



1
00:00:03,949 --> 00:00:02,570
well this talk grew out of a book that I

2
00:00:06,530 --> 00:00:03,959
published a couple of years ago called

3
00:00:08,179 --> 00:00:06,540
the Gothic and I will be talking about

4
00:00:10,700 --> 00:00:08,189
consciousness having to do with this

5
00:00:13,459 --> 00:00:10,710
theory in the talk this afternoon but it

6
00:00:15,890 --> 00:00:13,469
stems from the discovery of the last Oh

7
00:00:17,420 --> 00:00:15,900
20 years or so that our universe seems

8
00:00:18,920 --> 00:00:17,430
to be a very finely tuned place I'm not

9
00:00:20,570 --> 00:00:18,930
going to go through these in any detail

10
00:00:22,700 --> 00:00:20,580
but these are nine properties of the

11
00:00:24,710 --> 00:00:22,710
universe that pretty much today

12
00:00:27,140 --> 00:00:24,720
astrophysicists agree are rather

13
00:00:28,490 --> 00:00:27,150

remarkably finely tuned to make it

14

00:00:29,570 --> 00:00:28,500

possible for life to evolve in the

15

00:00:30,970 --> 00:00:29,580

universe they are the ratio of the

16

00:00:33,200 --> 00:00:30,980

gravitation with the Coulomb force

17

00:00:35,569 --> 00:00:33,210

strength of the nuclear force if that

18

00:00:38,119 --> 00:00:35,579

one were 10 or 20% higher or lower than

19

00:00:39,889 --> 00:00:38,129

it is we wouldn't have stars a certain

20

00:00:41,360 --> 00:00:39,899

carbon resonance that allows carbon to

21

00:00:43,610 --> 00:00:41,370

form in the interiors of stars which of

22

00:00:44,990 --> 00:00:43,620

course is necessary for life the

23

00:00:47,330 --> 00:00:45,000

expansion property of water upon

24

00:00:49,190 --> 00:00:47,340

freezing the fact that neutron is

25

00:00:51,590 --> 00:00:49,200

slightly heavier than the proton and not

26
00:00:53,119 --> 00:00:51,600
the other way around the average density

27
00:00:56,270 --> 00:00:53,129
of matter in the universe the strength

28
00:00:58,610 --> 00:00:56,280
of dark energy quantum clumping and the

29
00:01:00,680 --> 00:00:58,620
slight prevalence of matter over

30
00:01:02,029 --> 00:01:00,690
antimatter when the universe formed now

31
00:01:03,950 --> 00:01:02,039
all of these taken together could have

32
00:01:06,289 --> 00:01:03,960
been rather different than what they are

33
00:01:08,390 --> 00:01:06,299
and if they were we wouldn't be here no

34
00:01:09,890 --> 00:01:08,400
word other life be here but they are

35
00:01:11,899 --> 00:01:09,900
burg rather finely tuned and there are

36
00:01:14,899 --> 00:01:11,909
two explanations for this which I'll

37
00:01:16,640 --> 00:01:14,909
talk about next but first to mention

38
00:01:17,749 --> 00:01:16,650

that in current Astrophysical theory we

39

00:01:20,030 --> 00:01:17,759

think that the universe went through a

40

00:01:21,499 --> 00:01:20,040

tremendous period of inflation before it

41

00:01:23,749 --> 00:01:21,509

settled down into the rather slow

42

00:01:25,280 --> 00:01:23,759

expansion that we now call the Hubble

43

00:01:27,800 --> 00:01:25,290

expansion that is characterizing the

44

00:01:30,230 --> 00:01:27,810

universe in the first 10 to the minus 34

45

00:01:31,520 --> 00:01:30,240

seconds or thereabouts and that's sort

46

00:01:34,039 --> 00:01:31,530

of a billionth of a billionth of a

47

00:01:36,350 --> 00:01:34,049

billionth of a millionth of a second the

48

00:01:38,990 --> 00:01:36,360

universe expanded tremendously into a

49

00:01:40,910 --> 00:01:39,000

region of well it became a region of

50

00:01:42,260 --> 00:01:40,920

space that led to the formation of our

51
00:01:45,170 --> 00:01:42,270
universe and perhaps even other

52
00:01:46,609 --> 00:01:45,180
universes so the idea that there could

53
00:01:50,060 --> 00:01:46,619
be other universes forming out of this

54
00:01:51,620 --> 00:01:50,070
inflation function leads to the

55
00:01:53,960 --> 00:01:51,630
explanation that maybe our universe is

56
00:01:55,460 --> 00:01:53,970
not really special it's only that there

57
00:01:56,690 --> 00:01:55,470
are lots and lots of other universes

58
00:01:59,090 --> 00:01:56,700
that came out of this inflationary

59
00:02:00,740 --> 00:01:59,100
period in fact there may be literally an

60
00:02:02,959 --> 00:02:00,750
infinite number of other universes that

61
00:02:04,639 --> 00:02:02,969
came out of this inflationary period and

62
00:02:06,709 --> 00:02:04,649
therefore there must be a whole

63
00:02:08,960 --> 00:02:06,719

distribution whole ensemble of different

64

00:02:10,369 --> 00:02:08,970

laws and constants of nature that

65

00:02:12,290 --> 00:02:10,379

characterize these different universes

66

00:02:13,280 --> 00:02:12,300

and ours is the one we happen to be able

67

00:02:14,360 --> 00:02:13,290

to live in we wouldn't be

68

00:02:16,250 --> 00:02:14,370

any of the others because we couldn't

69

00:02:17,959 --> 00:02:16,260

have arisen in them and so this

70

00:02:20,089 --> 00:02:17,969

multiverse explanation for why our

71

00:02:21,589 --> 00:02:20,099

universe is finely tuned is the one that

72

00:02:23,539 --> 00:02:21,599

you'll find in mainstream astrophysics

73

00:02:25,039 --> 00:02:23,549

and there are books out on this by by

74

00:02:26,809 --> 00:02:25,049

people such as Sir Martin Rees the

75

00:02:28,610 --> 00:02:26,819

astronomer royal Leonard Susskind the

76

00:02:30,349 --> 00:02:28,620

Stanford physicist and one of the

77

00:02:31,910 --> 00:02:30,359

fathers of string theory and it's a

78

00:02:33,679 --> 00:02:31,920

perfectly plausible explanation that

79

00:02:36,259 --> 00:02:33,689

we're not special it's just that we are

80

00:02:37,849 --> 00:02:36,269

part of an ensemble of a huge vast

81

00:02:39,890 --> 00:02:37,859

number of other universes that

82

00:02:41,300 --> 00:02:39,900

unfortunately we can never see we can

83

00:02:43,910 --> 00:02:41,310

never directly detect we can never

84

00:02:45,470 --> 00:02:43,920

measure the other alternative of course

85

00:02:47,330 --> 00:02:45,480

the alternative is that there is an

86

00:02:49,160 --> 00:02:47,340

intelligence with a purpose behind the

87

00:02:50,509 --> 00:02:49,170

laws of nature not at all something

88

00:02:52,369 --> 00:02:50,519

having to do with intelligent design by

89

00:02:54,619 --> 00:02:52,379

the way but having to do with dreaming

90

00:02:56,629 --> 00:02:54,629

into existence the laws of nature and

91

00:02:58,580 --> 00:02:56,639

constants that would lead to a life

92

00:03:01,159 --> 00:02:58,590

friendly universe not just life on Earth

93

00:03:02,809 --> 00:03:01,169

I'm assuming but presumably life on many

94

00:03:04,940 --> 00:03:02,819

other planets around lots of other stars

95

00:03:06,800 --> 00:03:04,950

and lots of other galaxies in fact even

96

00:03:09,140 --> 00:03:06,810

Sir Fred Hoyle toward the end of his

97

00:03:10,970 --> 00:03:09,150

life called universe and obvious fix we

98

00:03:13,940 --> 00:03:10,980

looked at the the properties of the

99

00:03:15,920 --> 00:03:13,950

universe so I began to think about the

100

00:03:17,569 --> 00:03:15,930

notion that maybe the universe is the

101
00:03:18,830 --> 00:03:17,579
way it is because there's a conscious

102
00:03:20,860 --> 00:03:18,840
intelligence behind it

103
00:03:23,629 --> 00:03:20,870
behind the the origin of the universe

104
00:03:25,069 --> 00:03:23,639
this is Sir James Gene's one of the the

105
00:03:26,990 --> 00:03:25,079
prominent astrophysicists of the first

106
00:03:29,539 --> 00:03:27,000
half of the last century and he wrote

107
00:03:31,099 --> 00:03:29,549
about this he says the universe begins

108
00:03:33,649 --> 00:03:31,109
to look more like a great thought than

109
00:03:35,449 --> 00:03:33,659
like a great machine mine no longer

110
00:03:37,610 --> 00:03:35,459
appears as an accidental intruder into

111
00:03:39,500 --> 00:03:37,620
the realm of matter we are beginning to

112
00:03:41,960 --> 00:03:39,510
think that we ought rather to hail it

113
00:03:44,059 --> 00:03:41,970

that his mind as the creator and

114

00:03:45,259 --> 00:03:44,069

governor of the realm of matter and so

115

00:03:46,729 --> 00:03:45,269

he was proposing that there's an

116

00:03:49,099 --> 00:03:46,739

intelligence behind the universe

117

00:03:51,229 --> 00:03:49,109

to make it be the sort of special place

118

00:03:53,390 --> 00:03:51,239

that we're now we've really determined

119

00:03:55,849 --> 00:03:53,400

with great precision that it appears to

120

00:03:57,259 --> 00:03:55,859

be another of brilliant astrophysicist

121

00:03:59,929 --> 00:03:57,269

from that same era Sir Arthur Eddington

122

00:04:01,849 --> 00:03:59,939

here he is with Einstein and in ten was

123

00:04:05,270 --> 00:04:01,859

the one who made Einstein famous and you

124

00:04:07,159 --> 00:04:05,280

can see on the left side the headlines I

125

00:04:08,929 --> 00:04:07,169

seem to have lost the other point are

