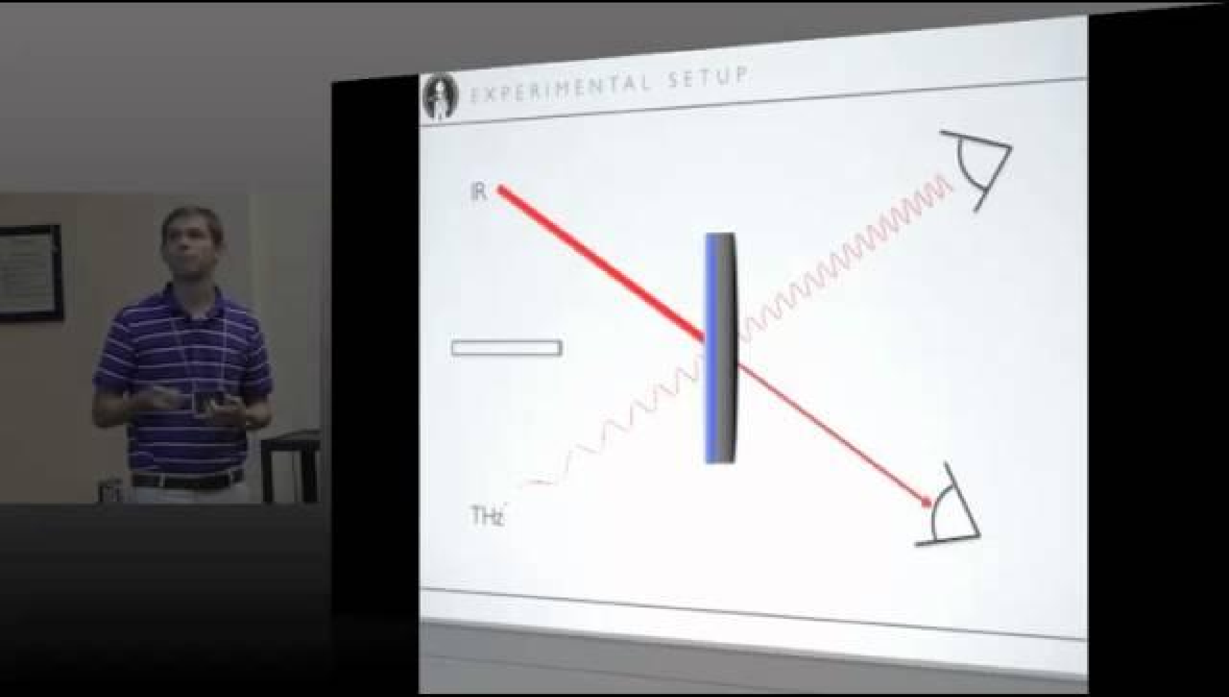
EXPERIMENTAL SETUP
IR
THz

1
00:00:11,420 --> 00:00:09,020
alright great well I'm really excited to

2
00:00:13,160 --> 00:00:11,430
be following these talks because last

3
00:00:14,779 --> 00:00:13,170
few have concentrated on prebiotic

4
00:00:18,050 --> 00:00:14,789
chemistry in the early Earth and I want

5
00:00:21,350 --> 00:00:18,060
to go even earlier about this early in

6
00:00:23,630 --> 00:00:21,360
the formation of the earth so when I

7
00:00:26,170 --> 00:00:23,640
think about the life cycle I think on a

8
00:00:28,370 --> 00:00:26,180
more cosmic scale where we start with a

9
00:00:31,130 --> 00:00:28,380
protoplanetary nebula here which

10
00:00:33,680 --> 00:00:31,140
eventually as a star turns on collapses

11
00:00:36,920 --> 00:00:33,690
down to form a protoplanetary disk thin

12
00:00:38,959 --> 00:00:36,930
that disk you get condensation of dust

13
00:00:41,329 --> 00:00:38,969

grains and Isis into larger bodies

14
00:00:44,119 --> 00:00:41,339
comets asteroids planetesimals and

15
00:00:46,009 --> 00:00:44,129
eventually planets and then on those

16
00:00:47,630 --> 00:00:46,019
planets you eventually get the impact of

17
00:00:49,819 --> 00:00:47,640
a lot of the leftover comets and

18
00:00:52,189 --> 00:00:49,829
asteroids and at some point in this life

19
00:00:55,630 --> 00:00:52,199
cycle life is formed and then is

20
00:00:59,799 --> 00:00:55,640
destroyed in a fiery explosion and

21
00:01:05,329 --> 00:00:59,809
returned back into the cosmic lifecycle

22
00:01:08,480 --> 00:01:05,339
so we've heard a lot about getting life

23
00:01:10,070 --> 00:01:08,490
from say amino acids as a starting

24
00:01:12,470 --> 00:01:10,080
material and we all know that amino

25
00:01:15,410 --> 00:01:12,480
acids are found in comets from the start

26
00:01:17,240 --> 00:01:15,420
up mission or meteoritic samples but

27
00:01:19,070 --> 00:01:17,250
what we don't know in my field

28
00:01:20,390 --> 00:01:19,080
astrochemistry is how the heck those

29
00:01:22,160 --> 00:01:20,400
things got there in the first place

30
00:01:24,800 --> 00:01:22,170
there's been a lot of theories but

31
00:01:27,170 --> 00:01:24,810
there's no proof definitive proof of how

32
00:01:29,300 --> 00:01:27,180
those amino acids glycine being that the

33
00:01:33,050 --> 00:01:29,310
simplest and most abundant one we found

34
00:01:36,080 --> 00:01:33,060
got their start with so I'm interested

35
00:01:39,440 --> 00:01:36,090
in exactly where in this cycle from the

36
00:01:41,240 --> 00:01:39,450
protoplanetary nebula to even impact on

37
00:01:43,040 --> 00:01:41,250
the planet did glycine form that it

38
00:01:47,150 --> 00:01:43,050

formed the gas phase one of these two

39
00:01:49,610 --> 00:01:47,160
phases did it form in the icy surfaces

40
00:01:51,350 --> 00:01:49,620
of dust grains anywhere along this path

41
00:01:53,870 --> 00:01:51,360
or did you have to wait until you're in

42
00:01:55,400 --> 00:01:53,880
the bulk ice on comets or even there's

43
00:01:58,940 --> 00:01:55,410
been some theoretical papers that say if

44
00:02:01,070 --> 00:01:58,950
you smash a comment into the earth the

45
00:02:03,380 --> 00:02:01,080
heat of that impact can drive the

46
00:02:10,009 --> 00:02:03,390
formation of a whole bunch of organic

47
00:02:11,449 --> 00:02:10,019
molecules so last year I presented on

48
00:02:14,570 --> 00:02:11,459
