
AbSciCon
2019

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

2
00:00:12,539 --> 00:00:09,110
[Applause]

3
00:00:14,759 --> 00:00:12,549
we now know that complex organics are

4
00:00:18,930 --> 00:00:14,769
every way the solar system therefore

5
00:00:21,960 --> 00:00:18,940
misra meteors comets asteroids and also

6
00:00:24,359 --> 00:00:21,970
planetary satellites and these organics

7
00:00:27,179 --> 00:00:24,369
are not nothing to do with terrestrial

8
00:00:30,720 --> 00:00:27,189
organic matter because we have now

9
00:00:33,030 --> 00:00:30,730
almost 100 middle axis where on earth we

10
00:00:35,520 --> 00:00:33,040
only use in our twenty and there are a

11
00:00:38,580 --> 00:00:35,530
neutral nuclear bases more than the five

12
00:00:44,580 --> 00:00:38,590
that we have or on earth and the amount

13
00:00:47,099 --> 00:00:44,590

of complexity is quite quite large I

14
00:00:49,170 --> 00:00:47,109
mean almost all biological molecules are

15
00:00:51,240 --> 00:00:49,180
found in a soluble component of

16
00:00:58,439 --> 00:00:51,250
meteoroids and the in soluble component

17
00:01:00,599 --> 00:00:58,449
consists of a very large mixture of a

18
00:01:03,660 --> 00:01:00,609
romantic name prophetic compounds and we

19
00:01:05,850 --> 00:01:03,670
also know that these organics are not

20
00:01:08,250 --> 00:01:05,860
made by biological means they are not

21
00:01:14,249 --> 00:01:08,260
returned products of life but they will

22
00:01:17,999 --> 00:01:14,259
be with up form a small molecules to a

23
00:01:20,120 --> 00:01:18,009
more larger molecules now the question

24
00:01:23,219 --> 00:01:20,130
is that are these molecules are formed

25
00:01:26,190 --> 00:01:23,229
in the solar system or they could have

26
00:01:28,710 --> 00:01:26,200
extra solar system origin so today I

27
00:01:30,810 --> 00:01:28,720
want to talk about the only place that

28
00:01:32,700 --> 00:01:30,820
we know that complex organics are being

29
00:01:35,850 --> 00:01:32,710
made and that which is in the late

30
00:01:37,530 --> 00:01:35,860
stages of solution so after the nuclear

31
00:01:39,840 --> 00:01:37,540
synthesis of the element carbon you

32
00:01:43,139 --> 00:01:39,850
stretch up to the surface and on the

33
00:01:45,959 --> 00:01:43,149
understand atmosphere you form C 2 C 3 C

34
00:01:47,609 --> 00:01:45,969
n dastar's course in taluk john branch

35
00:01:51,230 --> 00:01:47,619
starts they have very strong stellar

36
00:01:54,569 --> 00:01:51,240
winds it is their winds you can see now

37
00:01:57,810 --> 00:01:54,579
over 80 different kinds of molecules and

38
00:02:00,480 --> 00:01:57,820

after that is the sage coronary nebula

39
00:02:02,490 --> 00:02:00,490
which lasts about 20,000 years so we can

40
00:02:05,819 --> 00:02:02,500
detect by both infrared and microwave

41
00:02:08,790 --> 00:02:05,829
means that the rotational vibrational

42
00:02:11,180 --> 00:02:08,800
lines of over 80 different kind of

43
00:02:14,520 --> 00:02:11,190
molecules in the stellar winds which

44
00:02:17,369 --> 00:02:14,530
consists of chains or rings and other

45
00:02:19,350 --> 00:02:17,379
kinds of organic molecules so the AGB

46
00:02:21,210 --> 00:02:19,360
stars are very prolific molecular

47
00:02:22,650 --> 00:02:21,220
factories but the most interesting

48
00:02:25,470 --> 00:02:22,660
come in the French Way nebula phase

49
00:02:28,230 --> 00:02:25,480
where this weekend the a was first