126

00:04:11,960 --> 00:04:08,939

there it is the headlines from the New

127

00:04:15,409 --> 00:04:11,970

York Times when the discovery was made

128

00:04:17,599 --> 00:04:15,419

that the the Sun causes the bending of

129

00:04:19,550 --> 00:04:17,609

starlight during the Eclipse of 1919

130

00:04:21,469 --> 00:04:19,560

lights all askew in the heavens men of

131

00:04:23,180 --> 00:04:21,479

science more or less a gog of results of

132

00:04:27,000 --> 00:04:23,190

eclipse observations Einstein theory

133

00:04:28,830 --> 00:04:27,010

triumphs a book for twelve wise men

134

00:04:30,030 --> 00:04:28,840

this is what made Einstein famous and it

135

00:04:32,550 --> 00:04:30,040

was Sir Arthur Eddington who led that

136

00:04:35,070 --> 00:04:32,560

Eclipse expedition to príncipe in 1919

137

00:04:36,720 --> 00:04:35,080

that made the observation Sir Arthur

138

00:04:38,520 --> 00:04:36,730

Eddington was a brilliant man probably

139

00:04:40,140 --> 00:04:38,530

the predominant and the most prominent

140

00:04:42,860 --> 00:04:40,150

astrophysicist of the first half of the

141

00:04:45,300 --> 00:04:42,870

last century and he wrote as many books

142

00:04:47,790 --> 00:04:45,310

one of them the mathematical theory of

143

00:04:49,740 --> 00:04:47,800

relativity which was a the exposition of

144

00:04:51,840 --> 00:04:49,750

general relativity the first textbook on

145

00:04:54,450 --> 00:04:51,850

that which by the way I also used when I

146

00:04:56,790 --> 00:04:54,460

was a graduate student back in the 1970s

147

00:05:00,030 --> 00:04:56,800

and 1980s the original edition came out

148

00:05:02,580 --> 00:05:00,040

in 1923 he was also the one who proposed

149

00:05:06,480 --> 00:05:02,590

the thermonuclear reactions as the basis

150

00:05:09,090 --> 00:05:06,490

for the the energy of stars a brilliant

151
00:05:11,190 --> 00:05:09,100
man he also wrote however science and

152
00:05:13,890 --> 00:05:11,200
the unseen world because he was also a

153
00:05:15,450 --> 00:05:13,900
mystic it was a Quaker animistic and he

154
00:05:17,580 --> 00:05:15,460
asked the question therein are we in

155
00:05:19,260 --> 00:05:17,590
pursuing the mystical outlook facing the

156
00:05:22,590 --> 00:05:19,270
hard facts of experience surely we are

157
00:05:24,900 --> 00:05:22,600
and so he was not not ashamed to write

158
00:05:27,450 --> 00:05:24,910
about and talk about his view that in

159
00:05:28,830 --> 00:05:27,460
fact there's more to the reality more to

160
00:05:35,550 --> 00:05:28,840
reality than simply the physical

161
00:05:37,470 --> 00:05:35,560
universe now as it turns out there is

162
00:05:39,210 --> 00:05:37,480
more reason than ever today to take

163
00:05:41,760 --> 00:05:39,220

seriously the notion that consciousness

164

00:05:44,280 --> 00:05:41,770

is not some epiphenomena byproduct of

165

00:05:45,840 --> 00:05:44,290

life arising through evolution but

166

00:05:47,880 --> 00:05:45,850

rather the consciousness is a primary

167

00:05:49,980 --> 00:05:47,890

primary formative element in the

168

00:05:54,480 --> 00:05:49,990

universe and in fact consciousness is

169

00:05:55,770 --> 00:05:54,490

the basis of the universe this is

170

00:05:58,680 --> 00:05:55,780

another book that just came out a couple

171

00:06:00,480 --> 00:05:58,690

of years ago by a couple of physicists

172

00:06:01,740 --> 00:06:00,490

at the University of California Santa

173

00:06:03,990 --> 00:06:01,750

Cruz in fact one of them Bruce

174

00:06:05,580 --> 00:06:04,000

rosenbloom was the chair of the

175

00:06:09,030 --> 00:06:05,590

department and what they've done is to

176

00:06:10,710 --> 00:06:09,040

write a book for undergraduates or

177

00:06:13,440 --> 00:06:10,720

anyone interested in the philosophy of

178

00:06:16,890 --> 00:06:13,450

quantum physics the idea being that

179

00:06:18,390 --> 00:06:16,900

there are the interpretation of quantum

180

00:06:20,910 --> 00:06:18,400

physics has now gotten us to the point

181

00:06:23,820 --> 00:06:20,920

where it's really necessary to invoke

182

00:06:25,800 --> 00:06:23,830

consciousness as the the necessary

183

00:06:27,330 --> 00:06:25,810

ingredient to make reality happen to

184

00:06:30,060 --> 00:06:27,340

shape reality at the quantum level

185

00:06:31,440 --> 00:06:30,070

conscious is something you can't do

186

00:06:33,000 --> 00:06:31,450

without that's what we're going to be

187

00:06:34,710 --> 00:06:33,010

talking about during the rest of the

188

00:06:37,620 --> 00:06:34,720

presentation let me give you a few

189

00:06:39,090 --> 00:06:37,630

quotes from the book quantum theory is

190

00:06:40,830 --> 00:06:39,100

the most stop stunningly successful

191

00:06:42,840 --> 00:06:40,840

theory in all of science

192

00:06:45,240 --> 00:06:42,850

not a single one of its predictions has

193

00:06:48,180 --> 00:06:45,250

ever been proven wrong so quantum

194

00:06:50,670 --> 00:06:48,190

mechanics quantum theory really is a a

195

00:06:53,550 --> 00:06:50,680

wonderfully valid one wonderfully robust

196

00:06:55,620 --> 00:06:53,560

theory however quantum experiments hint

197

00:06:57,420 --> 00:06:55,630

at a worldview that has not yet been

198

00:06:59,070 --> 00:06:57,430

grasped the existence of something

199

00:07:01,050 --> 00:06:59,080

beyond what we usually consider physics

200

00:07:02,460 --> 00:07:01,060

beyond what we usually consider the

201
00:07:05,310 --> 00:07:02,470
physical world and they wrote this sort

202
00:07:07,320 --> 00:07:05,320
of thing with you can read in the books

203
00:07:10,200 --> 00:07:07,330
their trepidation of putting ideas like

204
00:07:11,670 --> 00:07:10,210
this out because they're afraid of being

205
00:07:15,300 --> 00:07:11,680
criticized by their colleagues for

206
00:07:17,400 --> 00:07:15,310
putting a sort of New Age fuzzy-wuzzy

207
00:07:18,690 --> 00:07:17,410
kinds of notions out there that might

208
00:07:20,159 --> 00:07:18,700
confuse people into thinking that

209
00:07:21,629 --> 00:07:20,169
somehow physics proves that there's God

210
00:07:22,200 --> 00:07:21,639
it doesn't of course and I'm not about

211
00:07:24,510 --> 00:07:22,210
to say that

212
00:07:26,640 --> 00:07:24,520
and it's lecture either but what physics

213
00:07:28,469 --> 00:07:26,650

does do today at the quantum level and

214

00:07:30,719 --> 00:07:28,479

therefore at all higher levels I think

215

00:07:33,480 --> 00:07:30,729

is to require that consciousness is

216

00:07:37,050 --> 00:07:33,490

necessary element in creating reality at

217

00:07:39,900 --> 00:07:37,060

that in the measurement of things at the

218

00:07:41,400 --> 00:07:39,910

quantum phase the other point they made

219

00:07:44,159 --> 00:07:41,410

which I had not really appreciated was

220

00:07:45,570 --> 00:07:44,169

that to really understand the

221

00:07:47,400 --> 00:07:45,580

philosophical implications of quantum

222

00:07:49,620 --> 00:07:47,410

physics you don't have to be a physicist

223

00:07:51,750 --> 00:07:49,630

you don't have to know the mathematics

224

00:07:54,840 --> 00:07:51,760

at all of quantum physics to appreciate

225

00:07:57,450 --> 00:07:54,850

the conundrum in quantum mechanics of

226

00:07:59,100 --> 00:07:57,460

requiring an observer with consciousness

227

00:08:01,469 --> 00:07:59,110

to actually make things happen

228

00:08:02,880 --> 00:08:01,479

you can perfectly well engage in

229

00:08:04,800 --> 00:08:02,890

philosophical discussions of quantum

230

00:08:07,529 --> 00:08:04,810

physics by understanding quantum physics

231

00:08:09,420 --> 00:08:07,539

at a qualitative level the the operators

232

00:08:10,830 --> 00:08:09,430

the the hilbert spaces all of that

233

00:08:13,200 --> 00:08:10,840

that's fine if you're going to

234

00:08:15,060 --> 00:08:13,210

manipulate equations and you know solve

235

00:08:16,680 --> 00:08:15,070

quantum problems but in terms of

236

00:08:19,170 --> 00:08:16,690

understanding what quantum physics

237

00:08:21,000 --> 00:08:19,180

really implies philosophically you don't

238

00:08:22,529 --> 00:08:21,010

need any of that you can be an

239

00:08:24,390 --> 00:08:22,539

undergraduate having taken this course

240

00:08:27,540 --> 00:08:24,400

with some deep thinking about what it

241

00:08:29,610 --> 00:08:27,550

means and discuss with other people and

242

00:08:32,670 --> 00:08:29,620

with physicists what it all means with

243

00:08:35,610 --> 00:08:32,680

some level of credibility and with you

244

00:08:37,079 --> 00:08:35,620

no no no less a deep understanding of

245

00:08:38,670 --> 00:08:37,089

what it means than if you can manipulate

246

00:08:40,920 --> 00:08:38,680

all the mathematics of quantum theory

247

00:08:43,050 --> 00:08:40,930

which is quite formidable which I've had

248

00:08:47,070 --> 00:08:43,060

