



1
00:00:04,220 --> 00:00:02,629
hello and welcome to the SSC meeting a

2
00:00:06,110 --> 00:00:04,230
secretary I'd like to welcome you I know

3
00:00:07,369 --> 00:00:06,120
it's the last day right now but this is

4
00:00:09,919 --> 00:00:07,379
I guess one of the first opportunities

5
00:00:11,959 --> 00:00:09,929
I've had to to welcome you I hope you're

6
00:00:13,249 --> 00:00:11,969
enjoying yourself so far what we're

7
00:00:15,499 --> 00:00:13,259
gonna do is going to diverge a little

8
00:00:17,510 --> 00:00:15,509
bit why because I'm an entomologist and

9
00:00:20,150 --> 00:00:17,520
I play with bugs so we're going to talk

10
00:00:22,160 --> 00:00:20,160
about protein semiconductors in relation

11
00:00:23,439 --> 00:00:22,170
to insect olfaction now a number of you

12
00:00:25,730 --> 00:00:23,449
probably are more familiar with

13
00:00:27,439 --> 00:00:25,740

semiconductors then you would be insect

14

00:00:29,269 --> 00:00:27,449

olfaction for that reason I'm gonna go

15

00:00:31,070 --> 00:00:29,279

spend a little more time talking about

16

00:00:32,959 --> 00:00:31,080

insect olfaction so that you understand

17

00:00:34,400 --> 00:00:32,969

where I'm coming from and why I'm gonna

18

00:00:35,900 --> 00:00:34,410

go in the direction of the

19

00:00:38,630 --> 00:00:35,910

semiconductors at the end of the talk

20

00:00:40,220 --> 00:00:38,640

first how do insects smell I think

21

00:00:41,569 --> 00:00:40,230

everyone knows I hope everyone knows

22

00:00:44,090 --> 00:00:41,579

that they all smell with their antennae

23

00:00:45,979 --> 00:00:44,100

they smell with their antennae and this

24

00:00:47,930 --> 00:00:45,989

is no more obvious in some of the large

25

00:00:51,380 --> 00:00:47,940

moths largest moth of the world right

26
00:00:53,689 --> 00:00:51,390
here 11 inch wingspan atticus Atlas and

27
00:00:54,920 --> 00:00:53,699
they take a look at the antennae here

28
00:00:57,529 --> 00:00:54,930
especially on the Saturn eye it's

29
00:00:59,090 --> 00:00:57,539
because they're so big but it's not

30
00:01:01,189 --> 00:00:59,100
really the antenna itself it's usually

31
00:01:03,560 --> 00:01:01,199
the sencilla so if you get a close-up of

32
00:01:05,210 --> 00:01:03,570
the sencilla you can see on this

33
00:01:07,039 --> 00:01:05,220
scanning electron micrograph that they

34
00:01:09,590 --> 00:01:07,049
have these long tricloid sencilla

35
00:01:11,510 --> 00:01:09,600
which we know are the detectors and

36
00:01:13,310 --> 00:01:11,520
these are the actual detectors of the

37
00:01:16,010 --> 00:01:13,320
molecules that they are smelling such as

38
00:01:17,289 --> 00:01:16,020

the pheromone or the plan odorants now

39

00:01:21,320 --> 00:01:17,299

if I go ahead and make a cross-section

40

00:01:24,050 --> 00:01:21,330

now of this you can see that the

41

00:01:26,120 --> 00:01:24,060

sencilla is does have some tiny pores in

42

00:01:27,499 --> 00:01:26,130

the side right there they also have some

43

00:01:29,120 --> 00:01:27,509

dendrites emanating from these cells

44

00:01:31,069 --> 00:01:29,130

down here try could get a neutron tour

45

00:01:33,850 --> 00:01:31,079

imagine cell the dendrites are sent up

46

00:01:36,980 --> 00:01:33,860

they're bathed in a saline solution and

47

00:01:40,280 --> 00:01:36,990

this is the basic setup for most types

48

00:01:42,380 --> 00:01:40,290

of insect sencilla this is where i'm an

49

00:01:44,179 --> 00:01:42,390

agreement with them and we do not differ

50

00:01:45,560 --> 00:01:44,189

at all things start to get a little

51
00:01:46,940 --> 00:01:45,570
hairy right now let me tell you what the

52
00:01:48,770 --> 00:01:46,950
current theory is right now so that

53
00:01:51,679 --> 00:01:48,780
you're up to date we have the pheromones

54
00:01:53,660 --> 00:01:51,689
out here the pheromone is in blue the

55
00:01:56,030 --> 00:01:53,670
pheromone diffuses through the air it

56
00:01:58,069 --> 00:01:56,040
lands on the sense illa this is a sense

57
00:01:59,929 --> 00:01:58,079
illa right here the outside there is a

58
00:02:02,209 --> 00:01:59,939
very very thin layer of wax they usually

59
00:02:04,069 --> 00:02:02,219
imbed in the wax and when they embed in

60
00:02:06,639 --> 00:02:04,079
the wax they diffuse through the wax

61
00:02:09,020 --> 00:02:06,649
make their way to some tiny pores

62
00:02:10,940 --> 00:02:09,030
through it and then they have to wait

63
00:02:13,150 --> 00:02:10,950

they have to wait because it's a lipid

64

00:02:15,730 --> 00:02:13,160

water and oil don't mix

65

00:02:17,740 --> 00:02:15,740

this is water the pheromones are a

66

00:02:18,940 --> 00:02:17,750

long-chain 14 carbon acetate and

67

00:02:20,920 --> 00:02:18,950

therefore they're not going to diffuse

68

00:02:22,540 --> 00:02:20,930

through it they have to wait for a

69

00:02:24,820 --> 00:02:22,550

pheromone binding protein which is

70

00:02:26,830 --> 00:02:24,830

pretty large in order to come along grab

71

00:02:29,050 --> 00:02:26,840

it from the poor pull it in

72

00:02:31,660 --> 00:02:29,060

it will then ferry it across this

73

00:02:36,460 --> 00:02:31,670

