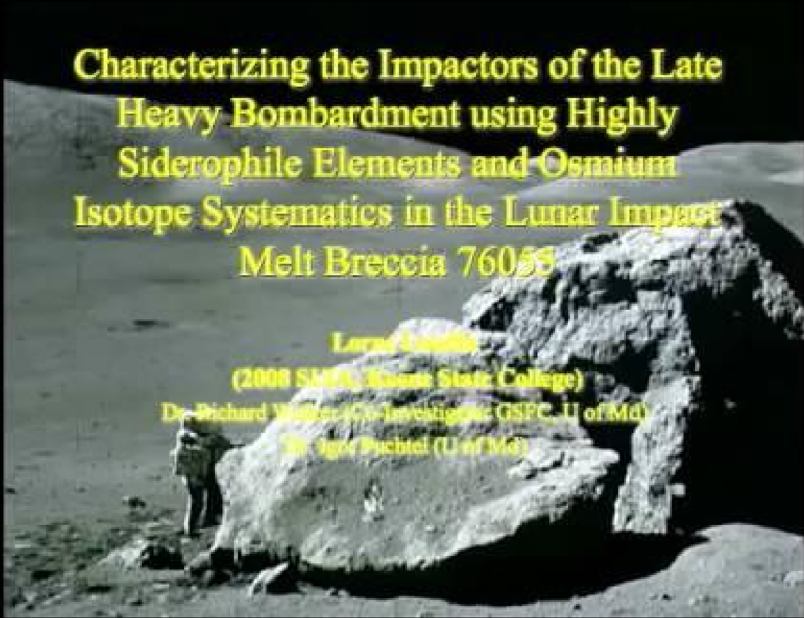
NASA Astrobiology Institute

GSFC Summer Student Presentations 2008



1
00:00:06,650 --> 00:00:04,400
okay Carl culture director and ghoulish

2
00:00:10,930 --> 00:00:06,660
deputy are both one travel and have

3
00:00:15,470 --> 00:00:10,940
asked me to introduce the seminar today

4
00:00:18,920 --> 00:00:15,480
we're fortunate having six summer

5
00:00:22,010 --> 00:00:18,930
interns from the astrobiology Center at

6
00:00:23,480 --> 00:00:22,020
Goddard here today to give brief

7
00:00:27,109 --> 00:00:23,490
summaries of the research that they

8
00:00:29,779 --> 00:00:27,119
perform this summer this is our fourth

9
00:00:33,260 --> 00:00:29,789
summer running this internship program

10
00:00:35,420 --> 00:00:33,270
which we're happy to say has been wildly

11
00:00:40,069 --> 00:00:35,430
successful this some are being no

12
00:00:42,170 --> 00:00:40,079
exception and I think it's safe to say

13
00:00:44,959 --> 00:00:42,180

that each and every intern that's gone

14
00:00:47,350 --> 00:00:44,969
through here is actually accomplished

15
00:00:49,760 --> 00:00:47,360
some new state-of-the-art research and

16
00:00:52,340 --> 00:00:49,770
of course the most important thing for

17
00:00:53,689 --> 00:00:52,350
each person is that they've experienced

18
00:00:56,270 --> 00:00:53,699
the manner in which state-of-the-art

19
00:01:00,740 --> 00:00:56,280
research is done and that's why they're

20
00:01:03,250 --> 00:01:00,750
here so without further ado let me call

21
00:01:06,820 --> 00:01:03,260
on our first intern intern Charlotte

22
00:01:09,469 --> 00:01:06,830
karlstrom was from every university

23
00:01:13,010 --> 00:01:09,479
who's been working this summer with jen

24
00:01:15,649 --> 00:01:13,020
i didn't bro a number of our s well as a

25
00:01:17,359 --> 00:01:15,659
team and she will speak to us today

26
00:01:19,640 --> 00:01:17,369
Charlotte will speak to us on molecular

27
00:01:24,980 --> 00:01:19,650
signatures of life and surface ice and

28
00:01:28,310 --> 00:01:24,990
snow as a Mars analog huh ok so my name

29
00:01:30,980 --> 00:01:28,320
is Charlotte cross term and I um ok so

30
00:01:33,260 --> 00:01:30,990
my summer project dealt with trying to

31
00:01:35,960 --> 00:01:33,270
find signatures of life and surface ice

32
00:01:38,030 --> 00:01:35,970
and snow so that we can take whatever we

33
00:01:40,069 --> 00:01:38,040
learn about signatures of life here on

34
00:01:44,060 --> 00:01:40,079
earth to other places where life isn't

35
00:01:45,980 --> 00:01:44,070
apparent like Mars or any other icy moon

36
00:01:49,580 --> 00:01:45,990
or well it doesn't have to be icy been

37
00:01:50,840 --> 00:01:49,590
any other planet really so not only we

38
00:01:53,020 --> 00:01:50,850

have to find what these signatures of

39
00:01:56,450 --> 00:01:53,030
life are but we have to be able to

40
00:01:59,630 --> 00:01:56,460
determine how to examine them in another

41
00:02:01,760 --> 00:01:59,640
place and so after we find the

42
00:02:03,709 --> 00:02:01,770
signatures we have to compare the

43
00:02:06,190 --> 00:02:03,719
effectiveness of pyrolysis which is with

44
00:02:08,570 --> 00:02:06,200
Sam the sample analysis at Mars

45
00:02:10,910 --> 00:02:08,580
instrument in Phoenix which is actually

46
00:02:11,840 --> 00:02:10,920
there right now the effectiveness of

47
00:02:13,490 --> 00:02:11,850
those

48
00:02:14,990 --> 00:02:13,500
this versus what we use conventionally

49
00:02:17,600 --> 00:02:15,000
which is the lipid extraction and

50
00:02:20,300 --> 00:02:17,610
derivatives ation and my work here was

51
00:02:23,480 --> 00:02:20,310
directly related to Sam in particular

52
00:02:25,880 --> 00:02:23,490
because of the GCMs that we use is the

53
00:02:28,220 --> 00:02:25,890
same setup as Sam as is that pyrolysis

54
00:02:32,000 --> 00:02:28,230
cell is set up just like Sam with the

55
00:02:34,790 --> 00:02:32,010
trap with the glass beads and 10 acts

56
00:02:38,350 --> 00:02:34,800
it's the exact same setup so this is why

57
00:02:40,520 --> 00:02:38,360
it's related to that so what are lipids

58
00:02:44,000 --> 00:02:40,530
lipids are fatty acids and their

59
00:02:46,550 --> 00:02:44,010
derivatives for the purpose of this is

60
00:02:49,160 --> 00:02:46,560
going to be just fats but they're found

61
00:02:51,890 --> 00:02:49,170
within cell membranes as you can see

62
00:02:55,460 --> 00:02:51,900
here and they're also used for cellular

63
00:02:58,370 --> 00:02:55,470

structure cellular messengers and energy

64
00:03:00,610 --> 00:02:58,380
storage so the picture that you see here

65
00:03:03,980 --> 00:03:00,620
are three of the most widely distributed

66
00:03:06,710 --> 00:03:03,990
fatty acids and these are important

67
00:03:08,960 --> 00:03:06,720
because they're found in pretty much all

68
00:03:11,330 --> 00:03:08,970
life but there there are signatures of

69
00:03:13,160 --> 00:03:11,340
life in life in themselves in that they

70
00:03:16,400 --> 00:03:13,170
they're even chained which is a

71
00:03:17,990 --> 00:03:16,410
signature of life because of lipogenesis

72
00:03:19,940 --> 00:03:18,000
how lipids are made it starts with

73
00:03:22,130 --> 00:03:19,950
acetic acid which is a two carbon chain

74
00:03:25,340 --> 00:03:22,140
so usually you get even numbers of

75
00:03:27,800 --> 00:03:25,350
carbons but also linoleic acid in the

76
00:03:30,470 --> 00:03:27,810
bottom shows on saturation which is also

77
00:03:32,660 --> 00:03:30,480
a trademark of life because usually when

78
00:03:34,970 --> 00:03:32,670
you see unsaturated fatty acids they

79
00:03:36,680 --> 00:03:34,980
have to be confined to some form of life

80
00:03:41,630 --> 00:03:36,690
so that they stay in the unsaturated

81
00:03:44,090 --> 00:03:41,640
State um this is a site in Norway where

82
00:03:45,740 --> 00:03:44,100
the samples were collected and here in

83
00:03:47,390 --> 00:03:45,750
the top left you see the green snow

84
00:03:50,300 --> 00:03:47,400
algae hear in the background where I'm

85
00:03:52,430 --> 00:03:50,310
pointing is the red snow algae and here

86
00:03:55,510 --> 00:03:52,440
is the cry of co night which usually

87
00:03:58,670 --> 00:03:55,520
form in this summer and they form when

88
00:04:00,410 --> 00:03:58,680

matter gets collected dark matter gets

89
00:04:02,630 --> 00:04:00,420
kool-aid collected in the eyes and then

90
00:04:05,620 --> 00:04:02,640
absorbs heat from the Sun and it starts

91
00:04:08,600 --> 00:04:05,630
sinking in and eventually they become

92
00:04:10,100 --> 00:04:08,610
harvest harvest source of life because

93
00:04:12,530 --> 00:04:10,110
they have lots of nutrients that good

94
00:04:15,260 --> 00:04:12,540
stuff where things like to grow this is

95
00:04:16,910 --> 00:04:15,270
a close-up microscopic images of the

96
00:04:19,460 --> 00:04:16,920
snow algae samples these were taking a

97
00:04:22,009 --> 00:04:19,470
thing two years before the samples that

98
00:04:24,529 --> 00:04:22,019
I'm analyzing but these are

99
00:04:26,749 --> 00:04:24,539
red snow algae samples these two are in

100
00:04:28,850 --> 00:04:26,759
red snow algae here you see the orange

101
00:04:30,770 --> 00:04:28,860
the yellow the red the green and these

102
00:04:32,869 --> 00:04:30,780
are mineral grains here you see the

103
00:04:35,480 --> 00:04:32,879
green and the red here is red and orange

104
00:04:37,999 --> 00:04:35,490
and here these are camino Moniz Novalis

105
00:04:40,850 --> 00:04:38,009
which is the most abundant snow algae

106
00:04:42,710 --> 00:04:40,860
and these is a green one and this is a

107
00:04:44,629 --> 00:04:42,720
red and this is actually pointing to the

108
00:04:47,390 --> 00:04:44,639
chlorophyll and both of them so you can

109
00:04:50,240 --> 00:04:47,400
see the different this is the setup of

110
00:04:52,279 --> 00:04:50,250
the instruments and the methodology that

111
00:04:54,469 --> 00:04:52,289
we use so there's two different methods

112
00:04:56,570 --> 00:04:54,479
the first one is the conventional and

113
00:04:59,570 --> 00:04:56,580

that's the wet chemistry method and that

114
00:05:01,580 --> 00:04:59,580
uses the eight accelerated sylvan

115
00:05:03,680 --> 00:05:01,590
extractor uses high temperatures and

116
00:05:05,809 --> 00:05:03,690
pressures to extract lipids from the

117
00:05:07,760 --> 00:05:05,819
cells and these are then methylated with

118
00:05:10,249 --> 00:05:07,770
acetic or and methanol at 100 degrees

119
00:05:12,620 --> 00:05:10,259
and this goes directly into the GC

120
00:05:15,409 --> 00:05:12,630
through here where they're separated and

121
00:05:17,390 --> 00:05:15,419
then analyzed in a mass spec the second

122
00:05:19,820 --> 00:05:17,400
method which is what as what Sam and

123
00:05:22,670 --> 00:05:19,830
Phoenix use is paralysis and that takes

124
00:05:25,399 --> 00:05:22,680
a sample and heats it to thermally

125
00:05:27,409 --> 00:05:25,409
evolved this the whatever is found in

126
00:05:29,510 --> 00:05:27,419
there and then that goes through the GC

127
00:05:30,860 --> 00:05:29,520
column and it's analyzed so those those

128
00:05:34,070 --> 00:05:30,870
are the two methods that we're comparing

129
00:05:36,409 --> 00:05:34,080
right now this is what I started with to

