54,420 --> 00:06:51,199
you know my mom works on that telescope

157
00:06:56,550 --> 00:06:54,430
you know that's that's very rewarding

158
00:06:57,909 --> 00:06:56,560
[Music]

159
00:07:00,150 --> 00:06:57,919
spitzer space telescope is a

160
00:07:02,150 --> 00:07:00,160
technological marvel i never had any

161
00:07:04,550 --> 00:07:02,160
conception that we'd be going for 16

162
00:07:06,790 --> 00:07:04,560
years the little machine that could go

163
00:07:09,430 --> 00:07:06,800

beyond its primary design

164
00:07:10,710 --> 00:07:09,440
longevity of the mission is a direct

165
00:07:11,749 --> 00:07:10,720
result

166
00:07:14,390 --> 00:07:11,759
of the

167
00:07:16,950 --> 00:07:14,400
engineers and scientists and people that

168
00:07:19,430 --> 00:07:16,960
have supported the mission in a place

169
00:07:22,070 --> 00:07:19,440
that dares mighty things

170
00:07:23,749 --> 00:07:22,080
you can do it together

171
00:07:27,029 --> 00:07:23,759
and so

172
00:07:31,510 --> 00:07:27,039
when you have that kind of union i think

173
00:07:33,909 --> 00:07:31,520
what happens is magic i'm hoping spitzer

174
00:07:37,670 --> 00:07:33,919
will be remembered

175
00:07:40,629 --> 00:07:37,680
as in a really amazing uh

176
00:07:43,430 --> 00:07:40,639
scientific gift and that it allowed us

177
00:07:46,469 --> 00:07:43,440
to kind of transform our understanding

178
00:07:49,029 --> 00:07:46,479
of some very important aspects of

179
00:07:51,189 --> 00:07:49,039
astronomy and i think spitzer's been

180
00:07:53,430 --> 00:07:51,199
integral to all that

181
00:07:56,390 --> 00:07:53,440
we have a huge archive that is waiting

182
00:07:57,830 --> 00:07:56,400
to be mined and it's its revelations

183
00:08:00,710 --> 00:07:57,840
already have been tremendous and

184
00:08:03,650 --> 00:08:00,720
revolutionary that only time will tell

185
00:08:15,990 --> 00:08:03,660
what is spitzer's greatest legacy

186
00:08:20,869 --> 00:08:18,309
let me now introduce you to joseph hunt

187
00:08:22,950 --> 00:08:20,879
spitzer space telescope project manager

188
00:08:25,029 --> 00:08:22,960

and suzanne dodd a former project

189
00:08:28,070 --> 00:08:25,039
manager for the mission welcome and

190
00:08:30,309 --> 00:08:28,080
thank you for joining us here today

191
00:08:32,949 --> 00:08:30,319
so suzanne let me

192
00:08:35,589 --> 00:08:32,959
ask you about spitzer's four great

193
00:08:37,750 --> 00:08:35,599
observatories and what part it plays in

194
00:08:40,790 --> 00:08:37,760
those four great observatories and what

195
00:08:43,269 --> 00:08:40,800
sets spitzer apart certainly so as paul

196
00:08:46,150 --> 00:08:43,279
mentioned spitzer is part of nasa's

197
00:08:48,870 --> 00:08:46,160
great observatory program the four grade

198
00:08:51,670 --> 00:08:48,880
observatories and spitzer measures in

199
00:08:54,310 --> 00:08:51,680
infrared light so infrared light is a

200
00:08:55,829 --> 00:08:54,320
sense census heat of coming off of

201
00:08:58,310 --> 00:08:55,839
objects

202
00:09:00,470 --> 00:08:58,320
it's similar to night vision goggles if

203
00:09:02,949 --> 00:09:00,480
you're familiar with how those work

204
00:09:05,509 --> 00:09:02,959
and the importance of infrared light

205
00:09:09,190 --> 00:09:05,519
again is it can it senses heat so it can

206
00:09:10,310 --> 00:09:09,200
see through dusty clouds and and it can

207
00:09:11,590 --> 00:09:10,320
see through

208
00:09:13,350 --> 00:09:11,600
uh

209
00:09:15,670 --> 00:09:13,360
the dust that that

210
00:09:17,990 --> 00:09:15,680
is in an image say from hubble

211
00:09:21,509 --> 00:09:18,000
uh spitzer can see through that to see

212
00:09:24,389 --> 00:09:21,519
star-forming reasons to see uh

213
00:09:27,990 --> 00:09:24,399

uh forming and merging

214
00:09:30,949 --> 00:09:28,000
and just a whole cornucopia of of

215
00:09:33,430 --> 00:09:30,959
objects in space that are not visible to

216
00:09:35,269 --> 00:09:33,440
eye our eyes in the optical but are

217
00:09:37,910 --> 00:09:35,279
visible in infrared

218
00:09:39,750 --> 00:09:37,920
and one of the unique things about

219
00:09:42,230 --> 00:09:39,760
spitzer that makes this all possible is

220
00:09:43,829 --> 00:09:42,240
its orbit so spencer was launched in

221
00:09:46,790 --> 00:09:43,839
2003

222
00:09:50,070 --> 00:09:46,800
and it's in a very unique earth trailing

223
00:09:53,509 --> 00:09:50,080
orbit so what that means is that spitzer

224
00:09:55,750 --> 00:09:53,519
is launched into the same

225
00:09:58,070 --> 00:09:55,760
orbit around the sun that our earth is

226
00:10:00,870 --> 00:09:58,080
but it trails away

227
00:10:02,630 --> 00:10:00,880
from the earth slowly so it's circling

228
00:10:05,110 --> 00:10:02,640
the earth falling

229
00:10:07,670 --> 00:10:05,120
excuse me it's circling the sun falling

230
00:10:10,550 --> 00:10:07,680
behind the earth and i have this little

231
00:10:13,269 --> 00:10:10,560
model here and just to to show you this

232
00:10:15,509 --> 00:10:13,279
uh the earth would be talking to and

233
00:10:17,350 --> 00:10:15,519
from the high gain antenna on the bottom

234
00:10:19,269 --> 00:10:17,360
and then the solar panel is always

235
00:10:21,910 --> 00:10:19,279
pointing at the sun so it's coming

236
00:10:24,150 --> 00:10:21,920
around it's leaving the earth but we get

237
00:10:26,710 --> 00:10:24,160
we get our power from the solar panel

238
00:10:28,790 --> 00:10:26,720

and then we communicate with this uh

239
00:10:30,949 --> 00:10:28,800
high gain antenna on the bottom

240
00:10:34,310 --> 00:10:30,959
so it's a it's a very unique orbit and

241
00:10:36,310 --> 00:10:34,320
it's unique because it's drifting from

242
00:10:38,870 --> 00:10:36,320
the earth and the moon so it's not

243
00:10:41,190 --> 00:10:38,880
getting the infrared radiation that the

244
00:10:44,069 --> 00:10:41,200
earth and the moon system create and

245
00:10:45,430 --> 00:10:44,079
it's also up above our atmosphere it

246
00:10:47,829 --> 00:10:45,440
would take you would have to have a

247
00:10:49,829 --> 00:10:47,839
telescope on the ground 10 times as big

248
00:10:52,150 --> 00:10:49,839
as spitzer to get the same quality data

249
00:10:54,230 --> 00:10:52,160
that spitzer gets from being above our

250
00:10:56,550 --> 00:10:54,240
atmosphere here at earth and that's what

251
00:10:59,829 --> 00:10:56,560
makes it so unique and so special for

252
00:11:02,470 --> 00:10:59,839
sure and welcome joseph how's the team

253
00:11:04,550 --> 00:11:02,480
feeling in anticipation of the big day

254
00:11:07,509 --> 00:11:04,560
next thursday well working with the

255
00:11:10,389 --> 00:11:07,519
spitzer team in general they're always

256
00:11:12,870 --> 00:11:10,399
excited about any of the activities that

257
00:11:15,430 --> 00:11:12,880
they have to pull together for the next

258
00:11:17,590 --> 00:11:15,440
great science observation and now

259
00:11:20,069 --> 00:11:17,600
planning for the end of mission i think

260
00:11:23,990 --> 00:11:20,079
this team stays focused all the time

261
00:11:26,389 --> 00:11:24,000
even though the emotions anxiety things

262
00:11:29,590 --> 00:11:26,399
that could attribute to people

263
00:11:30,710 --> 00:11:29,600

getting maybe a little sad uh this may

264
00:11:32,949 --> 00:11:30,720
be there

265
00:11:35,190 --> 00:11:32,959
someplace but i think this again this

266
00:11:36,870 --> 00:11:35,200
