
AbSciCon
2019

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

2
00:00:11,940 --> 00:00:09,170
[Applause]

3
00:00:14,610 --> 00:00:11,950
thank you for showing up late in the day

4
00:00:16,020 --> 00:00:14,620
and thanks to the ICT program for

5
00:00:17,880 --> 00:00:16,030
funding this has developed me we just

6
00:00:20,010 --> 00:00:17,890
started a few months ago we're gonna

7
00:00:22,590 --> 00:00:20,020
continue for the next couple years and

8
00:00:25,880 --> 00:00:22,600
I'm speaking on behalf of the mass spec

9
00:00:31,260 --> 00:00:25,890
orchid team oops

10
00:00:32,820 --> 00:00:31,270
oh sorry those zeros got it and I just

11
00:00:34,890 --> 00:00:32,830
wanted to tell you what our objectives

12
00:00:37,170 --> 00:00:34,900
are we're interested in searching for

13
00:00:40,350 --> 00:00:37,180

organic bio signatures and indicators of

14
00:00:44,340 --> 00:00:40,360
habitable conditions on both current and

15
00:00:47,460 --> 00:00:44,350
former ocean worlds so we love Europa

16
00:00:49,500 --> 00:00:47,470
I love Enceladus we all love Titan after

17
00:00:51,180 --> 00:00:49,510
the glorious announcement this afternoon

18
00:00:52,799 --> 00:00:51,190
but we're also interested in other

19
00:00:53,520 --> 00:00:52,809
places like Ceres it might tell

20
00:00:56,040 --> 00:00:53,530
something up

21
00:00:57,510 --> 00:00:56,050
former ocean worlds processes so we're

22
00:01:00,119 --> 00:00:57,520
interested in developing general

23
00:01:03,510 --> 00:01:00,129
capabilities to assess bio signatures

24
00:01:05,340 --> 00:01:03,520
and habitability and so what I mean by

25
00:01:07,830 --> 00:01:05,350
organic bio signatures so we're very

26
00:01:10,020 --> 00:01:07,840
interested in some of the classical

27
00:01:13,350 --> 00:01:10,030
tests for bio signatures things like the

28
00:01:15,060 --> 00:01:13,360
distributions of simple amino acids this

29
00:01:16,859 --> 00:01:15,070
is aspartic acid Peter Willis gave a

30
00:01:19,260 --> 00:01:16,869
great overview these kinds of concepts

31
00:01:22,140 --> 00:01:19,270
more complex molecules that might be

32
00:01:24,929 --> 00:01:22,150
only produced by biological processes as

33
00:01:27,060 --> 00:01:24,939
well as carboxylic acids you could have

34
00:01:29,219 --> 00:01:27,070
simple carboxylic acids that might

35
00:01:32,130 --> 00:01:29,229
either service food sources or as

36
00:01:34,770 --> 00:01:32,140
products of metabolism as well as lipid

37
00:01:36,899 --> 00:01:34,780
forming carboxylic acids and you can't

38
00:01:39,210 --> 00:01:36,909

see this in this image - well I'm sorry

39
00:01:42,030 --> 00:01:39,220
to say but this is just one example of a

40
00:01:44,310 --> 00:01:42,040
complex type of organic material known

41
00:01:46,740 --> 00:01:44,320
as a human some people think that this

42
00:01:48,630 --> 00:01:46,750
is a reasonable analogue to the organic

43
00:01:50,429 --> 00:01:48,640
material that's been found in Enceladus

44
00:01:52,109 --> 00:01:50,439
and we're interested in trying to

45
00:01:54,210 --> 00:01:52,119
characterize these types of materials on

46
00:01:56,850 --> 00:01:54,220
the other bodies as well as more geo

47
00:01:59,510 --> 00:01:56,860
processed products of these kinds of

48
00:02:02,370 --> 00:01:59,520
substances like keratin for example and

49
00:02:04,350 --> 00:02:02,380
then when I mean ability indicators I'm

50
00:02:06,630 --> 00:02:04,360
talking about both both individual

51
00:02:08,669 --> 00:02:06,640
molecules so you could imagine we're

52
00:02:11,819 --> 00:02:08,679
very interested in is their source

53
00:02:13,470 --> 00:02:11,829
sources of nitrogen on Europa surface or

54
00:02:15,680 --> 00:02:13,480
in the ocean that might support

55