ancillary lymph it will then make its

74

00:02:38,290 --> 00:02:36,470

way to a receptor and somehow binding is

75

00:02:40,180 --> 00:02:38,300

meant to occur whether it's with the

76

00:02:42,280 --> 00:02:40,190

pheromone directly or whether it's with

77

00:02:44,170 --> 00:02:42,290

the pheromone binding protein complex

78

00:02:46,450 --> 00:02:44,180

with the pheromone and this is how

79

00:02:49,420 --> 00:02:46,460

detection occurs you are now up to date

80

00:02:51,430 --> 00:02:49,430

and you can now publish any information

81

00:02:53,380 --> 00:02:51,440

on insect olfaction because this is

82

00:02:55,840 --> 00:02:53,390

about as far as we go you can apply for

83

00:02:59,200 --> 00:02:55,850

an NIH grant NSF grant and you will get

84

00:03:01,330 --> 00:02:59,210

funded for this now what is the

85

00:03:03,370 --> 00:03:01,340

overlying theme right here diffusion

86

00:03:05,140 --> 00:03:03,380

diffusion diffusion

87

00:03:07,390 --> 00:03:05,150

we've got diffusion through the air

88

00:03:09,670 --> 00:03:07,400

we've got diffusion through a wax layer

89

00:03:11,200 --> 00:03:09,680

and I've got now diffusion through this

90

00:03:13,030 --> 00:03:11,210

in similar limb even though it has to

91

00:03:14,710 --> 00:03:13,040

piggyback on a pheromone binding protein

92

00:03:16,090 --> 00:03:14,720

well this makes my job a little bit

93

00:03:18,780 --> 00:03:16,100

easier right now because when you've got

94

00:03:21,130 --> 00:03:18,790

a mechanism as singular as diffusion

95

00:03:22,630 --> 00:03:21,140

there are some laws that you can follow

96

00:03:24,400 --> 00:03:22,640

and you think to yourself wow this is

97

00:03:26,140 --> 00:03:24,410

diffusion I mean we can predict this

98

00:03:28,000 --> 00:03:26,150

sure it's going to be faster through air

99

00:03:29,380 --> 00:03:28,010

slower through the wax and a little bit

100

00:03:31,270 --> 00:03:29,390

faster there's a water though but there

101
00:03:33,610 --> 00:03:31,280
are some some generalizations that could

102
00:03:35,740 --> 00:03:33,620
be made and in former stalks I've let

103
00:03:38,110 --> 00:03:35,750
you know that diffusion does not account

104
00:03:40,570 --> 00:03:38,120
for the ability for the pheromone to

105
00:03:42,280 --> 00:03:40,580
reach the receptor in time if errant if

106
00:03:44,560 --> 00:03:42,290
the diffusion is all I have to work with

107
00:03:46,720 --> 00:03:44,570
and I assure you that this is all I have

108
00:03:48,100 --> 00:03:46,730
to work with then according to the

109
00:03:50,890 --> 00:03:48,110
current theory I can't get to that

110
00:03:52,780 --> 00:03:50,900
pheromone to the dendrite in time in

111
00:03:54,280 --> 00:03:52,790
order to say that the insect is now

112
00:03:57,340 --> 00:03:54,290
detecting it how long does this take

113
00:03:58,780 --> 00:03:57,350

this takes one millisecond no it takes a

114

00:04:01,750 --> 00:03:58,790

little bit less than one millisecond

115

00:04:03,190 --> 00:04:01,760

point eight point seven milliseconds now

116

00:04:04,420 --> 00:04:03,200

to you biologists some of you are

117

00:04:07,120 --> 00:04:04,430

impressed right now I think and Tom

118

00:04:08,979 --> 00:04:07,130

that's fast but do you physicists

119

00:04:10,720 --> 00:04:08,989

they're like that's casual you know one

120

00:04:13,630 --> 00:04:10,730

millisecond because you guys are dealing

121

00:04:15,970 --> 00:04:13,640

with nanoseconds picoseconds maybe

122

00:04:17,020 --> 00:04:15,980

femtoseconds we're but the biology is

123

00:04:18,909 --> 00:04:17,030

and what we're dealing with less than

124

00:04:23,290 --> 00:04:18,919

one millisecond that is lightning fast

125

00:04:25,300 --> 00:04:23,300

for a biological systems so what to do

126

00:04:26,650 --> 00:04:25,310

here is our cross section I've blown it

127

00:04:27,040 --> 00:04:26,660

up a little bit so you can take a close

128

00:04:28,119 --> 00:04:27,050

look

129

00:04:29,710 --> 00:04:28,129

see what we're talking about the

130

00:04:32,020 --> 00:04:29,720

pheromone pheromone I'm dealing with is

131

00:04:34,390 --> 00:04:32,030

about two nanometers long but the pores

132

00:04:36,490 --> 00:04:34,400

are between 10 and 50 nanometers in

133

00:04:37,749 --> 00:04:36,500

diameter what's going to happen when the

134

00:04:40,089 --> 00:04:37,759

pheromone hits the sencilla

135

00:04:41,260 --> 00:04:40,099

it's going to clog the pores it's going

136

00:04:43,240 --> 00:04:41,270

to clog the pores because there's just

137

00:04:45,490 --> 00:04:43,250

not that much room and it's not just the

138

00:04:47,740 --> 00:04:45,500

pheromone that gets in anything that the

139

00:04:49,330 --> 00:04:47,750

insect wants to smell is going to have

140

00:04:51,490 --> 00:04:49,340

to get through those pores and get to

141

00:04:54,309 --> 00:04:51,500

the dendrite anything plant odorants

142

00:04:55,899 --> 00:04:54,319

pheromone you name it and so everything

143

00:04:57,460 --> 00:04:55,909

is going to get clogged because it's not

144

00:04:59,309 --> 00:04:57,470

going to diffuse it has to wait for a

145

