
AbSciCon
2019

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

2
00:00:12,119 --> 00:00:09,049
[Applause]

3
00:00:14,310 --> 00:00:12,129
hi everyone my name is Tyler Roche I'm a

4
00:00:15,629 --> 00:00:14,320
grad student in the HUD lab at Georgia

5
00:00:17,730 --> 00:00:15,639
Tech and I'm working with the Center for

6
00:00:19,620 --> 00:00:17,740
chemical evolution so I'm just gonna

7
00:00:20,939 --> 00:00:19,630
thank you all for coming to my talk

8
00:00:23,160 --> 00:00:20,949
I'll be discussing the prebiotic

9
00:00:26,730 --> 00:00:23,170
relevance of keto sugars to the origin

10
00:00:29,099 --> 00:00:26,740
of Aldo's nucleotides so the RNA world

11
00:00:31,349 --> 00:00:29,109
model is a problem

12
00:00:34,140 --> 00:00:31,359
a popular hypothesis for the formation

13
00:00:37,740 --> 00:00:34,150

of the first genetic polymer RNA as

14
00:00:39,920 --> 00:00:37,750
posed by the model at the CCE we think

15
00:00:42,479 --> 00:00:39,930
that there could have been perhaps a

16
00:00:45,180 --> 00:00:42,489
proto RNA or some sort of genetic

17
00:00:47,970 --> 00:00:45,190
polymer that preceded RNA in the

18
00:00:51,090 --> 00:00:47,980
chemical evolution of of genetic

19
00:00:52,229 --> 00:00:51,100
polymers so you can imagine that in the

20
00:00:55,020 --> 00:00:52,239
same way that you could have a

21
00:00:58,799 --> 00:00:55,030
modification from RNA to DNA by the

22
00:01:01,169 --> 00:00:58,809
removal of the hydroxyl group on the 2

23
00:01:03,569 --> 00:01:01,179
carbon and the replacement of thymine

24
00:01:07,250 --> 00:01:03,579
for uracil you could have had some other

25
00:01:09,570 --> 00:01:07,260
substitutions from a proto RNA system

26
00:01:11,609 --> 00:01:09,580
including substitutions of perhaps the

27
00:01:13,710 --> 00:01:11,619
ionized linker which in RNA is a

28
00:01:15,990 --> 00:01:13,720
phosphate the tri functional connector

29
00:01:18,749 --> 00:01:16,000
which in RNA is ribose and the

30
00:01:20,910 --> 00:01:18,759
recognition unit components which in RNA

31
00:01:24,660 --> 00:01:20,920
are the canonical nucleobases that we

32
00:01:26,429 --> 00:01:24,670
know so with this model in mind it would

33
00:01:29,490 --> 00:01:26,439
be interesting to understand how these

34
00:01:31,920 --> 00:01:29,500
components were formed and combined to

35
00:01:35,060 --> 00:01:31,930
form either the proto RNA or the RNA

36
00:01:38,910 --> 00:01:35,070
itself as chemical evolution proceeded

37
00:01:41,399 --> 00:01:38,920
so in terms of RNA synthesis in a

38
00:01:45,179 --> 00:01:41,409

prebiotic context there are several

39
00:01:47,969 --> 00:01:45,189
stages that had to be undertaken for the

40
00:01:51,090 --> 00:01:47,979
RNA to form into it's fully oligomers

41
00:01:54,420 --> 00:01:51,100
state so we can imagine that the several

42
00:01:56,569 --> 00:01:54,430
steps included sugar formation nucleus

43
00:01:59,010 --> 00:01:56,579
sedation are glycosylated

44
00:02:01,440 --> 00:01:59,020
phosphorylation or oligomerization and

45
00:02:02,910 --> 00:02:01,450
all of these staff pose various

46
00:02:04,679 --> 00:02:02,920
challenges to prebiotic chemists

47
00:02:06,660 --> 00:02:04,689
attempting to understand how these

48
00:02:08,460 --> 00:02:06,670
happened so today I'm going to focus on

49
00:02:10,820 --> 00:02:08,470
sugar formation and nuclear sedation as

50
00:02:15,509 --> 00:02:10,830
two of the steps that I'm interested in

51
00:02:17,400 --> 00:02:15,519
looking at and investigating so the

52