130
00:05:38,330 --> 00:05:36,419
try to learn how to read mass spectra as

131
00:05:40,760 --> 00:05:38,340
well as gasps gasps chromatograms and

132
00:05:43,219 --> 00:05:40,770
this is the fatty fatty acid methyl

133
00:05:46,730 --> 00:05:43,229
ester standard each of the peaks

134
00:05:49,939 --> 00:05:46,740
represents a different compound the one

135
00:05:52,249 --> 00:05:49,949
that I have highlighted here it at 49 44

136
00:05:53,330 --> 00:05:52,259
minutes turns out to be hexadecane noak

137
00:05:55,850 --> 00:05:53,340
acid which is the most widely

138
00:05:57,170 --> 00:05:55,860

distributed fatty acid again and so this

139
00:06:00,469 --> 00:05:57,180
around here is basically another

140
00:06:04,519 --> 00:06:00,479
dimension to this the gas chromatogram

141
00:06:06,709 --> 00:06:04,529
and it shows that the process of fist

142
00:06:09,950 --> 00:06:06,719
and you can tell by its weight which is

143
00:06:12,769 --> 00:06:09,960
270 that's the molecular ion right here

144
00:06:15,230 --> 00:06:12,779
but each of the peaks is representative

145
00:06:16,670 --> 00:06:15,240
of a fragment of this molecule depending

146
00:06:19,249 --> 00:06:16,680
on how it breaks up so when you have

147
00:06:21,350 --> 00:06:19,259
only the part on the right with one

148
00:06:23,300 --> 00:06:21,360
carbon you get the 74 when you have two

149
00:06:26,180 --> 00:06:23,310
carbons you get the 87 and so on and so

150
00:06:28,279 --> 00:06:26,190
forth and this Peaks the correct format

151
00:06:30,829 --> 00:06:28,289
among peeps Peaks are important because

152
00:06:34,159 --> 00:06:30,839
you can either refute or support the

153
00:06:35,270 --> 00:06:34,169
identity of an unknown based on how the

154
00:06:37,490 --> 00:06:35,280
aleutian time

155
00:06:41,540 --> 00:06:37,500
because it's the same every time basin

156
00:06:43,670 --> 00:06:41,550
that it's on the same method this is the

157
00:06:45,770 --> 00:06:43,680
actual data of one of the samples this

158
00:06:47,600 --> 00:06:45,780
is the green algae and on the top you

159
00:06:49,790 --> 00:06:47,610
see the conventional method and is very

160
00:06:51,800 --> 00:06:49,800
clean and you can see each of the assets

161
00:06:53,510 --> 00:06:51,810
that we were expecting to find and these

162
00:06:54,950 --> 00:06:53,520
are actually found in all samples not

163
00:06:57,140 --> 00:06:54,960

just in this one the ones you see here

164
00:07:00,080 --> 00:06:57,150
when you order pyrolysis which actually

165
00:07:04,190 --> 00:07:00,090
was at 610 degrees Celsius you don't see

166
00:07:07,280 --> 00:07:04,200
a clear definition I guess of the peaks

167
00:07:09,290 --> 00:07:07,290
that we were looking for and here i

168
00:07:11,680 --> 00:07:09,300
found a lot of sugars and a lot of

169
00:07:14,530 --> 00:07:11,690
different things that not necessarily

170
00:07:19,659 --> 00:07:14,540
were expected to be found in the algae

171
00:07:22,820 --> 00:07:19,669
lots of sugars and unusual rings present

172
00:07:26,000 --> 00:07:22,830
and we wait let me go back we think that

173
00:07:28,520 --> 00:07:26,010
this could be also because the trap that

174
00:07:31,940 --> 00:07:28,530
the instrument has the pyrolysis self

175
00:07:33,920 --> 00:07:31,950
could have retained the fatty acid so

176
00:07:36,379 --> 00:07:33,930
another option for Sam is to get rid of

177
00:07:39,140 --> 00:07:36,389
the glass bead trap and the Tanakh to

178
00:07:40,430 --> 00:07:39,150
try to get all of the gas that we get so

179
00:07:42,170 --> 00:07:40,440
that's something that could be not to

180
00:07:45,260 --> 00:07:42,180
try to see if we see the same fatty

181
00:07:47,270 --> 00:07:45,270
acids that we know are present so these

182
00:07:49,100 --> 00:07:47,280
are all the fatty acids that were found

183
00:07:51,200 --> 00:07:49,110
in disloyalty samples using the

184
00:07:54,560 --> 00:07:51,210
conventional method and as you can see

185
00:07:57,500 --> 00:07:54,570
there's plenty of unsaturation here

186
00:07:59,350 --> 00:07:57,510
which we expected to find most of them

187
00:08:03,110 --> 00:07:59,360
are even chained which is also a

188
00:08:04,340 --> 00:08:03,120

something we expected and something

189
00:08:06,830 --> 00:08:04,350
interesting that we found is this

190
00:08:09,230 --> 00:08:06,840
company compound here at dodecane 11

191
00:08:11,630 --> 00:08:09,240
it's actually a dial not methoxy because

192
00:08:15,770 --> 00:08:11,640
this is once it's been derivatized it

193
00:08:17,840 --> 00:08:15,780
changes to the oh ch3 instead of the o H

194
00:08:19,190 --> 00:08:17,850
and that hasn't been found before and

195
00:08:21,200 --> 00:08:19,200
it's interesting because we don't really

196
00:08:24,380 --> 00:08:21,210
know what it's doing so that's something

197
00:08:26,900 --> 00:08:24,390
that needs to be looked at to in

198
00:08:29,210 --> 00:08:26,910
conclusion we determined that wet

199
00:08:31,880 --> 00:08:29,220
chemistry is a lot cleaner and clearer

200
00:08:34,219 --> 00:08:31,890
than its pyrolysis but since pyrolysis

201
00:08:37,490 --> 00:08:34,229
is what most of the instruments how are

202
00:08:39,790 --> 00:08:37,500
they are using it has to be taken into

203
00:08:42,770 --> 00:08:39,800
account it has to work it has to be

204
00:08:45,620 --> 00:08:42,780
worked with a little more to try to find

205
00:08:48,440 --> 00:08:45,630
if whoa how it matches the wet chemistry

206
00:08:49,880 --> 00:08:48,450
data um they're the

207
00:08:51,890 --> 00:08:49,890
also founded there are several fatty

208
00:08:53,950 --> 00:08:51,900
acids that service biomarkers for life

209
00:08:57,800 --> 00:08:53,960
identification which is a good thing and

210
00:09:01,730 --> 00:08:57,810
we found that those tend to agree with

211
00:09:04,460 --> 00:09:01,740
the even chain fatty acid theory of life

212
00:09:07,700 --> 00:09:04,470
how lip lipogenesis is made lipids are

213
00:09:09,770 --> 00:09:07,710

made the two carbon chain and also the

214
00:09:13,400 --> 00:09:09,780
unsaturation we found quite a few of

215
00:09:16,160 --> 00:09:13,410
saturated fatty acids and so I would

216
00:09:18,560 --> 00:09:16,170
like to take Thank GCA for a great

217
00:09:21,350 --> 00:09:18,570
summer dr. Jenn agram road for a lot of

218
00:09:23,420 --> 00:09:21,360
learning doctoring attempt Kate and dr.

219
00:09:26,570 --> 00:09:23,430
Palma happy for all their help what

220
00:09:28,610 --> 00:09:26,580
John's been gone to Norway this year dr.

221
00:09:30,680 --> 00:09:28,620
Michael Mumma for dca support and Miss

222
00:09:40,340 --> 00:09:30,690
Carreen Evie for everything she's done

223
00:09:43,280 --> 00:09:40,350
for us this summer question or two Shay

224
00:09:46,430 --> 00:09:43,290
good know what's good let's go first to

225
00:09:49,100 --> 00:09:46,440
allow anyone in the field and remote

226
00:09:51,020 --> 00:09:49,110
sites and other people out there who'd

227
00:09:58,280 --> 00:09:51,030
like to make a comment or ask your

228
00:10:01,910 --> 00:09:58,290
question Charlotte a passive group okay

229
00:10:04,160 --> 00:10:01,920
how about here in the room I would like

230
00:10:07,130 --> 00:10:04,170
to know why you found it surprising that

231
00:10:09,290 --> 00:10:07,140
you found sugars inside your soul your

232
00:10:12,020 --> 00:10:09,300
algae well it's not surprising that

233
00:10:14,510 --> 00:10:12,030
they're found in what we analyzed is

234
00:10:16,640 --> 00:10:14,520
surprising that they're inside

235
00:10:18,530 --> 00:10:16,650
considering that well we were looking

236
00:10:20,750 --> 00:10:18,540
for lipids in particular and those tend

237
00:10:22,910 --> 00:10:20,760
to give a strong signal and we didn't

238
00:10:24,920 --> 00:10:22,920

see that but we saw the sugars you know

239
00:10:27,470 --> 00:10:24,930
and they those could be not necessarily

240
00:10:28,730 --> 00:10:27,480
in theology but anywhere with you know

241
00:10:30,980 --> 00:10:28,740
within the sample since those weren't

242
00:10:34,370 --> 00:10:30,990
particularly extracted and analyzed just

243
00:10:36,710 --> 00:10:34,380
for that solution it no contamination

244
00:10:38,720 --> 00:10:36,720
necessarily but sources that are non

245
00:10:40,990 --> 00:10:38,730
algae if you call that contamination I

246
00:10:45,380 --> 00:10:41,000
guess I mean their environment I guess

247
00:10:49,480 --> 00:10:45,390
all right any other questions ok let's

248
00:10:53,850 --> 00:10:49,490
go on our next speaker will be area

249
00:10:57,100 --> 00:10:53,860
Louis it was a student at eckerd college

250
00:11:00,010 --> 00:10:57,110
her mentor this summer is dr. Jason

251
00:11:02,699 --> 00:11:00,020
gorkon and she's going to talk to us

252
00:11:05,820 --> 00:11:02,709
about amino acids in the bag using

253
00:11:09,389 --> 00:11:05,830
various approaches to protect

254
00:11:13,990 --> 00:11:09,399
contamination in meteoritic samples I

255
00:11:17,680 --> 00:11:14,000
never said because of the air now up up

256
00:11:21,850 --> 00:11:17,690
one more next to Charlotte's name and by

257
00:11:27,490 --> 00:11:21,860
now and then go to the little over right

258
00:11:30,670 --> 00:11:27,500
there hi I'm area Lewis and as dr.

