



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

[Music]

2
00:00:11,240 --> 00:00:09,140

[Applause]

3
00:00:13,530 --> 00:00:11,250

good morning everyone

4
00:00:15,439 --> 00:00:13,540

I'd like to thank the organizers for

5
00:00:17,870 --> 00:00:15,449

give me an opportunity to talk here and

6
00:00:21,359 --> 00:00:17,880

on the formation of complex organic

7
00:00:23,849 --> 00:00:21,369

materials or molecules comes from PAHs

8
00:00:24,989 --> 00:00:23,859

or polycyclic aromatic hydrocarbons it

9
00:00:26,700 --> 00:00:24,999

kind of goes along with the theme this

10
00:00:28,710 --> 00:00:26,710

morning about what our bio signatures

11
00:00:31,550 --> 00:00:28,720

how do you make other molecules can you

12
00:00:34,080 --> 00:00:31,560

make other molecules from the PAHs and

13
00:00:35,310 --> 00:00:34,090

what I'm going to talk about it give you

14

00:00:37,580 --> 00:00:35,320

a little background on the coms if

15

00:00:40,069 --> 00:00:37,590

you're not familiar with the term

16

00:00:41,849 --> 00:00:40,079

chemist view comes differently than

17

00:00:44,160 --> 00:00:41,859

astrobiologists and astronomers just to

18

00:00:47,220 --> 00:00:44,170

point out but for in the astrobiology

19

00:00:48,500 --> 00:00:47,230

context comes our organic molecules

20

00:00:52,790 --> 00:00:48,510

containing carbon hydrogen oxygen

21

00:00:56,340 --> 00:00:52,800

possibly nitrogen such as the aldehydes

22

00:00:57,689 --> 00:00:56,350

ketones going-ons and stuff which are

23

00:01:02,189 --> 00:00:57,699

carbon change with functional groups

24

00:01:04,110 --> 00:01:02,199

attached to them which can be useful in

25

00:01:09,210 --> 00:01:04,120

Bovada chemistry and the origins of life

26

00:01:10,710 --> 00:01:09,220

context pah is or polycyclic aromatic

27

00:01:11,999 --> 00:01:10,720

hydrocarbons if you're not familiar with

28

00:01:14,399 --> 00:01:12,009

them I think they've showed a couple of

29

00:01:17,490 --> 00:01:14,409

times this morning our carbon hydrogen

30

00:01:18,899 --> 00:01:17,500

molecules with cyclic aromatic rings of

31

00:01:22,649 --> 00:01:18,909

carbon in there they're important

32

00:01:25,109 --> 00:01:22,659

because they're one of the most abundant

33

00:01:27,630 --> 00:01:25,119

sources of carbon in the universe we

34

00:01:30,420 --> 00:01:27,640

find them all over the place pretty much

35

00:01:32,910 --> 00:01:30,430

and in the is him the interstellar

36

00:01:36,030 --> 00:01:32,920

medium the PAH is tend to be 50 to 100

37

00:01:37,289 --> 00:01:36,040

carbon atoms in size we also find pH is

38

00:01:38,760 --> 00:01:37,299

within the solar system but there's

39

00:01:40,800 --> 00:01:38,770

typically a lot smaller we find them in

40

00:01:43,679 --> 00:01:40,810

meteorites interplanetary dust particles

41

00:01:46,340 --> 00:01:43,689

cometary particles and such and they're

42

00:01:48,959 --> 00:01:46,350

usually about 24 atoms are smaller

43

00:01:50,609 --> 00:01:48,969

aromatic molecules also make up such as

44

00:01:53,249 --> 00:01:50,619

pH as components of the insoluble

45

00:01:56,670 --> 00:01:53,259

organic material which which we find in

46

00:01:58,260 --> 00:01:56,680

meteorites the aromatic structures are

47

00:01:59,969 --> 00:01:58,270

also important to the biochemistry a lot

48

00:02:01,880 --> 00:01:59,979

of our biochemistry are cyclic carbon

49

00:02:04,260 --> 00:02:01,890

structures or even aromatic structures

50

00:02:05,760 --> 00:02:04,270

so what's interesting about the pH is

51
00:02:07,560 --> 00:02:05,770
what happens when they undergo energetic

52