00:02:18,210 --> 00:02:15,690
habitable conditions as well as

56
00:02:19,740 --> 00:02:18,220
reactions so if you want to assess is

57
00:02:21,509 --> 00:02:19,750
there enough chemical energies to

58
00:02:22,320 --> 00:02:21,519
support life well you can't just say

59
00:02:24,090 --> 00:02:22,330
there's there's high

60
00:02:27,060 --> 00:02:24,100
there's energy you actually have to

61
00:02:28,920 --> 00:02:27,070
consider full reaction so for example if

62
00:02:32,280 --> 00:02:28,930
you're interested in meth Anna Genesis

63
00:02:34,590 --> 00:02:32,290

you need measurements of co2 hydrogen

64
00:02:36,960 --> 00:02:34,600
and methane so you can evaluate the

65
00:02:39,930 --> 00:02:36,970
potential for chemical energy makes our

66
00:02:41,910 --> 00:02:39,940
jobs a little bit harder just to

67
00:02:44,130 --> 00:02:41,920
illustrate why this is useful and why

68
00:02:46,920 --> 00:02:44,140
you might care about this a couple years

69
00:02:48,150 --> 00:02:46,930
ago we had a paper analyzing this in the

70
00:02:50,430 --> 00:02:48,160
Enceladus plume we had these

71
00:02:52,650 --> 00:02:50,440
measurements of coexisting hydrogen

72
00:02:54,180 --> 00:02:52,660
methane and co2 and when you have those

73
00:02:57,060 --> 00:02:54,190
measurements then you can construct

74
00:02:58,710 --> 00:02:57,070
these types of frameworks for evaluating

75
00:03:00,330 --> 00:02:58,720
how much chemical energy there is in

76
00:03:02,430 --> 00:03:00,340
that environment so this is known as the

77
00:03:04,980 --> 00:03:02,440
chemical affinity number of kilojoules

78
00:03:06,690 --> 00:03:04,990
so that's energy content as a function

79
00:03:08,820 --> 00:03:06,700
of different geochemical conditions and

80
00:03:11,670 --> 00:03:08,830
we identified this as the sweet spot for

81
00:03:12,960 --> 00:03:11,680
Enceladus is ocean for Europa's ocean we

82
00:03:15,450 --> 00:03:12,970
have no idea so that's why we're very

83
00:03:17,820 --> 00:03:15,460
interested and this just makes the point

84
00:03:19,980 --> 00:03:17,830
that in addition to organic molecules

85
00:03:22,290 --> 00:03:19,990
and biomolecules we should also think

86
00:03:25,460 --> 00:03:22,300
very seriously about simpler molecules

87
00:03:28,199 --> 00:03:25,470
that could affect biological processes

88
00:03:31,710 --> 00:03:28,209

some aspects Orca is a collaboration

89
00:03:33,120 --> 00:03:31,720
between three institutions and so we I'm

90
00:03:34,470 --> 00:03:33,130
just going to show you schematically

91
00:03:36,449 --> 00:03:34,480
what the instrument entails and what

92
00:03:39,180 --> 00:03:36,459
we're hoping to build so we have a front

93
00:03:40,380 --> 00:03:39,190
end that's being developed by APL I hope

94
00:03:43,170 --> 00:03:40,390
they still have time to do this work

95
00:03:44,699 --> 00:03:43,180
after winning that contract and then we

96
00:03:47,610 --> 00:03:44,709
also have the University of Michigan

97
00:03:48,780 --> 00:03:47,620
who's building a GC device and I'll get

98
00:03:51,150 --> 00:03:48,790
into this this is a really cool

99
00:03:53,220 --> 00:03:51,160
development and then lastly the detector

100
00:03:55,320 --> 00:03:53,230
is a mass spectrometer so I'm going to

101
00:03:57,180 --> 00:03:55,330
mainly talk about the swery mass

102
00:03:59,490 --> 00:03:57,190
spectrometer known as mass pecks

103
00:04:01,710 --> 00:03:59,500
but we also have a different option that

104
00:04:04,199 --> 00:04:01,720
we're investigating from the University

105
00:04:06,060 --> 00:04:04,209
of Bern known as a neutral gas mass

106
00:04:08,430 --> 00:04:06,070
spectrometer and so we value ating the

107
00:04:10,380 --> 00:04:08,440
trade because Murray's math specs is

108