00:02:20,070 --> 00:02:17,410
foremost reaction is the reaction that's

53
00:02:21,089 --> 00:02:20,080
most frequently invoked to explain the

54
00:02:24,300 --> 00:02:21,099
formation of sugar

55
00:02:26,550 --> 00:02:24,310
on the prebiotic earth and in fact the

56
00:02:28,949 --> 00:02:26,560
foremost reaction can form a variety of

57
00:02:33,479 --> 00:02:28,959
different sugars you can have branched

58
00:02:35,160 --> 00:02:33,489
sugars unbranched sugars keto sugars

59
00:02:37,890 --> 00:02:35,170
Aldo's sugars all sorts of different

60
00:02:39,839 --> 00:02:37,900
sugars with this reaction so if you're

61
00:02:41,759 --> 00:02:39,849
looking for ribose which is part of RNA

62
00:02:43,740 --> 00:02:41,769
it's not necessarily gonna be the

63
00:02:45,990 --> 00:02:43,750

easiest thing to find in fact in this

64
00:02:48,000 --> 00:02:46,000
chromatogram you can see that it's one

65
00:02:50,550 --> 00:02:48,010
of the many peaks present and it's not

66
00:02:54,000 --> 00:02:50,560
particularly large as one of the peaks

67
00:02:56,309 --> 00:02:54,010
so the question becomes how did life

68
00:02:59,930 --> 00:02:56,319
select for ribose how did it

69
00:03:02,580 --> 00:02:59,940
come out of this vast mix of sugars

70
00:03:06,559 --> 00:03:02,590
another question regarding the formation

71
00:03:08,819 --> 00:03:06,569
of RNA includes nucleus addition so

72
00:03:11,220 --> 00:03:08,829
there have been experiments showing that

73
00:03:13,440 --> 00:03:11,230
canonical nucleobases don't readily form

74
00:03:16,770 --> 00:03:13,450
nucleosides when combined with RNA and

75
00:03:18,960 --> 00:03:16,780
or combined with ribose in water you can

76
00:03:21,479 --> 00:03:18,970
form some nucleotides with some of these

77
00:03:23,129 --> 00:03:21,489
but it's not an easy process it's not

78
00:03:28,379 --> 00:03:23,139
something that happens in very high

79
00:03:29,849 --> 00:03:28,389
yields however research in the Center

80
00:03:32,729 --> 00:03:29,859
for chemical evolution has looked at

81
00:03:34,890 --> 00:03:32,739
various non canonical nuclear bases that

82
00:03:36,509 --> 00:03:34,900
have various properties that are

83
00:03:40,140 --> 00:03:36,519
beneficial potentially to their

84
00:03:42,030 --> 00:03:40,150
prebiotic formation into these

85
00:03:44,220 --> 00:03:42,040
nucleotides including their reactivity

86
00:03:46,710 --> 00:03:44,230
and their ability to undergo super

87
00:03:48,990 --> 00:03:46,720
molecular assembly so when you react

88
00:03:52,020 --> 00:03:49,000

these nucleobases with ribose you do in

89
00:03:54,449 --> 00:03:52,030
fact form nucleotides that can perhaps

90
00:03:57,479 --> 00:03:54,459
be selected for into a proto RNA system

91
00:03:59,250 --> 00:03:57,489
so in the non-canonical nucleobases

92
00:04:04,349 --> 00:03:59,260
react more readily to form these

93
00:04:06,619 --> 00:04:04,359
nucleotides so research performed by one

94
00:04:10,050 --> 00:04:06,629
of my group members David feel hoe

95
00:04:11,699 --> 00:04:10,060
included reactions with sugars and try

96
00:04:13,140 --> 00:04:11,709
me no prima diene to see if you could

97
00:04:16,289 --> 00:04:13,150
form nucleus IDEs with all these

98
00:04:18,689 --> 00:04:16,299
different sugars and the triggers of

99
00:04:22,439 --> 00:04:18,699
interest obviously for me include ribose

100
00:04:23,550 --> 00:04:22,449
and rib ulos so when you react tap with

101
00:04:25,500 --> 00:04:23,560
these sugars you can form these

102
00:04:27,120 --> 00:04:25,510