00:02:11,550 --> 00:02:07,570
processing we know they're in the is cm

53
00:02:13,500 --> 00:02:11,560
they're large molecules and so when the

54
00:02:16,350 --> 00:02:13,510
protozoa nebula forms or even in within

55
00:02:18,630 --> 00:02:16,360
areas within our own solar system you

56
00:02:20,699 --> 00:02:18,640
have high energetic particles going on

57
00:02:24,089 --> 00:02:20,709
so what happens to the chemistry of PAHs

58
00:02:26,880 --> 00:02:24,099
such as UV fatalis high-energy protons

59
00:02:30,089 --> 00:02:26,890
and electrons that's where the basis of

60
00:02:32,309 --> 00:02:30,099
this kind of started and it kind of goes

61
00:02:34,319 --> 00:02:32,319
to a bottom-up or top-down we heard that

62
00:02:36,179 --> 00:02:34,329
term earlier this morning but in this

63
00:02:37,800 --> 00:02:36,189

term it's like a bottom-up synthesis our

64

00:02:39,119 --> 00:02:37,810

top-down synthesis are the organics in

65

00:02:41,429 --> 00:02:39,129

the solar system formed from smaller

66

00:02:42,780 --> 00:02:41,439

molecules combining together or larger

67

00:02:45,089 --> 00:02:42,790

molecules from the I am getting

68

00:02:48,959 --> 00:02:45,099

processed down to smaller molecules so

69

00:02:51,530 --> 00:02:48,969

we wanted to investigate that and so we

70

00:02:53,490 --> 00:02:51,540

did some experiments called IC or

71

00:02:55,740 --> 00:02:53,500

investigation of carbon and evolution

72

00:02:58,830 --> 00:02:55,750

experiments and what we did was we took

73

00:03:01,890 --> 00:02:58,840

- PAH is Corning which is a 24 carbon

74

00:03:03,509 --> 00:03:01,900

atom very compact PAH structure ice oval

75

00:03:06,750 --> 00:03:03,519

and three I'm going to call it IV a just

76

00:03:09,300 --> 00:03:06,760

for short which is a 34 carbon atom PAH

77

00:03:12,569 --> 00:03:09,310

and what we did we did positive as thin

78

00:03:16,110 --> 00:03:12,579

films on a salt on salt windows and then

79

00:03:20,179 --> 00:03:16,120

we took them to the and expose them to

80

00:03:22,589 --> 00:03:20,189

UV provide photons protons and electrons

81

00:03:24,869 --> 00:03:22,599

and then what we were doing that we did

82

00:03:28,500 --> 00:03:24,879

pre and post infrared spectroscopy

83

00:03:30,869 --> 00:03:28,510

measurements and we the chamber itself

84

00:03:33,030 --> 00:03:30,879

had a RG a onna a residual gas analyzer

85

00:03:35,399 --> 00:03:33,040

to see what species were given off

86

00:03:39,420 --> 00:03:35,409

during a radiation and after a radiation

87

00:03:41,099 --> 00:03:39,430

we did the samples both single radiation

88

00:03:42,780 --> 00:03:41,109

sources and in combination to see if a

89

00:03:45,390 --> 00:03:42,790

combination radiation had an effect

90

00:03:49,309 --> 00:03:45,400

versus individual radiation sources and

91

00:03:51,869 --> 00:03:49,319

then we also did the samples with a

92

00:03:54,140 --> 00:03:51,879

layer of ice on them to see if that

93

00:03:56,520 --> 00:03:54,150

impact how that impacted the chemistry

94

00:03:57,899 --> 00:03:56,530

we did the experiments at the combined

95

00:03:59,099 --> 00:03:57,909

environmental effects facility at the

96

00:04:02,309 --> 00:03:59,109

Marshall Space Flight Center in

97

00:04:03,780 --> 00:04:02,319

Huntsville Alabama it's not necessarily

98

00:04:05,099 --> 00:04:03,790

set up for these type of experiments

99

00:04:06,960 --> 00:04:05,109

that we're doing a proof-of-concept with

100

00:04:09,780 --> 00:04:06,970

it it's actually set up to expose

101
00:04:11,009 --> 00:04:09,790
satellites to solar wind so we're using

102