some experience with both positively and

249

00:08:49,020 --> 00:08:47,080

negatively the quantum enigma quantum

250

00:08:50,460 --> 00:08:49,030

mechanics applies to everything we can

251
00:08:52,890 --> 00:08:50,470
now manipulate individual atoms and

252
00:08:54,570 --> 00:08:52,900
here's an example from 1989 already of a

253
00:08:58,170 --> 00:08:54,580
scanning tunneling microscope

254
00:09:02,519 --> 00:08:58,180
of the IBM spelled out with individual

255
00:09:04,470 --> 00:09:02,529
atoms now what's not widely realized is

256
00:09:07,139 --> 00:09:04,480
that an atom and it's wavefunction are

257
00:09:08,670 --> 00:09:07,149
the same thing it you know when I first

258
00:09:11,519 --> 00:09:08,680
started studying quantum physics I

259
00:09:12,840 --> 00:09:11,529
thought that the wave function which is

260
00:09:14,040 --> 00:09:12,850
the thing that the fuzzy thing that

261
00:09:15,269 --> 00:09:14,050
describes sort of where you're going to

262
00:09:18,329 --> 00:09:15,279
find a party when we make a measurement

263
00:09:20,250 --> 00:09:18,339

that that wave function is something to

264

00:09:22,860 --> 00:09:20,260

sort of over and above the particle that

265

00:09:24,540 --> 00:09:22,870

it's there and the particle is sort of

266

00:09:26,699 --> 00:09:24,550

jostled around or somehow is spread out

267

00:09:28,710 --> 00:09:26,709

within this wave function but it's

268

00:09:31,259 --> 00:09:28,720

actually the case that the wave function

269

00:09:33,269 --> 00:09:31,269

is the object and when you collapse the

270

00:09:35,069 --> 00:09:33,279

wave function you're causing the object

271

00:09:36,990 --> 00:09:35,079

to appear in a certain place and it's

272

00:09:38,610 --> 00:09:37,000

not a separate thing at all this is a

273

00:09:40,350 --> 00:09:38,620

very key aspect of quantum physics

274

00:09:42,870 --> 00:09:40,360

that's usually not appreciate even by

275

00:09:44,850 --> 00:09:42,880

people that you know get degrees in

276

00:09:46,920 --> 00:09:44,860

physics and are not necessarily quantum

277

00:09:48,870 --> 00:09:46,930

experts you know but they have spent

278

00:09:51,030 --> 00:09:48,880

quite a bit of time studying quantum

279

00:09:52,560 --> 00:09:51,040

physics it's sometimes not really

280

00:09:54,600 --> 00:09:52,570

appreciated that the wave function is

281

00:09:55,889 --> 00:09:54,610

the same thing as the the particle that

282

00:09:58,110 --> 00:09:55,899

ultimately comes out of a measurement

283

00:09:59,910 --> 00:09:58,120

and because the atom and its wave

284

00:10:01,139 --> 00:09:59,920

function of the same thing an atom can

285

00:10:02,670 --> 00:10:01,149

be in two places at once

286

00:10:05,400 --> 00:10:02,680

or three or four or actually an infinite

287

00:10:06,750 --> 00:10:05,410

number of places at once the observation

288

00:10:11,760 --> 00:10:06,760

collapsing the wave function is what

289

00:10:14,730 --> 00:10:11,770

creates literally creates the atom now

290

00:10:17,400 --> 00:10:14,740

let's give an example of the weirdness

291

00:10:19,530 --> 00:10:17,410

of a quantum measurement let's take this

292

00:10:21,990 --> 00:10:19,540

is a penny and you can slice this penny

293

00:10:25,620 --> 00:10:22,000

two ways you can slice the penny down

294

00:10:27,180 --> 00:10:25,630

the right down the middle and you can

295

00:10:29,160 --> 00:10:27,190

get the Lincoln on the front and the

296

00:10:31,980 --> 00:10:29,170

Memorial on the back or you could call

297

00:10:33,360 --> 00:10:31,990

this thing chopping the penny in half

298

00:10:34,500 --> 00:10:33,370

where you have the top half of a penny

299

00:10:36,600 --> 00:10:34,510

in the bottom half of the penny so I'll

300

00:10:39,210 --> 00:10:36,610

call this a slice and I'll call this a

301
00:10:42,000 --> 00:10:39,220
chop for the experiment the thought

302
00:10:44,310 --> 00:10:42,010
experiment assume we have a mutual

303
00:10:47,430 --> 00:10:44,320
friend called Niels mr. Fong call him

304
00:10:50,130 --> 00:10:47,440
Niels you might know why

305
00:10:52,439 --> 00:10:50,140
he has two machines the sliced chop and

306
00:10:54,060 --> 00:10:52,449
mail-out pennies one machine is labeled

307
00:10:56,460 --> 00:10:54,070
classical and the others label quantum

308
00:10:58,620 --> 00:10:56,470
now when he sets the classical machine

309
00:11:00,569 --> 00:10:58,630
to slice the cut is parallel through the

310
00:11:02,280 --> 00:11:00,579
penny such you wind up with two thin

311
00:11:03,990 --> 00:11:02,290
coins one is Lincoln on one side the

312
00:11:06,329 --> 00:11:04,000
other has Lincoln Memorial on on the

313
00:11:08,170 --> 00:11:06,339

other side when he sets the classical

314

00:11:09,820 --> 00:11:08,180

machine to chop the chop

315

00:11:12,160 --> 00:11:09,830

perpendicular to the penny resulting in

316

00:11:13,240 --> 00:11:12,170

two Halfmoon shape at Penny's wonderful

317

00:11:15,850 --> 00:11:13,250

Incan said the other was Lincoln

318

00:11:18,310 --> 00:11:15,860

shoulders so now he takes the 2 sliced

319

00:11:21,300 --> 00:11:18,320

pennies so the two the two sliced

320

00:11:23,680 --> 00:11:21,310

pennies on the top it takes those and

321

00:11:25,389 --> 00:11:23,690

puts one in an envelope label sliced

322

00:11:28,510 --> 00:11:25,399

pennies and emails one envelope to you

323

00:11:30,280 --> 00:11:28,520

and one to me now I open my envelope and

324

00:11:32,889 --> 00:11:30,290

I find a thin penny with Lincoln on it

325

00:11:34,720 --> 00:11:32,899

so I can safely infer that your envelope

326

00:11:36,519 --> 00:11:34,730

contains a thin penny with the Lincoln

327

00:11:37,750 --> 00:11:36,529

Lincoln Memorial on one side and sure

328

00:11:40,870 --> 00:11:37,760

enough when you open your envelope

329

00:11:42,660 --> 00:11:40,880

you're gonna see if I have this in my

330

00:11:45,490 --> 00:11:42,670

envelope you'll have that one all right

331

00:11:46,780 --> 00:11:45,500

well now my friend Niels takes the two

332

00:11:48,790 --> 00:11:46,790

chopped pennies and puts one in each

333

00:11:51,130 --> 00:11:48,800

envelope label chopped pennies again

334

00:11:53,199 --> 00:11:51,140

emails one to you and one to me now I

335

00:11:55,389 --> 00:11:53,209

opened my envelope and I find a penny

336

00:11:56,139 --> 00:11:55,399

with Lincoln's head in it so this is

337

00:11:58,120 --> 00:11:56,149

what's in my honey

338

00:12:00,699 --> 00:11:58,130

and sure enough I guess that you're

339

00:12:02,410 --> 00:12:00,709

gonna find the bottom half of the coin

340

00:12:04,150 --> 00:12:02,420

in yours and that's indeed what you find

341

00:12:06,610 --> 00:12:04,160

all right no big mystery here kind of

342

00:12:08,710 --> 00:12:06,620

boring now one day I get an envelope

343

00:12:10,540 --> 00:12:08,720

with the word quantum written on it

344

00:12:13,240 --> 00:12:10,550

and I figured this might be important so

345

00:12:15,370 --> 00:12:13,250

I call Niels and I ask Niels what do I

346

00:12:18,400 --> 00:12:15,380

have do I have a slice penny or a chop

347

00:12:20,019 --> 00:12:18,410

penny and he says well this time I use

348

00:12:22,920 --> 00:12:20,029

the quantum machine on this one not the

349

00:12:25,750 --> 00:12:22,930

classical machine so it's your choice I

350

00:12:27,280 --> 00:12:25,760

say oh well what do you mean you've

351
00:12:29,260 --> 00:12:27,290
already sliced or chopped the penny and

352
00:12:31,570 --> 00:12:29,270
mailed it to me I've got it in my hands

353
00:12:34,030 --> 00:12:31,580
how can I change that now he says well

354
00:12:36,640 --> 00:12:34,040
the quantum machine is special it

355
00:12:38,829 --> 00:12:36,650
processes penny and Mail's out the pairs

356
00:12:41,260 --> 00:12:38,839
and unlabeled envelopes without anybody

357
00:12:42,940 --> 00:12:41,270
looking at the pennies the process does

358
00:12:46,510 --> 00:12:42,950
not get turned into a slice or a chop

359
00:12:48,400 --> 00:12:46,520
until somebody looks at the coin do you

360
00:12:50,440 --> 00:12:48,410
mean to say I asked that I can decide

361
00:12:52,150 --> 00:12:50,450
whether I've got a sliced penny or a

362
00:12:54,819 --> 00:12:52,160
chopped penny now that envelope

363
00:12:57,480 --> 00:12:54,829

magically I will get one or the other

364

00:12:59,860 --> 00:12:57,490

that's correct says Niels and Danish and

365

00:13:01,060 --> 00:12:59,870

as soon as you open the envelope and

366

00:13:03,340 --> 00:13:01,070

look at whether you've got a sliced

367

00:13:05,650 --> 00:13:03,350

penny or a chopped penny guess what the

368

00:13:07,870 --> 00:13:05,660

other half the correct other half will

369

00:13:10,480 --> 00:13:07,880

be what your buddy over there is going

370

00:13:12,280 --> 00:13:10,490

to have in his envelope but I say it's

371

