
AbSciCon
2019

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

2
00:00:12,379 --> 00:00:09,080
[Applause]

3
00:00:15,869 --> 00:00:12,389
I'm gonna tell you about these detection

4
00:00:17,790 --> 00:00:15,879
that we reported in the paper about year

5
00:00:20,250 --> 00:00:17,800
and a half ago of methyl chloride in

6
00:00:22,140 --> 00:00:20,260
particular and the co materia regions

7
00:00:24,450 --> 00:00:22,150
and also about the ongoing lab work that

8
00:00:26,310 --> 00:00:24,460
we're doing at JPL to support this

9
00:00:29,069 --> 00:00:26,320
detection and maybe guide future

10
00:00:31,319 --> 00:00:29,079
observation to observe more of these

11
00:00:34,319 --> 00:00:31,329
pieces so first of all why methyl

12
00:00:36,660 --> 00:00:34,329
halides well these pieces are abundant

13
00:00:39,150 --> 00:00:36,670

in the atmosphere of the earth so a

14
00:00:40,860 --> 00:00:39,160
couple of decades ago they were mainly

15
00:00:43,110 --> 00:00:40,870
found because of industrial processes

16
00:00:44,670 --> 00:00:43,120
but these days they're actually the the

17
00:00:47,569 --> 00:00:44,680
main production source is actually for

18
00:00:51,209 --> 00:00:47,579
biological processes so for example

19
00:00:55,650 --> 00:00:51,219
metabolizing allergens into the oceans

20
00:00:58,669 --> 00:00:55,660
by allergies and they will reject our

21
00:01:01,709 --> 00:00:58,679
gano allergens into the atmosphere and

22
00:01:05,490 --> 00:01:01,719
due to this connection between biology

23
00:01:08,610 --> 00:01:05,500
and for these pieces they were proposed

24
00:01:12,480 --> 00:01:08,620
as potential biomarkers if observed in

25
00:01:14,310 --> 00:01:12,490
the atmosphere of exoplanets this was

26
00:01:15,420 --> 00:01:14,320
further supported by the fact that in

27
00:01:18,450 --> 00:01:15,430
the interstellar medium

28
00:01:21,840 --> 00:01:18,460
well we actually detect allergens pieces

29
00:01:24,530 --> 00:01:21,850
but very small ones so HCl HCl plus and

30
00:01:26,880 --> 00:01:24,540
so on and most of the halogens

31
00:01:28,800 --> 00:01:26,890
especially for chlorine here is actually

32
00:01:31,410 --> 00:01:28,810
found in the diffuse interstellar medium

33
00:01:34,170 --> 00:01:31,420
and noting two molecular clouds were

34
00:01:35,550 --> 00:01:34,180
star formations happening so the

35
00:01:37,830 --> 00:01:35,560
question we have is there is there an

36
00:01:39,810 --> 00:01:37,840
actual disconnect between the allergen

37
00:01:43,740 --> 00:01:39,820
chemistry and the organic chemistry that

38
00:01:47,190 --> 00:01:43,750

we see in star forming and plant forming

39
00:01:50,550 --> 00:01:47,200
environments so to figure this out we

40
00:01:53,100 --> 00:01:50,560
search for them into purchased of our

41
00:01:55,950 --> 00:01:53,110
environments and specifically within the

42
00:01:58,859 --> 00:01:55,960
framework of the pills program but is an

43
00:02:01,230 --> 00:01:58,869
Alma program so Alma looked at the

44
00:02:03,270 --> 00:02:01,240
rotation lines towards a low mass

45
00:02:06,990 --> 00:02:03,280
produced are here for this pills program

46
00:02:09,389 --> 00:02:07,000
led by yes or Genson so this producer RS

47
00:02:11,640 --> 00:02:09,399
16 to 9 3 24 22 is actually thought to

48
00:02:14,360 --> 00:02:11,650
be an analogue of water sun looked like

49
00:02:17,600 --> 00:02:14,370
when it was forming so we looked at

50
00:02:20,420 --> 00:02:17,610