259
00:11:34,389 --> 00:11:30,680
Loomis said I did a study on amino acid

260
00:11:36,250 --> 00:11:34,399
contamination using lcf d tov ms which

261
00:11:37,329 --> 00:11:36,260
is liquid chromatography fluorescence

262
00:11:41,440 --> 00:11:37,339
detector time-of-flight mass

263
00:11:43,810 --> 00:11:41,450

spectroscopy and i did this study

264
00:11:45,460 --> 00:11:43,820
concerning amino acids due to an snap

265
00:11:48,190 --> 00:11:45,470
and for those of you who don't know an

266
00:11:50,110 --> 00:11:48,200
smit is the antarctic antarctica search

267
00:11:51,579 --> 00:11:50,120
for meteorites and they choose

268
00:11:54,910 --> 00:11:51,589
antarctica is a site because it's very

269
00:11:56,860 --> 00:11:54,920
easy to see meteorites on white ice and

270
00:11:59,260 --> 00:11:56,870
also because of the way that the ice

271
00:12:01,660 --> 00:11:59,270
shifts you can get specific places sites

272
00:12:04,120 --> 00:12:01,670
such as Lewis cliffs that collect large

273
00:12:05,769 --> 00:12:04,130
large amounts of meteorites over long

274
00:12:08,139 --> 00:12:05,779
periods of time so they've been

275
00:12:09,699 --> 00:12:08,149
collecting these meteorites since 1976

276
00:12:11,470 --> 00:12:09,709
and they've collected over ten thousand

277
00:12:13,600 --> 00:12:11,480
meteorites since then and what they do

278
00:12:15,160 --> 00:12:13,610
is they find a meteorite as you can see

279
00:12:18,310 --> 00:12:15,170
two in the picture on your right and

280
00:12:21,240 --> 00:12:18,320
pretty much put it in a bag as much like

281
00:12:23,319 --> 00:12:21,250
the ones you see in the kit on the left

282
00:12:26,319 --> 00:12:23,329
but what's happened is when you take

283
00:12:28,000 --> 00:12:26,329
these meteorites from ann smith and you

284
00:12:31,180 --> 00:12:28,010
hydrolyze the meteorite samples you

285
00:12:34,600 --> 00:12:31,190
getting this large mystery peak in the

286
00:12:37,780 --> 00:12:34,610
chromatograph and so this mystery peak

287
00:12:41,530 --> 00:12:37,790
was determined to be epsilon amino and

288
00:12:44,079 --> 00:12:41,540

come okay epsilon amino and caproic acid

289
00:12:46,840 --> 00:12:44,089
also known as EK and it's a hydrolyzed

290
00:12:48,639 --> 00:12:46,850
ation product of nylon so this

291
00:12:50,889 --> 00:12:48,649
contamination source should be entirely

292
00:12:52,329 --> 00:12:50,899
preventable and you can tell that it's

293
00:12:55,079 --> 00:12:52,339
eco because if you look on the

294
00:12:57,100 --> 00:12:55,089
fluorescence detection here you see a

295
00:12:58,900 --> 00:12:57,110
fluorescence peak and the way that these

296
00:13:02,949 --> 00:12:58,910
are derivatized it should be only that

297
00:13:03,129 --> 00:13:02,959
primary amino acids fluoresce and so you

298
00:13:04,960 --> 00:13:03,139
know

299
00:13:06,609 --> 00:13:04,970
it's an amino acid something with a

300
00:13:08,619 --> 00:13:06,619
primary amine and then when you look at

301
00:13:12,220 --> 00:13:08,629
the mass spectra you can see that it's

302
00:13:17,379 --> 00:13:12,230
of mass 393 and you run standards

303
00:13:20,319 --> 00:13:17,389
against that so i looked at eco

304
00:13:22,119 --> 00:13:20,329
contaminations and specifically as well

305
00:13:26,019 --> 00:13:22,129
as contaminations from a handful of

306
00:13:27,939 --> 00:13:26,029
other amino acids because as amino acids

307
00:13:29,859 --> 00:13:27,949
are incredibly important to find

308
00:13:31,629 --> 00:13:29,869
potential the origin of life in the homo

309
00:13:34,139 --> 00:13:31,639
chirality of amino acids is something

310
00:13:37,359 --> 00:13:34,149
that's specifically interesting to

311
00:13:40,599 --> 00:13:37,369
astrobiology and so there's 20 coated or

312
00:13:43,239 --> 00:13:40,609
pro tenacious amino acids and I think we

313
00:13:47,470 --> 00:13:43,249

looked at about 14 a mix of biological

314
00:13:49,479 --> 00:13:47,480
and non-biological amino acids and I

315
00:13:51,309 --> 00:13:49,489
look for these using liquid

316
00:13:53,799 --> 00:13:51,319
chromatography fluorescence section top

317
00:13:55,869 --> 00:13:53,809
ms and this is a schematic of the

318
00:13:58,090 --> 00:13:55,879
instrument that i use and so if you

319
00:14:01,119 --> 00:13:58,100
start down here in the bottom right this

320
00:14:03,669 --> 00:14:01,129
is the hplc injection site and so you

321
00:14:06,659 --> 00:14:03,679
inject your sample and it goes on to the

322
00:14:10,989 --> 00:14:06,669
column we used c18 columns so this is a

323
00:14:12,669 --> 00:14:10,999
reverse and then the sample actually

324
00:14:17,769 --> 00:14:12,679
went through the fluorescence detector

325
00:14:18,999 --> 00:14:17,779
and from the fluorescence to the top so

326
00:14:22,539 --> 00:14:19,009
from this instrument we were able to

327
00:14:27,999 --> 00:14:22,549
determine exactly which amino acids were

328
00:14:31,929 --> 00:14:28,009
in the samples so specifically I looked

329
00:14:35,019 --> 00:14:31,939
at these three bags fr to 176 a 73 73

330
00:14:40,059 --> 00:14:35,029
and a knf bag which is from the

331
00:14:42,340 --> 00:14:40,069
corporation ken ken lamb I think and so

332
00:14:44,019 --> 00:14:42,350
the way that I looked at these bags is I

333
00:14:45,850 --> 00:14:44,029
put a clean water samples in each of the

334
00:14:48,009 --> 00:14:45,860
bags and left those clean water samples

335
00:14:50,499 --> 00:14:48,019
for 24 hours the samples were then

336
00:14:52,090 --> 00:14:50,509
extracted and split and half the sample

337
00:14:54,429 --> 00:14:52,100
was hydrolyzed and half of it was not

338
00:14:57,129 --> 00:14:54,439

and then those samples were derivatized

339
00:15:01,059 --> 00:14:57,139
and analyzed with the liquid

340
00:15:05,739 --> 00:15:01,069
chromatograph so these are the

341
00:15:07,659 --> 00:15:05,749
chromatogram results and so in order to

342
00:15:09,579 --> 00:15:07,669
just point out that the chromatograms

343
00:15:12,549 --> 00:15:09,589
not spectra it it's time versus

344
00:15:15,519 --> 00:15:12,559
intensity and as you can see clearly

345
00:15:16,809 --> 00:15:15,529
that some bags had far far less

346
00:15:20,259 --> 00:15:16,819
contamination and other

347
00:15:21,939 --> 00:15:20,269
with the FR 2176 showing much less

348
00:15:25,569 --> 00:15:21,949
contamination particularly in the Eco

349
00:15:28,059 --> 00:15:25,579
amino acid it's also noteworthy that I

350
00:15:30,849 --> 00:15:28,069
analyzed the bag that the knf bag was

351
00:15:32,590 --> 00:15:30,859
packaged in because i was seeing nylon

352
00:15:34,259 --> 00:15:32,600
Peaks that are eeka Peaks that should

353
00:15:37,629 --> 00:15:34,269
not have been in the interior bag and

354
00:15:39,429 --> 00:15:37,639
when I analyzed that outer bag the all

355
00:15:40,840 --> 00:15:39,439
these biological amino acids make sense

356
00:15:42,189 --> 00:15:40,850
since people were touching the bag and

357
00:15:44,769 --> 00:15:42,199
handling it not like it was going to be

358
00:15:47,650 --> 00:15:44,779
analyzed but there wasn't too much vika

359
00:15:49,389 --> 00:15:47,660
in it however we think that perhaps the

360
00:15:51,249 --> 00:15:49,399
interior bag was heat sealed into it and

361
00:15:54,639 --> 00:15:51,259
it-enabled contamination to be passed

362
00:15:56,409 --> 00:15:54,649
from the outer bag to the inner bag so

363
00:15:58,989 --> 00:15:56,419

these are quantitation of the

364
00:16:01,269 --> 00:15:58,999
qualitative results you just saw and if

365
00:16:02,529 --> 00:16:01,279
you look at the column on the left this

366
00:16:04,659 --> 00:16:02,539
is the bag that Ann's met was currently

367
00:16:06,579 --> 00:16:04,669
using they're using nylon bags which

368
00:16:10,889 --> 00:16:06,589
puts in huge huge amounts of eeka

369
00:16:16,779 --> 00:16:10,899
contamination and i think that the FR

370
00:16:19,569 --> 00:16:16,789
2176 bag which has only I think for four

371
00:16:22,029 --> 00:16:19,579
parts of four pika moles of

372
00:16:23,769 --> 00:16:22,039
contamination should be used instead and

373
00:16:25,359 --> 00:16:23,779
the reason that this would be a much

374
00:16:26,889 --> 00:16:25,369
better back to use is that this ikan

375
00:16:28,269 --> 00:16:26,899
contamination puts in a lot of extra

376
00:16:30,369 --> 00:16:28,279
carbons and nitrogens that would make it

377
00:16:32,859 --> 00:16:30,379
impossible to do isotope ratios on some

378
00:16:36,549 --> 00:16:32,869
of these meteorites and making it very

379
00:16:38,379 --> 00:16:36,559
difficult to determine origins so in

380
00:16:40,840 --> 00:16:38,389
summary contamination by eeka is

381
00:16:44,169 --> 00:16:40,850
preventable how the bag is packaged

382
00:16:45,849 --> 00:16:44,179
affects the bag and fr 2176 is a better

383
00:16:48,069 --> 00:16:45,859
bag for meteorite collection than what

384
00:16:52,029 --> 00:16:48,079
they're currently using and this is the

385
00:16:54,699 --> 00:16:52,039
FR 2176 bag on your right so i would

386
00:16:56,049 --> 00:16:54,709
like to thank jason Dorkin for being my

387
00:16:58,349 --> 00:16:56,059
mentor and helping me get acquainted

388
00:17:00,549 --> 00:16:58,359

with the instrument Danny Glavine for

389
00:17:03,699 --> 00:17:00,559
pretty much coming up with the bags and

390
00:17:06,100 --> 00:17:03,709
giving the bags to me Jamie uh I also

391
00:17:07,389 --> 00:17:06,110
cook Jim dou T and Milly Margaret

392
00:17:09,249 --> 00:17:07,399
showing me around the lab and helping me

393
00:17:10,899 --> 00:17:09,259
get used to the equipment heaven writer

394
00:17:13,569 --> 00:17:10,909
from Johnson Space Center for providing

395
00:17:15,009 --> 00:17:13,579
the bags wearing EV for organizing the

396
00:17:22,260 --> 00:17:15,019
internship and the nasa astrobiology

397
00:17:28,180 --> 00:17:24,280
don't think I'm never going to use those

398
00:17:33,850 --> 00:17:28,190
bags again yeah or any bags I'm gonna be

399
00:17:39,850 --> 00:17:33,860
doing what's that star desk Hey oh yeah

400
00:17:44,230 --> 00:17:39,860
oh alright ok any questions for for

401
00:17:46,090 --> 00:17:44,240
aerial or comments here at the center is

402
00:17:49,810 --> 00:17:46,100
there someone of someone on the far end

403
00:17:51,280 --> 00:17:49,820
has a question I heard you yeah I was

404
00:17:53,200 --> 00:17:51,290
wondering if there was a cost between

405
00:17:55,150 --> 00:17:53,210
the bags that they're currently using

406
00:17:59,200 --> 00:17:55,160
and the bag that you suggesting would

407
00:18:00,580 --> 00:17:59,210
have less of an issue per bag and you

408
00:18:02,830 --> 00:18:00,590
think vanilla ones are more expensive I

409
00:18:04,960 --> 00:18:02,840
don't have a number i was pretty cheap i

410
00:18:07,750 --> 00:18:04,970
I don't have the numbers i could get

411
00:18:09,910 --> 00:18:07,760
back to you on that but honestly when

412
00:18:10,960 --> 00:18:09,920
you think about the preciousness of the

413
00:18:14,020 --> 00:18:10,970

samples it's probably worth the upgrade

414
00:18:16,840 --> 00:18:14,030
right I was just identified if you

415
00:18:19,030 --> 00:18:16,850
identify yourself please I'm Sasha

416
00:18:23,320 --> 00:18:19,040
Afghan I'm an intern working here at

417
00:18:26,200 --> 00:18:23,330
NASA Ames thank you is there any plan to

418
00:18:28,120 --> 00:18:26,210
feed this stuff back to Kevin writer so

419
00:18:30,640 --> 00:18:28,130
that they can plan appropriately for the

420
00:18:33,970 --> 00:18:30,650
next expedition he's already out here

421
00:18:37,810 --> 00:18:33,980
good they know what are what are these

422
00:18:41,410 --> 00:18:37,820
other bags made of the bag is made of I

423
00:18:43,270 --> 00:18:41,420
can go back the bag the good bag is made

424
00:18:46,060 --> 00:18:43,280
of polyester low-density polyethylene

425
00:18:48,670 --> 00:18:46,070
oil and polyethylene the bag are using

426
00:18:52,530 --> 00:18:48,680
right now is just Maryland did I guess

427
00:18:55,060 --> 00:18:52,540
none of these are teflon no Teflon I

428
00:18:57,250 --> 00:18:55,070
actually was run as well human and

429
00:18:59,230 --> 00:18:57,260
Teflon had fairly high contamination

430
00:19:01,300 --> 00:18:59,240
levels nowhere near as high as nylon but

431
00:19:08,680 --> 00:19:01,310
still out of the realm that you want to

432
00:19:10,970 --> 00:19:08,690
use it I'm just curious is there way to

433
00:19:14,000 --> 00:19:10,980
know what other groups may be using them

434
00:19:15,500 --> 00:19:14,010
nylon bags and tell them about your

435
00:19:24,409 --> 00:19:15,510
results this is something that you guys

436
00:19:26,330 --> 00:19:24,419
do was about it no dick Danny just said

437
00:19:28,610 --> 00:19:26,340
that Jesse knows about it and I think it

438
00:19:30,140 --> 00:19:28,620

becomes pretty apparent if something has

439
00:19:31,850 --> 00:19:30,150
been in a nylon bag once you hydrolyze

440
00:19:33,230 --> 00:19:31,860
it like you see that peak all the time

441
00:19:39,140 --> 00:19:33,240
and it's absolutely huge compared to

442
00:19:41,390 --> 00:19:39,150
anything else so yeah there's a

443
00:19:42,770 --> 00:19:41,400
conference in march that i'm going to be

444
00:19:45,650 --> 00:19:42,780
doing a poster on about these results as

445
00:19:47,390 --> 00:19:45,660
well but i think it's fair sight think

446
00:19:50,120 --> 00:19:47,400
that the results of your research have

447
00:19:53,270 --> 00:19:50,130
really changed the protocol for a sample

448
00:19:55,100 --> 00:19:53,280
collection with your agent so very

449
00:19:59,240 --> 00:19:55,110
significant result thank you very much

450
00:20:02,630 --> 00:19:59,250
thank you ok we'll be right along we

451
00:20:04,789 --> 00:20:02,640
have Lauren Loudon who's a student at

452
00:20:07,370 --> 00:20:04,799
Keene State College he's been working

453
00:20:09,039 --> 00:20:07,380
with Richard Walker the geosciences

454
00:20:11,570 --> 00:20:09,049
Department the University of Maryland

455
00:20:13,490 --> 00:20:11,580
and working on lunar samples

456
00:20:16,000 --> 00:20:13,500
particularly with respect to the sadirah

457
00:20:19,610 --> 00:20:16,010
file elements and Osman isotopic

458
00:20:21,950 --> 00:20:19,620
isotopic systematics thank you dr. Lim

459
00:20:23,900 --> 00:20:21,960
away hi my name is Lauren Loudon I'm a

460
00:20:25,850 --> 00:20:23,910
student at Keene State College in New

461
00:20:27,620 --> 00:20:25,860
Hampshire and a second year intern here

462
00:20:30,169 --> 00:20:27,630
at the Goddard Center for astrobiology

463
00:20:32,750 --> 00:20:30,179

this summer I continued my work with dr.