00:05:03,219 --> 00:04:59,319

ferryboat in order to carry it across

146

00:05:04,869 --> 00:05:03,229

problem also so the researchers looked

147

00:05:06,879 --> 00:05:04,879

for the proteins because they got the

148

00:05:08,830 --> 00:05:06,889

funding for it research looked for

149

00:05:09,640 --> 00:05:08,840

proteins directly on the dendrite well

150

00:05:11,589 --> 00:05:09,650

that makes sense

151

00:05:12,999 --> 00:05:11,599

I mean we do know that there's got to be

152

00:05:15,459 --> 00:05:13,009

something there the dendrites are

153

00:05:17,020 --> 00:05:15,469

detecting it somehow so you take a look

154

00:05:19,119 --> 00:05:17,030

at the proteins and they found some of

155

00:05:21,550 --> 00:05:19,129

course because there's always proteins

156

00:05:23,379 --> 00:05:21,560

on dendrites but they were not the

157

00:05:26,350 --> 00:05:23,389

putative receptors so they had to keep

158

00:05:28,089 --> 00:05:26,360

looking the research then tuned to

159

00:05:29,709 --> 00:05:28,099

scanning the genetic code sagen ro l

160

00:05:32,350 --> 00:05:29,719

can't find him directly through direct

161

00:05:34,180 --> 00:05:32,360

means let's do this indirectly will scan

162

00:05:36,550 --> 00:05:34,190

the genetic code we're gonna look for G

163

00:05:38,980 --> 00:05:36,560

proteins why why you're gonna look for G

164

00:05:41,499 --> 00:05:38,990

proteins because we know that G proteins

165

00:05:43,959 --> 00:05:41,509

are involved in human olfaction so for

166

00:05:46,269 --> 00:05:43,969

um DS out there old news for you for the

167

00:05:47,860 --> 00:05:46,279

rest of you this is new news so the G

168

00:05:50,430 --> 00:05:47,870

proteins are looked at lo and behold

169

00:05:54,730 --> 00:05:50,440

they find them but they don't find them

170

00:05:56,320 --> 00:05:54,740

in great quantity mu new labeling comes

171

00:05:58,029 --> 00:05:56,330

in next yes they find them in the sense

172

00:05:59,860 --> 00:05:58,039

Allah but the immuno labeling comes in

173

00:06:02,320 --> 00:05:59,870

and they show a very low concentration

174

00:06:06,339 --> 00:06:02,330

of these putative receptors so the

175

00:06:06,939 --> 00:06:06,349

question is where are they and then the

176

00:06:09,730 --> 00:06:06,949

big one

177

00:06:11,980 --> 00:06:09,740

no receptor ligand binding has been

178

00:06:15,129 --> 00:06:11,990

demonstrated to date so as I stand

179

00:06:18,550 --> 00:06:15,139

before you there is no receptor ligand

180

00:06:20,769 --> 00:06:18,560

binding there is no receptor binding

181

00:06:23,649 --> 00:06:20,779

this has not been shown yet it is

182

00:06:25,570 --> 00:06:23,659

assumed this is also a problem why is

183

00:06:27,490 --> 00:06:25,580

this I mean as a matter of fact this is

184

00:06:29,700 --> 00:06:27,500

a huge problem why can't you show

185

00:06:32,350 --> 00:06:29,710

binding in pharmacology we know that

186

00:06:34,749 --> 00:06:32,360

molecules bind to like siedel choline

187

00:06:37,120 --> 00:06:34,759

acetylcholine receptors this makes sense

188

00:06:39,730 --> 00:06:37,130

but this we haven't been able to show

189

00:06:40,129 --> 00:06:39,740

any binding so this thing kind of brings

190

00:06:41,179 --> 00:06:40,139

me to

191

00:06:43,520 --> 00:06:41,189

theory which I've talked about before

192

00:06:45,350 --> 00:06:43,530

but let me just review for you right now

193

00:06:47,570 --> 00:06:45,360

the current theory is bought lock and

194

00:06:49,700 --> 00:06:47,580

key it's about this binding that I told

195

00:06:52,010 --> 00:06:49,710

you about the receptor and it's got the

196

00:06:53,659 --> 00:06:52,020

pheromone the lock and key hypothesis

197

00:06:55,820 --> 00:06:53,669

olfaction says we've got the receptor

198

00:06:57,890 --> 00:06:55,830

the pheromone comes along and it binds

199

00:07:00,350 --> 00:06:57,900

with it and this is what causes the

200

00:07:02,119 --> 00:07:00,360

message to make it to the dendrite the

201
00:07:03,890 --> 00:07:02,129
vibrational theory of odor which some of

202
00:07:06,200 --> 00:07:03,900
you know I am a proponent of does not

203
00:07:08,540 --> 00:07:06,210
say that it's a lock and key system it

204
00:07:10,429 --> 00:07:08,550
can operate either by touching the sense

205
00:07:13,399 --> 00:07:10,439
illa on the outside if it's acting as an

206
00:07:15,469 --> 00:07:13,409
antenna or it can simply come in close

207
00:07:17,570 --> 00:07:15,479
proximity very close proximity to the

208
00:07:19,339 --> 00:07:17,580
antenna and the antenna or that since

209
00:07:21,379 --> 00:07:19,349
Silla will be able to detect it that's

210
00:07:22,390 --> 00:07:21,389
the vibrational Theory voter I believe

211
00:07:25,010 --> 00:07:22,400
that insects are smelling

212
00:07:27,439 --> 00:07:25,020
electromagnetically so let's take a look

213
00:07:29,269 --> 00:07:27,449

but if i'm putting this forward some of

214

00:07:31,640 --> 00:07:29,279

you might be thinking i don't follow

215

00:07:33,740 --> 00:07:31,650

this is new stuff tom i need some help

216

00:07:35,390 --> 00:07:33,750

what's the mechanism i mean you've got a