00:04:12,929 --> 00:04:11,019
the solar wind in this instance to do

103
00:04:14,699 --> 00:04:12,939
our chemistry you have a proton

104
00:04:16,170 --> 00:04:14,709
accelerator going into this vacuum

105
00:04:19,740 --> 00:04:16,180
chamber as well as a high-energy

106
00:04:23,279 --> 00:04:19,750
electron accelerator and the UV light

107
00:04:27,330 --> 00:04:23,289
source so we did here's the energies we

108
00:04:31,440 --> 00:04:27,340
use we use about 700 ke V proton 90 ke V

109
00:04:33,580 --> 00:04:31,450
electrons the UV only experiments were

110
00:04:35,080 --> 00:04:33,590
done at NASA Ames in our laboratory

111
00:04:38,530 --> 00:04:35,090
with a hydrogen discharge lamp using

112
00:04:41,100 --> 00:04:38,540
10.2 evie we try to match the fluence as

113
00:04:43,240 --> 00:04:41,110

much as possible between the samples

114

00:04:44,560 --> 00:04:43,250

here's some visual results of what

115

00:04:45,790 --> 00:04:44,570

happened to the samples this is the

116

00:04:49,870 --> 00:04:45,800

sample holder that we made for the

117

00:04:51,940 --> 00:04:49,880

chamber is a huge chamber but we did

118

00:04:53,620 --> 00:04:51,950

duplicate samples cornea top the ice

119

00:04:56,620 --> 00:04:53,630

oval answering our IV a at the bottom

120

00:04:57,670 --> 00:04:56,630

you can actually see color changes going

121

00:04:59,830 --> 00:04:57,680

on with the quarantine it's a

122

00:05:02,140 --> 00:04:59,840

translucent material it actually changed

123

00:05:03,250 --> 00:05:02,150

colour upon bombardment the blue color

124

00:05:05,050 --> 00:05:03,260

that you're seeing here is actually

125

00:05:11,290 --> 00:05:05,060

color centers developed in the salt

126

00:05:12,940 --> 00:05:11,300

windows when we were irradiated a little

127

00:05:14,950 --> 00:05:12,950

bit more on the visual results a lot of

128

00:05:15,640 --> 00:05:14,960

pH is fluoresce when you put them under

129

00:05:19,480 --> 00:05:15,650

UV light

130

00:05:23,050 --> 00:05:19,490

and here's our control sample with no no

131

00:05:24,550 --> 00:05:23,060

irradiation going on and you can see it

132

00:05:26,830 --> 00:05:24,560

fluoresce is grayed out the other

133

00:05:28,780 --> 00:05:26,840

samples they had no wire layer water ice

134

00:05:30,129 --> 00:05:28,790

layer on them not so much they got

135

00:05:31,450 --> 00:05:30,139

pretty much this is telling us we're

136

00:05:33,640 --> 00:05:31,460

destroying the aromatic structure we're

137

00:05:37,469 --> 00:05:33,650

just really changing it altering it and

138

00:05:43,800 --> 00:05:41,380

shown here is the RGA results and you

139

00:05:48,760 --> 00:05:43,810

have the mass going from 1 to 100

140

00:05:50,560 --> 00:05:48,770

amu the y-axis is pressure and analog in

141

00:05:51,940 --> 00:05:50,570

a logarithmic scale and there's certain

142

00:05:53,650 --> 00:05:51,950

there are several time points going on

143

00:05:54,969 --> 00:05:53,660

here that before cool down just to give

144

00:05:58,779 --> 00:05:54,979

you idea of what the background looked

145

00:06:00,100 --> 00:05:58,789

like in the chamber after cool down when

146

00:06:01,719 --> 00:06:00,110

we started the electron gun this ease

147

00:06:03,790 --> 00:06:01,729

our electron irradiation experiments

148

00:06:06,969 --> 00:06:03,800

overnight and when we started warming up

149

00:06:09,520 --> 00:06:06,979

so let's go through them in a second

150

00:06:11,920 --> 00:06:09,530

let's get back to give it one second to

151
00:06:13,300 --> 00:06:11,930
go through the cycle and here is the

152
00:06:15,490 --> 00:06:13,310