00:13:14,110 --> 00:13:12,290

already been sliced or chopped he says

372

00:13:15,490 --> 00:13:14,120

no the quantum machine only does that

373

00:13:18,370 --> 00:13:15,500

part of it only that's part of the job

374

00:13:19,900 --> 00:13:18,380

it correlates the two halves but it

375

00:13:22,090 --> 00:13:19,910

takes your consciousness to complete the

376

00:13:22,360 --> 00:13:22,100

process you get to decide which way the

377

00:13:24,480 --> 00:13:22,370

penny

378

00:13:27,820 --> 00:13:24,490

has been have when you open the envelope

379

00:13:29,740 --> 00:13:27,830

now this very same thing can be done of

380

00:13:32,620 --> 00:13:29,750

course not with real pennies but it can

381

00:13:34,510 --> 00:13:32,630

be done with with quantum objects such

382

00:13:36,160 --> 00:13:34,520

as photons yes I'm going to talk about

383

00:13:38,470 --> 00:13:36,170

next I'm going to talk about the bell

384

00:13:39,940 --> 00:13:38,480

and equality and more importantly a new

385

00:13:41,500 --> 00:13:39,950

inequality that you might never have

386

00:13:43,690 --> 00:13:41,510

heard of called the Leggett inequality

387

00:13:45,850 --> 00:13:43,700

that was recently measured and was

388

00:13:49,060 --> 00:13:45,860

actually formulated almost thirty years

389

00:13:51,310 --> 00:13:49,070

ago by by a professor Leggett who was a

390

00:13:53,050 --> 00:13:51,320

Nobel Prize winner but it wasn't tested

391

00:13:55,000 --> 00:13:53,060

until about a year and a half ago when

392

00:13:56,470 --> 00:13:55,010

an article appeared in nature that a

393

00:13:58,120 --> 00:13:56,480

measurement was made by this prominent

394

00:14:00,250 --> 00:13:58,130

quantum optics group in at the

395

00:14:02,079 --> 00:14:00,260

University of Vienna read by led by

396

00:14:03,790 --> 00:14:02,089

Anton Zeilinger in which they measured

397

00:14:05,440 --> 00:14:03,800

the Leggett inequality which actually

398

00:14:07,540 --> 00:14:05,450

goes a step deeper than the bell one and

399

00:14:09,460 --> 00:14:07,550

rules out any possible interpretation

400

00:14:13,810 --> 00:14:09,470

other than that consciousness creates

401
00:14:16,690 --> 00:14:13,820
reality when the measurement is made now

402
00:14:18,220 --> 00:14:16,700
in the quantum enigma of course you

403
00:14:20,200 --> 00:14:18,230
don't have coins but you have twin state

404
00:14:22,269 --> 00:14:20,210
photons that don't have any particular

405
00:14:24,310 --> 00:14:22,279
polarization until the polarization in

406
00:14:25,960 --> 00:14:24,320
one of them is measured so twin state

407
00:14:27,910 --> 00:14:25,970
photons can be entangled in a state of

408
00:14:29,560 --> 00:14:27,920
identical polarization but really have

409
00:14:31,420 --> 00:14:29,570
no particular polarization until you

410
00:14:33,040 --> 00:14:31,430
measure it it's the observation of the

411
00:14:36,730 --> 00:14:33,050
polarization of one of the photons as

412
00:14:38,740 --> 00:14:36,740
being say vertical or horizontal that

413
00:14:41,380 --> 00:14:38,750

instantaneously collapses both photons

414

00:14:43,030 --> 00:14:41,390

to vertical positions and that's true

415

00:14:44,860 --> 00:14:43,040

when they fly apart you create a pair of

416

00:14:46,720 --> 00:14:44,870

photons one flies this way one flies

417

00:14:49,180 --> 00:14:46,730

that way I make a measurement over here

418

00:14:50,769 --> 00:14:49,190

that measurement and the kind of

419

00:14:52,660 --> 00:14:50,779

measurement I make is determined by what

420

00:14:54,460 --> 00:14:52,670

I decide over here that measurement will

421

00:14:56,320 --> 00:14:54,470

then be reflected in what this coin over

422

00:14:57,340 --> 00:14:56,330

here is going to do even though they're

423

00:14:59,850 --> 00:14:57,350

flying a part of the speed of light

424

00:15:01,900 --> 00:14:59,860

can't communicate with each other

425

00:15:03,730 --> 00:15:01,910

quantum probability is not the

426

00:15:05,260 --> 00:15:03,740

probability of where the atom is or it

427

00:15:07,360 --> 00:15:05,270

where a photon is it is the objective

428

00:15:10,240 --> 00:15:07,370

probability of where you will find it

429

00:15:12,340 --> 00:15:10,250

the atom was not in the box if the box

430

00:15:13,750 --> 00:15:12,350

is where the atom is the atom was not in

431

00:15:16,600 --> 00:15:13,760

the box before you observed it to be

432

00:15:18,610 --> 00:15:16,610

there and Heisenberg had this to say is

433

00:15:20,230 --> 00:15:18,620

there under Heisenberg's words but the

434

00:15:22,780 --> 00:15:20,240

atom where elementary particles are not

435

00:15:25,060 --> 00:15:22,790

real they form a world of potentialities

436

00:15:29,680 --> 00:15:25,070

or possibilities rather than one effects

437

00:15:33,670 --> 00:15:29,690

or things or facts let's look at the

438

00:15:36,280 --> 00:15:33,680

Bell inequality if you have a quantum

439

00:15:38,410 --> 00:15:36,290

object that has a spin

440

00:15:40,360 --> 00:15:38,420

then you can choose to measure the spin

441

00:15:41,620 --> 00:15:40,370

in any given direction and what you'll

442

00:15:42,730 --> 00:15:41,630

find is that whatever direction you

443

00:15:45,129 --> 00:15:42,740

choose as spinning is going to be either

444

00:15:46,960 --> 00:15:45,139

up or down by up I mean if it's spinning

445

00:15:48,550 --> 00:15:46,970

like this the access points up it is

446

00:15:50,680 --> 00:15:48,560

spinning like that the access points

447

00:15:52,569 --> 00:15:50,690

down so you have a you actually have two

448

00:15:54,280 --> 00:15:52,579

particles that are entangled with each

449

00:15:55,900 --> 00:15:54,290

other and I'll tell you in a second why

450

00:15:57,639 --> 00:15:55,910

we have two instead of one so one of

451
00:15:59,740 --> 00:15:57,649
them flies off in one direction I choose

452
00:16:02,110 --> 00:15:59,750
to measure its spin say in this

453
00:16:04,120 --> 00:16:02,120
direction and call that direction hey so

454
00:16:05,860 --> 00:16:04,130
I measure that now there are also two

455
00:16:08,139 --> 00:16:05,870
other directions I could could measure a

456
00:16:09,670 --> 00:16:08,149
B and C they're arbitrary I can choose

457
00:16:10,930 --> 00:16:09,680
them in any way I want to but there are

458
00:16:12,490 --> 00:16:10,940
two other possible directions I could

459
00:16:12,999 --> 00:16:12,500
measure but having measured this one

460
00:16:14,949 --> 00:16:13,009
direction

461
00:16:17,170 --> 00:16:14,959
quantum theory says I can't measure the

462
00:16:18,730 --> 00:16:17,180
second one but I can measure the second

463
00:16:20,620 --> 00:16:18,740

one indirectly because if the two

464

00:16:22,689 --> 00:16:20,630

particles were entangled its partner

465

00:16:24,759 --> 00:16:22,699

over here is guaranteed to have the

466

00:16:26,019 --> 00:16:24,769

opposite spin sometimes the same

467

00:16:27,910 --> 00:16:26,029

sometimes the opposite depending on

468

00:16:29,800 --> 00:16:27,920

which which kind of particle you choose

469

00:16:31,509 --> 00:16:29,810

let's assume it's exactly the opposite

470

00:16:33,189 --> 00:16:31,519

spin now I can make a measurement on

471

00:16:35,319 --> 00:16:33,199

this one in some other directions in

472

00:16:37,540 --> 00:16:35,329

second Direction call it B and I know

473

00:16:39,790 --> 00:16:37,550

then that if I measure this one to be in

474

00:16:41,889 --> 00:16:39,800

that direction then this one over here

475

00:16:43,660 --> 00:16:41,899

would be in this one the opposite

476

00:16:45,970 --> 00:16:43,670

direction so I determined to directions

477

00:16:47,680 --> 00:16:45,980

for this particle over here by virtue of

478

00:16:49,389 --> 00:16:47,690

a direct measurement and by virtue of a

479

00:16:51,639 --> 00:16:49,399

measurement of its partner in a

480

00:16:53,920 --> 00:16:51,649

different direction so I can write out

481

00:16:58,210 --> 00:16:53,930

these probabilities the probability of

482

00:17:00,970 --> 00:16:58,220

measuring probability of measuring say

483

00:17:03,220 --> 00:17:00,980

spin up in Direction a and spin down and

484

00:17:05,649 --> 00:17:03,230

direction B is the probability measuring

485

00:17:07,870 --> 00:17:05,659

spin up in Direction a down in Direction

486

00:17:09,760 --> 00:17:07,880

b-plus in direction C which I don't know

487

00:17:12,010 --> 00:17:09,770

which I never measured and again the

488

00:17:15,549 --> 00:17:12,020

plus the probability of spin up being

489

00:17:17,590 --> 00:17:15,559

positive in a a down in B and in the

490

00:17:19,240 --> 00:17:17,600

other direction in C and as you with a

491

00:17:24,809 --> 00:17:19,250

little bit of mathematical manipulation

492

00:17:28,179 --> 00:17:24,819

you can show that this plus that equals

493

00:17:29,860 --> 00:17:28,189

