
AbSciCon
2019

1
00:00:00,790 --> 00:00:07,320
[Music]

2
00:00:15,390 --> 00:00:10,100
[Applause]

3
00:00:18,150 --> 00:00:15,400
okay so and for going forward I use okay

4
00:00:21,240 --> 00:00:18,160
so this is the take-home messages like

5
00:00:24,269 --> 00:00:21,250
Enceladus plumes are small fast and cold

6
00:00:26,159 --> 00:00:24,279
and based on a common wisdom for one who

7
00:00:28,080 --> 00:00:26,169
have learned from the Cassini missions

8
00:00:30,420 --> 00:00:28,090
and they are the best place for looking

9
00:00:33,630 --> 00:00:30,430
for alien life in our solar system or at

10
00:00:37,920 --> 00:00:33,640
least one of the best place one issues

11
00:00:40,889 --> 00:00:37,930
is that like collecting device for

12
00:00:43,200 --> 00:00:40,899
testing this concept of acquired test in

13
00:00:45,689 --> 00:00:43,210

a simulated environment and we don't

14
00:00:48,630 --> 00:00:45,699
have a quite great analog setting for

15
00:00:55,860 --> 00:00:48,640
doing this so we're going to fill this

16
00:00:59,250 --> 00:00:55,870
gap by simulating the ice blooms in in a

17
00:01:01,680 --> 00:00:59,260
in a technology environment vertical gun

18
00:01:04,079 --> 00:01:01,690
range facility and as I Eames and

19
00:01:07,050 --> 00:01:04,089
focusing on the basic requirements for

20
00:01:09,110 --> 00:01:07,060
ice particle sights impact speed and

21
00:01:12,840 --> 00:01:09,120
temperature in a near space environment

22
00:01:15,960 --> 00:01:12,850
so the take-home message is that

23
00:01:19,110 --> 00:01:15,970
micrometer size our ice particles are

24
00:01:20,760 --> 00:01:19,120
obtained and demonstrated okay I'm still

25
00:01:24,840 --> 00:01:20,770
fighting with these things okay

26
00:01:27,000 --> 00:01:24,850
so I've been over ambitious so I'm going

27
00:01:29,550 --> 00:01:27,010
to fly by through those lights for the

28
00:01:32,610 --> 00:01:29,560
background sections so our desirable

29
00:01:36,120 --> 00:01:32,620
range is between some micrometers to 10

30
00:01:39,270 --> 00:01:36,130
micrometers particles based on the bulk

31
00:01:41,340 --> 00:01:39,280
observation for Cassini we can say that

32
00:01:43,380 --> 00:01:41,350
there is no really complete agreement

33
00:01:45,960 --> 00:01:43,390
among the authors about the full

34
00:01:48,030 --> 00:01:45,970
spectrum and coverage of the relative

35
00:01:49,890 --> 00:01:48,040
proportion between the nanograins and

36
00:01:51,840 --> 00:01:49,900
the micro size grain so there are

37
00:01:55,440 --> 00:01:51,850
conflicting information but this is why

38
00:01:57,960 --> 00:01:55,450

we anyway focus on that average and also

39
00:02:01,800 --> 00:01:57,970
including particle size lesser than 15

40
00:02:04,770 --> 00:02:01,810
micrometer and so they're also the

41
00:02:07,200 --> 00:02:04,780
fastest shoes so the Cassini flybys is

42
00:02:10,440 --> 00:02:07,210
between 17 and 17 kilometer per second

43
00:02:14,070 --> 00:02:10,450
relative to the relative ejection into

44
00:02:16,110 --> 00:02:14,080
outer space or the plumes and what we

45
00:02:18,360 --> 00:02:16,120
can achieve at the vertical gun facility

46
00:02:20,370 --> 00:02:18,370
is anything between open one kilometer

47
00:02:21,500 --> 00:02:20,380
per second to nearly two kilometer per

48
00:02:26,850 --> 00:02:21,510
second

49
00:02:29,250 --> 00:02:26,860
so cold well in fellow surface observe

50
00:02:32,910 --> 00:02:29,260
surfaces has been warmer than predicted

51
00:02:35,010 --> 00:02:32,920
like with the very hot temperature

52
00:02:37,020 --> 00:02:35,020
beneath oceans and cooling temperature

53
00:02:41,970 --> 00:02:37,030
as soon as we approach space or anything

54
00:02:44,040 --> 00:02:41,980
between two hundred 200 Celsius to minus

55
00:02:47,250 --> 00:02:44,050
200 Celsius are not too extreme from

56
00:02:49,620 --> 00:02:47,260
bottom to top and these are like the

57