nucleotides fairly readily but an

103
00:04:29,219 --> 00:04:27,130
interesting result of his was that if

104
00:04:33,089 --> 00:04:29,229
you react tribulus which is a keto sugar

105
00:04:34,780 --> 00:04:33,099
with tap try me no prima diene you can

106
00:04:37,480 --> 00:04:34,790
in fact form nucleotides

107
00:04:42,190 --> 00:04:37,490
formed as if they're from the aldose of

108
00:04:44,050 --> 00:04:42,200
that sugar so alder nucleotides but not

109
00:04:46,650 --> 00:04:44,060
kitto nucleotides were detected as

110
00:04:49,390 --> 00:04:46,660
products so to kind of get into that

111
00:04:52,240 --> 00:04:49,400
talking about aldoses and ketoses what

112
00:04:53,940 --> 00:04:52,250
do I mean exactly so when you look at

113
00:04:57,100 --> 00:04:53,950

these two sugars ribulose and ribose

114
00:04:59,680 --> 00:04:57,110
they're isomers they're both 5 carbon

115
00:05:01,750 --> 00:04:59,690
sugars rib ulos is a ketose because it

116
00:05:03,370 --> 00:05:01,760
has a ketone functional group and ribose

117
00:05:05,350 --> 00:05:03,380
is an aldehyde or an aldose sugar

118
00:05:07,810 --> 00:05:05,360
because it didn't it has an aldehyde

119
00:05:10,570 --> 00:05:07,820
functional group and in fact these can

120
00:05:11,920 --> 00:05:10,580
interconvert this is the mechanism by

121
00:05:15,040 --> 00:05:11,930
which it is thought that there

122
00:05:17,050 --> 00:05:15,050
interconverting and it involves the

123
00:05:19,390 --> 00:05:17,060
formation of an enol and then the

124
00:05:20,920 --> 00:05:19,400
migration of a carbonyl group so you can

125
00:05:23,020 --> 00:05:20,930
have this inter conversion between these

126
00:05:25,690 --> 00:05:23,030
ribose and rivulet sugars or any other

127
00:05:26,860 --> 00:05:25,700
elders and keto sugars and in fact you

128
00:05:28,720 --> 00:05:26,870
could have the same sort of thing

129
00:05:32,050 --> 00:05:28,730
happening with arabinose which is just

130
00:05:33,940 --> 00:05:32,060
another isomer of ribose that differs

131
00:05:37,240 --> 00:05:33,950
based on the chirality of one of the

132
00:05:39,040 --> 00:05:37,250
carbons so my hypothesis when looking at

133
00:05:41,290 --> 00:05:39,050
these sugars is that perhaps the

134
00:05:44,410 --> 00:05:41,300
nucleobases in solution could attack and

135
00:05:46,840 --> 00:05:44,420
trap the aldo sugars but not the keto

136
00:05:48,820 --> 00:05:46,850
sugars in the form of nucleotides and

137
00:05:52,780 --> 00:05:48,830
this is perhaps how the nucleotides were

138
00:05:55,360 --> 00:05:52,790

able to be formed on the early Earth so

139
00:05:56,380 --> 00:05:55,370
for one of my first experiments I wanted

140
00:05:58,180 --> 00:05:56,390
to see if I can look at the

141
00:06:00,280 --> 00:05:58,190
isomerization of rebel OHS which is a

142
00:06:03,010 --> 00:06:00,290
five carbon sugar that could isomerize

143
00:06:06,940 --> 00:06:03,020
into ribose and arabinose and I

144
00:06:09,910 --> 00:06:06,950
basically incubated this rib ulos at 65

145
00:06:12,730 --> 00:06:09,920
degrees for three days and looked at it

146
00:06:15,130 --> 00:06:12,740
by NMR and so the first spectrum you see

147
00:06:17,140 --> 00:06:15,140
appear is just the time point zero which

148
00:06:19,720 --> 00:06:17,150
should just be Regulus in solution and

149
00:06:22,990 --> 00:06:19,730
in fact you see the standard spectrum

150
00:06:25,510 --> 00:06:23,000
for rib ulos and when you allow that

151
00:06:28,180 --> 00:06:25,520
Regulus to incubate over time for three