that one plus something and the fact of

494

00:17:31,480 --> 00:17:29,870

the matter is that something is positive

495

00:17:33,370 --> 00:17:31,490

it's always got to be positive you can't

496

00:17:34,840 --> 00:17:33,380

have negative probabilities therefore

497

00:17:38,530 --> 00:17:34,850

this equation leads to an inequality

498

00:17:42,760 --> 00:17:38,540

that the spin in this direction a and

499

00:17:44,740 --> 00:17:42,770

Direction B plus the spin in Direction B

500

00:17:47,169 --> 00:17:44,750

and C it has to be greater than or equal

501
00:17:49,360 --> 00:17:47,179
to the spin in Direction AC so this is

502
00:17:50,150 --> 00:17:49,370
the Bell inequality this is what's

503
00:17:53,120 --> 00:17:50,160
predicted if

504
00:17:55,850 --> 00:17:53,130
particles have an intrinsic spin before

505
00:18:00,140 --> 00:17:55,860
you look at them now as it turns out

506
00:18:02,600 --> 00:18:00,150
quantum physics has a rule that says

507
00:18:05,090 --> 00:18:02,610
that if you take the spins in two

508
00:18:07,040 --> 00:18:05,100
different directions now this is the

509
00:18:10,880 --> 00:18:07,050
this is the formula that tells you what

510
00:18:12,320 --> 00:18:10,890
the probability is of finding the if you

511
00:18:14,570 --> 00:18:12,330
have a whole distribution of particles

512
00:18:17,030 --> 00:18:14,580
finding some fraction of them separated

513
00:18:19,130 --> 00:18:17,040

by some angle theta as it turns out if

514

00:18:21,380 --> 00:18:19,140

you put this formula into the belen

515

00:18:24,170 --> 00:18:21,390

equality the beltline equality is

516

00:18:26,090 --> 00:18:24,180

violated Bell inequality is not true and

517

00:18:28,670 --> 00:18:26,100

the Bell inequality is based upon the

518

00:18:30,650 --> 00:18:28,680

idea that spin is something that's

519

00:18:32,480 --> 00:18:30,660

intrinsic that's it's not dependent upon

520

00:18:34,070 --> 00:18:32,490

you're measuring it but it's there all

521

00:18:36,170 --> 00:18:34,080

along and you just choose to measure it

522

00:18:38,120 --> 00:18:36,180

so it's there when the particles were

523

00:18:40,940 --> 00:18:38,130

were joined together when they were made

524

00:18:42,200 --> 00:18:40,950

to fly apart there's the the spins in

525

00:18:43,760 --> 00:18:42,210

the different directions are inherent to

526

00:18:45,530 --> 00:18:43,770

the particles and when you choose to

527

00:18:49,310 --> 00:18:45,540

measure over here that's fine and this

528

00:18:51,020 --> 00:18:49,320

one's going to be an anti what's going

529

00:18:53,570 --> 00:18:51,030

to be in the opposite direction for any

530

00:18:55,040 --> 00:18:53,580

given spin because they were they were

531

00:18:56,570 --> 00:18:55,050

entangled here but really those spins

532

00:18:58,490 --> 00:18:56,580

belong to the particles and your

533

00:18:59,990 --> 00:18:58,500

measurement is is like a classical thing

534

00:19:02,780 --> 00:19:00,000

you look at something objectively you

535

00:19:04,490 --> 00:19:02,790

measure what it is but in fact the fact

536

00:19:06,380 --> 00:19:04,500

that the Bell inequality is violated and

537

00:19:09,050 --> 00:19:06,390

the quantum rule is followed implies

538

00:19:09,800 --> 00:19:09,060

that that spin is not really there until

539

00:19:13,250 --> 00:19:09,810

you make it happen

540

00:19:14,630 --> 00:19:13,260

the spin in a given direction is created

541

00:19:17,000 --> 00:19:14,640

by you're deciding to measure that

542

00:19:21,020 --> 00:19:17,010

direction and then that requires that

543

00:19:23,210 --> 00:19:21,030

its partner will be the in the opposite

544

00:19:25,130 --> 00:19:23,220

direction for that spin measurement and

545

00:19:26,690 --> 00:19:25,140

have its own angle of spin in a

546

00:19:29,360 --> 00:19:26,700

different direction which then this one

547

00:19:30,800 --> 00:19:29,370

would have so the Bell inequality is

548

00:19:32,690 --> 00:19:30,810

telling us or the violation of the Bell

549

00:19:36,460 --> 00:19:32,700

in equality is telling us that it's the

550

00:19:40,600 --> 00:19:36,470

observation that's creating the reality

551

00:19:43,010 --> 00:19:40,610

now as it turns out the Bell inequality

552

00:19:44,630 --> 00:19:43,020

could be violated and quantum physics

553

00:19:46,520 --> 00:19:44,640

could stay intact if you allowed

554

00:19:48,290 --> 00:19:46,530

particles to communicate with each other

555

00:19:50,540 --> 00:19:48,300

faster than the speed of light now this

556

00:19:52,520 --> 00:19:50,550

would violate special relativity but

557

00:19:55,310 --> 00:19:52,530

quantum mechanics would still be left

558

00:19:57,080 --> 00:19:55,320

intact and the notion that there is an

559

00:19:59,090 --> 00:19:57,090

underlying reality would be left intact

560

00:20:00,200 --> 00:19:59,100

if you allowed particles to communicate

561

00:20:02,780 --> 00:20:00,210

with each other faster than the speed of

562

00:20:03,950 --> 00:20:02,790

light well as it turns out the leggett

563

00:20:05,570 --> 00:20:03,960

inequality

564

00:20:07,370 --> 00:20:05,580

sort of takes away the last amount of

565

00:20:09,200 --> 00:20:07,380

freedom the last degree of freedom that

566

00:20:10,700 --> 00:20:09,210

was still left over in the Bell

567

00:20:13,400 --> 00:20:10,710

inequality that I was just talking about

568

00:20:15,680 --> 00:20:13,410

and this is a diagram of the Leggett

569

00:20:17,510 --> 00:20:15,690

inequality taken from New Scientist

570

00:20:19,190 --> 00:20:17,520

magazine and it's a fairly complicated

571

00:20:21,710 --> 00:20:19,200

one and that you're not measuring simply

572

00:20:23,300 --> 00:20:21,720

a spin here and a spin there from

573

00:20:25,070 --> 00:20:23,310

entangled particles you're taking

574

00:20:26,720 --> 00:20:25,080

entangled particles measuring a spin

575

00:20:27,920 --> 00:20:26,730

here a spin there and then you're

576

00:20:29,660 --> 00:20:27,930

measuring three elliptical polarization

577

00:20:32,090 --> 00:20:29,670

angles I don't want to go into that and

578

00:20:33,320 --> 00:20:32,100

part because it would be way above the

579

00:20:34,460 --> 00:20:33,330

level of this talk and secondly because

580

00:20:36,500 --> 00:20:34,470

I don't fully understand this yet

581

00:20:38,630 --> 00:20:36,510

because this has not been clarified in

582

00:20:40,880 --> 00:20:38,640

any qualitative way in the article and

583

00:20:42,830 --> 00:20:40,890

New Scientist nor in the anything I've

584

00:20:44,720 --> 00:20:42,840

found since that has given me an

585

00:20:46,520 --> 00:20:44,730

adequate explanation for what this what

586

00:20:49,460 --> 00:20:46,530

the details of this are but the point is

587

00:20:50,660 --> 00:20:49,470

that it's been hailed as the both by the

588

00:20:51,770 --> 00:20:50,670

group in Vienna that made the

589

00:20:54,680 --> 00:20:51,780

measurement that my New Scientist

590

00:20:56,510 --> 00:20:54,690

magazine has pretty much ruling out not

591

00:21:01,130 --> 00:20:56,520

only nonlocality

592

00:21:02,840 --> 00:21:01,140

but also realism as a an explanation for

593

00:21:05,570 --> 00:21:02,850

how particles can be correlated with

594

00:21:08,510 --> 00:21:05,580

each other and yet quantum mechanics

595

00:21:10,430 --> 00:21:08,520

predicts that the relationships between

596

00:21:12,440 --> 00:21:10,440

these measurements that you make are

597

00:21:13,910 --> 00:21:12,450

rather different quantum mechanically

598

00:21:15,110 --> 00:21:13,920

than they are if you assume that the

599

00:21:17,060 --> 00:21:15,120

particles could communicate with each

600

00:21:18,650 --> 00:21:17,070

other or that they would be if the

601
00:21:20,510 --> 00:21:18,660
particles really have these properties

602
00:21:21,680 --> 00:21:20,520
and you're simply measuring them but

603
00:21:23,060 --> 00:21:21,690
you're not creating anything when you

604
00:21:28,580 --> 00:21:23,070
make the measurement you're making a

605
00:21:29,900 --> 00:21:28,590
real objective measurement so recent

606
00:21:31,490 --> 00:21:29,910
experiments led by the group at the

607
00:21:33,380 --> 00:21:31,500
university of vienna austria provide the

608
00:21:35,450 --> 00:21:33,390
most compelling evidence yet that there

609
00:21:37,700 --> 00:21:35,460
is no objective reality beyond what we

610
00:21:40,570 --> 00:21:37,710
observe so it's really the observation

611
00:21:42,470 --> 00:21:40,580
the observation that creates the reality

612
00:21:44,590 --> 00:21:42,480
what they found is that legate's

613
00:21:46,640 --> 00:21:44,600

inequality is violated as well as bells

614

00:21:49,040 --> 00:21:46,650

even if you allow for instantaneous

615

00:21:50,840 --> 00:21:49,050

influences quantum measurements do not

616

00:21:53,030 --> 00:21:50,850