00:02:52,470 --> 00:02:49,630
area of interest will allow to get a

58
00:02:54,449 --> 00:02:52,480
sample that 10 micrometers particles or

59
00:02:56,430 --> 00:02:54,459
nanometer particles with the larger

60
00:02:58,050 --> 00:02:56,440
particle falling back to the planet and

61
00:03:00,030 --> 00:02:58,060
the smaller particle going out of the

62
00:03:01,920 --> 00:03:00,040
plume and there are several models for

63
00:03:05,130 --> 00:03:01,930

these are not you know issuing

64
00:03:06,750 --> 00:03:05,140
addressing these and our testing doesn't

65
00:03:09,600 --> 00:03:06,760
address the formation model for ice

66
00:03:11,580 --> 00:03:09,610
particle just produce I shave the most

67
00:03:13,440 --> 00:03:11,590
expensive ice ship you can imagine now

68
00:03:16,410 --> 00:03:13,450
we're using the NASA Ames vertical gun

69
00:03:18,570 --> 00:03:16,420
facility that has been established 15

70
00:03:20,550 --> 00:03:18,580
years ago but don't go to NASA Ames now

71
00:03:23,390 --> 00:03:20,560
it's going to be retired this guy so he

72
00:03:25,560 --> 00:03:23,400
worked for 15 years there is a very nice

73
00:03:28,289 --> 00:03:25,570
supporting setting and have been used

74
00:03:31,789 --> 00:03:28,299
for this facility for testing server

75
00:03:34,289 --> 00:03:31,799
impact experiment from crater scaling

76
00:03:38,160 --> 00:03:34,299
evolution tektites and crater formation

77
00:03:41,460 --> 00:03:38,170
and we have been we have been positives

78
00:03:44,449 --> 00:03:41,470
for producing a kind of thinking out of

79
00:03:46,979 --> 00:03:44,459
the box system and so we have a

80
00:03:48,509 --> 00:03:46,989
analytical chamber where we have the

81
00:03:51,120 --> 00:03:48,519
capability of loop using high-speed

82
00:03:55,020 --> 00:03:51,130
camera so we can document the fast

83
00:03:57,479 --> 00:03:55,030
motion of the particles our experimental

84
00:04:00,539 --> 00:03:57,489
chamber you can see here consists of

85
00:04:03,000 --> 00:04:00,549
using sea ice target cooling that has

86
00:04:06,270 --> 00:04:03,010
been cooled around by you know normal

87
00:04:09,060 --> 00:04:06,280
refrigerator to liquid nitrogen in about

88
00:04:12,660 --> 00:04:09,070

you know 24 hours and then we have the

89
00:04:15,539 --> 00:04:12,670
impactor of 16 degrees by 3 millimeters

90
00:04:18,960 --> 00:04:15,549
I pallets aluminium pallets and that we

91
00:04:21,539 --> 00:04:18,970
produce we get an ice brown that is a

92
00:04:26,040 --> 00:04:21,549
produced by impact and this is travel

93
00:04:28,500 --> 00:04:26,050
toward a target where we use an aluminum

94
00:04:30,770 --> 00:04:28,510
foil for capturing these particles and

95
00:04:33,089 --> 00:04:30,780
of course because it's so fast in

96
00:04:34,100 --> 00:04:33,099
microseconds we have these ice particles

97
00:04:37,339 --> 00:04:34,110
they are in

98
00:04:41,990 --> 00:04:37,349
about 200 Celsius the great light - 200

99
00:04:43,640 --> 00:04:42,000
so it still space cold so I just just

100
00:04:45,649 --> 00:04:43,650
let you know that we've been performing

101
00:04:48,350 --> 00:04:45,659
a lot experiment at the vertical guns

102
00:04:50,179 --> 00:04:48,360
facility for - testing the collector and

103
00:04:52,490 --> 00:04:50,189
different types of collector under a

104
00:04:56,570 --> 00:04:52,500
cottage grant through NASA Ames engine

105
00:04:59,119 --> 00:04:56,580
options apply laboratory so in support

106
00:05:02,360 --> 00:04:59,129
of the the ELSA missions that you

107
00:05:04,480 --> 00:05:02,370
provide familiar from your weight and we

108
00:05:06,800 --> 00:05:04,490
have been conducting uses priming for

109
00:05:08,839 --> 00:05:06,810
testing the efficiency of these

110
00:05:10,580 --> 00:05:08,849
collectors but also for looking at what

111
00:05:13,159 --> 00:05:10,590
happened to biology what happened to the

112
00:05:14,869 --> 00:05:13,169