217

00:07:38,269 --> 00:07:35,400

message on the outside of the sencilla

218

00:07:40,850 --> 00:07:38,279

and you got to get it to the inside

219

00:07:44,320 --> 00:07:40,860

dendrite the electrophysiologist tell us

220

00:07:47,300 --> 00:07:44,330

that the dendrite d polarizes a normal

221

00:07:50,629 --> 00:07:47,310

depolarization just like a normal neuron

222

00:07:52,189 --> 00:07:50,639

and a normal neuronal spike passes down

223

00:07:55,459 --> 00:07:52,199

the neuron to eventually reach the

224

00:07:57,350 --> 00:07:55,469

normal brain nothing new about this so

225

00:08:00,170 --> 00:07:57,360

because this is a normal spike we know

226

00:08:02,990 --> 00:08:00,180

that dendrite is somehow involved if the

227

00:08:04,639 --> 00:08:03,000

antenna was the detector the antenna was

228

00:08:06,920 --> 00:08:04,649

the detector this whole sencilla right

229

00:08:09,320 --> 00:08:06,930

here acting as an antenna then the

230

00:08:11,540 --> 00:08:09,330

neurons which we do know are projecting

231

00:08:13,459 --> 00:08:11,550

up would be unnecesarry we wouldn't need

232

00:08:15,980 --> 00:08:13,469

them because the detection is done at

233

00:08:17,480 --> 00:08:15,990

the level of the antenna but we know

234

00:08:19,760 --> 00:08:17,490

that there's a message going down the

235

00:08:21,559 --> 00:08:19,770

neuron so if the antenna is simply the

236

00:08:25,040 --> 00:08:21,569

primary detector but not the final

237

00:08:27,139 --> 00:08:25,050

detector then how does a normal spike

238

00:08:28,909 --> 00:08:27,149

and it's very normal get initiated in

239

00:08:32,719 --> 00:08:28,919

the nerve cell and this is what brings

240

00:08:34,250 --> 00:08:32,729

me to the proteins ultimately sooner or

241

00:08:36,170 --> 00:08:34,260

later one must consider that certain

242

00:08:38,659 --> 00:08:36,180

proteins on the dendrite are mediating

243

00:08:41,540 --> 00:08:38,669

this occurrence in some fashion but like

244

00:08:42,800 --> 00:08:41,550

the grinch but how and so because this

245

00:08:44,120 --> 00:08:42,810

is going on and I do believe that

246

00:08:45,590 --> 00:08:44,130

proteins are involved but I don't

247

00:08:47,360 --> 00:08:45,600

believe it's lock and key we got to take

248

00:08:49,100 --> 00:08:47,370

a look at these proteins but my problem

249

00:08:50,569 --> 00:08:49,110

is that because I'm not dealing with a

250

00:08:53,870 --> 00:08:50,579

lock and key I've got to figure out how

251
00:08:55,490 --> 00:08:53,880
to get an electromagnetic message in

252
00:08:58,250 --> 00:08:55,500
- an electromagnetic message as it

253
00:09:00,590 --> 00:08:58,260
passes down the nerve now there is a

254
00:09:02,270 --> 00:09:00,600
little bit of it's not just

255
00:09:05,030 --> 00:09:02,280
electromagnetic to electromagnetic

256
00:09:07,340 --> 00:09:05,040
there's going to have to be some some

257
00:09:08,660 --> 00:09:07,350
interplay here and so this kind of

258
00:09:10,880 --> 00:09:08,670
brings me to the point where I think all

259
00:09:12,950 --> 00:09:10,890
right I need a protein and I need it to

260
00:09:14,570 --> 00:09:12,960
react to electromagnetic energy I'll

261
00:09:16,820 --> 00:09:14,580
search the literature see what I can

262
00:09:18,170 --> 00:09:16,830
find what do I find well the first thing

263
00:09:20,240 --> 00:09:18,180

that pops up is probably the most

264

00:09:22,490 --> 00:09:20,250

studies rhodopsin I'm looking at you

265

00:09:24,920 --> 00:09:22,500

right now you're looking at me rhodopsin

266

00:09:27,140 --> 00:09:24,930

is firing it's a great system what

267

00:09:30,080 --> 00:09:27,150

happens in rhodopsin which is a protein

268

00:09:32,660 --> 00:09:30,090

by the way incoming light hits the

269

00:09:35,030 --> 00:09:32,670

rhodopsin molecule there is a shift in

270

00:09:37,300 --> 00:09:35,040

electron density this shift in electron

271

00:09:39,910 --> 00:09:37,310

density causes a conformational change

272

00:09:43,250 --> 00:09:39,920

can't get much easier than that it bends

273

00:09:44,810 --> 00:09:43,260

alright and so this is measured this is

274

00:09:46,340 --> 00:09:44,820

measured because the rhodopsin is there

275

00:09:48,320 --> 00:09:46,350

in our eye it's attached to the cell

276

00:09:50,030 --> 00:09:48,330

membrane cell membrane has some great

277

00:09:52,370 --> 00:09:50,040

electromagnetic properties to it and

278

00:09:57,410 --> 00:09:52,380

it's detected and it's a beautiful

279

00:09:59,240 --> 00:09:57,420

system and very very fast - however in

280

00:10:01,850 --> 00:09:59,250

order to study a system like this you

281

00:10:03,140 --> 00:10:01,860

can't really do it in vivo it's not that

282

00:10:05,420 --> 00:10:03,150

not that easy I mean you still they

283

00:10:06,890 --> 00:10:05,430

can't do it in a human eye and the

284

00:10:08,630 --> 00:10:06,900

rhodopsin has to be considered in many

285

00:10:10,660 --> 00:10:08,640

different lights and so we take a look

286

00:10:12,950 --> 00:10:10,670

at it by putting it onto an inorganic

287

00:10:14,690 --> 00:10:12,960