team stays so focused and one of the

267
00:11:39,190 --> 00:11:36,880
things that i must

268
00:11:41,350 --> 00:11:39,200
acknowledge is that when you have a team

269
00:11:43,990 --> 00:11:41,360
that's so distributed in different

270
00:11:46,230 --> 00:11:44,000
locations all of the things that paul

271
00:11:48,069 --> 00:11:46,240
and both susie has mentioned would never

272
00:11:50,389 --> 00:11:48,079
be possible without

273
00:11:53,750 --> 00:11:50,399
thousands i would say of people doing

274
00:11:56,310 --> 00:11:53,760
multiple things so you have to be proud

275
00:11:59,190 --> 00:11:56,320
right when you look back and say look at

276
00:12:01,590 --> 00:11:59,200
the team that's operating spitzer look

277
00:12:03,670 --> 00:12:01,600
at the team that's contributing to

278
00:12:06,550 --> 00:12:03,680
having all of this great science and the

279
00:12:08,550 --> 00:12:06,560
spitzer team has so much to be proud of

280
00:12:11,430 --> 00:12:08,560
that's for sure and you've been with

281
00:12:14,710 --> 00:12:11,440
this mission since before it launched

282
00:12:16,790 --> 00:12:14,720
and so after the last 18 years what do

283
00:12:19,030 --> 00:12:16,800
you think that the spitzer team as a

284
00:12:21,990 --> 00:12:19,040
whole will be most proud of

285
00:12:24,629 --> 00:12:22,000
well marina one thing i think that

286
00:12:27,110 --> 00:12:24,639
anyone would be proud of but mostly when

287
00:12:29,030 --> 00:12:27,120
you say the team is

288
00:12:31,269 --> 00:12:29,040

a lot of our team members we've had

289
00:12:34,150 --> 00:12:31,279
these new families that's been created

290
00:12:37,030 --> 00:12:34,160
over the life of a mission of 16 years

291
00:12:38,870 --> 00:12:37,040
long and now some of the

292
00:12:41,190 --> 00:12:38,880
members of the team are showing their

293
00:12:43,509 --> 00:12:41,200
kids some of the images that's coming

294
00:12:45,670 --> 00:12:43,519
down from spitzer but not just their

295
00:12:46,790 --> 00:12:45,680
kids we're sharing the information with

296
00:12:49,910 --> 00:12:46,800
schools

297
00:12:52,389 --> 00:12:49,920
and others right and to be able to say

298
00:12:55,030 --> 00:12:52,399
i'm a part of that new science that's

299
00:12:57,030 --> 00:12:55,040
coming down i think anyone within a team

300
00:12:59,190 --> 00:12:57,040
will be just more than proud because

301
00:13:00,949 --> 00:12:59,200
again the team is what makes the science

302
00:13:02,949 --> 00:13:00,959
matter that's so true and for

303
00:13:04,790 --> 00:13:02,959
generations to come they'll be able to

304
00:13:08,310 --> 00:13:04,800
enjoy what spitzer has accomplished and

305
00:13:10,389 --> 00:13:08,320
susie why is it so important to observe

306
00:13:14,069 --> 00:13:10,399
in this particular part of the spectrum

307
00:13:17,750 --> 00:13:14,079
well um in this in the infrared again it

308
00:13:19,750 --> 00:13:17,760
senses cool objects and so we can see

309
00:13:22,550 --> 00:13:19,760
through dust we are we're lifting the

310
00:13:24,310 --> 00:13:22,560
cosmic bale on the universe

311
00:13:26,310 --> 00:13:24,320
and there's just a cornucopia of

312
00:13:28,230 --> 00:13:26,320
astrophysics objects out there that we

313
00:13:29,269 --> 00:13:28,240

can observe there's

314
00:13:32,710 --> 00:13:29,279
again

315
00:13:35,110 --> 00:13:32,720
nebula supernova dying stars stellar

316
00:13:37,590 --> 00:13:35,120
nurseries the list goes on and on and

317
00:13:40,230 --> 00:13:37,600
it's really remarkable and

318
00:13:42,550 --> 00:13:40,240
in particular we also can discover

319
00:13:44,790 --> 00:13:42,560
things in our own solar system and one

320
00:13:48,389 --> 00:13:44,800
of my favorite uh discoveries for

321
00:13:50,150 --> 00:13:48,399
spitzer was a new ring around saturn

322
00:13:52,710 --> 00:13:50,160
and this was only made possible by

323
00:13:56,790 --> 00:13:52,720
observing it in infrared light

324
00:13:59,110 --> 00:13:56,800
the ring is 300 saturn's in diameter so

325
00:14:01,350 --> 00:13:59,120
it's gigantic

326
00:14:03,670 --> 00:14:01,360
but the particles are are tiny and and

327
00:14:05,430 --> 00:14:03,680
tenuous and diffuse and it was only the

328
00:14:07,110 --> 00:14:05,440
cool radiation given off by those

329
00:14:09,350 --> 00:14:07,120
particles in the ring

330
00:14:12,230 --> 00:14:09,360
uh that spitzer was able to detect it

331
00:14:14,790 --> 00:14:12,240
and no other uh observatory had detected

332
00:14:17,110 --> 00:14:14,800
it before so it's it's a fun discovery

333
00:14:19,110 --> 00:14:17,120
it's right in our backyard relatively uh

334
00:14:21,750 --> 00:14:19,120
in our solar system relatively speaking

335
00:14:23,189 --> 00:14:21,760
correct so it's it's one of my favorites

336
00:14:25,269 --> 00:14:23,199
that's amazing and that's right in our

337
00:14:27,030 --> 00:14:25,279
own solar system and far beyond and

338
00:14:29,509 --> 00:14:27,040

that's what's great about spitzer is

339
00:14:31,509 --> 00:14:29,519
it's discovered so much and

340
00:14:33,509 --> 00:14:31,519
beyond into our universe we'll continue

341
00:14:35,829 --> 00:14:33,519
to uh we'll continue to explore into the

342
00:14:37,910 --> 00:14:35,839
future and joseph much of the spitzer's

343
00:14:40,470 --> 00:14:37,920
team is original to the project which is

344
00:14:43,590 --> 00:14:40,480
pretty amazing do you think it's because

345
00:14:46,470 --> 00:14:43,600
spitzer was able to accomplish so much

346
00:14:49,030 --> 00:14:46,480
and it's over 16 years well when you say

347
00:14:50,790 --> 00:14:49,040
original one thing i would like to

348
00:14:51,670 --> 00:14:50,800
really point out is

349
00:14:56,470 --> 00:14:51,680
that

350
00:14:59,430 --> 00:14:56,480
have worked on spitzer

351
00:15:01,670 --> 00:14:59,440
they have a sense of ownership to the

352
00:15:04,310 --> 00:15:01,680
processes and their designs and things

353
00:15:06,870 --> 00:15:04,320
that they have developed during any

354
00:15:09,350 --> 00:15:06,880
anomaly or issues that we've had

355
00:15:11,910 --> 00:15:09,360
the teams have always had the ability to

356
00:15:14,710 --> 00:15:11,920
reach back when i say reach back meaning

357
00:15:17,269 --> 00:15:14,720
some of the heritage knowledge people

358
00:15:19,590 --> 00:15:17,279
have come forward to help us resolve

359
00:15:21,910 --> 00:15:19,600
issues that's a really great thing to

360
00:15:24,870 --> 00:15:21,920
have on any mission

361
00:15:26,949 --> 00:15:24,880
today or any day right so

362
00:15:29,110 --> 00:15:26,959
looking back over all of those many

363
00:15:30,949 --> 00:15:29,120

years i think having all of that

364
00:15:33,030 --> 00:15:30,959
heritage knowledge having the folks to

365
00:15:35,430 --> 00:15:33,040
be there available is one of the great

366
00:15:37,829 --> 00:15:35,440
attributes that has contributed to the

367
00:15:40,310 --> 00:15:37,839
success of the mission and it has been a

368
00:15:42,870 --> 00:15:40,320
success for sure and each telescope in

369
00:15:44,949 --> 00:15:42,880
the four great observatories operated in

370
00:15:47,590 --> 00:15:44,959
a different part of the electromagnetic

371
00:15:49,670 --> 00:15:47,600
spectrum what is the infrared portion of

372
00:15:52,690 --> 00:15:49,680
the spectrum that spitzer worked in and

373
00:15:56,710 --> 00:15:52,700
why does it work so well

374
00:15:58,470 --> 00:15:56,720
[Music]

