

Quantum Enigma

If quantum theory denies the straightforward physical reality of atoms, it would also seem to deny the straightforward physical reality of chairs, which are *made* of atoms.

Prior to the Leggett experiment it was thought that observation of one object can instantaneously influence the behavior of another greatly distant object – even if no physical force connects the two and even outside the light cone. (non-locality). It is even more mysterious. Consciousness is creating both realities via observation.

Observation creates a back history for the appropriate outcome. Delayed choice experiment of John Wheeler demonstrates this. Object makes its decision on reaching a semi-transparent mirror, but the type of measurement (interference or detection) is decided after the object has passed the mirror. Done with photons in 1987.

1
00:00:05,539 --> 00:00:03,530
the belly inequality could be violated

2
00:00:07,460 --> 00:00:05,549
and quantum physics could stay intact if

3
00:00:08,600 --> 00:00:07,470
you allowed particles to communicate

4
00:00:10,370 --> 00:00:08,610
with each other faster than the speed of

5
00:00:13,129 --> 00:00:10,380
light now this would violate special

6
00:00:16,189 --> 00:00:13,139
relativity but quantum mechanics would

7
00:00:17,900 --> 00:00:16,199
still be left intact and the notion that

8
00:00:19,790 --> 00:00:17,910
there is an underlying reality would be

9
00:00:21,170 --> 00:00:19,800
left intact if you allowed particles

10
00:00:23,599 --> 00:00:21,180
communicate with each other faster than

11
00:00:25,939 --> 00:00:23,609
the speed of light well as it turns out

12
00:00:27,589 --> 00:00:25,949
the legged inequality sort of takes away

13
00:00:29,630 --> 00:00:27,599

the last amount of freedom last degree

14

00:00:31,550 --> 00:00:29,640

of freedom that was still left over in

15

00:00:34,220 --> 00:00:31,560

the bell in equality that I was just

16

00:00:36,470 --> 00:00:34,230

talking about and this is a diagram of

17

00:00:38,299 --> 00:00:36,480

the legged inequality taken from New

18

00:00:39,619 --> 00:00:38,309

Scientist magazine it's a fairly

19

00:00:42,410 --> 00:00:39,629

complicated one and that you're not

20

00:00:44,240 --> 00:00:42,420

measuring simply a spin here and a spin

21

00:00:46,130 --> 00:00:44,250

there from entangled particles you're

22

00:00:47,990 --> 00:00:46,140

taking entangled particles measuring the

23

00:00:49,190 --> 00:00:48,000

spin here a spin there and then you're

24

00:00:50,869 --> 00:00:49,200

measuring three elliptical polarization

25

00:00:53,360 --> 00:00:50,879

angles I don't want to go into that in

26
00:00:54,470 --> 00:00:53,370
part because it would be way above the

27
00:00:55,729 --> 00:00:54,480
level of this talk and secondly because

28
00:00:57,770 --> 00:00:55,739
I don't fully understand this yet

29
00:00:59,990 --> 00:00:57,780
because this has not been clarified in

30
00:01:02,510 --> 00:01:00,000
any qualitative way in the article a new

31
00:01:04,429 --> 00:01:02,520
scientist nor in the anything I've found

32
00:01:06,080 --> 00:01:04,439
since that has given me an adequate

33
00:01:07,789 --> 00:01:06,090
explanation for what this what the

34
00:01:10,700 --> 00:01:07,799
details of this are but the point is

35
00:01:11,899 --> 00:01:10,710
that it's been hailed as the both by the

36
00:01:13,070 --> 00:01:11,909
group in Vienna that made the

37
00:01:16,450 --> 00:01:13,080
measurement at my New Scientist magazine

38
00:01:21,219 --> 00:01:16,460

as pretty much ruling out not only

39

00:01:23,330 --> 00:01:21,229

nonlocality but also realism as a

40

00:01:26,060 --> 00:01:23,340

explanation for how particles can be

41

00:01:28,569 --> 00:01:26,070

correlated with each other and yet

42

00:01:30,980 --> 00:01:28,579

quantum mechanics predicts that the

43

00:01:32,170 --> 00:01:30,990