semiconductor let's just use gallium

288

00:10:16,760 --> 00:10:14,700

arsenide it doesn't really matter but

289

00:10:18,620 --> 00:10:16,770

it's attached to a man-made inorganic

290

00:10:20,240 --> 00:10:18,630

semiconductor put there Barrett

291

00:10:22,460 --> 00:10:20,250

bacterial rhodopsin up there and take a

292

00:10:24,740 --> 00:10:22,470

look at it you shine light on it what

293

00:10:26,690 --> 00:10:24,750

happens a conformational change in the

294

00:10:29,330 --> 00:10:26,700

protein occurs so far so good

295

00:10:31,490 --> 00:10:29,340

and then it's detected by the inorganic

296

00:10:33,050 --> 00:10:31,500

semiconductor and then amplified for

297

00:10:34,370 --> 00:10:33,060

eventual detection by man sitting

298

00:10:36,200 --> 00:10:34,380

somewhere in the laboratory right now

299

00:10:38,480 --> 00:10:36,210

well that's nice and this helps to give

300

00:10:41,630 --> 00:10:38,490

us an idea of how bacterial rhodopsin

301
00:10:44,500 --> 00:10:41,640
works and helps to get us some answers

302
00:10:46,970 --> 00:10:44,510
so this has been suggested thus far

303
00:10:50,000 --> 00:10:46,980
rhodopsin is very well known to be

304
00:10:51,740 --> 00:10:50,010
packed into our eye why is that because

305
00:10:53,870 --> 00:10:51,750
if you've got a whole bunch of rays

306
00:10:55,730 --> 00:10:53,880
emanating from the back of the room and

307
00:10:57,560 --> 00:10:55,740
they are all parallel and they're gonna

308
00:11:00,500 --> 00:10:57,570
hit the wall behind me how many of them

309
00:11:02,030 --> 00:11:00,510
are am I gonna intercept very few no

310
00:11:03,650 --> 00:11:02,040
matter how fast I run back and forth I'm

311
00:11:05,690 --> 00:11:03,660
not going to intercept that many the

312
00:11:07,310 --> 00:11:05,700
ones that I I detect great but most of

313
00:11:08,600 --> 00:11:07,320

them are gonna go to my right to my left

314

00:11:10,940 --> 00:11:08,610

the top they're gonna miss me and

315

00:11:12,590 --> 00:11:10,950

therefore I need to do something I need

316

00:11:14,480 --> 00:11:12,600

to clone myself no no matter how

317

00:11:16,880 --> 00:11:14,490

unattractive this may sound to some of

318

00:11:19,070 --> 00:11:16,890

you if I cloned myself and spread myself

319

00:11:20,990 --> 00:11:19,080

out I would be able to detect more why

320

00:11:23,000 --> 00:11:21,000

because these rays are gonna be parallel

321

00:11:24,680 --> 00:11:23,010

and I've now increased my detection

322

00:11:25,940 --> 00:11:24,690

level it has been suggested by German

323

00:11:29,300 --> 00:11:25,950

researchers this is the way it has to be

324

00:11:32,210 --> 00:11:29,310

the insect is so ridiculously sensitive

325

00:11:35,450 --> 00:11:32,220

they must be packed in there the odorant

326
00:11:35,840 --> 00:11:35,460
receptors must be packed so they take a

327
00:11:38,930 --> 00:11:35,850
look

328
00:11:42,110 --> 00:11:38,940
immuno labeling they're not there find a

329
00:11:44,090 --> 00:11:42,120
few there's nowhere near what we are

330
00:11:45,290 --> 00:11:44,100
needed and so this is a problem as a

331
00:11:47,240 --> 00:11:45,300
matter of fact we found more other

332
00:11:49,550 --> 00:11:47,250
proteins than we found of the putative

333
00:11:50,990 --> 00:11:49,560
odorant receptors sensory neuron

334
00:11:53,390 --> 00:11:51,000
membrane proteins are found in a higher

335
00:11:56,660 --> 00:11:53,400
concentration than the putative odorant

336
00:11:58,100 --> 00:11:56,670
receptors this is a problem what is

337
00:12:00,640 --> 00:11:58,110
going on here based on the current

338
00:12:02,840 --> 00:12:00,650

paradigm I've got mice in Silla a

339

00:12:05,480 --> 00:12:02,850

pheromone comes in it's going to impact

340

00:12:07,130 --> 00:12:05,490

at a specific point that specific point

341

00:12:08,270 --> 00:12:07,140

is going to be right there it's not

342

00:12:09,710 --> 00:12:08,280

going to be on the other side it's only

343

00:12:11,600 --> 00:12:09,720

going to be at that specific point that

344

00:12:13,970 --> 00:12:11,610

pheromone will go through a pore at that

345

00:12:15,530 --> 00:12:13,980

specific point that pheromone will then

346

00:12:17,450 --> 00:12:15,540

hit the dendrite very close to that

347

00:12:20,210 --> 00:12:17,460

particular point it's a point effect is

348

00:12:22,280 --> 00:12:20,220

this the way an antenna works no an

349

00:12:23,810 --> 00:12:22,290

antenna works if you've got an

350

00:12:25,670 --> 00:12:23,820

electromagnetic frequency and the

351

00:12:28,040 --> 00:12:25,680

antenna is detecting it it is not a

352

00:12:30,470 --> 00:12:28,050

point affect the whole antenna will

353

00:12:32,330 --> 00:12:30,480

light up in a more or less fashion like

354

00:12:33,890 --> 00:12:32,340

this so if it's based upon antenna

355

00:12:35,300 --> 00:12:33,900

theory which I'm espousing right now

356

00:12:38,360 --> 00:12:35,310

you're going to have a different way of

357

00:12:39,830 --> 00:12:38,370

detecting it a conductor is a substance

358

00:12:42,950 --> 00:12:39,840

or body capable of transmitting

359