50
00:02:30,870 --> 00:02:28,240
detected in the late nineteen seventies

51
00:02:33,330 --> 00:02:30,880
of the so call and identify infrared

52
00:02:35,280 --> 00:02:33,340
emission bands at 3.30 six one to seven

53
00:02:36,960 --> 00:02:35,290
point seven eight point six zero and

54
00:02:39,360 --> 00:02:36,970
point three microns and they were

55
00:02:41,310 --> 00:02:39,370
pointed out almost immediately that the

56
00:02:44,340 --> 00:02:41,320
three points three micron feature is due

57
00:02:45,210 --> 00:02:44,350
to the stretching bow of rheumatic

58
00:02:49,020 --> 00:02:45,220
compounds

59
00:02:53,400 --> 00:02:49,030
now this uie bands are now seen in

60
00:02:55,410 --> 00:02:53,410
galaxies as far as 10 billion light

61
00:02:58,110 --> 00:02:55,420
years away so we know that complex

62
00:02:59,720 --> 00:02:58,120
organics are already present in the

63
00:03:02,550 --> 00:02:59,730

early universe

64
00:03:05,400 --> 00:03:02,560
okay now and also there are a lot of

65
00:03:08,130 --> 00:03:05,410
them because up to 20% of the total

66
00:03:11,340 --> 00:03:08,140
light output from those galaxies are

67
00:03:13,670 --> 00:03:11,350
coming in the form of this uie emissions

68
00:03:16,230 --> 00:03:13,680
now these are very interesting because

69
00:03:18,510 --> 00:03:16,240
we know that they are first seen in the

70
00:03:21,210 --> 00:03:18,520
planetary nebula but not seen in

71
00:03:23,340 --> 00:03:21,220
asymptotic giant branch star so they the

72
00:03:26,310 --> 00:03:23,350
first innocence must have occurred in

73
00:03:28,259 --> 00:03:26,320
between the and on asymptotic giant

74
00:03:30,270 --> 00:03:28,269
branch to the first formation of

75
00:03:34,920 --> 00:03:30,280
planetary nebulae which is a very short

76
00:03:36,720 --> 00:03:34,930
time so we have a for the stellar wind

77
00:03:38,880 --> 00:03:36,730
we have a dynamical age of about ten

78
00:03:40,949 --> 00:03:38,890
thousand years and the age of Franchi

79
00:03:43,290 --> 00:03:40,959
nebulae is less than is about twenty

80
00:03:46,770 --> 00:03:43,300
thousand years so we know that whatever

81
00:03:48,890 --> 00:03:46,780
sinister sucker must be in the thousand

82
00:03:51,660 --> 00:03:48,900
year lifetime that of course the most

83
00:03:54,030 --> 00:03:51,670
most interesting would be see to find a

84
00:03:56,190 --> 00:03:54,040
Discoverer objects in between these two

85
00:04:00,090 --> 00:03:56,200
stages you see we're there any sign of

86
00:04:02,370 --> 00:04:00,100
organic synthesis okay so in the air so

87
00:04:04,710 --> 00:04:02,380
Bruce if Nick and I were able to

88
00:04:07,080 --> 00:04:04,720

discover about thirty transitional

89
00:04:09,570 --> 00:04:07,090
objects and who you desire or the

90
00:04:11,400 --> 00:04:09,580
objects that exam examples of the

91
00:04:13,470 --> 00:04:11,410
appropriately nebulae that we discovered

92
00:04:15,840 --> 00:04:13,480
after the discovery the first thing you

93
00:04:18,180 --> 00:04:15,850
do to some spectroscopic follow-up we

94
00:04:21,300 --> 00:04:18,190
find that they have any fading

95
00:04:25,219 --> 00:04:21,310
transitions at a fox a mosaic stretch of

96
00:04:30,570 --> 00:04:25,229
either symmetric or anti-symmetric

97
00:04:32,130 --> 00:04:30,580
mesoamerican groups and yeah the eleven

98
00:04:33,350 --> 00:04:32,140
point three micron feature although

99
00:04:35,899 --> 00:04:33,360
usually