the search for a molecule called

49
00:02:16,940 --> 00:02:14,580
hydroxylamine here n h 2o h and this was

50
00:02:19,140 --> 00:02:16,950
kind of the last gasp for trying to form

51
00:02:20,940 --> 00:02:19,150
glycine in the gas phase

52
00:02:22,380 --> 00:02:20,950
this reaction with acetic acid which is

53
00:02:26,429 --> 00:02:22,390
very abundant in the interstellar medium

54
00:02:28,050 --> 00:02:26,439
directly forms glycine and NH 2 H was

55
00:02:30,089 --> 00:02:28,060
predicted by us for chemical models to

56
00:02:32,460 --> 00:02:30,099
be quite abundant but as it turned out

57
00:02:34,140 --> 00:02:32,470
we couldn't find it at all in fact our

58
00:02:35,520 --> 00:02:34,150
upper limits were about a million times

59
00:02:38,429 --> 00:02:35,530
less than what was predicted by the

60
00:02:40,289 --> 00:02:38,439
theories and then some very recent

61
00:02:42,000 --> 00:02:40,299
theoretical work has said this reaction

62
00:02:44,339 --> 00:02:42,010
has a reaction berry and won't go in the

63
00:02:46,259 --> 00:02:44,349

gas phase in the is M anyways so that

64
00:02:48,059 --> 00:02:46,269
kind of Nyx's the formation of glycine

65
00:02:49,920 --> 00:02:48,069
in the gas phase as long as as far as

66
00:02:52,440 --> 00:02:49,930
we're concerned so that leaves us with

67
00:02:55,170 --> 00:02:52,450
the solid phase and just about four

68
00:02:57,960 --> 00:02:55,180
months ago a very talented astro

69
00:03:00,899 --> 00:02:57,970
chemical modeller Rob Garrard use a

70
00:03:04,410 --> 00:03:00,909
complex gas grain reaction Network to

71
00:03:07,440 --> 00:03:04,420
see if he could form glycine in the icy

72
00:03:09,360 --> 00:03:07,450
mantels of dust grains and in fact he

73
00:03:11,250 --> 00:03:09,370
finds yeah we can form it and then we

74
00:03:14,099 --> 00:03:11,260
can actually pop it off from those dust

75
00:03:16,860 --> 00:03:14,109
grains into the gas phase and use Alma

76
00:03:19,080 --> 00:03:16,870
our most sensitive radio telescope to

77
00:03:21,690 --> 00:03:19,090
detect it there's the signal the

78
00:03:24,300 --> 00:03:21,700
strongest signal from glycine towards a

79
00:03:27,750 --> 00:03:24,310
nearby star forming region that's really

80
00:03:30,000 --> 00:03:27,760
cool but the accuracy of these gas grain

81
00:03:31,559 --> 00:03:30,010
chemical networks relies necessarily on

82
00:03:33,270 --> 00:03:31,569
how well we know the starting parameters

83
00:03:35,460 --> 00:03:33,280
what's available to work within these

84
00:03:36,720 --> 00:03:35,470
Isis how much is there there of it and

85
00:03:40,319 --> 00:03:36,730
what's the temperature of these

86
00:03:41,759 --> 00:03:40,329
molecules and the problem is in Isis we

87
00:03:43,740 --> 00:03:41,769
know very little about what's actually

88
00:03:46,470 --> 00:03:43,750

there we think we know a lot but we have

89
00:03:48,839 --> 00:03:46,480
very little proof this is a list of

90
00:03:51,000 --> 00:03:48,849
detected molecules in Isis we know about

91
00:03:53,280 --> 00:03:51,010
a hundred and seventy or so molecules in

92
00:03:54,990 --> 00:03:53,290
the interstellar medium the ones that

93
00:03:56,610 --> 00:03:55,000
aren't in brackets are the only ones

94
00:03:58,500 --> 00:03:56,620
that are confirmed to be a nice as the

95
00:04:00,479 --> 00:03:58,510
ones in brackets we think we see what

96
00:04:02,640 --> 00:04:00,489