00:04:12,620 --> 00:04:10,390
very souped up and it's very capable but

109
00:04:15,090 --> 00:04:12,630
it's more costly in terms of spacecraft

110
00:04:17,039 --> 00:04:15,100
resources and then the bern instrument

111
00:04:19,050 --> 00:04:17,049
is our lower resource options we're

112
00:04:22,340 --> 00:04:19,060
trying to assess the resource

113
00:04:24,810 --> 00:04:22,350

requirements versus a science payoff

114
00:04:27,000 --> 00:04:24,820
just to kind of set the context and

115
00:04:28,650 --> 00:04:27,010
peter did a good job on this tip in very

116
00:04:30,719 --> 00:04:28,660
simple terms I think we're going to be

117
00:04:32,940 --> 00:04:30,729
faced with this inconvenient truth about

118
00:04:34,320 --> 00:04:32,950
Europa and other ocean worlds that

119
00:04:36,030 --> 00:04:34,330
they're probably going to be impure

120
00:04:38,010 --> 00:04:36,040
bodies hosting

121
00:04:40,890 --> 00:04:38,020
phlex mixtures if we look at meteorites

122
00:04:42,570 --> 00:04:40,900
or natural water natural waters on the

123
00:04:44,420 --> 00:04:42,580
surface of the earth is a guide so we're

124
00:04:46,740 --> 00:04:44,430
not going to have like one amino acid

125
00:04:48,600 --> 00:04:46,750
encased in ice and be able to quantify

126
00:04:50,940 --> 00:04:48,610
detection limits in that way we have to

127
00:04:54,960 --> 00:04:50,950
figure out some way to handle complex

128
00:04:56,610 --> 00:04:54,970
mixtures of various substances and how

129
00:04:59,550 --> 00:04:56,620
we do this this just kind of shows you a

130
00:05:01,710 --> 00:04:59,560
flowchart of how the front end of Orca

131
00:05:04,110 --> 00:05:01,720
is designed to work so you can imagine

132
00:05:05,870 --> 00:05:04,120
you start with a mixture of all sorts of

133
00:05:09,240 --> 00:05:05,880
interesting things like salt water

134
00:05:11,130 --> 00:05:09,250
different gasses organics refractory or

135
00:05:12,960 --> 00:05:11,140
light organics and then you have to find

136
00:05:15,330 --> 00:05:12,970
a way to methought systematically

137
00:05:17,160 --> 00:05:15,340
simplify the mixture and analyze them so

138
00:05:19,050 --> 00:05:17,170

that's what we're developing to do so

139
00:05:21,180 --> 00:05:19,060
you can start with this horrible mixture

140
00:05:22,890 --> 00:05:21,190
it's very interesting you can do a first

141
00:05:25,020 --> 00:05:22,900
step where you melt the ice and then you

142
00:05:27,510 --> 00:05:25,030
can purge the headspace you can analyze

143
00:05:29,040 --> 00:05:27,520
some volatile so that's step one then

144
00:05:30,840 --> 00:05:29,050
the next step you can envision start

145
00:05:33,870 --> 00:05:30,850
heating this mixture up that's leftover

146
00:05:35,010 --> 00:05:33,880
and you can drive away the water you can

147
00:05:36,900 --> 00:05:35,020
drive off some of the lighter

148
00:05:39,960 --> 00:05:36,910
hydrocarbons like the gasoline type

149
00:05:41,970 --> 00:05:39,970
hydrocarbons analyze those with a GC and

150
00:05:43,650 --> 00:05:41,980
a mass spec and then we were doing this

151
00:05:45,990 --> 00:05:43,660
other development I'll detail the next

152
00:05:48,270 --> 00:05:46,000
slide we're exploring options for how

153
00:05:50,820 --> 00:05:48,280
we'd analyze amino acids using things

154
00:05:53,840 --> 00:05:50,830
like derivatives a ssin and salt removal

155
00:05:55,890 --> 00:05:53,850
and the final part of this process

156
00:05:57,450 --> 00:05:55,900
leverages some of the development that

157
00:05:58,830 --> 00:05:57,460
people have done in the past like the

158
00:06:01,080 --> 00:05:58,840
sam investigation where you just start

159
00:06:03,180 --> 00:06:01,090
baking this stuff and then you can break

160
00:06:04,920 --> 00:06:03,190
