
AbSciCon
2019

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

2
00:00:11,540 --> 00:00:09,070
[Applause]

3
00:00:13,490 --> 00:00:11,550
I'm delighted to be here today as a

4
00:00:15,110 --> 00:00:13,500
representative a team that's developed

5
00:00:17,780 --> 00:00:15,120
this origins of life laboratory in

6
00:00:19,220 --> 00:00:17,790
McMaster University the PI for this

7
00:00:21,170 --> 00:00:19,230
effort was Michael Reince Tedder

8
00:00:23,929 --> 00:00:21,180
biophysicist I am an astrophysicist

9
00:00:25,550 --> 00:00:23,939
young Fuli is a biochemist kind of a

10
00:00:29,150 --> 00:00:25,560
dream team in some way for an

11
00:00:32,179 --> 00:00:29,160
astrobiology setup I want to emphasize

12
00:00:33,890 --> 00:00:32,189
then that the key question that were

13
00:00:35,660 --> 00:00:33,900

interested in the origins of life one of

14
00:00:37,819 --> 00:00:35,670
the big questions is the role of

15
00:00:40,970 --> 00:00:37,829
information where does it come from how

16
00:00:43,369 --> 00:00:40,980
does it develop can it evolve the RNA

17
00:00:45,619 --> 00:00:43,379
world hypothesis provides a basis for

18
00:00:48,889 --> 00:00:45,629
thinking about that seems to be active

19
00:00:51,709 --> 00:00:48,899
in all young cells and coming to the

20
00:00:54,229 --> 00:00:51,719
talk earlier that we saw today the kind

21
00:00:56,630 --> 00:00:54,239
of environmental problems that you face

22
00:00:58,520 --> 00:00:56,640
in building up RNA polymers as you can

23
00:01:00,380 --> 00:00:58,530
see in warm little pond environments

24
00:01:02,419 --> 00:01:00,390
you've got UV that can destroy you

25
00:01:06,050 --> 00:01:02,429
you've got seepage at a bottom of ponds

26
00:01:07,520 --> 00:01:06,060
you have hydrolysis fighting you against

27
00:01:09,710 --> 00:01:07,530
this you've got a polymerization

28
00:01:11,740 --> 00:01:09,720
occurring at some rate in some kind of

29
00:01:13,789 --> 00:01:11,750
media and this is a beautiful

30
00:01:17,149 --> 00:01:13,799
experimental question that kind of

31
00:01:19,249 --> 00:01:17,159
defies easy simple theoretical address

32
00:01:21,520 --> 00:01:19,259
questions - so this has been our

33
00:01:24,200 --> 00:01:21,530
motivation in building up a laboratory

34
00:01:27,980 --> 00:01:24,210
which starts given that we're supposed

35
00:01:30,260 --> 00:01:27,990
to have molecules etc around nucleotides

36
00:01:32,600 --> 00:01:30,270
in this case lipids perhaps delivered

37
00:01:34,999 --> 00:01:32,610
from meteorites and the question is what

38
00:01:38,149 --> 00:01:35,009

happens next the first step how do we

39
00:01:39,859 --> 00:01:38,159
get polymers so in the as is shown in

40
00:01:41,270 --> 00:01:39,869
your diagram here we all know the

41
00:01:43,429 --> 00:01:41,280
importance of these condensation

42
00:01:45,020 --> 00:01:43,439
reactions particularly driven home by

43
00:01:48,830 --> 00:01:45,030
the work of David Deamer and his

44
00:01:50,840 --> 00:01:48,840
collaborators and in the situation that

45
00:01:52,219 --> 00:01:50,850
we're interested in warm little ponds or

46
00:01:55,700 --> 00:01:52,229
environments like this where we can

47
00:01:57,770 --> 00:01:55,710
easily have such warm wet dry cycles as

48
00:02:00,859 --> 00:01:57,780
well as thermal cycles that are driving

49
00:02:03,889 --> 00:02:00,869
the condensation reactions you see here

50
00:02:06,050 --> 00:02:03,899
some one of some nucleotides laying down

51
00:02:09,139 --> 00:02:06,060
on some layer which can be complicated

52