464
00:20:34,700 --> 00:20:32,760
Mumma or sorry doctors Walker in which

465
00:20:36,980 --> 00:20:34,710
Attell characterizing the impactors of

466
00:20:39,020 --> 00:20:36,990
the late heavy bombardment using highly

467
00:20:40,820 --> 00:20:39,030
sideral file elements and osmium isotope

468
00:20:44,720 --> 00:20:40,830
systematics in the lunar impact melt

469
00:20:46,460 --> 00:20:44,730
breccia 760 55 the brecha 760 55 was

470
00:20:49,010 --> 00:20:46,470
collected from the saran atakus basin

471
00:20:50,690 --> 00:20:49,020
during the Apollo 17 mission so we're

472
00:20:52,220 --> 00:20:50,700
concerned with the composition of the

473
00:20:54,049 --> 00:20:52,230
impacting objects that were involved

474
00:20:56,000 --> 00:20:54,059
with the late heavy bombardment late

475
00:20:58,159 --> 00:20:56,010
heavy bombardment took place about 3.9

476
00:21:00,560 --> 00:20:58,169
billion years before present and it is a

477
00:21:02,720 --> 00:21:00,570
hypothesized as one of the delivering

478
00:21:04,820 --> 00:21:02,730
mechanisms for prebiotic organics and

479
00:21:07,070 --> 00:21:04,830
water to the earth however there is much

480
00:21:09,320 --> 00:21:07,080
controversy over the composition of

481
00:21:13,159 --> 00:21:09,330
these objects and we're in the solar

482
00:21:14,840 --> 00:21:13,169
system these objects form lunar impact

483
00:21:17,060 --> 00:21:14,850
melt wretches are essentially

484
00:21:19,669 --> 00:21:17,070
fingerprints of the 3.9 Giga annum

485
00:21:22,130 --> 00:21:19,679
impactors a lunar impact melt breccia is

486
00:21:23,870 --> 00:21:22,140
composed of fragments of the lunar crust

487
00:21:24,169 --> 00:21:23,880
whatever else is contained in the lunar

488
00:21:26,840 --> 00:21:24,179

cross

489
00:21:28,879 --> 00:21:26,850
and melt from the impacting object this

490
00:21:30,769 --> 00:21:28,889
process retains the signatures of some

491
00:21:32,239 --> 00:21:30,779
elements the highly sideral file

492
00:21:34,279 --> 00:21:32,249
elements which include rhenium osmium

493
00:21:36,710 --> 00:21:34,289
iridium ruthenium platinum and palladium

494
00:21:38,989 --> 00:21:36,720
are the easiest to discern given their

495
00:21:41,180 --> 00:21:38,999
geochemical nature the highly sideral

496
00:21:43,519 --> 00:21:41,190
file elements prefer the metal phase

497
00:21:45,350 --> 00:21:43,529
over the silicate phase so upon core

498
00:21:47,359 --> 00:21:45,360
formation they're nearly quantitatively

499
00:21:50,320 --> 00:21:47,369
removed from the silicate portions of

500
00:21:52,399 --> 00:21:50,330
the earth we can then take our or our

501
00:21:54,289 --> 00:21:52,409
isotopic data from some of our highly

502
00:21:56,989 --> 00:21:54,299
sideral file elements and the highly

503
00:22:00,850 --> 00:21:56,999
sideral file element ratios and plot

504
00:22:03,440 --> 00:22:00,860
them comparing the values to other

505
00:22:07,580 --> 00:22:03,450
chondrites and lunar impact melts or

506
00:22:09,350 --> 00:22:07,590
other samples we analyze seven

507
00:22:12,470 --> 00:22:09,360
additional 40 to 200 milligrams

508
00:22:14,239 --> 00:22:12,480
subsamples of the brecha 760 55 by

509
00:22:15,830 --> 00:22:14,249
taking whole rock chunks and doing a

510
00:22:17,690 --> 00:22:15,840
high pressure temperature digestion on

511
00:22:19,730 --> 00:22:17,700
them we then measure the highly sideral

512
00:22:21,859 --> 00:22:19,740
file element concentrations by isotope

513
00:22:23,899 --> 00:22:21,869

dilution techniques using thermal

514
00:22:25,609 --> 00:22:23,909
ionization mass spectrometry and

515
00:22:29,060 --> 00:22:25,619
inductively coupled plasma mass

516
00:22:31,940 --> 00:22:29,070
spectrometry here we have a plot of

517
00:22:33,529 --> 00:22:31,950
iridium in parts per billion versus the

518
00:22:35,509 --> 00:22:33,539
other highly sideral file elements in

519
00:22:38,139 --> 00:22:35,519
parts per billion for some reason my

520
00:22:40,820 --> 00:22:38,149
y-axis is cut off I'm sorry about that

521
00:22:44,060 --> 00:22:40,830
usually in the past these graphs have

522
00:22:46,100 --> 00:22:44,070
been interpreted to mean two component

523
00:22:48,889 --> 00:22:46,110
mixing between a low highly sideral file

524
00:22:51,080 --> 00:22:48,899
and many a member component and a highly

525
00:22:52,639 --> 00:22:51,090
sideral file and member component the

526
00:22:54,799 --> 00:22:52,649
low end member component would be

527
00:22:56,720 --> 00:22:54,809
considered the lunar crust and the high

528
00:22:59,090 --> 00:22:56,730
hi Lisa Toro file and member the

529
00:23:02,539 --> 00:22:59,100
impacting object the slopes of the lines

530
00:23:04,669 --> 00:23:02,549
would then equal the ratio of a highly

531
00:23:07,310 --> 00:23:04,679
sideral file elements to iridium in the

532
00:23:09,409 --> 00:23:07,320
impacting object and the y-intercepts

533
00:23:11,090 --> 00:23:09,419
would equal the contribution of the

534
00:23:13,580 --> 00:23:11,100
target component so what's already in

535
00:23:15,769 --> 00:23:13,590
the lunar crust as you can see here what

536
00:23:17,960 --> 00:23:15,779
is very interesting is we have nonzero

537
00:23:20,359 --> 00:23:17,970
intercepts and palladium platinum and

538
00:23:22,580 --> 00:23:20,369

ruthenium this is unlike any other

539
00:23:24,379 --> 00:23:22,590
impact melt breccia we have seen in this

540
00:23:26,389 --> 00:23:24,389
high of a concentration and if we

541
00:23:28,669 --> 00:23:26,399
compare these values to pristine lunar

542
00:23:30,769 --> 00:23:28,679
rocks they usually have highly sideral

543
00:23:33,349 --> 00:23:30,779
file element concentrations in parts per

544
00:23:35,629 --> 00:23:33,359
trillion here's a comparison to the

545
00:23:37,400 --> 00:23:35,639
Apollo 14 breccia one four three two one

546
00:23:40,820 --> 00:23:37,410
analyzed by put stella

547
00:23:42,950 --> 00:23:40,830
on 2008 and we can see that within the

548
00:23:45,410 --> 00:23:42,960
uncertainty of our regression analysis

549
00:23:49,430 --> 00:23:45,420
the intercepts would be statistically

550
00:23:53,120 --> 00:23:49,440
unresolvable from zero here we have a

551
00:23:54,890 --> 00:23:53,130
plot of 187 osmium over 188 osmium

552
00:23:58,730 --> 00:23:54,900
versus what would be palladium and

553
00:24:01,070 --> 00:23:58,740
iridium the 187 osmium to 188 osmium

554
00:24:03,410 --> 00:24:01,080
ratio is a good proxy for the 187

555
00:24:06,200 --> 00:24:03,420
rhenium to 188 osmium ratio in the

556
00:24:09,110 --> 00:24:06,210
impacting object the X error bars here

557
00:24:12,500 --> 00:24:09,120
actually represent the range of 187

558
00:24:14,540 --> 00:24:12,510
osmium to 188 osmium in the sample the Y

559
00:24:17,300 --> 00:24:14,550
error bars would represent two sigma

560
00:24:19,700 --> 00:24:17,310
error from the regression analysis in

561
00:24:22,070 --> 00:24:19,710
the past we would have interpreted this

562
00:24:23,930 --> 00:24:22,080
beretta as diverging from the gnome

563
00:24:25,550 --> 00:24:23,940

chondritic groups which are plotted here

564
00:24:28,790 --> 00:24:25,560
we have ordinary enstatite and

565
00:24:30,200 --> 00:24:28,800
carbonaceous it would be plotting

566
00:24:31,910 --> 00:24:30,210
diverging from the gnome contracted

567
00:24:33,140 --> 00:24:31,920
groups but maybe overlapping within

568
00:24:35,360 --> 00:24:33,150
uncertainty with some of the

569
00:24:38,600 --> 00:24:35,370
carbonaceous however what I'll show you

570
00:24:40,850 --> 00:24:38,610
is that might not be usable here here we

571
00:24:43,850 --> 00:24:40,860
have a plot of 187 rhenium versus over

572
00:24:46,640 --> 00:24:43,860
188 osmium versus our osmium isotopic

573
00:24:49,370 --> 00:24:46,650
composition 187 osmium over 188 osmium

574
00:24:51,020 --> 00:24:49,380
this plot defines or you can see there

575
00:24:53,120 --> 00:24:51,030
is a correlation Oh loose correlation

576
00:24:55,330 --> 00:24:53,130
between the two isotopic compositions

577
00:24:58,040 --> 00:24:55,340
and this would traditionally define a

578
00:25:01,130 --> 00:24:58,050
isochron here I plotted for reference to

579
00:25:04,010 --> 00:25:01,140
4.55 Giga annum isochron and the 3.85

580
00:25:06,500 --> 00:25:04,020
Giga oh my so kromm when we age correct

581
00:25:09,890 --> 00:25:06,510
this data back to the three point eight

582
00:25:12,050 --> 00:25:09,900
five billion year impact we can see on a

583
00:25:15,110 --> 00:25:12,060
plot of osmium in parts per billion

584
00:25:19,400 --> 00:25:15,120
versus our osmium isotopic composition

585
00:25:21,790 --> 00:25:19,410
at 3.85 Giga annum that the isotopic

586
00:25:25,340 --> 00:25:21,800
composition has evolved from a

587
00:25:27,110 --> 00:25:25,350
isotopically uniform reservoir this is

588
00:25:29,390 --> 00:25:27,120

also a very unique thing to the spread

589
00:25:31,070 --> 00:25:29,400
show so we need to know why are there

590
00:25:32,990 --> 00:25:31,080
these large ranges in our reading of

591
00:25:35,300 --> 00:25:33,000
osmium and highly sideral file element

592
00:25:37,370 --> 00:25:35,310
ratios there are two possibilities the

593
00:25:40,130 --> 00:25:37,380
first being two component mixing between

594
00:25:41,720 --> 00:25:40,140
an impactor and the lunar crust to have

595
00:25:43,220 --> 00:25:41,730
this occur we need rhenium to

596
00:25:45,620 --> 00:25:43,230
fractionate from osmium during the

597
00:25:47,330 --> 00:25:45,630
impact and our other highly sideral file

598
00:25:49,940 --> 00:25:47,340
elements to fractionate from iridium

599
00:25:50,960 --> 00:25:49,950
there is a possibility of volatility

600
00:25:53,029 --> 00:25:50,970
here but

601
00:25:55,310 --> 00:25:53,039
we have reducing conditions under impact

602
00:25:58,610 --> 00:25:55,320
and it requires temperatures in excess

603
00:26:01,610 --> 00:25:58,620
of 3,000 k to fractionate or to melt

604
00:26:03,380 --> 00:26:01,620
rhenium the other option is three

605
00:26:05,330 --> 00:26:03,390
component mixing between a pre Serrano

606
00:26:07,669 --> 00:26:05,340
tates impactor the surrender thought is

607
00:26:09,830 --> 00:26:07,679
impactor and the lunar crust in this

608
00:26:11,870 --> 00:26:09,840
case the only requirement as that 22

609
00:26:14,390 --> 00:26:11,880
impactors have different rhenium osmium

610
00:26:18,020 --> 00:26:14,400
ratios and highly sideral file element

611
00:26:20,960 --> 00:26:18,030
ratios here i have a plot of what is

612
00:26:25,250 --> 00:26:20,970
iridium versus palladium and I this is

613
00:26:28,250 --> 00:26:25,260

just a schematic already may take two

614
00:26:30,649 --> 00:26:28,260
impactors to generate nonzero intercepts

615
00:26:32,659 --> 00:26:30,659
by mixing the two impactors and the

616
00:26:34,970 --> 00:26:32,669
lunar crust so almost three component

617
00:26:36,289 --> 00:26:34,980
mixing and there you see the surrender

618
00:26:38,120 --> 00:26:36,299
thought is impactor the priests Aranda

619
00:26:39,200 --> 00:26:38,130
thought is impactor and the mixing line

620
00:26:41,570 --> 00:26:39,210
which would give us the nonzero

621
00:26:43,399 --> 00:26:41,580
intercept these lines are exaggerated so

622
00:26:46,220 --> 00:26:43,409
this is not an accurate model of the

623
00:26:49,130 --> 00:26:46,230
impacting ratios and here for reference

624
00:26:52,130 --> 00:26:49,140
I plotted the Palladium values from the

625
00:26:53,899 --> 00:26:52,140
breccia 760 55 and you can see that this

626
00:26:56,570 --> 00:26:53,909
is one way that we might be able to

627
00:27:01,220 --> 00:26:56,580
evolve nonzero intercepts in the lunar

628
00:27:03,289 --> 00:27:01,230
trust in conclusion 760 55 is a very

629
00:27:05,539 --> 00:27:03,299
unique breccia where platinum palladium

630
00:27:07,970 --> 00:27:05,549
and Rossini Amal have nonzero intercepts

631
00:27:09,950 --> 00:27:07,980
on plot versus iridium there is a range

632
00:27:12,169 --> 00:27:09,960
of osmium composition which reflects

633
00:27:14,450 --> 00:27:12,179
variable rhenium osmium in the material

634
00:27:16,700 --> 00:27:14,460
palladium iridium platinum iridium and

635
00:27:18,560 --> 00:27:16,710
ruthenium iridium ratios are much more

636
00:27:22,310 --> 00:27:18,570
variable than in other lunar impact melt

637
00:27:24,350 --> 00:27:22,320
wretches the easiest you know conclusion

638
00:27:26,480 --> 00:27:24,360

to invoke that would result in all this

639
00:27:28,310 --> 00:27:26,490
is three component mixing between the

640
00:27:29,810 --> 00:27:28,320
serrano tates impactor a priest Aranda

641
00:27:31,940 --> 00:27:29,820
thought us impactor and the lunar crust

642
00:27:33,680 --> 00:27:31,950
but it's also we should note that there

643
00:27:36,020 --> 00:27:33,690
is a possibility for two component

644
00:27:38,510 --> 00:27:36,030
mixing but the situations that would

645
00:27:41,899 --> 00:27:38,520
need to result to have it give us the

646
00:27:44,480 --> 00:27:41,909
data that we see are much harder I just

647
00:27:46,730 --> 00:27:44,490
like to acknowledge dr. Mumma and Cory

648
00:27:48,799 --> 00:27:46,740
everybody else at the Goddard Center for

649
00:27:50,570 --> 00:27:48,809
astrobiology and the isotope

650
00:27:53,779 --> 00:27:50,580
geochemistry lab at the university of

651
00:28:00,889 --> 00:27:53,789
maryland thank you guys very much

652
00:28:02,719 --> 00:28:00,899
oh I was actually kind of itchy to go

653
00:28:05,210 --> 00:28:02,729