we're not certain and these are the

97
00:04:05,550 --> 00:04:02,650
major ice constituents you see here are

98
00:04:06,899 --> 00:04:05,560
actually quite simple molecules and the

99
00:04:08,399 --> 00:04:06,909
reason we're having so much trouble is

100
00:04:10,199 --> 00:04:08,409
because these observations are being

101
00:04:11,849 --> 00:04:10,209
done in the infrared the infrared is

102
00:04:14,369 --> 00:04:11,859
great for getting simple abundant

103
00:04:16,319 --> 00:04:14,379
molecules but it suffers a bit for a few

104
00:04:18,330 --> 00:04:16,329
reasons you have to do all of your

105
00:04:20,189 --> 00:04:18,340
observations in absorption for the most

106
00:04:22,800 --> 00:04:20,199
part which means that the ice that

107
00:04:24,480 --> 00:04:22,810
you're looking at behind it on a direct

108
00:04:26,640 --> 00:04:24,490
line of sight to us has to be a really

109
00:04:28,980 --> 00:04:26,650
bright source to absorb against that's

110
00:04:30,779 --> 00:04:28,990
usually a star and that really limits

111
00:04:32,730 --> 00:04:30,789
the number of places we can go looking

112
00:04:35,070 --> 00:04:32,740
for so our sample size is low too

113
00:04:37,469 --> 00:04:35,080

art with and the features in the

114
00:04:39,180 --> 00:04:37,479
infrared are usually broad and they

115
00:04:40,620 --> 00:04:39,190
blend together in these Isis and you

116
00:04:42,120 --> 00:04:40,630
really have to have an abundant molecule

117
00:04:44,580 --> 00:04:42,130
with distinct features to pick them out

118
00:04:45,990 --> 00:04:44,590
if you want to look in a mission that

119
00:04:48,330 --> 00:04:46,000
would be cool you wouldn't have to have

120
00:04:49,980 --> 00:04:48,340
a background star but the problem is if

121
00:04:51,689 --> 00:04:49,990
you want to fall on the part of the

122
00:04:54,240 --> 00:04:51,699
blackbody radiation curve where you can

123
00:04:56,490 --> 00:04:54,250
actually get light out of the grains in

124
00:04:58,290 --> 00:04:56,500
a detectable amount the grains have to

125
00:04:59,999 --> 00:04:58,300
be so hot that you can't have ice on

126
00:05:01,350 --> 00:05:00,009
them in the first place the other

127
00:05:02,999 --> 00:05:01,360
problem is the clouds that you're

128
00:05:04,710 --> 00:05:03,009
emitting from have such a high optical

129
00:05:06,960 --> 00:05:04,720
depth those photons just can't escape

130
00:05:10,170 --> 00:05:06,970
first part so you're kind of screwed for

131
00:05:11,999 --> 00:05:10,180
a mission and in the laboratory you're

132
00:05:13,499 --> 00:05:12,009
in directly measuring the optical

133
00:05:16,800 --> 00:05:13,509
constants that's n the index of

134
00:05:18,120 --> 00:05:16,810
refraction k the amount of absorption

135
00:05:20,610 --> 00:05:18,130
you get through here and these are

136
00:05:22,439 --> 00:05:20,620
really important for modelers who are

137
00:05:24,270 --> 00:05:22,449
looking at radiative transfer so how

138
00:05:28,320 --> 00:05:24,280

light gets through different layers of

139
00:05:29,939 --> 00:05:28,330
Isis say and unfortunately in directly

140
00:05:31,230 --> 00:05:29,949
measuring these in the infrared produces

141
00:05:33,180 --> 00:05:31,240
errors and those errors propagate

142
00:05:36,149 --> 00:05:33,190
through and make these calculations a

143
00:05:38,040 --> 00:05:36,159
little wishy-washy so what I want to do

144