375
00:15:59,670 --> 00:15:58,480
how do you make sense of something you

376
00:16:01,910 --> 00:15:59,680
can't see

377
00:16:04,389 --> 00:16:01,920
this is the electromagnetic spectrum

378
00:16:06,949 --> 00:16:04,399
where light travels in waves without it

379
00:16:09,509 --> 00:16:06,959
the world you know could not exist the

380
00:16:11,269 --> 00:16:09,519
human eye can only see this very small

381
00:16:13,749 --> 00:16:11,279
part of the spectrum called visible

382
00:16:16,150 --> 00:16:13,759
light but a whole new universe is

383
00:16:18,870 --> 00:16:16,160
revealed by looking through the infrared

384
00:16:21,670 --> 00:16:18,880
infrared light can't be seen but it can

385
00:16:24,629 --> 00:16:21,680
be felt in the form of heat every object

386
00:16:26,870 --> 00:16:24,639
whether hot or cold gives off heat

387
00:16:29,430 --> 00:16:26,880
special thermal cameras use colors to

388
00:16:31,269 --> 00:16:29,440

show us if something is warm or cold

389
00:16:33,269 --> 00:16:31,279
some objects are hot enough to show

390
00:16:35,509 --> 00:16:33,279
visible light and things that are too

391
00:16:37,829 --> 00:16:35,519
cold to be seen by the naked eye can let

392
00:16:40,389 --> 00:16:37,839
off in infrared such as your body or

393
00:16:42,710 --> 00:16:40,399
this cup of coffee ir light can be used

394
00:16:45,670 --> 00:16:42,720
in very practical ways

395
00:16:47,509 --> 00:16:45,680
longer ir waves can cook your dinner

396
00:16:50,470 --> 00:16:47,519
shorter ir waves that are used in your

397
00:16:52,629 --> 00:16:50,480
tv's remote control and firemen use ir

398
00:16:55,110 --> 00:16:52,639
cameras to see through smoke to find

399
00:16:57,590 --> 00:16:55,120
people trapped in a fire so how does

400
00:16:59,910 --> 00:16:57,600
this apply to a telescope on top of

401
00:17:01,829 --> 00:16:59,920
showing us colder objects infrared

402
00:17:04,789 --> 00:17:01,839
wavelengths can see through large

403
00:17:07,270 --> 00:17:04,799
amounts of gas and dust lifting the veil

404
00:17:09,510 --> 00:17:07,280
to what lies on the other side spitzer

405
00:17:11,990 --> 00:17:09,520
sees objects like exoplanets or the

406
00:17:14,630 --> 00:17:12,000
milky way by looking at their infrared

407
00:17:16,789 --> 00:17:14,640
glow from the heat they give off this

408
00:17:19,620 --> 00:17:16,799
gives us the ability to see what is

409
00:17:23,669 --> 00:17:19,630
beyond and that's ir in a minute

410
00:17:27,990 --> 00:17:25,990
thank you so much joseph and suzanne as

411
00:17:30,070 --> 00:17:28,000
a reminder we are inviting everyone to

412
00:17:31,750 --> 00:17:30,080
ask questions of our panelists if you

413
00:17:33,990 --> 00:17:31,760

are a member of the media on our phone

414
00:17:36,390 --> 00:17:34,000
lines press star one to be put into the

415
00:17:39,750 --> 00:17:36,400
queue and if you are on social media

416
00:17:41,909 --> 00:17:39,760
make sure you use the hashtag asknasa so

417
00:17:44,150 --> 00:17:41,919
now that we understand spitzer's role in

418
00:17:46,230 --> 00:17:44,160
the four great observatories and its

419
00:17:48,230 --> 00:17:46,240
ability to gaze into the infrared

420
00:17:51,190 --> 00:17:48,240
universe here to tell us about some of

421
00:17:53,190 --> 00:17:51,200
the amazing discoveries and science that

422
00:17:55,029 --> 00:17:53,200
came from this telescope are michael

423
00:17:57,909 --> 00:17:55,039
werner the spitzer space telescope

424
00:18:00,310 --> 00:17:57,919
project scientist and farisa morales a

425
00:18:01,990 --> 00:18:00,320
spitzer scientist welcome thank you

426
00:18:03,750 --> 00:18:02,000
marina my question marina what a

427
00:18:06,230 --> 00:18:03,760
wonderful day we are celebrating here

428
00:18:08,710 --> 00:18:06,240
today an incredible revelation about

429
00:18:10,870 --> 00:18:08,720
spitzer mike are the many observations

430
00:18:13,669 --> 00:18:10,880
and discoveries that it made that it

431
00:18:15,990 --> 00:18:13,679
wasn't originally planned to do like

432
00:18:18,070 --> 00:18:16,000
exoplanets for example now spitzer

433
00:18:21,270 --> 00:18:18,080
studied hundreds of exoplanets and was

434
00:18:24,150 --> 00:18:21,280
one of the first to study the atmosphere

435
00:18:26,830 --> 00:18:24,160
around these exoplanets and perhaps its

436
00:18:29,029 --> 00:18:26,840
most famous exoplanet subject was the

437
00:18:30,870 --> 00:18:29,039
trappist-1 system can you tell me a

438
00:18:32,310 --> 00:18:30,880

little bit about this system i'd like to

439
00:18:34,630 --> 00:18:32,320
do a little demonstration here this

440
00:18:37,510 --> 00:18:34,640
grapefruit is the star this ping-pong

441
00:18:39,909 --> 00:18:37,520
ball is a planet and we know from the so

442
00:18:42,070 --> 00:18:39,919
here's the planet going around the star

443
00:18:44,070 --> 00:18:42,080
we know from the kepler space telescope

444
00:18:46,230 --> 00:18:44,080
that most stars in our galaxy have

445
00:18:49,029 --> 00:18:46,240
planets around them and because of that

446
00:18:51,430 --> 00:18:49,039
there are many cases in which the planet

447
00:18:53,350 --> 00:18:51,440
is orbiting edge on as we see it so we

448
00:18:54,390 --> 00:18:53,360
can see the planet move in front of the

449
00:18:56,549 --> 00:18:54,400
star

450
00:18:58,070 --> 00:18:56,559
that's the case of the trappist system

451
00:18:59,590 --> 00:18:58,080
when the planet moves in front of the

452
00:19:01,190 --> 00:18:59,600
star

453
00:19:03,190 --> 00:19:01,200
you see a little less light from the

454
00:19:04,549 --> 00:19:03,200
star than you did and now it comes back

455
00:19:06,789 --> 00:19:04,559
out you see more

456
00:19:08,789 --> 00:19:06,799
light from the star the depth of that

457
00:19:11,029 --> 00:19:08,799
drop tells you about the size of the

458
00:19:13,510 --> 00:19:11,039
planet and if this is an orbit where it

459
00:19:15,830 --> 00:19:13,520
goes around say every three days the

460
00:19:18,230 --> 00:19:15,840
length of the orbit tells you how far

461
00:19:19,669 --> 00:19:18,240
from the star the planet actually is

462
00:19:21,909 --> 00:19:19,679
and you can get lots of other

463
00:19:24,310 --> 00:19:21,919

information by studying these so-called

464
00:19:26,549 --> 00:19:24,320
transiting planets it's quite remarkable

465
00:19:28,230 --> 00:19:26,559
how much information you can get about

466
00:19:30,710 --> 00:19:28,240
planets which you never really see

467
00:19:32,870 --> 00:19:30,720
distinctly apart from the star in the

468
00:19:35,270 --> 00:19:32,880
case of the trappist system there's a

469
00:19:37,590 --> 00:19:35,280
beautiful artist's conception there

470
00:19:39,750 --> 00:19:37,600
we monitor it for 20 days with spitzer

471
00:19:40,630 --> 00:19:39,760
which is possible in our orbit because

472
00:19:42,230 --> 00:19:40,640
of the

473
00:19:43,110 --> 00:19:42,240
freedom distance from the earth and the

474
00:19:45,190 --> 00:19:43,120
moon

475
00:19:45,990 --> 00:19:45,200
and saw so many

476
00:19:48,630 --> 00:19:46,000
uh

477
00:19:49,909 --> 00:19:48,640
patterns interwoven planets of patterns

478
00:19:52,230 --> 00:19:49,919
of transits

479
00:19:54,310 --> 00:19:52,240
that we had the team that was working on

480
00:19:56,630 --> 00:19:54,320
it sort of sorted all that out and found

481
00:19:58,950 --> 00:19:56,640
that there are actually seven planets

482
00:20:01,590 --> 00:19:58,960
orbiting that star quite snuggled up

483
00:20:03,669 --> 00:20:01,600
close to it it's a faint red star

484
00:20:05,909 --> 00:20:03,679
and of those seven planets they're all

485
00:20:08,149 --> 00:20:05,919
about the size of the earth we expect

486
00:20:09,909 --> 00:20:08,159
that about three of them will are in the

487
00:20:12,149 --> 00:20:09,919
habitable zone which is where water

488