100
00:04:38,350 --> 00:04:35,909
due to our plane bearing motor or

101
00:04:40,999 --> 00:04:38,360
related compounds but there are other

102
00:04:43,189 --> 00:04:41,009
bands which suggest that these rings are

103
00:04:45,439 --> 00:04:43,199
very small the most interestingly they

104
00:04:48,700 --> 00:04:45,449
are broad emission features around 8 and

105
00:04:52,070 --> 00:04:48,710
12 micron and we suggested because many

106
00:04:54,529 --> 00:04:52,080
aliphatic compounds have entrained many

107
00:04:57,200 --> 00:04:54,539
mouths around 8 microns and our flame

108
00:04:59,330 --> 00:04:57,210
animals around 12 micron so these two

109
00:05:02,390 --> 00:04:59,340
facto features could be due to a

110
00:05:05,959 --> 00:05:02,400
superposition of airy-fairy compounds of

111
00:05:09,320 --> 00:05:05,969
different sizes and strengths so to

112
00:05:12,950 --> 00:05:09,330
summarize we have a phenomenon which has

113
00:05:14,089 --> 00:05:12,960

a set of strong features also which some

114
00:05:15,860 --> 00:05:14,099
of them could be due to a romantic

115
00:05:18,559 --> 00:05:15,870
compounds and there are also either

116
00:05:21,200 --> 00:05:18,569
fadec compounds but they are also plot

117
00:05:23,869 --> 00:05:21,210
features which about 2 microns wide

118
00:05:26,360 --> 00:05:23,879
which are probably due to a super

119
00:05:29,360 --> 00:05:26,370
composition of different plane and

120
00:05:31,249 --> 00:05:29,370
imprint burning books no so the key

121
00:05:34,820 --> 00:05:31,259
question is that what is the temporal

122
00:05:37,820 --> 00:05:34,830
structure of this carrier so in the last

123
00:05:41,450 --> 00:05:37,830
30 years the most popular hypothesis is

124
00:05:45,490 --> 00:05:41,460
the polycyclic hydrocarbon hypothesis

125
00:05:49,550 --> 00:05:45,500
which says that if you have a 50 carbon

126
00:05:54,320 --> 00:05:49,560
ring molecule that the it will be

127
00:05:55,700 --> 00:05:54,330
excited by UV radiation in the cascade

128
00:05:59,119 --> 00:05:55,710
down it will go through these different

129
00:06:00,920 --> 00:05:59,129
vibrations and give you this uie base

130
00:06:04,730 --> 00:06:00,930
but these hypotheses have a lot of

131
00:06:06,800 --> 00:06:04,740
problems I mean the most obvious one is

132
00:06:08,930 --> 00:06:06,810
that there is the simple molecules the

133
00:06:11,149 --> 00:06:08,940
lines are narrow and they are primary

134
00:06:13,129 --> 00:06:11,159
excited by UV there very little

135
00:06:15,290 --> 00:06:13,139
absorption in the visible but we now

136
00:06:17,600 --> 00:06:15,300
know that the uie bands are seeing

137
00:06:20,899 --> 00:06:17,610
refraction Epperly proprietary nebulae

138
00:06:24,379 --> 00:06:20,909

so they are definitely excited by lower

139
00:06:27,589 --> 00:06:24,389
energy photons and also if the UI events

140
00:06:30,050 --> 00:06:27,599
are due to create molecules they would

141
00:06:33,050 --> 00:06:30,060
have very strong electronic transitions

142
00:06:36,070 --> 00:06:33,060
but their detection limit is 3 order

143
00:06:38,480 --> 00:06:36,080
magnitude lower than what was predicted

144
00:06:41,149 --> 00:06:38,490
now the cameras that were unhappy about

145
00:06:43,430 --> 00:06:41,159
this hypothesis because pH molecules are

146
00:06:45,260 --> 00:06:43,440
very simple molecules and and their

147
00:06:47,360 --> 00:06:45,270
properties are well known

