

# A NEW CLASS OF QUANTUM THEORIES

**BERNARDO**  
**KASTRUP**

**SABINE**  
**HOSSENFELDER**



1  
00:00:02,869 --> 00:00:01,270  
recall that you can click on the

2  
00:00:05,190 --> 00:00:02,879  
timestamp in the description to skip

3  
00:00:07,909 --> 00:00:05,200  
this intro it's generally beneficial to

4  
00:00:09,910 --> 00:00:07,919  
speak to one another live as facial

5  
00:00:12,070 --> 00:00:09,920  
expressions and vocal tonality convey

6  
00:00:13,509 --> 00:00:12,080  
much that's lost over text especially

7  
00:00:15,270 --> 00:00:13,519  
text that's limited to a certain amount

8  
00:00:17,189 --> 00:00:15,280  
of characters that's one of the reasons

9  
00:00:19,429 --> 00:00:17,199  
for today's theo locution with sabine

10  
00:00:21,269 --> 00:00:19,439  
haasenfelder and bernardo castro as the

11  
00:00:23,990 --> 00:00:21,279  
medium of twitter has one's twitter

12  
00:00:26,390 --> 00:00:24,000  
following requesting bloodshed however

13  
00:00:29,269 --> 00:00:26,400

truculence pales in comparison to

14

00:00:31,589 --> 00:00:29,279

congenial mutual constructiveness and

15

00:00:33,190 --> 00:00:31,599

the latter is which theolocations are or

16

00:00:35,270 --> 00:00:33,200

at least what they are at their best

17

00:00:37,750 --> 00:00:35,280

sabina hossenfelder is a theoretical

18

00:00:40,229 --> 00:00:37,760

physicist researching quantum gravity as

19

00:00:42,549 --> 00:00:40,239

well as having the ever elucidating

20

00:00:44,790 --> 00:00:42,559

youtube channel sabina hostenfelder link

21

00:00:46,549 --> 00:00:44,800

in the description as well as being a

22

00:00:48,790 --> 00:00:46,559

researcher one of the prime researchers

23

00:00:50,790 --> 00:00:48,800

in super determinism super determinism

24

00:00:53,430 --> 00:00:50,800

is what brings us here today at least

25

00:00:55,430 --> 00:00:53,440

thematically and at most inevitably if

26

00:00:57,350 --> 00:00:55,440

the theory is to be believed bernardo

27

00:00:59,189 --> 00:00:57,360

castro is the executive director of the

28

00:01:01,029 --> 00:00:59,199

essentia foundation all links are in the

29

00:01:02,630 --> 00:01:01,039

description by the way bernardo is one

30

00:01:05,350 --> 00:01:02,640

of the most cogent champions of

31

00:01:07,109 --> 00:01:05,360

metaphysical idealism the view that

32

00:01:09,030 --> 00:01:07,119

reality is essentially mental put

33

00:01:11,670 --> 00:01:09,040

forward with the analytical precision

34

00:01:13,590 --> 00:01:11,680

imbued in him from his phd in philosophy

35

00:01:15,109 --> 00:01:13,600

and computer engineering click on the

36

00:01:16,870 --> 00:01:15,119

time stamp in the description if you'd

37

00:01:19,030 --> 00:01:16,880

like to skip this intro my name is

38

00:01:20,789 --> 00:01:19,040

kirchey mungle i'm a torontonian

39

00:01:23,109 --> 00:01:20,799

filmmaker with a background in

40

00:01:25,510 --> 00:01:23,119

mathematical physics dedicated to the

41

00:01:27,350 --> 00:01:25,520

explication of the variegated terrain of

42

00:01:29,270 --> 00:01:27,360

theories of everything from a

43

00:01:31,270 --> 00:01:29,280

theoretical physics perspective but as

44

00:01:33,030 --> 00:01:31,280

well as analyzing consciousness and

45

00:01:35,190 --> 00:01:33,040

seeing its potential connection to

46

00:01:37,109 --> 00:01:35,200

fundamental reality whatever that is

47

00:01:39,670 --> 00:01:37,119

essentially this channel is dedicated to

48

00:01:41,749 --> 00:01:39,680

exploring the under nature of reality

49

00:01:43,350 --> 00:01:41,759

the constitutional laws that govern it

50

00:01:45,670 --> 00:01:43,360

provided those laws exist at all and are

51  
00:01:47,590 --> 00:01:45,680  
even noble to us if you enjoy witnessing

52  
00:01:50,389 --> 00:01:47,600  
and engaging with others on the topics

53  
00:01:52,550 --> 00:01:50,399  
of psychology consciousness physics etc

54  
00:01:54,230 --> 00:01:52,560  
the channels themes then do consider

55  
00:01:56,149 --> 00:01:54,240  
going to the discord and the subreddit

56  
00:01:57,990 --> 00:01:56,159  
which are linked in the description

57  
00:02:00,630 --> 00:01:58,000  
there's also a link to the patreon that

58  
00:02:02,550 --> 00:02:00,640  
is patreon.com slash kirchheim uncle if

59  
00:02:04,469 --> 00:02:02,560  
you'd like to support this podcast as

60  
00:02:06,389 --> 00:02:04,479  
the patrons and the sponsors are the

61  
00:02:08,710 --> 00:02:06,399  
only reasons that i'm able to have

62  
00:02:10,710 --> 00:02:08,720  
podcasts of this quality and this depth

63  
00:02:12,150 --> 00:02:10,720

given that i can do this now full time

64

00:02:14,309 --> 00:02:12,160

thanks to both the patrons and the

65

00:02:16,229 --> 00:02:14,319

sponsors support speaking of sponsors

66

00:02:17,990 --> 00:02:16,239

there are two the first sponsor is

67

00:02:19,430 --> 00:02:18,000

brilliant during the winter break i

68

00:02:21,190 --> 00:02:19,440

decided to brush up on some of the

69

00:02:23,430 --> 00:02:21,200

fundamentals of physics particularly

70

00:02:25,350 --> 00:02:23,440

with regard to information theory as i'd

71

00:02:26,949 --> 00:02:25,360

like to interview chiara marletto on

72

00:02:28,630 --> 00:02:26,959

constructor theory which is heavily

73

00:02:30,309 --> 00:02:28,640

based in information theory now

74

00:02:31,670 --> 00:02:30,319

information theory is predicated on

75

00:02:34,070 --> 00:02:31,680

entropy at least there's a fundamental

76  
00:02:35,750 --> 00:02:34,080  
formula for entropy so i ended up taking

77  
00:02:37,830 --> 00:02:35,760  
the brilliant course i challenged myself

78  
00:02:39,830 --> 00:02:37,840  
to do one lesson per day and i took the

79  
00:02:42,150 --> 00:02:39,840  
course's random variable distributions

80  
00:02:43,830 --> 00:02:42,160  
and knowledge slash uncertainty what i

81  
00:02:45,509 --> 00:02:43,840  
loved is that despite knowing the

82  
00:02:47,750 --> 00:02:45,519  
formula for entropy which is essentially

83  
00:02:49,670 --> 00:02:47,760  
hammered into you as an undergraduate it

84  
00:02:51,509 --> 00:02:49,680  
seems like it comes down from the sky

85  
00:02:53,190 --> 00:02:51,519  
arbitrarily and with brilliance for the

86  
00:02:54,790 --> 00:02:53,200  
first time i was able to see how the

87  
00:02:57,110 --> 00:02:54,800  
formula for entropy which you're seeing

88  
00:02:58,869 --> 00:02:57,120

right now is actually extremely natural

89

00:03:00,790 --> 00:02:58,879

and it'd be strange to define it in any

90

00:03:02,470 --> 00:03:00,800

other manner there are plenty of courses

91

00:03:03,750 --> 00:03:02,480

and you can even learn group theory

92

00:03:05,190 --> 00:03:03,760

which is what's being referenced when

93

00:03:08,070 --> 00:03:05,200

you hear that the standard model is

94

00:03:09,750 --> 00:03:08,080

predicated on  $u_1$  cross  $su_2$  cross  $su_3$

95

00:03:11,750 --> 00:03:09,760

those are lead groups continuous lead

96

00:03:14,470 --> 00:03:11,760

groups visit [brilliant.org](http://brilliant.org)