00:02:10,880 --> 00:02:09,149
there can be lipids clays salts various

53
00:02:14,120 --> 00:02:10,890
kinds of things mixed in this messy

54
00:02:16,640 --> 00:02:14,130
prebiotic environment we have heat and

55
00:02:18,979 --> 00:02:16,650
rise driving the thermal aspects of this

56
00:02:21,260 --> 00:02:18,989
the wedding and drawing allows you to

57
00:02:23,360 --> 00:02:21,270
form in one cycle a dime

58
00:02:25,430 --> 00:02:23,370
and there's some ability of these

59
00:02:28,850 --> 00:02:25,440
molecules afterwards during the wet

60
00:02:30,980 --> 00:02:28,860
phase during the next dry phase dimer

61
00:02:34,040 --> 00:02:30,990
can make dimer if appropriate conditions

62
00:02:37,280 --> 00:02:34,050
you have a former and by this process

63
00:02:40,760 --> 00:02:37,290

the important role of surfaces here can

64
00:02:43,640 --> 00:02:40,770
actually help this process along so this

65
00:02:45,260 --> 00:02:43,650
is the perfect kind of physical and

66
00:02:48,220 --> 00:02:45,270
chemical setup that motivates our

67
00:02:50,600 --> 00:02:48,230
laboratory as you see here this is

68
00:02:52,730 --> 00:02:50,610
designed by us and built by angstrom

69
00:02:55,550 --> 00:02:52,740
engineering of top-level technology

70
00:02:59,000 --> 00:02:55,560
company near Kitchener Ontario near our

71
00:03:01,400 --> 00:02:59,010
University that wonderful fanciful you

72
00:03:02,960 --> 00:03:01,410
know life generating machine and the

73
00:03:06,740 --> 00:03:02,970
frogs there is their artistic

74
00:03:09,650 --> 00:03:06,750
presentation the apparatus what you have

75
00:03:11,690 --> 00:03:09,660
on the Left pictures is Renet one of our

76
00:03:14,270 --> 00:03:11,700
students working in this it's a computer

77
00:03:16,880 --> 00:03:14,280
controlled situation we've got a

78
00:03:20,390 --> 00:03:16,890
temperature control we have control of

79
00:03:22,130 --> 00:03:20,400
the wet/dry cycles very carefully built

80
00:03:24,470 --> 00:03:22,140
in I'll show you in a moment

81
00:03:26,840 --> 00:03:24,480
we have pressures just going to one bar

82
00:03:30,380 --> 00:03:26,850
we can put different gasses into this we

83
00:03:32,660 --> 00:03:30,390
have a radiation field which is I can

84
00:03:35,330 --> 00:03:32,670
get my light going here the radiation

85
00:03:37,730 --> 00:03:35,340
field and eight and lamps carefully

86
00:03:40,490 --> 00:03:37,740
design LEDs from going from infrared to

87
00:03:42,770 --> 00:03:40,500
UV in these cylinder heads here nicely

88
00:03:45,890 --> 00:03:42,780

cooled so we I will show you the

89
00:03:48,530 --> 00:03:45,900
conditions here so looking into our lab

90
00:03:50,120 --> 00:03:48,540
into the simulator we've got various

91
00:03:50,720 --> 00:03:50,130
kinds of radiation fields showing you

92
00:03:53,420 --> 00:03:50,730
here

93
00:03:54,710 --> 00:03:53,430
our intent is to do this experiment as

94
00:03:56,990 --> 00:03:54,720
you define the conditions on other

95
00:03:59,870 --> 00:03:57,000
planets other planets getting the

96
00:04:01,760 --> 00:03:59,880
Trappist one system here are two spectra

97
00:04:04,670 --> 00:04:01,770
the solar spectrum is an example the

98
00:04:06,800 --> 00:04:04,680
Trappist one star so we are now putting

99
00:04:09,260 --> 00:04:06,810
together the program that will program

100
00:04:11,470 --> 00:04:09,270
in these radiation fields everything can

101
00:04:14,390 --> 00:04:11,480
be oscillated against everything else

102
00:04:17,539 --> 00:04:14,400
while the radiation is well the water