off different pieces of this complex

161
00:06:07,170 --> 00:06:04,930
organic material and you can learn

162
00:06:10,320 --> 00:06:07,180
something about its chemical character

163
00:06:13,260 --> 00:06:10,330

which is really useful to know here's

164
00:06:15,210 --> 00:06:13,270
the wet lab desalination ship so why we

165
00:06:17,250 --> 00:06:15,220
think this is so useful and important is

166
00:06:19,800 --> 00:06:17,260
because if you have a lot of salts like

167
00:06:22,260 --> 00:06:19,810
which just recently rediscovered just a

168
00:06:24,180 --> 00:06:22,270
couple weeks ago they can interfere with

169
00:06:26,490 --> 00:06:24,190
chemical derivatives ation reactions

170
00:06:29,040 --> 00:06:26,500
which make a meet amino acids amina bowl

171
00:06:30,630 --> 00:06:29,050
- GC analysis so gotta figure out a way

172
00:06:32,820 --> 00:06:30,640
to deal with salts and what we're

173
00:06:35,490 --> 00:06:32,830
developing an APL has been building this

174
00:06:38,790 --> 00:06:35,500
device is you can imagine you start with

175
00:06:41,370 --> 00:06:38,800
a mixture of water salts and amino acids

176
00:06:42,900 --> 00:06:41,380
and then they have an exchange resin so

177
00:06:45,180 --> 00:06:42,910
when you flush this solution through

178
00:06:47,640 --> 00:06:45,190
there what happens is the amino acids

179
00:06:49,470 --> 00:06:47,650
stick to the resin and the salts get

180
00:06:51,510 --> 00:06:49,480
flushed out into the waste

181
00:06:53,730 --> 00:06:51,520
and then you do a subsequent illusion

182
00:06:55,860 --> 00:06:53,740
with ammonium hydroxide and that can

183
00:06:57,780 --> 00:06:55,870
pull out the amino acids so that's a way

184
00:07:00,030 --> 00:06:57,790
to do the separation and this figure

185
00:07:01,680 --> 00:07:00,040
here just shows a lab demonstration of

186
00:07:04,110 --> 00:07:01,690
how that works so you have a calcium

187
00:07:06,390 --> 00:07:04,120
chloride brine you start flushing it

188
00:07:08,550 --> 00:07:06,400

through the amino acid sticks to the

189
00:07:10,200 --> 00:07:08,560
resin the calcium chloride just goes

190
00:07:12,240 --> 00:07:10,210
straight through perfectly happy and

191
00:07:17,370 --> 00:07:12,250
then you do the ammonium hydroxide wash

192
00:07:18,480 --> 00:07:17,380
and oh and you see tryptophan this is I

193
00:07:20,640 --> 00:07:18,490
think this is one of the really cool

194
00:07:22,710 --> 00:07:20,650
things I'm willing to risk my neck but

195
00:07:24,780 --> 00:07:22,720
this could be the future of GC for

196
00:07:27,030 --> 00:07:24,790
spaceflight missions so you might have

197
00:07:29,040 --> 00:07:27,040
dealt with GC in the laboratory that's

198
00:07:31,440 --> 00:07:29,050
like these horrible metal coils and

199
00:07:33,360 --> 00:07:31,450
cages and it's wrapped around there and

200
00:07:33,840 --> 00:07:33,370
it takes a lot of space it's difficult

201
00:07:36,480 --> 00:07:33,850
to handle

202
00:07:38,130 --> 00:07:36,490
well what we're developing is a micro

203
00:07:39,780 --> 00:07:38,140
device chief see so you can see here

204
00:07:42,600 --> 00:07:39,790
these are dimensions it's on the order

205
00:07:44,610 --> 00:07:42,610
of centimeters or inches and the column

206
00:07:47,490 --> 00:07:44,620
is actually etched on a silicon chip

207
00:07:49,680 --> 00:07:47,500
right there so this is a column that's

208
00:07:51,240 --> 00:07:49,690
actually 10 meters long but it doesn't

209
00:07:53,280 --> 00:07:51,250
take up ten meters of space it's

210
00:07:55,320 --> 00:07:53,290
actually really small and nice to use

211
00:07:57,510 --> 00:07:55,330
and so what you actually do is you pump

212
00:07:59,220 --> 00:07:57,520
in a sample that goes through a pre

213