00:05:39,540 --> 00:05:38,050
is see if we can get a little bit better

145
00:05:40,980 --> 00:05:39,550
by looking in the terahertz region of

146
00:05:43,140 --> 00:05:40,990
the spectrum so my background is in

147
00:05:46,920 --> 00:05:43,150
laboratory microwave spectroscopy and

148
00:05:48,959 --> 00:05:46,930
submillimetre spectroscopy and in space

149
00:05:51,180 --> 00:05:48,969
astronomical observations in absorption

150
00:05:53,430 --> 00:05:51,190
you don't need a background star to

151
00:05:55,409 --> 00:05:53,440
absorb in the terahertz the black and

152
00:05:57,029 --> 00:05:55,419
grey body radiation coming off of dust

153
00:05:58,770 --> 00:05:57,039
is sufficiently you can just absorb

154
00:06:00,450 --> 00:05:58,780
against the background continuum so we

155
00:06:03,540 --> 00:06:00,460
can look at a whole lot more place as a

156
00:06:05,219 --> 00:06:03,550
wider sample set and there might

157
00:06:06,809 --> 00:06:05,229
actually be some narrower features here

158
00:06:09,420 --> 00:06:06,819
and the terahertz features tend to be a

159
00:06:11,399 --> 00:06:09,430
little more distinct spectrally we can

160
00:06:13,709 --> 00:06:11,409
also look at a mission because the

161
00:06:15,469 --> 00:06:13,719
blackbody curve allows us to have colder

162
00:06:18,629 --> 00:06:15,479
ice grains that are emitting photons

163
00:06:20,010 --> 00:06:18,639

that we can see especially since there's

164
00:06:21,300 --> 00:06:20,020
a lower optical depth in the terahertz

165
00:06:24,290 --> 00:06:21,310
so they have a better chance of reaching

166
00:06:26,969 --> 00:06:24,300
us so we can look at their signals and

167
00:06:28,649 --> 00:06:26,979
we can also directly measure the optical

168
00:06:31,680 --> 00:06:28,659
constants so we get are so much higher

169
00:06:34,020 --> 00:06:31,690
accuracy and the terahertz so what's our

170
00:06:36,659 --> 00:06:34,030
experimental tech what's been done in

171
00:06:38,189 --> 00:06:36,669
the terahertz so far experimentally well

172
00:06:39,409 --> 00:06:38,199
some people have tried to cheat they

173
00:06:42,029 --> 00:06:39,419
take a Fourier transform infrared

174
00:06:43,890 --> 00:06:42,039
spectrometer and push it out of spec and

175
00:06:45,719 --> 00:06:43,900
then get all the way down to about three

176
00:06:48,119 --> 00:06:45,729
terahertz which is pretty good

177
00:06:50,820 --> 00:06:48,129
and they have fairly decent resolution

178
00:06:52,290 --> 00:06:50,830
about one wave number but you're still

179
00:06:54,059 --> 00:06:52,300
in directly measuring the optical

180
00:06:56,429 --> 00:06:54,069
constants and the work done so far has

181
00:06:59,659 --> 00:06:56,439
been largely on these known interstellar

182
00:07:01,709 --> 00:06:59,669
molecules so water methanol ammonia

183
00:07:04,920 --> 00:07:01,719
simple things that we already know are

184
00:07:06,540 --> 00:07:04,930
there so what we want to do is see if we

185
00:07:08,159 --> 00:07:06,550
can look at some more interesting

186
00:07:10,649 --> 00:07:08,169
molecules that we think have to be in

187
00:07:13,260 --> 00:07:10,659
these Isis to form glycine but we're not

188
00:07:15,179 --> 00:07:13,270

certain so we take a silicon substrate

189
00:07:17,909 --> 00:07:15,189
ins few millimeters thick and cool it

190
00:07:22,260 --> 00:07:17,919
down to between 10 and 150 Kelvin and an

191
00:07:24,929 --> 00:07:22,270