103
00:04:19,789 --> 00:04:17,549
and while you have wetness that can

104
00:04:23,540 --> 00:04:19,799
screen you from UV so at that point the

105
00:04:26,360 --> 00:04:23,550
UV would be off when you dry UV becomes

106
00:04:29,719 --> 00:04:26,370
a problem for you so the UV field turns

107
00:04:31,430 --> 00:04:29,729
on so all of these can be cycled in any

108
00:04:33,260 --> 00:04:31,440
manner that you wish

109
00:04:36,770 --> 00:04:33,270
for the given in piped environment that

110
00:04:38,450 --> 00:04:36,780
you want I'll show you this movie here

111
00:04:40,160 --> 00:04:38,460
so we're looking in the chamber this is

112
00:04:42,230 --> 00:04:40,170
the beautiful fall over the talk this

113
00:04:45,500 --> 00:04:42,240

morning we don't actually have a wet

114
00:04:49,010 --> 00:04:45,510
pond we do this by deuce that appear and

115
00:04:51,110 --> 00:04:49,020
disappear to 85% humidity so if you look

116
00:04:53,510 --> 00:04:51,120
inside the chamber you see that dude

117
00:04:55,160 --> 00:04:53,520
developing on the right-hand side you

118
00:04:56,540 --> 00:04:55,170
see the relative humidity dry up the

119
00:04:58,070 --> 00:04:56,550
peak that do piers

120
00:04:59,960 --> 00:04:58,080
there's a slight difference between the

121
00:05:02,570 --> 00:04:59,970
plate and the background so there's a

122
00:05:05,240 --> 00:05:02,580
due developing disappeared this can be

123
00:05:08,480 --> 00:05:05,250
beautifully controlled by the expert

124
00:05:11,030 --> 00:05:08,490
design or engineers and so we can very

125
00:05:12,860 --> 00:05:11,040
nicely produce any kind of wet/dry cycle

126
00:05:16,130 --> 00:05:12,870
the thermal cycling that you want to

127
00:05:19,130 --> 00:05:16,140
program in it's taken us a few months to

128
00:05:21,110 --> 00:05:19,140
find the optimal procedure for this but

129
00:05:27,860 --> 00:05:21,120
before you you have a machine that works

130
00:05:29,660 --> 00:05:27,870
extremely well so the way we prepare our

131
00:05:32,000 --> 00:05:29,670
many ponds these are many ponds I put on

132
00:05:33,920 --> 00:05:32,010
cyclic silicon wafers once the meter

133
00:05:35,810 --> 00:05:33,930
squared you pipette on whatever

134
00:05:38,060 --> 00:05:35,820
ingredients you think should be in your

135
00:05:43,150 --> 00:05:38,070
pond in whatever concentrations that you

136
00:05:46,460 --> 00:05:43,160
want here as shown four of them and

137
00:05:48,740 --> 00:05:46,470
shown here pipe heading on the important

138
00:05:53,260 --> 00:05:48,750

things during what dry cycles sorry

139
00:05:55,940 --> 00:05:53,270
about this you see the in the top here

140
00:05:58,040 --> 00:05:55,950
there's many layers of vesicles that

141
00:06:00,590 --> 00:05:58,050
layer one on top of the other during

142
00:06:03,320 --> 00:06:00,600
course of many cycles these layers that

143
00:06:05,870 --> 00:06:03,330
can be up to hundreds of layers here one

144
00:06:08,990 --> 00:06:05,880
atop the other and inside of each day as

145
00:06:10,910 --> 00:06:09,000
you trap some monomers dimers etc that

146
00:06:13,160 --> 00:06:10,920
find one of their mobile between these

147
00:06:15,350 --> 00:06:13,170
membranes they find one other they link

148
00:06:17,270 --> 00:06:15,360
up during the drive phase when you wet

149
00:06:19,250 --> 00:06:17,280
these things break up into little bags

150
00:06:22,160 --> 00:06:19,260
eventually and eventually you can

151
00:06:24,140 --> 00:06:22,170
encapsulate things so I will show you

152
00:06:26,600 --> 00:06:24,150