back to that one slide where you show

654
00:28:11,090 --> 00:28:05,220
the Iridium isotopic ratios versatility

655
00:28:13,549 --> 00:28:11,100
of the palladium iridium abundance ratio

656
00:28:16,729 --> 00:28:13,559
it's dead right there that kind of looks

657
00:28:20,239 --> 00:28:16,739
like you've got two distinct families of

658
00:28:21,979 --> 00:28:20,249
points on that chart is that just my

659
00:28:24,560 --> 00:28:21,989
eyeballs getting older zit is it

660
00:28:26,060 --> 00:28:24,570
possible it's real pay tithing etho I

661
00:28:29,839 --> 00:28:26,070
mean that this two different slopes

662
00:28:32,629 --> 00:28:29,849
almost like two different slopes I can

663
00:28:35,210 --> 00:28:32,639

sort of say once one one set of data

664
00:28:36,710 --> 00:28:35,220
coming through here for example one

665
00:28:39,619 --> 00:28:36,720
mixing line and then another one which

666
00:28:41,839 --> 00:28:39,629
is displaced from back up here well I

667
00:28:45,320 --> 00:28:41,849
think what we're having kind of problems

668
00:28:47,749 --> 00:28:45,330
look now is that if if we have more than

669
00:28:50,029 --> 00:28:47,759
two component mixing these might not be

670
00:28:52,430 --> 00:28:50,039
appropriate graphs to use to show a

671
00:28:54,739 --> 00:28:52,440
mixing mixing trend and I would actually

672
00:28:57,889 --> 00:28:54,749
have to ask dr. Walker if this would

673
00:28:59,869 --> 00:28:57,899
even be an appropriate graph to show a

674
00:29:03,580 --> 00:28:59,879
two component or um you know different

675
00:29:05,450 --> 00:29:03,590
mixing trends on you know I know like

676
00:29:07,729 --> 00:29:05,460
traditionally or in the past we would

677
00:29:10,299 --> 00:29:07,739
show to show like a good mixing wine we

678
00:29:13,039 --> 00:29:10,309
would plot osmium concentration versus

679
00:29:15,950 --> 00:29:13,049
osmium isotopic composition and that

680
00:29:17,479 --> 00:29:15,960
would give us a nice mixing trend so he

681
00:29:19,159 --> 00:29:17,489
can generate about ten of these

682
00:29:22,580 --> 00:29:19,169
different plots are different clan yeah

683
00:29:25,580 --> 00:29:22,590
yeah some of the apparent correlation to

684
00:29:28,460 --> 00:29:25,590
go away in our figures okay let me go to

685
00:29:33,440 --> 00:29:28,470
our remote sites and ask dependent any

686
00:29:39,669 --> 00:29:33,450
questions out there ok any questions

687
00:29:46,070 --> 00:29:42,730
right thank you very much long thank you

688
00:29:47,419 --> 00:29:46,080

question so you are now admitted to

689
00:29:49,760 --> 00:29:47,429
university of elephant albums that i

690
00:29:55,870 --> 00:29:49,770
admitted he had quit no matter what most

691
00:30:00,230 --> 00:29:58,730
now rich rich walker just advised me

692
00:30:02,659 --> 00:30:00,240
privately he's not about to let him out

693
00:30:05,330 --> 00:30:02,669
for vacation until he completes what

694
00:30:09,159 --> 00:30:05,340
publication the application application

695
00:30:12,950 --> 00:30:09,169
i see the application our next speaker

696
00:30:16,639 --> 00:30:12,960
texas from the realm of meteoritic sand

697
00:30:20,240 --> 00:30:16,649
lunar samples to the realm of our sister

698
00:30:23,450 --> 00:30:20,250
planet mars where she has been looking

699
00:30:27,590 --> 00:30:23,460
at the search for signatures of carbon

700
00:30:29,029 --> 00:30:27,600
and life not Nadia rod otha from

701
00:30:31,519 --> 00:30:29,039
Connecticut College has been working

702
00:30:33,919 --> 00:30:31,529
with Geronimo Villanueva here at Goddard

703
00:30:36,560 --> 00:30:33,929
on high-resolution spectroscopy of Mars

704
00:30:37,669 --> 00:30:36,570
not you hi my name is investor aadhavan

705
00:30:39,500 --> 00:30:37,679
this summer I worked in the

706
00:30:41,240 --> 00:30:39,510
high-resolution spectral survey of my

707
00:30:43,430 --> 00:30:41,250
city infrared wavelengths and I searched

708
00:30:45,769 --> 00:30:43,440
for signatures of life as an

709
00:30:47,840 --> 00:30:45,779
introduction before 1970s there were

710
00:30:51,320 --> 00:30:47,850
very few observations of Mars Dan and

711
00:30:54,049 --> 00:30:51,330
here i am showing um a spectrum is an

712
00:30:57,980 --> 00:30:54,059
example of a spectrum that was obtained

713
00:30:59,960 --> 00:30:57,990

in 1963 and along the x-axis i've

714
00:31:02,539 --> 00:30:59,970
plotted the wavelength in micrometers

715
00:31:05,539 --> 00:31:02,549
and along the y-axis is the resolving

716
00:31:07,460 --> 00:31:05,549
power before 1970s most of the

717
00:31:09,649 --> 00:31:07,470
observations with them were done with

718
00:31:13,460 --> 00:31:09,659
the resolving power of lower than 10,000

719
00:31:16,340 --> 00:31:13,470
like this observation here done it 300

720
00:31:19,370 --> 00:31:16,350
the resolving power and that's why on

721
00:31:22,810 --> 00:31:19,380
the spectrum of things showed only very

722
00:31:25,090 --> 00:31:22,820
bright co2 whines but no week features

723
00:31:27,399 --> 00:31:25,100
in the new millennium more and more

724
00:31:29,450 --> 00:31:27,409
observations were done with your

725
00:31:31,940 --> 00:31:29,460
instruments with the resolving power

726
00:31:34,419 --> 00:31:31,950
higher than 10,000 and that's why

727
00:31:38,240 --> 00:31:34,429
scientists were able to identify week

728
00:31:39,980 --> 00:31:38,250
molecules of carbon monoxide methane HDL

729
00:31:43,490 --> 00:31:39,990
and other molecules that are relevant

730
00:31:45,289 --> 00:31:43,500
for the search of life on Mars the data

731
00:31:47,269 --> 00:31:45,299
analyzed this summer was taken within

732
00:31:49,250 --> 00:31:47,279
their spec spectrometer at CAC tool and

733
00:31:51,360 --> 00:31:49,260
it's a spectrometer with the resolving

734
00:31:55,620 --> 00:31:51,370
power for 40,000 and

735
00:32:00,090 --> 00:31:55,630
if it has three really wide regions at

736
00:32:03,360 --> 00:32:00,100
the infrared center around 1.3 3.3 and 5

737
00:32:05,850 --> 00:32:03,370
microns due to the fact that the range

738
00:32:09,960 --> 00:32:05,860

is really large and the resulting powers

739
00:32:11,910 --> 00:32:09,970
hi the area under every region is very

740
00:32:15,630 --> 00:32:11,920
large and this means that we can detect

741
00:32:17,520 --> 00:32:15,640
so many weak lines and retrieve for very

742
00:32:20,310 --> 00:32:17,530
precise abundances of the molecules

743
00:32:24,180 --> 00:32:20,320
observed this is an example of the

744
00:32:26,940 --> 00:32:24,190
dispatcher we observe and x2 the fact

745
00:32:28,860 --> 00:32:26,950
that the resolving power is 40,000 we

746
00:32:32,460 --> 00:32:28,870
can observe many weak lines of carbon

747
00:32:35,520 --> 00:32:32,470
dioxide and even we can revise lines in

748
00:32:38,549 --> 00:32:35,530
between in contrast to the same spectrum

749
00:32:41,250 --> 00:32:38,559
taken in 1963 with the law resolving

750
00:32:44,850 --> 00:32:41,260
power showed no such lines in only very

751
00:32:46,740 --> 00:32:44,860
bright lines the data analyzes summer

752
00:32:49,110 --> 00:32:46,750
was taken with inner spec spectrometer

753
00:32:51,860 --> 00:32:49,120
at capturing Hawaii and all the data is

754
00:32:54,990 --> 00:32:51,870
taken along a slit positioned along Mars

755
00:32:57,540 --> 00:32:55,000
spanning from north to south and all

756
00:32:59,790 --> 00:32:57,550
data comes in images like this where

757
00:33:02,070 --> 00:32:59,800
every order is a spectrum a different

758
00:33:06,150 --> 00:33:02,080
wavelength and it's Ben's from north to

759
00:33:08,580 --> 00:33:06,160
south along the slit all the spectra

760
00:33:10,700 --> 00:33:08,590
contain terrestrial Martian and solar

761
00:33:12,690 --> 00:33:10,710
lines and my task this summer was to

762
00:33:14,490 --> 00:33:12,700
remove with the restaurant solar

763
00:33:18,510 --> 00:33:14,500

alliance in order to obtain only the

764
00:33:21,270 --> 00:33:18,520
Martian lines the data that analyzed

765
00:33:24,990 --> 00:33:21,280
this taken on March 21st in March 22nd

766
00:33:27,380 --> 00:33:25,000
2003 the four of the nurse Peck settings

767
00:33:30,900 --> 00:33:27,390
within respect through setting

768
00:33:32,730 --> 00:33:30,910
identified water carbon dioxide and all

769
00:33:35,370 --> 00:33:32,740
the single Delta molecules as well as

770
00:33:39,060 --> 00:33:35,380
solar lines the egg white setting center

771
00:33:40,760 --> 00:33:39,070
around five microns showed carbon

772
00:33:44,850 --> 00:33:40,770
dioxide water and carbon monoxide

773
00:33:47,210 --> 00:33:44,860
molecules the k1 and k2 settings are

774
00:33:50,850 --> 00:33:47,220
important because they include a

775
00:33:53,880 --> 00:33:50,860
wavelength of 3.3 which is the other

776
00:33:56,370 --> 00:33:53,890
here and in these settings we can

777
00:33:57,990 --> 00:33:56,380
observe many hydrocarbons which are

778
00:34:01,980 --> 00:33:58,000
relevant for the search of life on Mars

779
00:34:03,720 --> 00:34:01,990
in any biomarkers and mice in order to

780
00:34:06,830 --> 00:34:03,730
process inspector I used

781
00:34:10,260 --> 00:34:06,840
so programs developed here the gutter

782
00:34:13,320 --> 00:34:10,270
astrobiology Center for data processing

783
00:34:15,390 --> 00:34:13,330
I organized and corrupted all the orders

784
00:34:16,860 --> 00:34:15,400
of interest Queen bad pitch that bad

785
00:34:19,440 --> 00:34:16,870
pixels and straightened the other

786
00:34:21,330 --> 00:34:19,450
spatial and spectral e and after that i

787
00:34:24,360 --> 00:34:21,340
calibrated the frames and score the

788
00:34:26,910 --> 00:34:24,370

results of with the residual analysis I

789
00:34:29,160 --> 00:34:26,920
the program led me to find the observing

790
00:34:31,980 --> 00:34:29,170
geometry to calculate local atmospheric

791
00:34:33,510 --> 00:34:31,990
conditions and extract Martian residuals

792
00:34:38,190 --> 00:34:33,520
as well as the molecular column

793
00:34:40,500 --> 00:34:38,200
densities after all my work of the

794
00:34:43,020 --> 00:34:40,510
summer I plotted all spectra and graph

795
00:34:45,330 --> 00:34:43,030
like this where along the x-axis I

796
00:34:47,520 --> 00:34:45,340
plotted the frequency must rest frame

797
00:34:50,400 --> 00:34:47,530
and the y-axis is the normalized

798
00:34:52,470 --> 00:34:50,410
absorption spectrum in blackpool here I

799
00:34:55,770 --> 00:34:52,480
show the observed spectrum that contains

800
00:34:58,410 --> 00:34:55,780
Martian terrestrial and solar wines red

801
00:35:00,840 --> 00:34:58,420
is the model of the terrestrial lines

802
00:35:03,930 --> 00:35:00,850
videos for the program and when the two

803
00:35:06,750 --> 00:35:03,940
are subtracted you receive the residual

804
00:35:10,170 --> 00:35:06,760
or these are marginalized as well or

805
00:35:12,990 --> 00:35:10,180
solar lines here on this order I

806
00:35:15,360 --> 00:35:13,000
identified carbon dioxide carbon dioxide

807
00:35:18,650 --> 00:35:15,370
to a branch as well as water molecules

808
00:35:23,340 --> 00:35:18,660
and solar Alliance and so for all orders

809
00:35:28,470 --> 00:35:23,350
identified with the type of each solar

810
00:35:30,570 --> 00:35:28,480
line observe I also confirmed them I'm

811
00:35:33,600 --> 00:35:30,580
you co2 band at my mentor here on

812
00:35:36,300 --> 00:35:33,610
overland I ever found and the new lines

813
00:35:38,450 --> 00:35:36,310

are plotted in red it's important for us

814
00:35:40,980 --> 00:35:38,460
to identify unknown features because

815
00:35:43,790 --> 00:35:40,990
they'll let scientists not mistake

816
00:35:48,990 --> 00:35:43,800
carbon dioxide with methane or other

817
00:35:51,270 --> 00:35:49,000
reclines better biomarkers these are two

818
00:35:53,910 --> 00:35:51,280
orders so that I used to retrieve water

819
00:35:56,670 --> 00:35:53,920
and auto single Delta balances on Mars

820
00:35:58,830 --> 00:35:56,680
the order here shows very bright water

821
00:36:01,530 --> 00:35:58,840
alliance and this is Georgia that has

822
00:36:04,440 --> 00:36:01,540
the greatest abundance of auto single

823
00:36:07,350 --> 00:36:04,450
Delta on Mars and this is the plot that

824
00:36:09,840 --> 00:36:07,360
I created so on the x-axis is the

825
00:36:12,860 --> 00:36:09,850
latitude of Marcin degrees and the

826
00:36:15,849 --> 00:36:12,870
y-axis is the molecular line intensity

827
00:36:16,749 --> 00:36:15,859
employ florida water vapor which is

828
00:36:19,089 --> 00:36:16,759
very high in the northern hemisphere

829
00:36:22,569 --> 00:36:19,099
because the data was taken at the time

830
00:36:26,470 --> 00:36:22,579
when it was late summer on Mars and auto

831
00:36:29,109 --> 00:36:26,480
single Delta is quoted in red all the

832
00:36:31,539 --> 00:36:29,119
single Delta is important because it is

833
00:36:36,849 --> 00:36:31,549
a sign of the existence of awesome

834
00:36:39,819 --> 00:36:36,859
because after the fall after Collins

835
00:36:43,210 --> 00:36:39,829
hits the ozone is falsifying 202 single

836
00:36:46,450 --> 00:36:43,220
Delta in a photo at one point 27 Mike

837
00:36:48,700 --> 00:36:46,460
Ross is emitted and the pot here shows

838
00:36:50,950 --> 00:36:48,710

the expected anti correlation between

839
00:36:53,950 --> 00:36:50,960
water vapor and mice and no two single

840
00:36:56,380 --> 00:36:53,960
Delta online and I would like to thank

841
00:36:58,630 --> 00:36:56,390
the goddess Center for astrobiology dr.