evacuated healing cryostat we spray gas

192
00:07:28,589 --> 00:07:24,939
phase molecules at it and they freeze

193
00:07:30,600 --> 00:07:28,599
into a layer of ice so this is a really

194
00:07:32,480 --> 00:07:30,610
simple technique and then we can shoot

195
00:07:35,369 --> 00:07:32,490
radiation through it so we have our own

196
00:07:37,529 --> 00:07:35,379
ftir here for diagnostic purposes and

197
00:07:38,969 --> 00:07:37,539
then we can shoot terahertz through the

198
00:07:43,170 --> 00:07:38,979
other way and we detect these signals

199
00:07:44,519 --> 00:07:43,180
and transfer them to absorption spectra

200
00:07:46,920 --> 00:07:44,529
so here's a layout of the actual

201
00:07:49,679 --> 00:07:46,930
spectrometer we have our silicon

202
00:07:52,350 --> 00:07:49,689
substrate here in our cryo set our ftir

203
00:07:54,360 --> 00:07:52,360
gets bounced in the way we generate our

204
00:07:55,920 --> 00:07:54,370
terahertz is actually really cool we

205
00:07:59,550 --> 00:07:55,930
take a really high-powered laser

206
00:08:01,350 --> 00:07:59,560
operating at 800 nanometers we frequency

207
00:08:03,300 --> 00:08:01,360
double some of the light so we have two

208
00:08:05,820 --> 00:08:03,310
colors of light going into our nitrogen

209
00:08:07,879 --> 00:08:05,830
purge box and then we focus it down if

210
00:08:10,170 --> 00:08:07,889
you focus it right it turns into a

211
00:08:13,079 --> 00:08:10,180
plasma in air it looks like a little

212
00:08:14,969 --> 00:08:13,089
miniature Sun and it's the oscillation

213
00:08:17,070 --> 00:08:14,979

of electrons back and forth in this

214
00:08:21,119 --> 00:08:17,080
plasma that emits a very broad very

215
00:08:22,529 --> 00:08:21,129
intense burst of terahertz radiation so

216
00:08:24,480 --> 00:08:22,539
we take that focus it through the sample

217
00:08:25,949 --> 00:08:24,490
and then detect it on the other side

218
00:08:27,480 --> 00:08:25,959
using what's called electro-optical

219
00:08:29,129 --> 00:08:27,490
rectification which is a really cool

220
00:08:31,320 --> 00:08:29,139
technique that I don't have time to talk

221
00:08:33,089 --> 00:08:31,330
about suffice it to say what it does is

222
00:08:35,370 --> 00:08:33,099
it directly measures the electric field

223
00:08:37,259 --> 00:08:35,380
of our pulse that's how we can get these

224
00:08:38,939 --> 00:08:37,269
optical constants out directly we don't

225
00:08:41,490 --> 00:08:38,949
have to do any Kramer's chromate kroenig

226
00:08:44,519 --> 00:08:41,500
analyses or other assumptions get these

227
00:08:47,220 --> 00:08:44,529
optical constants out right now we can

228
00:08:50,730 --> 00:08:47,230
cover from about 300 gigahertz to 7.5

229
00:08:52,710 --> 00:08:50,740
terahertz at modest resolution within

230
00:08:54,630 --> 00:08:52,720
the next few months we know we can get

231
00:08:56,879 --> 00:08:54,640
ourselves probably up to about 20

232
00:08:59,579 --> 00:08:56,889
terahertz in broadband but

233
00:09:02,400 --> 00:08:59,589
and down to about a factor of 10 better

234
00:09:03,869 --> 00:09:02,410
and resolution so this is what we've

235
00:09:05,669 --> 00:09:03,879
looked at so far we've had our

236
00:09:08,249 --> 00:09:05,679
instrument operating for about a little

237
00:09:10,979 --> 00:09:08,259
over a month at this level of efficiency

238
00:09:13,139 --> 00:09:10,989

we've done the simple Isis so far as