background right here it has a little

153
00:06:16,990 --> 00:06:15,500
bit of background contamination after

154
00:06:18,610 --> 00:06:17,000
cool down it's a little bit less intense

155
00:06:21,010 --> 00:06:18,620
we start the electron gun we start

156
00:06:24,159 --> 00:06:21,020
seeing a little bit more even overnight

157
00:06:26,020 --> 00:06:24,169
and then when we get to warm up we get

158
00:06:28,090 --> 00:06:26,030
all this other electronic material

159
00:06:31,360 --> 00:06:28,100
showing up and what that actually looks

160
00:06:34,000 --> 00:06:31,370
like again here's a stack plot from ten

161
00:06:35,650 --> 00:06:34,010
to a hundred mass units we've got the

162
00:06:38,409 --> 00:06:35,660
protons the electrons and come in

163
00:06:41,080 --> 00:06:38,419

combined set protons in the red here

164

00:06:43,920 --> 00:06:41,090

electrons black blue and green for the

165

00:06:47,719 --> 00:06:43,930

combined again these are both large PAHs

166

00:06:49,939 --> 00:06:47,729

Corning itself is about 300 amu

167

00:06:52,760 --> 00:06:49,949

I saw bill answering is another 120 amu

168

00:06:54,740 --> 00:06:52,770

above that and so the fat and we if you

169

00:06:56,570 --> 00:06:54,750

put a pH in a mass spectrometer you

170

00:06:58,129 --> 00:06:56,580

don't necessarily get these lower these

171

00:07:01,219 --> 00:06:58,139

small fragments that we're seeing here

172

00:07:02,960 --> 00:07:01,229

and what you see here is one you see a

173

00:07:05,210 --> 00:07:02,970

distinct pattern difference between the

174

00:07:06,350 --> 00:07:05,220

protons and electrons if you look at the

175

00:07:08,480 --> 00:07:06,360

patterns you're seeing you're seeing a

176

00:07:10,430 --> 00:07:08,490

c1 a carbon one carbon two carbon three

177

00:07:14,480 --> 00:07:10,440

carbon up to about seven carbon chains

178

00:07:15,980 --> 00:07:14,490

in length the protons seem to stop

179

00:07:17,960 --> 00:07:15,990

around the three to four carbon chain

180

00:07:19,909 --> 00:07:17,970

lengths you also see it seems like it's

181

00:07:23,060 --> 00:07:19,919

stripping off hydrogen's one at a time

182

00:07:24,920 --> 00:07:23,070

before you get to some Peaks and the

183

00:07:27,129 --> 00:07:24,930

right now the pro the combination looked

184

00:07:29,089 --> 00:07:27,139

just like a combined proton and electron

185

00:07:30,140 --> 00:07:29,099

spectrum we need to do some more work on

186

00:07:32,469 --> 00:07:30,150

that to see if there's actually a

187

00:07:35,390 --> 00:07:32,479

difference with the combined radiation

188

00:07:36,770 --> 00:07:35,400

pointing out a couple of Peaks the 69

189

00:07:38,659 --> 00:07:36,780

peak was unusual because we're children

190

00:07:41,210 --> 00:07:38,669

I figure out what it's going on and then

191

00:07:43,760 --> 00:07:41,220

we've got a twenty six peak here in the

192

00:07:45,379 --> 00:07:43,770

c2 area that we're going to look at when

193

00:07:46,670 --> 00:07:45,389

we put a water ice layer on it and you

194

00:07:48,800 --> 00:07:46,680

can actually visually see the water ice

195

00:07:50,839 --> 00:07:48,810

layer our fragmentation pattern didn't

196

00:07:52,279 --> 00:07:50,849

really change that much the main Peaks

197

00:07:56,839 --> 00:07:52,289

the main fragmentation Peaks didn't

198

00:07:59,719 --> 00:07:56,849

change but it did kind of get kind of

199

00:08:01,339 --> 00:07:59,729

stopped these individual hydrogens being

200

00:08:04,159 --> 00:08:01,349

stripped off the main fragments whooshes

201
00:08:05,659 --> 00:08:04,169
that we're still there just to show you

202