97

00:03:16,149 --> 00:03:14,480

toetoe to get 20 off an annual

98

00:03:18,309 --> 00:03:16,159

subscription and i recommend that you

99

00:03:20,070 --> 00:03:18,319

don't stop before four lessons i think

100

00:03:21,830 --> 00:03:20,080

you'll be greatly surprised at the ease

101  
00:03:23,750 --> 00:03:21,840  
at which you can now comprehend subjects

102  
00:03:26,470 --> 00:03:23,760  
you previously had a difficult time

103  
00:03:28,550 --> 00:03:26,480  
grokking the second sponsor is also now

104  
00:03:30,550 --> 00:03:28,560  
also is an end-to-end supply chain

105  
00:03:32,630 --> 00:03:30,560  
optimization software company with

106  
00:03:34,630 --> 00:03:32,640  
software that helps business users

107  
00:03:36,789 --> 00:03:34,640  
optimize sales and operations planning

108  
00:03:38,710 --> 00:03:36,799  
to avoid stockouts reduce return and

109  
00:03:41,110 --> 00:03:38,720  
inventory write-downs while reducing

110  
00:03:44,309 --> 00:03:41,120  
inventory investment it's a supply chain

111  
00:03:46,390 --> 00:03:44,319  
ai that drives smart roi headed by amjad

112  
00:03:48,710 --> 00:03:46,400  
hussein who's been a huge supporter of

113  
00:03:51,750 --> 00:03:48,720

this podcast since near its inception in

114

00:03:53,670 --> 00:03:51,760

fact amjad has his own podcast on ai and

115

00:03:55,589 --> 00:03:53,680

consciousness and business growth and if

116

00:03:57,429 --> 00:03:55,599

you'd like to support the tow podcast

117

00:03:59,190 --> 00:03:57,439

then visit the link in the description

118

00:04:01,190 --> 00:03:59,200

to see amjad's podcast because

119

00:04:03,670 --> 00:04:01,200

subscribing to him or at least visiting

120

00:04:06,470 --> 00:04:03,680

supports the toe podcast indirectly

121

00:04:08,869 --> 00:04:06,480

thank you and enjoy we should be live

122

00:04:11,429 --> 00:04:08,879

if you can see this

123

00:04:13,190 --> 00:04:11,439

please type in

124

00:04:16,550 --> 00:04:13,200

dexter's lab

125

00:04:20,870 --> 00:04:18,949

you're saying that to us

126

00:04:23,189 --> 00:04:20,880

to the audience to the live chat if you

127

00:04:24,870 --> 00:04:23,199

can see this type in dexter's lab

128

00:04:27,270 --> 00:04:24,880

so sabina why don't you start with an

129

00:04:28,710 --> 00:04:27,280

overview of what super determinism is

130

00:04:32,310 --> 00:04:28,720

for people who

131

00:04:33,670 --> 00:04:32,320

perhaps aren't as acquainted as you are

132

00:04:37,110 --> 00:04:33,680

okay so

133

00:04:40,150 --> 00:04:37,120

super determinism isn't really a theory

134

00:04:42,150 --> 00:04:40,160

it's a property of a class of theories

135

00:04:45,110 --> 00:04:42,160

which you find in the foundations of

136

00:04:48,230 --> 00:04:45,120

quantum mechanics

137

00:04:50,310 --> 00:04:48,240

and they are designed to solve a problem

138

00:04:52,790 --> 00:04:50,320

which is the measurement problem

139

00:04:55,350 --> 00:04:52,800

uh in quantum mechanics more precisely

140

00:04:57,189 --> 00:04:55,360

the problem is that in quantum mechanics

141

00:04:59,110 --> 00:04:57,199

we have

142

00:05:00,710 --> 00:04:59,120

an evolution law for the wave function

143

00:05:02,230 --> 00:05:00,720

which is the schrodinger equation that

144

00:05:05,909 --> 00:05:02,240

everybody who's listening has probably

145

00:05:07,430 --> 00:05:05,919

heard of and then we have the update of

146

00:05:09,749 --> 00:05:07,440

the wave function which is sometimes

147

00:05:12,070 --> 00:05:09,759

called the collapse or the reduction of

148

00:05:15,430 --> 00:05:12,080

the wave function and

149

00:05:17,189 --> 00:05:15,440

this update is non-local which means

150

00:05:19,350 --> 00:05:17,199

it's not compatible with einstein's

151

00:05:21,029 --> 00:05:19,360

theory of general relativity

152

00:05:23,749 --> 00:05:21,039

and now there are several ways people

153

00:05:25,909 --> 00:05:23,759

try to wiggle out of this one and that's

154

00:05:27,510 --> 00:05:25,919

probably the most popular one at the

155

00:05:29,590 --> 00:05:27,520

moment is to say well it's just not a

156

00:05:31,830 --> 00:05:29,600

physical process we're just updating our

157

00:05:33,510 --> 00:05:31,840

knowledge about something let's not ask

158

00:05:35,029 --> 00:05:33,520

about what because that's where the

159

00:05:38,950 --> 00:05:35,039

problem starts

160

00:05:40,390 --> 00:05:38,960

and um that has its own problems uh one

161

00:05:41,350 --> 00:05:40,400

of which is that it doesn't actually

162

00:05:43,830 --> 00:05:41,360

tell us

163

00:05:45,830 --> 00:05:43,840

what's happening physically like i mean

164

00:05:47,590 --> 00:05:45,840

we have to put something there if we

165

00:05:50,390 --> 00:05:47,600

want to take the expectation value of

166

00:05:52,070 --> 00:05:50,400

something so just what is it that

167

00:05:53,990 --> 00:05:52,080

locally happens so it's compatible with

168

00:05:56,710 --> 00:05:54,000

general relativity the other problem

169

00:05:57,510 --> 00:05:56,720

with this idea of updating knowledge uh

170

00:05:58,790 --> 00:05:57,520

and

171

00:06:01,990 --> 00:05:58,800

stuff like this

172

00:06:03,990 --> 00:06:02,000

is that we think of quantum mechanics as

173

00:06:07,350 --> 00:06:04,000

a fundamental theory that describes the

174

00:06:08,469 --> 00:06:07,360

constituents of nature and that means

175

00:06:10,390 --> 00:06:08,479

that

176

00:06:13,590 --> 00:06:10,400

in its assumptions there shouldn't be

177

00:06:15,670 --> 00:06:13,600

any macroscopic objects or other

178

00:06:17,749 --> 00:06:15,680

expressions like detector observer

179

00:06:20,790 --> 00:06:17,759

knowledge and that kind of thing instead

180

00:06:23,029 --> 00:06:20,800

it should follow from the theory now you

181

00:06:25,749 --> 00:06:23,039

may say well the obvious way to fix this

182

00:06:28,230 --> 00:06:25,759

is just to replace this weird collapse

183

00:06:29,909 --> 00:06:28,240

with a local process that's compatible

184

00:06:32,830 --> 00:06:29,919

with um einstein's assumption of

185

00:06:35,510 --> 00:06:32,840

relativity and so on

186

00:06:37,590 --> 00:06:35,520

and it brings up the question like why

187

00:06:40,629 --> 00:06:37,600

haven't physicists tried to do this well

188

00:06:44,790 --> 00:06:40,639

the reason is that um 50 years ago or

189

00:06:46,790 --> 00:06:44,800

something um they became convinced that

190

00:06:49,430 --> 00:06:46,800

this isn't possible notably because of

191

00:06:51,110 --> 00:06:49,440

bell's theorem so bell's theorem says

192

00:06:52,710 --> 00:06:51,120

basically if you want a theory to make a

193

00:06:53,990 --> 00:06:52,720

long story short that describes our

194

00:06:55,270 --> 00:06:54,000

observations

195

00:06:56,150 --> 00:06:55,280

um

196

00:06:57,189 --> 00:06:56,160

which

197

00:06:58,309 --> 00:06:57,199

is

198

00:06:59,909 --> 00:06:58,319

local

199

00:07:02,550 --> 00:06:59,919

like the way that we would want to have

200

00:07:04,230 --> 00:07:02,560

it then it has to violate an assumption

201  
00:07:05,749 --> 00:07:04,240  
that's called statistical independence

202  
00:07:07,029 --> 00:07:05,759  
and that's what's called super

203  
00:07:08,790 --> 00:07:07,039  
determinism

204  
00:07:10,629 --> 00:07:08,800  
okay now you may wonder why the heck is

205  
00:07:13,430 --> 00:07:10,639  
it called super determinism if it's

206  
00:07:16,550 --> 00:07:13,440  
about violating statistical

207  
00:07:19,909 --> 00:07:16,560  
independence and i don't know it's just

208  
00:07:21,430 --> 00:07:19,919  
that that's what it came to be called um

209  
00:07:23,189 --> 00:07:21,440  
a theory which

210  
00:07:24,629 --> 00:07:23,199  
violates statistical independence

211  
00:07:26,150 --> 00:07:24,639  
doesn't even necessarily have to be

212  
00:07:27,029 --> 00:07:26,160  
deterministic

213  
00:07:28,790 --> 00:07:27,039

and

214

00:07:30,870 --> 00:07:28,800

then there are a lot of philosophers who

215

00:07:32,790 --> 00:07:30,880

have gone on to

216

00:07:35,189 --> 00:07:32,800

claim that this requires some kind of

217

00:07:37,510 --> 00:07:35,199

conspiracy that it would require us to

218

00:07:40,390 --> 00:07:37,520

throw out free will and so on so it's

219

00:07:42,070 --> 00:07:40,400

been loaded with this philosophical

220

00:07:44,230 --> 00:07:42,080

baggage which for me as a

221

00:07:46,629 --> 00:07:44,240

phenomenologist is completely irrelevant

222

00:07:49,350 --> 00:07:46,639

you know the only thing i want is i want

223

00:07:52,309 --> 00:07:49,360

a local theory that reproduces quantum

224

00:07:55,350 --> 00:07:52,319

mechanics on the average so

225

00:07:57,270 --> 00:07:55,360

oh yeah i forgot to say this so

226

00:07:59,589 --> 00:07:57,280

those theories which underlie quantum

227

00:08:01,510 --> 00:07:59,599

mechanics are hidden variables theories

228

00:08:03,869 --> 00:08:01,520

so they say well the reason that quantum

229

00:08:05,589 --> 00:08:03,879

mechanics looks uh random

230

00:08:07,189 --> 00:08:05,599

non-deterministic is because there's

231

00:08:09,749 --> 00:08:07,199

some information which we don't know and

232

00:08:11,909 --> 00:08:09,759

those are the hidden variables and as

233

00:08:14,469 --> 00:08:11,919

always i have to add that they're only

234

00:08:17,029 --> 00:08:14,479

called hidden because of some historical

235

00:08:19,029 --> 00:08:17,039

quirk in the nomenclature

236

00:08:21,430 --> 00:08:19,039

that it doesn't mean that they are

237

00:08:23,510 --> 00:08:21,440

unobservable they may at some point

238

00:08:25,350 --> 00:08:23,520

become observable they're just not

239

00:08:27,350 --> 00:08:25,360

present in the current formulation of

240

00:08:29,350 --> 00:08:27,360

quantum mechanics

241

00:08:30,390 --> 00:08:29,360

great and bernardo what are your

242

00:08:32,149 --> 00:08:30,400

thoughts on that what do you agree with

243

00:08:34,389 --> 00:08:32,159

and what do you disagree with perhaps we

244

00:08:35,909 --> 00:08:34,399

can put this in the form of an amiable

245

00:08:37,110 --> 00:08:35,919

criticism where you start with the

246

00:08:38,389 --> 00:08:37,120

disagreements and then end on the

247

00:08:40,790 --> 00:08:38,399

agreements

248

00:08:42,949 --> 00:08:40,800

it's pretty easy to do because i i agree

249

00:08:43,750 --> 00:08:42,959

with the great many things zabina just

250

00:08:45,990 --> 00:08:43,760

said

251  
00:08:48,470 --> 00:08:46,000  
and with the values that she espouses

252  
00:08:51,509 --> 00:08:48,480  
and fights for and like her

253  
00:08:53,590 --> 00:08:51,519  
the bernardo of today not the bernardo

254  
00:08:56,550 --> 00:08:53,600  
20 years ago or 25 years ago but the

255  
00:08:59,190 --> 00:08:56,560  
barnardo of today is against

256  
00:09:01,590 --> 00:08:59,200  
metaphysical commitments in science like

257  
00:09:02,470 --> 00:09:01,600  
the platonic commitment that built his

258  
00:09:04,630 --> 00:09:02,480  
truth

259  
00:09:07,110 --> 00:09:04,640  
so true theories should be beautiful and

260  
00:09:09,990 --> 00:09:07,120  
beautiful theories should be true i got

261  
00:09:12,470 --> 00:09:10,000  
burned very early on with the super

262  
00:09:13,670 --> 00:09:12,480  
symmetry which we used to call susie i

263  
00:09:15,910 --> 00:09:13,680

don't know whether it's still called

264

00:09:17,910 --> 00:09:15,920

susie but the idea is suzy is so

265

00:09:20,630 --> 00:09:17,920

beautiful we all fell in love with susie

266

00:09:22,550 --> 00:09:20,640

so susie needed to be true it's not at

267

00:09:25,509 --> 00:09:22,560

least not in the energy ranges where we

268

00:09:26,310 --> 00:09:25,519

can look with the lhc turns out it's not

269

00:09:29,110 --> 00:09:26,320

true

270

00:09:31,269 --> 00:09:29,120

so i think it's a good value to espouse

271

00:09:34,070 --> 00:09:31,279

that science should be guided by

272

00:09:36,389 --> 00:09:34,080

hard-nosed empirical evidence

273

00:09:39,190 --> 00:09:36,399

not by metaphysical commitment

274

00:09:40,710 --> 00:09:39,200

uh by notions of truth and beauty being

275

00:09:42,389 --> 00:09:40,720

the same thing

276

00:09:44,630 --> 00:09:42,399

and not by

277

00:09:47,030 --> 00:09:44,640

fantasy entities like

278

00:09:49,590 --> 00:09:47,040

the many worlds interpretation

279

00:09:51,829 --> 00:09:49,600

or the many hyperdimensional brains and

280

00:09:53,750 --> 00:09:51,839

brain collisions of m theory and all

281

00:09:57,030 --> 00:09:53,760

kinds of fantasies that that are still

282

00:09:58,630 --> 00:09:57,040

put forward in physics so i'm i'm right

283

00:10:00,470 --> 00:09:58,640

with her

284

00:10:03,910 --> 00:10:00,480

in all this point

285

00:10:05,829 --> 00:10:03,920

um i do feel though that when it comes

286

00:10:07,030 --> 00:10:05,839

to hidden variables

287

00:10:08,630 --> 00:10:07,040

zabini

288

00:10:11,670 --> 00:10:08,640

runs the risk or maybe he's already

289

00:10:13,990 --> 00:10:11,680

doing it of of betraying those values

290

00:10:15,670 --> 00:10:14,000

because although it may be a historical

291

00:10:17,829 --> 00:10:15,680

quirk there is a good reason hidden

292

00:10:20,069 --> 00:10:17,839

variables are called hidden nobody has

293

00:10:22,790 --> 00:10:20,079

ever observed them now it's worse than

294

00:10:25,030 --> 00:10:22,800

that nobody has ever defined them they

295

00:10:26,630 --> 00:10:25,040

are not even well-formed theoretical

296

00:10:28,630 --> 00:10:26,640

fantasies

297

00:10:31,590 --> 00:10:28,640

nobody said what they are and how they

298

00:10:34,310 --> 00:10:31,600

work the only thing that he said is well

299

00:10:36,630 --> 00:10:34,320

if we want to safeguard certain

300

00:10:38,790 --> 00:10:36,640

metaphysical assumptions

301  
00:10:40,630 --> 00:10:38,800  
then there should be these variables we

302  
00:10:42,790 --> 00:10:40,640  
don't know what they are that somehow we

303  
00:10:45,030 --> 00:10:42,800  
don't know how do what they need to do

304  
00:10:47,030 --> 00:10:45,040  
so we can stick to our

305  
00:10:48,150 --> 00:10:47,040  
favorite metaphysical assumptions and in

306  
00:10:50,870 --> 00:10:48,160  
this case

307  
00:10:53,350 --> 00:10:50,880  
the assumption is not determinism i i am

308  
00:10:55,829 --> 00:10:53,360  
with sabine that i want to have a

309  
00:10:58,389 --> 00:10:55,839  
deterministic theory for single

310  
00:11:00,389 --> 00:10:58,399  
measurements not only for ensembles i

311  
00:11:01,990 --> 00:11:00,399  
want to predict the outcome of a single

312  
00:11:04,949 --> 00:11:02,000  
measurement and everything we've learned

313  
00:11:07,590 --> 00:11:04,959

in science over the past 4 500 500 years

314

00:11:10,310 --> 00:11:07,600

tells us that this should be possible

315

00:11:11,829 --> 00:11:10,320

because it has always been possible up

316

00:11:14,470 --> 00:11:11,839

until now

317

00:11:17,190 --> 00:11:14,480

but the way to do this i think

318

00:11:19,269 --> 00:11:17,200

is not to reject what 40 years of

319

00:11:21,030 --> 00:11:19,279

experiments have been telling us which

320

00:11:23,590 --> 00:11:21,040

is that a certain metaphysical

321

00:11:24,550 --> 00:11:23,600

assumption called physical realism is

322

00:11:27,350 --> 00:11:24,560

false

323

00:11:29,190 --> 00:11:27,360

physical realism is the notion that

324

00:11:31,509 --> 00:11:29,200

physical properties have standalone

325

00:11:33,829 --> 00:11:31,519

existence that they were already there

326

00:11:36,230 --> 00:11:33,839

before you measure them and that the act

327

00:11:38,230 --> 00:11:36,240

of measurement simply discloses what

328

00:11:39,269 --> 00:11:38,240

they already were immediately prior to

329

00:11:41,030 --> 00:11:39,279

measurement

330

00:11:43,269 --> 00:11:41,040

there's another technical term for this

331

00:11:44,550 --> 00:11:43,279

it's known contextuality

332

00:11:48,230 --> 00:11:44,560

now i think experiments have been

333

00:11:49,829 --> 00:11:48,240

telling us that this is not the case

334

00:11:51,509 --> 00:11:49,839

and and it's not that strange

335

00:11:52,629 --> 00:11:51,519

experiments are telling us that physical

336

00:11:54,870 --> 00:11:52,639

properties

337

00:11:56,710 --> 00:11:54,880

appear as a product of the act of

338

00:12:00,470 --> 00:11:56,720

measurement now how can we understand

339

00:12:02,710 --> 00:12:00,480

this just think of an airplane cockpit

340

00:12:05,350 --> 00:12:02,720

what is displayed on the dials is the

341

00:12:08,069 --> 00:12:05,360

result of what the sensors outside the

342

00:12:11,110 --> 00:12:08,079

airplane are measuring about the real

343

00:12:12,710 --> 00:12:11,120

world outside if you don't make those

344

00:12:15,190 --> 00:12:12,720

measurements there is nothing on the

345

00:12:17,350 --> 00:12:15,200

dashboard the dials display nothing

346

00:12:19,910 --> 00:12:17,360

nothing is there does that mean that

347

00:12:21,590 --> 00:12:19,920

there is no world of course not it only

348

00:12:23,829 --> 00:12:21,600

means that you are not measuring the

349

00:12:26,310 --> 00:12:23,839

world and therefore you see nothing i

350

00:12:28,389 --> 00:12:26,320

think what experiment is telling us is

351

00:12:30,069 --> 00:12:28,399

that the physical entities we talk about

352

00:12:31,910 --> 00:12:30,079

today the physical properties we talk

353

00:12:35,110 --> 00:12:31,920

about today the observables of quantum

354

00:12:37,030 --> 00:12:35,120

mechanics mass angular momentum charge

355

00:12:39,750 --> 00:12:37,040

all those good things they are the

356

00:12:42,310 --> 00:12:39,760

dashboard they are not the world as it

357

00:12:44,389 --> 00:12:42,320

is in and of itself they are the way a

358

00:12:47,269 --> 00:12:44,399

deeper layer of reality

359

00:12:49,670 --> 00:12:47,279

presents itself to us how it presents

360

00:12:51,430 --> 00:12:49,680

itself to us and therefore if we don't

361

00:12:53,269 --> 00:12:51,440

measure there are no physical properties

362

00:12:55,430 --> 00:12:53,279

for the same reason that the airplane

363

00:12:57,350 --> 00:12:55,440

sensors don't measure the world outside

364

00:12:59,509 --> 00:12:57,360

nothing is on the dashboard the physical

365

00:13:00,949 --> 00:12:59,519

world is the dashboard and i think

366

00:13:03,110 --> 00:13:00,959

heeding this

367

00:13:05,350 --> 00:13:03,120

and understanding what nature has been

368

00:13:07,269 --> 00:13:05,360

communicating to us after decades of

369

00:13:09,750 --> 00:13:07,279

consistent experiments

370

00:13:11,829 --> 00:13:09,760

is the way to find a deterministic

371

00:13:13,590 --> 00:13:11,839

theory for single measurements

372

00:13:15,190 --> 00:13:13,600

sabina what is your response and feel

373

00:13:16,710 --> 00:13:15,200

free to speak directly to bernardo no

374

