



AbSciCon  
2019

The logo is a circular emblem with a green border. Inside the circle, there is a stylized landscape with green trees at the bottom, blue mountains in the middle, and a white satellite dish or antenna structure in the background. A dark blue satellite orbit with a white dot at the top and bottom crosses the circle diagonally. The text 'AbSciCon' is written in a black, sans-serif font across the top half of the circle, and '2019' is written in a larger, bold, black, sans-serif font across the bottom half. Small white stars and circles are scattered around the perimeter of the circle.

1  
00:00:00,790 --> 00:00:07,320

[Music]

2  
00:00:11,289 --> 00:00:09,240

[Applause]

3  
00:00:12,879 --> 00:00:11,299

all right so today I'm going to talk to

4  
00:00:15,730 --> 00:00:12,889

you about corals which is a laser

5  
00:00:17,950 --> 00:00:15,740

desorption / ablation mass spectrometer

6  
00:00:19,720 --> 00:00:17,960

if you had the opportunity to go to the

7  
00:00:22,120 --> 00:00:19,730

workshop yesterday you would have heard

8  
00:00:24,820 --> 00:00:22,130

me describe it grandly in one minute

9  
00:00:25,960 --> 00:00:24,830

using arm wavy movements but today

10  
00:00:28,960 --> 00:00:25,970

you're gonna actually see that it's a

11  
00:00:30,550 --> 00:00:28,970

it's a real instrument so I normally

12  
00:00:32,290 --> 00:00:30,560

start off when I try to talk about this

13  
00:00:34,660 --> 00:00:32,300

particular instrument concept by

14

00:00:36,040 --> 00:00:34,670

advocating for mass spectrometry but

15

00:00:38,590 --> 00:00:36,050

Peter did that for me so I don't really

16

00:00:42,280 --> 00:00:38,600

have to do that right now I will kind of

17

00:00:45,970 --> 00:00:42,290

introduce maybe the evolutionary arc of

18

00:00:48,040 --> 00:00:45,980

mass analyzers so there's our variety of

19

00:00:50,260 --> 00:00:48,050

options when you want when you know you

20

00:00:53,529 --> 00:00:50,270

want to fly a mass spectrometer of types

21

00:00:55,240 --> 00:00:53,539

of mass filters that you can fly I'm a

22

00:00:57,100 --> 00:00:55,250

product of NASA Goddard so I'm

23

00:00:59,380 --> 00:00:57,110

intimately familiar with quadrupole mass

24

00:01:02,650 --> 00:00:59,390

spectrometry which has been surveying

25

00:01:04,749 --> 00:01:02,660

the solar system since pioneer Venus but

26

00:01:06,510 --> 00:01:04,759

we have sector field instruments that

27

00:01:08,859 --> 00:01:06,520

were before then in the Apollo era

28

00:01:12,160 --> 00:01:08,869

time-of-flight instruments from Vega

29

00:01:14,350 --> 00:01:12,170

Giotto Rosetta and then most more

30

00:01:16,089 --> 00:01:14,360

recently are the Paul type ion traps

31

00:01:17,199 --> 00:01:16,099

that were flown on Rosetta and then we

32

00:01:19,029 --> 00:01:17,209

heard a little bit about the Mars

33

00:01:22,180 --> 00:01:19,039

organic molecule analyzer the moma

34

00:01:24,430 --> 00:01:22,190

instrument onboard the ExoMars Rover so

35

00:01:26,980 --> 00:01:24,440

all of these systems have been qualified

36

00:01:29,440 --> 00:01:26,990

or have successfully successfully been

37

00:01:31,410 --> 00:01:29,450

deployed to a number of planetary

38

00:01:33,699 --> 00:01:31,420

environments so they're by definition

39

00:01:35,320 --> 00:01:33,709

heritage or legacy analyzers and they

40

00:01:37,109 --> 00:01:35,330

still bring a lot to the table and

41