relationships between these measurements

44

00:01:34,490 --> 00:01:32,180

that you make are rather different

45

00:01:35,660 --> 00:01:34,500

quantum mechanically than they are if

46

00:01:37,700 --> 00:01:35,670

you assume that the particles could

47

00:01:39,230 --> 00:01:37,710

communicate with each other or that they

48

00:01:40,609 --> 00:01:39,240

would be if the particles really have

49

00:01:42,440 --> 00:01:40,619

these properties and you're simply

50

00:01:43,609 --> 00:01:42,450

measuring them but you're not creating

51
00:01:44,749 --> 00:01:43,619
anything when you make the measurement

52
00:01:50,569 --> 00:01:44,759
you're making a real objective

53
00:01:51,679 --> 00:01:50,579
measurement so recent experiments led by

54
00:01:53,179 --> 00:01:51,689
the group at the University of Vienna

55
00:01:55,219 --> 00:01:53,189
Austria provide the most compelling

56
00:01:57,889 --> 00:01:55,229
evidence yet that there is no objective

57
00:02:00,499 --> 00:01:57,899
reality beyond what we observe so it's

58
00:02:03,139 --> 00:02:00,509
really the observation the observation

59
00:02:04,969 --> 00:02:03,149
that creates the reality what they found

60
00:02:07,520 --> 00:02:04,979
is that legate's in equality is violated

61
00:02:09,589 --> 00:02:07,530
as well as bells even if you allow for

62
00:02:11,540 --> 00:02:09,599
instantaneous influences quantum

63
00:02:14,089 --> 00:02:11,550

measurements do not fit with the idea of

64

00:02:14,360 --> 00:02:14,099

an objective reality so as they say in

65

00:02:20,000 --> 00:02:14,370

the

66

00:02:21,320 --> 00:02:20,010

it we in fact create reality now if

67

00:02:23,750 --> 00:02:21,330

quantum theory denies a straightforward

68

00:02:25,100 --> 00:02:23,760

physical reality of atoms it would also

69

00:02:26,990 --> 00:02:25,110

seem to deny the straightforward

70

00:02:29,330 --> 00:02:27,000

physical reality of chairs which are

71

00:02:31,339 --> 00:02:29,340

made of atoms now we like to think that

72

00:02:33,559 --> 00:02:31,349

the world can be divided into quantum

73

00:02:35,539 --> 00:02:33,569

and classical realms and in fact that's

74

00:02:38,420 --> 00:02:35,549

sort of the way physics operates

75

00:02:41,360 --> 00:02:38,430

practically but in fact there really is

76

00:02:44,119 --> 00:02:41,370

you know only one reality here and the

77

00:02:47,599 --> 00:02:44,129

transition from quantum to macro reality

78

00:02:50,360 --> 00:02:47,609

is not not a real one in fact it's not

79

00:02:53,270 --> 00:02:50,370

not even really blurry it's there's one

80

00:02:55,250 --> 00:02:53,280

continuous law of physics and it takes

81

00:02:56,750 --> 00:02:55,260

us from one level to the other you can

82

00:02:58,539 --> 00:02:56,760

have quantum object objects that are

83

00:03:00,860 --> 00:02:58,549

very large for example there is a

84

00:03:02,720 --> 00:03:00,870

gravitational wave detecting bar that

85

00:03:04,640 --> 00:03:02,730

weighs about a ton that has to be

86

00:03:06,289 --> 00:03:04,650

analyzed using quantum mechanics because

87

00:03:08,210 --> 00:03:06,299

of the the precision of what you're

88

00:03:12,890 --> 00:03:08,220

looking for and the precision of

89

00:03:15,619 --> 00:03:12,900

knowledge of the the the well of that

90

00:03:17,390 --> 00:03:15,629

bar itself so a quantum objects not

91

00:03:20,349 --> 00:03:17,400

necessarily one that's tiny it can be a

92

00:03:24,020 --> 00:03:20,359

huge thing the size of a well one ton

93

00:03:25,640 --> 00:03:24,030

barbell prior to the legged experiment

94

00:03:26,839 --> 00:03:25,650

was thought that observation one object

95

00:03:28,819 --> 00:03:26,849

and instantaneous influence behavior

96

00:03:30,530 --> 00:03:28,829

another object another one is greatly

97

00:03:32,509 --> 00:03:30,540

distant even though physical force