00:08:07,070 --> 00:08:05,669
one interesting thing between another

203
00:08:09,290 --> 00:08:07,080
interesting thing between the electron

204
00:08:10,550 --> 00:08:09,300
and proton here is right before the

205
00:08:12,320 --> 00:08:10,560
start of the electron gun when we

206
00:08:14,960 --> 00:08:12,330
started electron gun we see a order of

207
00:08:16,730 --> 00:08:14,970
magnitude increase in that 69 peak in

208
00:08:20,060 --> 00:08:16,740
that twenty six p26 peak is

209
00:08:21,260 --> 00:08:20,070
characteristic of acetylene and pH is

210
00:08:23,360 --> 00:08:21,270
when they get really energetic like to

211
00:08:25,370 --> 00:08:23,370
give off a C to H group of settle angry

212
00:08:27,200 --> 00:08:25,380
hydro group we don't see that so much

213
00:08:28,399 --> 00:08:27,210

with the proton the only time we give

214

00:08:31,279 --> 00:08:28,409

off these Peaks is when we start warming

215

00:08:33,589 --> 00:08:31,289

up the sample so after the irradiation

216

00:08:37,089 --> 00:08:33,599

so the electrons seem to be sputtering

217

00:08:42,019 --> 00:08:37,099

the stuff off as well as producing it

218

00:08:46,269 --> 00:08:42,029

and then the combination is again kind

219

00:08:50,420 --> 00:08:48,560

now this is a lot going on on this slide

220

00:08:54,260 --> 00:08:50,430

but I'll try to it's the it's the pre

221

00:08:56,449 --> 00:08:54,270

the pre and post infrared spectra and

222

00:08:58,490 --> 00:08:56,459

what you're seeing here are different

223

00:09:00,050 --> 00:08:58,500

spectra we took the infrared spectra of

224

00:09:03,260 --> 00:09:00,060

the radiated sample and said

225

00:09:04,400 --> 00:09:03,270

tract it off the pre radiated sample so

226

00:09:06,620 --> 00:09:04,410

the neutrally an altered sample

227

00:09:10,880 --> 00:09:06,630

subtracted from the altered samples and

228

00:09:13,400 --> 00:09:10,890

this is for quarantine the purple here

229

00:09:15,800 --> 00:09:13,410

is a UV results the black is the

230

00:09:17,480 --> 00:09:15,810

electron bombardment the red is the

231

00:09:20,170 --> 00:09:17,490

proton bombardment and the blue is a

232

00:09:23,840 --> 00:09:20,180

combined a couple of things to point out

233

00:09:27,140 --> 00:09:23,850

you see a bump kind of pointing coming

234

00:09:30,560 --> 00:09:27,150

out around eight to ten microns in the

235

00:09:33,470 --> 00:09:30,570

UV you see a couple of bumps coming out

236

00:09:36,680 --> 00:09:33,480

between five and a half and fifteen

237

00:09:38,240 --> 00:09:36,690

microns and the electron and proton as

238

00:09:39,410 --> 00:09:38,250

well as combination we do see a couple

239

00:09:40,820 --> 00:09:39,420

of new bands that are very small

240

00:09:41,750 --> 00:09:40,830

features and the combine that we don't

241

00:09:44,480 --> 00:09:41,760

see on the other ones we got to

242

00:09:46,880 --> 00:09:44,490

investigate and we're kind of comparing

243

00:09:47,990 --> 00:09:46,890

this bottom color that you see here

244

00:09:50,150 --> 00:09:48,000

actually matches up to different

245

00:09:52,100 --> 00:09:50,160

hydrogenation states of a pH

246

00:09:55,100 --> 00:09:52,110

theoretically that we've taken off of

247

00:09:56,540 --> 00:09:55,110

our paw database and so it looks like

248

00:09:58,220 --> 00:09:56,550

we're hydrogenating as well as doing

249

00:09:59,390 --> 00:09:58,230

some other things to it but the

250

00:10:00,710 --> 00:09:59,400

interesting thing here and you'll have a

251
00:10:03,470 --> 00:10:00,720
talk on this in a little bit

252
00:10:06,830 --> 00:10:03,480
are these broad features that we're