00:01:39,490 --> 00:01:37,119

they're viable instruments for

42

00:01:41,830 --> 00:01:39,500

progressive future mission concepts

43

00:01:43,419 --> 00:01:41,840

they're relatively low cost because once

44

00:01:45,699 --> 00:01:43,429

you've flown at once you have a heritage

45

00:01:47,760 --> 00:01:45,709

designed to pull from they're relatively

46

00:01:51,370 --> 00:01:47,770

low risk because they've been shown to

47

00:01:53,080 --> 00:01:51,380

survive launch cruise deployment and we

48

00:01:55,479 --> 00:01:53,090

know what we get from them from a

49

00:01:58,029 --> 00:01:55,489

performance perspective however since

50

00:02:00,339 --> 00:01:58,039

the Apollo era for sector field

51  
00:02:02,169 --> 00:02:00,349  
instruments for example on there's been

52  
00:02:04,120 --> 00:02:02,179  
a lot of time and a lot of investment in

53  
00:02:06,880 --> 00:02:04,130  
advancing what I'm gonna call

54  
00:02:08,979 --> 00:02:06,890  
next-generation technologies that kind

55  
00:02:11,979 --> 00:02:08,989  
of are are pushing the forefront of the

56  
00:02:14,260 --> 00:02:11,989  
field forward this is my arbitrary way

57  
00:02:17,020 --> 00:02:14,270  
of designating how those technologies

58  
00:02:19,600 --> 00:02:17,030  
might be classified there are those that

59  
00:02:21,940 --> 00:02:19,610  
maybe use heritage analyzers but add

60  
00:02:22,480 --> 00:02:21,950  
something new to them to enhance the

61  
00:02:25,690 --> 00:02:22,490  
performance

62  
00:02:27,730 --> 00:02:25,700  
to extend the mass range to increase one

63  
00:02:29,560 --> 00:02:27,740

performance metric or another but what

64

00:02:32,860 --> 00:02:29,570

I'm going to talk to you today about it

65

00:02:34,570 --> 00:02:32,870

are two key capabilities that I think we

66

00:02:36,970 --> 00:02:34,580

really need to focus in on especially in

67

00:02:39,400 --> 00:02:36,980

the astrobiology context and that's

68

00:02:41,410 --> 00:02:39,410

molecular disambiguation and when we're

69

00:02:43,690 --> 00:02:41,420

talking about a Europa Lander mission we

70

00:02:47,320 --> 00:02:43,700

need innovative sampling and ionization

71

00:02:49,630 --> 00:02:47,330

sources so here's a traditional mass

72

00:02:51,100 --> 00:02:49,640

spectrum those who have seen my

73

00:02:53,050 --> 00:02:51,110

presentations before notice I always

74

00:02:54,790 --> 00:02:53,060

seem to pick on this one but once you

75

00:02:57,430 --> 00:02:54,800

make an animation you want to kind of

76

00:02:59,710 --> 00:02:57,440

stick with it so this is a spectrum from

77

00:03:02,800 --> 00:02:59,720

one of the inbound flybys of the Cassini

78

00:03:04,420 --> 00:03:02,810

Asst this is Cassini I and M s and we

79

00:03:06,640 --> 00:03:04,430

have matched to charge ratio on the x

80

00:03:08,620 --> 00:03:06,650

axis and we have intensity on the Y and

81

00:03:11,890 --> 00:03:08,630

we see there are a bunch of features

82

00:03:14,380 --> 00:03:11,900

here and we have a good idea of what the

83

00:03:17,740 --> 00:03:14,390

primary constituents of these Peaks are

84

00:03:20,740 --> 00:03:17,750

because you know we can one way we can

85

00:03:22,900 --> 00:03:20,750

do is we can try to rebuild reproduce

86

00:03:25,690 --> 00:03:22,910

the relative abundances of these Peaks

87

00:03:27,790 --> 00:03:25,700

looking at diagnostic fragmentation

88

00:03:30,040 --> 00:03:27,800

patterns or isotopic abundances of