00:12:46,850 --> 00:12:42,960

electricity heat or sound the Antonine

360

00:12:49,280 --> 00:12:46,860

would be an insulator but a

361

00:12:51,580 --> 00:12:49,290

semiconductor any of a class of solids

362

00:12:54,200 --> 00:12:51,590

whose electrical conductivity is between

363

00:12:55,670 --> 00:12:54,210

that of a conductor in an insulator and

364

00:12:57,550 --> 00:12:55,680

this is what we're dealing with right

365

00:12:59,720 --> 00:12:57,560

now at least that's what I'm proposing a

366

00:13:02,050 --> 00:12:59,730

protein semi conductor is a semi

367

00:13:05,390 --> 00:13:02,060

conductor god bless you with a protein

368

00:13:06,710 --> 00:13:05,400

constituent a protein constituent so

369

00:13:09,140 --> 00:13:06,720

proteins are able to detect

370

00:13:11,630 --> 00:13:09,150

electromagnetic frequencies well known

371

00:13:12,890 --> 00:13:11,640

great field going on out there so I told

372

00:13:15,590 --> 00:13:12,900

you right at spawns time of one

373

00:13:18,410 --> 00:13:15,600

millisecond one millisecond equals 1

374

00:13:19,790 --> 00:13:18,420

million Pico seconds the researchers

375

00:13:21,350 --> 00:13:19,800

have taken a look at this upon the

376

00:13:23,539 --> 00:13:21,360

absorption of light there is a ship

377

00:13:25,699 --> 00:13:23,549

of electron density in rhodopsin which

378

00:13:29,929 --> 00:13:25,709

begins the photo isomerization process

379

00:13:32,449 --> 00:13:29,939

in about 1.6 pica seconds as measured by

380

00:13:34,970 --> 00:13:32,459

a 500 vent the second laser well that's

381

00:13:36,530 --> 00:13:34,980

great that's plenty of time I mean now

382

00:13:38,210 --> 00:13:36,540

I've got a mechanism that works within

383

00:13:40,069 --> 00:13:38,220

the time period that I need which is 1

384

00:13:41,900 --> 00:13:40,079

millisecond allowed to take to recover

385

00:13:44,090 --> 00:13:41,910

it's about 300 milliseconds

386

00:13:46,129 --> 00:13:44,100

what about bacteria rhodopsin resets

387

00:13:47,989 --> 00:13:46,139

itself in about 10 milliseconds well

388

00:13:50,479 --> 00:13:47,999

this is great this again gives me plenty

389

00:13:52,910 --> 00:13:50,489

of time because 98% of it is going to be

390

00:13:55,639 --> 00:13:52,920

reset in just 20 milliseconds so it's

391

00:13:58,100 --> 00:13:55,649

fast detection it's fast recovery this

392

00:13:59,600 --> 00:13:58,110

is looking good it has been shown now

393

00:14:01,429 --> 00:13:59,610

for some of you may not think well this

394

00:14:02,629 --> 00:14:01,439

is this is nice time but this is I need

395

00:14:05,179 --> 00:14:02,639

some more evidence can you give me

396

00:14:07,429 --> 00:14:05,189

something more I'll be happy to it has

397

00:14:10,869 --> 00:14:07,439

been shown that upon strong illumination

398

00:14:13,819 --> 00:14:10,879

rhabdo meter real skeleton shows

399

00:14:15,439 --> 00:14:13,829

structural changes so they take the

400

00:14:17,539 --> 00:14:15,449

light and they hit the RAB de Mar de

401
00:14:19,369 --> 00:14:17,549
this causes structural changes in the

402
00:14:22,039 --> 00:14:19,379
cytoskeleton it's a very interesting

403
00:14:24,309 --> 00:14:22,049
response it's not really seen that much

404
00:14:26,720 --> 00:14:24,319
but it's an interesting characteristic

405
00:14:28,429 --> 00:14:26,730
Kumar and killed two German researchers

406
00:14:30,189 --> 00:14:28,439
have found that pheromone stimulation

407
00:14:32,739 --> 00:14:30,199
not just any stimulation but high

408
00:14:34,939 --> 00:14:32,749
pheromone stimulation induces

409
00:14:37,609 --> 00:14:34,949
cytoskeletal changes in olfactory

410
00:14:39,470 --> 00:14:37,619
dendrites of the male Saturn I at Moss

411
00:14:41,470 --> 00:14:39,480
beautiful I've got another connection

412
00:14:44,150 --> 00:14:41,480
let me give you another connection

413
00:14:46,699 --> 00:14:44,160

g-protein coupled receptors proteins

414

00:14:48,019 --> 00:14:46,709

belong to many different families one of

415

00:14:50,539 --> 00:14:48,029

the more common ones are the g-protein

416

00:14:52,609 --> 00:14:50,549

coupled receptors they are known as 7

417

00:14:54,559 --> 00:14:52,619

transmembrane alpha helix structures

418

00:14:57,499 --> 00:14:54,569

they pass through the membrane seven

419

00:14:59,689 --> 00:14:57,509

times the g-protein coupled receptors I

420

00:15:01,579 --> 00:14:59,699

talked about in human olfaction is the

421

00:15:03,859 --> 00:15:01,589

same thing as what you find in the

422

00:15:06,049 --> 00:15:03,869

insects the odorant receptors are the

423

00:15:08,030 --> 00:15:06,059

same and so when I'm proposing on this

424

00:15:09,499 --> 00:15:08,040

last slide right now is when the

425

00:15:11,869 --> 00:15:09,509

pheromone molecules get close to the

426

00:15:13,999 --> 00:15:11,879

sencilla they light up as detected by

427

00:15:16,759 --> 00:15:14,009

protein semiconductors and this is how

428

00:15:17,780 --> 00:15:16,769

my theory is now being put forward thank

429

00:15:20,770 --> 00:15:17,790

you very much for your time

430

00:15:26,629 --> 00:15:24,129

[Applause]