00:20:14,789 --> 00:20:12,159

would be liquid on their surfaces which

489
00:20:16,070 --> 00:20:14,799
is important if they're we feel it's

490
00:20:18,230 --> 00:20:16,080
important if they're going to harbor

491
00:20:20,230 --> 00:20:18,240
life or if they do harbor life

492
00:20:22,549 --> 00:20:20,240
so this system has been well studied by

493
00:20:24,950 --> 00:20:22,559
spitzer it's the best characterized

494
00:20:26,789 --> 00:20:24,960
solar system outside of our own

495
00:20:28,789 --> 00:20:26,799
and it's sitting there awaiting the

496
00:20:30,390 --> 00:20:28,799
james webb space telescope

497
00:20:31,669 --> 00:20:30,400
which paul will be talking about later

498
00:20:33,750 --> 00:20:31,679
which will provide additional

499
00:20:36,149 --> 00:20:33,760
information about this exciting and

500
00:20:38,149 --> 00:20:36,159
surprising system of exoplanets it's

501
00:20:40,310 --> 00:20:38,159
amazing because in the end the science

502
00:20:42,230 --> 00:20:40,320
will just continue to live on absolutely

503
00:20:44,470 --> 00:20:42,240
which is amazing now my personal

504
00:20:46,710 --> 00:20:44,480
favorite is the 360 degree view of the

505
00:20:49,110 --> 00:20:46,720
milky way it's so fascinating how is

506
00:20:51,350 --> 00:20:49,120
spitzer able to map out that milky way

507
00:20:53,510 --> 00:20:51,360
so extensively well the the milky way

508
00:20:55,990 --> 00:20:53,520
survey which is called glimpse is an

509
00:20:57,909 --> 00:20:56,000
example of a legacy science program that

510
00:20:59,909 --> 00:20:57,919
we initiated early on

511
00:21:02,710 --> 00:20:59,919
to enable teams to do really big

512
00:21:04,549 --> 00:21:02,720
projects now to do this big image

513
00:21:05,669 --> 00:21:04,559

spitzer had to be first of all very

514
00:21:08,149 --> 00:21:05,679
sensitive

515
00:21:09,750 --> 00:21:08,159
because it's cold in space

516
00:21:11,750 --> 00:21:09,760
it's free of the

517
00:21:14,070 --> 00:21:11,760
contamination of foreground infrared

518
00:21:16,310 --> 00:21:14,080
radiation it views against the cold

519
00:21:17,909 --> 00:21:16,320
background of space as opposed to the

520
00:21:20,230 --> 00:21:17,919
warm infrared background of our

521
00:21:23,190 --> 00:21:20,240
atmosphere say so spitzer is very

522
00:21:25,830 --> 00:21:23,200
sensitive each image that went into that

523
00:21:28,070 --> 00:21:25,840
composite took only a few seconds it has

524
00:21:30,390 --> 00:21:28,080
a big field of view it sees a big piece

525
00:21:32,149 --> 00:21:30,400
of sky at one time with what's called an

526
00:21:34,390 --> 00:21:32,159
array kind of think of the

527
00:21:37,270 --> 00:21:34,400
camera your cell phone lots of pixels

528
00:21:39,350 --> 00:21:37,280
that spitzer's camera

529
00:21:40,390 --> 00:21:39,360
also spitzer is very maneuverable it's a

530
00:21:42,470 --> 00:21:40,400
compact

531
00:21:45,510 --> 00:21:42,480
and tightly constructed spacecraft so it

532
00:21:47,830 --> 00:21:45,520
can hop from one image to the other very

533
00:21:49,909 --> 00:21:47,840
quickly and the other thing that enabled

534
00:21:51,750 --> 00:21:49,919
this was our orbit

535
00:21:53,190 --> 00:21:51,760
because of the fact that we're far from

536
00:21:54,710 --> 00:21:53,200
the earth we don't have to worry about

537
00:21:57,590 --> 00:21:54,720
where the earth is as we're planning our

538
00:21:59,990 --> 00:21:57,600

observations we could set aside huge

539
00:22:02,710 --> 00:22:00,000
swaths of time to allow the team to bite

540
00:22:05,029 --> 00:22:02,720
off big chunks of the milky way

541
00:22:07,669 --> 00:22:05,039
one after the other as a result we have

542
00:22:09,350 --> 00:22:07,679
a database in our archive with millions

543
00:22:13,029 --> 00:22:09,360
of sources in it

544
00:22:15,510 --> 00:22:13,039
young stars old stars evolved stars

545
00:22:16,310 --> 00:22:15,520
interstellar dust interstellar gas

546
00:22:22,630 --> 00:22:16,320
a

547
00:22:24,549 --> 00:22:22,640
will be continued to be used by

548
00:22:26,470 --> 00:22:24,559
scientists far into the future and what

549
00:22:28,789 --> 00:22:26,480
was great about spitzer is you could use

550
00:22:30,390 --> 00:22:28,799
it for lengthy periods of time when you

551
00:22:32,549 --> 00:22:30,400
were looking at one object i believe you

552
00:22:33,430 --> 00:22:32,559
said 40 days was spent on the trappist

553
00:22:35,110 --> 00:22:33,440
system

554
00:22:36,310 --> 00:22:35,120
20 days of

555
00:22:38,870 --> 00:22:36,320
intense

556
00:22:41,669 --> 00:22:38,880
uh round-the-clock observation and then

557
00:22:43,110 --> 00:22:41,679
20 additional days point you know object

558
00:22:44,870 --> 00:22:43,120
by object to determine their

559
00:22:47,350 --> 00:22:44,880
characteristics more completely and for

560
00:22:49,669 --> 00:22:47,360
the milky way it was less but still oh

561
00:22:51,430 --> 00:22:49,679
no it was more it was rewarding

562
00:22:53,750 --> 00:22:51,440
thousands of hours when all was said and

563
00:22:55,350 --> 00:22:53,760

done oh that's amazing it's a remarkable

564
00:22:57,830 --> 00:22:55,360
it was worth it to be able to get that

565
00:22:59,430 --> 00:22:57,840
picture that's for sure and farisa

566
00:23:01,270 --> 00:22:59,440
welcome

567
00:23:02,950 --> 00:23:01,280
now spitzer is almost like the little

568
00:23:05,029 --> 00:23:02,960
engine that could we always talk about

569
00:23:07,190 --> 00:23:05,039
this and why do you believe that spitzer

570
00:23:09,669 --> 00:23:07,200
was so revolutionary joseph talked about

571
00:23:12,070 --> 00:23:09,679
how the mission endured with a strong

572
00:23:14,549 --> 00:23:12,080
team and mike talked about that science

573
00:23:16,870 --> 00:23:14,559
that it returned that's just so amazing

574
00:23:18,470 --> 00:23:16,880
and why do you think it lasted so long

575
00:23:20,950 --> 00:23:18,480
you know spitter space telescope really

576
00:23:22,950 --> 00:23:20,960
is or has been revolutionary because

577
00:23:25,350 --> 00:23:22,960
it's the effort of hundreds of people

578
00:23:27,270 --> 00:23:25,360
coming together just to mention a few i

579
00:23:30,630 --> 00:23:27,280
mean from private industry like lockheed

580
00:23:32,630 --> 00:23:30,640
martin and boeing and ball aerospace

581
00:23:34,950 --> 00:23:32,640
universities building instruments to

582
00:23:36,789 --> 00:23:34,960
build the telescope caltech with the

583
00:23:39,750 --> 00:23:36,799
spitter science center supporting the

584
00:23:41,510 --> 00:23:39,760
science and jpl right supporting the

585
00:23:43,269 --> 00:23:41,520
project the operations the deep space

586
00:23:45,430 --> 00:23:43,279
network to communicate with it so it

587
00:23:47,190 --> 00:23:45,440
really is hundreds of people lots of

588
00:23:49,110 --> 00:23:47,200

teams coming together to make it work

589
00:23:51,350 --> 00:23:49,120
for thousands of astronomers to use and

590
00:23:53,669 --> 00:23:51,360
you can just imagine after over 16 years

591
00:23:55,350 --> 00:23:53,679
of observations a tremendous wealth

592
00:23:58,470 --> 00:23:55,360
right the archive that we have which is

593
00:24:00,549 --> 00:23:58,480
a repository of of data of infrared data

594
00:24:02,149 --> 00:24:00,559
that is waiting to be mined

595
00:24:04,310 --> 00:24:02,159
and i know you guys can't wait to get to

596
00:24:07,110 --> 00:24:04,320
that that's for sure well spitzer is

597
00:24:09,110 --> 00:24:07,120
very famous for its beautiful imagery

598
00:24:11,669 --> 00:24:09,120
what people don't know is the picture we

599
00:24:14,470 --> 00:24:11,679
see is not something spitzer just takes

600
00:24:17,140 --> 00:24:14,480
a picture of it's a lengthy process from

601
00:24:21,590 --> 00:24:17,150
capture to awe

602
00:24:24,230 --> 00:24:21,600
[Music]