00:13:17,670 --> 00:13:16,720

need to say bernardo or him just say

375

00:13:19,190 --> 00:13:17,680

your

376

00:13:21,269 --> 00:13:19,200

for example

377

00:13:22,870 --> 00:13:21,279

well you've been

378

00:13:24,310 --> 00:13:22,880

talking about what experiments are

379

00:13:26,389 --> 00:13:24,320

telling us but how do you know what

380

00:13:28,310 --> 00:13:26,399

experiments are telling us well you need

381

00:13:30,550 --> 00:13:28,320

some mathematics that extracts

382

00:13:31,590 --> 00:13:30,560

information from the data

383

00:13:34,470 --> 00:13:31,600

and

384

00:13:37,269 --> 00:13:34,480

in your interpretation you strongly rely

385

00:13:39,269 --> 00:13:37,279

on certain assumptions that go into

386

00:13:42,150 --> 00:13:39,279

the derivation of certain inequalities

387

00:13:44,629 --> 00:13:42,160

one of this assumption is statistical

388

00:13:46,870 --> 00:13:44,639

independence so if you don't have this

389

00:13:48,470 --> 00:13:46,880

assumption of statistical independence

390

00:13:51,189 --> 00:13:48,480

then those experiments tell you

391

00:13:53,430 --> 00:13:51,199

something entirely different um

392

00:13:55,030 --> 00:13:53,440

just to give a concrete example how you

393

00:13:57,350 --> 00:13:55,040

can look at violations of belts

394

00:13:59,110 --> 00:13:57,360

inequality and that that's also

395

00:14:00,870 --> 00:13:59,120

it goes the same way for

396

00:14:02,310 --> 00:14:00,880

all other kinds of inequalities really

397

00:14:04,870 --> 00:14:02,320

it doesn't really matter which one is

398

00:14:07,269 --> 00:14:04,880

chsh or

399

00:14:08,629 --> 00:14:07,279

legates or what have you

400

00:14:12,550 --> 00:14:08,639

they all make this assumption of

401  
00:14:18,069 --> 00:14:15,430  
concretely the conclusion which you can

402  
00:14:21,110 --> 00:14:18,079  
draw from the observed violations of

403  
00:14:22,870 --> 00:14:21,120  
those inequalities is

404  
00:14:25,990 --> 00:14:22,880  
that

405  
00:14:29,030 --> 00:14:26,000  
describes

406  
00:14:30,389 --> 00:14:29,040  
nature must violate at least one of the

407  
00:14:34,389 --> 00:14:30,399  
assumptions

408  
00:14:37,110 --> 00:14:34,399  
and normally people say well we assume

409  
00:14:38,389 --> 00:14:37,120  
that statistical independence has to be

410  
00:14:41,269 --> 00:14:38,399  
valid

411  
00:14:43,110 --> 00:14:41,279  
let's not ask right now why that is then

412  
00:14:46,310 --> 00:14:43,120  
it follows that local causality has to

413  
00:14:49,590 --> 00:14:46,320

be violated if you on the other hand say

414

00:14:51,829 --> 00:14:49,600

well we we want the theory to be local

415

00:14:55,670 --> 00:14:51,839

then it follows statistical independence

416

00:14:59,030 --> 00:14:55,680

has to be violated and in my mind that's

417

00:15:00,550 --> 00:14:59,040

the more promising way to pursue because

418

00:15:03,030 --> 00:15:00,560

as i just said

419

00:15:04,790 --> 00:15:03,040

locality is fulfilled in nitrogen's

420

00:15:06,710 --> 00:15:04,800

theory of general relativity and

421

00:15:08,150 --> 00:15:06,720

eventually those two theories have to

422

00:15:09,750 --> 00:15:08,160

communicate with each other which is

423

00:15:11,750 --> 00:15:09,760

kind of a big unsolved problem blah blah

424

00:15:14,069 --> 00:15:11,760

blah it can talk about this for an hour

425

00:15:15,509 --> 00:15:14,079

but i assume you're uh familiar with

426

00:15:17,750 --> 00:15:15,519

that

427

00:15:19,829 --> 00:15:17,760

and also maybe i should before i forget

428

00:15:22,310 --> 00:15:19,839

about this all this talk about

429

00:15:25,750 --> 00:15:22,320

physical realism and so on and so forth

430

00:15:27,910 --> 00:15:25,760

it goes past me basically because i

431

00:15:30,550 --> 00:15:27,920

would say i'm an instrumentalist you

432

00:15:32,949 --> 00:15:30,560

know i i care about what i can predict

433

00:15:35,110 --> 00:15:32,959

with my theory if you want to call

434

00:15:37,590 --> 00:15:35,120

something about this real or not real or

435

00:15:39,509 --> 00:15:37,600

whatever i i'll leave this up to

436

00:15:41,350 --> 00:15:39,519

philosophers

437

00:15:43,670 --> 00:15:41,360

maybe on a very general level i could

438

00:15:46,389 --> 00:15:43,680

say that in the hidden variables theory

439

00:15:48,550 --> 00:15:46,399

the wave function itself isn't a real

440

00:15:50,710 --> 00:15:48,560

thing it's some kind of an average value

441

00:15:51,670 --> 00:15:50,720

it isn't any more real

442

00:15:53,590 --> 00:15:51,680

than

443

00:15:55,110 --> 00:15:53,600

the average person you know that's not

444

00:15:56,949 --> 00:15:55,120

that's not a real thing that's a

445

00:15:58,790 --> 00:15:56,959

statistical thing you can define it you

446

00:16:01,030 --> 00:15:58,800

can write it down but it doesn't really

447

00:16:03,910 --> 00:16:01,040

exist in the real world

448

00:16:05,110 --> 00:16:03,920

right now hidden variables theories are

449

00:16:06,870 --> 00:16:05,120

philosophy

450

00:16:08,790 --> 00:16:06,880

you don't specify what the hidden

451

00:16:10,710 --> 00:16:08,800

variables are you don't say how they

452

00:16:13,509 --> 00:16:10,720

work you don't have an equation i look

453

00:16:15,350 --> 00:16:13,519

at your path integral the key term in

454

00:16:17,430 --> 00:16:15,360

the in your path integral or at least as

455

00:16:18,949 --> 00:16:17,440

of 2020 is

456

00:16:20,949 --> 00:16:18,959

quantumness

457

00:16:22,470 --> 00:16:20,959

which is a placeholder for something you

458

00:16:24,069 --> 00:16:22,480

want to put there at some point into the

459

00:16:27,030 --> 00:16:24,079

key term because that's what you want to

460

00:16:30,069 --> 00:16:27,040

minimize nature wants to minimize

461

00:16:32,230 --> 00:16:30,079

quantumness according to you

462

00:16:34,710 --> 00:16:32,240

this is not theory

463

00:16:37,189 --> 00:16:34,720

this this is not even the outline of a

464

00:16:39,110 --> 00:16:37,199

theory this this is a philosophy now

465

00:16:41,350 --> 00:16:39,120

regarding you you're talking about the

466

00:16:44,150 --> 00:16:41,360

wrong paper i hope

467

00:16:46,629 --> 00:16:44,160

if you excuse me um for interrupting you

468

00:16:48,550 --> 00:16:46,639

but this is indeed not a hidden

469

00:16:50,949 --> 00:16:48,560

variables theory and nothing in the

470

00:16:52,470 --> 00:16:50,959

paper claims it is you're looking at the

471

00:16:54,310 --> 00:16:52,480

wrong paper

472

00:16:57,110 --> 00:16:54,320

the paper you should be looking at is

473

00:16:58,949 --> 00:16:57,120

called a local deterministic toy model

474

00:17:00,949 --> 00:16:58,959

and it does have hidden variables we

475

00:17:03,590 --> 00:17:00,959

explain exactly what they are and how

476  
00:17:04,470 --> 00:17:03,600  
you specify what the hidden variables

477  
00:17:06,870 --> 00:17:04,480  
are

478  
00:17:08,630 --> 00:17:06,880  
precisely specified so you can control

479  
00:17:09,990 --> 00:17:08,640  
for their state when you reset the

480  
00:17:12,150 --> 00:17:10,000  
experimental conditions in your

481  
00:17:13,590 --> 00:17:12,160  
experimental proposal so you know

482  
00:17:15,750 --> 00:17:13,600  
exactly how to bring the hidden

483  
00:17:17,669 --> 00:17:15,760  
variables to the initial state

484  
00:17:19,510 --> 00:17:17,679  
that's a completely different that's a

485  
00:17:22,789 --> 00:17:19,520  
completely different question you're

486  
00:17:25,909 --> 00:17:22,799  
asking did i define the variables

487  
00:17:28,150 --> 00:17:25,919  
right i've i've defined them i can tell

488  
00:17:29,669 --> 00:17:28,160

you what the distribution is

489

00:17:32,230 --> 00:17:29,679

also i mean there's a reason the thing

490

00:17:34,310 --> 00:17:32,240

is called the toy model because we we

491

00:17:35,830 --> 00:17:34,320

made this up to prove a point namely

492

00:17:37,669 --> 00:17:35,840

that those theories are not

493

00:17:40,390 --> 00:17:37,679

conspiratorial

494

00:17:41,990 --> 00:17:40,400

um you you said there aren't any models

495

00:17:43,510 --> 00:17:42,000

you don't know what the hidden variables

496

00:17:45,430 --> 00:17:43,520

are i can tell you what they are they

497

00:17:46,870 --> 00:17:45,440

are random variables that are uniformly

498

00:17:50,390 --> 00:17:46,880

distributed

499

00:17:52,390 --> 00:17:50,400

uh in the complex disk with radius one

500

00:17:54,070 --> 00:17:52,400

so you want an answer to this question i

501  
00:17:55,909 --> 00:17:54,080  
should also add you know that what you

502  
00:17:58,870 --> 00:17:55,919  
just said about there aren't any hidden

503  
00:18:01,029 --> 00:17:58,880  
variables models um it's just wrong you

504  
00:18:02,630 --> 00:18:01,039  
know it's not that my model is the only

505  
00:18:03,990 --> 00:18:02,640  
hidden variables model that's super

506  
00:18:05,830 --> 00:18:04,000  
deterministic

507  
00:18:09,029 --> 00:18:05,840  
there are others and we have the

508  
00:18:10,630 --> 00:18:09,039  
references in the paper and um you know

509  
00:18:12,710 --> 00:18:10,640  
i i don't want to be too out to you on

510  
00:18:14,150 --> 00:18:12,720  
this because i hear this constantly you

511  
00:18:15,750 --> 00:18:14,160  
know people are always like super

512  
00:18:18,230 --> 00:18:15,760  
determinism isn't the thing and they

513  
00:18:20,549 --> 00:18:18,240

never bother to look at the literature

514

00:18:22,310 --> 00:18:20,559

um to see what models people have

515

00:18:24,549 --> 00:18:22,320

actually worked with

516

00:18:26,950 --> 00:18:24,559

so you've made many points give me a

517

00:18:28,630 --> 00:18:26,960

chance to try to address not only one of

518

00:18:30,549 --> 00:18:28,640

them but a few of them even if you don't

519

00:18:32,630 --> 00:18:30,559

like what i said about the first you've

520

00:18:35,190 --> 00:18:32,640

made many points in a row let me try to

521

00:18:37,590 --> 00:18:35,200

address a few in a row as well before we

522

00:18:40,070 --> 00:18:37,600

go back to this so let me do this in

523

00:18:42,710 --> 00:18:40,080

order statistical independence you call

524

00:18:44,789 --> 00:18:42,720

it a mere assumption i don't think it is

525

00:18:46,710 --> 00:18:44,799

a mere assumption so let's try to

526

00:18:49,830 --> 00:18:46,720

illustrate for the audience what it

527

00:18:52,710 --> 00:18:49,840

means what this technical term means

528

00:18:54,390 --> 00:18:52,720

it means that the thing you're measuring

529

00:18:56,950 --> 00:18:54,400

does not change

530

00:18:59,750 --> 00:18:56,960

just because you set up your measurement

531

00:19:01,669 --> 00:18:59,760

apparatus in a certain way or another

532

00:19:03,029 --> 00:19:01,679

for instance if you are photographing

533

00:19:05,750 --> 00:19:03,039

the moon

534

00:19:07,750 --> 00:19:05,760

statistical independence says that the

535

00:19:09,590 --> 00:19:07,760

moon will not change will not do

536

00:19:10,549 --> 00:19:09,600

something else will not be something

537

00:19:12,630 --> 00:19:10,559

else

538

00:19:15,430 --> 00:19:12,640

because you set your aperture or

539

00:19:17,590 --> 00:19:15,440

exposure to certain values the moon is

540

00:19:19,909 --> 00:19:17,600

what it is it doesn't depend on the

541

00:19:21,430 --> 00:19:19,919

settings of the instrument you use to

542

00:19:23,190 --> 00:19:21,440

make a measurement of the moon or to

543

00:19:25,029 --> 00:19:23,200

take a picture of the moon

544

00:19:27,750 --> 00:19:25,039

this is what statistical independence

545

00:19:31,110 --> 00:19:27,760

means is it an assumption i don't think

546

00:19:33,669 --> 00:19:31,120

it is i think the entire history of all

547

00:19:34,950 --> 00:19:33,679

of science tells us that this is how

548

00:19:37,110 --> 00:19:34,960

things work

549

00:19:39,909 --> 00:19:37,120

reality does not change

550

00:19:41,669 --> 00:19:39,919

based purely on the settings of what we

551

00:19:43,350 --> 00:19:41,679

use to measure it what we use to

552

00:19:45,350 --> 00:19:43,360

photograph the moon the moon doesn't

553

00:19:47,990 --> 00:19:45,360

change because i changed the aperture on

554

00:19:49,990 --> 00:19:48,000

my camera now you say that we cannot

555

00:19:51,350 --> 00:19:50,000

carry what you call an assumption i

556

00:19:54,390 --> 00:19:51,360

don't think it's an assumption i think

557

00:19:56,549 --> 00:19:54,400

it's a very very solid observation very

558

00:19:58,549 --> 00:19:56,559

self-evident observation about nature in

559

00:20:00,549 --> 00:19:58,559

all aspects of science but okay i will

560

00:20:02,950 --> 00:20:00,559

continue to call it as call it an

561

00:20:05,270 --> 00:20:02,960

assumption you say we cannot carry that

562

00:20:07,590 --> 00:20:05,280

assumption from the classical world to

563

00:20:10,710 --> 00:20:07,600

the quantum world that carrying this

564

00:20:12,710 --> 00:20:10,720

thing over is arbitrary but you are

565

00:20:15,110 --> 00:20:12,720

carrying something over from the classic

566

00:20:17,029 --> 00:20:15,120

world to the quantum world you're trying

567

00:20:18,549 --> 00:20:17,039

to carry and you don't like the isms so

568

00:20:20,390 --> 00:20:18,559

i'm not going to call it physical

569

00:20:21,590 --> 00:20:20,400

realism i'm going to specify exactly

570

00:20:24,390 --> 00:20:21,600

what it is

571

00:20:26,710 --> 00:20:24,400

you don't want to carry the notion that

572

00:20:29,430 --> 00:20:26,720

objects have standalone sorry you do

573

00:20:31,830 --> 00:20:29,440

want to carry the notion that objects

574

00:20:33,990 --> 00:20:31,840

have a standalone existence that they

575

00:20:35,990 --> 00:20:34,000

are what they are irrespective of what

576

00:20:37,750 --> 00:20:36,000

they are whether they are being measured

577

00:20:40,310 --> 00:20:37,760

you want to carry that over from the

578

00:20:42,549 --> 00:20:40,320

classical world to the physical world so

579

00:20:44,789 --> 00:20:42,559

i don't think you can have the cake and

580

00:20:46,470 --> 00:20:44,799

eat it too either you don't carry

581

00:20:48,789 --> 00:20:46,480

assumptions from the classical to the

582

00:20:51,110 --> 00:20:48,799

quantum or you do carry them and then

583

00:20:53,669 --> 00:20:51,120

you ought to carry a

584

00:20:57,029 --> 00:20:53,679

statistical independence because it's

585

00:21:00,070 --> 00:20:57,039

one of nature's most self-evident givens

586

00:21:02,549 --> 00:21:00,080

now hidden variables themselves unless

587

00:21:04,870 --> 00:21:02,559

there is something very new that you're

588

00:21:06,870 --> 00:21:04,880

springing on me right now

589

00:21:10,310 --> 00:21:06,880

they are not defined the experiment you

590

00:21:12,630 --> 00:21:10,320

have put forward is based exactly on the

591

00:21:14,630 --> 00:21:12,640

fact that you cannot reset the

592

00:21:16,310 --> 00:21:14,640

experimental conditions to what they

593

00:21:17,909 --> 00:21:16,320

were in the very beginning when you do a

594

00:21:20,070 --> 00:21:17,919

new series of measurements on the

595

00:21:22,470 --> 00:21:20,080

quantum system that's why you talk about

596

00:21:24,310 --> 00:21:22,480

having to cool everything down have to

597

00:21:26,870 --> 00:21:24,320

reduce it having to reduce the degrees

598

00:21:28,789 --> 00:21:26,880

of freedom of the measurement apparatus

599

00:21:31,029 --> 00:21:28,799

having to do the series of measurements

600

00:21:33,029 --> 00:21:31,039

very quickly in succession because

601  
00:21:35,909 --> 00:21:33,039  
you're afraid that whatever state the

602  
00:21:38,149 --> 00:21:35,919  
hidden variables are in they may drift

603  
00:21:40,470 --> 00:21:38,159  
all that is based on the notion that you

604  
00:21:42,870 --> 00:21:40,480  
don't know what the hidden variables are

605  
00:21:44,870 --> 00:21:42,880  
and we don't need the hidden variables

606  
00:21:46,390 --> 00:21:44,880  
for anything else in nature look let's

607  
00:21:48,549 --> 00:21:46,400  
let's take the other variables the

608  
00:21:50,950 --> 00:21:48,559  
unhidden ones the ones we know basic

609  
00:21:54,070 --> 00:21:50,960  
properties of physical entities let's

610  
00:21:57,029 --> 00:21:54,080  
take mass charge and angular momentum

611  
00:21:59,510 --> 00:21:57,039  
if we remove them from the picture

612  
00:22:01,430 --> 00:21:59,520  
we cannot account for any of the causal

613  
00:22:03,830 --> 00:22:01,440

chains in nature not only in a quantum

614

00:22:06,070 --> 00:22:03,840

experiment anywhere you take mass away

615

00:22:07,830 --> 00:22:06,080

you cannot account for inertia you take

616

00:22:10,149 --> 00:22:07,840

angular momentum away you cannot account

617

00:22:12,230 --> 00:22:10,159

for magnetism you take charge away you

618

00:22:14,470 --> 00:22:12,240

cannot account for electricity but you

619

00:22:17,990 --> 00:22:14,480

take the even hidden variables away

620

00:22:19,590 --> 00:22:18,000

nothing changes we are still fine so i

621

00:22:21,990 --> 00:22:19,600

think they are pure theoretical

622

00:22:25,029 --> 00:22:22,000

fantasies unless and until you can see

623

00:22:26,470 --> 00:22:25,039

exactly what they are how they work how

624

00:22:28,870 --> 00:22:26,480

they can be measured

625

00:22:31,029 --> 00:22:28,880

and how they can be falsified because

626

00:22:33,750 --> 00:22:31,039

the experiment you have proposed

627

00:22:35,990 --> 00:22:33,760

by construction cannot falsify the

628

00:22:38,390 --> 00:22:36,000

hidden variables hypothesis and i can

629

00:22:41,190 --> 00:22:38,400

elaborate on this at length to explain

630

00:22:42,870 --> 00:22:41,200

why i'm saying this but it okay i'll

631

00:22:44,470 --> 00:22:42,880

stop i spoke enough yeah we'll let

632

00:22:47,270 --> 00:22:44,480

sabina respond

633

00:22:49,110 --> 00:22:47,280

well i noticed in your

634

00:22:51,190 --> 00:22:49,120

blog post or whatever you want to call

635

00:22:53,830 --> 00:22:51,200

it that you were trying to criticize the

636

00:22:55,430 --> 00:22:53,840

experiment that i proposed um

637

00:22:57,350 --> 00:22:55,440

unfortunately you don't seem to have

638

00:22:59,270 --> 00:22:57,360

actually look at the original paper

639

00:23:01,990 --> 00:22:59,280

where proposed the experiment you quoted

640

00:23:04,549 --> 00:23:02,000

the paper from 2019 which refers to a

641

00:23:06,950 --> 00:23:04,559

paper from 2011

642

00:23:09,190 --> 00:23:06,960

i believe in which i have

643

00:23:11,029 --> 00:23:09,200

explained exactly how you can circumvent

644

00:23:12,549 --> 00:23:11,039

this problem that you don't know how the

645

00:23:13,590 --> 00:23:12,559

hidden variables

646

00:23:15,990 --> 00:23:13,600

um

647

00:23:19,029 --> 00:23:16,000

the state of the hidden variables for in

648

00:23:21,270 --> 00:23:19,039