98

00:03:34,449 --> 00:03:32,519

connects the two well it's even more

99

00:03:36,440 --> 00:03:34,459

mysterious now because what these

100

00:03:38,089 --> 00:03:36,450

experiments are telling us the leg

101
00:03:41,569 --> 00:03:38,099
experiments is a consciousness creating

102
00:03:43,430 --> 00:03:41,579
both realities the observation now the

103
00:03:45,080 --> 00:03:43,440
the last thing that is a rather

104
00:03:48,170 --> 00:03:45,090
mysterious about quantum physics and

105
00:03:49,339 --> 00:03:48,180
this ruling out of the notion that the

106
00:03:51,229 --> 00:03:49,349
particles can communicate with each

107
00:03:52,640 --> 00:03:51,239
other or that there is some realism in

108
00:03:54,830 --> 00:03:52,650
the particles that were measuring rather

109
00:03:56,089 --> 00:03:54,840
than being created at the point of

110
00:03:58,339 --> 00:03:56,099
measurement at the moment of measurement

111
00:04:02,539 --> 00:03:58,349
is that the observation also creates it

112
00:04:07,520 --> 00:04:02,549
back history it's possible for objects

113
00:04:10,580 --> 00:04:07,530

to say this is a wheeler time delay

114

00:04:15,319 --> 00:04:10,590

experiment that I'm thinking of if you

115

00:04:16,789 --> 00:04:15,329

let a save a quantum object encounter a

116

00:04:19,159 --> 00:04:16,799

with an effectively a beam splitter

117

00:04:21,170 --> 00:04:19,169

where it can be divided and go along two

118

00:04:23,480 --> 00:04:21,180

possible paths then there are two things

119

00:04:25,909 --> 00:04:23,490

that can happen if the object splits in

120

00:04:27,920 --> 00:04:25,919

half and goes along two paths then it's

121

00:04:29,779 --> 00:04:27,930

possible that these two

122

00:04:31,070 --> 00:04:29,789

as when the obvious emerge will

123

00:04:32,990 --> 00:04:31,080

interfere with each other and you get an

124

00:04:34,520 --> 00:04:33,000

interference pattern and so if you get

125

00:04:36,680 --> 00:04:34,530

an interference pattern then you know

126
00:04:38,420 --> 00:04:36,690
that the object has been split at some

127
00:04:41,900 --> 00:04:38,430
point and gone off along two parallel

128
00:04:44,600 --> 00:04:41,910
paths and therefore this shows the

129
00:04:46,850 --> 00:04:44,610
interference pattern that that is a

130
00:04:48,379 --> 00:04:46,860
signature of that having happened the

131
00:04:50,270 --> 00:04:48,389
alternative is that the particle can go

132
00:04:52,279 --> 00:04:50,280
along one path or the other and you can

133
00:04:54,379 --> 00:04:52,289
then detect which path it emerges from

134
00:04:55,760 --> 00:04:54,389
when you make your measurement but

135
00:04:58,550 --> 00:04:55,770
whether you whether the particle goes

136
00:05:00,409 --> 00:04:58,560
along one path splits and then along

137
00:05:02,570 --> 00:05:00,419
both of them and interferes or whether

138
00:05:07,100 --> 00:05:02,580

it goes along a path doesn't split but

139

00:05:09,140 --> 00:05:07,110

goes along a or b that depends upon what

140

00:05:10,550 --> 00:05:09,150

measurement you make down here so you

141

00:05:12,260 --> 00:05:10,560

determine down here when you make the

142

00:05:14,140 --> 00:05:12,270

measurement what the particle does back

143

00:05:17,180 --> 00:05:14,150

here when it reaches the beam splitter

144

00:05:19,010 --> 00:05:17,190

well in fact what you've done is sort of

145

00:05:21,260 --> 00:05:19,020

created backwards in time causation

146

00:05:23,540 --> 00:05:21,270

because the object has to do what you

147

00:05:25,760 --> 00:05:23,550

measure if you decide to detect which

148

00:05:27,290 --> 00:05:25,770

slit the object comes out of then it's

149

00:05:29,180 --> 00:05:27,300

not possible for that object to is split

150

00:05:31,070 --> 00:05:29,190

in two back here because that's not

151
00:05:32,779 --> 00:05:31,080