239
00:09:17,039 --> 00:09:13,149
well as methyl formate here which is a

240
00:09:18,539 --> 00:09:17,049
very well-known interstellar weed in a

241
00:09:20,189 --> 00:09:18,549
more complex molecule and we've also

242
00:09:21,929 --> 00:09:20,199
started to do some mixtures and I think

243
00:09:23,629 --> 00:09:21,939
my labmates back home have actually run

244
00:09:25,559 --> 00:09:23,639
a few more mixtures while I've been here

245
00:09:27,629 --> 00:09:25,569
so I'm just going to show you results

246
00:09:29,789 --> 00:09:27,639
from to hear the simplest and the most

247
00:09:31,859 --> 00:09:29,799
complex pure species we've run because

248
00:09:32,789 --> 00:09:31,869
their spectra they're cool to look at

249
00:09:34,259 --> 00:09:32,799
but they're all going to look kind of

250
00:09:37,259 --> 00:09:34,269
the same if I show you everything we've

251
00:09:40,349 --> 00:09:37,269
done so here's water the most abundant

252
00:09:42,059 --> 00:09:40,359
interstellar ice and what we have here

253
00:09:44,489 --> 00:09:42,069
are just three different thicknesses so

254
00:09:45,989 --> 00:09:44,499
we started putting down ice and we

255
00:09:48,210 --> 00:09:45,999
gradually increase the thickness and

256
00:09:50,759 --> 00:09:48,220
kept taking absorption spectra from

257
00:09:52,049 --> 00:09:50,769
about 300 gigahertz up to seven and a

258
00:09:54,239 --> 00:09:52,059
half terahertz and you can see here

259
00:09:56,249 --> 00:09:54,249
these nice distinct absorption features

260
00:09:57,509 --> 00:09:56,259
are growing in right out in the

261
00:10:00,150 --> 00:09:57,519
terahertz region that we're interested

262
00:10:01,739 --> 00:10:00,160
in it we can also tell the difference in

263
00:10:03,809 --> 00:10:01,749

the structure of the ice so if you

264
00:10:05,369 --> 00:10:03,819
deposit at a higher temperature there's

265
00:10:07,769 --> 00:10:05,379
energy for these molecules to move

266
00:10:11,249 --> 00:10:07,779
around and get into a formation that

267
00:10:12,900 --> 00:10:11,259
they like kristalyn if you deposit at a

268
00:10:15,150 --> 00:10:12,910
lower temperature say down at 10 Kelvin

269
00:10:17,220 --> 00:10:15,160
here they just stick in whatever way

270
00:10:19,859 --> 00:10:17,230
that they actually hit the ice and they

271
00:10:21,389 --> 00:10:19,869
they form an or morphus solid so you can

272
00:10:23,759 --> 00:10:21,399
see the difference in sharp distinct

273
00:10:27,179 --> 00:10:23,769
features versus a just kind of blobby

274
00:10:28,739 --> 00:10:27,189
thing here and the formation of this ice

275
00:10:31,109 --> 00:10:28,749
the weather its crystalline or amorphous

276
00:10:32,669 --> 00:10:31,119
is a big question in an astro chemistry

277
00:10:34,559 --> 00:10:32,679
right now it has a big impact on the way

278
00:10:36,840 --> 00:10:34,569
the molecules move around inside the ice

279
00:10:40,679 --> 00:10:36,850
to react the matrix that they have to

280
00:10:42,179 --> 00:10:40,689
work with so here's methyl formate it's

281
00:10:44,129 --> 00:10:42,189
the poster child for grain surface

282
00:10:46,710 --> 00:10:44,139
chemistry in the is em as far as we know

283
00:10:48,929 --> 00:10:46,720
we can't form this in the gas phase at

284
00:10:50,549 --> 00:10:48,939
all there's a whole whopping ton of it

285
00:10:52,019 --> 00:10:50,559
out there it pollutes our spector all

286