rotational lines nearby one of

51
00:02:23,000 --> 00:02:20,430
sources source be around 16 to 9 free

52
00:02:25,400 --> 00:02:23,010
and within this large program we

53
00:02:27,890 --> 00:02:25,410
actually covered a large frequency range

54
00:02:32,180 --> 00:02:27,900
at a very nice pectoral resolution that

55
00:02:35,120 --> 00:02:32,190
allowed us to to look at this lines and

56
00:02:37,310 --> 00:02:35,130
also at a very high angular resolution

57
00:02:39,080 --> 00:02:37,320
point five our second which for this

58
00:02:40,490 --> 00:02:39,090
sources correspond to about sixty you

59
00:02:43,699 --> 00:02:40,500
it's actually very small for pretty

60
00:02:46,040 --> 00:02:43,709
stuff so this is what the data look like

61
00:02:47,780 --> 00:02:46,050
it's lots and lots of lines it's

62
00:02:50,870 --> 00:02:47,790
actually a spectrum that is taking at

63
00:02:52,400 --> 00:02:50,880

one special like expected at one

64
00:02:54,620 --> 00:02:52,410
position towards the star we actually

65
00:02:56,590 --> 00:02:54,630
have a whole map of these and all of

66
00:03:00,650 --> 00:02:56,600
these are rotational lines from

67
00:03:02,360 --> 00:03:00,660
molecules and myths of them are like

68
00:03:03,680 --> 00:03:02,370
molecules that we know that we have been

69
00:03:06,860 --> 00:03:03,690
observed that have been observed before

70
00:03:09,440 --> 00:03:06,870
like methanol dimethyl ether and so on

71
00:03:10,790 --> 00:03:09,450
deteriorated version of these but some

72
00:03:12,320 --> 00:03:10,800
of these lines are actually due to

73
00:03:15,080 --> 00:03:12,330
molecules that haven't been identified

74
00:03:18,140 --> 00:03:15,090
before and this was the case for methyl

75
00:03:20,300 --> 00:03:18,150
chloride so this is what we found this

76
00:03:23,960 --> 00:03:20,310
is the detection that we got so for the

77
00:03:26,570 --> 00:03:23,970
35 chlorine and the 37 chlorine as you

78
00:03:30,560 --> 00:03:26,580
can see the lines are like very intense

79
00:03:33,350 --> 00:03:30,570
we can actually detect them up to k

80
00:03:38,090 --> 00:03:33,360
equal four into is 13 to 12 transition

81
00:03:40,280 --> 00:03:38,100
for this symmetric top molecule so nice

82
00:03:42,110 --> 00:03:40,290
we can fit them we can derive a benign

83
00:03:44,770 --> 00:03:42,120
we can direct column density for these

84
00:03:48,710 --> 00:03:44,780
two species and by doing the ratio of 35

85
00:03:50,660 --> 00:03:48,720
chlorine over 37 we actually find 2.1 in

86
00:03:52,370 --> 00:03:50,670
this star forming region so for those of

87
00:03:54,470 --> 00:03:52,380
you who are familiar with the value of

88
00:03:56,060 --> 00:03:54,480

isotopic ratio for chlorine and the

89
00:03:57,590 --> 00:03:56,070
solar system it's going to be a bit of a

90
00:04:00,410 --> 00:03:57,600
surprise in the solar system we expect

91
00:04:03,440 --> 00:04:00,420
the value at 3.1 but it's actually not

92
00:04:05,570 --> 00:04:03,450
surprising to find 2.1 because detection

93
00:04:08,330 --> 00:04:05,580
previous detection of HC else of it

94
00:04:11,449 --> 00:04:08,340
found this ratio to be 2.1 and it's

95
00:04:14,509 --> 00:04:11,459
actually now accepted that this ratio

96
00:04:19,219 --> 00:04:14,519
changes in different molecular clouds

97
00:04:22,280 --> 00:04:19,229
nearby our solar system so this is what

98
00:04:25,490 --> 00:04:22,290
also combining these two abundances and

99
00:04:27,150 --> 00:04:25,500