842
00:37:09,160 --> 00:36:58,640
mobile my mentor dr. Villanueva Corey

843
00:37:11,289 --> 00:37:09,170
Navy and all summer in terms thank you

844
00:37:14,979 --> 00:37:11,299
very much not yet I wanted to ask you

845
00:37:17,859 --> 00:37:14,989
briefly is a great deal of information I

846
00:37:19,870 --> 00:37:17,869
want to ask you in your opinion what is

847
00:37:27,400 --> 00:37:19,880
the most valuable thing you learn this

848
00:37:29,620 --> 00:37:27,410
song I think how to process all the

849
00:37:34,059 --> 00:37:29,630
spectra and how to retrieve all Martian

850
00:37:36,999 --> 00:37:34,069
wise and how to remove all that the rest

851
00:37:38,769 --> 00:37:37,009
feel and solar lines that we observe

852
00:37:41,710 --> 00:37:38,779
from the earth atmosphere because kept

853
00:37:43,269 --> 00:37:41,720
is a personal space telescope you have a

854
00:37:45,789 --> 00:37:43,279
lot of contamination from the Earth's

855
00:37:47,799 --> 00:37:45,799
atmosphere you can still very satisfied

856
00:37:51,700 --> 00:37:47,809
with the gun because this is a great

857
00:37:54,849 --> 00:37:51,710
challenge to do this so well anyone else

858
00:37:59,680 --> 00:37:54,859
your wish to Ashford how do you extract

859
00:38:02,470 --> 00:37:59,690
the Mars rest frame correction you have

860
00:38:05,109 --> 00:38:02,480
an X accessing Mars best yes we use the

861
00:38:08,859 --> 00:38:05,119
Doppler shift and to be correct all the

862
00:38:10,660 --> 00:38:08,869
lines for the Doppler shift so which

863
00:38:15,579 --> 00:38:10,670

direction is a red shifted or blue

864
00:38:19,779 --> 00:38:15,589
shifted oh not fair nice minus 15

865
00:38:22,020 --> 00:38:19,789
kilometer for this that's based on

866
00:38:23,940 --> 00:38:22,030
comparison with the rest frequencies

867
00:38:27,390 --> 00:38:23,950
for non lines such as water vapor in

868
00:38:30,150 --> 00:38:27,400
soil did you look at all at the

869
00:38:32,430 --> 00:38:30,160
hydrocarbon variance with latitude like

870
00:38:38,460 --> 00:38:32,440
you did with water and no I feel sorry

871
00:38:45,810 --> 00:38:38,470
for water notes it's angled ok any

872
00:38:51,510 --> 00:38:45,820
questions the remote sites okay thank

873
00:38:54,630 --> 00:38:51,520
you very much our next speaker is Lily

874
00:38:56,460 --> 00:38:54,640
rains student at Eckerd College she's

875
00:38:59,130 --> 00:38:56,470
working here this summer with marla more

876
00:39:01,590 --> 00:38:59,140
on issues related to the carbon

877
00:39:06,180 --> 00:39:01,600
structure chemistry and spectroscopy of

878
00:39:08,160 --> 00:39:06,190
frozen methane good afternoon my name is

879
00:39:09,870 --> 00:39:08,170
Lily rains and as dr. rumah said I

880
00:39:13,260 --> 00:39:09,880
studied the structure chemistry and

881
00:39:15,000 --> 00:39:13,270
spectroscopy of frozen epic one of the

882
00:39:16,710 --> 00:39:15,010
reasons that FN is so interesting is

883
00:39:19,800 --> 00:39:16,720
because it is found in a wide variety of

884
00:39:21,540 --> 00:39:19,810
solar bodies in the solar system it's

885
00:39:23,550 --> 00:39:21,550
been found on titan and on many transit

886
00:39:25,980 --> 00:39:23,560
union objects for examples with under

887
00:39:28,170 --> 00:39:25,990
Oort cloud comets count ukitake which is

888
00:39:32,100 --> 00:39:28,180

shown here on the right on Pluto lower

889
00:39:34,440 --> 00:39:32,110
and 2005 FY men I spectrum from 2005 at

890
00:39:36,300 --> 00:39:34,450
19 take it in the near-ir that shows the

891
00:39:38,880 --> 00:39:36,310
presence of ethane is shown here these

892
00:39:39,960 --> 00:39:38,890
three peaks are distinctive of ethane in

893
00:39:42,240 --> 00:39:39,970
addition ethane form from the

894
00:39:43,740 --> 00:39:42,250
irradiation of methane which is abundant

895
00:39:45,870 --> 00:39:43,750
throughout the solar system therefore

896
00:39:48,690 --> 00:39:45,880
it's reasonable to believe that we could

897
00:39:50,460 --> 00:39:48,700
potentially detect methane in where any

898
00:39:52,980 --> 00:39:50,470
location where you can find methane as

899
00:39:54,600 --> 00:39:52,990
opposed to radiation in addition most a

900
00:39:56,610 --> 00:39:54,610
values that are currently used to relate

901
00:39:58,350 --> 00:39:56,620
peak intensity to the number of

902
00:40:00,000 --> 00:39:58,360
molecules in a given set for ethane are

903
00:40:01,800 --> 00:40:00,010
based on crystal and ethane only and

904
00:40:05,310 --> 00:40:01,810
there have been very few investigation

905
00:40:06,270 --> 00:40:05,320
to Athens behavior in the near-ir this

906
00:40:08,550 --> 00:40:06,280
data would be particularly useful

907
00:40:11,490 --> 00:40:08,560
because the near-ir generally does not

908
00:40:13,980 --> 00:40:11,500
suffer as much interference from Earth's

909
00:40:15,330 --> 00:40:13,990
atmosphere and therefore her face

910
00:40:18,950 --> 00:40:15,340
observatories can use this data to

911
00:40:21,390 --> 00:40:18,960
ethane and other bodies we studied the

912
00:40:23,790 --> 00:40:21,400
properties of ethane under changing

913
00:40:25,410 --> 00:40:23,800

temperatures and radiation doses this

914
00:40:27,720 --> 00:40:25,420
summer we did this by forming ice

915
00:40:29,490 --> 00:40:27,730
samples by condensing gases on to a

916
00:40:32,100 --> 00:40:29,500
small substrate that was cool to the

917
00:40:33,630 --> 00:40:32,110
desired temperature as seen here we

918
00:40:35,579 --> 00:40:33,640
typically deposited our ethane ices

919
00:40:37,650 --> 00:40:35,589
around 10 to 60 Calvin

920
00:40:39,870 --> 00:40:37,660
and we took ir spectra periodically

921
00:40:41,099 --> 00:40:39,880
during our ice formation and while

922
00:40:43,410 --> 00:40:41,109
changing the temperature and radiation

923
00:40:45,599 --> 00:40:43,420
dose our radiation was in the form of

924
00:40:47,969 --> 00:40:45,609
accelerated protons generated by a Van

925
00:40:50,359 --> 00:40:47,979
de Graaff accelerated shown below is a

926
00:40:52,109 --> 00:40:50,369
typical spectrum of amorphous effing

927
00:40:54,989 --> 00:40:52,119
highlighted are the regions in the

928
00:40:56,849 --> 00:40:54,999
near-ir from about 4,500 to 4,000

929
00:40:58,249 --> 00:40:56,859
reciprocal centimeters these bands are

930
00:41:01,620 --> 00:40:58,259
very weak but they're very distinctive

931
00:41:03,559 --> 00:41:01,630
mention here are the peaks and 1460

932
00:41:06,509 --> 00:41:03,569
reciprocal centimeters in the mid I are

933
00:41:08,519 --> 00:41:06,519
the peaks of the mid-ir were much more

934
00:41:10,529 --> 00:41:08,529
cleanly separated and much stronger than

935
00:41:11,940 --> 00:41:10,539
those in the near hair because these

936
00:41:14,880 --> 00:41:11,950
peaks were clear we were able to

937
00:41:19,049 --> 00:41:14,890
determine a values for metastable and

938
00:41:21,180 --> 00:41:19,059

amorphous ethane ices a values in this

939
00:41:24,299 --> 00:41:21,190
case refers to a way to relate peak

940
00:41:26,339 --> 00:41:24,309
intensity to the thickness of a sample

941
00:41:28,499 --> 00:41:26,349
or the number of molecules present to

942
00:41:29,999 --> 00:41:28,509
this we measured how band area increased

943
00:41:32,880 --> 00:41:30,009
with the increase in thickness of a nice

944
00:41:35,640 --> 00:41:32,890
and this data is shown here with band

945
00:41:36,930 --> 00:41:35,650
area across relative thickness for four

946
00:41:39,150 --> 00:41:36,940
different bands and metastable I think

947
00:41:40,739 --> 00:41:39,160
and these values are shown here these

948
00:41:44,729 --> 00:41:40,749
same calculations were done for amores I

949
00:41:47,309 --> 00:41:44,739
think as well the peaks in the mid I are

950
00:41:49,529 --> 00:41:47,319
around 1460 reciprocal centimeters are

951
00:41:50,789 --> 00:41:49,539
also interesting because they are the

952
00:41:52,259 --> 00:41:50,799
most distinct between the three

953
00:41:54,299 --> 00:41:52,269
different phases of ethane we studied

954
00:41:56,130 --> 00:41:54,309
the summer as you can see in here we

955
00:41:59,009 --> 00:41:56,140
have an amorphous ice and metastable ice

956
00:42:02,910 --> 00:41:59,019
and a crystal and ice all being stable

957
00:42:04,650 --> 00:42:02,920
at 14 Kelvin so here are spectra of

958
00:42:06,779 --> 00:42:04,660
ethane in the near-ir again for these

959
00:42:08,609 --> 00:42:06,789
three different phases unlike in the mid

960
00:42:10,440 --> 00:42:08,619
I are these Peaks are very similar

961
00:42:13,009 --> 00:42:10,450
across the same through phases except

962
00:42:14,969 --> 00:42:13,019
for this one around 2.5 microns or

963
00:42:17,130 --> 00:42:14,979

approximately 4,000 reciprocal

964
00:42:20,099 --> 00:42:17,140
centimeters this is the only really wit

965
00:42:23,339 --> 00:42:20,109
accurate way to tell very in the near-ir

966
00:42:26,430 --> 00:42:23,349
b phase of anything eyes shown here is

967
00:42:28,559 --> 00:42:26,440
one of our amorphous ice spectra

968
00:42:30,630 --> 00:42:28,569
overlaid with the special from 2005 FY 9

969
00:42:32,670 --> 00:42:30,640
shown earlier as you can see these three

970
00:42:35,519 --> 00:42:32,680
peaks do correlate with these seen in FY

971
00:42:39,690 --> 00:42:35,529
9 however the peak that identifies the

972
00:42:41,400 --> 00:42:39,700
phase is not shown so future earth-based

973
00:42:43,349 --> 00:42:41,410
observations if they include this week

974
00:42:47,219 --> 00:42:43,359
we could potentially determine the phase

975
00:42:48,599 --> 00:42:47,229
of ethane present on body these three

976
00:42:49,040 --> 00:42:48,609
different phases of methane are formed

977
00:42:50,740 --> 00:42:49,050
by two

978
00:42:53,120 --> 00:42:50,750
ethane ices at different temperatures

979
00:42:54,980 --> 00:42:53,130
amorphous ice is formed between 10 to 25

980
00:42:57,650 --> 00:42:54,990
Kelvin metastable ice is formed between

981
00:43:00,140 --> 00:42:57,660
25 to 50 Kelvin and krissalyn ice is

982
00:43:01,670 --> 00:43:00,150
formed between 50 to 60 other metastable

983
00:43:03,350 --> 00:43:01,680
Isis are particularly interesting

984
00:43:05,480 --> 00:43:03,360
because this is the temperature range

985
00:43:07,760 --> 00:43:05,490
that most transient feeney objects

986
00:43:10,970 --> 00:43:07,770
similar to Pluto exist at these are

987
00:43:12,920 --> 00:43:10,980
typically between and they're about or

988
00:43:14,830 --> 00:43:12,930

less than 40 Kelvin so we would expect

989
00:43:18,590 --> 00:43:14,840
to see metastable Isis on these bodies

990
00:43:20,210 --> 00:43:18,600
shown here this demonstrates the thermal

991
00:43:22,160 --> 00:43:20,220
properties of these Isis they will

992
00:43:23,330 --> 00:43:22,170
retain their structure when cool however

993
00:43:26,330 --> 00:43:23,340
when they're heated they will become

994
00:43:28,270 --> 00:43:26,340
crystalyn irreversible shown here on

995
00:43:32,090 --> 00:43:28,280
Spector a3 is the same sample of ice