just some of our first results here

153
00:06:28,730 --> 00:06:26,610
first of all microscopy just with pure

154
00:06:33,290 --> 00:06:28,740
lipids the typical one used in all

155
00:06:38,210 --> 00:06:33,300
experiments with the dcmp with just a

156
00:06:40,940 --> 00:06:38,220
mixture of sorry of here a MP and UMP

157
00:06:44,270 --> 00:06:40,950
put in here so for this kind of a

158
00:06:48,090 --> 00:06:44,280
uniform field looking down and lipid

159
00:06:50,970 --> 00:06:48,100
in early with God we one cycle takes

160
00:06:52,740 --> 00:06:50,980
about an hour to do so we can do you

161
00:06:55,950 --> 00:06:52,750
know in one week we can get good way

162
00:06:58,470 --> 00:06:55,960
through 70 cycles make the cycle as long

163
00:07:01,920 --> 00:06:58,480

as you wish and effectively a minute at

164
00:07:03,660 --> 00:07:01,930
a month a year you know that doesn't

165
00:07:05,550 --> 00:07:03,670
matter just a number of cycles it

166
00:07:08,990 --> 00:07:05,560
matters here you see the growth of

167
00:07:11,460 --> 00:07:09,000
rather large structures a hundred micron

168
00:07:15,920 --> 00:07:11,470
100 micrometer is shown in here

169
00:07:20,850 --> 00:07:18,630
intermediates in the number of cycles

170
00:07:22,590 --> 00:07:20,860
you have these largest structures here

171
00:07:25,680 --> 00:07:22,600
which are starting to break up into the

172
00:07:29,970 --> 00:07:25,690
smaller vesicle type rain structures

173
00:07:31,380 --> 00:07:29,980
shown in here the walls get thicker and

174
00:07:34,170 --> 00:07:31,390
into this I'll show you where the

175
00:07:36,840 --> 00:07:34,180
nucleotides are in a moment in the final

176
00:07:38,490 --> 00:07:36,850
phase we get now on wrasse quite a

177
00:07:41,340 --> 00:07:38,500
complicated structure as these larger

178
00:07:43,440 --> 00:07:41,350
ones are broken up you have these VC Col

179
00:07:46,500 --> 00:07:43,450
like structures now inside about five

180
00:07:47,520 --> 00:07:46,510
foot about 50 microns or so as David

181
00:07:51,800 --> 00:07:47,530
Deamer others have found in their

182
00:07:54,210 --> 00:07:51,810
experiments and if I show you now just

183
00:07:56,550 --> 00:07:54,220
we're going to use like autofluorescence

184
00:08:00,150 --> 00:07:56,560
now these are nucleotides will glow

185
00:08:03,420 --> 00:08:00,160
they're excited and by light coming in

186
00:08:05,310 --> 00:08:03,430
here and the rate of the like the images

187
00:08:08,010 --> 00:08:05,320
now that you see here are actually

188
00:08:10,770 --> 00:08:08,020

mission from the nucleotides looking at

189
00:08:13,050 --> 00:08:10,780
their distribution so I'll go from our

190
00:08:16,170 --> 00:08:13,060
first stage to the later stages the last

191
00:08:19,380 --> 00:08:16,180
stages sequentially so here we see this

192
00:08:21,930 --> 00:08:19,390
uniform kind of distribution early on

193
00:08:23,550 --> 00:08:21,940
we've got these large empty regions that

194
00:08:25,200 --> 00:08:23,560
are formed the green as well nucleotides

195
00:08:26,730 --> 00:08:25,210
they're still kind of spread out but

196
00:08:29,580 --> 00:08:26,740
they're finding their way being

197
00:08:32,580 --> 00:08:29,590
concentrated in those walls a little bit

198
00:08:34,200 --> 00:08:32,590
later your few more cycles on you see

199
00:08:35,969 --> 00:08:34,210
that these larger structures are

200
00:08:38,400 --> 00:08:35,979
breaking up most of the nucleotides are

201
00:08:39,990 --> 00:08:38,410
being concentrated now in the walls by

202