comparing them to that of methanol one

100
00:04:29,550 --> 00:04:27,160
of very big

101
00:04:32,580 --> 00:04:29,560
this organic molecule in this region we

102
00:04:34,890 --> 00:04:32,590
found a ratio about 10 to the minus 4 so

103
00:04:36,630 --> 00:04:34,900
it's Medicare ID is not in abundance

104
00:04:38,850 --> 00:04:36,640
pieces in these environments but it's

105
00:04:40,920 --> 00:04:38,860
not negligible either and we see it here

106
00:04:44,160 --> 00:04:40,930
I'm showing you here the emission of

107
00:04:47,340 --> 00:04:44,170
methyl chloride around this protostars

108
00:04:48,540 --> 00:04:47,350
eschews be here and I was actually the

109
00:04:53,370 --> 00:04:48,550
spectrum that I show you here was

110
00:04:55,140 --> 00:04:53,380
extracted at this position to here so so

111
00:04:58,230 --> 00:04:55,150
we detected this methyl chloride around

112
00:05:00,180 --> 00:04:58,240
illumise protostar and some of the

113
00:05:02,490 --> 00:05:00,190

members of the pills team we're actually

114
00:05:05,670 --> 00:05:02,500
also members of the Rosina team that

115
00:05:09,750 --> 00:05:05,680
looked at the outgassing a comet 67p and

116
00:05:12,120 --> 00:05:09,760
so we like them to look in the spectra

117
00:05:14,130 --> 00:05:12,130
of Rosina and especially the DFM s to

118
00:05:16,080 --> 00:05:14,140
see if a that we would find this methyl

119
00:05:19,560 --> 00:05:16,090
tried and it was actually there have a

120
00:05:22,470 --> 00:05:19,570
small shoulder here around my 50s so

121
00:05:24,170 --> 00:05:22,480
that the the resolution of this mass

122
00:05:27,990 --> 00:05:24,180
spectrometer is such that you can

123
00:05:31,410 --> 00:05:28,000
disentangle different isomer at one

124
00:05:33,510 --> 00:05:31,420
specific amu we can disentangle for

125
00:05:36,330 --> 00:05:33,520
different atomic composition and that's

126
00:05:39,000 --> 00:05:36,340
how we could like get this methyl

127
00:05:41,640 --> 00:05:39,010
chloride detection we see the 35

128
00:05:44,700 --> 00:05:41,650
chlorine we don't see the 37 but it's

129
00:05:48,780 --> 00:05:44,710
not surprising if you accept this free

130
00:05:51,240 --> 00:05:48,790
point one isotopic ratio for chlorine in

131
00:05:53,070 --> 00:05:51,250
the solar system what is interesting is

132
00:05:56,370 --> 00:05:53,080
to look at the abundance at which we

133
00:05:59,190 --> 00:05:56,380
observed ethyl chloride versus methanol

134
00:06:01,050 --> 00:05:59,200
around 67 P and we found 10 to the minus

135
00:06:04,440 --> 00:06:01,060
4 which is similar to what we've seen

136
00:06:06,980 --> 00:06:04,450
for the protostar and this supports the

137
00:06:09,360 --> 00:06:06,990
possible scenario of an inheritance of

138
00:06:11,790 --> 00:06:09,370

chemistry form in the pretty little

139
00:06:13,830 --> 00:06:11,800
regions that would be inherited down to

140
00:06:16,020 --> 00:06:13,840
come at from ingredients or at least a

141
00:06:19,530 --> 00:06:16,030
scenario what the chemistry is similar

142
00:06:21,210 --> 00:06:19,540
in these two environments so the

143
00:06:23,670 --> 00:06:21,220
question is how do we form methyl

144
00:06:25,770 --> 00:06:23,680
chlorine how does it got here and while

145
00:06:27,270 --> 00:06:25,780
we don't know yet but other chemical

146
00:06:30,420 --> 00:06:27,280
models actually took a crack headed

147
00:06:33,090 --> 00:06:30,430
after this detection was published and

148