603
00:24:26,149 --> 00:24:24,240
the spitzer space telescope has blown us

604
00:24:28,950 --> 00:24:26,159
away with incredible imagery over the

605
00:24:31,029 --> 00:24:28,960
last 16 years however getting these

606
00:24:33,669 --> 00:24:31,039
images is much more difficult than you

607
00:24:35,909 --> 00:24:33,679
may think spacecraft images are not

608
00:24:38,470 --> 00:24:35,919
photographs but pictorial presentations

609
00:24:39,430 --> 00:24:38,480
of data satellite systems measure light

610
00:24:41,669 --> 00:24:39,440
at different bands of the

611
00:24:43,909 --> 00:24:41,679
electromagnetic spectrum in spitzer's

612
00:24:46,710 --> 00:24:43,919
case it's the infrared

613
00:24:48,789 --> 00:24:46,720

this is raw data processed from spitzer

614
00:24:51,190 --> 00:24:48,799
to analyze this flood of numbers

615
00:24:53,669 --> 00:24:51,200
scientists rely on computers not only to

616
00:24:56,070 --> 00:24:53,679
do calculations but also to change data

617
00:24:58,549 --> 00:24:56,080
into images similar to the process our

618
00:25:00,470 --> 00:24:58,559
digital cameras use to get that perfect

619
00:25:02,710 --> 00:25:00,480
picture even with the computer

620
00:25:04,789 --> 00:25:02,720
scientists go through a painstaking

621
00:25:07,430 --> 00:25:04,799
process to make sure the images are

622
00:25:09,590 --> 00:25:07,440
technically correct so the raw data gets

623
00:25:11,669 --> 00:25:09,600
turned into this

624
00:25:14,070 --> 00:25:11,679
spitzer's infrared images are not true

625
00:25:16,149 --> 00:25:14,080
color images since we can't see infrared

626
00:25:18,390 --> 00:25:16,159
wavelengths with our eyes scientists

627
00:25:20,870 --> 00:25:18,400
pick representative colors to show the

628
00:25:22,710 --> 00:25:20,880
infrared light detected by the telescope

629
00:25:24,789 --> 00:25:22,720
computer-aided data collection and

630
00:25:27,350 --> 00:25:24,799
processing is essential but the

631
00:25:30,070 --> 00:25:27,360
scientists truly bring the data into a

632
00:25:32,390 --> 00:25:30,080
visual piece of art that we can enjoy

633
00:25:33,470 --> 00:25:32,400
and understand and that is the art of

634
00:25:38,630 --> 00:25:33,480
spitzer in a minute

635
00:25:43,269 --> 00:25:40,710
and what incredible imagery we will be

636
00:25:45,269 --> 00:25:43,279
able to enjoy for generations to come

637
00:25:47,510 --> 00:25:45,279
now spitzer's images are just

638
00:25:49,190 --> 00:25:47,520

breathtaking what do you think spitzer

639
00:25:51,269 --> 00:25:49,200
unveiled farisa

640
00:25:53,350 --> 00:25:51,279
spitzer space telescope has unveiled the

641
00:25:55,590 --> 00:25:53,360
infrared universe i mean it has allowed

642
00:25:57,750 --> 00:25:55,600
us to see what our human eyes could not

643
00:25:59,990 --> 00:25:57,760
see and as you saw from the video these

644
00:26:02,070 --> 00:26:00,000
these huge molecular clouds in our

645
00:26:04,310 --> 00:26:02,080
galaxy which are stellar nurseries

646
00:26:06,630 --> 00:26:04,320
become transparent when you're observing

647
00:26:09,269 --> 00:26:06,640
in infrared radiation and it allows us

648
00:26:11,190 --> 00:26:09,279
to see these baby stars forming in in

649
00:26:14,070 --> 00:26:11,200
you know hundreds of light years across

650
00:26:16,630 --> 00:26:14,080
and the process of forming a star

651
00:26:18,310 --> 00:26:16,640
some of the debris is left over to form

652
00:26:20,950 --> 00:26:18,320
and coagulate into little planetary

653
00:26:22,549 --> 00:26:20,960
systems spitzer has been a pathfinder in

654
00:26:25,269 --> 00:26:22,559
allowing us to find out which ones are

655
00:26:27,750 --> 00:26:25,279
forming now for future exploration

656
00:26:29,750 --> 00:26:27,760
stellar nurseries amazing that it can

657
00:26:31,909 --> 00:26:29,760
peer into that and as a spitzer

658
00:26:32,789 --> 00:26:31,919
scientist how do you analyze all of that

659
00:26:33,909 --> 00:26:32,799
data

660
00:26:36,230 --> 00:26:33,919
you know there's two things you can do

661
00:26:37,510 --> 00:26:36,240
with with light

662
00:26:39,029 --> 00:26:37,520
any flavor of light in this case

663
00:26:40,789 --> 00:26:39,039

infrared light you can do photometry

664
00:26:43,190 --> 00:26:40,799
which is basically counting photons on

665
00:26:44,950 --> 00:26:43,200
how much light falls on a pixel which is

666
00:26:45,909 --> 00:26:44,960
basically what our phones have or you

667
00:26:48,149 --> 00:26:45,919
can do another technique called

668
00:26:49,750 --> 00:26:48,159
spectroscopy and with spectroscopy the

669
00:26:52,390 --> 00:26:49,760
light gets broken down it means rainbow

670
00:26:53,909 --> 00:26:52,400
components and you can analyze how much

671
00:26:56,710 --> 00:26:53,919
light you're seeing per wavelength how

672
00:26:58,549 --> 00:26:56,720
much how much energy and that is very

673
00:27:01,029 --> 00:26:58,559
interesting an interesting technique and

674
00:27:01,830 --> 00:27:01,039
an amazing technique that humans have

675
00:27:07,029 --> 00:27:01,840
to

676
00:27:09,590 --> 00:27:07,039
from the dust for example that emitted

677
00:27:12,549 --> 00:27:09,600
that radiation and

678
00:27:13,830 --> 00:27:12,559
when you analyze through spectroscopy uh

679
00:27:15,990 --> 00:27:13,840
the composition for example you can

680
00:27:19,029 --> 00:27:16,000
obtain the chemical composition of the

681
00:27:21,590 --> 00:27:19,039
dust orbiting another star and you can

682
00:27:23,350 --> 00:27:21,600
also get information about the structure

683
00:27:25,590 --> 00:27:23,360
of for example other planetary systems

684
00:27:27,029 --> 00:27:25,600
that are forming so it's amazing how

685
00:27:28,470 --> 00:27:27,039
data can be

686
00:27:30,230 --> 00:27:28,480
studied and how much information it

687
00:27:33,029 --> 00:27:30,240
brings us that's amazing from an

688
00:27:35,269 --> 00:27:33,039

engineering marvel of a telescope to its

689
00:27:37,110 --> 00:27:35,279
beautiful science return that's for sure

690
00:27:38,789 --> 00:27:37,120
and there will be much to speak about

691
00:27:40,789 --> 00:27:38,799
when it comes to spitzer for generations

692
00:27:42,710 --> 00:27:40,799
to come i feel but mike what do you

693
00:27:44,549 --> 00:27:42,720
personally think its legacy will be well

694
00:27:46,870 --> 00:27:44,559
to begin with uh several of us have

695
00:27:48,630 --> 00:27:46,880
already mentioned the archive of data

696
00:27:50,549 --> 00:27:48,640
which is already being mined by

697
00:27:52,950 --> 00:27:50,559
astronomers and will continue to be

698
00:27:54,789 --> 00:27:52,960
mined for decades

699
00:27:57,350 --> 00:27:54,799
an important science area that's well

700
00:27:58,789 --> 00:27:57,360
represented in that archive is the study

701
00:28:01,510 --> 00:27:58,799
of the very distant universe we've

702
00:28:03,190 --> 00:28:01,520
talked about exoplanets which are nearby

703
00:28:05,669 --> 00:28:03,200
but spitzer particularly working with

704
00:28:07,510 --> 00:28:05,679
hubble has seen galaxies as they were

705
00:28:09,830 --> 00:28:07,520
when the universe was only a few percent

706
00:28:12,070 --> 00:28:09,840
of its current age and they like the

707
00:28:14,549 --> 00:28:12,080
exoplanets will be well studied by the

708
00:28:16,870 --> 00:28:14,559
james webb space telescope but there's a

709
00:28:19,830 --> 00:28:16,880
human dimension to the legacy as well

710
00:28:22,070 --> 00:28:19,840
and again joseph and farisa both hinted

711
00:28:25,269 --> 00:28:22,080
at this which is the importance of the

712
00:28:26,630 --> 00:28:25,279
teamwork as an example of what people

713
00:28:29,110 --> 00:28:26,640

can accomplish

714
00:28:32,870 --> 00:28:29,120
when they're well led well supported and

715
00:28:35,430 --> 00:28:32,880
empowered the work of the spitzer team

716
00:28:37,510 --> 00:28:35,440
in producing this amazing observatory

717
00:28:40,149 --> 00:28:37,520
and using it so effectively is

718
00:28:42,789 --> 00:28:40,159
absolutely astounding and i think it

719
00:28:44,789 --> 00:28:42,799
stands as a sterling example of what

720
00:28:46,389 --> 00:28:44,799
people are capable of doing

721
00:28:48,630 --> 00:28:46,399
and i think that's important in these

722
00:28:51,190 --> 00:28:48,640
troubled times to realize that there's a

723
00:28:53,430 --> 00:28:51,200
genius and an ability and a strength in

724
00:28:55,430 --> 00:28:53,440
the human spirit which is capable of

725
00:28:57,350 --> 00:28:55,440
doing amazing things so that's another

726
00:28:59,510 --> 00:28:57,360
part of the legacy well you should all

727
00:29:03,110 --> 00:28:59,520
be so proud because it is just

728
00:29:06,070 --> 00:29:03,120
absolutely amazing thank you so much now

729
00:29:08,710 --> 00:29:06,080
spitzer was such a powerhouse in nasa's

730
00:29:11,269 --> 00:29:08,720
astrophysics portfolio and will continue

731
00:29:12,389 --> 00:29:11,279
to bring a wealth of information as we

732
00:29:15,510 --> 00:29:12,399
move ahead

733
00:29:17,510 --> 00:29:15,520
here to talk about why spitzer is ending

734
00:29:20,710 --> 00:29:17,520
and its legacy yet to come through

735
00:29:22,389 --> 00:29:20,720
future missions is paul hurts so paul

736
00:29:24,470 --> 00:29:22,399
tell me a little bit about why we are

737
00:29:27,510 --> 00:29:24,480
ending spitzer's mission and the science

738
00:29:30,710 --> 00:29:27,520

that we'll live on

739
00:29:36,470 --> 00:29:33,590
at nasa we review all of our missions

740
00:29:38,230 --> 00:29:36,480
for their science productivity

741
00:29:39,269 --> 00:29:38,240
uh as they go along through their

742
00:29:41,830 --> 00:29:39,279
mission

743
00:29:44,070 --> 00:29:41,840
in 2016 we

744
00:29:47,029 --> 00:29:44,080
looked ahead and saw the upcoming launch

745
00:29:49,190 --> 00:29:47,039
of the james webb space telescope nasa's

746
00:29:51,830 --> 00:29:49,200
next great observatory

747
00:29:54,230 --> 00:29:51,840
which is also an infrared observatory

748
00:29:56,389 --> 00:29:54,240
and the decision was made that the

749
00:29:59,190 --> 00:29:56,399
spitzer mission should end as the james

750
00:30:01,269 --> 00:29:59,200
webb mission was beginning