00:08:43,170 --> 00:08:40,000
the very process we've been talking

203
00:08:45,420 --> 00:08:43,180
about a little bit further on you now

204
00:08:49,170 --> 00:08:45,430
see this very broken up kind of

205
00:08:50,670 --> 00:08:49,180
structure and peering into those on the

206
00:08:55,570 --> 00:08:50,680
scale you see that nucleotides are

207
00:08:57,890 --> 00:08:55,580
encapsulated very nicely

208
00:09:01,610 --> 00:08:57,900
we have various physical assays

209
00:09:04,700 --> 00:09:01,620
techniques by driving at these analysis

210
00:09:07,520 --> 00:09:04,710
for this including Neutron and here

211
00:09:09,710 --> 00:09:07,530
x-ray diffraction experiments so we can

212
00:09:11,780 --> 00:09:09,720
run on the samples to determine what's

213
00:09:13,640 --> 00:09:11,790

is the structure of the layers and where

214
00:09:15,920 --> 00:09:13,650
are the monomers in these layers these

215
00:09:18,950 --> 00:09:15,930
can be followed up by molecular dynamics

216
00:09:22,490 --> 00:09:18,960
simulations so here's the basic geometry

217
00:09:25,430 --> 00:09:22,500
shown down here the x-ray machine in the

218
00:09:27,740 --> 00:09:25,440
laboratory diffracting off this bilayer

219
00:09:29,570 --> 00:09:27,750
as an example this is the kind of 2d

220
00:09:35,270 --> 00:09:29,580
diffraction pattern you get the Bragg

221
00:09:37,070 --> 00:09:35,280
Peaks which you can then explore here

222
00:09:39,350 --> 00:09:37,080
we've got the various distance scale

223
00:09:42,650 --> 00:09:39,360
between the molecules between the lipids

224
00:09:44,840 --> 00:09:42,660
there's the bilayer here and by doing

225
00:09:47,720 --> 00:09:44,850
the analysis with some computer analysis

226
00:09:49,910 --> 00:09:47,730
behind you here they the distribution

227
00:09:53,630 --> 00:09:49,920
here in this diagram with the intensity

228
00:09:56,540 --> 00:09:53,640
as a function of Q here this shows the

229
00:10:00,160 --> 00:09:56,550
typical scales the typical scale in your

230
00:10:02,900 --> 00:10:00,170
bilayers might be 4.9 angstroms

231
00:10:05,480 --> 00:10:02,910
disorganised nucleotides have a

232
00:10:07,760 --> 00:10:05,490
separation of about 4.6 entrance that

233
00:10:10,040 --> 00:10:07,770
accounts for this peak and the organized

234
00:10:12,020 --> 00:10:10,050
nucleotides separated by about the

235
00:10:14,870 --> 00:10:12,030
distance of involve a phosphodiester

236
00:10:18,920 --> 00:10:14,880
bond I should say are in this growing

237
00:10:23,660 --> 00:10:18,930
peak right down here now if you follow

238
00:10:26,150 --> 00:10:23,670

this with time you find this graph here

239
00:10:27,830 --> 00:10:26,160
which is a question number of cycles

240
00:10:29,720 --> 00:10:27,840
we've gone to about 70 in this

241
00:10:31,670 --> 00:10:29,730
experiment by the way all this work is

242
00:10:35,120 --> 00:10:31,680
still unpublished please is this the

243
00:10:36,950 --> 00:10:35,130
first steps but this is just new stuff

244
00:10:39,650 --> 00:10:36,960
for showing you for the first time first

245
00:10:44,180 --> 00:10:39,660
results of our lab but you see the

246
00:10:46,460 --> 00:10:44,190
growing organized nucleotide fraction

247
00:10:50,300 --> 00:10:46,470
reaching up to about 10% now after about

248
00:10:52,970 --> 00:10:50,310
simony cycles in these organized units

249
00:10:55,700 --> 00:10:52,980
this graph doesn't tell you yet that

250
00:10:59,210 --> 00:10:55,710
they are actual polymers of course but

251
00:11:00,980 --> 00:10:59,220
they're organized like polymers to