89

00:03:32,310 --> 00:03:30,050

plausible species underneath each of

90

00:03:35,410 --> 00:03:32,320

these some people in the room do this

91

00:03:37,090 --> 00:03:35,420

there are also you know when you're a

92

00:03:39,250 --> 00:03:37,100

spaceflight instrument usually you don't

93

00:03:41,530 --> 00:03:39,260

fly a single analytical instrument so

94

00:03:43,630 --> 00:03:41,540

you can have corroborated measurements

95

00:03:45,370 --> 00:03:43,640

from other complimentary payload

96

00:03:47,740 --> 00:03:45,380

instruments that can give you some

97

00:03:50,680 --> 00:03:47,750

insight into what these Peaks might be

98

00:03:52,900 --> 00:03:50,690

but we can't with 100% certainty say

99

00:03:55,000 --> 00:03:52,910

that there aren't at least some minor

100

00:03:58,090 --> 00:03:55,010

component of these Peaks could be a

101  
00:04:00,400 --> 00:03:58,100  
variety of molecular signatures as I

102  
00:04:02,800 --> 00:04:00,410  
said I'm kind of pushing for a laser

103  
00:04:06,070 --> 00:04:02,810  
ablation mass spectrometer so once you

104  
00:04:08,470 --> 00:04:06,080  
start adding more novel ionization

105  
00:04:10,540 --> 00:04:08,480  
sources then you start adding in organic

106  
00:04:12,850 --> 00:04:10,550  
isobaric interferences that you have to

107  
00:04:14,110 --> 00:04:12,860  
account for so the problems not going

108  
00:04:15,910 --> 00:04:14,120  
away it's actually getting a little bit

109  
00:04:18,280 --> 00:04:15,920  
more complicated with these advanced

110  
00:04:20,740 --> 00:04:18,290  
technologies so we have a bunch of ways

111  
00:04:22,780 --> 00:04:20,750  
that we can try to separate these

112  
00:04:24,430 --> 00:04:22,790  
signals that are potentially competing

113  
00:04:26,140 --> 00:04:24,440

with one another we've done this

114

00:04:27,880 --> 00:04:26,150

historically by using things like gas

115

00:04:31,330 --> 00:04:27,890

chromatography which will use the

116

00:04:32,800 --> 00:04:31,340

affinity of competing molecules their

117

00:04:34,900 --> 00:04:32,810

affinity for the stationary phase to

118

00:04:35,680 --> 00:04:34,910

separate them out through time that's

119

00:04:36,220 --> 00:04:35,690

still viable

120

00:04:39,460 --> 00:04:36,230

the

121

00:04:40,990 --> 00:04:39,470

MoMA instrument uses a kind of a neat

122

00:04:43,950 --> 00:04:41,000

little tool called tandem mass

123

00:04:46,060 --> 00:04:43,960

spectrometry and that's where you can

124

00:04:48,340 --> 00:04:46,070

this one there you go

125

00:04:50,560 --> 00:04:48,350

you can see a peak of interest you may

126

00:04:52,450 --> 00:04:50,570

not know what it is exactly but you can

127

00:04:54,760 --> 00:04:52,460

eject the peaks that you're not

128

00:04:57,100 --> 00:04:54,770

interested in focus in on this one and

129

00:04:59,110 --> 00:04:57,110

intentionally break it apart to look at

130

00:05:01,000 --> 00:04:59,120

the structure of that molecule and to

131

00:05:03,220 --> 00:05:01,010

provide confidence and what you think it

132

00:05:05,890 --> 00:05:03,230

is and what I'm going to be pushing for

133

00:05:08,980 --> 00:05:05,900

today is what's called ultra-high mass

134

00:05:10,270 --> 00:05:08,990

resolution and that's where those Peaks

135

00:05:12,040 --> 00:05:10,280

that you saw on the previous slide

136

00:05:14,170 --> 00:05:12,050

becomes so skinny

137