fit with the idea of an objective

617

00:21:54,500 --> 00:21:53,040

reality so as they say in in the

618

00:21:58,730 --> 00:21:54,510

magazine rather than passively observing

619

00:22:00,050 --> 00:21:58,740

it we in fact create reality now if

620

00:22:02,480 --> 00:22:00,060

quantum theory denies a straightforward

621

00:22:03,560 --> 00:22:02,490

physical reality of atoms it would also

622

00:22:05,750 --> 00:22:03,570

seem to deny the straightforward

623

00:22:08,150 --> 00:22:05,760

physical reality of chairs which are

624

00:22:10,070 --> 00:22:08,160

made of atoms now we like to think that

625

00:22:12,290 --> 00:22:10,080

the world can be divided into quantum

626

00:22:14,270 --> 00:22:12,300

and classical realms and in fact that's

627

00:22:16,960 --> 00:22:14,280

sort of the way physics operates

628

00:22:19,330 --> 00:22:16,970

practically but in fact the

629

00:22:22,659 --> 00:22:19,340

is you know only one reality here and

630

00:22:26,020 --> 00:22:22,669

the transition from quantum to macro

631

00:22:28,539 --> 00:22:26,030

reality is not not a real one in fact

632

00:22:31,210 --> 00:22:28,549

it's not not even really blurry it's

633

00:22:32,890 --> 00:22:31,220

there's one continuous law of physics

634

00:22:34,870 --> 00:22:32,900

you know it takes us from one level to

635

00:22:36,220 --> 00:22:34,880

the other you can have quantum object

636

00:22:39,070 --> 00:22:36,230

objects that are very large for example

637

00:22:41,409 --> 00:22:39,080

there is a gravitational wave detecting

638

00:22:42,970 --> 00:22:41,419

bar that weighs about a ton that has to

639

00:22:44,890 --> 00:22:42,980

be analyzed using quantum mechanics

640

00:22:46,990 --> 00:22:44,900

because of the the precision of what

641

00:22:51,159 --> 00:22:47,000

you're looking for and the precision of

642

00:22:54,370 --> 00:22:51,169

knowledge of the the the the well of

643

00:22:56,140 --> 00:22:54,380

that bar itself so a quantum options not

644

00:22:59,100 --> 00:22:56,150

necessarily one that's tiny it can be a

645

00:23:02,740 --> 00:22:59,110

huge thing the size of a well one ton

646

00:23:03,970 --> 00:23:02,750

barbell prior to the Leggett experiment

647

00:23:05,440 --> 00:23:03,980

it was thought that observation one

648

00:23:07,360 --> 00:23:05,450

object can instantaneous influence the

649

00:23:09,279 --> 00:23:07,370

behavior another object another one it's

650

00:23:11,289 --> 00:23:09,289

greatly distant even no physical force

651

00:23:13,169 --> 00:23:11,299

connects the two well it's even more

652

00:23:15,250 --> 00:23:13,179

mysterious now because what these

653

00:23:16,870 --> 00:23:15,260

experiments are telling us the Leggett

654

00:23:20,320 --> 00:23:16,880

experiments is a consciousness creating

655

00:23:22,180 --> 00:23:20,330

both realities via observation now the

656

00:23:23,799 --> 00:23:22,190

the last thing that is a rather

657

00:23:26,919 --> 00:23:23,809

mysterious about quantum physics and

658

00:23:28,149 --> 00:23:26,929

this ruling out of the notion that the

659

00:23:29,950 --> 00:23:28,159

particles can communicate with each

660

00:23:31,390 --> 00:23:29,960

other or that there is some realism in

661

00:23:33,549 --> 00:23:31,400

the particles that were measuring rather

662

00:23:34,810 --> 00:23:33,559

than being created at the point of

663

00:23:37,060 --> 00:23:34,820

measurement at the moment of measurement

664

00:23:41,320 --> 00:23:37,070

is that the observation also creates it

665

00:23:46,270 --> 00:23:41,330

back history it's possible for objects

666

00:23:49,299 --> 00:23:46,280

to say this is a wheeler time delay

667

00:23:54,039 --> 00:23:49,309

experiment that I'm thinking of if you

668

00:23:55,510 --> 00:23:54,049

let a safe quantum object encounter a

669

00:23:57,909 --> 00:23:55,520

with an effectively a beam splitter

670

00:23:59,980 --> 00:23:57,919

where it can be divided and go along two

671

00:24:02,200 --> 00:23:59,990

possible paths and there are two things

672

00:24:04,659 --> 00:24:02,210

that can happen if the object splits in

673

00:24:07,450 --> 00:24:04,669

half and goes along two paths then it's

674

00:24:09,010 --> 00:24:07,460

possible that these two paths when the

675

00:24:10,060 --> 00:24:09,020

obvious emerge will interfere with each

676
00:24:11,799 --> 00:24:10,070
other and you'll get an interference

677
00:24:13,600 --> 00:24:11,809
pattern and so if you get an

678
00:24:15,640 --> 00:24:13,610
interference pattern then you know that

679
00:24:17,409 --> 00:24:15,650
the object has been split at some point

680
00:24:20,950 --> 00:24:17,419
and gone off along two parallel paths

681
00:24:23,320 --> 00:24:20,960
and therefore this shows the

682
00:24:25,570 --> 00:24:23,330
interference pattern that that is a

683
00:24:27,130 --> 00:24:25,580
signature of that having happened the

684
00:24:29,020 --> 00:24:27,140
alternative is that the particle can go

685
00:24:30,340 --> 00:24:29,030
along one path or the other and you can

686
00:24:31,960 --> 00:24:30,350
then detect which

687
00:24:34,000 --> 00:24:31,970
it emerges from when you make your

688
00:24:36,909 --> 00:24:34,010

measurement but whether you whether the

689

00:24:38,529 --> 00:24:36,919

particle goes along one path splits and

690

00:24:40,810 --> 00:24:38,539

then along both of them and interferes

691

00:24:44,430 --> 00:24:40,820

or whether it goes along a path does a

692

00:24:46,630 --> 00:24:44,440

split that goes along a or B that

693

00:24:48,850 --> 00:24:46,640

depends upon what measurement you make

694

00:24:50,110 --> 00:24:48,860

down here so you determine down here

695

00:24:52,090 --> 00:24:50,120

when you make the measurement what the

696

00:24:54,789 --> 00:24:52,100

particle does back here when it reaches

697

00:24:56,740 --> 00:24:54,799

the beam splitter well in fact what

698

00:24:59,289 --> 00:24:56,750

you've done is sort of created backwards

699

00:25:01,090 --> 00:24:59,299

in time causation because the object has

700

00:25:03,580 --> 00:25:01,100

to do what you measure if you decide to

701
00:25:05,289 --> 00:25:03,590
detect which slit the object comes out

702
00:25:06,850 --> 00:25:05,299
of then it's not possible for that

703
00:25:08,649 --> 00:25:06,860
object to is split in two back here

704
00:25:10,630 --> 00:25:08,659
because that's not consistent with what

705
00:25:12,760 --> 00:25:10,640
you measure if you make a measurement

706
00:25:14,080 --> 00:25:12,770
that gets an interference pattern then

707
00:25:15,850 --> 00:25:14,090
that demonstrates that the object is

708
00:25:18,070 --> 00:25:15,860
gone along two paths after it's gone

709
00:25:19,899 --> 00:25:18,080
through the beam splitter but the object

710
00:25:21,549 --> 00:25:19,909
did that back here it's possible for you

711
00:25:22,990 --> 00:25:21,559
to not make your decision on which

712
00:25:24,460 --> 00:25:23,000
measurement you're going to make until

713
00:25:26,740 --> 00:25:24,470

after the object has passed that point

714

00:25:28,899 --> 00:25:26,750

of no return so once again it's the

715

00:25:30,789 --> 00:25:28,909

observation that creates the reality and

716

00:25:34,299 --> 00:25:30,799

in fact even creates the back history

717

00:25:36,909 --> 00:25:34,309

for that reality so the point of all

718

00:25:37,990 --> 00:25:36,919

this is that it certainly looks as if

719

00:25:40,630 --> 00:25:38,000

there's evidence coming out of the

720

00:25:42,640 --> 00:25:40,640

physics lab not for god but for the

721

00:25:44,860 --> 00:25:42,650

notion that consciousness is creating

722

00:25:46,299 --> 00:25:44,870

reality at the level of quantum physics

723

00:25:48,460 --> 00:25:46,309

and if it's creating reality at the

724

00:25:50,500 --> 00:25:48,470

level of quantum physics then by

725

00:25:52,060 --> 00:25:50,510

implication the rest of reality somehow

726

00:25:54,159 --> 00:25:52,070

also is being created by consciousness

727

00:25:56,169 --> 00:25:54,169

and I think consciousness is actually

728

00:25:58,000 --> 00:25:56,179

the the formative element behind the

729

00:25:59,500 --> 00:25:58,010

universe it's not that somehow it's an

730

00:26:01,600 --> 00:25:59,510

epiphenomenon coming out of our brains

731

00:26:03,340 --> 00:26:01,610

and on a matter of biochemistry taking

732

00:26:04,779 --> 00:26:03,350

place in here but rather it's

733

00:26:06,730 --> 00:26:04,789

consciousness that is the ultimate

734

00:26:09,430 --> 00:26:06,740

reality out of which everything else has

735

00:26:11,020 --> 00:26:09,440

come and that is my explanation for why

736

00:26:12,430 --> 00:26:11,030

the universe is finely tuned it's not

737

00:26:14,140 --> 00:26:12,440

certainly a proof by any means if you

738

00:26:15,730 --> 00:26:14,150

want to go away from this talk thinking