in the prepared state you make repeated

649

00:23:24,549 --> 00:23:21,280

measurement on the same system

650

00:23:25,270 --> 00:23:24,559

and then i made some estimate for um you

651  
00:23:26,870 --> 00:23:25,280  
know

652  
00:23:29,190 --> 00:23:26,880  
what the size of the systems would have

653  
00:23:31,990 --> 00:23:29,200  
to be how code it um should have to be

654  
00:23:33,909 --> 00:23:32,000  
and so on now you're complaining that

655  
00:23:35,909 --> 00:23:33,919  
you can't falsify it but of course if no

656  
00:23:38,230 --> 00:23:35,919  
one makes the experiment to falsify it

657  
00:23:40,549 --> 00:23:38,240  
and we're not going to falsify it no no

658  
00:23:41,990 --> 00:23:40,559  
my my point is the experiment cannot

659  
00:23:43,909 --> 00:23:42,000  
falsify it

660  
00:23:46,310 --> 00:23:43,919  
so sabine can you respond to this

661  
00:23:49,350 --> 00:23:46,320  
unfalsifiable claim of the model

662  
00:23:50,470 --> 00:23:49,360  
yeah i mean you you propose a model um

663  
00:23:52,230 --> 00:23:50,480

and then

664

00:23:54,149 --> 00:23:52,240

you make a prediction and if the

665

00:23:56,950 --> 00:23:54,159

prediction isn't correct

666

00:24:00,470 --> 00:23:56,960

then you falsified the model

667

00:24:02,390 --> 00:24:00,480

that's not how it will work of course

668

00:24:04,470 --> 00:24:02,400

that's not how it will work yeah well

669

00:24:06,630 --> 00:24:04,480

that's quite possibly the case

670

00:24:08,950 --> 00:24:06,640

i can explain how and why

671

00:24:09,909 --> 00:24:08,960

you know if this is a general criticism

672

00:24:12,070 --> 00:24:09,919

about

673

00:24:13,990 --> 00:24:12,080

falsification we can have this argument

674

00:24:15,990 --> 00:24:14,000

you know we can argue that no theory has

675

00:24:17,750 --> 00:24:16,000

ever actually been falsified if that's

676

00:24:19,990 --> 00:24:17,760

what you want to say i would actually

677

00:24:21,590 --> 00:24:20,000

agree with this you know the ether has

678

00:24:23,669 --> 00:24:21,600

never really been falsified blah blah

679

00:24:25,350 --> 00:24:23,679

blah blah as i've said a few times we

680

00:24:27,830 --> 00:24:25,360

don't really falsify theories we

681

00:24:29,510 --> 00:24:27,840

implausify them until people give uh

682

00:24:32,789 --> 00:24:29,520

give up on them but i think that's kind

683

00:24:34,950 --> 00:24:32,799

of a really um tangential point

684

00:24:36,950 --> 00:24:34,960

so can i elaborate on why i

685

00:24:38,390 --> 00:24:36,960

made that claim so let me

686

00:24:40,710 --> 00:24:38,400

first we have to explain the experiment

687

00:24:42,950 --> 00:24:40,720

a little bit so so people can follow the

688

00:24:44,789 --> 00:24:42,960

experiment is the following

689

00:24:47,269 --> 00:24:44,799

since we do not know what the hidden

690

00:24:50,070 --> 00:24:47,279

variables are

691

00:24:51,909 --> 00:24:50,080

we have to adopt certain procedures to

692

00:24:54,070 --> 00:24:51,919

minimize the chance that whatever they

693

00:24:56,149 --> 00:24:54,080

are their values can drift because the

694

00:24:58,390 --> 00:24:56,159

experiment is based on the following

695

00:25:00,470 --> 00:24:58,400

if you have a quantum system

696

00:25:01,909 --> 00:25:00,480

and you make a series of measurements on

697

00:25:03,510 --> 00:25:01,919

that system

698

00:25:05,430 --> 00:25:03,520

according to the bond rule of quantum

699

00:25:07,430 --> 00:25:05,440

mechanics you have a certain statistical

700

00:25:09,350 --> 00:25:07,440

distribution of measurements that is not

701  
00:25:11,990 --> 00:25:09,360  
deterministic

702  
00:25:14,549 --> 00:25:12,000  
if super determinism is right if there

703  
00:25:16,630 --> 00:25:14,559  
are these mysterious hidden variables

704  
00:25:18,630 --> 00:25:16,640  
then the series of measurements will be

705  
00:25:19,990 --> 00:25:18,640  
determined by the system's initial

706  
00:25:21,350 --> 00:25:20,000  
condition

707  
00:25:22,789 --> 00:25:21,360  
so the experiment is based on the

708  
00:25:24,230 --> 00:25:22,799  
following idea

709  
00:25:26,470 --> 00:25:24,240  
even if i don't know what the hidden

710  
00:25:28,149 --> 00:25:26,480  
variables are and i cannot know how to

711  
00:25:29,430 --> 00:25:28,159  
restore the initial conditions of the

712  
00:25:30,789 --> 00:25:29,440  
system because of course we need to

713  
00:25:32,390 --> 00:25:30,799

restore the initial condition of the

714

00:25:34,789 --> 00:25:32,400

hidden variables too

715

00:25:37,350 --> 00:25:34,799

even without knowing what they are

716

00:25:39,430 --> 00:25:37,360

if i cool down the system and i make a

717

00:25:41,750 --> 00:25:39,440

fast series of measurements

718

00:25:43,669 --> 00:25:41,760

stop and immediately do a next series of

719

00:25:45,510 --> 00:25:43,679

measurements after returning the initial

720

00:25:46,789 --> 00:25:45,520

conditions as best as i can

721

00:25:48,870 --> 00:25:46,799

and then do the same thing and do

722

00:25:51,110 --> 00:25:48,880

another series of measurements

723

00:25:53,029 --> 00:25:51,120

if super determinism is right the series

724

00:25:54,630 --> 00:25:53,039

of measurements will all be determined

725

00:25:56,310 --> 00:25:54,640

by more or less the same initial

726

00:25:58,390 --> 00:25:56,320

conditions if i do them in rapid

727

00:26:01,110 --> 00:25:58,400

succession before the hidden variables

728

00:26:02,070 --> 00:26:01,120

have a chance to drift in volume and i

729

00:26:04,390 --> 00:26:02,080

will find

730

00:26:06,230 --> 00:26:04,400

time correlations between the series

731

00:26:08,470 --> 00:26:06,240

which would then if that's the case

732

00:26:09,350 --> 00:26:08,480

contradict the bond rule

733

00:26:11,350 --> 00:26:09,360

now

734

00:26:13,029 --> 00:26:11,360

because the whole thing is based on

735

00:26:15,590 --> 00:26:13,039

having to do these series of

736

00:26:17,750 --> 00:26:15,600

measurements in rapid succession but

737

00:26:19,269 --> 00:26:17,760

having enough measurements to find if

738

00:26:21,190 --> 00:26:19,279

there is a correlation between the

739

00:26:22,470 --> 00:26:21,200

series you end up in the following

740

00:26:24,789 --> 00:26:22,480

situation

741

00:26:26,710 --> 00:26:24,799

if and when the experiment fails and

742

00:26:28,789 --> 00:26:26,720

validates born rule

743

00:26:30,870 --> 00:26:28,799

one can always say well

744

00:26:32,870 --> 00:26:30,880

i didn't make enough measurements per

745

00:26:35,350 --> 00:26:32,880

series so i don't know that they

746

00:26:37,750 --> 00:26:35,360

correlate so it's inconclusive

747

00:26:39,029 --> 00:26:37,760

well then you make more measurements per

748

00:26:42,470 --> 00:26:39,039

series

749

00:26:44,070 --> 00:26:42,480

takes longer to make so it will take

750

00:26:45,909 --> 00:26:44,080

longer for you to start the next series

751  
00:26:48,789 --> 00:26:45,919  
and then one can say well it's just

752  
00:26:51,190 --> 00:26:48,799  
because the initial state has drifted

753  
00:26:53,669 --> 00:26:51,200  
i took too long to do the next series so

754  
00:26:55,350 --> 00:26:53,679  
whatever happens one will always be able

755  
00:26:58,070 --> 00:26:55,360  
to claim that the experiment is

756  
00:27:00,789 --> 00:26:58,080  
inconclusive and doesn't falsify the

757  
00:27:02,710 --> 00:27:00,799  
hidden variables why because it's so

758  
00:27:05,190 --> 00:27:02,720  
loosely defined we are not saying what

759  
00:27:06,870 --> 00:27:05,200  
the hidden variables are are and how

760  
00:27:08,549 --> 00:27:06,880  
they work we are not seeing anything we

761  
00:27:11,110 --> 00:27:08,559  
are just hoping that there is something

762  
00:27:11,990 --> 00:27:11,120  
that somehow does what it needs to do

763  
00:27:14,470 --> 00:27:12,000

for

764

00:27:16,070 --> 00:27:14,480

this picture of nature this metaphysical

765

00:27:17,590 --> 00:27:16,080

commitment the fit that physical

766

00:27:20,789 --> 00:27:17,600

properties should have standalone

767

00:27:23,190 --> 00:27:20,799

existence to survive

768

00:27:24,789 --> 00:27:23,200

well two things first as i already said

769

00:27:25,990 --> 00:27:24,799

earlier you're talking about the wrong

770

00:27:28,710 --> 00:27:26,000

experiment

771

00:27:31,190 --> 00:27:28,720

talk about

772

00:27:33,590 --> 00:27:31,200

no you were talking about a change in

773

00:27:36,070 --> 00:27:33,600

the initial conditions i told you that

774

00:27:37,750 --> 00:27:36,080

the experiment you should be doing is

775

00:27:40,630 --> 00:27:37,760

repeated measurement of non-commuting

776

00:27:43,990 --> 00:27:40,640

variables on the same state

777

00:27:46,630 --> 00:27:44,000

that alone is sufficient in the 2019

778

00:27:48,549 --> 00:27:46,640

paper i was talking about a simplified

779

00:27:49,830 --> 00:27:48,559

experiment i mentioned this in the test

780

00:27:51,909 --> 00:27:49,840

text

781

00:27:54,230 --> 00:27:51,919

and i can explain why

782

00:27:56,070 --> 00:27:54,240

i have reason to think that this is

783

00:27:57,269 --> 00:27:56,080

probably enough

784

00:27:59,190 --> 00:27:57,279

but i'm not sure you're actually

785

00:28:03,669 --> 00:27:59,200

interested in hearing that

786

00:28:06,789 --> 00:28:03,679

okay but oh i am okay good i'll tell you

787

00:28:09,269 --> 00:28:06,799

but so let me make a more general point

788

00:28:10,789 --> 00:28:09,279

which is that you can't

789

00:28:12,870 --> 00:28:10,799

falsify

790

00:28:15,350 --> 00:28:12,880

super determinism i totally agree with

791

00:28:18,070 --> 00:28:15,360

that because super determinism is not a

792

00:28:19,669 --> 00:28:18,080

theory it's a property of a class of

793

00:28:22,789 --> 00:28:19,679

theories

794

00:28:24,630 --> 00:28:22,799

what you can falsify are specific models

795

00:28:27,029 --> 00:28:24,640

and yes you are entirely right those

796

00:28:29,350 --> 00:28:27,039

models would have to specify what the

797

00:28:31,590 --> 00:28:29,360

hidden variables are or at least what

798

00:28:33,190 --> 00:28:31,600

their properties are if you don't say

799

00:28:35,669 --> 00:28:33,200

anything about it you can't make any

800

00:28:37,909 --> 00:28:35,679

predictions

801

00:28:40,070 --> 00:28:37,919

so what are the hidden variables

802

00:28:41,830 --> 00:28:40,080

well that depends on your model you know

803

00:28:43,909 --> 00:28:41,840

that different models that people have

804

00:28:47,830 --> 00:28:43,919

put forward i would say that at the

805

00:28:49,990 --> 00:28:47,840

moment they're all unsatisfactory

806

00:28:51,669 --> 00:28:50,000

so according to your model to your model

807

00:28:52,950 --> 00:28:51,679

what are the hidden variables in your

808

00:28:57,029 --> 00:28:52,960

model

809

00:28:58,789 --> 00:28:57,039

complained about with the path integral

810

00:29:00,470 --> 00:28:58,799

we explained this in the paper the

811

00:29:03,190 --> 00:29:00,480

hidden verb

812

00:29:05,350 --> 00:29:03,200

the hidden variables are the degrees of

813

00:29:07,590 --> 00:29:05,360

freedom of the detector which are not

814

00:29:09,590 --> 00:29:07,600

the measurement setting okay and now i

815

00:29:12,549 --> 00:29:09,600

can explain to you

816

00:29:13,990 --> 00:29:12,559

why i think that makes sense because

817

00:29:16,549 --> 00:29:14,000

i have a background as a particle

818

00:29:18,789 --> 00:29:16,559

physicist okay so i i don't like the

819

00:29:21,510 --> 00:29:18,799

idea of introducing new degrees of

820

00:29:23,269 --> 00:29:21,520

freedom and throw them over the already

821

00:29:24,389 --> 00:29:23,279

existing elementary particles in the

822

00:29:26,149 --> 00:29:24,399

standard model

823

00:29:27,269 --> 00:29:26,159

you know this whole problem you know i

824

00:29:29,750 --> 00:29:27,279

get the impression you have some

825

00:29:31,269 --> 00:29:29,760

background in particular so this is not

826  
00:29:32,389 --> 00:29:31,279  
a good idea

827  
00:29:34,870 --> 00:29:32,399  
however

828  
00:29:37,990 --> 00:29:34,880  
we know just empirically

829  
00:29:39,110 --> 00:29:38,000  
that the measurement setting

830  
00:29:41,510 --> 00:29:39,120  
affects

831  
00:29:43,590 --> 00:29:41,520  
the average value of the distribution

832  
00:29:46,389 --> 00:29:43,600  
that's bounce rule okay so that's the

833  
00:29:51,269 --> 00:29:48,549  
you mean like

834  
00:29:52,789 --> 00:29:51,279  
like the angular momentum you set

835  
00:29:53,909 --> 00:29:52,799  
to affect the distribution because

836  
00:29:57,590 --> 00:29:53,919  
everything will fall along the

837  
00:29:59,350 --> 00:29:57,600  
eigenvalues of of the detector

838  
00:30:00,549 --> 00:29:59,360

basically yeah i mean i mean something

839

00:30:02,470 --> 00:30:00,559

much more

840

00:30:04,470 --> 00:30:02,480

simple if you want to calculate the

841

00:30:05,990 --> 00:30:04,480

probability of a measurement outcome you

842

00:30:07,909 --> 00:30:06,000

have to say what is the thing that you

843

00:30:10,070 --> 00:30:07,919

measure right otherwise how are you

844

00:30:12,149 --> 00:30:10,080

going to project it on the eigenstates

845

00:30:13,750 --> 00:30:12,159

okay so so that's that but this brings

846

00:30:15,830 --> 00:30:13,760

up the question like what's with all the

847

00:30:17,510 --> 00:30:15,840

other details of the detector what

848

00:30:20,149 --> 00:30:17,520

happened with them like a detector is

849

00:30:23,190 --> 00:30:20,159

not just a measurement eyeing state it's

850

00:30:25,110 --> 00:30:23,200

a complicated big thing that has many

851

00:30:27,269 --> 00:30:25,120

uh degrees of freedom

852

00:30:28,789 --> 00:30:27,279

so um the model that i'm trying to

853

00:30:30,310 --> 00:30:28,799

develop which is the thing that you're

854

00:30:31,909 --> 00:30:30,320

complaining about with the quantum nurse

855

00:30:33,830 --> 00:30:31,919

and that's that's the

856

00:30:35,750 --> 00:30:33,840

you know that that's the

857

00:30:37,990 --> 00:30:35,760

discussion in the paper where i say this

858

00:30:40,710 --> 00:30:38,000

is the part which i haven't figured out

859

00:30:42,950 --> 00:30:40,720

is exactly how those degrees of freedom

860

00:30:44,950 --> 00:30:42,960

enter the evolutionary

861

00:30:47,029 --> 00:30:44,960

but this is the idea so the degrees of

862

00:30:48,630 --> 00:30:47,039

freedom of the detector

863

00:30:51,990 --> 00:30:48,640

except for the for the measurement

864

00:30:55,430 --> 00:30:52,000

setting itself are the hidden variables

865

00:30:56,870 --> 00:30:55,440

and now once you buy this and i i i

866

00:30:58,950 --> 00:30:56,880

agree with you that i don't actually

867

00:30:59,750 --> 00:30:58,960

know exactly what the evolution or looks

868

00:31:02,389 --> 00:30:59,760

like

869

00:31:04,470 --> 00:31:02,399

you can very precisely estimate how long

870

00:31:07,669 --> 00:31:04,480

it will take i mean maybe not as

871

00:31:09,110 --> 00:31:07,679

precisely as i'm hoping but in principle

872

00:31:11,110 --> 00:31:09,120

you can estimate how long it would take

873

00:31:13,750 --> 00:31:11,120

for them to change

874

00:31:16,230 --> 00:31:13,760

and that's why i think the the simpler

875

00:31:18,630 --> 00:31:16,240

estimated in 2090 papers probably

876

00:31:21,430 --> 00:31:18,640

sufficient

877

00:31:23,990 --> 00:31:21,440

okay i i i will work with you i'm not

878

00:31:24,710 --> 00:31:24,000

i'm really not closed-minded about this

879

00:31:26,710 --> 00:31:24,720

but

880

00:31:27,990 --> 00:31:26,720

there are things about this that

881

00:31:30,230 --> 00:31:28,000

normally would

882

00:31:32,870 --> 00:31:30,240

trigger your worst part

883

00:31:34,549 --> 00:31:32,880

and in this case it doesn't and and it

884

00:31:36,470 --> 00:31:34,559

still triggers mine

885

00:31:39,269 --> 00:31:36,480

um

886

00:31:41,909 --> 00:31:39,279

however complex the experiment or the

887

00:31:43,750 --> 00:31:41,919

the measurement apparatus is

888

00:31:45,110 --> 00:31:43,760

if we are talking about the local hidden

889

00:31:47,350 --> 00:31:45,120

variables

890

00:31:51,269 --> 00:31:47,360

what matters is

891

00:31:53,990 --> 00:31:51,279

what the thing measured interacts with

892

00:31:57,190 --> 00:31:54,000

the thing measured say you're looking at

893

00:31:59,430 --> 00:31:57,200

spin of an elementary particle

894

00:32:00,710 --> 00:31:59,440

the thing measure measured this timing

895

00:32:02,470 --> 00:32:00,720

so it has

896

00:32:04,549 --> 00:32:02,480

an interaction with a

897

00:32:06,549 --> 00:32:04,559

tiny measurement surface

898

00:32:08,870 --> 00:32:06,559

of the same order of magnitude as an

899

00:32:11,029 --> 00:32:08,880

elementary particle

900

00:32:13,750 --> 00:32:11,039

everything else in the apparatus is

901  
00:32:16,070 --> 00:32:13,760  
about amplifying what's measured say

902  
00:32:18,070 --> 00:32:16,080  
photo multipliers

903  
00:32:19,269 --> 00:32:18,080  
sending that signal and then displaying

904  
00:32:22,149 --> 00:32:19,279  
a way that is

905  
00:32:24,470 --> 00:32:22,159  
cognitively amenable to a human being

906  
00:32:25,990 --> 00:32:24,480  
but the measurement surface itself is

907  
00:32:27,750 --> 00:32:26,000  
tiny so

908  
00:32:29,750 --> 00:32:27,760  
whatever is going on in the other

909  
00:32:31,830 --> 00:32:29,760  
degrees of freedom of the measurement

910  
00:32:34,950 --> 00:32:31,840  
apparatus

911  
00:32:37,029 --> 00:32:34,960  
shouldn't have a local causal effect on

912  
00:32:39,430 --> 00:32:37,039  
what happens on on the point of

913  
00:32:41,990 --> 00:32:39,440

interaction right

914

00:32:44,789 --> 00:32:42,000

so i think we may just disagree on what

915

00:32:46,710 --> 00:32:44,799

we mean by uh detection or measurement

916

00:32:48,789 --> 00:32:46,720

process um i would say that the

917

00:32:51,110 --> 00:32:48,799

amplification actually is the

918

00:32:54,710 --> 00:32:51,120

measurement like that's what what we

919

00:32:56,070 --> 00:32:54,720

need to convert a teeny tiny thing like

920

00:32:57,830 --> 00:32:56,080

single photon going through a beam

921

00:33:00,230 --> 00:32:57,840

splitter into something that we can

922

00:33:03,110 --> 00:33:00,240

actually read out and normally this

923

00:33:05,350 --> 00:33:03,120

process is described by decoherence

924

00:33:07,909 --> 00:33:05,360

and that's also an interaction with with

925

00:33:10,549 --> 00:33:07,919

many particles now i actually do think

926  
00:33:14,310 --> 00:33:10,559  
that this process of the coherence that

927  
00:33:14,320 --> 00:33:18,310  
gone on about

928  
00:33:21,909 --> 00:33:19,430  
captures

929  
00:33:24,710 --> 00:33:21,919  
some part of the truth you know it tells

930  
00:33:26,389 --> 00:33:24,720  
you how the environment selects the

931  