152
00:06:29,650 --> 00:06:28,190
days you took a look at it by NMR and I

153
00:06:31,120 --> 00:06:29,660
can identify Peaks that were

154
00:06:34,180 --> 00:06:31,130
correspondent to both ribose and

155
00:06:37,270 --> 00:06:34,190
arabinose now there are hypothetically

156
00:06:39,760 --> 00:06:37,280
more than these possible Peaks that

157
00:06:43,780 --> 00:06:39,770
could form in terms of all the possible

158
00:06:45,520 --> 00:06:43,790
different four configurations of ribose

159
00:06:48,769 --> 00:06:45,530
and arabinose including the furanose

160
00:06:50,569 --> 00:06:48,779
pyranose forms the alpha beta and

161
00:06:52,399 --> 00:06:50,579
so some of those Peaks are present some

162
00:06:54,319 --> 00:06:52,409
of those are not present in high enough

163
00:06:56,179 --> 00:06:54,329

concentrations because there is a

164
00:06:58,309 --> 00:06:56,189
dynamic equilibrium between those that

165
00:07:02,119 --> 00:06:58,319
prefers a certain configuration for

166
00:07:03,589 --> 00:07:02,129
those sugars so the result of this is

167
00:07:05,479 --> 00:07:03,599
that right rib ulos does readily

168
00:07:09,919 --> 00:07:05,489
isomerize in solution into ribose and

169
00:07:11,989 --> 00:07:09,929
arabinose the next experiment that I

170
00:07:13,549 --> 00:07:11,999
performed was one where I'd ride down

171
00:07:16,309 --> 00:07:13,559
review lows with try Meena prema Dean

172
00:07:18,169 --> 00:07:16,319
and I wanted to see if I could form

173
00:07:19,579 --> 00:07:18,179
different nucleotides both arabinose and

174
00:07:22,549 --> 00:07:19,589
ribonucleotides

175
00:07:25,309 --> 00:07:22,559
and so I performed this reaction these

176
00:07:27,019 --> 00:07:25,319
are the possible linkages that could

177
00:07:28,729 --> 00:07:27,029
form with these nucleotides and I've

178
00:07:32,629 --> 00:07:28,739
omitted the pyranose forms but those

179
00:07:34,879 --> 00:07:32,639
could possibly exist as well and after I

180
00:07:37,729 --> 00:07:34,889
perform this reaction I looked at it via

181
00:07:39,559 --> 00:07:37,739
NMR and I was able to identify Peaks it

182
00:07:42,350 --> 00:07:39,569
not only correspondent to the isomerized

183
00:07:44,269 --> 00:07:42,360
sugars ribose and arabinose here more

184
00:07:46,639 --> 00:07:44,279
about another arabinose peak here but i

185
00:07:49,129 --> 00:07:46,649
was also able to identify Peaks that

186
00:07:53,119 --> 00:07:49,139
corresponded to nucleus sides of tap and

187
00:07:55,519 --> 00:07:53,129
these sugars so the results here is that

188
00:07:58,309 --> 00:07:55,529

it's pretty clear that RHIB ulos does

189
00:08:02,649 --> 00:07:58,319
form these aldo nucleotides when it's

190
00:08:04,969 --> 00:08:02,659
reacted with triming up remedy so

191
00:08:06,709 --> 00:08:04,979
another experiment that i performed then

192
00:08:08,600 --> 00:08:06,719
was basically i wanted to take each of

193
00:08:11,299 --> 00:08:08,610
these sugars and incubate them over time

194
00:08:15,619 --> 00:08:11,309
to see if I could get sort of a

195
00:08:17,299 --> 00:08:15,629
long-term ink isomerization rate one

196
00:08:19,189 --> 00:08:17,309
sighing queue baited them I would take

197
00:08:21,169 --> 00:08:19,199
time points every day and then I would

198
00:08:23,419 --> 00:08:21,179
react those time points with barbra

199
00:08:25,159 --> 00:08:23,429
Charak acid at room temperature now

200
00:08:27,649 --> 00:08:25,169
barbarick acid was useful in this

201
00:08:30,789 --> 00:08:27,659