00:05:15,840 --> 00:05:14,180

that you can actually elucidate the

138

00:05:17,710 --> 00:05:15,850

different components that might be

139

00:05:19,930 --> 00:05:17,720

competing with them so this is a

140

00:05:22,390 --> 00:05:19,940

Murchison sample we've heard you know

141

00:05:25,360 --> 00:05:22,400

number of talks have highlighted the

142

00:05:27,010 --> 00:05:25,370

complexity of Murchison sample but it

143

00:05:29,920 --> 00:05:27,020

just shows that within what looks like a

144

00:05:32,380 --> 00:05:29,930

single peak are a multitude of Peaks so

145

00:05:35,260 --> 00:05:32,390

if you're able to tickle out that that's

146

00:05:37,600 --> 00:05:35,270

dead at complexity than it really

147

00:05:40,000 --> 00:05:37,610

provides something so paul Mahaffey gave

148

00:05:42,460 --> 00:05:40,010

another kind of visual so I'm gonna give

149

00:05:45,580 --> 00:05:42,470

a different concept he he talked about a

150

00:05:47,770 --> 00:05:45,590

monatomic isobaric interference here we

151  
00:05:49,060 --> 00:05:47,780  
have a polyatomic so we have two organic

152  
00:05:52,030 --> 00:05:49,070  
compounds since we're talking about

153  
00:05:55,960 --> 00:05:52,040  
europa and with a lot of traditional

154  
00:05:57,970 --> 00:05:55,970  
instruments two peaks two distinct

155  
00:05:59,860 --> 00:05:57,980  
organic compounds might overlap with one

156  
00:06:01,720 --> 00:05:59,870  
another but as we progress towards

157  
00:06:03,550 --> 00:06:01,730  
higher and higher resolution instruments

158  
00:06:06,160 --> 00:06:03,560  
we're able to effectively separate them

159  
00:06:10,210 --> 00:06:06,170  
out without requiring an additional sub

160  
00:06:12,490 --> 00:06:10,220  
system like a chromatography system so

161  
00:06:14,140 --> 00:06:12,500  
the type of analyzer that I'm fighting

162  
00:06:16,180 --> 00:06:14,150  
you know advocating for here is called

163  
00:06:17,860 --> 00:06:16,190

an orbit trap mass analyzer and the way

164

00:06:19,900 --> 00:06:17,870

it works is a little bit different than

165

00:06:23,110 --> 00:06:19,910

all of those heritage analyzers you have

166

00:06:25,870 --> 00:06:23,120

a source of ions and a pulse gets

167

00:06:27,760 --> 00:06:25,880

injected into this analyzer and they

168

00:06:30,310 --> 00:06:27,770

oscillate around this football-shaped

169

00:06:32,770 --> 00:06:30,320

electrode and the rate at which they

170

00:06:35,710 --> 00:06:32,780

oscillate maps to the mass-to-charge

171

00:06:38,080 --> 00:06:35,720

ratio of those species it's kind of neat

172

00:06:39,790 --> 00:06:38,090

for spaceflight not just because of the

173

00:06:42,460 --> 00:06:39,800

science products which is are these

174

00:06:45,010 --> 00:06:42,470

high-resolution mass spectra but there

175

00:06:47,130 --> 00:06:45,020

are no heavy magnets there are no RF

176

00:06:49,780 --> 00:06:47,140

supplies and there's actually no

177

00:06:50,020 --> 00:06:49,790

traditional detector assembly which is

178

00:06:51,910 --> 00:06:50,030

off

179

00:06:53,950 --> 00:06:51,920

considered a consumable for spaceflight

180

00:06:56,320 --> 00:06:53,960

applications and so you're able to start

181

00:06:58,540 --> 00:06:56,330

identifying what were previously

182

00:07:00,880 --> 00:06:58,550

isobaric species with the same nominal

183

00:07:03,040 --> 00:07:00,890

mass-to-charge ratio separating them out

184