organics at impacts and try to do also

113
00:05:16,820 --> 00:05:14,879

some kind of planetary protection to see

114
00:05:18,589 --> 00:05:16,830
in to protect our science so lot of

115
00:05:21,350 --> 00:05:18,599
things and now but now it's just

116
00:05:24,050 --> 00:05:21,360
focusing on production on ice particles

117
00:05:26,800 --> 00:05:24,060
so the quest for smaller particles is

118
00:05:30,730 --> 00:05:26,810
not just our idea there's been a lot of

119
00:05:33,769 --> 00:05:30,740
studies focusing on velocity work and

120
00:05:35,839 --> 00:05:33,779
particularly for looking what's that by

121
00:05:37,939 --> 00:05:35,849
a product by impacting a bar you spin

122
00:05:40,249 --> 00:05:37,949
the various angle while the manager

123
00:05:41,990 --> 00:05:40,259
issues that a lot of grain size

124
00:05:44,450 --> 00:05:42,000
distribution are achieved but there's

125
00:05:46,779 --> 00:05:44,460
not been really an effort or attempt to

126
00:05:49,219 --> 00:05:46,789
try to get really really narrow sides

127
00:05:51,050 --> 00:05:49,229
particles so they got a jumble of things

128
00:05:53,029 --> 00:05:51,060
I try to look at what they are but I

129
00:05:55,730 --> 00:05:53,039
think we are being you know making

130
00:05:58,369 --> 00:05:55,740
progress in these and there are several

131
00:06:00,740 --> 00:05:58,379
application for these like looking at

132
00:06:03,290 --> 00:06:00,750
cometary tail so there being a lot of

133
00:06:06,559 --> 00:06:03,300
work done also for testing the wild

134
00:06:09,350 --> 00:06:06,569
looking at data from the wild to common

135
00:06:11,269 --> 00:06:09,360
missions by using this approach so these

136
00:06:14,480 --> 00:06:11,279
are what first experiments how we got

137
00:06:16,939 --> 00:06:14,490
there so we starting 2017

138
00:06:18,559 --> 00:06:16,949

try to use it a micrometer screen and

139
00:06:21,140 --> 00:06:18,569
you can see the result of what's

140
00:06:23,360 --> 00:06:21,150
happening so we have the ice target in

141
00:06:25,909 --> 00:06:23,370
on your right and then you get the plume

142
00:06:27,829 --> 00:06:25,919
and when we have a screen and then we

143
00:06:30,529 --> 00:06:27,839
get this wheel a different components

144
00:06:33,019 --> 00:06:30,539
and grain size of the plumes and what

145
00:06:35,209 --> 00:06:33,029
stop you that's what happened I mean we

146
00:06:38,059 --> 00:06:35,219
get a blast of these multiple grant

147
00:06:40,189 --> 00:06:38,069
sides as prod as a big project I'll fast

148
00:06:42,260 --> 00:06:40,199
traveling they destroy everything they

149
00:06:44,930 --> 00:06:42,270
destroyed the aluminum foil target in a

150
00:06:45,869 --> 00:06:44,940
completely mess stumbling block are we

151
00:06:48,449 --> 00:06:45,879
go next

152
00:06:51,329 --> 00:06:48,459
at that point I remain alone because the

153
00:06:53,939 --> 00:06:51,339
person David Wilson was doing that moved

154
00:06:56,119 --> 00:06:53,949
to another planet and so I - you know

155
00:06:58,109 --> 00:06:56,129
continuous his work in a trying to

156
00:07:01,320 --> 00:06:58,119
non-engineers I had to try to do

157
00:07:03,600 --> 00:07:01,330
something so this is what happen you can

158
00:07:07,559 --> 00:07:03,610
see really the the holes in this 10

159
00:07:09,839 --> 00:07:07,569
micrometer the micrometer sieved so the

160
00:07:12,389 --> 00:07:09,849
winning solution is saving device i'm

161
00:07:14,639 --> 00:07:12,399
sedimentology spy origin three lifes ago

162
00:07:17,519 --> 00:07:14,649
so what i do but there's a rack do for

163
00:07:20,429 --> 00:07:17,529

looking at sediment brain so we use a

164
00:07:22,109 --> 00:07:20,439
pile of sheep i not an engineer but i'm

165
00:07:24,419 --> 00:07:22,119
we're so proud about doing this things

166
00:07:26,669 --> 00:07:24,429
going configuration concept with the

167