00:08:00,930 --> 00:07:59,230

concentrator so you get a nice plug of

214
00:08:03,390 --> 00:08:00,940
organics and then you thermally desorb

215
00:08:05,580 --> 00:08:03,400
it through this column and then you can

216
00:08:07,140 --> 00:08:05,590
do analysis so we have one option where

217
00:08:10,110 --> 00:08:07,150
you could do an alternative analysis

218
00:08:12,870 --> 00:08:10,120
with a micro photo ionization detector

219
00:08:15,450 --> 00:08:12,880
or we can also just go directly into the

220
00:08:17,610 --> 00:08:15,460
mass spec and our lab model we just plug

221
00:08:19,590 --> 00:08:17,620
in a USB Drive directly into a data

222
00:08:22,020 --> 00:08:19,600
acquisition board and we start getting

223
00:08:24,780 --> 00:08:22,030
some data here's some data we've

224
00:08:26,520 --> 00:08:24,790
collected with the IC to investigation

225
00:08:28,980 --> 00:08:26,530
so this is just a really simple mixture

226
00:08:32,400 --> 00:08:28,990
to demonstrate the proof-of-concept so

227
00:08:34,260 --> 00:08:32,410
we just did a quick isothermal and some

228
00:08:36,540 --> 00:08:34,270
temperature wrap ramping shown here and

229
00:08:38,700 --> 00:08:36,550
then in a span of like two minutes

230
00:08:40,589 --> 00:08:38,710
you're able to separate these simple

231
00:08:42,659 --> 00:08:40,599
hydrocarbons from pentane to no-name

232
00:08:44,100 --> 00:08:42,669
pretty effectively with this small

233
00:08:46,170 --> 00:08:44,110
device so we're feeling pretty

234
00:08:50,640 --> 00:08:46,180
optimistic that this might have some

235
00:08:52,410 --> 00:08:50,650
promise what's to come so the really

236
00:08:55,170 --> 00:08:52,420
cool thing is you can actually then add

237
00:08:57,120 --> 00:08:55,180
additional columns on the same silicon

238
00:08:58,800 --> 00:08:57,130

chip so you have the first GC column

239
00:09:00,690 --> 00:08:58,810
like we all know and it gives you all

240
00:09:02,319 --> 00:09:00,700
these peaks and you can add a second

241
00:09:04,449 --> 00:09:02,329
column after that

242
00:09:06,129 --> 00:09:04,459
and it adds greater ability to separate

243
00:09:08,289 --> 00:09:06,139
because you can use different types of

244
00:09:10,569 --> 00:09:08,299
stationary phases so the first stage you

245
00:09:12,759 --> 00:09:10,579
could use like a nonpolar column then

246
00:09:14,859 --> 00:09:12,769
here you can use a polar column and you

247
00:09:17,169 --> 00:09:14,869
can pick different chiral columns so

248
00:09:19,419 --> 00:09:17,179
there's a lot of flexibility for tuning

249
00:09:20,859 --> 00:09:19,429
this two different types of analytes so

250
00:09:23,259 --> 00:09:20,869
we're really excited about that and

251
00:09:25,539 --> 00:09:23,269
here's some demonstration of what our

252
00:09:27,429 --> 00:09:25,549
Michigan team had done previously where

253
00:09:30,009 --> 00:09:27,439
they just took a mixture of 50 volatile

254
00:09:31,600 --> 00:09:30,019
organic compounds and you can see since

255
00:09:33,939 --> 00:09:31,610
it having Peaks yeah you actually get

256
00:09:35,650 --> 00:09:33,949
these little spots in two dimensions and

257
00:09:38,379 --> 00:09:35,660
what's nice about it is some of these

258
00:09:40,090 --> 00:09:38,389
spots are the same horizontal distance

259
00:09:41,949 --> 00:09:40,100
away so if you had a one dimensional

260
00:09:44,289 --> 00:09:41,959
chromatogram they would fall on top of

261
00:09:45,789 --> 00:09:44,299
each other and not be separated but if

262
00:09:47,229 --> 00:09:45,799
you have the second dimension then you

263
00:09:49,689 --> 00:09:47,239

can actually pull them away from each

264
00:09:51,119 --> 00:09:49,699
other and do a nice clean quantitative

265
00:09:54,999 --> 00:09:51,129