148
00:06:49,969 --> 00:06:47,370
there are a lot of literature about that

149
00:06:51,559 --> 00:06:49,979
the lines that they were detected

150
00:06:54,860 --> 00:06:51,569
astronomically I've read nothing to do

151
00:06:56,510 --> 00:06:54,870
with dye pH molecules now however to fit

152
00:06:58,580 --> 00:06:56,520
if you look in the literature as the

153
00:07:00,890 --> 00:06:58,590
Ronco literature used a beautiful feed

154
00:07:03,800 --> 00:07:00,900
to the UAE burns how did they do it

155
00:07:06,040 --> 00:07:03,810
it uses a mixture of pH molecules of

156
00:07:08,749 --> 00:07:06,050
different sizes structures shapes

157
00:07:12,350 --> 00:07:08,759
ionization states if you know in order

158
00:07:15,710 --> 00:07:12,360
to create a feat which is for example

159
00:07:17,990 --> 00:07:15,720
the astronomical spectra the Ames group

160
00:07:20,089 --> 00:07:18,000
are very kind to allow us to have access

161
00:07:23,180 --> 00:07:20,099
the database and also they're feeling

162
00:07:25,309 --> 00:07:23,190
routines so in the papers homogeneous

163
00:07:28,129 --> 00:07:25,319

vehicle journal we're able to show that

164
00:07:30,589 --> 00:07:28,139
their routine able to fit almost

165
00:07:32,180 --> 00:07:30,599
anything so it's really not very useful

166
00:07:34,909 --> 00:07:32,190
because they have so many free

167
00:07:37,309 --> 00:07:34,919
parameters in the feeling process now if

168
00:07:39,830 --> 00:07:37,319
they are not eh molecules what then what

169
00:07:41,779 --> 00:07:39,840
is now if you mix two elements hydrogen

170
00:07:44,960 --> 00:07:41,789
and carbon together they can create

171
00:07:48,290 --> 00:07:44,970
amorphous forms of a variety of of

172
00:07:50,689 --> 00:07:48,300
structures so pH molecule is just the

173
00:07:53,600 --> 00:07:50,699
line in the bottom so in one corner we

174
00:07:55,550 --> 00:07:53,610
have graphite which is pure romantic and

175
00:07:58,100 --> 00:07:55,560
then we have a purity ferric which is

176
00:08:03,680 --> 00:07:58,110
like diamond but really anything in the

177
00:08:06,800 --> 00:08:03,690
middle is possible so so into now 2011

178
00:08:07,939 --> 00:08:06,810
we proposed a model that means that you

179
00:08:10,010 --> 00:08:07,949
to mix romatic

180
00:08:14,450 --> 00:08:10,020
a definite organic nanoparticles and

181
00:08:16,879 --> 00:08:14,460
which has small rings but these rings

182
00:08:18,219 --> 00:08:16,889
are linked by the Vedic chains of

183
00:08:22,059 --> 00:08:18,229
different sizes and different

184
00:08:26,240 --> 00:08:22,069
orientations and they also have

185
00:08:28,279 --> 00:08:26,250
impurities like oxygen nitrogen sulphur

186
00:08:30,260 --> 00:08:28,289
and so on so they are not two

187
00:08:39,680 --> 00:08:30,270
dimensional but three dimensional and

188
00:08:41,240 --> 00:08:39,690

they not simple planar structures or

189
00:08:44,420 --> 00:08:41,250
fixed structures but amorphous

190
00:08:47,210 --> 00:08:44,430
okay so this is an example of a hundred

191
00:08:50,329 --> 00:08:47,220
and sixty-nine carbon molecules that you

192
00:08:52,610 --> 00:08:50,339
can see get an idea of the schematics of

193
00:08:53,870 --> 00:08:52,620
this kind of structure so yeah a

194
00:08:56,420 --> 00:08:53,880
disorganized

195
00:08:58,819 --> 00:08:56,430
okay so the last several years we

196
00:09:00,620 --> 00:08:58,829
published a number of papers on the