00:10:54,569 --> 00:10:52,029
the time and it has to be formed on the

287
00:10:56,340 --> 00:10:54,579
grain surfaces despite that there's no

288
00:10:57,809 --> 00:10:56,350

definitive detection of it or gneisses

289
00:11:01,139 --> 00:10:57,819
so if we can do that that would be

290
00:11:02,729 --> 00:11:01,149
fantastic and it's rather complex

291
00:11:03,929 --> 00:11:02,739
structure so maybe we can see some

292
00:11:06,210 --> 00:11:03,939
interesting features from it and the

293
00:11:07,799 --> 00:11:06,220
terahertz the same kind of plot we're

294
00:11:10,590 --> 00:11:07,809
just making the ice thicker and thicker

295
00:11:12,030 --> 00:11:10,600
as it grows in you can see here we got

296
00:11:13,590 --> 00:11:12,040
actually a lot more structure to the

297
00:11:15,629 --> 00:11:13,600
spectrum than we had in water and in

298
00:11:18,360 --> 00:11:15,639
different places which is fantastic for

299
00:11:20,370 --> 00:11:18,370
distinguishing things we can also look

300
00:11:23,009 --> 00:11:20,380
at crystal and versus amorphous again

301
00:11:24,600 --> 00:11:23,019
and you see here we're excited really

302
00:11:26,309 --> 00:11:24,610
excited about this spectra because these

303
00:11:28,170 --> 00:11:26,319
seem to be very sharp very distinct

304
00:11:29,400 --> 00:11:28,180
features even at low resolution so if

305
00:11:31,079 --> 00:11:29,410
you can imagine ten times better

306
00:11:32,759 --> 00:11:31,089
resolution on this and a couple months

307
00:11:36,329 --> 00:11:32,769
we think we're going to get some really

308
00:11:38,189 --> 00:11:36,339
interesting features here so where are

309
00:11:40,199 --> 00:11:38,199
we going next with this well we want to

310
00:11:42,809 --> 00:11:40,209
compare to the Herschel data archive and

311
00:11:44,519 --> 00:11:42,819
the spectra that are coming off of the

312
00:11:46,170 --> 00:11:44,529
almost science verification data these

313
00:11:48,180 --> 00:11:46,180

operate real near are interested

314
00:11:50,309 --> 00:11:48,190
frequency range these are

315
00:11:51,930 --> 00:11:50,319
state-of-the-art facilities and the data

316
00:11:52,860 --> 00:11:51,940
is all publicly available within the

317
00:11:55,470 --> 00:11:52,870
next year or two which would be

318
00:11:58,139 --> 00:11:55,480
fantastic ideally we'd like to operate

319
00:12:00,389 --> 00:11:58,149
with Sofia the Fifi instrument exactly

320
00:12:01,769 --> 00:12:00,399
mimics our frequency range and about the

321
00:12:04,860 --> 00:12:01,779
same resolution which would be fantastic

322
00:12:06,420 --> 00:12:04,870
but it hasn't come online yet science

323
00:12:07,740 --> 00:12:06,430
testing is just coming up for this new

324
00:12:09,689 --> 00:12:07,750
proposal cycle and they're offering

325
00:12:11,939 --> 00:12:09,699
seven and a half hours of which we're

326
00:12:14,160 --> 00:12:11,949
going to get none so we're going to have

327
00:12:16,530 --> 00:12:14,170
to wait a year to look at that but we're

328
00:12:18,090 --> 00:12:16,540
really excited because even these

329
00:12:19,679 --> 00:12:18,100
preliminary results show that we should

330
00:12:20,939 --> 00:12:19,689
be able to identify some more complex

331
00:12:23,670 --> 00:12:20,949
molecules and get a better understanding

332
00:12:26,730 --> 00:12:23,680
of what we have to work with to make

333
00:12:30,480 --> 00:12:26,740