00:33:29,350 --> 00:33:26,399  
pointer bases

932  
00:33:32,149 --> 00:33:29,360  
but it doesn't tell you how the outcome

933  
00:33:34,470 --> 00:33:32,159  
of a measurement

934  
00:33:36,389 --> 00:33:34,480  
is always a detector eigenstate in the

935  
00:33:38,070 --> 00:33:36,399  
normal declarance paradigm you always

936  
00:33:40,389 --> 00:33:38,080  
end up with a mixed state i mean

937  
00:33:42,870 --> 00:33:40,399  
generically unless the state happened to

938  
00:33:46,070 --> 00:33:42,880

be a detective state already and so what

939

00:33:47,830 --> 00:33:46,080

what um super determinism does for you

940

00:33:50,310 --> 00:33:47,840

what the violation of statistical

941

00:33:52,389 --> 00:33:50,320

independence allows you to do is it

942

00:33:55,430 --> 00:33:52,399

allows you to write down

943

00:33:57,990 --> 00:33:55,440

a local evolution law that will bring

944

00:34:00,549 --> 00:33:58,000

the initial state into a detector

945

00:34:03,830 --> 00:34:00,559

eigenstate

946

00:34:06,149 --> 00:34:03,840

i agree with what you often say that

947

00:34:08,389 --> 00:34:06,159

this notion that super determinism

948

00:34:09,909 --> 00:34:08,399

validates the whole of science

949

00:34:12,310 --> 00:34:09,919

that's nonsensical

950

00:34:14,710 --> 00:34:12,320

i agree with you there

951  
00:34:16,470 --> 00:34:14,720  
but what you just said that the

952  
00:34:19,190 --> 00:34:16,480  
amplification

953  
00:34:22,710 --> 00:34:19,200  
of the original measured signal

954  
00:34:25,270 --> 00:34:22,720  
can determine the measure outcome

955  
00:34:26,710 --> 00:34:25,280  
now that sounds spooky to me

956  
00:34:28,950 --> 00:34:26,720  
because you're saying is that okay there

957  
00:34:30,790 --> 00:34:28,960  
is there is an interaction between the

958  
00:34:33,190 --> 00:34:30,800  
system measured and a measurement

959  
00:34:35,030 --> 00:34:33,200  
surface which is tiny everything else is

960  
00:34:37,430 --> 00:34:35,040  
just simplification and

961  
00:34:39,109 --> 00:34:37,440  
transmission and displaying

962  
00:34:40,950 --> 00:34:39,119  
the result of that measurement outcome

963  
00:34:43,270 --> 00:34:40,960

but you say something

964

00:34:45,270 --> 00:34:43,280

causally efficacious happens in that

965

00:34:47,190 --> 00:34:45,280

chain of amplification

966

00:34:49,589 --> 00:34:47,200

that actually

967

00:34:51,589 --> 00:34:49,599

determines the outcome of measurement

968

00:34:54,230 --> 00:34:51,599

not the interaction on the measurement

969

00:34:56,389 --> 00:34:54,240

surface but the amplification of that

970

00:34:58,790 --> 00:34:56,399

it's like the photo multipliers to give

971

00:35:00,630 --> 00:34:58,800

me a different energy reading from my

972

00:35:02,310 --> 00:35:00,640

tile calorimeter

973

00:35:04,150 --> 00:35:02,320

now if if that's the case then i have to

974

00:35:05,910 --> 00:35:04,160

throw away all my experiments because

975

00:35:07,670 --> 00:35:05,920

what i'm seeing is not the result of

976  
00:35:12,230 --> 00:35:07,680  
measurement it's something the detector

977  
00:35:16,630 --> 00:35:14,630  
how do you reconcile this now

978  
00:35:18,630 --> 00:35:16,640  
we have to assume that amplification

979  
00:35:20,790 --> 00:35:18,640  
does not distort the result of

980  
00:35:23,750 --> 00:35:20,800  
measurement so if you measured angular

981  
00:35:26,310 --> 00:35:23,760  
momentum plus one in a certain direction

982  
00:35:29,109 --> 00:35:26,320  
then then that is the reality of what's

983  
00:35:30,950 --> 00:35:29,119  
measured and not something engendered

984  
00:35:32,870 --> 00:35:30,960  
by the photo multipliers or whatever

985  
00:35:35,670 --> 00:35:32,880  
whatever amplification system you used

986  
00:35:37,109 --> 00:35:35,680  
in your detector

987  
00:35:39,910 --> 00:35:37,119  
yeah i'm not sure i understand the

988  
00:35:42,150 --> 00:35:39,920

question like so i mean you measure some

989

00:35:43,990 --> 00:35:42,160

variable you measure the spin you get a

990

00:35:46,550 --> 00:35:44,000

probability distribution at the same as

991

00:35:48,630 --> 00:35:46,560

in quantum mechanics

992

00:35:50,790 --> 00:35:48,640

okay so what those other degrees of

993

00:35:51,990 --> 00:35:50,800

freedom of the detector do for you is

994

00:35:54,470 --> 00:35:52,000

that they

995

00:35:56,790 --> 00:35:54,480

um decide

996

00:35:59,510 --> 00:35:56,800

which the outcome is

997

00:36:00,710 --> 00:35:59,520

so it doesn't they don't change the mean

998

00:36:03,349 --> 00:36:00,720

value

999

00:36:05,349 --> 00:36:03,359

the average bonds rule that's

1000

00:36:07,430 --> 00:36:05,359

what you need the detector either states

1001  
00:36:09,589 --> 00:36:07,440  
for

1002  
00:36:12,710 --> 00:36:09,599  
they just they're the random variables

1003  
00:36:14,550 --> 00:36:12,720  
that decide what what is the actual

1004  
00:36:17,190 --> 00:36:14,560  
outcome

1005  
00:36:19,430 --> 00:36:17,200  
then i go back to my original point

1006  
00:36:20,870 --> 00:36:19,440  
how can all this complexity of the

1007  
00:36:22,230 --> 00:36:20,880  
detector

1008  
00:36:24,069 --> 00:36:22,240  
influence the measurement the

1009  
00:36:27,589 --> 00:36:24,079  
measurement outcome if the actual

1010  
00:36:29,750 --> 00:36:27,599  
measurement happens on a surface area of

1011  
00:36:31,510 --> 00:36:29,760  
the same order of magnitude as the

1012  
00:36:33,829 --> 00:36:31,520  
elementary subatomic particle that is

1013  
00:36:35,670 --> 00:36:33,839

being measured

1014

00:36:37,670 --> 00:36:35,680

well it just doesn't as i said i i don't

1015

00:36:39,190 --> 00:36:37,680

know what so you think that an

1016

00:36:40,790 --> 00:36:39,200

interaction with a single particle is

1017

00:36:43,109 --> 00:36:40,800

the measurement

1018

00:36:45,829 --> 00:36:43,119

no i'm saying it's not

1019

00:36:48,950 --> 00:36:45,839

then whatever you're saying

1020

00:36:54,470 --> 00:36:51,910

the the settings of the detector

1021

00:36:56,790 --> 00:36:54,480

determine the measurement outcome in

1022

00:36:58,950 --> 00:36:56,800

other words the settings of the detector

1023

00:37:00,630 --> 00:36:58,960

change the thing that is measured the

1024

00:37:02,470 --> 00:37:00,640

setting of the camera changes the moon

1025

00:37:03,910 --> 00:37:02,480

when i photograph the moon although i

1026  
00:37:05,510 --> 00:37:03,920  
know it's a classical intuition you

1027  
00:37:07,510 --> 00:37:05,520  
don't want to transfer it but

1028  
00:37:08,950 --> 00:37:07,520  
essentially for people to follow us

1029  
00:37:10,870 --> 00:37:08,960  
that's what you're saying

1030  
00:37:11,910 --> 00:37:10,880  
the thing that is measured

1031  
00:37:14,950 --> 00:37:11,920  
changes

1032  
00:37:17,510 --> 00:37:14,960  
depending on how i set up my detector

1033  
00:37:19,750 --> 00:37:17,520  
no the thing doesn't change

1034  
00:37:22,390 --> 00:37:19,760  
as i as i said i i don't want to

1035  
00:37:24,710 --> 00:37:22,400  
introduce any new degrees of freedom

1036  
00:37:27,109 --> 00:37:24,720  
so i think that i think the point where

1037  
00:37:29,190 --> 00:37:27,119  
people get confused is that they think

1038  
00:37:31,589 --> 00:37:29,200

the hidden variables

1039

00:37:34,950 --> 00:37:31,599

in burst theorem or really in all of

1040

00:37:36,710 --> 00:37:34,960

those other theorems are properties of

1041

00:37:38,470 --> 00:37:36,720

the prepared state they're kind of

1042

00:37:39,829 --> 00:37:38,480

little additional degrees of freedom

1043

00:37:41,829 --> 00:37:39,839

that sit inside the particle or

1044

00:37:43,990 --> 00:37:41,839

something and if that's how you

1045

00:37:45,910 --> 00:37:44,000

interpret it then you arrive at this

1046

00:37:47,430 --> 00:37:45,920

weird conclusion that

1047

00:37:49,030 --> 00:37:47,440

the measurement setting at the time of

1048

00:37:51,030 --> 00:37:49,040

measurement changes something about the

1049

00:37:52,550 --> 00:37:51,040

particle and actually must have changed

1050

00:37:55,030 --> 00:37:52,560

it earlier

1051  
00:37:57,270 --> 00:37:55,040  
but this is just not what the hidden

1052  
00:37:59,190 --> 00:37:57,280  
variables in both theorem are

1053  
00:38:01,670 --> 00:37:59,200  
the hidden variables in bell's theorem

1054  
00:38:04,069 --> 00:38:01,680  
are that what determines the outcome of

1055  
00:38:06,550 --> 00:38:04,079  
the measurement so if i only give you an

1056  
00:38:08,310 --> 00:38:06,560  
initial state of a particle with

1057  
00:38:10,470 --> 00:38:08,320  
whatever variables there are if you want

1058  
00:38:12,870 --> 00:38:10,480  
to add more or you just only take the

1059  
00:38:16,550 --> 00:38:12,880  
normal ones that doesn't determine the

1060  
00:38:18,870 --> 00:38:16,560  
outcome you also need the evolution law

1061  
00:38:21,349 --> 00:38:18,880  
so what i'm saying and this is why i use

1062  
00:38:24,150 --> 00:38:21,359  
this carefully phrased sentence in my

1063  
00:38:27,910 --> 00:38:24,160

video which you just threw out

1064

00:38:29,270 --> 00:38:27,920

um that what the particle

1065

00:38:32,630 --> 00:38:29,280

does

1066

00:38:34,630 --> 00:38:32,640

depends on what you measure okay and

1067

00:38:36,710 --> 00:38:34,640

what this refers to what the particle

1068

00:38:38,390 --> 00:38:36,720

does concretely i'm referring to the

1069

00:38:40,630 --> 00:38:38,400

evolution law

1070

00:38:42,950 --> 00:38:40,640

so if you look at for example if you had

1071

00:38:44,630 --> 00:38:42,960

looked at my toy model paper you would

1072

00:38:46,390 --> 00:38:44,640

have seen that this is exactly what the

1073

00:38:47,109 --> 00:38:46,400

evolution law does

1074

00:38:51,510 --> 00:38:47,119

the

1075

00:38:53,030 --> 00:38:51,520

law

1076

00:38:55,270 --> 00:38:53,040

so i have a quick note a quick note

1077

00:38:57,270 --> 00:38:55,280

bernardo that may help so instead of

1078

00:38:58,710 --> 00:38:57,280

saying you're saying and so on say are

1079

00:39:01,030 --> 00:38:58,720

you saying because this way we can find

1080

00:39:04,230 --> 00:39:01,040

out if there's agreement no i'll go

1081

00:39:07,190 --> 00:39:04,240

along with her terminology

1082

00:39:09,109 --> 00:39:07,200

for the sake of the discussion

1083

00:39:12,550 --> 00:39:09,119

what the particle does

1084

00:39:15,510 --> 00:39:12,560

depends on the detectors settings

1085

00:39:18,790 --> 00:39:15,520

but the particle only interacts with a

1086

00:39:20,470 --> 00:39:18,800

tiny measurement surface on the detector

1087

00:39:21,829 --> 00:39:20,480

far away

1088

00:39:23,510 --> 00:39:21,839

from

1089

00:39:27,030 --> 00:39:23,520

whatever else is going on in the

1090

00:39:30,390 --> 00:39:29,510

how are we to reconcile i mean isn't

1091

00:39:32,630 --> 00:39:30,400

that

1092

00:39:34,710 --> 00:39:32,640

this is what you need for for

1093

00:39:36,950 --> 00:39:34,720

to break statistical independence but

1094

00:39:39,750 --> 00:39:36,960

it's like saying that there is

1095

00:39:42,790 --> 00:39:39,760

a complex causal chain

1096

00:39:45,589 --> 00:39:42,800

between the aperture and exposure

1097

00:39:48,310 --> 00:39:45,599

settings of my camera and the moon

1098

00:39:50,550 --> 00:39:48,320

so that what the moon does depends on

1099

00:39:54,230 --> 00:39:50,560

the aperture and exposure i use on my

1100

00:39:56,310 --> 00:39:54,240

camera when i'm photographing the moon

1101

00:39:58,470 --> 00:39:56,320

it's a very complex cause of chain

1102

00:40:01,030 --> 00:39:58,480

because the interaction between the moon

1103

00:40:05,190 --> 00:40:01,040

and my camera is just the photons from

1104

00:40:07,990 --> 00:40:05,200

the moon hitting the sensor on my camera

1105

00:40:11,030 --> 00:40:08,000

i think we are being asked to believe in

1106

00:40:13,510 --> 00:40:11,040

in something very non-trivial

1107

00:40:16,150 --> 00:40:13,520

even fantastical

1108

00:40:19,670 --> 00:40:16,160

if we do not have an account that tells

1109

00:40:22,069 --> 00:40:19,680

us precisely how this happens

1110

00:40:25,910 --> 00:40:22,079

why this is possible

1111

00:40:29,670 --> 00:40:25,920

it stretches credulity uh sabine but

1112

00:40:31,829 --> 00:40:30,470

so

1113

00:40:33,589 --> 00:40:31,839

i think

1114

00:40:35,270 --> 00:40:33,599

we're not making any progress on this

1115

00:40:37,030 --> 00:40:35,280

question on what you mean by the surface

1116

00:40:38,950 --> 00:40:37,040

of the measurement i just don't know as

1117

00:40:41,190 --> 00:40:38,960

i just said uh

1118

00:40:43,510 --> 00:40:41,200

even normally in the normal decoherence

1119

00:40:46,230 --> 00:40:43,520

paradigm and so on a measurement is a

1120

00:40:47,589 --> 00:40:46,240

process with a huge number of particles

1121

00:40:49,349 --> 00:40:47,599

you know we're talking of the order 10

1122

00:40:51,109 --> 00:40:49,359

to the 23 or something anything that

1123

00:40:54,230 --> 00:40:51,119

causes decoherence

1124

00:40:56,710 --> 00:40:54,240

um so i'm not exactly sure where the

1125

00:40:58,309 --> 00:40:56,720

where the disagreement is now you're

1126

00:41:00,150 --> 00:40:58,319

asking

1127

00:41:02,710 --> 00:41:00,160

exactly how does it work

1128

00:41:03,750 --> 00:41:02,720

do i have a theory no i already told you

1129

00:41:05,910 --> 00:41:03,760

um

1130

00:41:07,750 --> 00:41:05,920

right this is exactly what i'm what i'm

1131

00:41:09,589 --> 00:41:07,760

trying to develop i'm trying to figure

1132

00:41:10,950 --> 00:41:09,599

out exactly how to write down the

1133

00:41:13,190 --> 00:41:10,960

mathematics

1134

00:41:15,109 --> 00:41:13,200

and also i should say that when you say

1135

00:41:16,790 --> 00:41:15,119

that this is what it takes to break

1136

00:41:18,470 --> 00:41:16,800

statistical independence that's not true

1137

00:41:19,750 --> 00:41:18,480

that's my particular model you know

1138

00:41:21,270 --> 00:41:19,760

there are other people who are working

1139

00:41:22,470 --> 00:41:21,280  
on different model and they have

1140

00:41:24,230 --> 00:41:22,480  
different hidden variables and

1141

00:41:25,349 --> 00:41:24,240  
completely different ideas

1142

00:41:27,430 --> 00:41:25,359  
so

1143

00:41:28,950 --> 00:41:27,440  
you know even if you don't like what

1144

00:41:30,470 --> 00:41:28,960  
i've been telling you because you think

1145

00:41:32,470 --> 00:41:30,480  
i'm crazy talking about the degrees of

1146

00:41:36,230 --> 00:41:32,480  
freedom of the detector which i think is

1147

00:41:39,589 --> 00:41:37,430  
to do

1148

00:41:41,190 --> 00:41:39,599  
then please don't also throw out all

1149

00:41:43,270 --> 00:41:41,200  
those other people's ideas because

1150

00:41:45,030 --> 00:41:43,280  
they're completely innocent

1151  
00:41:46,950 --> 00:41:45,040  
no it's okay and there's nothing wrong

1152  
00:41:49,190 --> 00:41:46,960  
with work in progress everything that

1153  
00:41:51,349 --> 00:41:49,200  
has ever been created that's good and

1154  
00:41:52,470 --> 00:41:51,359  
useful and proven was once working

1155  
00:41:56,069 --> 00:41:52,480  
progress there

1156  
00:41:58,630 --> 00:41:56,079  
is nothing wrong with that whatsoever

1157  
00:42:01,990 --> 00:41:58,640  
i do feel that

1158  
00:42:03,190 --> 00:42:02,000  
you are very early taking on a very

1159  
00:42:06,630 --> 00:42:03,200  
strong

1160  
00:42:08,470 --> 00:42:06,640  
very committed even combative position

1161  
00:42:09,589 --> 00:42:08,480  
against almost the whole of the physics

1162  
00:42:13,829 --> 00:42:09,599  
community

1163  
00:42:19,430 --> 00:42:17,190

before you have something that is more

1164

00:42:22,309 --> 00:42:19,440

substantiated i personally feel it

1165

00:42:25,510 --> 00:42:22,319

doesn't do service to the cause to come

1166

00:42:26,630 --> 00:42:25,520

out so strongly so combative before you

1167

00:42:28,630 --> 00:42:26,640

even know

1168

00:42:30,230 --> 00:42:28,640

you know within some

1169

00:42:31,670 --> 00:42:30,240

with some degree of precision what

1170

00:42:34,069 --> 00:42:31,680

you're talking about

1171

00:42:35,910 --> 00:42:34,079

that i don't think is useful but

1172

00:42:37,990 --> 00:42:35,920

early stage research

1173

00:42:39,990 --> 00:42:38,000

that's what everything has to go through

1174

00:42:42,390 --> 00:42:40,000

there is absolutely nothing wrong with

1175

00:42:43,910 --> 00:42:42,400

that now on the on the part of the

1176

00:42:46,230 --> 00:42:43,920

coherence

1177

00:42:50,390 --> 00:42:46,240

in the video you put out like three days

1178

00:42:52,230 --> 00:42:50,400

ago i think the 19th yeah three days ago

1179

00:42:54,230 --> 00:42:52,240

which is a video addressing

1180

00:42:56,870 --> 00:42:54,240

some experimental results

1181

00:42:59,430 --> 00:42:56,880

that suggest that quantum mechanics is

1182

00:43:01,589 --> 00:42:59,440

right that the different observers can

1183

00:43:03,829 --> 00:43:01,599

have different but

1184

00:43:05,349 --> 00:43:03,839

true accounts of the same series of

1185

00:43:07,589 --> 00:43:05,359

events that's a prediction of quantum

1186

00:43:10,150 --> 00:43:07,599

mechanics ravelli sort of

1187

00:43:11,750 --> 00:43:10,160

elaborated vastly on this

1188

00:43:14,309 --> 00:43:11,760

back in

1189

00:43:15,750 --> 00:43:14,319

and these experiments using the the

1190

00:43:18,069 --> 00:43:15,760

wigner's friend

1191

00:43:21,190 --> 00:43:18,079

thought experiment uh seem to have

1192

00:43:23,589 --> 00:43:21,200

confirmed that um your criticism against

1193

00:43:25,589 --> 00:43:23,599

that is that instead of

1194

00:43:29,030 --> 00:43:25,599

witness human friends

1195

00:43:30,870 --> 00:43:29,040

photons were used as observers

1196

00:43:34,150 --> 00:43:30,880

and your criticism was

1197

00:43:36,550 --> 00:43:34,160

well a photon is not a valid observer

1198

00:43:38,069 --> 00:43:36,560

because a photon doesn't cause the

1199

00:43:41,030 --> 00:43:38,079

coherence

1200

00:43:42,630 --> 00:43:41,040

but you yourself has acknowledged like

1201

00:43:44,790 --> 00:43:42,640

the fathers of the coherence that the

1202

00:43:46,950 --> 00:43:44,800

coherence doesn't solve the measurement

1203

00:43:48,150 --> 00:43:46,960

problem it's an operational useful rule

1204

00:43:51,030 --> 00:43:48,160

of thumb

1205

00:43:53,750 --> 00:43:51,040

uh but it it presupposes that which aims

1206

00:43:55,190 --> 00:43:53,760

to which it aims to explain which is the

1207

00:43:57,510 --> 00:43:55,200

existence of a

1208

00:43:59,190 --> 00:43:57,520

classical state around a quantum system

1209

00:44:01,430 --> 00:43:59,200

in a superposition

1210

00:44:03,349 --> 00:44:01,440

into which the superposition information

1211

00:44:05,510 --> 00:44:03,359

sort of can

1212

00:44:07,109 --> 00:44:05,520

speak metaphorically here so people can