739

00:26:17,500 --> 00:26:15,740

there is a multiverse of universes and

740

00:26:19,480 --> 00:26:17,510

ours is not special and we're just one

741

00:26:21,430 --> 00:26:19,490

of an ensemble that's fine it's equally

742

00:26:22,779 --> 00:26:21,440

logical it's equally rational but I

743

00:26:24,970 --> 00:26:22,789

don't think it has any advantage over

744

00:26:29,250 --> 00:26:24,980

the notion that it's cost us all the way

745

00:26:43,330 --> 00:26:29,260

behind the universe thank you

746

00:26:53,119 --> 00:26:46,700

okay we have a nice long time for

747

00:26:58,909 --> 00:26:53,129

questions and okay I'll start with the

748

00:27:01,639 --> 00:26:58,919

guy I saw first my name is Kenny Arnett

749

00:27:06,259 --> 00:27:01,649

I'm wondering what happens on a lifeless

750

00:27:11,869 --> 00:27:06,269

planet to quantum mechanics where there

751

00:27:13,720 --> 00:27:11,879

is no consciousness around their very

752

00:27:15,830 --> 00:27:13,730

being on life let's find I don't know

753

00:27:17,450 --> 00:27:15,840

you've raised a good you've raised a

754

00:27:20,480 --> 00:27:17,460

question though that I think deserves an

755

00:27:21,769 --> 00:27:20,490

answer let me open up my computer again

756

00:27:23,239 --> 00:27:21,779

because after all I've got about a

757

00:27:24,529 --> 00:27:23,249

couple of minutes of extra time because

758

00:27:28,220 --> 00:27:24,539

I went early didn't I

759

00:27:32,239 --> 00:27:28,230

so let's see if I can find a slide here

760

00:27:34,220 --> 00:27:32,249

that I prepared is possible response to

761

00:27:39,710 --> 00:27:34,230

a question that might have come up like

762

00:27:42,649 --> 00:27:39,720

that the von Neumann chain the question

763

00:27:44,810 --> 00:27:42,659

is do you really need an observer or can

764

00:27:47,509 --> 00:27:44,820

anything and anything that interacts

765

00:27:49,519 --> 00:27:47,519

with a quantum situation constitute a

766

00:27:51,499 --> 00:27:49,529

measurement and this question looked at

767

00:27:53,720 --> 00:27:51,509

rather carefully back in 1932 already by

768

00:27:55,580 --> 00:27:53,730

John von Neumann Jonathan Newman was a

769

00:27:57,830 --> 00:27:55,590

mathematical genius he was one of the

770

00:28:01,159 --> 00:27:57,840

people that invented the the operator

771

00:28:03,109 --> 00:28:01,169

analysis of quantum mechanics and the

772

00:28:07,700 --> 00:28:03,119

operating operator formalism of quantum

773

00:28:09,109 --> 00:28:07,710

mechanics and what he showed was that

774

00:28:11,060 --> 00:28:09,119

quantum theory makes physics encounters

775

00:28:12,619 --> 00:28:11,070

with consciousness inevitable so he

776

00:28:14,060 --> 00:28:12,629

considered an apparatus a measuring

777

00:28:16,879 --> 00:28:14,070

apparatus like a Geiger counter he said

778

00:28:20,149 --> 00:28:16,889

okay now that Geiger counter whether it

779

00:28:24,009 --> 00:28:20,159

goes off or not let's see for a second

780

00:28:28,460 --> 00:28:24,019

here huh takes a measuring apparatus

781

00:28:30,859 --> 00:28:28,470

that would look at whether or not say a

782

00:28:34,039 --> 00:28:30,869

a quantum event is happening in a given

783

00:28:35,960 --> 00:28:34,049

box and you could argue well that Geiger

784

00:28:37,909 --> 00:28:35,970

counters measurement is really

785

00:28:39,019 --> 00:28:37,919

equivalent to an observer looking at

786

00:28:40,820 --> 00:28:39,029

that in the Geiger counter of course is

787

00:28:42,680 --> 00:28:40,830

not conscious so kind of Geiger counter

788

00:28:44,330 --> 00:28:42,690

substitute for a human being

789

00:28:48,170 --> 00:28:44,340

there was no what happens at the Geiger

790

00:28:51,200 --> 00:28:48,180

counters the Geiger counters state

791

00:28:53,720 --> 00:28:51,210

becomes becomes entangled with a state

792

00:28:55,340 --> 00:28:53,730

of the the quantum situations trying to

793

00:28:57,170 --> 00:28:55,350

measure if you then try to put a

794

00:29:00,020 --> 00:28:57,180

detector to measure whether the Geiger

795

00:29:01,940 --> 00:29:00,030

counter has registered or not then that

796

00:29:03,620 --> 00:29:01,950

detector becomes entangled with become

797

00:29:05,330 --> 00:29:03,630

superimposed with quantum mechanically

798

00:29:06,950 --> 00:29:05,340

with a Geiger counter the detector with

799

00:29:08,840 --> 00:29:06,960

a Geiger counter the Geiger counter with

800

00:29:10,640 --> 00:29:08,850

a quantum object and the whole thing

801
00:29:12,020 --> 00:29:10,650
forms a chain and the chain is not

802
00:29:14,900 --> 00:29:12,030
broken until a conscious observer

803
00:29:15,980 --> 00:29:14,910
decides to make a measurement and I see

804
00:29:16,910 --> 00:29:15,990
a hand going up in the back there's

805
00:29:19,100 --> 00:29:16,920
probably going to challenge that

806
00:29:21,230 --> 00:29:19,110
interpretation but this anointment chain

807
00:29:22,670 --> 00:29:21,240
is that the the explanation or the

808
00:29:24,140 --> 00:29:22,680
rationalization or the rationale I

809
00:29:26,510 --> 00:29:24,150
should say I suppose more realistically

810
00:29:28,760 --> 00:29:26,520
the rationale for why it really takes an

811
00:29:32,330 --> 00:29:28,770
observer to make a quantum event happen

812
00:29:37,700 --> 00:29:32,340
and to break the both bring about the

813
00:29:41,510 --> 00:29:37,710

vehicle here to the state dick shop let

814

00:29:43,720 --> 00:29:41,520

me just give another viewpoint on all

815

00:29:46,340 --> 00:29:43,730

this that we've talked about many times

816

00:29:50,660 --> 00:29:46,350

before just so it's on the floor

817

00:29:53,270 --> 00:29:50,670

I think the conclusions being jumped to

818

00:29:55,480 --> 00:29:53,280

in the new scientist article and a lot

819

00:29:57,590 --> 00:29:55,490

of other places are just naive and

820

00:29:59,450 --> 00:29:57,600

there's an awful lot of confusion about

821

00:30:04,040 --> 00:29:59,460

all this so let me give you my viewpoint

822

00:30:05,360 --> 00:30:04,050

you can react for two entangled

823

00:30:09,470 --> 00:30:05,370

particles take off in different

824

00:30:12,170 --> 00:30:09,480

directions they are in a state that's no

825

00:30:13,280 --> 00:30:12,180

less real than anything with a simple

826

00:30:15,050 --> 00:30:13,290

up-or-down spin

827

00:30:18,080 --> 00:30:15,060

they're in a very definite state that's

828

00:30:21,530 --> 00:30:18,090

a superpose state and in a in a Hilbert

829

00:30:23,410 --> 00:30:21,540

space that's just a vector at 45 degrees

830

00:30:26,690 --> 00:30:23,420

rather than at zero or 90 degrees

831

00:30:30,290 --> 00:30:26,700

exactly as determined or and exactly as

832

00:30:32,510 --> 00:30:30,300

real as anything else it's just not in

833

00:30:35,540 --> 00:30:32,520

on our basis it's in a definite state of

834

00:30:38,630 --> 00:30:35,550

superposition now it is true that when

835

00:30:42,020 --> 00:30:38,640

you measure that interaction changes it

836

00:30:44,990 --> 00:30:42,030

to be in an upstate or a Down state in

837

00:30:46,850 --> 00:30:45,000

it in a binary system but consciousness

838

00:30:48,260 --> 00:30:46,860

in my view has nothing whatsoever to do

839

00:30:49,730 --> 00:30:48,270

with it and von Arnim is simply wrong

840

00:30:54,290 --> 00:30:49,740

about this

841

00:30:55,869 --> 00:30:54,300

so the leap that I would object to is

842

00:30:57,999 --> 00:30:55,879

the one that says

843

00:31:00,729 --> 00:30:58,009

these phenomena which you've pretty much

844

00:31:03,059 --> 00:31:00,739

correctly described imply that the

845

00:31:05,859 --> 00:31:03,069

consciousness creates the universe

846

00:31:09,579 --> 00:31:05,869

reality that's being discussed as a very

847

00:31:12,249 --> 00:31:09,589

naive definition of reality I would say

848

00:31:13,869 --> 00:31:12,259

and our interactions do have something

849

00:31:16,809 --> 00:31:13,879

to do with what happens in the universe

850

00:31:18,639 --> 00:31:16,819

obviously but it's all out there and

851

00:31:20,589 --> 00:31:18,649

it's real whether we interact with it or

852

00:31:22,509 --> 00:31:20,599

not and the interactions that are

853

00:31:27,519 --> 00:31:22,519

involved in quantum measurement are a

854

00:31:29,229 --> 00:31:27,529

lot more prosaic than then are sometimes

855

00:31:30,459 --> 00:31:29,239

portrayed thank you well it's certainly

856

00:31:32,499 --> 00:31:30,469

something we're not going to settle here

857

00:31:34,659 --> 00:31:32,509

because it's a very deep issue I'd like

858

00:31:36,879 --> 00:31:34,669

to point out though that the the notion

859

00:31:38,979 --> 00:31:36,889

that you have a spin that objectively

860

00:31:41,379 --> 00:31:38,989

exists that you simply measure out here

861

00:31:43,529 --> 00:31:41,389