00:06:35,279 --> 00:06:33,100
they actually found that you could form

149
00:06:37,529 --> 00:06:35,289
a methyl chloride efficiently by

150
00:06:39,980 --> 00:06:37,539
chlorination or at regeneration of

151
00:06:43,280 --> 00:06:39,990
carbon of methyl onto the gray

152
00:06:47,030 --> 00:06:43,290
surface that you find in this in the

153
00:06:50,900 --> 00:06:47,040
purchaser or envelope so you form ch3cl

154
00:06:53,480 --> 00:06:50,910
and then the grains in the outer part of

155
00:06:56,420 --> 00:06:53,490
the particular envelope flow towards the

156
00:06:59,120 --> 00:06:56,430
central object so when it's forming and

157
00:07:01,160 --> 00:06:59,130
so the grains warm up and Myka's that

158
00:07:03,500 --> 00:07:01,170
you would form into the the ice surface

159
00:07:06,200 --> 00:07:03,510
will dissolve in the gas phase and be

160
00:07:09,620 --> 00:07:06,210
able thats how we can detect them with

161
00:07:11,480 --> 00:07:09,630
radio interferometers of course this is

162
00:07:13,430 --> 00:07:11,490
the theory this is what the models tells

163
00:07:15,410 --> 00:07:13,440

us but we need to perform laboratory

164
00:07:17,810 --> 00:07:15,420
experiments to figure out what is the

165
00:07:19,970 --> 00:07:17,820
actual formation mechanism but before

166
00:07:23,510 --> 00:07:19,980
doing that what we also need to know is

167
00:07:25,220 --> 00:07:23,520
how to quantify methyl chloride in this

168
00:07:28,100 --> 00:07:25,230
in the solid state if we want to test

169
00:07:29,720 --> 00:07:28,110
this formation scenario and for this so

170
00:07:32,030 --> 00:07:29,730
we need to do laboratory study and

171
00:07:34,940 --> 00:07:32,040
specifically looking at a spectroscopic

172
00:07:37,760 --> 00:07:34,950
studies because spectroscopy is the main

173
00:07:40,430 --> 00:07:37,770
tool that we have to look at molecule

174
00:07:42,380 --> 00:07:40,440
formation in the solid state so infrared

175
00:07:43,790 --> 00:07:42,390
spectroscopy in the mid are so that's

176
00:07:46,550 --> 00:07:43,800
what we're currently doing so it's

177
00:07:48,410 --> 00:07:46,560
ongoing work at JPL

178
00:07:51,530 --> 00:07:48,420
that we're doing cycle looking in the

179
00:07:53,750 --> 00:07:51,540
spectroscopy of these methyl halides so

180
00:07:55,430 --> 00:07:53,760
in pure ice films in this case and what

181
00:07:58,910 --> 00:07:55,440
we would like to know is to derive band

182
00:08:02,270 --> 00:07:58,920
strength for the different vibration of

183
00:08:03,710 --> 00:08:02,280
this pure of its molecules in the solid

184
00:08:05,960 --> 00:08:03,720
States so here I'm showing you the

185
00:08:09,830 --> 00:08:05,970
spectra that we get by depositing so

186
00:08:12,220 --> 00:08:09,840
molecule so ch3 FC or a CLC Revere or C

187
00:08:15,170 --> 00:08:12,230
a tree I on two cold substrates

188
00:08:16,370 --> 00:08:15,180

interrogating the spectroscopy with

189
00:08:19,430 --> 00:08:16,380
Fourier transform infrared spectroscopy

190
00:08:24,020 --> 00:08:19,440
and as you can see well we can attribute

191
00:08:25,820 --> 00:08:24,030
the emission the vibrations so for the

192
00:08:26,900 --> 00:08:25,830
CH stretching and the CH free

193
00:08:29,000 --> 00:08:26,910
deformation here

194
00:08:31,250 --> 00:08:29,010
there's not a huge change between the

195
00:08:33,260 --> 00:08:31,260
different types of allergens but of

196
00:08:37,850 --> 00:08:33,270
course once you go towards here tree