1213

00:44:09,270 --> 00:44:07,119

understand the information of the

1214

00:44:11,430 --> 00:44:09,280

superposition can leak into that

1215

00:44:13,990 --> 00:44:11,440

classical world around it and therefore

1216

00:44:16,470 --> 00:44:14,000

in some sense become lost because it in

1217

00:44:18,390 --> 00:44:16,480

some sense diluted in the state of of

1218

00:44:20,870 --> 00:44:18,400

the surrounding environment

1219

00:44:23,670 --> 00:44:20,880

but are if you discard a photon i mean

1220

00:44:25,670 --> 00:44:23,680

we have detectors that are made up of

1221

00:44:26,790 --> 00:44:25,680

a small number of elementary particles

1222

00:44:28,790 --> 00:44:26,800

today

1223

00:44:30,950 --> 00:44:28,800

um and they are detectors i presume you

1224

00:44:32,790 --> 00:44:30,960

would acknowledge or or you have to give

1225

00:44:35,910 --> 00:44:32,800

a special place to human consciousness

1226

00:44:37,750 --> 00:44:35,920

like wigner himself once tried to do

1227

00:44:39,030 --> 00:44:37,760

so assuming that you don't do that that

1228

00:44:41,829 --> 00:44:39,040

you're not saying no you have to have

1229

00:44:43,589 --> 00:44:41,839

human consciousness to be an observer

1230

00:44:45,829 --> 00:44:43,599

i don't see why

1231

00:44:48,630 --> 00:44:45,839

you would establish a distinction

1232

00:44:51,030 --> 00:44:48,640

between a slightly more complex system

1233

00:44:53,109 --> 00:44:51,040

capable of the coherence in a photon i

1234

00:44:55,430 --> 00:44:53,119

think both are valid observers and the

1235

00:44:56,550 --> 00:44:55,440

conclusions of those experiments are

1236

00:44:58,950 --> 00:44:56,560

valid

1237

00:45:02,829 --> 00:44:58,960

physical quantities are relational they

1238

00:45:06,150 --> 00:45:04,710

absolute so

1239

00:45:07,829 --> 00:45:06,160

first of all you're throwing together

1240

00:45:09,430 --> 00:45:07,839

various different things maybe let me

1241

00:45:11,990 --> 00:45:09,440

start with the first thing you said you

1242

00:45:13,109 --> 00:45:12,000

were complaining that

1243

00:45:17,430 --> 00:45:13,119

i'm very

1244

00:45:18,950 --> 00:45:17,440

competitive or whatever so i have no

1245

00:45:20,710 --> 00:45:18,960

idea honestly

1246

00:45:23,270 --> 00:45:20,720

why you would say that

1247

00:45:25,829 --> 00:45:23,280

i've written like three papers in 10

1248

00:45:27,430 --> 00:45:25,839

years if that's what you call combative

1249

00:45:29,030 --> 00:45:27,440

i don't know what you want

1250

00:45:31,190 --> 00:45:29,040

people are working on

1251

00:45:33,910 --> 00:45:31,200

my video well my my

1252

00:45:36,550 --> 00:45:33,920

video is a summary

1253

00:45:39,109 --> 00:45:36,560

well i i really i think i only made this

1254

00:45:41,990 --> 00:45:39,119

one video about super determinism that's

1255

00:45:44,710 --> 00:45:42,000

a summary in which i'm trying to weed

1256

00:45:46,950 --> 00:45:44,720

out the most common misconceptions about

1257

00:45:48,950 --> 00:45:46,960

super determinism it doesn't actually

1258

00:45:52,230 --> 00:45:48,960

say anything particular about my own

1259

00:45:53,750 --> 00:45:52,240

work i wouldn't do this in a video

1260

00:45:55,670 --> 00:45:53,760

because most people wouldn't understand

1261

00:45:57,270 --> 00:45:55,680

it anyway so i find this a little bit

1262

00:46:00,150 --> 00:45:57,280

weird that you

1263

00:46:02,470 --> 00:46:00,160

would be picking on this now um your

1264

00:46:04,390 --> 00:46:02,480

other question you are asking about uh

1265

00:46:06,710 --> 00:46:04,400

my video which came out this weekend in

1266

00:46:07,990 --> 00:46:06,720

which i do not talk about super

1267

00:46:11,109 --> 00:46:08,000

determinism now you seem to be

1268

00:46:13,430 --> 00:46:11,119

criticizing me that i don't

1269

00:46:16,550 --> 00:46:13,440

that's a little bit weird like i can't

1270

00:46:18,069 --> 00:46:16,560

in in every video uh tell people what

1271

00:46:19,589 --> 00:46:18,079

what's the exact thing that i'm working

1272

00:46:21,109 --> 00:46:19,599

on at the moment and how this would

1273

00:46:21,829 --> 00:46:21,119

affect this conclusion and so on this is

1274

00:46:23,990 --> 00:46:21,839

just

1275

00:46:25,510 --> 00:46:24,000

nobody would be interested in it

1276

00:46:28,790 --> 00:46:25,520

okay so

1277

00:46:30,950 --> 00:46:28,800

it's correct that in this video i do not

1278

00:46:32,550 --> 00:46:30,960

talk about how this would look like from

1279

00:46:34,309 --> 00:46:32,560

the perspective of super determinism but

1280

00:46:36,390 --> 00:46:34,319

i explained this in one of my papers if

1281

00:46:37,750 --> 00:46:36,400

if you're interested i can

1282

00:46:39,829 --> 00:46:37,760

continue the link to this which is

1283

00:46:41,430 --> 00:46:39,839

actually the reason why i was um looking

1284

00:46:42,870 --> 00:46:41,440

at those papers to begin with i

1285

00:46:44,550 --> 00:46:42,880

appreciate it now

1286

00:46:45,829 --> 00:46:44,560

coming to the coherence again i just

1287

00:46:47,190 --> 00:46:45,839

don't know what you're talking about

1288

00:46:50,150 --> 00:46:47,200

like if you have a look at any

1289

00:46:51,910 --> 00:46:50,160

decoherence formalism it always involves

1290

00:46:53,910 --> 00:46:51,920

an interaction with some kind of

1291

00:46:56,230 --> 00:46:53,920

environment that has a lot of degrees of

1292

00:46:58,470 --> 00:46:56,240

freedom and a single photon just isn't

1293

00:47:00,390 --> 00:46:58,480

that environment that causes decoherence

1294

00:47:02,309 --> 00:47:00,400

i mean what's supposed to cause the

1295

00:47:04,470 --> 00:47:02,319

decoherence

1296

00:47:06,630 --> 00:47:04,480

my point is not that it should cause the

1297

00:47:08,630 --> 00:47:06,640

coherence my point is

1298

00:47:10,950 --> 00:47:08,640

why should it cause the coherence in

1299

00:47:12,950 --> 00:47:10,960

order to be a proper observer because we

1300

00:47:14,150 --> 00:47:12,960

have these interference experiments that

1301

00:47:16,470 --> 00:47:14,160

give us information about the

1302

00:47:19,349 --> 00:47:16,480

superposition states so the photon

1303

00:47:21,270 --> 00:47:19,359

doesn't need to decohere anything for us

1304

00:47:23,510 --> 00:47:21,280

to get information about what's going on

1305

00:47:26,309 --> 00:47:23,520

which is exactly what the paper by

1306

00:47:29,030 --> 00:47:26,319

priyati and others from from scotland

1307

00:47:31,990 --> 00:47:29,040

did but in your video you'd say very

1308

00:47:34,630 --> 00:47:32,000

explicitly the photon is not a proper

1309

00:47:36,549 --> 00:47:34,640

observer because it does not cause the

1310

00:47:38,790 --> 00:47:36,559

coherence and my point is why should it

1311

00:47:40,710 --> 00:47:38,800

need to cause the coherence we can do an

1312

00:47:44,470 --> 00:47:40,720

interference experiment and we can

1313

00:47:46,150 --> 00:47:44,480

gather information without collapse

1314

00:47:48,150 --> 00:47:46,160

while the photon is in a superposition

1315

00:47:49,510 --> 00:47:48,160

state and i'm bringing this up in

1316

00:47:51,190 --> 00:47:49,520

relation to our previous discussion

1317

00:47:53,349 --> 00:47:51,200

because it bears on what i perceive to

1318

00:47:55,109 --> 00:47:53,359

be the same metaphysical commitment

1319

00:47:57,510 --> 00:47:55,119

which is the commitment that physical

1320

00:47:59,750 --> 00:47:57,520

properties have standalone existence and

1321

00:48:02,069 --> 00:47:59,760

therefore they are non-contextual they

1322

00:48:03,829 --> 00:48:02,079

are absolute they are not relational and

1323

00:48:05,430 --> 00:48:03,839

it's the same topic that you addressed

1324

00:48:07,030 --> 00:48:05,440

in your latest video although under a

1325

00:48:09,589 --> 00:48:07,040

new name i don't mind that you bring

1326  
00:48:10,309 --> 00:48:09,599  
super determinism into it my only qualm

1327  
00:48:11,190 --> 00:48:10,319  
is

1328  
00:48:12,470 --> 00:48:11,200  
why

1329  
00:48:14,390 --> 00:48:12,480  
throw away

1330  
00:48:16,069 --> 00:48:14,400  
the entire experiment and the careful

1331  
00:48:18,309 --> 00:48:16,079  
work that was done about it i mean you

1332  
00:48:21,030 --> 00:48:18,319  
end the video with a big red cross on

1333  
00:48:23,030 --> 00:48:21,040  
top of the paper saying it means nothing

1334  
00:48:25,750 --> 00:48:23,040  
and you're doing that based solely on

1335  
00:48:27,430 --> 00:48:25,760  
this notion that well it means nothing

1336  
00:48:29,670 --> 00:48:27,440  
because the photon is not a valid

1337  
00:48:31,589 --> 00:48:29,680  
observer but you know since the advent

1338  
00:48:33,670 --> 00:48:31,599

of interference experiments we don't

1339

00:48:35,990 --> 00:48:33,680

need the coherence to have an

1340

00:48:37,910 --> 00:48:36,000

experimental outcome why isn't the photo

1341

00:48:40,630 --> 00:48:37,920

a valid observer why isn't the photo a

1342

00:48:42,230 --> 00:48:40,640

good friend of wigner

1343

00:48:46,390 --> 00:48:42,240

of course you can make

1344

00:48:49,109 --> 00:48:46,400

all kinds of measurement on photons but

1345

00:48:51,030 --> 00:48:49,119

those measurements would never disagree

1346

00:48:53,750 --> 00:48:51,040

with each other like

1347

00:48:55,670 --> 00:48:53,760

quantum mechanics would just give you

1348

00:48:57,349 --> 00:48:55,680

some answers you know that where the

1349

00:49:00,309 --> 00:48:57,359

disagreement comes from between the

1350

00:49:02,150 --> 00:49:00,319

different observers is that you disagree

1351  
00:49:04,470 --> 00:49:02,160  
over exactly where the measurement

1352  
00:49:06,630 --> 00:49:04,480  
happens

1353  
00:49:08,069 --> 00:49:06,640  
but the quantum mechanical theory

1354  
00:49:10,630 --> 00:49:08,079  
quantum theory

1355  
00:49:13,270 --> 00:49:10,640  
tells us that different observers can

1356  
00:49:15,430 --> 00:49:13,280  
provide equally true but different

1357  
00:49:17,109 --> 00:49:15,440  
accounts of the same sequence of events

1358  
00:49:18,549 --> 00:49:17,119  
sequence of events

1359  
00:49:21,109 --> 00:49:18,559  
right that's it

1360  
00:49:22,870 --> 00:49:21,119  
we know that that's the math of it

1361  
00:49:26,630 --> 00:49:22,880  
that's completely meaningless unless you

1362  
00:49:31,030 --> 00:49:28,710  
an observer is a any system that

1363  
00:49:33,270 --> 00:49:31,040

interacts with with the thing observed

1364

00:49:36,630 --> 00:49:33,280

in a way that changes its state

1365

00:49:38,630 --> 00:49:36,640

well i would disagree with that

1366

00:49:41,190 --> 00:49:38,640

that i mean that's just in practice

1367

00:49:44,309 --> 00:49:41,200

that's not how we make observations then

1368

00:49:46,710 --> 00:49:44,319

what's an observer fundamentally

1369

00:49:48,390 --> 00:49:46,720

well that's exactly the problem that i'm

1370

00:49:50,710 --> 00:49:48,400

trying to explain in my video quantum

1371

00:49:53,190 --> 00:49:50,720

mechanics does not tell you what a

1372

00:49:55,990 --> 00:49:53,200

measurement is so according to you what

1373

00:50:00,309 --> 00:49:58,390

well i i think this this whole idea of

1374

00:50:01,910 --> 00:50:00,319

the observer is kind of irrelevant as he

1375

00:50:03,349 --> 00:50:01,920

already said it kind of brings in this

1376

00:50:05,109 --> 00:50:03,359

idea that consciousness has something to

1377

00:50:06,630 --> 00:50:05,119

do with it um

1378

00:50:09,270 --> 00:50:06,640

i think it's entirely sufficient when we

1379

00:50:12,710 --> 00:50:09,280

talk about detectors uh and as i already

1380

00:50:16,309 --> 00:50:12,720

said a detector is anything large enough

1381

00:50:18,870 --> 00:50:16,319

to cause decoherence that does not mean

1382

00:50:21,270 --> 00:50:18,880

that i say the coherence is sufficient

1383

00:50:23,589 --> 00:50:21,280

to explain what happens in a measurement

1384

00:50:25,670 --> 00:50:23,599

i'm just saying that that's roughly the

1385

00:50:27,670 --> 00:50:25,680

size at which you would reasonably call

1386

00:50:30,069 --> 00:50:27,680

the finger detector

1387

00:50:31,349 --> 00:50:30,079

but if i can do an interference

1388

00:50:33,270 --> 00:50:31,359

experiment

1389

00:50:36,069 --> 00:50:33,280

and gather information about the state

1390

00:50:38,470 --> 00:50:36,079

of the photo entangled with whatever is

1391

00:50:40,069 --> 00:50:38,480

being measured and i gather valid

1392

00:50:41,910 --> 00:50:40,079

accurate information about that

1393

00:50:43,750 --> 00:50:41,920

superposition state

1394

00:50:45,829 --> 00:50:43,760

why is that not a measurement why is the

1395

00:50:47,829 --> 00:50:45,839

photon then not a detector

1396

00:50:49,510 --> 00:50:47,839

didn't it cohere because you haven't you

1397

00:50:51,589 --> 00:50:49,520

haven't collapsed the wave function

1398

00:50:54,790 --> 00:50:51,599

that's the whole point of a measurement

1399

00:50:56,710 --> 00:50:54,800

that you collapse the wave function

1400

00:50:58,790 --> 00:50:56,720

but then interference experiments are

1401  
00:51:01,190 --> 00:50:58,800  
invalid we should throw them away they

1402  
00:51:03,190 --> 00:51:01,200  
don't provide valid information

1403  
00:51:05,030 --> 00:51:03,200  
about the superposition state i don't

1404  
00:51:07,510 --> 00:51:05,040  
know why you would say that

1405  
00:51:09,349 --> 00:51:07,520  
because the paper you were criticizing

1406  
00:51:10,470 --> 00:51:09,359  
used an interference experiment to

1407  
00:51:12,230 --> 00:51:10,480  
gather information about the

1408  
00:51:14,309 --> 00:51:12,240  
superposition state and extract

1409  
00:51:16,470 --> 00:51:14,319  
conclusions from that well sure you can

1410  
00:51:19,430 --> 00:51:16,480  
do that i have absolutely no problem

1411  
00:51:21,270 --> 00:51:19,440  
with that you know this also i mean

1412  
00:51:24,549 --> 00:51:21,280  
you make it sound like i have a problem

1413  
00:51:25,990 --> 00:51:24,559

with the experiment experiment is fine

1414

00:51:27,670 --> 00:51:26,000

you know i'm sure they they're great

1415

00:51:30,230 --> 00:51:27,680

people and they have a great laboratory

1416

00:51:32,390 --> 00:51:30,240

and they're all nice people and and what

1417

00:51:34,230 --> 00:51:32,400

have you i'm just saying this experiment

1418

00:51:35,990 --> 00:51:34,240

doesn't show that objective reality

1419

00:51:38,150 --> 00:51:36,000

doesn't exist the conclusions are

1420

00:51:39,030 --> 00:51:38,160

entirely unwarranted

1421

00:51:40,549 --> 00:51:39,040

well

1422

00:51:42,630 --> 00:51:40,559

that's that's the science press

1423

00:51:43,829 --> 00:51:42,640

objective reality doesn't exist exist oh

1424

00:51:46,150 --> 00:51:43,839

there's nonsense

1425

00:51:48,150 --> 00:51:46,160

let's speak technically the experiment

1426

00:51:50,790 --> 00:51:48,160

suggests that physical quantities are

1427

00:51:53,430 --> 00:51:50,800

indeed relational and contextual

1428

00:51:55,670 --> 00:51:53,440

you seem to dismiss that conclusion

1429

00:51:58,470 --> 00:51:55,680

no i have no problem with physical

1430

00:52:01,430 --> 00:51:58,480

quantities being relational or whatever

1431

00:52:03,109 --> 00:52:01,440

also i mean if if i may say we were

1432

00:52:05,270 --> 00:52:03,119

trying to talk about super determinism

1433

00:52:07,589 --> 00:52:05,280

and now we've we've drifted off to you

1434

00:52:11,270 --> 00:52:07,599

trying to criticize a video that i put

1435

00:52:15,190 --> 00:52:13,270

okay what other question regarding super

1436

00:52:16,549 --> 00:52:15,200

determinism do you have bernardo for

1437

00:52:19,270 --> 00:52:16,559

sabina

1438

00:52:23,510 --> 00:52:19,280

i don't want to get too much uh air time

1439

00:52:26,470 --> 00:52:23,520

i have um my little notes uh here

1440

00:52:29,670 --> 00:52:27,750

okay perhaps we'll take an audience

1441

00:52:30,710 --> 00:52:29,680

question about super determinism i mean

1442

00:52:32,230 --> 00:52:30,720

unless you

1443

00:52:33,349 --> 00:52:32,240

have one ready because it'll take a

1444

00:52:35,030 --> 00:52:33,359

while for the audience to see this is a

1445

00:52:37,430 --> 00:52:35,040

bit of a delay

1446

00:52:40,790 --> 00:52:39,030

i think i made most of the points i

1447

00:52:42,390 --> 00:52:40,800

wanted to make sabine you have a

1448

00:52:43,349 --> 00:52:42,400

question for bernardo

1449

00:52:48,069 --> 00:52:43,359

well

1450

00:52:53,990 --> 00:52:51,910

curious why people are so opposed to

1451  
00:52:56,150 --> 00:52:54,000  
violating statistical independence like

1452  
00:52:56,950 --> 00:52:56,160  
this entire story about the moon and so

1453  
00:52:59,589 --> 00:52:56,960  
on

1454  
00:53:00,790 --> 00:52:59,599  
i think you are aware

1455  
00:53:03,750 --> 00:53:00,800  
that

1456  
00:53:05,430 --> 00:53:03,760  
this is using a macroscopic

1457  
00:53:06,710 --> 00:53:05,440  
comparison

1458  
00:53:09,270 --> 00:53:06,720  
for

1459  
00:53:11,109 --> 00:53:09,280  
something we only ever observe in a

1460  
00:53:12,790 --> 00:53:11,119  
quantum experiment right so of course it

1461  
00:53:15,670 --> 00:53:12,800  
sounds completely crazy

1462  
00:53:17,430 --> 00:53:15,680  
right so so i don't really know why

1463  
00:53:20,069 --> 00:53:17,440

people are

1464

00:53:22,150 --> 00:53:20,079

so willing to throw out this option of

1465

00:53:24,470 --> 00:53:22,160

violating statistical independence i i

1466

00:53:27,589 --> 00:53:24,480

really don't get it

1467

00:53:28,549 --> 00:53:27,599

i i don't think it should be thrown out

1468

00:53:31,829 --> 00:53:28,559

but

1469

00:53:34,470 --> 00:53:31,839

to come out strongly and say

1470

00:53:37,030 --> 00:53:34,480

it has to be thrown out because reality

1471

00:53:39,670 --> 00:53:37,040

is that statistical independence doesn't

1472

00:53:42,069 --> 00:53:39,680

hold i think that's a very very strong

1473

00:53:44,230 --> 00:53:42,079

statement and it shouldn't be made

1474

00:53:45,829 --> 00:53:44,240

lightly because statistical independence

1475

00:53:48,710 --> 00:53:45,839

is something we have learned throughout

1476

00:53:51,430 --> 00:53:48,720

the history of science is applicable

1477

00:53:53,670 --> 00:53:51,440

uh and to now suddenly depart from that

1478

00:53:56,069 --> 00:53:53,680

there has to be a very good rationale

1479

00:53:57,670 --> 00:53:56,079

for that very very well substantiated

1480

00:54:00,230 --> 00:53:57,680

there's nothing wrong in being in a

1481

00:54:02,710 --> 00:54:00,240

minority position i am in a minority

1482

00:54:05,030 --> 00:54:02,720

position all the time i know very well

1483

00:54:08,069 --> 00:54:05,040

what that feels like but it's important

1484

00:54:10,069 --> 00:54:08,079

to be able to substantiate very well why

1485

00:54:11,589 --> 00:54:10,079

we are taking that minority position and