431

00:15:34,210 --> 00:15:26,639

okay we have a few minutes for questions

432

00:15:39,980 --> 00:15:37,730

Francesca McCartney - Jessica would you

433

00:15:42,769 --> 00:15:39,990

comment or do you have a comment on Luca

434

00:15:44,360 --> 00:15:42,779

turns off action research I'd be happy

435

00:15:46,759 --> 00:15:44,370

to comment on that Luca turns olfaction

436

00:15:48,379 --> 00:15:46,769

research is based upon the vibrational

437

00:15:50,660 --> 00:15:48,389

energy the same as the insects the

438

00:15:52,430 --> 00:15:50,670

problem is that Luca turns theory looks

439

00:15:54,019 --> 00:15:52,440
at electron tunneling which is a

440

00:15:56,180 --> 00:15:54,029
fundamentally different theory than the

441

00:15:58,280 --> 00:15:56,190
dielectric antenna theory and so if you

442

00:16:01,670 --> 00:15:58,290
take a look at how these two mechanisms

443

00:16:03,199 --> 00:16:01,680
line up they don't they're still looking

444

00:16:04,790 --> 00:16:03,209
at the vibrational energy but it's two

445

00:16:07,100 --> 00:16:04,800
different ways of looking at the

446

00:16:08,329 --> 00:16:07,110
vibrational energies on the - even

447

00:16:09,980 --> 00:16:08,339
though I support what he's doing and

448

00:16:11,329 --> 00:16:09,990
I've communicated with them we don't

449

00:16:14,420 --> 00:16:11,339
have much to talk about because we're

450

00:16:15,560 --> 00:16:14,430
looking at two different things next

451

00:16:19,370 --> 00:16:15,570

question over here

452

00:16:22,759 --> 00:16:19,380

Glenn Rhine I assume that bugs can smell

453

00:16:26,170 --> 00:16:22,769

in the dark yes so your theory requires

454

00:16:29,030 --> 00:16:26,180

light activation of the semi conductor

455

00:16:30,680 --> 00:16:29,040

mechanism no I never said that because

456

00:16:33,470 --> 00:16:30,690

you told us a lot about how light

457

00:16:35,420 --> 00:16:33,480

activates the semiconductors so that's

458

00:16:37,550 --> 00:16:35,430

one half of the question the other half

459

00:16:40,310 --> 00:16:37,560

of the question is why do you need an

460

00:16:43,160 --> 00:16:40,320

inter mayer intermediary protein

461

00:16:44,900 --> 00:16:43,170

molecule to act as the transducer when

462

00:16:47,300 --> 00:16:44,910

electromagnetic fields can directly

463

00:16:50,090 --> 00:16:47,310

affect receptors at least in mammalian

464

00:16:53,150 --> 00:16:50,100

systems and an electromagnetic field can

465

00:16:54,470 --> 00:16:53,160

propagate right through the whole center

466

00:16:56,900 --> 00:16:54,480

part of whatever you called it and

467

00:16:58,970 --> 00:16:56,910

activate the cytoplasmic receptor

468

00:17:00,230 --> 00:16:58,980

yes it is still possible that that is

469

00:17:01,970 --> 00:17:00,240

happening the reason why I consider that

470

00:17:04,610 --> 00:17:01,980

unlikely is because the neuronal

471

00:17:06,169 --> 00:17:04,620

response is so clean and so basic that

472

00:17:08,390 --> 00:17:06,179

it I do believe that a protein is

473

00:17:10,280 --> 00:17:08,400

allowing ions to enter a neuronal

474

00:17:11,929 --> 00:17:10,290

response is all about ion interchange

475

00:17:14,449 --> 00:17:11,939

calcium influx was talked about in

476

00:17:16,010 --> 00:17:14,459

Lucas's talk earlier on is really

477

00:17:17,299 --> 00:17:16,020

nothing different here and therefore

478

00:17:20,990 --> 00:17:17,309

you're going to need a protein in order

479

00:17:22,610 --> 00:17:21,000

to have ions come in and set the normal

480

00:17:23,960 --> 00:17:22,620

neuronal response so therefore I do

481

00:17:28,940 --> 00:17:23,970

believe that proteins are involved

482

00:17:31,680 --> 00:17:28,950

however it's not necessary is short

483

00:17:34,230 --> 00:17:31,690

antenna Theory small antenna much

484

00:17:37,710 --> 00:17:34,240

smaller than wavelength resonant

485

00:17:40,470 --> 00:17:37,720

antennas part of this no actually these

486

00:17:43,230 --> 00:17:40,480

antennae or scencilla are set up at about

487

00:17:44,580 --> 00:17:43,240

the right wavelength for the infrared

488

00:17:46,440 --> 00:17:44,590

frequencies which are coming from the

489

00:17:48,180 --> 00:17:46,450

vibrational molecules now as you know

490

00:17:50,070 --> 00:17:48,190

they don't have to line up perform a I'm

491

00:17:50,909 --> 00:17:50,080

not sure what your background is but

492

00:17:52,529 --> 00:17:50,919

they don't have to line up perfectly

493

00:17:54,029 --> 00:17:52,539

doesn't have to be a one-to-one but it

494

00:17:56,940 --> 00:17:54,039

has to be pretty close and they are

495

00:18:00,210 --> 00:17:56,950

close good question good antenna

496

00:18:03,570 --> 00:18:00,220