glycine and other amino acids not on

334
00:12:32,550 --> 00:12:30,490
earth but before we got here with that

335
00:12:40,139 --> 00:12:32,560
sources of funding and acknowledgments

336
00:12:52,000 --> 00:12:40,149
and thank you for your attention all

337
00:12:57,560 --> 00:12:55,910
are you planning to propose of your

338
00:13:00,560 --> 00:12:57,570

observations for the next cycle or do

339
00:13:02,630 --> 00:13:00,570
you want to wait for working and

340
00:13:03,800 --> 00:13:02,640
commissioning Oh Fifi yeah we're gonna

341
00:13:06,590 --> 00:13:03,810
have to wait for the commissioning and

342
00:13:08,690 --> 00:13:06,600
safety to go online the great instrument

343
00:13:10,190 --> 00:13:08,700
theoretically covers a good frequency

344
00:13:12,380 --> 00:13:10,200
range but the windows they're offering

345
00:13:15,050 --> 00:13:12,390
are so small they cover maybe one or two

346
00:13:17,360 --> 00:13:15,060
of our resolution elements right now so

347
00:13:19,100 --> 00:13:17,370
it's just not a broadband enough system

348
00:13:20,990 --> 00:13:19,110
we'd love to use Fifi but we don't think

349
00:13:35,500 --> 00:13:21,000
we have a shot at seven and a half hours

350
00:13:40,790 --> 00:13:37,970
so I realize this is an incredibly long

351
00:13:43,190 --> 00:13:40,800
shot but what are the prospects if any

352
00:13:44,600 --> 00:13:43,200
for eventually ever detecting a chiral

353
00:13:48,140 --> 00:13:44,610
signature in this glycine or anything

354
00:13:50,720 --> 00:13:48,150
like that ah well I don't I don't know

355
00:13:53,840 --> 00:13:50,730
what how much to give away here there

356
00:13:56,510 --> 00:13:53,850
are there have been reports mumblings

357
00:13:59,330 --> 00:13:56,520
among my colleagues of some possible

358
00:14:00,590 --> 00:13:59,340
detection of some tyrol molecules most

359
00:14:02,720 --> 00:14:00,600
of these are just single line detection

360
00:14:03,860 --> 00:14:02,730
right now so that's just one spectral

361
00:14:05,840 --> 00:14:03,870
feature not enough to definitively

362
00:14:08,810 --> 00:14:05,850
identify anything but i would say

363
00:14:12,290 --> 00:14:08,820

especially with Alma coming online fully

364
00:14:13,880 --> 00:14:12,300
within the next year or so and we should

365
00:14:17,510 --> 00:14:13,890
we should see some detection of chiral

366
00:14:24,800 --> 00:14:17,520
molecules shortly I think awesome thank

367
00:14:28,340 --> 00:14:24,810
you yeah just to follow up can you there

368
00:14:30,530 --> 00:14:28,350
any ice topic ratio so you can go can we

369
00:14:34,580 --> 00:14:30,540
get isotopic ratios uh yeah absolutely

370
00:14:37,400 --> 00:14:34,590
um so I mean we pick up h2d ratios all

371
00:14:40,070 --> 00:14:37,410
the time and that's actually how we're

372
00:14:41,360 --> 00:14:40,080
trying not us but Astra chemical

373
00:14:44,510 --> 00:14:41,370
modelers are trying to understand the

374
00:14:45,590 --> 00:14:44,520
infall of water to former assoc from the

375
00:14:49,460 --> 00:14:45,600
different parts of forming

376
00:14:51,410 --> 00:14:49,470
protoplanetary disks carbon-12 carbon-13

377
00:14:54,290 --> 00:14:51,420
ratios are easy to pick up from carbon

378
00:14:59,480 --> 00:14:54,300
monoxide measurements as well as oxygen

379
00:15:00,920 --> 00:14:59,490
18 17 ratios yeah all right well if

380
00:15:02,329 --> 00:15:00,930
that's it can we give a hand for all