analysis

266
00:09:57,129 --> 00:09:55,009
here's math specs I love math specs math

267
00:09:58,780 --> 00:09:57,139
specs is being developed for Europa

268
00:10:00,579 --> 00:09:58,790
clipper so it's leveraging that heritage

269
00:10:02,769 --> 00:10:00,589
what we're really hoping to do is

270
00:10:04,660 --> 00:10:02,779
provide the local scale information to

271
00:10:06,579 --> 00:10:04,670
complement what clipper is going to tell

272
00:10:07,960 --> 00:10:06,589
us from the global perspective using the

273
00:10:10,689 --> 00:10:07,970
same instrument so it's a nice way to

274
00:10:12,639 --> 00:10:10,699
compare and contrast that mass spec

275
00:10:14,559 --> 00:10:12,649
needle up to a thousand atomic mass

276
00:10:17,739 --> 00:10:14,569
units it has a lot of flexibility for

277
00:10:21,639 --> 00:10:17,749
looking at small things or big things it

278
00:10:24,100 --> 00:10:21,649
can go up to 50,000 resolution M to

279
00:10:26,590 --> 00:10:24,110
Delta M so you can pull apart a lot of

280
00:10:28,720 --> 00:10:26,600
things that are very similar in mass and

281
00:10:31,090 --> 00:10:28,730
what we're hoping for this to be is a

282
00:10:34,539 --> 00:10:31,100
pathfinder for isotope biogeochemistry

283
00:10:36,309 --> 00:10:34,549
on the surface of icy worlds and i kind

284
00:10:38,799 --> 00:10:36,319
of show you how this works so this is a

285
00:10:41,319 --> 00:10:38,809
famous plot in geochemistry showing how

286
00:10:44,829 --> 00:10:41,329
you can organize the origin of methane

287
00:10:46,449 --> 00:10:44,839
based on carbon and hydrogen isotopes

288
00:10:49,269 --> 00:10:46,459

and there seems to be certain regimes

289
00:10:51,879 --> 00:10:49,279
that separate abiotic versus biotic

290
00:10:54,159 --> 00:10:51,889
gases so we're trying to use these kinds

291
00:10:56,650 --> 00:10:54,169
of empirical rules and rules based on

292
00:10:58,449 --> 00:10:56,660
physical chemistry and then trying to

293
00:11:00,340 --> 00:10:58,459
compare that to the data on Europa which

294
00:11:02,139 --> 00:11:00,350
we don't yet have so this is I think

295
00:11:05,259 --> 00:11:02,149
this is a nice path forward for this

296
00:11:07,629 --> 00:11:05,269
type of isotope work why you need high

297
00:11:09,639 --> 00:11:07,639
resolution so the classic case that

298
00:11:12,009 --> 00:11:09,649
we've struggled with with Cassini it's

299
00:11:14,199 --> 00:11:12,019
separating things like CEO for men -

300
00:11:15,760 --> 00:11:14,209
they have a nominal mass of 28 so

301
00:11:17,770 --> 00:11:15,770
Cassini

302
00:11:18,940 --> 00:11:17,780
we have big problems there but with math

303
00:11:20,740 --> 00:11:18,950
specs you can see in this lab

304
00:11:22,990 --> 00:11:20,750
demonstration we're nicely able to pull

305
00:11:25,510 --> 00:11:23,000
apart those Peaks and to discriminate

306
00:11:27,220 --> 00:11:25,520
between CO and n2 and this is really

307
00:11:29,440 --> 00:11:27,230
important so if you want to fill in that

308
00:11:33,010 --> 00:11:29,450
methane isotope plot well you need to

309
00:11:35,710 --> 00:11:33,020
measure both 13c methane and deuterated

310
00:11:37,780 --> 00:11:35,720
methane those both have a mass of 17 so

311
00:11:39,400 --> 00:11:37,790
that's a problem unless you have high

312
00:11:41,650 --> 00:11:39,410
resolution if you have high resolution

313
00:11:44,170 --> 00:11:41,660

it's great because these species

314
00:11:46,600 --> 00:11:44,180
actually defer at some of the decimal

315
00:11:48,310 --> 00:11:46,610
place level of mass so we like to think

316
00:11:52,090 --> 00:11:48,320
of decimal places as our friend from

317
00:11:54,040 --> 00:11:52,100
aspects and I mentioned organics our

318
00:11:56,890 --> 00:11:54,050