00:07:06,070 --> 00:07:03,050

and that allows you to do you know some

185

00:07:07,570 --> 00:07:06,080

more quantitative metrics so what I want

186

00:07:10,000 --> 00:07:07,580

to do is to take that type of mass

187

00:07:13,480 --> 00:07:10,010

analyzer and integrate it with a laser

188

00:07:16,570 --> 00:07:13,490

source why a laser well there are a

189

00:07:20,440 --> 00:07:16,580

variety of reasons for it specific to

190

00:07:23,110 --> 00:07:20,450

Europa laser is access the less volatile

191

00:07:24,940 --> 00:07:23,120

the more refractory organics that may be

192

00:07:27,310 --> 00:07:24,950

embedded in the sample but they also

193

00:07:30,160 --> 00:07:27,320

allow us to break apart the inorganic

194

00:07:32,020 --> 00:07:30,170

phases so the salts and the other you

195

00:07:34,480 --> 00:07:32,030

know geological phases that may have

196

00:07:36,730 --> 00:07:34,490

been brought to the surface from ocean

197

00:07:38,860 --> 00:07:36,740

exchange can be accessed with these with

198

00:07:42,070 --> 00:07:38,870

these laser sources it doesn't require

199

00:07:43,960 --> 00:07:42,080

physical contact with the sample it

200

00:07:46,120 --> 00:07:43,970

provides spatially resolved measurements

201  
00:07:48,700 --> 00:07:46,130  
so you're limited the spatial resolution

202  
00:07:51,580 --> 00:07:48,710  
is only limited to the size of your your

203  
00:07:53,650 --> 00:07:51,590  
laser beam and a good example of some

204  
00:07:56,170 --> 00:07:53,660  
you know other benefits that it brings

205  
00:07:58,120 --> 00:07:56,180  
to the table are are highlighted by the

206  
00:08:01,090 --> 00:07:58,130  
moma instrument which will fly the first

207  
00:08:03,940 --> 00:08:01,100  
laser enabled mass spectrometry to space

208  
00:08:06,190 --> 00:08:03,950  
and so here we can see you know these

209  
00:08:07,870 --> 00:08:06,200  
are synthetic Mars analog samples but

210  
00:08:11,680 --> 00:08:07,880  
we've doped it with an organic compound

211  
00:08:13,780 --> 00:08:11,690  
and regardless of what the matrix is

212  
00:08:16,870 --> 00:08:13,790  
whether it's a single mineral of

213  
00:08:19,540 --> 00:08:16,880

basaltic matrix or a phyllosilicate we

214

00:08:23,200 --> 00:08:19,550

can also add potentially degradation

215

00:08:25,750 --> 00:08:23,210

oxidative compounds in there and what

216

00:08:27,820 --> 00:08:25,760

otherwise might be you know might have

217

00:08:30,040 --> 00:08:27,830

induced the combustion of this organic

218

00:08:32,230 --> 00:08:30,050

because the pulse-width of a laser is so

219

00:08:34,450 --> 00:08:32,240

short we don't actually thermally alter

220

00:08:36,550 --> 00:08:34,460

the sample as much as a pyrolysis

221

00:08:40,330 --> 00:08:36,560

technique and so we're able to see that

222

00:08:42,340 --> 00:08:40,340

the primary molecule on top of that

223

00:08:44,020 --> 00:08:42,350

laser processing requires orders of

224

00:08:46,780 --> 00:08:44,030

magnitude less sample than traditional

225

00:08:50,770 --> 00:08:46,790

pyrolysis techniques and if you have the

226

00:08:52,660 --> 00:08:50,780

mass and available to fly maybe I'll

227

00:08:56,410 --> 00:08:52,670

call it an overqualified laser system if

228

00:08:58,180 --> 00:08:56,420

you have a high-energy laser system more

229

00:09:00,130 --> 00:08:58,190

than you need to maybe desorb some of

230

00:09:02,530 --> 00:09:00,140