751
00:30:02,789 --> 00:30:01,279
at the time we extended the spitzer

752
00:30:05,350 --> 00:30:02,799
mission all the way through the launch

753
00:30:07,669 --> 00:30:05,360
of james webb in 2018

754
00:30:12,149 --> 00:30:07,679
when the james webb launch was delayed

755
00:30:13,669 --> 00:30:12,159
until 2021 we extended spitzer until now

756
00:30:15,750 --> 00:30:13,679
in 2020

757
00:30:17,110 --> 00:30:15,760
but the time has come for the spitzer

758
00:30:19,430 --> 00:30:17,120
mission to end

759
00:30:21,510 --> 00:30:19,440
as we move on to the launch of james

760
00:30:22,710 --> 00:30:21,520
webb next year

761
00:30:25,029 --> 00:30:22,720
and uh

762
00:30:26,950 --> 00:30:25,039
operation of spitzer is becoming more

763
00:30:29,830 --> 00:30:26,960

difficult as it gets further away from

764
00:30:32,630 --> 00:30:29,840
the earth as the angle between the earth

765
00:30:34,830 --> 00:30:32,640
the sun and the telescope changes makes

766
00:30:36,789 --> 00:30:34,840
it more difficult to

767
00:30:38,789 --> 00:30:36,799
simultaneously keep the solar panels

768
00:30:41,110 --> 00:30:38,799
pointed at the sun to keep the

769
00:30:43,430 --> 00:30:41,120
communications antenna pointed at the

770
00:30:45,909 --> 00:30:43,440
earth to keep the telescope pointed at

771
00:30:48,950 --> 00:30:45,919
the stars and planets we want to look at

772
00:30:51,029 --> 00:30:48,960
and to keep the sun off of the telescope

773
00:30:53,590 --> 00:30:51,039
so that it stays very cold and is able

774
00:30:55,909 --> 00:30:53,600
to continue its infrared

775
00:30:58,070 --> 00:30:55,919
we we can continue to operate it today

776
00:31:00,549 --> 00:30:58,080
but in the very near future it will

777
00:31:03,509 --> 00:31:00,559
become very difficult to continue

778
00:31:05,830 --> 00:31:03,519
operating the spitzer space telescope

779
00:31:09,269 --> 00:31:05,840
thank you so much paul now we're going

780
00:31:12,070 --> 00:31:09,279
to open up the panel to our media and

781
00:31:14,789 --> 00:31:12,080
social media questions and our first

782
00:31:18,310 --> 00:31:14,799
question is on the phone from stephen

783
00:31:20,950 --> 00:31:18,320
clark with space flight now welcome

784
00:31:24,710 --> 00:31:22,630
hi thank you all for doing this and for

785
00:31:26,549 --> 00:31:24,720
taking my question

786
00:31:27,669 --> 00:31:26,559
i i just wanted to get an update maybe

787
00:31:28,789 --> 00:31:27,679
from

788
00:31:30,870 --> 00:31:28,799

mr hunt

789
00:31:32,789 --> 00:31:30,880
about the process to

790
00:31:34,549 --> 00:31:32,799
shut down the telescope

791
00:31:36,230 --> 00:31:34,559
have science observations already ended

792
00:31:38,149 --> 00:31:36,240
are you still getting down some final

793
00:31:40,710 --> 00:31:38,159
images over this next week

794
00:31:42,470 --> 00:31:40,720
and can you talk about the process to

795
00:31:43,990 --> 00:31:42,480
shut down the telescope what commands

796
00:31:44,789 --> 00:31:44,000
will you be sending to turn it off and

797
00:31:46,470 --> 00:31:44,799
to

798
00:31:48,710 --> 00:31:46,480
save or passivate it

799
00:31:50,950 --> 00:31:48,720
and maybe for paul hertz uh do you have

800
00:31:53,110 --> 00:31:50,960
the total life cycle cost for the

801
00:31:53,909 --> 00:31:53,120
spitzer space telescope from development

802
00:31:56,310 --> 00:31:53,919
through

803
00:31:59,269 --> 00:31:56,320
uh in this mission thank you

804
00:32:00,389 --> 00:31:59,279
okay sure so i'll go first paul and uh

805
00:32:03,190 --> 00:32:00,399
yes so

806
00:32:06,310 --> 00:32:03,200
over the course of the next week

807
00:32:09,110 --> 00:32:06,320
we will still have a set of uh science

808
00:32:11,909 --> 00:32:09,120
activities that are scheduled to be ran

809
00:32:15,909 --> 00:32:11,919
on the telescope uh we are complete most

810
00:32:18,789 --> 00:32:15,919
of our science activities on the 28th

811
00:32:21,110 --> 00:32:18,799
and complete our final science playback

812
00:32:23,350 --> 00:32:21,120
on the 29th

813
00:32:25,909 --> 00:32:23,360

then continuing forward

814
00:32:27,350 --> 00:32:25,919
what happens for the intermission

815
00:32:30,549 --> 00:32:27,360
passivation

816
00:32:33,190 --> 00:32:30,559
or safe mode in place so for the spitzer

817
00:32:35,509 --> 00:32:33,200
spacecraft because of what paul had

818
00:32:37,909 --> 00:32:35,519
mentioned earlier about

819
00:32:43,029 --> 00:32:37,919
extending the operations

820
00:32:46,789 --> 00:32:43,039
to couple with jwst jwst was delayed uh

821
00:32:49,669 --> 00:32:46,799
spitzer steele had some extended uh

822
00:32:53,509 --> 00:32:49,679
operations in science uh we've reached

823
00:32:55,750 --> 00:32:53,519
the point that what we're going to do is

824
00:32:58,310 --> 00:32:55,760
utilize the engineering time of what we

825
00:32:59,909 --> 00:32:58,320
did was utilize the engineering time to

826
00:33:02,549 --> 00:32:59,919
really focus

827
00:33:05,430 --> 00:33:02,559
on returning more science as far as

828
00:33:07,830 --> 00:33:05,440
passivation there's really nothing on

829
00:33:09,590 --> 00:33:07,840
picture that you would need to passivate

830
00:33:11,430 --> 00:33:09,600
we use nitrogen

831
00:33:13,830 --> 00:33:11,440
to keep it stable which is the very

832
00:33:16,710 --> 00:33:13,840
inert gas

833
00:33:17,909 --> 00:33:16,720
based on the orbit which susan susie

834
00:33:20,870 --> 00:33:17,919
mentioned

835
00:33:24,230 --> 00:33:20,880
our orbit we are receding away from

836
00:33:27,190 --> 00:33:24,240
earth with about 160

837
00:33:29,669 --> 00:33:27,200
miles away will continue out on this

838
00:33:32,789 --> 00:33:29,679

trajectory so really there's nothing out

839
00:33:34,149 --> 00:33:32,799
there for spitzer to crash into

840
00:33:37,350 --> 00:33:34,159
other than

841
00:33:42,870 --> 00:33:40,710
some field of debris uh so there's

842
00:33:46,389 --> 00:33:42,880
nothing there so what we're gonna do is

843
00:33:49,269 --> 00:33:46,399
on the 30th we're gonna put spitzer in a

844
00:33:51,269 --> 00:33:49,279
hibernation mode per se we're gonna

845
00:33:54,149 --> 00:33:51,279
command it from the ground

846
00:33:56,950 --> 00:33:54,159
to put it in safe mode in safe mode it

847
00:33:59,190 --> 00:33:56,960
goes into a sun coning attitude and it

848
00:34:07,909 --> 00:33:59,200
will just stay in that attitude

849
00:34:13,510 --> 00:34:09,589
and i think you had a second part of

850
00:34:15,109 --> 00:34:13,520
your question about costs to paul paul

851
00:34:17,109 --> 00:34:15,119
would you be able to ask

852
00:34:21,510 --> 00:34:17,119
yes would paul be able to answer

853
00:34:25,589 --> 00:34:24,149
so that's a great question and uh we

854
00:34:27,589 --> 00:34:25,599
should have had been ready for that one

855
00:34:30,470 --> 00:34:27,599
but quite frankly we haven't i don't

856
00:34:31,349 --> 00:34:30,480
have that number off top of my head okay

857
00:34:33,430 --> 00:34:31,359
great

858
00:34:34,470 --> 00:34:33,440
okay next question comes from kimberly

859
00:34:35,990 --> 00:34:34,480
cartier

860
00:34:37,990 --> 00:34:36,000
from eos

861
00:34:40,069 --> 00:34:38,000
hello kimberly

862
00:34:42,230 --> 00:34:40,079
hi thanks so much for taking my question

863
00:34:43,669 --> 00:34:42,240

and for putting together this event

864
00:34:45,589 --> 00:34:43,679
um now

865
00:34:47,990 --> 00:34:45,599
given that the james webb space

866
00:34:50,710 --> 00:34:48,000
telescope is obviously not launched yet

867
00:34:52,790 --> 00:34:50,720
and it's going to essentially

868
00:34:54,389 --> 00:34:52,800
take over for spitzer in terms of

869
00:34:57,030 --> 00:34:54,399
infrared coverage

870
00:35:00,829 --> 00:34:57,040
is there any concerns about the gap in

871
00:35:05,910 --> 00:35:03,030
paul would you be able to answer that

872
00:35:08,150 --> 00:35:05,920
question for kimberly

873
00:35:11,750 --> 00:35:08,160
sure i'll be glad to uh there's no

874
00:35:12,870 --> 00:35:11,760
concern about the gap um uh because the

875
00:35:14,390 --> 00:35:12,880
universe

876
00:35:15,829 --> 00:35:14,400
you know we're observing it now with

877
00:35:17,750 --> 00:35:15,839
spitzer

878
00:35:19,589 --> 00:35:17,760
starting next year when the james webb

879
00:35:21,670 --> 00:35:19,599
space telescope launches we'll be

880
00:35:24,230 --> 00:35:21,680
observing it with james webb uh the

881
00:35:26,470 --> 00:35:24,240
james webb mirror is 50 times larger in

882
00:35:29,670 --> 00:35:26,480
the spitzer mirror so we'll be able to

883
00:35:31,829 --> 00:35:29,680
observe uh even deeper into the universe

884
00:35:33,990 --> 00:35:31,839
in fact james webb is designed to detect

885
00:35:36,870 --> 00:35:34,000
the first light after the big bang the

886
00:35:38,870 --> 00:35:36,880
first stars in the first galaxies um and

887
00:35:40,710 --> 00:35:38,880
even beyond that we're

888
00:35:42,870 --> 00:35:40,720

we're started building the

889
00:35:44,390 --> 00:35:42,880
wide field infrared survey telescope

890
00:35:46,630 --> 00:35:44,400
wfirth which will be the great

891
00:35:48,950 --> 00:35:46,640
observatory to follow web

892
00:35:51,109 --> 00:35:48,960
wfirst has the sensitivity of hubble but

893
00:35:53,190 --> 00:35:51,119
a hundred times the field of view so

894
00:35:55,990 --> 00:35:53,200
with every wfirst image we'll be doing a

895
00:35:57,910 --> 00:35:56,000
hundred hubble deep fields so we're well

896
00:35:59,990 --> 00:35:57,920
positioned to continue studying the

897
00:36:03,030 --> 00:36:00,000
universe in infrared

898
00:36:05,510 --> 00:36:03,040
and the gap of a year or so really is

899
00:36:07,510 --> 00:36:05,520
not a concern

900
00:36:10,390 --> 00:36:07,520
thank you so much paul and now we head

901
00:36:12,470 --> 00:36:10,400
over to social media remember if you

902
00:36:14,470 --> 00:36:12,480
want to ask our panelists a question

903
00:36:17,510 --> 00:36:14,480
head over to social media and hashtag

904
00:36:20,230 --> 00:36:17,520
ask nasa this is from at

905
00:36:23,030 --> 00:36:20,240
dan biko and dan would like to know this

906
00:36:25,510 --> 00:36:23,040
is sad news is there a replacement in