that sort of runs afoul in the idea or

862

00:31:45,369 --> 00:31:43,539

the the fact I should say that whenever

863

00:31:47,199 --> 00:31:45,379

regardless of which direction you choose

864

00:31:50,919 --> 00:31:47,209

to measure the spin in it's going to be

865

00:31:52,689 --> 00:31:50,929

a $\frac{1}{2}$ H bar it's going to be either up

866

00:31:53,739 --> 00:31:52,699

or down it's not going to be at some

867

00:31:57,430 --> 00:31:53,749

hang we're not going to measure some

868

00:32:00,279 --> 00:31:57,440

fraction of $\frac{1}{2}$ H bar or H bar whichever

869

00:32:03,369 --> 00:32:00,289

the spin is of the particle so it's not

870

00:32:04,629 --> 00:32:03,379

it's you are creating a reality here

871

00:32:06,309 --> 00:32:04,639

when you make a measurement because the

872

00:32:07,509 --> 00:32:06,319

object would not know that you're going

873

00:32:09,639 --> 00:32:07,519

to measure in this direction therefore

874

00:32:11,469 --> 00:32:09,649

has to be aligned this way it can't be

875

00:32:12,399 --> 00:32:11,479

that way or that way because you're

876

00:32:13,599 --> 00:32:12,409

always going to measure there an up or

877

00:32:22,809 --> 00:32:13,609

down you're never going to measure a

878

00:32:25,389 --> 00:32:22,819

fraction of that whether you've begun to

879

00:32:27,939 --> 00:32:25,399

connect these theories with human

880

00:32:29,769 --> 00:32:27,949

identity you know who we are in

881

00:32:32,939 --> 00:32:29,779

relationship to the quantum world and

882

00:32:37,599 --> 00:32:35,649

well in the book the goth area I do make

883

00:32:39,069 --> 00:32:37,609

some suggestions along those lines I

884

00:32:40,680 --> 00:32:39,079

mean that's not the the point of this

885

00:32:43,239 --> 00:32:40,690

talk I didn't want to preach about my

886

00:32:44,499 --> 00:32:43,249

metaphysics of God but since you asked

887

00:32:46,149 --> 00:32:44,509

the question I'll say a sentence or two

888

00:32:48,129 --> 00:32:46,159

about that I think that basically it's

889

00:32:49,869 --> 00:32:48,139

that the rationale behind the universe

890

00:32:51,399 --> 00:32:49,879

is that there's a consciousness that

891

00:32:52,899 --> 00:32:51,409

created the universe because that

892

00:32:55,059 --> 00:32:52,909

conscious wanted to experience what it's

893

00:32:56,649 --> 00:32:55,069

like to live in that universe as you as

894

00:32:58,119 --> 00:32:56,659

me as the animals as the plants as

895

00:33:00,159 --> 00:32:58,129

whatever aliens exist in the Andromeda

896

00:33:02,199 --> 00:33:00,169

galaxy the point of it is to create a

897

00:33:03,669 --> 00:33:02,209

universe in which life can arise

898

00:33:05,559 --> 00:33:03,679

following the laws of Darwinian

899

00:33:07,719 --> 00:33:05,569

evolution good point are when you

900

00:33:09,310 --> 00:33:07,729

evolution is a key aspect of this life

901

00:33:11,320 --> 00:33:09,320

can evolve and that conscious

902

00:33:12,610 --> 00:33:11,330

can experience its potential which is

903

00:33:14,680 --> 00:33:12,620

the experience that we're having right

904

00:33:16,810 --> 00:33:14,690

here in this room now in part so that's

905

00:33:19,029 --> 00:33:16,820

my metaphysical interpretation what how

906

00:33:20,230 --> 00:33:19,039

it relates to quantum physics at any

907

00:33:22,240 --> 00:33:20,240

level deeper than what I've said here

908

00:33:24,700 --> 00:33:22,250

today I wouldn't know and this is my my

909

00:33:27,249 --> 00:33:24,710

attempt to show that quantum physics at

910

00:33:29,169 --> 00:33:27,259

least if it quantum physics cannot prove

911

00:33:30,970 --> 00:33:29,179

the existence of God and cannot do that

912

00:33:32,889 --> 00:33:30,980

but it does certainly point to the idea

913

00:33:35,200 --> 00:33:32,899

that consciousness is a key element in

914

00:33:38,889 --> 00:33:35,210

the creation of reality and with with

915

00:33:41,289 --> 00:33:38,899

apologies to dick Schaap how does

916

00:33:44,950 --> 00:33:41,299

perception affect the consciousness of

917

00:33:46,779 --> 00:33:44,960

reality in the equation of consciousness

918

00:33:49,749 --> 00:33:46,789

creating reality how does perception

919

00:33:52,389 --> 00:33:49,759

affect it well I'd say ending on your

920

00:33:55,029 --> 00:33:52,399

head is a spin up or down I'm taking

921

00:33:56,980 --> 00:33:55,039

perception as being the what constants

922

00:33:58,330 --> 00:33:56,990

does in the making of the measurement

923

00:33:59,649 --> 00:33:58,340

process I mean that's part of

924

00:34:01,119 --> 00:33:59,659

consciousness and the consciousness

925

00:34:03,039 --> 00:34:01,129

consciousness being active in this

926
00:34:05,230 --> 00:34:03,049
process making an observation is

927
00:34:16,210 --> 00:34:05,240
perception I don't understand the

928
00:34:18,250 --> 00:34:16,220
question beyond that it's been it's

929
00:34:20,379 --> 00:34:18,260
spinning whichever way you choose to

930
00:34:21,609 --> 00:34:20,389
measure it if you choose to measure the

931
00:34:23,260 --> 00:34:21,619
spin in this direction it's gonna be

932
00:34:25,119 --> 00:34:23,270
there up or down it's not gonna be some

933
00:34:25,419 --> 00:34:25,129
fraction of that it's gonna be either up

934
00:34:27,579 --> 00:34:25,429
or down

935
00:34:29,649 --> 00:34:27,589
very mysterious you know it's not what

936
00:34:32,290 --> 00:34:29,659
you think if you spin take take a globe

937
00:34:34,300 --> 00:34:32,300
you know spinning around its axis and

938
00:34:35,829 --> 00:34:34,310

you've tilted in various directions if

939

00:34:37,240 --> 00:34:35,839

you choose to measure its spin and say

940

00:34:39,069 --> 00:34:37,250

this direction by spinning in that one

941

00:34:41,200 --> 00:34:39,079

you'll get some fractional some

942

00:34:43,359 --> 00:34:41,210

fractional value for what the projection

943

00:34:44,710 --> 00:34:43,369

of the this axis is on that one but you

944

00:34:45,819 --> 00:34:44,720

make a quantum spin measurements all

945

00:34:47,409 --> 00:34:45,829

they're always going to be up or down

946

00:34:55,569 --> 00:34:47,419

regardless of which direction you

947

00:34:58,329 --> 00:34:55,579

measure you get to choose so like if

948

00:34:59,800 --> 00:34:58,339

there is a crowd of people and there's a

949

00:35:02,500 --> 00:34:59,810

rock in the center or something

950

00:35:05,290 --> 00:35:02,510

everybody's looking at it if someone

951
00:35:09,250 --> 00:35:05,300
looked away it the rock wouldn't

952
00:35:12,870 --> 00:35:09,260
disappear so it's like you have to have

953
00:35:17,500 --> 00:35:12,880
no one watching something for it they

954
00:35:18,940 --> 00:35:17,510
kind of forgot to really be there well

955
00:35:19,990 --> 00:35:18,950
Einstein asked the same sort of question

956
00:35:22,000 --> 00:35:20,000
because my son didn't much care for

957
00:35:23,240 --> 00:35:22,010
quantum physics and so he asked one of

958
00:35:24,440 --> 00:35:23,250
his colleagues well do you really

959
00:35:27,140 --> 00:35:24,450
the moon is not there when you don't

960
00:35:28,880 --> 00:35:27,150
look at it and he was really didn't like

961
00:35:30,590 --> 00:35:28,890
quantum physics but as it turns out

962
00:35:33,220 --> 00:35:30,600
Einstein was proven wrong because the

963
00:35:35,480 --> 00:35:33,230

Bell inequality demonstrated that the

964

00:35:38,030 --> 00:35:35,490

einstein-podolsky-rosen paradox was

965

00:35:40,460 --> 00:35:38,040

indeed mistaken and so was Einstein now

966

00:35:42,380 --> 00:35:40,470

you know the question of whether things

967

00:35:43,550 --> 00:35:42,390

are not there when we're not looking I

968

00:35:45,470 --> 00:35:43,560

wouldn't want to go that far I mean

969

00:35:47,450 --> 00:35:45,480

clearly that's that's not even it

970

00:35:49,460 --> 00:35:47,460

doesn't happen though at the quantum

971

00:35:51,590 --> 00:35:49,470

level at the quantum level it certainly

972

00:35:54,500 --> 00:35:51,600

seems it seems to happen because things

973

00:35:57,050 --> 00:35:54,510

don't actually get put in their proper

974

00:35:59,360 --> 00:35:57,060

place until you make the measurement so

975

00:36:00,530 --> 00:35:59,370

I'm I guess I'm forced to say that

976

00:36:03,110 --> 00:36:00,540

there's a mystery here when you try to

977

00:36:04,520 --> 00:36:03,120

extrapolate this to our this the state

978

00:36:07,070 --> 00:36:04,530

of the universe in the state of

979

00:36:08,360 --> 00:36:07,080

ourselves a mystery that we'll just have

980

00:36:10,970 --> 00:36:08,370

to live with but it certainly points

981

00:36:12,950 --> 00:36:10,980

that way unfortunately I'm sure there

982

00:36:15,110 --> 00:36:12,960

were a lot more interesting questions

983

00:36:16,720 --> 00:36:15,120

but we're all out of time so thank you