996
00:43:34,130 --> 00:43:32,100
deposited 50k go down to 14 rewarmed

997
00:43:35,840 --> 00:43:34,140
remains metastable however as soon as

998
00:43:39,050 --> 00:43:35,850
it's heated to 65 k and then cooled back

999
00:43:40,580 --> 00:43:39,060
down will remain crystal in contrast

1000
00:43:42,950 --> 00:43:40,590
when these Isis are exposed to radiation

1001
00:43:44,240 --> 00:43:42,960
they have a tendency to become amorphous

1002
00:43:47,270 --> 00:43:44,250
and to produce many different

1003
00:43:49,370 --> 00:43:47,280
hydrocarbons as radiation products shown

1004
00:43:51,970 --> 00:43:49,380
here is a sample that was exposed to

1005
00:43:57,020 --> 00:43:51,980
about 10 electron volts per molecule of

1006
00:43:59,320 --> 00:43:57,030
accelerator pigeons in conclusion this

1007
00:44:01,400 --> 00:43:59,330
research we did over the summer

1008
00:44:03,080 --> 00:44:01,410
determines that the differences between

1009
00:44:05,240 --> 00:44:03,090
amorphous metastable and crystal and

1010
00:44:07,490 --> 00:44:05,250
Isis and ir spectra both in the near and

1011
00:44:11,060 --> 00:44:07,500
mid I are significant and potentially

1012
00:44:13,070 --> 00:44:11,070
useful for base observatories and Isis

1013
00:44:14,420 --> 00:44:13,080

will retain their structure when they

1014
00:44:16,010 --> 00:44:14,430
are cooled however they will become

1015
00:44:18,500 --> 00:44:16,020
crystal and heated to a sufficient

1016
00:44:21,770 --> 00:44:18,510
temperature but these same Isis will

1017
00:44:23,300 --> 00:44:21,780
become amorphous when irradiated that

1018
00:44:24,620 --> 00:44:23,310
are improved understanding that they may

1019
00:44:26,200 --> 00:44:24,630
contribute to future searches for

1020
00:44:28,820 --> 00:44:26,210
hydrocarbons in the outer solar system

1021
00:44:31,700 --> 00:44:28,830
particularly meth missions similar to

1022
00:44:34,430 --> 00:44:31,710
the New Horizons mission to / vixen

1023
00:44:36,440 --> 00:44:34,440
obtains better data I'd like to thank

1024
00:44:38,780 --> 00:44:36,450
dr. Marla morgue dr. Reggie Hudson and

1025
00:44:41,480 --> 00:44:38,790
dr. Jean Peters for all their help this

1026
00:44:42,920 --> 00:44:41,490
summer Steve Brown Tom Ward and Eugene

1027
00:44:45,140 --> 00:44:42,930
Jerry Shengo for the operation of the

1028
00:44:46,700 --> 00:44:45,150
vandegraaff proton accelerator career in

1029
00:44:48,170 --> 00:44:46,710
heavy and nasa for this great

1030
00:44:54,420 --> 00:44:48,180
opportunity and I like to thank you all

1031
00:44:59,380 --> 00:44:56,770
all right I think we take questions from

1032
00:45:03,070 --> 00:44:59,390
the remote sites first anybody out there

1033
00:45:05,580 --> 00:45:03,080
want to yes I was wondering what the

1034
00:45:09,100 --> 00:45:05,590
measure of significance was for spectra

1035
00:45:10,990 --> 00:45:09,110
is it is it qualitative where they look

1036
00:45:14,170 --> 00:45:11,000
different as we saw or is there is there

1037
00:45:17,710 --> 00:45:14,180
a quantitative way to say that two

1038
00:45:19,030 --> 00:45:17,720

spectra significantly different well

1039
00:45:21,370 --> 00:45:19,040
mostly relied on quantitative

1040
00:45:23,410 --> 00:45:21,380
differences because as you can see

1041
00:45:24,910 --> 00:45:23,420
around the page around 14 16 reciprocal

1042
00:45:26,470 --> 00:45:24,920
centimeters it's very distinct you can

1043
00:45:28,930 --> 00:45:26,480
very clearly quantitate if we tell the

1044
00:45:31,510 --> 00:45:28,940
phase of the ethane however we also did

1045
00:45:33,040 --> 00:45:31,520
measure band areas and we figured out

1046
00:45:35,500 --> 00:45:33,050
the relative intensities between these

1047
00:45:42,160 --> 00:45:35,510
peeps so we can have a good idea what

1048
00:45:46,870 --> 00:45:42,170
phase that thing is it thank you around

1049
00:45:49,390 --> 00:45:46,880
the room here anyone I wanted to ask you

1050
00:45:50,950 --> 00:45:49,400
about your your comparison of your

1051
00:45:53,430 --> 00:45:50,960
laboratory spectrum of the three eyes

1052
00:45:57,640 --> 00:45:53,440
phases you have read spectrum with the

1053
00:45:59,470 --> 00:45:57,650
spectrum of the remote I guess it was

1054
00:46:03,370 --> 00:45:59,480
detached object in the Kuiper disk

1055
00:46:05,110 --> 00:46:03,380
heartless yeah you indicated that the

1056
00:46:08,680 --> 00:46:05,120
amorphous signals that would identify

1057
00:46:10,090 --> 00:46:08,690
amorphous ice was not seen and it wasn't

1058
00:46:13,000 --> 00:46:10,100
clear to me whether you meant it hadn't

1059
00:46:16,840 --> 00:46:13,010
been tested or was tested and wasn't

1060
00:46:18,250 --> 00:46:16,850
there well we're not sure from reading

1061
00:46:19,690 --> 00:46:18,260
this paper it's it's hard to tell if

1062
00:46:22,000 --> 00:46:19,700
they did take the observation after that

1063
00:46:23,980 --> 00:46:22,010

wavelength or not yeah so you know let's

1064
00:46:27,490 --> 00:46:23,990
clearly suggests the future work is

1065
00:46:29,470 --> 00:46:27,500
needed yeah very good very much I do

1066
00:46:31,840 --> 00:46:29,480
have one question to you have the

1067
00:46:33,190 --> 00:46:31,850
amorphous de meta stable and the crystal

1068
00:46:34,780 --> 00:46:33,200
and ice and you showed that with the

1069
00:46:36,610 --> 00:46:34,790
metastable when you went to higher

1070
00:46:38,590 --> 00:46:36,620
temperatures you get to crystal and came

1071
00:46:40,300 --> 00:46:38,600
back does the amorphous go to the

1072
00:46:41,770 --> 00:46:40,310
metastable or does it go straight to the

1073
00:46:43,030 --> 00:46:41,780
Christmas no actually the amorphous goes

1074
00:46:44,620 --> 00:46:43,040
to the crystal and it goes at a

1075
00:46:47,290 --> 00:46:44,630
temperature much lower than metastable

1076
00:46:49,480 --> 00:46:47,300
ice requires okay so you can only form

1077
00:46:54,040 --> 00:46:49,490
the metastable ice if the item Solomon

1078
00:46:57,370 --> 00:46:54,050
temperature okay all right thank you

1079
00:47:01,730 --> 00:46:57,380
very much ah next we're going to go

1080
00:47:03,859 --> 00:47:01,740
outside the solar system virtually and

1081
00:47:05,480 --> 00:47:03,869
listen to Kaman todorov who has been

1082
00:47:06,920 --> 00:47:05,490
working with Greg gunning came as a

1083
00:47:09,260 --> 00:47:06,930
student at Connecticut College and will

1084
00:47:11,630 --> 00:47:09,270
talk to us about the atmosphere of a

1085
00:47:15,410 --> 00:47:11,640
recently discovered the actual planet is

1086
00:47:17,990 --> 00:47:15,420
medically spitzer um hello my name is

1087
00:47:21,100 --> 00:47:18,000
calvin toed roof on and recirculate gem

1088
00:47:24,740 --> 00:47:21,110

ink on this summer I are working on

1089
00:47:26,690 --> 00:47:24,750
observations from Iraq tell instrument

1090
00:47:29,960 --> 00:47:26,700
on board of the specie space telescope

1091
00:47:32,750 --> 00:47:29,970
and we looked at secondary transit of X

1092
00:47:35,090 --> 00:47:32,760
product at B 1 B which the transducer

1093
00:47:38,420 --> 00:47:35,100
then we did that to study its atmosphere

1094
00:47:41,330 --> 00:47:38,430
um first why do we want to study exit

1095
00:47:45,260 --> 00:47:41,340
planning on studying exoplanets houses

1096
00:47:47,660 --> 00:47:45,270
on a lot about formation and evolution

1097
00:47:51,230 --> 00:47:47,670
of planetary systems in general not only

1098
00:47:53,000 --> 00:47:51,240
based on our solar system we also

1099
00:47:56,920 --> 00:47:53,010
developed the kinks that would allow us

1100
00:47:59,060 --> 00:47:56,930
to study much smaller exit finance when

1101
00:48:03,920 --> 00:47:59,070
observations that are available with

1102
00:48:06,950 --> 00:48:03,930
more sensitive telescopes um so far arm

1103
00:48:09,859 --> 00:48:06,960
what we know about have one is that it's

1104
00:48:13,940 --> 00:48:09,869
transiting exoplanet that which means

1105
00:48:17,630 --> 00:48:13,950
that eclipses it's our star um and it

1106
00:48:19,970 --> 00:48:17,640
orbits ag0 main sequence board the

1107
00:48:22,040 --> 00:48:19,980
distance to earth is happy for the

1108
00:48:24,349 --> 00:48:22,050
parasite come there's four and a half

1109
00:48:28,040 --> 00:48:24,359
day orbital period the semi-major axis

1110
00:48:31,310 --> 00:48:28,050
is five percent that occurs it's about

1111
00:48:32,660 --> 00:48:31,320
half the size of Jupiter will have the

1112
00:48:36,170 --> 00:48:32,670
mass of Jupiter and a bit bigger than

1113
00:48:39,170 --> 00:48:36,180

attributed in terms of radius and all

1114
00:48:41,390 --> 00:48:39,180
these were determined by back rush from

1115
00:48:43,970 --> 00:48:41,400
however they discovered the final and

1116
00:48:45,580 --> 00:48:43,980
then they were improved later but we

1117
00:48:48,740 --> 00:48:45,590
don't know anything about that

1118
00:48:51,859 --> 00:48:48,750
misleading properties of this planet so

1119
00:48:53,570 --> 00:48:51,869
we want to know more about them so we

1120
00:48:55,820 --> 00:48:53,580
looked at the secondary transit home

1121
00:48:58,160 --> 00:48:55,830
which is the time when the planet is

1122
00:49:00,290 --> 00:48:58,170
behind the star at this time we can

1123
00:49:04,210 --> 00:49:00,300
notice the small job brightness in the

1124
00:49:07,130 --> 00:49:04,220
infrared whether part because lose the

1125
00:49:10,490 --> 00:49:07,140
blackbody flux from our the palette

1126
00:49:11,990 --> 00:49:10,500
itself are we can detect these forests

1127
00:49:13,250 --> 00:49:12,000
with the species Spitzer Space Telescope

1128
00:49:17,120 --> 00:49:13,260
which

1129
00:49:20,050 --> 00:49:17,130
telescope and what we do is we perform

1130
00:49:22,670 --> 00:49:20,060
series observations over about six hours

1131
00:49:24,170 --> 00:49:22,680
we measure the brightness in it and the

1132
00:49:27,500 --> 00:49:24,180
product versus time which give us a

1133
00:49:31,640 --> 00:49:27,510
light curve um this is a sample of our

1134
00:49:36,590 --> 00:49:31,650
datum find it be the smaller at one of

1135
00:49:39,170 --> 00:49:36,600
the two is the Hat one planet um and

1136
00:49:45,260 --> 00:49:39,180
this is a zoomed view and this is ours

1137
00:49:47,780 --> 00:49:45,270
planet o our star and planet establish

1138
00:49:50,210 --> 00:49:47,790

images of what so the first thing we did

1139
00:49:54,770 --> 00:49:50,220
was to clean up the cosmic rays which

1140
00:49:58,070 --> 00:49:54,780
are faint bright pixels in the white

1141
00:50:03,100 --> 00:49:58,080
circles then we integrated the pixels

1142
00:50:06,200 --> 00:50:03,110
around the aperture box of the star and

1143
00:50:09,340 --> 00:50:06,210
that gave us a measure of the brightness

1144
00:50:12,170 --> 00:50:09,350
of the stars of normal and then we used

1145
00:50:13,670 --> 00:50:12,180
fairly conventional methods of

1146
00:50:16,610 --> 00:50:13,680
determining the background levels

1147
00:50:22,840 --> 00:50:16,620