00:07:28,379 --> 00:07:26,679
side view so you have the salty water

168
00:07:30,389 --> 00:07:28,389
the plumes that has to go to twist

169
00:07:32,879 --> 00:07:30,399
screens 1 millimeters 150 mean

170
00:07:35,309 --> 00:07:32,889
micrometer screen one time one 10

171
00:07:39,600 --> 00:07:35,319
micrometer screen against an aluminum

172
00:07:41,399 --> 00:07:39,610
foil lateral view on a side so we have

173
00:07:44,129 --> 00:07:41,409
to decide how to put this how to make

174
00:07:46,199 --> 00:07:44,139
them becoming true this design and then

175
00:07:49,889 --> 00:07:46,209
this is what we do like we have the ice

176
00:07:52,199 --> 00:07:49,899
target and then we have the we have the

177
00:07:55,259 --> 00:07:52,209
different screens and this is the the

178
00:07:57,989 --> 00:07:55,269
aluminum target here we used a beginning

179
00:08:00,569 --> 00:07:57,999
only two screens and we have a likes a

180
00:08:03,119 --> 00:08:00,579
plexiglass window to limit the angle of

181
00:08:06,359 --> 00:08:03,129
surprise that you can see arab so we

182
00:08:09,779 --> 00:08:06,369
basically have producing an expensive i

183
00:08:11,759 --> 00:08:09,789
shave with the fastest gun on west so

184
00:08:14,369 --> 00:08:11,769
which is kind of like kind of really

185
00:08:17,339 --> 00:08:14,379
you're expensive so speed is found in an

186
00:08:19,589 --> 00:08:17,349
obvious way we know the time between the

187
00:08:23,149 --> 00:08:19,599
target and the impact and we know the

188
00:08:27,540 --> 00:08:23,159

distance we can calculate the speed and

189
00:08:30,569 --> 00:08:27,550
here there is a just to let you

190
00:08:33,120 --> 00:08:30,579
appreciate him what happening so we have

191
00:08:36,149 --> 00:08:33,130
this screen that has been blocking the

192
00:08:38,399 --> 00:08:36,159
most of the the the coarser particle and

193
00:08:40,439 --> 00:08:38,409
the finest particle goes through past

194
00:08:42,689 --> 00:08:40,449
this screen and then past the other and

195
00:08:44,550 --> 00:08:42,699
they get to the target so a target

196
00:08:45,329 --> 00:08:44,560
here's the result we have three types of

197
00:08:48,059 --> 00:08:45,339
particles

198
00:08:50,189 --> 00:08:48,069
holes obvious look in their micro

199
00:08:53,639 --> 00:08:50,199
craters and dents and soul residues

200
00:08:55,590 --> 00:08:53,649
against our target so salty dust i mean

201
00:08:57,559 --> 00:08:55,600
was very very happy to see these because

202
00:08:58,720 --> 00:08:57,569
was a picture taken and the right

203
00:09:00,640 --> 00:08:58,730
illumination

204
00:09:02,710 --> 00:09:00,650
and this is not my dandruff at the

205
00:09:06,010 --> 00:09:02,720
beginning I thought it was by was salty

206
00:09:10,300 --> 00:09:06,020
and not that kind of down roof so this

207
00:09:13,540 --> 00:09:10,310
is like a larger example of a salt and

208
00:09:15,720 --> 00:09:13,550
then what we do so we use image analysis

209
00:09:18,610 --> 00:09:15,730
that goes from the raw images on your

210
00:09:21,280 --> 00:09:18,620
left-hand side then we do image

211
00:09:24,520 --> 00:09:21,290
enhancement contrast filter imaging by

212
00:09:26,890 --> 00:09:24,530
analyzing and we try to basically have a

213
00:09:29,350 --> 00:09:26,900

right balance between background to

214
00:09:32,470 --> 00:09:29,360
noise so background as this you know or

215
00:09:34,870 --> 00:09:32,480
is on two lines and and is the noise and

216
00:09:37,810 --> 00:09:34,880
the singers the right finest amount of

217
00:09:40,140 --> 00:09:37,820
particles we can detect a major so the

218
00:09:42,610 --> 00:09:40,150
second is about a second step is about

219
00:09:46,120 --> 00:09:42,620
analyzing each particles and data

220
00:09:48,190 --> 00:09:46,130
reduction why because that's noise to

221
00:09:50,380 --> 00:09:48,200
background so I'll very beginning we get

222
00:09:53,140 --> 00:09:50,390