197
00:08:40,790 --> 00:08:37,860
rocks or CAC X so C F or C CL stretch

198
00:08:42,470 --> 00:08:40,800
very clear like changes due to the

199
00:08:46,160 --> 00:08:42,480
presence of the allergen and the nature

200
00:08:47,450 --> 00:08:46,170
of the allergen to get the bends ranked

201
00:08:50,060 --> 00:08:47,460
what we're doing is that we're

202
00:08:51,770 --> 00:08:50,070
integrating the optical depth under

203
00:08:53,460 --> 00:08:51,780
these bands divided by the column

204
00:08:56,370 --> 00:08:53,470
density of ice between

205
00:08:58,170 --> 00:08:56,380
and this is what we report here I warmed

206
00:09:00,690 --> 00:08:58,180
up the ice at different temperatures and

207
00:09:03,510 --> 00:09:00,700
as you can see the band strength for a

208
00:09:05,760 --> 00:09:03,520
difference see extra edge and CHP rock

209
00:09:09,180 --> 00:09:05,770
doesn't really change with temperature

210
00:09:11,040 --> 00:09:09,190
I'm inversa decrees here for chri high

211
00:09:13,890 --> 00:09:11,050
temperature most likely due to the onset

212
00:09:16,020 --> 00:09:13,900
of this origin but what actually changed

213
00:09:18,600 --> 00:09:16,030

is the shape of the features that you

214
00:09:20,880 --> 00:09:18,610
get so this is what we get when we

215
00:09:22,710 --> 00:09:20,890
deposit this films at low temperature

216
00:09:25,500 --> 00:09:22,720
and when we increase temperature we have

217
00:09:27,680 --> 00:09:25,510
like like very different shape my

218
00:09:31,170 --> 00:09:27,690
Seikaly due to the crystallization of

219
00:09:33,090 --> 00:09:31,180
these films in water ice we also observe

220
00:09:34,740 --> 00:09:33,100
the change of temperature here that is

221
00:09:38,820 --> 00:09:34,750
most likely due to the diffusion of

222
00:09:41,070 --> 00:09:38,830
molecules so here so water to see a tree

223
00:09:42,990 --> 00:09:41,080
I attend to one mixture at high

224
00:09:44,880 --> 00:09:43,000
temperature you can have diffusion these

225
00:09:46,410 --> 00:09:44,890
molecules likely segregates and that's

226
00:09:50,430 --> 00:09:46,420
why we can observe signature of

227
00:09:51,090 --> 00:09:50,440
crystallization so we get this been

228
00:09:53,940 --> 00:09:51,100
strength

229
00:09:55,800 --> 00:09:53,950
another characteristic and other

230
00:09:57,510 --> 00:09:55,810
behavior of this icing that we are

231
00:10:01,140 --> 00:09:57,520
highly interested in would be to look at

232
00:10:02,730 --> 00:10:01,150
the thermal desorption of his ices and

233
00:10:06,480 --> 00:10:02,740
that's what we've been doing this time

234
00:10:08,610 --> 00:10:06,490
by depositing ice film onto not a window

235
00:10:12,440 --> 00:10:08,620
band to a currently called

236
00:10:14,820 --> 00:10:12,450
micro balance so we deposited them

237
00:10:17,100 --> 00:10:14,830
different ice films of different

238
00:10:20,010 --> 00:10:17,110

thicknesses and what we did with micro

239
00:10:21,480 --> 00:10:20,020
balance is to follow the ice loss versus

240
00:10:24,180 --> 00:10:21,490
temperature and looking at the

241
00:10:25,980 --> 00:10:24,190
derivative here so ice loss rate versus

242
00:10:27,750 --> 00:10:25,990
temperature which you can see is that

243
00:10:29,820 --> 00:10:27,760
for the different thicknesses well the

244
00:10:32,580 --> 00:10:29,830
rate does not change this is typical of

245
00:10:36,770 --> 00:10:32,590
zero for the desorption kinetics you can

246