253
00:10:08,030 --> 00:10:06,840
seeing kind of correlate with the

254
00:10:09,530 --> 00:10:08,040
plateaus that you see in the

255
00:10:11,150 --> 00:10:09,540
unidentified infrared emission bands

256
00:10:13,460 --> 00:10:11,160
with the pop bands we see in the in the

257
00:10:14,780 --> 00:10:13,470
infrared all over the place so is that

258
00:10:17,180 --> 00:10:14,790
an indication that they're processed

259
00:10:19,550 --> 00:10:17,190
pause I don't know we got to do a lot

260
00:10:21,460 --> 00:10:19,560
more work focusing in on the CH stretch

261
00:10:23,960 --> 00:10:21,470
here's ISIL answering here's quarantine

262
00:10:26,120 --> 00:10:23,970
what you can see is the CH stretch the

263
00:10:28,850 --> 00:10:26,130

aromatic group in the LF attic the

264

00:10:31,820 --> 00:10:28,860

aliphatics grow upon which again is the

265

00:10:33,380 --> 00:10:31,830

indication of hydrogenation in the

266

00:10:36,890 --> 00:10:33,390

proton and electron and a combined

267

00:10:39,170 --> 00:10:36,900

versus the UV but the electrons were

268

00:10:41,180 --> 00:10:39,180

unique in that they created this 3.0 3

269

00:10:43,580 --> 00:10:41,190

micron feature we didn't see that in the

270

00:10:48,170 --> 00:10:43,590

protons that's kind of a characteristic

271

00:10:50,390 --> 00:10:48,180

of a CH stretching group off of a C

272

00:10:52,280 --> 00:10:50,400

triple bond C or maybe a settle Lane

273

00:10:53,360 --> 00:10:52,290

these were taken at room temperature and

274

00:10:55,220 --> 00:10:53,370

room pressure so it couldn't be a

275

00:10:57,830 --> 00:10:55,230

settling gas by itself so it has to be a

276

00:11:02,510 --> 00:10:57,840

functional group like that attached to

277

00:11:04,220 --> 00:11:02,520

the PAH so what we kind of figure is

278

00:11:06,410 --> 00:11:04,230

going on is that we're taking the P and

279

00:11:07,970 --> 00:11:06,420

actually is taking the PAH hitting it

280

00:11:09,370 --> 00:11:07,980

with protons electrons creating all

281

00:11:13,639 --> 00:11:09,380

these interesting structures such as

282

00:11:14,780 --> 00:11:13,649

acetylene and other groups

283

00:11:15,920 --> 00:11:14,790

if you start going digging through the

284

00:11:19,040 --> 00:11:15,930

mass spectra you see a lot of

285

00:11:20,689 --> 00:11:19,050

complicated stuff going on so we're

286

00:11:22,400 --> 00:11:20,699

processing the pah is creating all these

287

00:11:26,900 --> 00:11:22,410

other organics from it from a top-down

288

00:11:28,400 --> 00:11:26,910

approach versus a bottom-up approach but

289

00:11:31,220 --> 00:11:28,410

again these are preliminary we're going

290

00:11:32,749 --> 00:11:31,230

to do a lot more work and I'll end on

291

00:11:35,329 --> 00:11:32,759

that on the conclusions a little bit is

292

00:11:37,309 --> 00:11:35,339

that the radiation processing does

293

00:11:39,319 --> 00:11:37,319

fragment the pH is modifies the

294

00:11:41,449 --> 00:11:39,329

chemistry of the pH is giving you a

295

00:11:45,259 --> 00:11:41,459

whole complex mixture of smaller

296

00:11:47,239 --> 00:11:45,269

molecules there is a difference between

297

00:11:50,090 --> 00:11:47,249

the electron and proton and UV

298

00:11:51,769 --> 00:11:50,100

radiations we are going this is a

299

00:11:52,609 --> 00:11:51,779

mock-up of our new system that we're

300

00:11:55,100 --> 00:11:52,619

going to come on it's called

301

00:11:56,389 --> 00:11:55,110

I see that we're starting in July when

302

00:11:58,309 --> 00:11:56,399

do you be able to do in situ

303

00:12:01,850 --> 00:11:58,319