252
00:11:03,290 --> 00:11:00,990
follow that up one wants to do things

253
00:11:05,060 --> 00:11:03,300
like a gel electrophoresis as an example

254
00:11:08,480 --> 00:11:05,070
as David Deamer was just showing

255
00:11:10,819 --> 00:11:08,490
so here is Renee preparing the samples

256
00:11:13,790 --> 00:11:10,829
we have centrifuge cleaning things up

257
00:11:16,430 --> 00:11:13,800
getting ready put the samples now gel

258
00:11:19,490 --> 00:11:16,440
electrophoresis columns which are shown

259
00:11:21,319 --> 00:11:19,500
here so this is again another part of

260
00:11:23,230 --> 00:11:21,329
our laboratory laboratory by the way is

261
00:11:25,910 --> 00:11:23,240
full equipped for all the physics

262
00:11:27,590 --> 00:11:25,920
biophysics setups a biochemical assays

263
00:11:31,759 --> 00:11:27,600

the various instrumentation we've been

264
00:11:34,309 --> 00:11:31,769
showing you and here I can just show you

265
00:11:37,490 --> 00:11:34,319
is the gel electrophoresis experiment

266
00:11:39,650 --> 00:11:37,500
here are two ladders 100 base pairs just

267
00:11:42,050 --> 00:11:39,660
a standard ladder everybody uses and

268
00:11:44,210 --> 00:11:42,060
again these molecules are negatively

269
00:11:46,850 --> 00:11:44,220
charged the lightest molecules move the

270
00:11:50,300 --> 00:11:46,860
furthest down in the gel that's the way

271
00:11:52,309 --> 00:11:50,310
this technique works and here is the

272
00:11:54,980 --> 00:11:52,319
result

273
00:11:57,439 --> 00:11:54,990
so this is the the ladder I showed you

274
00:11:59,360 --> 00:11:57,449
hundred base pairs this these are spread

275
00:12:02,960 --> 00:11:59,370
out a little bit because of salt effects

276
00:12:05,720 --> 00:12:02,970
we think but you can see in this pretty

277
00:12:08,780 --> 00:12:05,730
well resolved we've gotten already to

278
00:12:11,750 --> 00:12:08,790
about fifty mirrors perhaps we will

279
00:12:13,430 --> 00:12:11,760
check that but this has been with a

280
00:12:15,740 --> 00:12:13,440
rapidity kind of things I'm very

281
00:12:17,629 --> 00:12:15,750
interested in what David's results were

282
00:12:20,720 --> 00:12:17,639
in his own experiments but they seem to

283
00:12:22,970 --> 00:12:20,730
be working just fine here will of course

284
00:12:25,160 --> 00:12:22,980
want to do base sequencing of this work

285
00:12:27,710 --> 00:12:25,170
and in the next experiment in next part

286
00:12:29,780 --> 00:12:27,720
of the experiment but for what this says

287
00:12:31,579 --> 00:12:29,790
now given the reliability that David is

288
00:12:33,230 --> 00:12:31,589

pointed to for understanding an

289
00:12:35,120 --> 00:12:33,240
interpreted gel electrophoresis data

290
00:12:39,650 --> 00:12:35,130
this is hopeful that we're actually

291
00:12:41,569 --> 00:12:39,660
demonstrating this so I would just like

292
00:12:42,800 --> 00:12:41,579
to conclude that so far in these

293
00:12:44,660 --> 00:12:42,810
experiments we've been able to

294
00:12:46,639 --> 00:12:44,670
demonstrate under conditions of warm

295
00:12:49,009 --> 00:12:46,649
little ponds where we've got thermal

296
00:12:51,740 --> 00:12:49,019
cycles taking up to 80 degrees and down

297
00:12:53,629 --> 00:12:51,750
allowing bonds to form and dry wet

298
00:12:56,150 --> 00:12:53,639
cycles which allow for this alternate

299
00:12:58,639 --> 00:12:56,160
mobility and nailing things down to

300
00:13:01,040 --> 00:12:58,649
allow the polymers to grow that we're

301
00:13:01,970 --> 00:13:01,050