00:10:39,570 --> 00:10:36,780
fit this rates by music by this equation

247
00:10:40,860 --> 00:10:39,580
extracting here the doozers and energy

248
00:10:43,560 --> 00:10:40,870
said adsorption that you need to

249
00:10:46,860 --> 00:10:43,570
overcome to have desorption occurring

250
00:10:48,060 --> 00:10:46,870
these are the energy that I gets as you

251
00:10:50,700 --> 00:10:48,070
can see if there's not a clear

252
00:10:52,680 --> 00:10:50,710
correlation with the mass here Tracy L

253
00:10:54,540 --> 00:10:52,690
is a bit out of the way here and this

254
00:10:56,370 --> 00:10:54,550
miss actually because not just the mass

255
00:10:59,670 --> 00:10:56,380
is involved into the desorption of this

256
00:11:02,040 --> 00:10:59,680
species but also other parameters such

257
00:11:04,530 --> 00:11:02,050
as the polarity or even the size of

258
00:11:05,320 --> 00:11:04,540
these molecules ch3cl here is really

259
00:11:07,120 --> 00:11:05,330
standing out

260
00:11:09,040 --> 00:11:07,130
could he explain this like the dipole

261
00:11:10,870 --> 00:11:09,050
moment here and could explain why it's

262
00:11:15,940 --> 00:11:10,880
stickier and it takes more energy to

263
00:11:18,130 --> 00:11:15,950

dissolve so pushing further towards

264
00:11:20,110 --> 00:11:18,140
Astrophysical implication we can use

265
00:11:23,860 --> 00:11:20,120
this sublimation energy that we derived

266
00:11:26,620 --> 00:11:23,870
in the laboratory to like measure well

267
00:11:28,930 --> 00:11:26,630
predicts and derive where the desorption

268
00:11:30,819 --> 00:11:28,940
France of these species are going to be

269
00:11:33,670 --> 00:11:30,829
in around protostars

270
00:11:35,380 --> 00:11:33,680
so like derive where the snow lines are

271
00:11:37,569 --> 00:11:35,390
going to occur and that's what I've been

272
00:11:39,100 --> 00:11:37,579
doing here with quick calculation so the

273
00:11:41,019 --> 00:11:39,110
definition of the snow line of the

274
00:11:44,590 --> 00:11:41,029
desorption front is where the flux of

275
00:11:48,430 --> 00:11:44,600
adsorption equals the flux of adsorption

276
00:11:50,620 --> 00:11:48,440
equals the flux of desorption by like

277
00:11:53,110 --> 00:11:50,630
equating the impingement rate of the

278
00:11:55,269 --> 00:11:53,120
item of the molecules equals to

279
00:11:57,519 --> 00:11:55,279
desorption rates you can derive this

280
00:12:00,400 --> 00:11:57,529
temperature here which for a species

281
00:12:02,650 --> 00:12:00,410
using typical abundances gives you the

282
00:12:05,319 --> 00:12:02,660
following temperature around the

283
00:12:09,699 --> 00:12:05,329
protostar and by like using this

284
00:12:11,500 --> 00:12:09,709
temperature and a temperature profile

285
00:12:14,410 --> 00:12:11,510
around Purdue star so here it's actually

286
00:12:15,670 --> 00:12:14,420
the profile for sixty to ninety three we

287
00:12:17,530 --> 00:12:15,680
are observed methyl chloride you can

288
00:12:19,180 --> 00:12:17,540

actually predict that methyl chloride

289
00:12:22,090 --> 00:12:19,190
pure methyl chloride will dissolve

290
00:12:24,220 --> 00:12:22,100
around 130 EU from the central object

291
00:12:28,210 --> 00:12:24,230
it's going to be further out for methyl

292
00:12:30,819 --> 00:12:28,220
fluoride and closer for the other methyl

293
00:12:34,329 --> 00:12:30,829
halide which is interesting to see also

294
00:12:34,720 --> 00:12:34,339
is that another 140 you value better