experiment for two reasons one it is

202
00:08:33,679 --> 00:08:30,799
quite visible via UV so it allowed us to

203
00:08:36,379 --> 00:08:33,689
monitor the progress of these reactions

204
00:08:39,139 --> 00:08:36,389
or the amount of nucleoside formed when

205
00:08:40,790 --> 00:08:39,149
we analyzed it by lc-ms and the other

206
00:08:42,649 --> 00:08:40,800
benefit of using barbra toric acid is

207
00:08:44,389 --> 00:08:42,659
highly reactive so it's one of the most

208
00:08:46,519 --> 00:08:44,399
reactive nucleobases that we work with

209
00:08:48,650 --> 00:08:46,529
and so I could perform this reaction at

210
00:08:51,199 --> 00:08:48,660
room temperature which means once it's

211
00:08:52,879 --> 00:08:51,209
heating up and inked and isomerizing at

212
00:08:54,499 --> 00:08:52,889
a higher temperature if I bring it down

213
00:08:56,389 --> 00:08:54,509

to room temperature presumably it sort

214
00:08:59,689 --> 00:08:56,399
of freezes the isomerization state of

215
00:09:01,730 --> 00:08:59,699
those sugars you know locks in the

216
00:09:04,760 --> 00:09:01,740
different concentrations of

217
00:09:06,320 --> 00:09:04,770
arabinose or rib Boulos and then it will

218
00:09:07,970 --> 00:09:06,330
react with the barber trick acid form

219
00:09:10,400 --> 00:09:07,980
those nucleosides and then I can track

220
00:09:13,610 --> 00:09:10,410
them so the results of this experiment

221
00:09:17,270 --> 00:09:13,620
showed that these the screen trace is

222
00:09:20,300 --> 00:09:17,280
ribose this blue traces arabinose just

223
00:09:21,920 --> 00:09:20,310
reacted with barbarac acid after being

224
00:09:24,980 --> 00:09:21,930
allowed to incubate for just a day and

225
00:09:27,620 --> 00:09:24,990
then the two red traces are Regulus

226
00:09:30,530 --> 00:09:27,630
the first one is regulars incubated for

227
00:09:33,530 --> 00:09:30,540
one day and then the darker red trace is

228
00:09:37,280 --> 00:09:33,540
RHIB ulos incubated for 408 hours and

229
00:09:39,440 --> 00:09:37,290
these are all at 65 degrees and once I

230
00:09:42,950 --> 00:09:39,450
react each of those time points with

231
00:09:47,120 --> 00:09:42,960
barbaric acid you can see them here now

232
00:09:49,400 --> 00:09:47,130
I have scaled these up the yield of the

233
00:09:51,020 --> 00:09:49,410
nucleotide formation is small so I've

234
00:09:53,150 --> 00:09:51,030
scaled up so that you can see the

235
00:09:55,820 --> 00:09:53,160
formation of these Peaks and what you

236
00:09:59,060 --> 00:09:55,830
can see is that the formation of the Rye

237
00:10:02,480 --> 00:09:59,070
beside Peaks are increasing as you allow

238
00:10:04,820 --> 00:10:02,490

Regulus to isomerize over time and you

239
00:10:07,400 --> 00:10:04,830
can kind of also see the formation of

240
00:10:09,680 --> 00:10:07,410
this small arabinose I'd peak as well so

241
00:10:12,290 --> 00:10:09,690
the result of this is that once you

242
00:10:15,350 --> 00:10:12,300
allow RHIB ulos to isomerize in solution

243
00:10:18,680 --> 00:10:15,360
it can go to either ribose or arabinose

244
00:10:22,970 --> 00:10:18,690
which then once I add barbaric acid will

245
00:10:25,010 --> 00:10:22,980
react to form these nucleotides I did

246
00:10:28,210 --> 00:10:25,020
the same experiment with hexa sugars

247
00:10:31,310 --> 00:10:28,220
just to see if these trends followed

248
00:10:33,230 --> 00:10:31,320
based on the fact that there are ketosis

249
00:10:35,630 --> 00:10:33,240
and didn't have any effect based on the

250