197
00:09:05,509 --> 00:09:00,630
properties of these small molecules and

198
00:09:08,120 --> 00:09:05,519
how they may be related to the upset you

199
00:09:10,850 --> 00:09:08,130
idea structure I won't be able to go

200
00:09:13,280 --> 00:09:10,860
into the details here but just to let

201
00:09:16,340 --> 00:09:13,290
you know that the way we do it is we

202
00:09:18,710 --> 00:09:16,350
start with simple 3 H molecules so that

203
00:09:21,650 --> 00:09:18,720
we know what we are talking about and we

204
00:09:24,319 --> 00:09:21,660
catch a defect

205
00:09:26,629 --> 00:09:24,329
change to the structure by gradually

206
00:09:29,059 --> 00:09:26,639
adding adding more complexity then we

207
00:09:31,100 --> 00:09:29,069
can hopefully understand where the

208
00:09:34,090 --> 00:09:31,110
vibrational modes are so it just shows

209
00:09:38,030 --> 00:09:34,100
some examples here that now with the

210
00:09:40,100 --> 00:09:38,040
present column chemistry techniques is

211
00:09:42,470 --> 00:09:40,110
really possible to do these kind of

212
00:09:45,860 --> 00:09:42,480
calculations because the chemists never

213
00:09:47,410 --> 00:09:45,870

did that because to the chemist as soon

214
00:09:50,329 --> 00:09:47,420
as they understand the principle of

215
00:09:53,360 --> 00:09:50,339
vibrations they are already happy but

216
00:09:56,990 --> 00:09:53,370
for us that people want to compare the

217
00:09:59,059 --> 00:09:57,000
astronomical spectrum with molecules we

218
00:10:01,370 --> 00:09:59,069
have to look at more complex structures

219
00:10:03,889 --> 00:10:01,380
and see what kind of moles are there and

220
00:10:07,160 --> 00:10:03,899
in the process we discover that for

221
00:10:09,499 --> 00:10:07,170
example there are some couple modes and

222
00:10:13,929 --> 00:10:09,509
which are or some more complex

223
00:10:16,480 --> 00:10:13,939
vibrational modes which are not been

224
00:10:19,340 --> 00:10:16,490
studied in the literature

225
00:10:21,410 --> 00:10:19,350
ok so I'm here just showing some

226
00:10:26,809 --> 00:10:21,420
examples you say that these kind of

227
00:10:31,100 --> 00:10:26,819
calculations are possible so the

228
00:10:33,679 --> 00:10:31,110
interesting thing is that if stars in

229
00:10:36,620 --> 00:10:33,689
the near the end of their lives are able

230
00:10:40,129 --> 00:10:36,630
to make very complex organics because

231
00:10:42,710 --> 00:10:40,139
they they can make it over a short

232
00:10:45,019 --> 00:10:42,720
period of time over hundreds or even

233
00:10:46,550 --> 00:10:45,029
thousands of years and we know that

234
00:10:50,389 --> 00:10:46,560
through the stellar wind they can be

235
00:10:53,150 --> 00:10:50,399
ejected or wasted a solar system Oh

236
00:10:55,429 --> 00:10:53,160
Tsutomu create galaxies across the

237
00:10:57,710 --> 00:10:55,439
industry medium so it's quite possible

238
00:11:00,710 --> 00:10:57,720

that some of those complex organic would

239
00:11:05,689 --> 00:11:00,720
be injected into our primordial

240
00:11:07,580 --> 00:11:05,699
solar system so they some evidence of it

241
00:11:09,740 --> 00:11:07,590
you seen for example in

242
00:11:12,380 --> 00:11:09,750
case of the pasola grains we now know

243
00:11:16,120 --> 00:11:12,390
that we had hold in our hands products

244
00:11:18,830 --> 00:11:16,130
of minerals which are ejected created by

245
00:11:23,660 --> 00:11:18,840