1486

00:54:13,270 --> 00:54:11,599

saying that everybody else is wrong i

1487

00:54:15,349 --> 00:54:13,280

mean

1488

00:54:17,589 --> 00:54:15,359

i didn't want to to pick on you when i

1489

00:54:19,670 --> 00:54:17,599

said that that you were coming out

1490

00:54:21,589 --> 00:54:19,680

coming across very combatively it was

1491

00:54:24,309 --> 00:54:21,599

just as part of your video you knew to

1492

00:54:25,589 --> 00:54:24,319

say that all those old male physicists

1493

00:54:27,750 --> 00:54:25,599

don't have a clue what they're talking

1494

00:54:30,309 --> 00:54:27,760

about something of that tone which i

1495

00:54:32,069 --> 00:54:30,319

like i like that tone but i think you're

1496

00:54:34,069 --> 00:54:32,079

exposing yourself now in this but in

1497

00:54:35,430 --> 00:54:34,079

this specific area of your work where

1498

00:54:37,349 --> 00:54:35,440

it's so early

1499

00:54:39,910 --> 00:54:37,359

but uh you know keep in mind you're

1500

00:54:42,710 --> 00:54:39,920

you're going against practically the

1501  
00:54:45,589 --> 00:54:42,720  
entire physics community here

1502  
00:54:46,390 --> 00:54:45,599  
um and you're going very strongly after

1503  
00:54:47,510 --> 00:54:46,400  
them

1504  
00:54:49,829 --> 00:54:47,520  
and

1505  
00:54:52,549 --> 00:54:49,839  
in you're doing that before you have

1506  
00:54:53,910 --> 00:54:52,559  
even the outline of a theory that can be

1507  
00:54:55,030 --> 00:54:53,920  
defined and you're asking people to

1508  
00:54:56,950 --> 00:54:55,040  
throw away

1509  
00:54:59,109 --> 00:54:56,960  
learnings you call them we call them

1510  
00:55:00,789 --> 00:54:59,119  
assumptions i call them learnings that

1511  
00:55:01,670 --> 00:55:00,799  
we have accumulated over hundreds of

1512  
00:55:03,829 --> 00:55:01,680  
years

1513  
00:55:05,430 --> 00:55:03,839

and and i sense that you're doing that

1514

00:55:07,190 --> 00:55:05,440

because of a metaphysical commitment

1515

00:55:09,190 --> 00:55:07,200

which is the very thing you are on a

1516

00:55:11,589 --> 00:55:09,200

crusade against thank goodness you are

1517

00:55:13,670 --> 00:55:11,599

in a crusade against that and i'm with

1518

00:55:15,670 --> 00:55:13,680

you on that crusade and i feel slightly

1519

00:55:18,549 --> 00:55:15,680

betrayed

1520

00:55:19,829 --> 00:55:18,559

with your talk of hidden variables

1521

00:55:22,309 --> 00:55:19,839

i don't know where you're talking about

1522

00:55:25,910 --> 00:55:22,319

my metaphysical commitments i as i tried

1523

00:55:30,069 --> 00:55:28,069

i i don't know why you were

1524

00:55:31,829 --> 00:55:30,079

now rotating back to physical realism

1525

00:55:35,190 --> 00:55:31,839

when i told you in the very beginning

1526

00:55:37,270 --> 00:55:35,200

that my problem is

1527

00:55:39,270 --> 00:55:37,280

that non-locality

1528

00:55:41,270 --> 00:55:39,280

is not in the measurement collapse it's

1529

00:55:43,750 --> 00:55:41,280

not compatible with general relativity

1530

00:55:45,829 --> 00:55:43,760

i'm trying to solve a

1531

00:55:48,549 --> 00:55:45,839

mathematical problem

1532

00:55:50,710 --> 00:55:48,559

and that's the only solution

1533

00:55:53,430 --> 00:55:50,720

that i think works

1534

00:55:56,789 --> 00:55:53,440

and now all you you talk about why i'm

1535

00:55:58,710 --> 00:55:56,799

so combative uh and so on and so forth

1536

00:56:00,390 --> 00:55:58,720

i don't really know why why

1537

00:56:02,230 --> 00:56:00,400

where this conversation is going it

1538

00:56:03,510 --> 00:56:02,240

doesn't really make a lot of sense to me

1539

00:56:05,270 --> 00:56:03,520

what is the disagreement bernardo

1540

00:56:06,789 --> 00:56:05,280

besides the strength which or at least

1541

00:56:08,630 --> 00:56:06,799

perceives strength at which sabino puts

1542

00:56:10,630 --> 00:56:08,640

out a position because to me that's an

1543

00:56:12,230 --> 00:56:10,640

ad hominem from my perspective do you

1544

00:56:13,910 --> 00:56:12,240

have an argument about the argument

1545

00:56:16,069 --> 00:56:13,920

itself

1546

00:56:18,230 --> 00:56:16,079

i think hidden variables at this stage

1547

00:56:20,870 --> 00:56:18,240

are fantasy and we have absolutely no

1548

00:56:21,750 --> 00:56:20,880

experimental reason to entertain them or

1549

00:56:26,630 --> 00:56:21,760

to

1550

00:56:29,349 --> 00:56:26,640

statistical independence which has held

1551

00:56:30,630 --> 00:56:29,359  
for 400 years of science literally

1552

00:56:32,870 --> 00:56:30,640  
everywhere

1553

00:56:35,109 --> 00:56:32,880  
we do not have a good empirical reason

1554

00:56:37,430 --> 00:56:35,119  
to depart from that or a good empirical

1555

00:56:40,549 --> 00:56:37,440  
reason to postulate hidden fantastical

1556

00:56:42,630 --> 00:56:40,559  
entities that that that are completely

1557

00:56:44,630 --> 00:56:42,640  
counterintuitive and for which we do not

1558

00:56:45,670 --> 00:56:44,640  
have even an explicit theoretical

1559

00:56:48,549 --> 00:56:45,680  
account

1560

00:56:52,150 --> 00:56:48,559  
so i think the whole thing is a fantasy

1561

00:56:53,910 --> 00:56:52,160  
that departs from empirical rigor

1562

00:56:55,670 --> 00:56:53,920  
you know well i could likewise say that

1563

00:56:57,750 --> 00:56:55,680

it's completely insane to throw out

1564

00:56:59,270 --> 00:56:57,760

locality which has been historically

1565

00:57:01,910 --> 00:56:59,280

dramatically

1566

00:57:02,789 --> 00:57:01,920

uh successful

1567

00:57:05,349 --> 00:57:02,799

right

1568

00:57:07,030 --> 00:57:05,359

and also i mean about this you you're

1569

00:57:08,950 --> 00:57:07,040

talking about statistical independence

1570

00:57:12,710 --> 00:57:08,960

again you're using a notion of

1571

00:57:15,109 --> 00:57:12,720

statistical independence that we use in

1572

00:57:17,589 --> 00:57:15,119

statistical mechanics and so on which

1573

00:57:19,430 --> 00:57:17,599

just has nothing to do with this notion

1574

00:57:21,430 --> 00:57:19,440

of statistical independence that enters

1575

00:57:23,190 --> 00:57:21,440

spells theorem i don't even know why

1576  
00:57:23,990 --> 00:57:23,200  
people think they they are the same

1577  
00:57:28,309 --> 00:57:24,000  
thing

1578  
00:57:30,230 --> 00:57:28,319  
or maybe people get confused about why

1579  
00:57:32,470 --> 00:57:30,240  
that it just that it's called

1580  
00:57:34,150 --> 00:57:32,480  
statistical independence i mean we

1581  
00:57:36,069 --> 00:57:34,160  
already noticed when we were talking

1582  
00:57:37,750 --> 00:57:36,079  
about what it actually means to violate

1583  
00:57:39,510 --> 00:57:37,760  
statistical independence that you don't

1584  
00:57:41,109 --> 00:57:39,520  
even know what it means

1585  
00:57:42,549 --> 00:57:41,119  
you know right people write down this

1586  
00:57:44,710 --> 00:57:42,559  
equation they don't know what the hidden

1587  
00:57:46,950 --> 00:57:44,720  
variables are they they confuse

1588  
00:57:48,630 --> 00:57:46,960

causation with correlation and then they

1589

00:57:50,150 --> 00:57:48,640

come to all these weird conclusions

1590

00:57:52,390 --> 00:57:50,160

about there having to be some kind of

1591

00:57:55,589 --> 00:57:52,400

conspiracy and so on and so forth now

1592

00:57:58,230 --> 00:57:55,599

look i'm a maths person okay so i work

1593

00:58:00,710 --> 00:57:58,240

with equations so all this kind of stuff

1594

00:58:03,510 --> 00:58:00,720

it goes right past me

1595

00:58:04,870 --> 00:58:03,520

what i want to know is can i write down

1596

00:58:07,349 --> 00:58:04,880

a theory

1597

00:58:09,510 --> 00:58:07,359

that's internally consistent i will

1598

00:58:12,150 --> 00:58:09,520

actually make predictions and now you're

1599

00:58:13,990 --> 00:58:12,160

asking you know why am i

1600

00:58:16,150 --> 00:58:14,000

saying something about it if i don't

1601  
00:58:17,670 --> 00:58:16,160  
have a full theory well that's actually

1602  
00:58:19,750 --> 00:58:17,680  
a good question and

1603  
00:58:22,150 --> 00:58:19,760  
maybe i should spend a minute trying to

1604  
00:58:24,309 --> 00:58:22,160  
answer it it's because i've seen from

1605  
00:58:27,190 --> 00:58:24,319  
what's happened in quantum gravity and

1606  
00:58:30,470 --> 00:58:27,200  
also in particle physics that this idea

1607  
00:58:33,030 --> 00:58:30,480  
to formulate a full theory that is

1608  
00:58:35,109 --> 00:58:33,040  
mathematically consistent mathematically

1609  
00:58:36,870 --> 00:58:35,119  
consistent and then you go and test it

1610  
00:58:39,990 --> 00:58:36,880  
just doesn't work

1611  
00:58:41,589 --> 00:58:40,000  
you need experimental guidance and so

1612  
00:58:45,030 --> 00:58:41,599  
trying to fumble together all the

1613  
00:58:47,270 --> 00:58:45,040

details without any kind of experimental

1614

00:58:50,230 --> 00:58:47,280

evidence that you can use to build the

1615

00:58:52,710 --> 00:58:50,240

theory just isn't going to work and this

1616

00:58:54,430 --> 00:58:52,720

is why i've been going around for 12

1617

00:58:56,870 --> 00:58:54,440

years trying to convince

1618

00:58:59,270 --> 00:58:56,880

experimentalists to please stop doing

1619

00:59:01,270 --> 00:58:59,280

always the same belt type tests which

1620

00:59:04,789 --> 00:59:01,280

will always give the same result but we

1621

00:59:07,910 --> 00:59:04,799

already know this please do some other

1622

00:59:09,910 --> 00:59:07,920

experiment that could reveal some

1623

00:59:11,670 --> 00:59:09,920

evidence for those hidden variables and

1624

00:59:13,190 --> 00:59:11,680

i'm i'm very frustrated that no one

1625

00:59:15,270 --> 00:59:13,200

wants to touch it because everyone's

1626  
00:59:16,630 --> 00:59:15,280  
like oh super determinism oh right that

1627  
00:59:18,390 --> 00:59:16,640  
was this weird thing where you have to

1628  
00:59:20,309 --> 00:59:18,400  
throw out free will right so they're

1629  
00:59:22,710 --> 00:59:20,319  
afraid to touch it

1630  
00:59:23,750 --> 00:59:22,720  
i i i agree with you but i sympathize

1631  
00:59:25,910 --> 00:59:23,760  
with them

1632  
00:59:28,390 --> 00:59:25,920  
you have to propose a minimally precise

1633  
00:59:30,390 --> 00:59:28,400  
experiment what you have proposed so far

1634  
00:59:31,750 --> 00:59:30,400  
is so vague

1635  
00:59:32,470 --> 00:59:31,760  
you don't know what you're controlling

1636  
00:59:34,950 --> 00:59:32,480  
for

1637  
00:59:37,750 --> 00:59:34,960  
you don't know what the thresholds are

1638  
00:59:40,950 --> 00:59:37,760

like bell's theorem right that's also

1639

00:59:43,670 --> 00:59:40,960

terribly vague no it's very precise this

1640

00:59:45,589 --> 00:59:43,680

statistic very precise well has bell

1641

00:59:48,950 --> 00:59:45,599

told you what the hidden variables are

1642

00:59:51,270 --> 00:59:48,960

in his theory no he hasn't right

1643

00:59:53,910 --> 00:59:51,280

but i have to do it

1644

00:59:55,990 --> 00:59:53,920

he said what exactly is the statistical

1645

00:59:58,870 --> 00:59:56,000

measurement the ensemble measurement

1646

01:00:00,549 --> 00:59:58,880

that you would expect in case the hidden

1647

01:00:02,870 --> 01:00:00,559

variable local hidden variables are the

1648

01:00:05,190 --> 01:00:02,880

case and the difference with what

1649

01:00:07,430 --> 01:00:05,200

quantum mechanics predicts so the

1650

01:00:10,630 --> 01:00:07,440

experimentalist knows exactly what to

1651  
01:00:12,870 --> 01:00:10,640  
measure under what conditions and how to

1652  
01:00:15,589 --> 01:00:12,880  
how to interpret the measurement but if

1653  
01:00:17,190 --> 01:00:15,599  
we if you're told well you have to cool

1654  
01:00:19,190 --> 01:00:17,200  
the detector down when you have to

1655  
01:00:21,270 --> 01:00:19,200  
reduce the degrees of fear freedom of

1656  
01:00:22,950 --> 01:00:21,280  
the detector and you have to make enough

1657  
01:00:25,750 --> 01:00:22,960  
measurements in rapid succession

1658  
01:00:26,870 --> 01:00:25,760  
experimentally experimentalist will ask

1659  
01:00:29,910 --> 01:00:26,880  
how cool

1660  
01:00:31,750 --> 01:00:29,920  
how rapid is rapid enough what exactly

1661  
01:00:33,510 --> 01:00:31,760  
do i need to measurement and what

1662  
01:00:35,750 --> 01:00:33,520  
exactly are the degrees of freedom that

1663  
01:00:37,510 --> 01:00:35,760

i'm allowed to have if there aren't

1664

01:00:38,549 --> 01:00:37,520

answers to that question then it's you

1665

01:00:40,390 --> 01:00:38,559

know

1666

01:00:42,069 --> 01:00:40,400

but i do have answers to this question

1667

01:00:44,309 --> 01:00:42,079

in the paper that you didn't read from

1668

01:00:45,910 --> 01:00:44,319

2011 i've now said this a few times

1669

01:00:48,230 --> 01:00:45,920

there are numbers in the paper i've

1670

01:00:49,910 --> 01:00:48,240

actually counted the degrees of freedom

1671

01:00:51,750 --> 01:00:49,920

i've estimated the temperature and the

1672

01:00:53,190 --> 01:00:51,760

size of the thing and how quickly you

1673

01:00:54,870 --> 01:00:53,200

have to repeat the measurements and so

1674

01:00:57,349 --> 01:00:54,880

on

1675

01:00:59,990 --> 01:00:57,359

in the 2019 or 2020 paper it was not

1676

01:01:01,990 --> 01:01:00,000

there that's right because i've already

1677

01:01:04,870 --> 01:01:02,000

published this in an earlier paper you

1678

01:01:06,549 --> 01:01:04,880

know i don't like to plagiarize myself

1679

01:01:08,230 --> 01:01:06,559

and maybe i'm a little bit old-fashioned

1680

01:01:10,549 --> 01:01:08,240

but there's a reference in the paper

1681

01:01:13,270 --> 01:01:10,559

which uh to the earlier paper where you

1682

01:01:15,430 --> 01:01:13,280

can look up the numbers

1683

01:01:17,349 --> 01:01:15,440

maybe the experimentalists are also only

1684

01:01:18,950 --> 01:01:17,359

looking at your latest papers and they

1685

01:01:21,109 --> 01:01:18,960

are extracting the same conclusions i

1686

01:01:23,030 --> 01:01:21,119

did which is throw your hands up and say

1687

01:01:26,309 --> 01:01:23,040

what can i do well actually i'm actually

1688

01:01:29,270 --> 01:01:26,319

in in touch with um at least three

1689

01:01:31,349 --> 01:01:29,280

experimentalists um who have different

1690

01:01:32,630 --> 01:01:31,359

ideas of how to go about it so i'm not

1691

01:01:34,230 --> 01:01:32,640

completely

1692

01:01:36,789 --> 01:01:34,240

hopeless at this point that maybe it

1693

01:01:38,789 --> 01:01:36,799

will happen within my lifetime

1694

01:01:41,349 --> 01:01:38,799

okay let's get to an audience question

1695

01:01:43,349 --> 01:01:41,359

this question comes from gastronic it

1696

01:01:44,630 --> 01:01:43,359

may help me referring to gastronic

1697

01:01:47,109 --> 01:01:44,640

understand the discussion of super

1698

01:01:49,190 --> 01:01:47,119

determinism better if it is clear and

1699

01:01:50,549 --> 01:01:49,200

i'll you already outlined this sabine

1700

01:01:51,750 --> 01:01:50,559

but perhaps it can be outlined again

1701

01:01:53,750 --> 01:01:51,760

what is meant by the definition of

1702

01:01:55,589 --> 01:01:53,760

looking slash not looking at and or

1703

01:01:57,270 --> 01:01:55,599

measuring slash not measuring in the

1704

01:02:00,710 --> 01:01:57,280

context of the double slit experiment

1705

01:02:05,829 --> 01:02:02,710

well as i already said you know

1706

01:02:08,470 --> 01:02:05,839

in my mind a measurement is an

1707

01:02:09,910 --> 01:02:08,480

interaction with an apparatus that can

1708

01:02:12,549 --> 01:02:09,920

amplify

1709

01:02:15,349 --> 01:02:12,559

a small signal and that apparatus has to

1710

01:02:17,670 --> 01:02:15,359

be large enough to cause

1711

01:02:20,789 --> 01:02:17,680

decoherence but i don't think that the

1712

01:02:22,950 --> 01:02:20,799

decoherence is sufficient to actually

1713

01:02:24,870 --> 01:02:22,960

describe the measurement process this is

1714

01:02:26,789 --> 01:02:24,880

what you need super determinant for i

1715

01:02:28,230 --> 01:02:26,799

hope this helps

1716

01:02:30,789 --> 01:02:28,240

this question is to both of you comes

1717

01:02:32,870 --> 01:02:30,799

from salvatore pais

1718

01:02:34,789 --> 01:02:32,880

salvatore pius wants to know this isn't

1719

01:02:37,029 --> 01:02:34,799

specifically about super determinism but

1720

01:02:38,309 --> 01:02:37,039

salvator pius asks if

1721

01:02:40,470 --> 01:02:38,319

you all believe that there could be a

1722

01:02:41,670 --> 01:02:40,480

super force a force of unification for

1723

01:02:42,549 --> 01:02:41,680

all forces

1724

01:02:44,630 --> 01:02:42,559

that

1725

01:02:46,470 --> 01:02:44,640

and just so you know sal wrote down sal

1726

01:02:48,470 --> 01:02:46,480

believes that this super force quote

1727

01:02:50,390 --> 01:02:48,480

unquote exists at all points in space

1728

01:02:52,230 --> 01:02:50,400

and time at planck scales and is equal

1729

01:02:54,309 --> 01:02:52,240

to the planck unit of force namely  $c$  to

1730

01:02:56,309 --> 01:02:54,319

the four divided by  $g$

1731

01:02:58,069 --> 01:02:56,319

which in his mind has shown that the

1732

01:03:00,549 --> 01:02:58,079

strong nuclear force equals the force of

1733

01:03:02,309 --> 01:03:00,559

gravity which equals the super force so

1734

01:03:04,710 --> 01:03:02,319

what is your take on this what is your

1735

01:03:06,309 --> 01:03:04,720

opinion on this salvatore pius wants to

1736

01:03:07,829 --> 01:03:06,319

know

1737

01:03:10,230 --> 01:03:07,839

bernardo do you have any

1738

01:03:13,349 --> 01:03:10,240

thoughts on that

1739

01:03:15,589 --> 01:03:13,359

and then sources are our models um

1740

01:03:17,430 --> 01:03:15,599

if you don't want to talk about a

1741

01:03:19,510 --> 01:03:17,440

talk about forces you talk about force

1742

01:03:21,109 --> 01:03:19,520

carrying particles and if you don't want

1743

01:03:23,910 --> 01:03:21,119

to talk about particles you talk about

1744

01:03:26,470 --> 01:03:23,920

field excitations these are models the

1745

01:03:27,990 --> 01:03:26,480

question boiled down boils down to

1746

01:03:29,670 --> 01:03:28,000

do i think we

1747

01:03:31,990 --> 01:03:29,680

will one day

1748

01:03:34,069 --> 01:03:32,000

get to

1749

01:03:35,270 --> 01:03:34,079

a unification theory

1750

01:03:37,750 --> 01:03:35,280

that

1751

01:03:40,390 --> 01:03:37,760

brings gravity into the fold of what is

1752

01:03:41,349 --> 01:03:40,400

today known as one of the 17 quantum

1753

01:03:43,430 --> 01:03:41,359

fields

1754

01:03:45,510 --> 01:03:43,440

do i think a grand unification will be

1755

01:03:46,630 --> 01:03:45,520

possible yes i think i think it will be

1756

01:03:48,390 --> 01:03:46,640

possible

1757

01:03:50,710 --> 01:03:48,400

it may not go along the lines of m

1758

01:03:52,549 --> 01:03:50,720

theory maybe it goes along the lines of

1759

01:03:55,109 --> 01:03:52,559