295
00:12:36,610 --> 00:12:34,730
again

296
00:12:38,470 --> 00:12:36,620
it's actually quite close to where we

297
00:12:40,360 --> 00:12:38,480
detect this methyl chloride here with

298
00:12:42,040 --> 00:12:40,370
our mother beam that I show you here is

299
00:12:44,199 --> 00:12:42,050
about 68 you

300
00:12:46,540 --> 00:12:44,209
and it's actually corresponds to here

301
00:12:48,519 --> 00:12:46,550
where the two beams where here we have

302
00:12:50,680 --> 00:12:48,529
this like onset of this urgent when you

303
00:12:53,860 --> 00:12:50,690
start to see methyl chloride popping up

304
00:12:58,269 --> 00:12:53,870
into the gas phase all right so that

305
00:13:01,210 --> 00:12:58,279
leaves me to my conclusions so I showed

306
00:13:02,980 --> 00:13:01,220
you detections of methyl chloride around

307
00:13:05,829 --> 00:13:02,990
pretty star around pretty star and

308
00:13:09,370 --> 00:13:05,839
around a comet's really showing that

309
00:13:11,439 --> 00:13:09,380
there's a link between the organic and

310
00:13:13,900 --> 00:13:11,449
the allergen chemistry in industrial

311
00:13:16,980 --> 00:13:13,910
environments these molecules are not

312
00:13:19,740 --> 00:13:16,990
direct biomarkers if observed in the

313
00:13:21,750 --> 00:13:19,750

in the atmosphere of exempt annette's

314
00:13:23,220 --> 00:13:21,760
however we need more detection to figure

315
00:13:25,710 --> 00:13:23,230
out what is the standard like the

316
00:13:28,740 --> 00:13:25,720
regular like typical amounts of his

317
00:13:30,240 --> 00:13:28,750
compounds in interest our environment to

318
00:13:36,389 --> 00:13:30,250
see if an exoplanet she would have

319
00:13:38,579 --> 00:13:36,399
differences in in in in abundance for

320
00:13:41,310 --> 00:13:38,589
the spectroscopic experiments we serve

321
00:13:44,550 --> 00:13:41,320
at the CX and the CH works were highly

322
00:13:46,620 --> 00:13:44,560
depending on the type of methyl halides

323
00:13:48,269 --> 00:13:46,630
that you have and the ur like depends

324
00:13:51,180 --> 00:13:48,279
their shape depends on the temperature

325
00:13:52,769 --> 00:13:51,190
of the ice film so they can be used to

326
00:13:55,040 --> 00:13:52,779
probe the ice environment we also derive

327
00:13:58,320 --> 00:13:55,050
Ben's rain that now can be employed to

328
00:14:00,720 --> 00:13:58,330
quantify a cone the formation of these

329
00:14:03,120 --> 00:14:00,730
pieces in ice films the desorption

330
00:14:04,949 --> 00:14:03,130
energy showed us that they're not

331
00:14:06,870 --> 00:14:04,959
circular it is to the mass of these

332
00:14:10,019 --> 00:14:06,880
pieces that other parameters are

333
00:14:13,050 --> 00:14:10,029
involved when predicting when measuring

334
00:14:15,240 --> 00:14:13,060
disturbs in energy of molecules you need

335
00:14:18,660 --> 00:14:15,250
to look at effects like the size of

336
00:14:20,160 --> 00:14:18,670
polarity and the calculation of where

337
00:14:21,420 --> 00:14:20,170
the sublimation front would be showed us

338
00:14:23,579 --> 00:14:21,430

that it's in agreement with what has

339
00:14:25,949 --> 00:14:23,589
been observed by Alma but the search for

340
00:14:28,110 --> 00:14:25,959
CH ret which didn't detect yet is going

341
00:14:30,180 --> 00:14:28,120
to be much more complicated since it is

342
00:14:32,360 --> 00:14:30,190
or further out and the Colombian cities

343
00:14:35,880 --> 00:14:32,370
are expecting dust to be lower than