these organics that also allows you to

231

00:09:03,129 --> 00:09:02,540

do a kind of pseudo tandem mass

232

00:09:05,439 --> 00:09:03,139

spectrometry

233

00:09:07,720 --> 00:09:05,449

so you can identify your organic at a

234

00:09:09,669 --> 00:09:07,730

low fluence and if you want to derive

235

00:09:11,619 --> 00:09:09,679

some of the structure if you want to try

236

00:09:13,379 --> 00:09:11,629

to identify if it's an isomer which

237

00:09:15,879 --> 00:09:13,389

which isomer it might be you can

238

00:09:18,249 --> 00:09:15,889

inundate it with more energy than you

239

00:09:20,169 --> 00:09:18,259

need to just see it intentionally break

240

00:09:25,590 --> 00:09:20,179

it up that way and give yourself some

241

00:09:27,909 --> 00:09:25,600

pseudo tandem mass spectrum so this

242

00:09:31,359 --> 00:09:27,919

orbit trap mass analyzer there's been a

243

00:09:34,269 --> 00:09:31,369

prototype in the in an overly oil France

244

00:09:36,099 --> 00:09:34,279

operational since maybe 2012 and so I

245

00:09:38,559 --> 00:09:36,109

had the opportunity to go out there a

246

00:09:40,299 --> 00:09:38,569

little over a year ago and that kind of

247

00:09:42,309 --> 00:09:40,309

serves as the proof of concept for the

248

00:09:44,799 --> 00:09:42,319

corrals instrument so I'm gonna say when

249

00:09:46,509 --> 00:09:44,809

you need to conform to the form fit and

250

00:09:50,499 --> 00:09:46,519

function of a flight instrument it

251  
00:09:52,329 --> 00:09:50,509  
certainly met the function we're

252  
00:09:54,549 --> 00:09:52,339  
building up this is a breadboard we have

253  
00:09:55,989 --> 00:09:54,559  
in operation now at NASA Goddard only

254  
00:09:59,109 --> 00:09:55,999  
brought online within the last couple of

255  
00:10:00,789 --> 00:09:59,119  
weeks and this the inside of this

256  
00:10:02,199 --> 00:10:00,799  
instrument looks just like with the

257  
00:10:05,499 --> 00:10:02,209  
corrals instrument wheel so this meets

258  
00:10:07,869 --> 00:10:05,509  
the form and the function but with this

259  
00:10:10,419 --> 00:10:07,879  
IC to opportunity and with negotiations

260  
00:10:12,989 --> 00:10:10,429  
going on with at JPL pre project team

261  
00:10:16,329 --> 00:10:12,999  
were designing this and we will be

262  
00:10:17,979 --> 00:10:16,339  
building and qualifying the an

263  
00:10:20,039 --> 00:10:17,989

engineering test unit that meets the

264

00:10:23,079 --> 00:10:20,049

form fit and function of a flight model

265

00:10:24,850 --> 00:10:23,089

so we've we have a prototype of the

266

00:10:27,369 --> 00:10:24,860

laser operational so here's you know

267

00:10:30,039 --> 00:10:27,379

some of the performance metrics of that

268

00:10:32,289 --> 00:10:30,049

laser system it's hot again it's highly

269

00:10:33,970 --> 00:10:32,299

capable so it brings three times the

270

00:10:35,530 --> 00:10:33,980

energy per pulse that the moma laser

271

00:10:37,600 --> 00:10:35,540

does because we are interested in that

272

00:10:39,309 --> 00:10:37,610

in source decay and all of this put

273

00:10:41,369 --> 00:10:39,319

together should allow us to again

274

00:10:44,259 --> 00:10:41,379

measure the organic and the inorganic

275

00:10:48,549 --> 00:10:44,269

composition of samples delivered from

276  
00:10:49,779 --> 00:10:48,559  
the europa surface and so I just wanted

277  
00:10:51,970 --> 00:10:49,789  