very effective in growing polymers that

302
00:13:04,100 --> 00:13:01,980
probably matter

303
00:13:07,340 --> 00:13:04,110
these have been encapsulated within

304
00:13:09,530 --> 00:13:07,350
these these vesicles we don't know how

305
00:13:12,110 --> 00:13:09,540
much of this RNA polymerize ation may

306
00:13:13,309 --> 00:13:12,120
occur inside the vesicle yet that's the

307
00:13:14,829 --> 00:13:13,319
next thing the next part of the

308
00:13:18,040 --> 00:13:14,839
experiment to try to determine that

309
00:13:20,350 --> 00:13:18,050
ultimately of course a huge step ahead

310
00:13:22,960 --> 00:13:20,360
we do not know if any of this material

311
00:13:25,359 --> 00:13:22,970
is capable of transcribing itself and

312
00:13:27,669 --> 00:13:25,369
that is the giant leap that of course

313
00:13:30,639 --> 00:13:27,679

we're all interested in the step towards

314
00:13:32,979 --> 00:13:30,649
some kind of evolution but I hope that

315
00:13:35,650 --> 00:13:32,989
you find this we feel that this is not

316
00:13:37,749 --> 00:13:35,660
only robust way of examining physics and

317
00:13:39,639 --> 00:13:37,759
chemistry in an early Earth environment

318
00:13:41,259 --> 00:13:39,649
but we will soon be able to ask the

319
00:13:42,009 --> 00:13:41,269
quest answered the edge question are we

320
00:13:44,859 --> 00:13:42,019
alone

321
00:13:46,509 --> 00:13:44,869
by doing this say in a Trappist one or

322
00:13:49,889 --> 00:13:46,519
any other kind of world you might want

323
00:13:53,229 --> 00:13:49,899
to dial up we will simply dial up a star

324
00:13:55,479 --> 00:13:53,239
radiation field and be able to run these

325
00:13:56,919 --> 00:13:55,489
under a variety of conditions so with

326
00:14:05,049 --> 00:13:56,929
that I'd like to thank you very much for

327
00:14:06,850 --> 00:14:05,059
your attention thank thank you Ralph -

328
00:14:11,169 --> 00:14:06,860
first question here in the centre I

329
00:14:13,660 --> 00:14:11,179
tomorrow Faraci from SPC Paris I I

330
00:14:17,439 --> 00:14:13,670
wanted to know if you did

331
00:14:22,090 --> 00:14:17,449
perhaps some low angle x-ray scattering

332
00:14:27,579 --> 00:14:22,100
to see if there is any super molecular

333
00:14:30,519 --> 00:14:27,589
structures that have a larger land scale

334
00:14:34,499 --> 00:14:30,529
than and then single a stacking distance

335
00:14:36,999 --> 00:14:34,509
and the answer to that is that and you

336
00:14:39,340 --> 00:14:37,009
know there's a range of structures that

337
00:14:41,019 --> 00:14:39,350
you do find there's a there's quite a

338
00:14:44,289 --> 00:14:41,029

distribution that you saw but still

339
00:14:46,960 --> 00:14:44,299
fairly heat and this has been followed

340
00:14:49,449 --> 00:14:46,970
up by molecular dynamics simulations so

341
00:14:52,389 --> 00:14:49,459
we think we have a good feeling between

342
00:14:53,980 --> 00:14:52,399
micro dynamics and the data as to you

343
00:14:57,460 --> 00:14:53,990
know what levels of structure we should

344
00:15:00,759 --> 00:14:57,470
be seeing yeah yeah but I was just

345
00:15:02,769 --> 00:15:00,769
meaning that at that q you are sensible

346
00:15:06,030 --> 00:15:02,779
to the the distance between the nuclear

347
00:15:08,379 --> 00:15:06,040
bases but if you go at lower Q you can

348
00:15:11,159 --> 00:15:08,389
look at the distance between the

349
00:15:14,650 --> 00:15:11,169
different layers or various other

350
00:15:17,139 --> 00:15:14,660
organization of the of the strength of

351
00:15:18,999 --> 00:15:17,149
oligomer that you have yeah we do probe