acid Ultron French stars because of the

246
00:11:26,600 --> 00:11:23,670
isotopic ratios so whether they the kind

247
00:11:29,390 --> 00:11:26,610
of organics that we see in Titan or in

248
00:11:32,630 --> 00:11:29,400
comets or which roy's have anything to

249
00:11:34,970 --> 00:11:32,640
do with Stella organics is something

250
00:11:38,420 --> 00:11:34,980
that we should explore more in the

251
00:11:40,910 --> 00:11:38,430
future so first I want to point out that

252
00:11:42,980 --> 00:11:40,920
organic compounds everywhere in the

253
00:11:43,940 --> 00:11:42,990
universe so we have a lot of organics in

254
00:11:47,060 --> 00:11:43,950
the solar system

255
00:11:49,400 --> 00:11:47,070
the in star say in the interstellar

256
00:11:52,280 --> 00:11:49,410
clouds a the diffuse industrial medium

257
00:11:54,440 --> 00:11:52,290
by looking at ISO absorption line

258
00:11:58,010 --> 00:11:54,450
studies we know that 50 percent at least

259
00:12:01,730 --> 00:11:58,020
of the carbon in the diffuse is a medium

260
00:12:05,540 --> 00:12:01,740
in the form of a defect and a detection

261
00:12:07,970 --> 00:12:05,550
of the UI EBA and Swift's galaxies at

262
00:12:10,430 --> 00:12:07,980
highest ratio of two suggesting it were

263
00:12:13,850 --> 00:12:10,440

early stage of the universe we already

264
00:12:20,240 --> 00:12:13,860
have complex organics so these organics

265
00:12:24,620 --> 00:12:20,250
of them sorry a consistent with the

266
00:12:26,660 --> 00:12:24,630
carrier being complex molecules wisdom

267
00:12:28,970 --> 00:12:26,670
of a structure with mixer America the

268
00:12:31,490 --> 00:12:28,980
phallic structure and I want to

269
00:12:33,650 --> 00:12:31,500
emphasize that the only objects that we

270
00:12:36,980 --> 00:12:33,660
can actually see these organics being

271
00:12:39,710 --> 00:12:36,990
made in the prevention ability and

272
00:12:42,230 --> 00:12:39,720
primary nebulae where they have with an

273
00:12:48,650 --> 00:12:42,240
apical age or evolutionary age or for

274
00:12:50,870 --> 00:12:48,660
thousands of years so if space a very

275
00:12:54,500 --> 00:12:50,880
strong constraint about what kind of

276
00:12:57,320 --> 00:12:54,510
chemical network that we have available

277
00:13:01,310 --> 00:12:57,330
to form these organics and these are not

278
00:13:03,590 --> 00:13:01,320
exotic objects because over 95% of all

279
00:13:05,150 --> 00:13:03,600
stars in our own galaxy goes to be a

280
00:13:07,370 --> 00:13:05,160
penny in every face so these are

281
00:13:11,930 --> 00:13:07,380
ordinary stars every star would go

282
00:13:16,490 --> 00:13:11,940
through this phase of making organics

283
00:13:20,720 --> 00:13:16,500
over a short period of time so we know

284
00:13:25,010 --> 00:13:20,730
that each VES rejecter

285
00:13:27,200 --> 00:13:25,020
I can survive the journey suit in the

286
00:13:30,470 --> 00:13:27,210
cernium all the way to the solar system

287
00:13:33,350 --> 00:13:30,480
and to the earth so is not impossible

288
00:13:35,900 --> 00:13:33,360

that some of the macro organics that we

289
00:13:41,030 --> 00:13:35,910
have now in the solar system may have

290
00:13:44,030 --> 00:13:41,040
find a heritage in in stars so I just

291
00:13:46,640 --> 00:13:44,040
want to leave to you some of the earth

292
00:13:49,340 --> 00:13:46,650
the papers I saw in the boat technical

293
00:13:52,630 --> 00:13:49,350
aspects those will be cited in some of