consistent with what you measure if you

152
00:05:34,189 --> 00:05:32,789
make a measurement that gets an

153
00:05:35,510 --> 00:05:34,199
interference pattern then that

154
00:05:37,430 --> 00:05:35,520
demonstrates that the object has gone

155
00:05:39,439 --> 00:05:37,440
along two paths after it's gone through

156
00:05:41,750 --> 00:05:39,449
the beam splitter but the object of that

157
00:05:43,250 --> 00:05:41,760
back here it's possible for you to not

158
00:05:44,689 --> 00:05:43,260
make your decision on which measurement

159
00:05:45,920 --> 00:05:44,699
you're going to make until after the

160
00:05:48,110 --> 00:05:45,930
object has passed that point of no

161
00:05:50,180 --> 00:05:48,120
return so once again it's the

162
00:05:52,040 --> 00:05:50,190
observation that creates the reality and

163
00:05:55,580 --> 00:05:52,050

in fact even creates the back history

164

00:05:58,040 --> 00:05:55,590

for that reality so the point of all

165

00:05:59,270 --> 00:05:58,050

this is that and certainly looks as if

166

00:06:01,909 --> 00:05:59,280

there's evidence coming out of the

167

00:06:04,010 --> 00:06:01,919

physics lab not for God but for the

168

00:06:06,140 --> 00:06:04,020

notion that consciousness is creating

169

00:06:07,969 --> 00:06:06,150

reality at the level of quantum physics

170

00:06:10,820 --> 00:06:07,979

and if it's creating reality at level of

171

00:06:12,350 --> 00:06:10,830

quantum physics then by implication the

172

00:06:14,540 --> 00:06:12,360

rest of reality sama also is being

173

00:06:16,189 --> 00:06:14,550

created by consciousness and I think

174

00:06:17,960 --> 00:06:16,199

consciousness is actually the the

175

00:06:19,399 --> 00:06:17,970

formative element behind the universe

176

00:06:20,899 --> 00:06:19,409

it's not that somehow it's an

177

00:06:22,969 --> 00:06:20,909

epiphenomenon coming out of our brains

178

00:06:24,710 --> 00:06:22,979

and on a matter of biochemistry taking

179

00:06:26,629 --> 00:06:24,720

place in here but rather its

180

00:06:28,339 --> 00:06:26,639

consciousness it is the ultimate reality

181

00:06:30,860 --> 00:06:28,349

out of which everything else has come

182

00:06:32,390 --> 00:06:30,870

and that is my explanation for why the

183

00:06:33,830 --> 00:06:32,400

universe is finely tuned it's not

184

00:06:35,510 --> 00:06:33,840

certainly a proof by any means if you

185

00:06:37,190 --> 00:06:35,520

want to go away from this talk thinking

186

00:06:39,050 --> 00:06:37,200

there is a multiverse of universes and

187

00:06:40,879 --> 00:06:39,060

ours is not special we're just one of an

188

00:06:41,810 --> 00:06:40,889

ensemble that's fine it's equally

189

00:06:43,580 --> 00:06:41,820

logical it's equally

190

00:06:45,590 --> 00:06:43,590

rational but I don't think it has any

191

00:06:48,530 --> 00:06:45,600

advantage over the notion that has cost

192

00:07:08,090 --> 00:06:48,540

us all the way behind the universe thank

193

00:07:14,360 --> 00:07:08,100

you okay we have a nice long time for

194

00:07:19,910 --> 00:07:14,370

questions um and okay i'll start with

195

00:07:22,400 --> 00:07:19,920

the guy i saw first my name is Kenny

196

00:07:26,530 --> 00:07:22,410

Arnett I'm wondering what happens on a

197

00:07:32,080 --> 00:07:26,540

lifeless planet to quantum mechanics

198

00:07:36,920 --> 00:07:34,460

there having been on life was fine it i

199

00:07:38,390 --> 00:07:36,930

don't know you've raised a good you've

200

00:07:41,360 --> 00:07:38,400

raised a question though that i think

201
00:07:42,800 --> 00:07:41,370
deserves an answer let me open up my

202
00:07:43,940 --> 00:07:42,810
computer again because after all I've

203
00:07:47,050 --> 00:07:43,950
got about a couple of minutes of extra

204
00:07:49,790 --> 00:07:47,060
time because I went early didn't I so

205