measurements why we're irradiating with

304

00:12:05,329 --> 00:12:01,860

raman spectroscopy IR spectroscopy and

305

00:12:07,160 --> 00:12:05,339

of the RGA so hopefully and just I would

306

00:12:09,199 --> 00:12:07,170

like to thank the organizers again and

307

00:12:11,720 --> 00:12:09,209

think our funding agencies so well with

308

00:12:16,119 --> 00:12:11,730

that I'll hopefully answer any questions

309

00:12:48,040 --> 00:12:19,100

we have time for before like two or

310

00:12:53,930 --> 00:12:50,740

that's an interesting question

311

00:12:55,819 --> 00:12:53,940

I'm not sure on the on the electron

312

00:12:59,269 --> 00:12:55,829

bombardment are our new setups going to

313

00:13:00,920 --> 00:12:59,279

have electron guns capable of doing this

314

00:13:04,160 --> 00:13:00,930

this was a proof-of-concept so we only

315

00:13:06,560 --> 00:13:04,170

do one point and so we'd like to go back

316

00:13:08,600 --> 00:13:06,570

and do the measurements where we can

317

00:13:09,699 --> 00:13:08,610

actually change the energies and change

318

00:13:13,610 --> 00:13:09,709

the fluence --is and see which

319

00:13:15,259 --> 00:13:13,620

parameters are most important I've got a

320

00:13:16,699 --> 00:13:15,269

theory on the electron with which ones

321

00:13:20,480 --> 00:13:16,709

which energy levels might be the biggest

322

00:13:33,160 --> 00:13:20,490

one but I'm not sure you know we can go

323

00:13:40,100 --> 00:13:36,410

that's I don't know I have to I have to

324

00:13:42,019 --> 00:13:40,110

go change that in there I'm yeah no no

325

00:13:43,910 --> 00:13:42,029

and this is a kind of a new area for us

326

00:13:45,170 --> 00:13:43,920

as well and so I'm learning a lot about

327

00:13:47,090 --> 00:13:45,180

the different ways to look at the data

328

00:13:49,699 --> 00:13:47,100

I'll plot the data one way I go back and

329

00:13:50,870 --> 00:13:49,709

say wait a minute you know that's a good

330

00:13:55,410 --> 00:13:50,880

idea I gotta go back and try this one

331

00:13:55,420 --> 00:14:11,389

another quick question hi

332

00:14:16,139 --> 00:14:13,500

that's a good question and I'm trying to

333

00:14:18,930 --> 00:14:16,149

figure out the mass spectra is a complex

334

00:14:20,460 --> 00:14:18,940

mixture right now I'm really curious but

335

00:14:22,259 --> 00:14:20,470

we're going to see when we do these

336

00:14:24,750 --> 00:14:22,269

experiments we can do them in situ and

337

00:14:27,480 --> 00:14:24,760

combine the infrared the Raman and the

338

00:14:29,250 --> 00:14:27,490

mass spec and especially doing it but

339

00:14:30,780 --> 00:14:29,260

with the pH by itself and the pH with

340

00:14:32,910 --> 00:14:30,790

water ice and pH with different things

341

00:14:34,259 --> 00:14:32,920

in there I'm really curious what kind of

342

00:14:36,240 --> 00:14:34,269

chemistry you're going I wouldn't I

343

00:14:37,620 --> 00:14:36,250

wouldn't be surprised if you start

344

00:14:41,130 --> 00:14:37,630

changing stuff around we know we know we

345

00:14:42,860 --> 00:14:41,140

and we do stuff with the UV and organic

346

00:14:46,110 --> 00:14:42,870

mixtures in a water ice and we make

347

00:14:47,790 --> 00:14:46,120

nuclear bases and stuff like that this

348

00:14:49,470 --> 00:14:47,800

is coming from the top down again so I

349

00:14:51,030 --> 00:14:49,480

wouldn't be surprised but I don't know I

350

00:14:53,220 --> 00:14:51,040

have to do the experiments to find out I

351

00:14:58,230 --> 00:14:53,230

mean excited by getting this stuff up

352

00:15:01,910 --> 00:14:58,240

and running and doing it so yeah thank