a lot of particles like this just not

223
00:09:55,210 --> 00:09:53,150
just the particles and then what we do

224
00:09:57,430 --> 00:09:55,220
is the cut off a mathematical cut off

225
00:10:00,430 --> 00:09:57,440
based on roundness and aspect ratio the

226
00:10:03,550 --> 00:10:00,440
particles so we get a lower area but

227
00:10:05,710 --> 00:10:03,560
more realistic numbers so about 30,000

228
00:10:07,930 --> 00:10:05,720
40,000 particles per centimeter square

229
00:10:09,460 --> 00:10:07,940
and so we keep going reanalyzing at

230
00:10:11,650 --> 00:10:09,470
least two or three times for sake of a

231
00:10:14,410 --> 00:10:11,660
roll bars so these are more likely the

232
00:10:17,440 --> 00:10:14,420
real number of our density in terms of

233
00:10:20,070 --> 00:10:17,450
efficiency and so we can get then the

234
00:10:24,790 --> 00:10:20,080
particle size diameter how much time and

235
00:10:30,430 --> 00:10:24,800
then we use Makoku metrology software

236
00:10:32,770 --> 00:10:30,440
where we can shoot for higher darnit

237
00:10:34,480 --> 00:10:32,780
magnification so you can see here that

238
00:10:36,340 --> 00:10:34,490

we have even more noise because we're

239
00:10:38,800 --> 00:10:36,350
more noise we have it to trace these

240
00:10:41,980 --> 00:10:38,810
particle by hands and acquiring with the

241
00:10:45,490 --> 00:10:41,990
same software you know smaller particles

242
00:10:46,810 --> 00:10:45,500
but in a more difficult way so we know

243
00:10:49,090 --> 00:10:46,820
that these dents and these finer

244
00:10:50,800 --> 00:10:49,100
particles are not artifact because we

245
00:10:53,230 --> 00:10:50,810
have a negative control which does not

246
00:10:55,540 --> 00:10:53,240
shoot should aluminum target that you

247
00:10:58,360 --> 00:10:55,550
can see on the lower part and in this

248
00:11:00,190 --> 00:10:58,370
way you can see that we get the mini

249
00:11:02,860 --> 00:11:00,200
farad diameter there's a caliper

250
00:11:05,080 --> 00:11:02,870
diameter thats go stores model particles

251
00:11:08,380 --> 00:11:05,090
we're able to see now a majority of

252
00:11:11,400 --> 00:11:08,390
particle below 10 micrometers and so

253
00:11:14,999 --> 00:11:11,410
conclusion we can get these particles

254
00:11:17,189 --> 00:11:15,009
and then in high fidelity environment

255
00:11:20,639 --> 00:11:17,199
has it has a broad set of applications

256
00:11:22,799 --> 00:11:20,649
from Europeans ensalada spoons cometary

257
00:11:25,019 --> 00:11:22,809
plumes and then we have a major

258
00:11:26,909 --> 00:11:25,029
limitation we have to a fidelity to real

259
00:11:28,889 --> 00:11:26,919
production and processes that produce

260
00:11:31,199 --> 00:11:28,899
particles but we don't worry about it

261
00:11:33,269 --> 00:11:31,209
because we want the eye shape gear and

262
00:11:36,599 --> 00:11:33,279
the future work will be improving love

263
00:11:38,489 --> 00:11:36,609

noise no love noise witness substrate so

264
00:11:40,999 --> 00:11:38,499
we can capture even smaller particle and

265
00:11:45,269 --> 00:11:41,009
demonstrate they do exist and then

266
00:11:47,339 --> 00:11:45,279
application and thank you to vertical

267
00:11:49,199 --> 00:11:47,349
gun facility guys that we are wonderful

268
00:11:50,999 --> 00:11:49,209
and supportive environment in loving

269
00:11:52,769 --> 00:11:51,009
memory of David Wilson we really miss

270
00:11:55,799 --> 00:11:52,779
too much but this work is thanks to him

271
00:11:58,579 --> 00:11:55,809
it was the interface with the robot gold

272
00:12:02,069 --> 00:11:58,589
at the AP also in the chief engineer and

273
00:12:07,109 --> 00:12:02,079
we thank the I called the grant a lead

274
00:12:09,029 --> 00:12:07,119
on atoms to APL and NASA Ames center

275
00:12:13,859 --> 00:12:09,039
innovation funding that supported us

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