00:10:39,550 --> 00:10:35,640
carbon number and you can see the same

251
00:10:42,050 --> 00:10:39,560
thing here so the green is glucose at

252
00:10:44,510 --> 00:10:42,060
not incubated at all reacted with

253
00:10:46,880 --> 00:10:44,520
barbour Turek acid the blue trace is

254
00:10:49,490 --> 00:10:46,890
mannose again not incubated for any time

255
00:10:51,260 --> 00:10:49,500
reacted with barbaric acid so you can

256
00:10:54,080 --> 00:10:51,270
see that there's a large peak here that

257
00:10:56,000 --> 00:10:54,090
represents a glucoside or a glucose

258
00:10:57,590 --> 00:10:56,010
nucleoside and there's a large peak here

259
00:11:00,170 --> 00:10:57,600
that represents a man aside or Manas

260
00:11:02,780 --> 00:11:00,180
nucleoside and when I incubate fructose

261
00:11:05,000 --> 00:11:02,790
for 408 hours you can see it go from

262
00:11:07,910 --> 00:11:05,010
having no nucleoside peaks to having

263
00:11:11,600 --> 00:11:07,920

large mannose and glucoside peaks so

264
00:11:13,700 --> 00:11:11,610
this again to me indicates that when you

265
00:11:15,610 --> 00:11:13,710
have these keto sugars and you let them

266
00:11:18,610 --> 00:11:15,620
incubate over time the

267
00:11:21,710 --> 00:11:18,620
interconvert into the different aldose

268
00:11:24,590 --> 00:11:21,720
isomers and those can then react with

269
00:11:29,180 --> 00:11:24,600
nucleosides or with nucleobases to form

270
00:11:31,639 --> 00:11:29,190
nucleotides so the scheme that I'd like

271
00:11:33,769 --> 00:11:31,649
to leave you with is one where you have

272
00:11:35,420 --> 00:11:33,779
something like rib ulos for example

273
00:11:37,280 --> 00:11:35,430
which not only can interconvert between

274
00:11:40,009 --> 00:11:37,290
sugars but you know these sugars go

275
00:11:41,600 --> 00:11:40,019
between their linear and cyclic forms so

276
00:11:44,509 --> 00:11:41,610
you could have regulars that can

277
00:11:47,439 --> 00:11:44,519
interconvert to ribose and arabinose as

278
00:11:50,150 --> 00:11:47,449
well and these can again also

279
00:11:51,980 --> 00:11:50,160
interconvert with their cyclic forms but

280
00:11:53,840 --> 00:11:51,990
not only do you have this system which

281
00:11:55,670 --> 00:11:53,850
i've kind of demonstrated you could

282
00:11:57,439 --> 00:11:55,680
hypothetically have a larger system

283
00:11:59,389 --> 00:11:57,449
where you could have regulars

284
00:12:02,329 --> 00:11:59,399
interconverting in twos i lullo's by the

285
00:12:06,139 --> 00:12:02,339
carbonyl or the formation of an enol in

286
00:12:08,990 --> 00:12:06,149
between the 2 and 3 carbons rather than

287
00:12:10,759 --> 00:12:09,000
the 1 and 2 carbons and then that could

288
00:12:13,939 --> 00:12:10,769

isomerize into the sugars look so some

289
00:12:16,759 --> 00:12:13,949
xylose so in terms of the prebiotic

290
00:12:19,730 --> 00:12:16,769
context and and implications of this I

291
00:12:22,220 --> 00:12:19,740
think that once you form these sugars

292
00:12:24,139 --> 00:12:22,230
you they can isomerize readily and they

293
00:12:27,379 --> 00:12:24,149
can basically inter convert into any

294
00:12:29,449 --> 00:12:27,389
possible sugar of that structural

295
00:12:31,309 --> 00:12:29,459
arrangement and length so once you have

296
00:12:34,160 --> 00:12:31,319
an unbranched five carbon sugar in

297
00:12:36,319 --> 00:12:34,170
solution hypothetically could isomerize

298
00:12:38,900 --> 00:12:36,329
into any other unbranched five carbon

299
00:12:41,990 --> 00:12:38,910