907
00:36:27,910 --> 00:36:25,520
the works and i think that paul you just

908
00:36:29,510 --> 00:36:27,920
mentioned we've got a james webb and w

909
00:36:32,630 --> 00:36:29,520
first if you want to go ahead and talk a

910
00:36:39,349 --> 00:36:35,670
right well uh while neither

911
00:36:40,470 --> 00:36:39,359
web nor w first will exactly replace

912
00:36:41,670 --> 00:36:40,480
spitzer

913
00:36:44,230 --> 00:36:41,680

they both

914
00:36:46,870 --> 00:36:44,240
are built on the legacy of spitzer first

915
00:36:49,430 --> 00:36:46,880
of all the science that spitzer did

916
00:36:51,349 --> 00:36:49,440
has revealed a lot of

917
00:36:53,990 --> 00:36:51,359
mysteries of the universe that we want

918
00:36:55,270 --> 00:36:54,000
to follow up with webb and wfirst

919
00:36:57,589 --> 00:36:55,280
in addition

920
00:37:00,950 --> 00:36:57,599
something we didn't talk about is that

921
00:37:03,750 --> 00:37:00,960
spitzer demonstrated a passive cooling

922
00:37:06,150 --> 00:37:03,760
of a telescope the spitzer telescope is

923
00:37:07,349 --> 00:37:06,160
kept cold by just radiating out into

924
00:37:09,109 --> 00:37:07,359
space

925
00:37:10,950 --> 00:37:09,119
and it's only a few tens of degrees

926
00:37:13,270 --> 00:37:10,960
above absolute zero

927
00:37:15,670 --> 00:37:13,280
it doesn't require a complex cooling

928
00:37:17,270 --> 00:37:15,680
system to stay cold and that's exactly

929
00:37:19,750 --> 00:37:17,280
how we're going to keep the james webb

930
00:37:21,750 --> 00:37:19,760
space telescope mirror cold even though

931
00:37:23,990 --> 00:37:21,760
it's 50 times bigger than the spitzer

932
00:37:27,190 --> 00:37:24,000
space telescope we'll cool it down to

933
00:37:29,829 --> 00:37:27,200
below 50 degrees abs above absolute zero

934
00:37:31,910 --> 00:37:29,839
by passively radiating out of the space

935
00:37:33,510 --> 00:37:31,920
a technique that was developed and

936
00:37:35,510 --> 00:37:33,520
demonstrated by the spitzer space

937
00:37:37,829 --> 00:37:35,520
telescope

938
00:37:41,190 --> 00:37:37,839

thank you so much paul our next question

939
00:37:43,430 --> 00:37:41,200
from social media is from iris iris

940
00:37:47,510 --> 00:37:43,440
wants to know what is the spitzer team

941
00:37:50,390 --> 00:37:47,520
going to be doing after the shutdown

942
00:37:52,950 --> 00:37:50,400
i'll take that question ours so um good

943
00:37:55,589 --> 00:37:52,960
question what will the team be doing so

944
00:37:58,230 --> 00:37:55,599
actually we are closing out the mission

945
00:38:00,150 --> 00:37:58,240
and shutting down the observatory is

946
00:38:03,190 --> 00:38:00,160
just one phase of that

947
00:38:06,390 --> 00:38:03,200
during the close out we decommission

948
00:38:09,109 --> 00:38:06,400
the flight and the ground assets

949
00:38:11,589 --> 00:38:09,119
so once the spacecraft is declared

950
00:38:13,910 --> 00:38:11,599
decommissioned we'll start the closeout

951
00:38:16,550 --> 00:38:13,920
process for archiving all of the

952
00:38:18,310 --> 00:38:16,560
documentation and all of our

953
00:38:20,069 --> 00:38:18,320
non-science

954
00:38:21,990 --> 00:38:20,079
data which is the engineering data that

955
00:38:24,950 --> 00:38:22,000
we've collected off for the observatory

956
00:38:31,109 --> 00:38:24,960
for the many years of operations so that

957
00:38:37,990 --> 00:38:34,390
thank you so much joseph

958
00:38:39,829 --> 00:38:38,000
now we have megan bartel from space.com

959
00:38:41,349 --> 00:38:39,839
on the lines thank you for joining us

960
00:38:43,109 --> 00:38:41,359
megan

961
00:38:45,349 --> 00:38:43,119
thanks for taking my call can you hear

962
00:38:47,829 --> 00:38:45,359
me yes i can

963
00:38:49,750 --> 00:38:47,839

great uh this is a question from mike if

964
00:38:50,790 --> 00:38:49,760
you could just uh you've talked about

965
00:38:53,510 --> 00:38:50,800
the science a lot but if you could

966
00:38:55,030 --> 00:38:53,520
summarize sort of what your own personal

967
00:38:58,710 --> 00:38:55,040
favorite discovery

968
00:39:01,270 --> 00:38:58,720
from the mission is that would be great

969
00:39:03,670 --> 00:39:01,280
well from from from the very big picture

970
00:39:06,069 --> 00:39:03,680
clearly the results on exoplanets and

971
00:39:07,430 --> 00:39:06,079
the results on the distant universe

972
00:39:09,750 --> 00:39:07,440
are the two

973
00:39:12,390 --> 00:39:09,760
major areas of spitzer's

974
00:39:14,390 --> 00:39:12,400
contributions as we discussed earlier

975
00:39:15,589 --> 00:39:14,400
but i have a soft spot in my heart for

976
00:39:17,510 --> 00:39:15,599
several

977
00:39:19,670 --> 00:39:17,520
smaller

978
00:39:20,950 --> 00:39:19,680
discoveries and i just to mention one of

979
00:39:23,829 --> 00:39:20,960
them um

980
00:39:26,150 --> 00:39:23,839
my colleague mike jura from ucla

981
00:39:28,470 --> 00:39:26,160
discovered that you can

982
00:39:31,270 --> 00:39:28,480
determine the composition of

983
00:39:33,430 --> 00:39:31,280
exoplanetary systems by studying the

984
00:39:36,870 --> 00:39:33,440
atmospheres of white dwarfs

985
00:39:38,790 --> 00:39:36,880
sounds very surprising but a white dwarf

986
00:39:40,710 --> 00:39:38,800
which is an evolved star

987
00:39:43,910 --> 00:39:40,720
if it had a planetary system while it

988
00:39:48,710 --> 00:39:45,910

part of that planetary system comets or

989
00:39:50,710 --> 00:39:48,720
asteroids may approach the white dwarf

990
00:39:51,829 --> 00:39:50,720
get torn apart by its very strong

991
00:39:54,150 --> 00:39:51,839
gravity

992
00:39:55,910 --> 00:39:54,160
that material will fall onto the

993
00:39:57,109 --> 00:39:55,920
atmosphere of the white dwarf and can be

994
00:39:58,870 --> 00:39:57,119
observed

995
00:40:01,349 --> 00:39:58,880
because the atmosphere is polluted by

996
00:40:03,270 --> 00:40:01,359
that material it's a very

997
00:40:05,349 --> 00:40:03,280
solid but somewhat roundabout way of

998
00:40:07,270 --> 00:40:05,359
studying the composition of

999
00:40:09,270 --> 00:40:07,280
extrasolar planetary systems which

1000
00:40:11,589 --> 00:40:09,280
really can't be done any other way so

1001
00:40:13,430 --> 00:40:11,599
that's just one of several little gems

1002
00:40:14,790 --> 00:40:13,440
that i followed with great delight over

1003
00:40:16,550 --> 00:40:14,800
the years

1004
00:40:18,150 --> 00:40:16,560
wonderful wonderful we also have a

1005
00:40:21,349 --> 00:40:18,160
follow-up question right now from

1006
00:40:22,870 --> 00:40:21,359
kimberly cartier from eos welcome back

1007
00:40:24,710 --> 00:40:22,880
kimberly

1008
00:40:26,630 --> 00:40:24,720
hi thanks so much for the opportunity

1009
00:40:29,349 --> 00:40:26,640
for a second question i'm sort of

1010
00:40:32,069 --> 00:40:29,359
following on to that are there other

1011
00:40:34,870 --> 00:40:32,079
uh observations from inside the solar

1012
00:40:37,750 --> 00:40:34,880
system or of solar system objects that

1013
00:40:39,750 --> 00:40:37,760

are particularly exciting for you

1014
00:40:42,550 --> 00:40:39,760
or anyone now

1015
00:40:44,710 --> 00:40:42,560
i think the most exciting apart from

1016
00:40:46,790 --> 00:40:44,720
saturn's rings that susie mentioned

1017
00:40:49,270 --> 00:40:46,800
the most exciting solar system result

1018
00:40:50,829 --> 00:40:49,280
came early in the system in the mission

1019
00:40:53,910 --> 00:40:50,839
when the deep impact

1020
00:40:56,630 --> 00:40:53,920
spacecraft collided with the nucleus of

1021
00:40:59,510 --> 00:40:56,640
a comet and put out put out a great

1022
00:41:02,150 --> 00:40:59,520
spray of gas and dust spitzer and many

1023
00:41:04,230 --> 00:41:02,160
other telescopes observed that in detail

1024
00:41:07,190 --> 00:41:04,240
because it was a first look at the

1025
00:41:09,750 --> 00:41:07,200
primordial material buried beneath the

1026
00:41:12,309 --> 00:41:09,760
crusty outer surface of a comet

1027
00:41:13,829 --> 00:41:12,319
and very interestingly we found that the

1028
00:41:15,270 --> 00:41:13,839
composition of that material which

1029
00:41:17,910 --> 00:41:15,280
contained a lot of

1030
00:41:20,470 --> 00:41:17,920
silicate minerals and so forth was very

1031
00:41:22,309 --> 00:41:20,480
very similar to the composition of

1032
00:41:24,309 --> 00:41:22,319
material which we see around

1033
00:41:29,349 --> 00:41:24,319
exoplanetary systems

1034
00:41:31,990 --> 00:41:29,359
one of many ways in which spitzer

1035
00:41:34,150 --> 00:41:32,000
established important links between our

1036
00:41:37,030 --> 00:41:34,160
own solar system which we study well

1037
00:41:38,550 --> 00:41:37,040
from inside and these external systems

1038
00:41:40,470 --> 00:41:38,560

where we can see them from the outside

1039
00:41:42,069 --> 00:41:40,480
and sort of got a bigger picture but

1040
00:41:43,109 --> 00:41:42,079
there are lots of commonalities which

1041
00:41:44,950 --> 00:41:43,119
have been

1042
00:41:48,150 --> 00:41:44,960
improved our understanding of both the

1043
00:41:50,390 --> 00:41:48,160
solar system and exoplanetary systems

1044
00:41:52,069 --> 00:41:50,400
the similarity in composition is just

1045
00:41:53,589 --> 00:41:52,079
one of those

1046
00:41:56,309 --> 00:41:53,599
thank you so much mike we also have a

1047
00:42:00,829 --> 00:41:56,319
follow-up question from steven clark

1048
00:42:05,190 --> 00:42:03,109
steven hi thank you for taking another

1049
00:42:07,589 --> 00:42:05,200
question from me um to follow up on my

1050
00:42:09,670 --> 00:42:07,599
earlier question to joseph

1051
00:42:10,950 --> 00:42:09,680
uh so the spacecraft is going to go into

1052
00:42:13,030 --> 00:42:10,960
a safe mode

1053
00:42:15,750 --> 00:42:13,040
is turning the receiver and radio

1054
00:42:18,470 --> 00:42:15,760
transmitter off part of that process

1055
00:42:20,309 --> 00:42:18,480
or do those remain on and is there any

1056
00:42:22,309 --> 00:42:20,319
possibility to

1057
00:42:23,829 --> 00:42:22,319
reestablish contact with the spacecraft

1058
00:42:24,870 --> 00:42:23,839
at some point in the distant future

1059
00:42:30,150 --> 00:42:24,880
thank you

1060
00:42:32,230 --> 00:42:30,160