loop quantum gravity

1760

01:03:57,750 --> 01:03:55,119

but i think ultimately i think nature is

1761

01:03:58,870 --> 01:03:57,760

screaming to us that whether we know it

1762

01:04:01,430 --> 01:03:58,880

or not

1763

01:04:02,950 --> 01:04:01,440

there is such a thing nature behaves in

1764

01:04:05,430 --> 01:04:02,960

a unified way

1765

01:04:08,069 --> 01:04:05,440

um such that there are no building

1766

01:04:10,150 --> 01:04:08,079

contradictory contradictions in nature

1767

01:04:12,470 --> 01:04:10,160

so yes i think eventually something like

1768

01:04:13,910 --> 01:04:12,480

this will be possible

1769

01:04:16,549 --> 01:04:13,920

sabine do you have any opinions on

1770

01:04:18,870 --> 01:04:16,559

salvator pisces question

1771

01:04:19,910 --> 01:04:18,880

no i'd rather not uh

1772

01:04:25,510 --> 01:04:19,920

um

1773

01:04:26,789 --> 01:04:25,520

speaking

1774

01:04:28,309 --> 01:04:26,799

we know that

1775

01:04:30,789 --> 01:04:28,319

nature

1776

01:04:33,510 --> 01:04:30,799

has never shown any internal

1777

01:04:35,270 --> 01:04:33,520

uh inconsistency so at least when it

1778

01:04:37,829 --> 01:04:35,280

comes to the

1779

01:04:39,349 --> 01:04:37,839

problem of combining quantum theory with

1780

01:04:41,990 --> 01:04:39,359

general relativity there has to be a

1781

01:04:43,910 --> 01:04:42,000

solution to this um now as i have

1782

01:04:46,549 --> 01:04:43,920

probably made clear i think that super

1783

01:04:48,230 --> 01:04:46,559

determinism is a part of the answer now

1784

01:04:50,150 --> 01:04:48,240

when it comes to the unification of the

1785

01:04:52,230 --> 01:04:50,160

other interactions i'm i'm not that sure

1786

01:04:54,309 --> 01:04:52,240

i'm not sure we actually need it may or

1787

01:04:57,349 --> 01:04:54,319

may not work out in the end well i know

1788

01:04:59,349 --> 01:04:57,359

you both have to get going so thank you

1789

01:05:00,950 --> 01:04:59,359

all for being here thank you sabine

1790

01:05:03,270 --> 01:05:00,960

thank you bernardo for spending some

1791

01:05:05,670 --> 01:05:03,280

time with myself and with the audience

1792

01:05:07,349 --> 01:05:05,680

and perhaps we can go through that 2011

1793

01:05:09,190 --> 01:05:07,359

paper at some point in the future and

1794

01:05:12,069 --> 01:05:09,200

have a more

1795

01:05:14,470 --> 01:05:12,079

specific and constructive conversation

1796

01:05:16,630 --> 01:05:14,480

thank you so much

1797

01:05:17,670 --> 01:05:16,640

okay thank you guys

1798

01:05:19,349 --> 01:05:17,680

thank you

1799

01:05:21,430 --> 01:05:19,359

it was at this point that sabine had to

1800

01:05:23,510 --> 01:05:21,440

leave and so bernardo stayed behind to

1801

01:05:25,349 --> 01:05:23,520

take some audience questions one-on-one

1802

01:05:27,430 --> 01:05:25,359

okay radcapsul says

1803

01:05:29,430 --> 01:05:27,440

without thought there is no science if

1804

01:05:31,270 --> 01:05:29,440

one wants to apply reason and logic as

1805

01:05:33,510 --> 01:05:31,280

the scientific method requires one has

1806

01:05:35,270 --> 01:05:33,520

to first have one has to first know what

1807

01:05:37,510 --> 01:05:35,280

thoughts are and where they originate do

1808

01:05:38,950 --> 01:05:37,520

you agree

1809

01:05:41,589 --> 01:05:38,960

absolutely

1810

01:05:44,230 --> 01:05:41,599

and that's one of

1811

01:05:47,029 --> 01:05:44,240

the weakest links um

1812

01:05:49,670 --> 01:05:47,039

in in our epistemology today and how we

1813

01:05:51,029 --> 01:05:49,680

deal with our own knowledge

1814

01:05:54,150 --> 01:05:51,039

we are

1815

01:05:56,470 --> 01:05:54,160

will miserably lack insight

1816

01:05:58,710 --> 01:05:56,480

into the thinker

1817

01:06:01,109 --> 01:05:58,720

and we think that thoughts

1818

01:06:02,789 --> 01:06:01,119

are objective entities that have a

1819

01:06:05,589 --> 01:06:02,799

reality of their own

1820

01:06:07,430 --> 01:06:05,599

um independence of the thinker

1821

01:06:09,589 --> 01:06:07,440

and the thinkers hidden assumptions and

1822

01:06:12,630 --> 01:06:09,599

prejudices and commitments

1823

01:06:15,029 --> 01:06:12,640

and so on and so forth

1824

01:06:16,630 --> 01:06:15,039

gemson says what evidence or reason do

1825

01:06:18,710 --> 01:06:16,640

you have for meaning that consciousness

1826  
01:06:19,910 --> 01:06:18,720  
is not evolving

1827  
01:06:23,589 --> 01:06:19,920  
is not what

1828  
01:06:26,309 --> 01:06:24,470  
um

1829  
01:06:27,589 --> 01:06:26,319  
i think the contents of consciousness

1830  
01:06:33,829 --> 01:06:27,599  
are evolving

1831  
01:06:34,950 --> 01:06:33,839  
i think not so long ago not so long ago

1832  
01:06:36,069 --> 01:06:34,960  
there was

1833  
01:06:39,349 --> 01:06:36,079  
no

1834  
01:06:42,150 --> 01:06:39,359  
capacity for metacognition in nature

1835  
01:06:43,910 --> 01:06:42,160  
sorry it's my allergy

1836  
01:06:45,750 --> 01:06:43,920  
so the contents of consciousness are

1837  
01:06:47,589 --> 01:06:45,760  
evolving there are more insights there

1838  
01:06:49,430 --> 01:06:47,599

is more understanding we

1839

01:06:52,549 --> 01:06:49,440

we have a better grip

1840

01:06:54,789 --> 01:06:52,559

on what's going on um we're still very

1841

01:06:56,710 --> 01:06:54,799

very far away from

1842

01:06:59,029 --> 01:06:56,720

a complete understanding of what's going

1843

01:07:01,190 --> 01:06:59,039

on i think we still make many many many

1844

01:07:03,190 --> 01:07:01,200

mistakes there are a great number of

1845

01:07:04,069 --> 01:07:03,200

things we take for granted that are not

1846

01:07:05,750 --> 01:07:04,079

true

1847

01:07:08,470 --> 01:07:05,760

i think we would be tremendously

1848

01:07:11,589 --> 01:07:08,480

surprised by the depth of our ignorance

1849

01:07:14,870 --> 01:07:11,599

if suddenly we became aware of it

1850

01:07:17,589 --> 01:07:14,880

but steps are being made we are not

1851

01:07:19,270 --> 01:07:17,599

where we were in the middle ages we have

1852

01:07:21,910 --> 01:07:19,280

advanced and

1853

01:07:23,589 --> 01:07:21,920

we've identified some common pitfalls

1854

01:07:25,829 --> 01:07:23,599

and we don't fall in those anymore we

1855

01:07:30,309 --> 01:07:25,839

fall in others still but at least in

1856

01:07:34,789 --> 01:07:32,870

man in blackened woods says question for

1857

01:07:40,230 --> 01:07:34,799

bernardo can you envision a way in which

1858

01:07:44,630 --> 01:07:43,349

if one would prove

1859

01:07:46,549 --> 01:07:44,640

that um

1860

01:07:48,630 --> 01:07:46,559

what we call physical entities which are

1861

01:07:52,230 --> 01:07:48,640

entirely defined by physical quantities

1862

01:07:54,309 --> 01:07:52,240

like mass charge momentum so so forth

1863

01:07:56,549 --> 01:07:54,319

if one could prove

1864

01:08:00,069 --> 01:07:56,559

that those have

1865

01:08:02,390 --> 01:08:00,079

a objective and stand-alone reality

1866

01:08:06,150 --> 01:08:02,400

irrespective of

1867

01:08:07,349 --> 01:08:06,160

the observational context

1868

01:08:09,270 --> 01:08:07,359

that would

1869

01:08:11,670 --> 01:08:09,280

go some way

1870

01:08:13,990 --> 01:08:11,680

into indicating that idealism is

1871

01:08:16,870 --> 01:08:14,000

implausible

1872

01:08:18,630 --> 01:08:16,880

it might also go some way in indicating

1873

01:08:21,590 --> 01:08:18,640

that a great many things about cognitive

1874

01:08:25,269 --> 01:08:21,600

psychology are implausible as well

1875

01:08:27,269 --> 01:08:25,279

and some aspects of our colloquial

1876

01:08:28,309 --> 01:08:27,279

materialist understanding of the world

1877

01:08:31,590 --> 01:08:28,319

as well

1878

01:08:33,669 --> 01:08:31,600

so that that would be um one way

1879

01:08:35,189 --> 01:08:33,679

and as it turns out for the last 40

1880

01:08:38,470 --> 01:08:35,199

years and that was a discussion we had

1881

01:08:39,669 --> 01:08:38,480

today precisely the opposite is is what

1882

01:08:42,950 --> 01:08:39,679

is emerging

1883

01:08:44,309 --> 01:08:42,960

uh unless you give up on statistical

1884

01:08:45,430 --> 01:08:44,319

independence

1885

01:08:50,070 --> 01:08:45,440

and you

1886

01:08:55,590 --> 01:08:50,080

how to say i want to use a word that

1887

01:08:58,229 --> 01:08:55,600

isn't disparaging and you take on board

1888

01:09:00,149 --> 01:08:58,239

the possibility that

1889

01:09:02,070 --> 01:09:00,159

the settings of the camera change what

1890

01:09:04,070 --> 01:09:02,080

the moon is or does

1891

01:09:06,550 --> 01:09:04,080

if you take that on board

1892

01:09:08,309 --> 01:09:06,560

then yes you can say well

1893

01:09:10,470 --> 01:09:08,319

physical realism the standalone

1894

01:09:12,709 --> 01:09:10,480

existence of physical entities has

1895

01:09:15,829 --> 01:09:12,719

survived these experiments

1896

01:09:17,990 --> 01:09:15,839

but you pay a very big price for it you

1897

01:09:20,229 --> 01:09:18,000

you have to part with something that has

1898

01:09:21,669 --> 01:09:20,239

been reliable for the entire history of

1899

01:09:23,749 --> 01:09:21,679

science

1900

01:09:24,870 --> 01:09:23,759

which is statistical independence or you

1901  
01:09:27,269 --> 01:09:24,880  
have to

1902  
01:09:29,269 --> 01:09:27,279  
take on board the notion that there are

1903  
01:09:30,309 --> 01:09:29,279  
countless real

1904  
01:09:32,149 --> 01:09:30,319  
physical

1905  
01:09:34,070 --> 01:09:32,159  
parallel universes

1906  
01:09:36,309 --> 01:09:34,080  
countless popping out every

1907  
01:09:37,990 --> 01:09:36,319  
infinitesimal fraction of a six second

1908  
01:09:39,669 --> 01:09:38,000  
out of nowhere for no reason for which

1909  
01:09:41,510 --> 01:09:39,679  
we have absolutely zero empirical

1910  
01:09:44,709 --> 01:09:41,520  
evidence that's another way to get out

1911  
01:09:46,950 --> 01:09:44,719  
of it so ultimately it gets down to a

1912  
01:09:47,829 --> 01:09:46,960  
context of plausibility

1913  
01:09:50,229 --> 01:09:47,839

you know

1914

01:09:52,309 --> 01:09:50,239

and sabino zavina was correct today that

1915

01:09:54,709 --> 01:09:52,319

science is about

1916

01:09:57,270 --> 01:09:54,719

what can be rendered

1917

01:09:59,430 --> 01:09:57,280

most implausible or at least implausible

1918

01:10:01,030 --> 01:09:59,440

because you know whatever data you come

1919

01:10:03,590 --> 01:10:01,040

to me with

1920

01:10:05,189 --> 01:10:03,600

i can always say well it's the hidden

1921

01:10:07,110 --> 01:10:05,199

flying spaghetti monster that

1922

01:10:08,950 --> 01:10:07,120

manipulated the physical world from

1923

01:10:11,030 --> 01:10:08,960

behind the curtains you know i cannot

1924

01:10:13,510 --> 01:10:11,040

disprove that hypothesis

1925

01:10:15,430 --> 01:10:13,520

but it's very implausible and i think on

1926

01:10:18,950 --> 01:10:15,440

that same account

1927

01:10:20,550 --> 01:10:18,960

parting with a statistical independence

1928

01:10:22,790 --> 01:10:20,560

in the name of

1929

01:10:24,390 --> 01:10:22,800

hidden variables for which we have no

1930

01:10:26,390 --> 01:10:24,400

empirical evidence

1931

01:10:29,030 --> 01:10:26,400

is implausible and

1932

01:10:30,229 --> 01:10:29,040

multi-universe is popping out from out

1933

01:10:32,310 --> 01:10:30,239

of nowhere for no reason every

1934

01:10:33,669 --> 01:10:32,320

infinitesimal fraction of a second is

1935

01:10:35,910 --> 01:10:33,679

implausible

1936

01:10:38,709 --> 01:10:35,920

and what remains on the table is very

1937

01:10:40,550 --> 01:10:38,719

very very plausible completely intuitive

1938

01:10:42,870 --> 01:10:40,560

physical entities are the outcome of

1939

01:10:44,550 --> 01:10:42,880

measurement just as the indications on

1940

01:10:46,550 --> 01:10:44,560

the dials of a dashboard

1941

01:10:49,110 --> 01:10:46,560

are the outcome of measurement if you

1942

01:10:51,030 --> 01:10:49,120

don't measure the dials show nothing if

1943

01:10:53,110 --> 01:10:51,040

you don't measure there is no physical

1944

01:10:54,950 --> 01:10:53,120

world but what is the thing that is

1945

01:10:56,229 --> 01:10:54,960

being measured that's the question

1946

01:10:57,430 --> 01:10:56,239

that's where we are going to make

1947

01:11:00,310 --> 01:10:57,440

progress

1948

01:11:01,990 --> 01:11:00,320

if we read what 40 years of experiments

1949

01:11:04,390 --> 01:11:02,000

are telling us if you reheat that

1950

01:11:07,590 --> 01:11:04,400

message we understand that there is a

1951  
01:11:09,270 --> 01:11:07,600  
deeper layer of reality whose appearance

1952  
01:11:11,510 --> 01:11:09,280  
is physicality

1953  
01:11:12,790 --> 01:11:11,520  
but not the essence the essence is

1954  
01:11:16,310 --> 01:11:12,800  
something else

1955  
01:11:18,790 --> 01:11:16,320  
physics is relative to that deeper layer

1956  
01:11:20,709 --> 01:11:18,800  
and i believe we may even

1957  
01:11:23,430 --> 01:11:20,719  
arrive eventually

1958  
01:11:25,510 --> 01:11:23,440  
at a deterministic theory of nature

1959  
01:11:26,390 --> 01:11:25,520  
if we start investigating that deeper

1960  
01:11:28,550 --> 01:11:26,400  
layer

1961  
01:11:30,390 --> 01:11:28,560  
without holding on to our metaphysical

1962  
01:11:32,790 --> 01:11:30,400  
prejudices that physicality should be

1963  
01:11:34,950 --> 01:11:32,800

the end of the story because it's

1964

01:11:36,390 --> 01:11:34,960

holding on to that

1965

01:11:37,590 --> 01:11:36,400

that will prevent us from making

1966

01:11:39,510 --> 01:11:37,600

progress

1967

01:11:41,590 --> 01:11:39,520

if we don't heed the results of

1968

01:11:43,270 --> 01:11:41,600

experiments but keep on fighting with

1969

01:11:46,550 --> 01:11:43,280

experiments

1970

01:11:48,149 --> 01:11:46,560

based on very implausible hypothesis

1971

01:11:50,470 --> 01:11:48,159

we will slow down progress we'll not

1972

01:11:53,030 --> 01:11:50,480

stop eventually this whole thing will

1973

01:11:55,030 --> 01:11:53,040

fizzle out you know fantasy doesn't

1974

01:11:55,910 --> 01:11:55,040

cannot last forever

1975

01:11:58,550 --> 01:11:55,920

um

1976

01:11:59,990 --> 01:11:58,560

but it will it will slow it down

1977

01:12:02,149 --> 01:12:00,000

digen

1978

01:12:05,030 --> 01:12:02,159

cppl wants to know thoughts on

1979

01:12:06,870 --> 01:12:05,040

yoshibok's theory of consciousness

1980

01:12:09,830 --> 01:12:06,880

that's a question for you i don't know

1981

01:12:13,189 --> 01:12:09,840

what progress he has made um since i had

1982

01:12:17,590 --> 01:12:13,199

an interaction i think with this joshua

1983

01:12:20,630 --> 01:12:17,600

on my forum years ago 2016 i think

1984

01:12:22,950 --> 01:12:20,640

but i think 2016 if this is the correct

1985

01:12:24,550 --> 01:12:22,960

your shabbah

1986

01:13:24,229 --> 01:12:24,560

i

1987

01:13:24,239 --> 01:13:29,189

okay everyone

1988

01:13:33,189 --> 01:13:31,270

yeah some people want to know if that

1989

01:13:35,510 --> 01:13:33,199

was the salvator pious who asked that

1990

01:13:36,709 --> 01:13:35,520

question yes that's true he is indeed

1991

01:13:40,229 --> 01:13:36,719

real he's a

1992

01:13:42,630 --> 01:13:40,239

person he's a perfect

1993

01:13:44,950 --> 01:13:42,640

and jolly fellow we recorded some small

1994

01:13:47,110 --> 01:13:44,960

conversations already about 15 minutes

1995

01:13:48,550 --> 01:13:47,120

maybe 30 minutes worth of extra material

1996

01:13:51,189 --> 01:13:48,560

to go at the end of our conversation

1997

01:13:52,950 --> 01:13:51,199

once we do have our live conversation

1998

01:13:55,110 --> 01:13:52,960

because usually what happens is i

1999

01:13:57,510 --> 01:13:55,120

privatize the live recordings which i'm

2000

01:13:59,350 --> 01:13:57,520

going to do here and add extra footage

2001  
01:14:01,430 --> 01:13:59,360  
improve the quality add a patreon

2002  
01:14:04,149 --> 01:14:01,440  
request etc

2003  
01:14:06,390 --> 01:14:04,159  
speaking of a patreon request if this is

2004  
01:14:07,990 --> 01:14:06,400  
the sort of content that you enjoy and

2005  
01:14:10,310 --> 01:14:08,000  
want to see more of and you have the

2006  
01:14:12,510 --> 01:14:10,320  
means and the wants then please do

2007  
01:14:14,790 --> 01:14:12,520  
consider going to

2008  
01:14:16,709 --> 01:14:14,800  
patreon.com it's a significant amount of

2009  
01:14:19,030 --> 01:14:16,719  
work to put some of these on sometimes

2010  
01:14:20,950 --> 01:14:19,040  
they take weeks so for example with sal

2011  
01:14:22,550 --> 01:14:20,960  
i want to go through his patents to do

2012  
01:14:24,790 --> 01:14:22,560  
them justice and that's going to take

2013  
01:14:27,189 --> 01:14:24,800

quite some time the reason that sal

2014

01:14:29,030 --> 01:14:27,199

reached out to myself and not others

2015

01:14:32,070 --> 01:14:29,040

will make sense once the interview is

2016

01:14:33,750 --> 01:14:32,080

conducted as well as the reason for

2017

01:14:36,070 --> 01:14:33,760

the interview being pushed to march will

2018

01:14:37,669 --> 01:14:36,080

make sense as well

2019

01:14:39,110 --> 01:14:37,679

if you're listening to this on the audio

2020

01:14:40,790 --> 01:14:39,120

platforms i know that right now you're

2021

01:14:43,030 --> 01:14:40,800

watching but if you're listening to this

2022

01:14:44,630 --> 01:14:43,040

on the audio platforms please do leave a

2023

01:14:46,470 --> 01:14:44,640

review on whichever platform you're on

2024

01:14:47,669 --> 01:14:46,480

whether it's itunes

2025

01:14:49,430 --> 01:14:47,679

google

2026

01:14:51,350 --> 01:14:49,440

spotify it

2027

01:14:53,830 --> 01:14:51,360

greatly aids the distribution i don't

2028

01:14:55,270 --> 01:14:53,840

think you can leave reviews on spotify

2029

01:14:56,709 --> 01:14:55,280

and if you're watching this and you had

2030

01:14:58,709 --> 01:14:56,719

no clue that there was the audio

2031

01:15:00,470 --> 01:14:58,719

platform versions then search theories

2032

01:15:02,709 --> 01:15:00,480

of everything plus whatever audio

2033

01:15:03,750 --> 01:15:02,719

platform it is that is of your choice so

2034

01:15:05,430 --> 01:15:03,760

itunes

2035

01:15:07,030 --> 01:15:05,440

pandora you can find it as well as the

2036

01:15:10,790 --> 01:15:07,040

links to them are in the description

2037

01:15:15,750 --> 01:15:12,950

okay thank you all for being here i

2038

01:15:20,630 --> 01:15:17,669

take care everyone thank you again thank

2039

01:15:24,310 --> 01:15:22,630

the podcast is now finished if you'd

2040

01:15:27,510 --> 01:15:24,320

like to support conversations like this

2041

01:15:31,590 --> 01:15:27,520

then do consider going to [patreon.com](https://patreon.com)

2042

01:15:34,229 --> 01:15:31,600

c-u-r-t j-a-i-m-u-n-g-a-l

2043

01:15:35,990 --> 01:15:34,239

that is kurt jaimungle it's support from

2044

01:15:37,830 --> 01:15:36,000

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