removing them other instrument effects

1148
00:50:26,150 --> 00:50:22,850
um our error analysis was based on a

1149
00:50:28,730 --> 00:50:26,160
bootstrap Montek our simulations which

1150
00:50:30,860 --> 00:50:28,740
is a well-established method and in

1151
00:50:36,230 --> 00:50:30,870
cases when this the exact distribution

1152
00:50:40,130 --> 00:50:36,240
of the points is not known so basically

1153
00:50:43,130 --> 00:50:40,140
what we do is we take our dataset we fit

1154
00:50:45,620 --> 00:50:43,140
our model best fit model in it and then

1155
00:50:49,130 --> 00:50:45,630
we take the differences represented by

1156
00:50:52,370 --> 00:50:49,140
the red to say it wine and then we just

1157
00:50:56,090 --> 00:50:52,380
mix them around in time and then we add

1158
00:50:58,220 --> 00:50:56,100
them back to arm to the best fit model

1159
00:51:02,260 --> 00:50:58,230
with this gives us a new simulated data

1160
00:51:05,450 --> 00:51:02,270
set which we can later armed with

1161
00:51:08,810 --> 00:51:05,460
another model to it and then measure the

1162
00:51:12,140 --> 00:51:08,820
eclipse again we repeat that about 1,000

1163
00:51:14,890 --> 00:51:12,150

or 2,000 times and take the standard

1164
00:51:20,330 --> 00:51:14,900
deviation of the simulated Eclipse depth

1165
00:51:24,900 --> 00:51:20,340
to be our standard deviation and this is

1166
00:51:28,320 --> 00:51:24,910
my result um so the iraq is too

1167
00:51:33,240 --> 00:51:28,330
has four wavelengths and I analyzed all

1168
00:51:37,350 --> 00:51:33,250
four wavelengths that a 5m r 5.8 4.5 and

1169
00:51:40,260 --> 00:51:37,360
3.6 the data is bin so each point

1170
00:51:44,160 --> 00:51:40,270
represents 20 our actual data point and

1171
00:51:47,850 --> 00:51:44,170
this is a lot of time essentially versus

1172
00:51:50,250 --> 00:51:47,860
relative brightness and as you can see

1173
00:51:53,850 --> 00:51:50,260
we get different Eclipse depths of

1174
00:51:57,060 --> 00:51:53,860
different wavelengths but this is

1175
00:51:58,670 --> 00:51:57,070
significant because as you can see from

1176
00:52:02,640 --> 00:51:58,680
this plot which is basically wavelength

1177
00:52:06,600 --> 00:52:02,650
versus the clip step on that this is

1178
00:52:09,300 --> 00:52:06,610
essentially a broadband very low

1179
00:52:13,790 --> 00:52:09,310
resolution spectrum of the atmosphere of

1180
00:52:16,530 --> 00:52:13,800
the planet because the clips depth is

1181
00:52:20,640 --> 00:52:16,540
essentially a measure of how bright is

1182
00:52:24,270 --> 00:52:20,650
the exit planet um these points are

1183
00:52:28,140 --> 00:52:24,280
actually a another planet HD 294 58

1184
00:52:29,940 --> 00:52:28,150
which is very similar to hot one except

1185
00:52:33,570 --> 00:52:29,950
it's actually a bit closer towards its

1186
00:52:37,770 --> 00:52:33,580
star this was analyzed earlier this year

1187
00:52:44,100 --> 00:52:37,780
by Heather Krypton so what they did was

1188
00:52:46,590 --> 00:52:44,110

they fitted a model of of the spectrum

1189
00:52:50,580 --> 00:52:46,600
these inspection models the red spectrum

1190
00:52:52,200 --> 00:52:50,590
is a arm expect is a model in which the

1191
00:52:55,830 --> 00:52:52,210
atmosphere doesn't have a temperature

1192
00:52:59,310 --> 00:52:55,840
english meaning that the lower layers of

1193
00:53:01,920 --> 00:52:59,320
the atmosphere are hotter than the upper

1194
00:53:04,620 --> 00:53:01,930
layers and as you see this model doesn't

1195
00:53:06,270 --> 00:53:04,630
fit very well are however the model

1196
00:53:08,160 --> 00:53:06,280
which includes a temperature inversion

1197
00:53:11,310 --> 00:53:08,170
meaning them the upper atmosphere is

1198
00:53:16,860 --> 00:53:11,320
much hotter than the lower arm it's a

1199
00:53:22,380 --> 00:53:16,870
bit better and hot one has similar

1200
00:53:25,800 --> 00:53:22,390
structure to it some similar structure

1201
00:53:28,080 --> 00:53:25,810
of its spectrum and this plot just shows

1202
00:53:31,770 --> 00:53:28,090
what would happen if we brought half on

1203
00:53:33,570 --> 00:53:31,780
a bit closer to its star and you can see

1204
00:53:37,110 --> 00:53:33,580
that it's actually very similar and both

1205
00:53:39,300 --> 00:53:37,120
within error bars to hd2 1458 so this

1206
00:53:41,570 --> 00:53:39,310
implies that hat one also has a

1207
00:53:46,290 --> 00:53:41,580
temperature inversion in the atmosphere

1208
00:53:52,200 --> 00:53:46,300
thank you i won't think dr. Demming dr.

1209
00:53:55,440 --> 00:53:52,210
Harrington from ucf forearm taking the

1210
00:53:58,500 --> 00:53:55,450
data to dr. moment after call Abby and

1211
00:54:10,170 --> 00:53:58,510
las demas interest on anyone has any

1212
00:54:13,760 --> 00:54:10,180
questions george'll I'm first I just I'm

1213
00:54:16,620 --> 00:54:13,770

curious about the bootstrap simulation I

1214
00:54:18,690 --> 00:54:16,630
was code for that something that that

1215
00:54:21,090 --> 00:54:18,700
you came up with or which program will

1216
00:54:24,120 --> 00:54:21,100
cover to package the jeans i wrote the

1217
00:54:29,250 --> 00:54:24,130
code um involve analysis thought his

1218
00:54:35,820 --> 00:54:29,260
little baby almost all real except for

1219
00:54:42,990 --> 00:54:35,830
students here at her injury which I

1220
00:54:50,880 --> 00:54:45,240
okay how about around around anybody

1221
00:54:54,420 --> 00:54:50,890
here want to pitch in wait we can't let

1222
00:54:57,980 --> 00:54:54,430
get off this worried about what's ideal

1223
00:55:01,530 --> 00:54:57,990
what's it stand for um idea is

1224
00:55:06,660 --> 00:55:01,540
interactive data language I think it's

1225
00:55:08,460 --> 00:55:06,670
see it's essentially programming

1226
00:55:12,560 --> 00:55:08,470
language that allows you to do real-time

1227
00:55:14,670 --> 00:55:12,570
analysis as well as write scripts for it

1228
00:55:17,520 --> 00:55:14,680
which basically means that you can type

1229
00:55:19,230 --> 00:55:17,530
commands and analyze it but just I can

1230
00:55:22,050 --> 00:55:19,240
command or you could write a script and

1231
00:55:26,490 --> 00:55:22,060
just run the soup and how did you do

1232
00:55:29,400 --> 00:55:26,500
things for you you've got a planet that

1233
00:55:32,340 --> 00:55:29,410
is substantially larger than Jupiter but

1234
00:55:34,680 --> 00:55:32,350
it's about half the mass and said yes

1235
00:55:38,010 --> 00:55:34,690
it's very close to the star so it's much

1236
00:55:41,160 --> 00:55:38,020
hotter yes and this makes positive that

1237
00:55:43,920 --> 00:55:41,170
makes be there because especially they

1238
00:55:46,590 --> 00:55:43,930

don't know yeah thermal expansion this

1239
00:55:50,670 --> 00:55:46,600
entry the largest deviation was a long

1240
00:55:52,890 --> 00:55:50,680
wavelengths in both cases why I've been

1241
00:55:54,720 --> 00:55:52,900
nice as biggest in the well but they

1242
00:55:56,370 --> 00:55:54,730
were consistently low I mean your models

1243
00:55:58,320 --> 00:55:56,380
basically went nicely up they were

1244
00:56:01,710 --> 00:55:58,330
relatively flat none of them had a bend

1245
00:56:06,210 --> 00:56:01,720
in them oh the three points are you know

1246
00:56:07,950 --> 00:56:06,220
well this is the best model that the

1247
00:56:12,020 --> 00:56:07,960
people from Harvard came up with this is

1248
00:56:16,440 --> 00:56:12,030
this a lot of room for improvement yes

1249
00:56:18,570 --> 00:56:16,450
okay but methane is which has a band

1250
00:56:21,470 --> 00:56:18,580
that that eight micron band was not the

1251
00:56:25,770 --> 00:56:21,480
answer now did they include methane in

1252
00:56:27,150 --> 00:56:25,780
boxers the obviously screwed up or

1253
00:56:30,560 --> 00:56:27,160
something you need but something's

1254
00:56:36,420 --> 00:56:30,570
different always believe the data right

1255
00:56:39,000 --> 00:56:36,430
yeah there's a sea together yeah point

1256
00:56:39,430 --> 00:56:39,010
my friend there's a strong water man so

1257
00:56:42,550 --> 00:56:39,440
maybe

1258
00:56:48,069 --> 00:56:42,560
that good little fire yo even more

1259
00:56:51,160 --> 00:56:48,079
elevated that small can I think gang I

1260
00:56:54,760 --> 00:56:51,170
had a question or comment no okay anyone

1261
00:56:57,609 --> 00:56:54,770
else okay that concludes our formal

1262
00:56:59,500 --> 00:56:57,619
talks but I first want to always sign

1263
00:57:02,620 --> 00:56:59,510

off here and thank everyone for

1264
00:57:05,920 --> 00:57:02,630
participating listening I would like to

1265
00:57:08,829 --> 00:57:05,930
give special recognition to the six

1266
00:57:12,370 --> 00:57:08,839
mentors who worked with these young

1267
00:57:15,730 --> 00:57:12,380
people today drink summer and as you can

1268
00:57:18,160 --> 00:57:15,740
see the result has extremely good for

1269
00:57:23,710 --> 00:57:18,170
everyone concerned anything I'd like to

1270
00:57:26,829 --> 00:57:23,720
give a hand to the mentors himself last

1271
00:57:29,380 --> 00:57:26,839
perhaps most significant I wish to draw

1272
00:57:33,040 --> 00:57:29,390
a special credit to give special credit

1273
00:57:41,109 --> 00:57:33,050
to Corey eb it was about this zoom in on

1274
00:57:43,690 --> 00:57:41,119
herself has really done a standing job

1275
00:57:46,180 --> 00:57:43,700
in you know shepherding everyone and

1276
00:57:53,819 --> 00:57:46,190
indeed throughout the summer and making

1277
00:57:58,089 --> 00:57:56,380
unfortunately the folks on both sides

1278
00:58:00,730 --> 00:57:58,099
don't get to share in the goodies that

1279
00:58:03,069 --> 00:58:00,740
we've laid out other side of room here

1280
00:58:07,359 --> 00:58:03,079
but we hope you'll have a snack where

1281
00:58:09,190 --> 00:58:07,369
you wherever you are we're about to go

1282
00:58:11,380 --> 00:58:09,200
up I just wanted to say real quickly

1283
00:58:14,980 --> 00:58:11,390
that as always all the students were

1284
00:58:17,500 --> 00:58:14,990
excellent very good presentations very

1285
00:58:19,120 --> 00:58:17,510
articulately given and I want to say

1286
00:58:22,150 --> 00:58:19,130
thank you for all your time and Corey

1287
00:58:24,280 --> 00:58:22,160
and Marco the talent behind the curtain

1288
00:58:27,370 --> 00:58:24,290

thanks for all their good work I missed

1289
00:58:31,690 --> 00:58:27,380
as well and these will be posted on the

1290
00:58:33,370 --> 00:58:31,700
NI website in a couple days so you can

1291
00:58:37,359 --> 00:58:33,380
view lease over again with the slides

1292
00:58:40,150 --> 00:58:37,369
and the video good we had one question

1293
00:58:42,309 --> 00:58:40,160
about that before we started today when

1294
00:58:44,439 --> 00:58:42,319
one of the students I won't mention who

1295
00:58:47,349 --> 00:58:44,449
she wanted to send it to her mom or

1296
00:58:52,469 --> 00:58:47,359
something can you look at it 40 times to

1297
00:58:55,299 --> 00:58:52,479
see if not to improve okay thanks a lot