great interest too so here's some data

319
00:11:58,570 --> 00:11:56,900
we've generated from ic2 so far so this

320
00:12:01,660 --> 00:11:58,580
is a standard mixture called Grob

321
00:12:03,670 --> 00:12:01,670
mixture contains a suite of nonpolar or

322
00:12:05,850 --> 00:12:03,680
weakly puller organics so the examples

323
00:12:08,440 --> 00:12:05,860
I'm showing here are one octanol and

324
00:12:11,200 --> 00:12:08,450
decane this is what the manufacturer

325
00:12:13,630 --> 00:12:11,210
sends to us this is the mass specs data

326
00:12:15,850 --> 00:12:13,640
so we're able to reproduce with similar

327
00:12:18,730 --> 00:12:15,860
efficiency what you can do in the

328
00:12:20,410 --> 00:12:18,740
conventional laboratory here's what the

329
00:12:22,870 --> 00:12:20,420
mass spectra looked like so these are

330
00:12:24,640 --> 00:12:22,880
from NIST these little stick figures and

331
00:12:27,550 --> 00:12:24,650
mass effects is able to produce

332
00:12:30,460 --> 00:12:27,560
comparable stick figures over a wide

333
00:12:32,410 --> 00:12:30,470
range of mass and we've just started

334
00:12:33,670 --> 00:12:32,420
working on some quantitative analysis

335
00:12:36,190 --> 00:12:33,680
this just shows some of these

336
00:12:38,020 --> 00:12:36,200
calibration curves we've generated as a

337
00:12:39,640 --> 00:12:38,030
function of concentration and then the

338
00:12:41,830 --> 00:12:39,650

peak areas that I showed in the previous

339
00:12:43,870 --> 00:12:41,840
slide so it's looking pretty promising

340
00:12:46,150 --> 00:12:43,880
but we'd like to improve this in the

341
00:12:48,130 --> 00:12:46,160
next year or so by starting to use

342
00:12:49,990 --> 00:12:48,140
internal standards based on fluorinated

343
00:12:51,280 --> 00:12:50,000
compounds for instance and then

344
00:12:53,170 --> 00:12:51,290
extending these to even lower

345
00:12:56,080 --> 00:12:53,180
concentrations which some people might

346
00:12:57,700 --> 00:12:56,090
expect for the surface of europa and

347
00:13:03,120 --> 00:12:57,710
with that I will open up for any

348
00:13:13,960 --> 00:13:06,790
any questions for Chris yeah come use

349
00:13:15,880 --> 00:13:13,970
the mic quickly so the column on the

350
00:13:18,370 --> 00:13:15,890
silicon chip is really cool it's very

351
00:13:20,230 --> 00:13:18,380
innovative 1/8 but even looking at low

352
00:13:22,810 --> 00:13:20,240
masses one of the big things that makes

353
00:13:24,820 --> 00:13:22,820
a GC heavy and big is the oven part

354
00:13:26,050 --> 00:13:24,830
right and you need it for baked outs to

355
00:13:27,970 --> 00:13:26,060
make sure you keep your column clean so

356
00:13:29,200 --> 00:13:27,980
then what's the temperature what's the

357
00:13:30,940 --> 00:13:29,210
high temperature you can get to with the

358
00:13:33,730 --> 00:13:30,950
chip column the high temperature I think

359
00:13:37,260 --> 00:13:33,740
is around 350 degrees Celsius yeah

360
00:13:43,930 --> 00:13:42,040
anything else go for it

361
00:13:45,700 --> 00:13:43,940
so do you guys have have you been able

362
00:13:48,280 --> 00:13:45,710
to measure any changes in flow rate

363
00:13:51,160 --> 00:13:48,290

along this kind of more circuitous path

364
00:13:53,500 --> 00:13:51,170
I don't know what maybe the University

365
00:13:55,630 --> 00:13:53,510
of Michigan team has but we have haven't

366
00:13:57,670 --> 00:13:55,640
had that test with math specs yet so

367
00:13:59,710 --> 00:13:57,680
what we're hoping to do with ic2 is we

368
00:14:01,360 --> 00:13:59,720
want to interface them together and then

369
00:14:03,370 --> 00:14:01,370
test for these various organic mixtures

370
00:14:08,340 --> 00:14:03,380
so we'll have those data hopefully next