susie mentioned in all in her discussion

1061
00:42:35,030 --> 00:42:32,240
was the orbit geometry and how the

1062
00:42:38,550 --> 00:42:35,040
spacecraft recedes away

1063
00:42:41,750 --> 00:42:38,560

as will getting further away the radio

1064
00:42:43,670 --> 00:42:41,760
signal continues to weaken so it you

1065
00:42:46,550 --> 00:42:43,680
know the

1066
00:42:49,990 --> 00:42:46,560
possibility of contacting it

1067
00:42:52,309 --> 00:42:50,000
becomes more complex and more difficult

1068
00:42:54,870 --> 00:42:52,319
again one of the things that i

1069
00:42:57,270 --> 00:42:54,880
uh included earlier in talking about the

1070
00:42:58,390 --> 00:42:57,280
closeout so when you're decommissioning

1071
00:43:01,910 --> 00:42:58,400
the spacecraft

1072
00:43:04,870 --> 00:43:01,920
you also decommission the ground system

1073
00:43:07,829 --> 00:43:04,880
spitzer use a very customized ground

1074
00:43:09,910 --> 00:43:07,839
system to create the science sequences

1075
00:43:11,670 --> 00:43:09,920
and the products that you need

1076
00:43:14,550 --> 00:43:11,680
to collect the science

1077
00:43:17,589 --> 00:43:14,560
once that system is dissolved it makes

1078
00:43:20,870 --> 00:43:17,599
it very difficult or

1079
00:43:22,550 --> 00:43:20,880
impossible to resurrect so the

1080
00:43:24,710 --> 00:43:22,560
likelihood of

1081
00:43:27,430 --> 00:43:24,720
recommanding or resurrecting science

1082
00:43:30,069 --> 00:43:27,440
operation would sign with spitzer would

1083
00:43:36,790 --> 00:43:33,589
thank you joseph and we have a question

1084
00:43:39,430 --> 00:43:36,800
on social media from manish

1085
00:43:42,870 --> 00:43:39,440
what is the future of exoplanet

1086
00:43:45,190 --> 00:43:42,880
discovery once nasa spitzer stops

1087
00:43:47,430 --> 00:43:45,200
collecting data paul can you take that

1088
00:43:53,030 --> 00:43:49,750

sure i'll be glad to marina but before i

1089
00:43:55,510 --> 00:43:53,040
do let me say that we have found the

1090
00:43:58,270 --> 00:43:55,520
total cost of the spitzer mission from a

1091
00:44:00,950 --> 00:43:58,280
previous question and the total cost is

1092
00:44:03,510 --> 00:44:00,960
1.36 billion dollars

1093
00:44:06,150 --> 00:44:03,520
spent over the last 20 plus years that

1094
00:44:08,790 --> 00:44:06,160
includes building and operating and

1095
00:44:09,990 --> 00:44:08,800
launching the observatory

1096
00:44:14,230 --> 00:44:10,000
so uh

1097
00:44:16,470 --> 00:44:14,240
two years ago in 2018 nasa launched its

1098
00:44:19,510 --> 00:44:16,480
next exoplanet mission the transiting

1099
00:44:22,710 --> 00:44:19,520
exoplanet survey satellite called tess

1100
00:44:25,270 --> 00:44:22,720
a tess is surveying the entire sky

1101
00:44:27,589 --> 00:44:25,280
looking for transiting exoplanets around

1102
00:44:29,829 --> 00:44:27,599
the nearest and brightest stars

1103
00:44:31,990 --> 00:44:29,839
it's already found over a thousand

1104
00:44:34,309 --> 00:44:32,000
candidate exoplanets in just its first

1105
00:44:36,630 --> 00:44:34,319
year and a half of operations we've

1106
00:44:38,309 --> 00:44:36,640
approved tests for another three years

1107
00:44:39,589 --> 00:44:38,319
of operations

1108
00:44:42,630 --> 00:44:39,599
so far

1109
00:44:44,150 --> 00:44:42,640
and so the future of exoplanet studies

1110
00:44:45,510 --> 00:44:44,160
is very bright

1111
00:44:48,790 --> 00:44:45,520
with the tess

1112
00:44:50,550 --> 00:44:48,800
telescope discovering new exoplanets

1113
00:44:51,910 --> 00:44:50,560

james webb space telescope which you've

1114
00:44:54,309 --> 00:44:51,920
already talked about will be launching

1115
00:44:56,870 --> 00:44:54,319
next year and one of its key science

1116
00:44:58,470 --> 00:44:56,880
areas will be uh characterizing

1117
00:45:00,950 --> 00:44:58,480
individual exoplanets the most

1118
00:45:03,670 --> 00:45:00,960
interesting ones using its suite of four

1119
00:45:05,430 --> 00:45:03,680
very powerful instruments on board in

1120
00:45:09,109 --> 00:45:05,440
addition the hubble space telescope

1121
00:45:11,190 --> 00:45:09,119
continues to study exoplanets

1122
00:45:12,790 --> 00:45:11,200
thank you so much paul and i think one

1123
00:45:15,030 --> 00:45:12,800
of the most amazing things at least for

1124
00:45:17,670 --> 00:45:15,040
the public to fall in love with spitzer

1125
00:45:19,109 --> 00:45:17,680
has been from its many incredible images

1126
00:45:20,710 --> 00:45:19,119
and i know each of you have your

1127
00:45:22,150 --> 00:45:20,720
favorites so if we could just go down

1128
00:45:24,069 --> 00:45:22,160
the line and you could tell me what your

1129
00:45:26,710 --> 00:45:24,079
favorite spitzer image is i would

1130
00:45:30,870 --> 00:45:26,720
appreciate it uh yes marina my favorite

1131
00:45:32,790 --> 00:45:30,880
images is of a region called ngc 1333

1132
00:45:34,550 --> 00:45:32,800
where stars are forming

1133
00:45:37,430 --> 00:45:34,560
it's very colorful

1134
00:45:40,230 --> 00:45:37,440
it shows a progression between the very

1135
00:45:42,309 --> 00:45:40,240
youngest stars and slightly older ones

1136
00:45:43,349 --> 00:45:42,319
and this is a geometrical progression in

1137
00:45:45,589 --> 00:45:43,359
space

1138
00:45:49,190 --> 00:45:45,599

and you can imagine that there's a wave

1139
00:45:52,470 --> 00:45:49,200
of star formation propagating along that

1140
00:45:54,630 --> 00:45:52,480
trajectory and each generation of stars

1141
00:45:57,190 --> 00:45:54,640
triggers the star formation the next

1142
00:45:58,150 --> 00:45:57,200
generation by the pressure that it puts

1143
00:46:00,870 --> 00:45:58,160
on the

1144
00:46:05,510 --> 00:46:00,880
surrounding molecular gas and dust so my

1145
00:46:08,390 --> 00:46:07,030
well i have many favorites but i'm going

1146
00:46:10,790 --> 00:46:08,400
to highlight one that was very

1147
00:46:12,950 --> 00:46:10,800
impressive to me

1148
00:46:15,030 --> 00:46:12,960
it's called mountains of creation and

1149
00:46:17,349 --> 00:46:15,040
it's an amazing very impressive hundreds

1150
00:46:19,990 --> 00:46:17,359
of light years across molecular cloud

1151
00:46:22,470 --> 00:46:20,000
that shows the erosion of this cloud as

1152
00:46:24,230 --> 00:46:22,480
it forms baby stars uh it's very

1153
00:46:26,550 --> 00:46:24,240
impressive to me it's a beautiful one

1154
00:46:28,470 --> 00:46:26,560
yeah joseph hi maureen so that's a

1155
00:46:31,190 --> 00:46:28,480
really difficult question

1156
00:46:33,670 --> 00:46:31,200
because you know

1157
00:46:35,510 --> 00:46:33,680
absolutely i remember for our launch

1158
00:46:37,670 --> 00:46:35,520
anniversary we were putting together

1159
00:46:39,990 --> 00:46:37,680
images and that same question was asked

1160
00:46:41,829 --> 00:46:40,000
and he spent minutes just

1161
00:46:44,790 --> 00:46:41,839
strolling through but

1162
00:46:46,870 --> 00:46:44,800
mike explained the science of it and i

1163
00:46:49,589 --> 00:46:46,880

think looking at the um

1164
00:46:52,950 --> 00:46:49,599
the graphic or the artist concept of it

1165
00:46:54,069 --> 00:46:52,960
for the trappist-1 uh system would

1166
00:46:55,109 --> 00:46:54,079
probably be

1167
00:46:57,829 --> 00:46:55,119
my

1168
00:47:01,270 --> 00:46:57,839
most favorite wonderful susie um well

1169
00:47:04,069 --> 00:47:01,280
besides saturn and saturn's rings um i

1170
00:47:07,270 --> 00:47:04,079
really like um m81 which is just a

1171
00:47:10,790 --> 00:47:07,280
classic spiral galaxy and i think that

1172
00:47:13,190 --> 00:47:10,800
kind of epitomizes uh what spitzer can

1173
00:47:15,430 --> 00:47:13,200
do in the infrared and how you can just

1174
00:47:17,829 --> 00:47:15,440
dig into that data and see the star

1175
00:47:20,150 --> 00:47:17,839
forming regions see the see the regions

1176
00:47:22,549 --> 00:47:20,160
where the stars are also dying by sort

1177
00:47:23,910 --> 00:47:22,559
of just changing the wavelengths that

1178
00:47:26,230 --> 00:47:23,920
you're looking at and stretching the

1179
00:47:27,510 --> 00:47:26,240
colors a little bit it's just it's just

1180
00:47:29,910 --> 00:47:27,520
the classic

1181
00:47:31,670 --> 00:47:29,920
spitzer image in my mind and the galaxy

1182
00:47:32,790 --> 00:47:31,680
pictures are just so beautiful i love

1183
00:47:34,790 --> 00:47:32,800
the crab

1184
00:47:37,910 --> 00:47:34,800
nebula and there's just so many

1185
00:47:39,990 --> 00:47:37,920
beautiful ones to go online and research

1186
00:47:42,790 --> 00:47:40,000
and look up and i hope that everyone's

1187
00:47:44,309 --> 00:47:42,800
love for spitzer will get reignited and

1188
00:47:46,069 --> 00:47:44,319

they'll be able to go out and do a lot

1189
00:47:48,150 --> 00:47:46,079
of research on their own thank you so

1190
00:47:51,109 --> 00:47:48,160
much all of you for being here and paul

1191
00:47:53,750 --> 00:47:51,119
back in headquarters and we are going to

1192
00:47:56,230 --> 00:47:53,760
end our show now spitzer is not that far

1193
00:47:58,950 --> 00:47:56,240
away from us in relation to the cosmos

1194
00:48:01,990 --> 00:47:58,960
as a whole but it has managed to unlock

1195
00:48:04,870 --> 00:48:02,000
secrets within our own solar system plus

1196
00:48:06,870 --> 00:48:04,880
galaxies and nebulas that are millions

1197
00:48:09,910 --> 00:48:06,880
of light years away spitzer will

1198
00:48:12,790 --> 00:48:09,920
continue to impact us on our future

1199
00:48:15,270 --> 00:48:12,800
quest for knowledge for more information

1200
00:48:19,430 --> 00:48:15,280
on the spitzer space telescope please go

1201
00:48:23,990 --> 00:48:21,910
spitzer thank you so much for joining us

1202
00:48:27,190 --> 00:48:24,000
today we will leave you with a look at

1203
00:48:43,500 --> 00:48:27,200
the numerous breathtaking images from

1204
00:49:43,910 --> 00:49:20,200
[Music]

1205
00:49:57,990 --> 00:49:45,880
uh

1206
00:50:19,250 --> 00:49:58,000
[Music]

1207
00:50:22,080 --> 00:50:19,260
um

1208
00:50:34,560 --> 00:50:22,090
[Applause]

1209
00:50:34,570 --> 00:50:39,270
[Music]

1210
00:50:48,520 --> 00:50:40,290
[Applause]

1211
00:50:48,530 --> 00:51:09,670
[Music]

1212
00:51:09,680 --> 00:51:20,850
um