to go over some of the data that we've

278  
00:10:54,159 --> 00:10:51,980  
collected recently so here's an example

279  
00:10:56,739 --> 00:10:54,169  
of a type of experiment we could run

280  
00:10:58,960 --> 00:10:56,749  
this is at the in the French laboratory

281  
00:11:00,869 --> 00:10:58,970  
so here we have magnesium sulfate salt

282  
00:11:04,359 --> 00:11:00,879  
before and after irradiation

283  
00:11:07,299 --> 00:11:04,369  
this salt was doped with an amino acid

284  
00:11:10,090 --> 00:11:07,309  
and so the power of this spectrum shows

285  
00:11:11,799 --> 00:11:10,100  
that this instrument meets our mass

286  
00:11:13,840 --> 00:11:11,809  
resolution requirements you can see our

287  
00:11:16,239 --> 00:11:13,850  
parts per million mass accuracy which is

288  
00:11:16,690 --> 00:11:16,249

also critical because that gives you the

289

00:11:19,060 --> 00:11:16,700

molecular

290

00:11:20,710 --> 00:11:19,070

soit geometry but what I really like

291

00:11:23,530 --> 00:11:20,720

about this spectrum is that it shows the

292

00:11:25,390 --> 00:11:23,540

organics the primary molecule the the

293

00:11:26,920 --> 00:11:25,400

quintessential fragment you'll find this

294

00:11:30,310 --> 00:11:26,930

on the NIST database for an e i--

295

00:11:32,110 --> 00:11:30,320

spectrum - as the dominant fragment and

296

00:11:33,610 --> 00:11:32,120

then the inorganic fraction you can even

297

00:11:35,590 --> 00:11:33,620

if you're a geologist you'll even see

298

00:11:38,830 --> 00:11:35,600

that we can get the isotopic composition

299

00:11:40,990 --> 00:11:38,840

of magnesium as well so we were curious

300

00:11:44,350 --> 00:11:41,000

you know what what are our limits of

301  
00:11:46,150 --> 00:11:44,360  
detection for example can we see organic

302  
00:11:48,370 --> 00:11:46,160  
compounds at the level that the moment

303  
00:11:50,100 --> 00:11:48,380  
instrument does which is at the one Pico

304  
00:11:51,730 --> 00:11:50,110  
mole per millimeter squared

305  
00:11:54,340 --> 00:11:51,740  
concentration level because it's a

306  
00:11:56,830 --> 00:11:54,350  
surface technique and so we kind of

307  
00:11:58,780 --> 00:11:56,840  
simulated a Europa Lander situation

308  
00:12:00,760 --> 00:11:58,790  
where we had in our case it was a

309  
00:12:03,160 --> 00:12:00,770  
solution that was allowed to dry down

310  
00:12:05,110 --> 00:12:03,170  
rather than an ice to sublimate but

311  
00:12:07,570 --> 00:12:05,120  
looking at the residue we were able to

312  
00:12:09,700 --> 00:12:07,580  
see a variety of organics this is just

313  
00:12:12,420 --> 00:12:09,710

in positive mode but we're able to see

314

00:12:14,860 --> 00:12:12,430

the molecular ions of amino acids in

315

00:12:16,300 --> 00:12:14,870

this kind of context at the Pico mole

316

00:12:17,890 --> 00:12:16,310

per millimeter square mole so highly

317

00:12:19,810 --> 00:12:17,900

sensitive and again we're able to get

318

00:12:22,930 --> 00:12:19,820

isotopic abundances we heard that that's

319

00:12:24,220 --> 00:12:22,940

maybe not the top priority of a Europa

320

00:12:27,640 --> 00:12:24,230

Lander mission but it's something that

321

00:12:29,440 --> 00:12:27,650

we're able to deliver on as well so more

322

00:12:31,650 --> 00:12:29,450

work is being done looking at the

323

00:12:33,460 --> 00:12:31,660

capabilities of these progressive

324

00:12:35,530 --> 00:12:33,470