352
00:15:21,309 --> 00:15:19,009
the distance between layers I showed you

353
00:15:23,700 --> 00:15:21,319
that number I believe up there and the

354
00:15:26,250 --> 00:15:23,710
separation between

355
00:15:29,550 --> 00:15:26,260
yeah we get all those distances pretty

356
00:15:31,200 --> 00:15:29,560
well and second which is the range of

357
00:15:33,510 --> 00:15:31,210
concentration you think you are

358
00:15:35,900 --> 00:15:33,520
exploring during dry worked in cycles

359
00:15:39,150 --> 00:15:35,910
yes I think these were molar types

360
00:15:41,040 --> 00:15:39,160
setups in these experiments so and we

361
00:15:44,640 --> 00:15:41,050
actually forgot to mention we have equal

362
00:15:46,200 --> 00:15:44,650
a one on one of a MP and UMP and the

363
00:15:49,200 --> 00:15:46,210

mixtures that we had here which are

364
00:15:52,890 --> 00:15:49,210
actually good for building larger

365
00:15:54,080 --> 00:15:52,900
polymers as is known I got a question

366
00:15:58,490 --> 00:15:54,090
over here

367
00:16:02,550 --> 00:15:58,500
yes Ralph I just want to comment that

368
00:16:07,530 --> 00:16:02,560
implicit in your talk is the use of base

369
00:16:12,480 --> 00:16:07,540
pairing monomers the ANP and the UMP are

370
00:16:16,200 --> 00:16:12,490
in fact the base pairing of RNA and we I

371
00:16:18,690 --> 00:16:16,210
think you have found that the if we try

372
00:16:21,870 --> 00:16:18,700
to make these monomers out of a single

373
00:16:24,210 --> 00:16:21,880
nucleotide either poly Ujala go use or

374
00:16:28,440 --> 00:16:24,220
Allah Koei's it doesn't work nearly as

375
00:16:31,740 --> 00:16:28,450
well as having both prison that would be

376
00:16:34,170 --> 00:16:31,750
able to form a duplex strand and not

377
00:16:36,630 --> 00:16:34,180
just a single strand and we're getting

378
00:16:39,630 --> 00:16:36,640
strong evidence if that's the case from

379
00:16:41,850 --> 00:16:39,640
some atomic force microscopy that we're

380
00:16:44,370 --> 00:16:41,860
doing where we can actually see these

381
00:16:48,180 --> 00:16:44,380
strands accumulating I want to make a

382
00:16:50,310 --> 00:16:48,190
surface that's fascinating thanks for

383
00:16:52,920 --> 00:16:50,320
that remark one more question

384
00:16:55,710 --> 00:16:52,930
hi I'm Melina Popovich a blue marble

385
00:16:57,930 --> 00:16:55,720
space and such as science have you run

386
00:17:02,790 --> 00:16:57,940
nan de natura ng gel or excuse me

387
00:17:05,180 --> 00:17:02,800
denaturing gels no it's it's taken I'm

388
00:17:07,500 --> 00:17:05,190

not a biochemist myself we rely on

389
00:17:10,650 --> 00:17:07,510
collaboration with dr. yang Fu's labs

390
00:17:13,170 --> 00:17:10,660
laboratory to help us out with that it's

391
00:17:15,510 --> 00:17:13,180
been quite a trick just to get as you

392
00:17:18,750 --> 00:17:15,520
know it's very tricky to get RNA to go

393
00:17:20,400 --> 00:17:18,760
through gels probably because they the

394
00:17:22,560 --> 00:17:20,410
nature of the molecule they tend to ball

395
00:17:24,840 --> 00:17:22,570
up etc so it's been quite a trick even

396
00:17:28,020 --> 00:17:24,850
to get that data that I showed you

397
00:17:29,610 --> 00:17:28,030
I'm just not sure the extent of the

398
00:17:31,020 --> 00:17:29,620
experiment done with other gels yet I

399
00:17:35,070 --> 00:17:31,030
think this is the first one we've got

400
00:17:37,710 --> 00:17:35,080
working after some months of effort so

401
00:17:40,880 --> 00:17:37,720
we're still in the baby steps