00:07:53,990 --> 00:07:49,800
let's see if i can find slide here that

206
00:07:55,580 --> 00:07:54,000
i prepared as possible response to a

207
00:08:01,100 --> 00:07:55,590
question that might have come up like

208
00:08:04,010 --> 00:08:01,110
that the von Neumann chain the question

209
00:08:06,170 --> 00:08:04,020
is do you really need an observer or can

210
00:08:08,900 --> 00:08:06,180
anything and anything that interacts

211
00:08:10,910 --> 00:08:08,910
with a quantum situation constitute a

212
00:08:12,860 --> 00:08:10,920
measurement and this question looked at

213
00:08:15,110 --> 00:08:12,870

rather carefully back in 1932 already by

214

00:08:16,940 --> 00:08:15,120

john von neumann john vannoni minh was a

215

00:08:19,220 --> 00:08:16,950

mathematical genius he was one of the

216

00:08:22,460 --> 00:08:19,230

people that invented the the operator

217

00:08:24,470 --> 00:08:22,470

analysis of quantum mechanics the

218

00:08:28,970 --> 00:08:24,480

operator operator formalism of quantum

219

00:08:30,500 --> 00:08:28,980

mechanics and when he showed was that

220

00:08:32,360 --> 00:08:30,510

quantum theory makes physics encounters

221

00:08:33,980 --> 00:08:32,370

with consciousness inevitable so he

222

00:08:35,450 --> 00:08:33,990

considered an apparatus a measuring

223

00:08:38,240 --> 00:08:35,460

apparatus like a Geiger counter he said

224

00:08:41,540 --> 00:08:38,250

ok now that Geiger counter whether it

225

00:08:45,370 --> 00:08:41,550

goes off or not let's see for a second

226
00:08:49,960 --> 00:08:45,380
here huh take some measuring apparatus

227
00:08:52,250 --> 00:08:49,970
that would look at whether or not say a

228
00:08:55,639 --> 00:08:52,260
quantum event is happening in a given

229
00:08:58,519 --> 00:08:55,649
box and you can argue well that guy girl

230
00:08:59,749 --> 00:08:58,529
measurement is really equivalent to an

231
00:09:01,460 --> 00:08:59,759
observer looking at that the Geiger

232
00:09:02,749 --> 00:09:01,470
counter of course is not conscious so

233
00:09:04,850 --> 00:09:02,759
kind of Geiger counter substitute for a

234
00:09:07,639 --> 00:09:04,860
human being his answer was no what

235
00:09:10,999 --> 00:09:07,649
happens at the Geiger counters the

236
00:09:14,059 --> 00:09:11,009
Geiger counters state becomes becomes

237
00:09:16,220 --> 00:09:14,069
entangled with the state of the quantum

238
00:09:18,019 --> 00:09:16,230

situations trying to measure if you then

239

00:09:20,389 --> 00:09:18,029

try to put a detector to measure whether

240

00:09:22,579 --> 00:09:20,399

the Geiger counter has registered or not

241

00:09:24,530 --> 00:09:22,589

then that detector becomes entangled

242

00:09:26,239 --> 00:09:24,540

with become superimposed with quantum

243

00:09:27,350 --> 00:09:26,249

mechanically with a Geiger counter the

244

00:09:29,299 --> 00:09:27,360

detected with a Geiger counter the

245

00:09:31,429 --> 00:09:29,309

Geiger counter with a quantum object and

246

00:09:33,230 --> 00:09:31,439

the whole thing forms a chain and the

247

00:09:35,900 --> 00:09:33,240

chain is not broken until a conscious

248

00:09:37,160 --> 00:09:35,910

observer decides to make a measurement

249

00:09:38,299 --> 00:09:37,170

and I see a hand going up in the back

250

00:09:40,489 --> 00:09:38,309

there's probably going to challenge that

251

00:09:42,590 --> 00:09:40,499

interpretation but this anointment chain

252

00:09:44,059 --> 00:09:42,600

is that the explanation or the

253

00:09:45,530 --> 00:09:44,069

rationalization or the rationale I

254

00:09:47,869 --> 00:09:45,540

should say I suppose more realistically

255

00:09:50,119 --> 00:09:47,879

the rationale for why it really takes an

256

00:09:53,720 --> 00:09:50,129

observer to make a quantum event happen

257

00:09:59,090 --> 00:09:53,730

and to break the well bring about the