instruments that we're building with

325

00:12:37,990 --> 00:12:35,540

progressive levels of fidelity we're

326

00:12:40,570 --> 00:12:38,000

looking at how our fragmentation

327

00:12:42,100 --> 00:12:40,580

patterns they said if you over if you

328

00:12:43,900 --> 00:12:42,110

inundate the sample with excess energy

329

00:12:45,640 --> 00:12:43,910

you can intentionally fragment so we're

330

00:12:47,410 --> 00:12:45,650

looking at correlations between our

331

00:12:49,690 --> 00:12:47,420

fragmentation patterns with a laser

332

00:12:51,880 --> 00:12:49,700

source and how they map to the

333

00:12:54,270 --> 00:12:51,890

traditional misty eye mass spectrum

334

00:12:57,310 --> 00:12:54,280

we're looking at a variety of different

335

00:12:59,260 --> 00:12:57,320

you know compositions sample matrices so

336

00:13:01,150 --> 00:12:59,270

here's a an example for Thole ins which

337

00:13:04,570 --> 00:13:01,160

is apt given the announcement just an

338

00:13:07,090 --> 00:13:04,580

hour ago looking at inorganic phases so

339

00:13:09,280 --> 00:13:07,100

here we're looking at major and minor

340

00:13:15,820 --> 00:13:09,290

elements in a basaltic phase for example

341

00:13:17,590 --> 00:13:15,830

and doped with that's good it's also a

342

00:13:20,740 --> 00:13:17,600

pathfinder for more advanced instruments

343

00:13:22,790 --> 00:13:20,750

but with that I'll leave the conclusion

344

00:13:24,160 --> 00:13:22,800

slide up there

345

00:13:24,850 --> 00:13:24,170

[Applause]

346

00:13:27,990 --> 00:13:24,860

[Music]

347

00:13:28,200 --> 00:13:28,000

[Applause]

348

00:13:45,910 --> 00:13:28,210

[Music]

349

00:13:50,960 --> 00:13:49,670

so the high-mass range can be tuned for

350

00:13:53,450 --> 00:13:50,970

what is so with this type of mass

351  
00:13:55,880 --> 00:13:53,460  
analyzer you have windows that you can

352  
00:13:57,500 --> 00:13:55,890  
look at and the window is about 40 x

353  
00:13:59,570 --> 00:13:57,510  
from your lowest mass to your highest

354  
00:14:02,930 --> 00:13:59,580  
mass we can certainly see higher so our

355  
00:14:04,130 --> 00:14:02,940  
our corrals STM has a couple of modes

356  
00:14:06,410 --> 00:14:04,140  
defined so when we're looking at the

357  
00:14:08,570 --> 00:14:06,420  
inorganic fraction which might overwhelm

358  
00:14:11,990 --> 00:14:08,580  
the signal of trace organics we would

359  
00:14:14,780 --> 00:14:12,000  
look at from you know sodium Mass 23 up

360  
00:14:16,370 --> 00:14:14,790  
to maybe cut it off at 74 so we don't

361  
00:14:20,030 --> 00:14:16,380  
have glycine in there and then we could

362  
00:14:22,340 --> 00:14:20,040  
go from 75 up to 40 X that but it's

363  
00:14:25,190 --> 00:14:22,350

actually tunable where you want but it

364

00:14:30,040 --> 00:14:25,200

needs to be 40 X the lowest mass is your

365

00:14:35,180 --> 00:14:32,120

where's the turnoff yeah so we had this

366

00:14:37,970 --> 00:14:35,190

conversation about what how large of a

367

00:14:41,930 --> 00:14:37,980

macro molecule can you analyze without a

368

00:14:44,330 --> 00:14:41,940

multi matrix and so that yeah without

369

00:14:46,160 --> 00:14:44,340

fragmenting it beyond recognition and so

370

00:14:48,380 --> 00:14:46,170

I think I told you this that we were

371

00:14:51,590 --> 00:14:48,390

measuring dye and tripeptides

372

00:14:52,910 --> 00:14:51,600

we haven't tested beyond that as of yet