question can you relate this to the the

497

00:18:06,570 --> 00:18:03,580

way the dendrites on neural neurons in

498

00:18:09,450 --> 00:18:06,580

the brain work related to would that way

499

00:18:11,669 --> 00:18:09,460

neurons in the brain actually yeah

500

00:18:15,269 --> 00:18:11,679

actually this is a question which is

501
00:18:17,100 --> 00:18:15,279
outside the my talk it would not be easy

502
00:18:19,740 --> 00:18:17,110
to do so because the vertebrate neuron

503
00:18:21,810 --> 00:18:19,750
is much much much simpler than the

504
00:18:25,080 --> 00:18:21,820
insect neuron and I'm so happy to say

505
00:18:26,879 --> 00:18:25,090
that insect neurons are far more

506
00:18:28,499 --> 00:18:26,889
complicated vertebrate neurons are very

507
00:18:30,509 --> 00:18:28,509
simple they just you know you'll have

508
00:18:31,830 --> 00:18:30,519
you know billions of them whereas the

509
00:18:33,840 --> 00:18:31,840
insect neurons because there's only a

510
00:18:35,430 --> 00:18:33,850
few hundred thousand of them are much

511
00:18:37,529 --> 00:18:35,440
more diverse and have very different

512
00:18:38,730 --> 00:18:37,539
capabilities so to make a comparison I

513
00:18:41,549 --> 00:18:38,740

just can't I just can't

514

00:18:43,139 --> 00:18:41,559

and I'm sorry Tom and your last slide

515

00:18:45,990 --> 00:18:43,149

here it seems to me you're showing

516

00:18:48,210 --> 00:18:46,000

pheromone molecules directly stimulating

517

00:18:50,999 --> 00:18:48,220

the antenna but surely you mean some

518

00:18:54,119 --> 00:18:51,009

electromagnetic emission or property of

519

00:18:55,889 --> 00:18:54,129

the ligand stimulating the antenna can

520

00:18:57,570 --> 00:18:55,899

you explain what you mean exactly well

521

00:19:01,919 --> 00:18:57,580

not a ligand in the sense that there is

522

00:19:03,419 --> 00:19:01,929

binding Ligon would suggest binding yeah

523

00:19:05,190 --> 00:19:03,429

yeah what these are these are pheromone

524

00:19:07,139 --> 00:19:05,200

molecules that are impacting the outside

525

00:19:08,369 --> 00:19:07,149

of the sencilla what I am saying is that

526

00:19:11,389 --> 00:19:08,379

the pheromone is not actually getting

527

00:19:13,710 --> 00:19:11,399

inside the sencilla which is a necessary

528

00:19:15,690 --> 00:19:13,720

prerequisite in order for the dendrite

529

00:19:17,820 --> 00:19:15,700

to detect it according to the current

530

00:19:19,799 --> 00:19:17,830

theory of insect olfaction because they

531

00:19:21,899 --> 00:19:19,809

need the lock and key that pheromone

532

00:19:23,369 --> 00:19:21,909

needs to get in there with my system it

533

00:19:25,710 --> 00:19:23,379

just it needs to get on the outside of

534

00:19:27,419 --> 00:19:25,720

it and we're in very close proximity set

535

00:19:29,700 --> 00:19:27,429

off the antenna and boom the antenna

536

00:19:32,789 --> 00:19:29,710

lights up in this beautiful display that

537

00:19:37,350 --> 00:19:35,879

Jim beekler couldn't you test this by

538

00:19:39,090 --> 00:19:37,360

getting rid of the pheromones and

539

00:19:39,930 --> 00:19:39,100

finding the resonant frequency and just

540

00:19:41,519 --> 00:19:39,940

seeing the antenna

541

00:19:44,490 --> 00:19:41,529

that resonant frequency and see how the

542

00:19:45,869 --> 00:19:44,500

insects react I can't do that great

543

00:19:48,210 --> 00:19:45,879

question though it's been talked about

544

00:19:49,350 --> 00:19:48,220

for many many years the reason why is if

545

00:19:50,820 --> 00:19:49,360

you take a look at the vibrational

546

00:19:52,619 --> 00:19:50,830

frequencies of a given pheromone

547

00:19:54,450 --> 00:19:52,629

molecule there's more than one there's

548

00:19:57,869 --> 00:19:54,460

more than two there's more than ten and

549

00:19:59,549 --> 00:19:57,879

so the insect we know is not responding

550

00:20:02,279 --> 00:19:59,559

to a single frequency it's detecting

551
00:20:04,560 --> 00:20:02,289
them all at once and saying this is a 14

552
00:20:06,360 --> 00:20:04,570
carbon acetate this is my pheromone I

553
00:20:08,129 --> 00:20:06,370
recognize it because if you start

554
00:20:09,480 --> 00:20:08,139
playing around with it and only putting

555
00:20:11,909 --> 00:20:09,490
one or two frequencies in there the

556
00:20:13,590 --> 00:20:11,919
insect will get no response researchers

557
00:20:14,970 --> 00:20:13,600
have looked at it you really do need the

558
00:20:16,619 --> 00:20:14,980
whole kit and caboodle and when you need

559
00:20:18,749 --> 00:20:16,629
the whole kit and caboodle you need the

560
00:20:22,350 --> 00:20:18,759
pheromone because it produces everything

561
00:20:26,419 --> 00:20:22,360
that's needed yes afraid we need to cut