sugar so in terms of what this means for

300
00:12:43,250 --> 00:12:42,000
prebiotic chemistry i think that these

301
00:12:45,079 --> 00:12:43,260
sugar forming reactions don't

302
00:12:47,120 --> 00:12:45,089
necessarily need to be selective for

303
00:12:49,160 --> 00:12:47,130
something like ribose if you can form

304
00:12:50,960 --> 00:12:49,170
rib you Lowe's or any other five carbon

305
00:12:52,910 --> 00:12:50,970
sugar then you're pretty much there

306
00:12:57,170 --> 00:12:52,920
you're able to get any other five carbon

307
00:12:59,230 --> 00:12:57,180
sugar in solution so in conclusion I

308
00:13:02,030 --> 00:12:59,240
think the prebiotic formation of sugars

309
00:13:04,160 --> 00:13:02,040
likely allowed for some inter conversion

310
00:13:06,500 --> 00:13:04,170
that gets you all these different

311
00:13:08,360 --> 00:13:06,510
isomers you can have these nucleobases

312
00:13:10,430 --> 00:13:08,370
in the solution that would be able to

313
00:13:13,220 --> 00:13:10,440

sort of trap these sugars in their

314
00:13:17,269 --> 00:13:13,230
aldose forms allowing for the formation

315
00:13:19,069 --> 00:13:17,279
of nucleotides and that life or chemical

316
00:13:20,840 --> 00:13:19,079
evolution could have selected from this

317
00:13:24,319 --> 00:13:20,850
large pool of nucleotides on the early

318
00:13:25,880 --> 00:13:24,329
earth so I'd like to thank my advisor

319
00:13:27,829 --> 00:13:25,890
Nick hood and my group members

320
00:13:28,949 --> 00:13:27,839
especially David fiallo for helping me

321
00:13:31,410 --> 00:13:28,959
out with this

322
00:13:32,309 --> 00:13:31,420
several other collaborators including

323
00:13:34,559 --> 00:13:32,319
dr. Krishnamoorthy

324
00:13:36,660 --> 00:13:34,569
dr. Miller Sivan dr. Schuster and the

325
00:13:38,009 --> 00:13:36,670
rest of my graduate committee have been

326
00:13:39,900 --> 00:13:38,019
a great help with this and I'd like to

327
00:13:44,470 --> 00:13:39,910
thank the NSF and NASA for funding

328
00:13:51,079 --> 00:13:47,449
[Applause]

329
00:13:56,419 --> 00:13:51,089
very nice we'll do we have one question

330
00:13:56,429 --> 00:14:04,900
yes right here

331
00:14:10,830 --> 00:14:07,460
so then

332
00:14:14,130 --> 00:14:10,840
it's not yours irreversible you could

333
00:14:16,230 --> 00:14:14,140
have nuclear sedation and hydrolysis you

334
00:14:17,700 --> 00:14:16,240
can imagine this is all done in solution

335
00:14:19,530 --> 00:14:17,710
phase but you can imagine some sort of

336
00:14:21,270 --> 00:14:19,540
system where there's also a drying cycle

337
00:14:24,840 --> 00:14:21,280
which it would allow for that nucleoside

338
00:14:26,640 --> 00:14:24,850

formation to happen and then the other

339
00:14:28,860 --> 00:14:26,650
component that could drive that nuclear

340
00:14:31,730 --> 00:14:28,870
sedation in sort of a directed fashion

341
00:14:34,650 --> 00:14:31,740
is I mentioned that these nucleobases

342
00:14:36,540 --> 00:14:34,660
assemble in a super molecular fashion so

343
00:14:38,880 --> 00:14:36,550
you could imagine that perhaps when they

344
00:14:40,980 --> 00:14:38,890
react with the sugar they could then be

345
00:14:43,020 --> 00:14:40,990
drawn into the super molecular assembly

346
00:14:44,340 --> 00:14:43,030
where the sugars hanging off the end and

347
00:14:46,680 --> 00:14:44,350
then perhaps you could have some

348
00:14:48,510 --> 00:14:46,690
oligomerization followed you know if

349
00:14:50,000 --> 00:14:48,520
once you get a critical mass of sugars