

A photograph of Daniel P. Sheehan, an older man with grey hair, wearing a brown suit jacket, standing at a podium and speaking. He is holding a blue pen in his right hand. The background is dark with some blue and purple lighting.

IT'S ABOUT TIME

DANIEL P. SHEEHAN



**SOCIETY
FOR
SCIENTIFIC
EXPLORATION**

1
00:00:08,090 --> 00:00:06,180
all right good afternoon I'm Daniel

2
00:00:10,500 --> 00:00:08,100
Sheehan from the University of San Diego

3
00:00:12,720 --> 00:00:10,510
today I'd like to give a brief talk

4
00:00:15,509 --> 00:00:12,730
about a very large subject called time

5
00:00:16,590 --> 00:00:15,519
which is foundational not just to

6
00:00:19,020 --> 00:00:16,600
everything that occurs because

7
00:00:21,120 --> 00:00:19,030
everything occurs in time but because

8
00:00:23,130 --> 00:00:21,130
the subject of time is undergoing I

9
00:00:25,800 --> 00:00:23,140
would say rather rapid change possibly

10
00:00:27,300 --> 00:00:25,810
paradigm will change in physics over the

11
00:00:29,610 --> 00:00:27,310
last ten to twenty years has become

12
00:00:32,490 --> 00:00:29,620
fairly evident that our understanding of

13
00:00:35,130 --> 00:00:32,500

time is possibly certainly needs some

14

00:00:38,580 --> 00:00:35,140

sort of tweaking and possibly complete

15

00:00:41,600 --> 00:00:38,590

reconstruction and so what I'd like to

16

00:00:47,190 --> 00:00:41,610

talk about is turn the whole thing off

17

00:00:50,030 --> 00:00:47,200

again okay is to talk it's about time to

18

00:00:52,590 --> 00:00:50,040

talk seriously about time because in

19

00:00:55,590 --> 00:00:52,600

discussing time physicists typically

20

00:00:57,569 --> 00:00:55,600

make kind of personal prejudices about

21

00:00:59,130 --> 00:00:57,579

how it should be approached and as a

22

00:01:01,650 --> 00:00:59,140

result I think we're missing a number of

23

00:01:03,900 --> 00:01:01,660

opportunities which I think SSC in

24

00:01:07,309 --> 00:01:03,910

particular is well situated to address

25

00:01:09,749 --> 00:01:07,319

in particular issues associated with SCI

26

00:01:14,879 --> 00:01:09,759

consciousness and the ontology of

27

00:01:17,489 --> 00:01:14,889

quantum mechanics so my talk will use as

28

00:01:18,690 --> 00:01:17,499

its lever the process of retro causation

29

00:01:21,599 --> 00:01:18,700

which has only really come into fashion

30

00:01:23,069 --> 00:01:21,609

over the last ten years or so and in

31

00:01:26,609 --> 00:01:23,079

order to do this I'd like first to talk

32

00:01:29,160 --> 00:01:26,619

about time symmetry and asymmetry and

33

00:01:31,379 --> 00:01:29,170

then talk about retro causation as it

34

00:01:35,370 --> 00:01:31,389

occurs both in theory and an experiment

35

00:01:38,940 --> 00:01:35,380

and then a brief theory that Patricia

36

00:01:41,179 --> 00:01:38,950

Cyrus and I developed about several

37

00:01:43,559 --> 00:01:41,189

years ago which may help explain

38

00:01:46,499 --> 00:01:43,569

precognition and finally some possible

39

00:01:48,539 --> 00:01:46,509

applications of this I would like to

40

00:01:51,389 --> 00:01:48,549

acknowledge a number of people to begin

41

00:01:54,779 --> 00:01:51,399

first of all Patricia Cyrus and I'm

42

00:01:59,879 --> 00:01:54,789

Absalon litzer Eli Cohen Julia Moss

43

00:02:02,429 --> 00:01:59,889

bridge and I've seen yes and Garrett

44

00:02:05,129 --> 00:02:02,439

Medel Garrett sorry and finally this is

45

00:02:07,409 --> 00:02:05,139

um this talk is dedicated to Richard

46

00:02:11,220 --> 00:02:07,419

shout who was one of our valued

47

00:02:13,289 --> 00:02:11,230

colleagues here so first of all the

48

00:02:15,899 --> 00:02:13,299

fundamental equations of physics are

49

00:02:17,520 --> 00:02:15,909

time symmetric and what that means is

50

00:02:19,410 --> 00:02:17,530

that if one takes positive

51
00:02:23,040 --> 00:02:19,420
time and replaces it with negative time

52
00:02:25,020 --> 00:02:23,050
one gets the same equations back so for

53
00:02:27,270 --> 00:02:25,030
instance if one looks at Newton's second

54
00:02:28,890 --> 00:02:27,280
law force equals MA mass times

55
00:02:31,680 --> 00:02:28,900
acceleration which is a second time

56
00:02:33,449 --> 00:02:31,690
derivative of position if one puts in

57
00:02:34,650 --> 00:02:33,459
positive time down here obviously which

58
00:02:38,130 --> 00:02:34,660
you square it you get a positive number

59
00:02:40,020 --> 00:02:38,140
but if you put a negative time since the

60
00:02:42,570 --> 00:02:40,030
time is squared in the denominator it

61
00:02:45,570 --> 00:02:42,580
becomes positive as well and so the

62
00:02:47,910 --> 00:02:45,580
equation is the same whether it is time

63
00:02:50,090 --> 00:02:47,920

forward or time reversed and this is

64

00:02:54,540 --> 00:02:50,100

fundamentally true of all the equations

65

00:02:58,290 --> 00:02:54,550

of physics they keep turning this off

66

00:03:01,020 --> 00:02:58,300

okay so to put this into into concrete

67

00:03:03,720 --> 00:03:01,030

perspective consider a hill in which you

68

00:03:06,509 --> 00:03:03,730

have a ball which is presently situated

69

00:03:08,520 --> 00:03:06,519

in the middle of the hill you woods you

70

00:03:10,320 --> 00:03:08,530

could say that in the past it was at the

71

00:03:11,550 --> 00:03:10,330

top of the hill in the future it is at

72

00:03:13,830 --> 00:03:11,560

the bottom of the hill and you could and

73

00:03:15,150 --> 00:03:13,840

you would possibly say well why is it at

74

00:03:17,220 --> 00:03:15,160

the at the middle of the hill right now

75

00:03:19,920 --> 00:03:17,230

is it because it was at the top of the

76

00:03:22,020 --> 00:03:19,930

hill earlier or is it because it is at

77

00:03:24,840 --> 00:03:22,030

the bottom of the hill later and the

78

00:03:27,180 --> 00:03:24,850

answer is it's both you can calculate

79

00:03:29,100 --> 00:03:27,190

the present position of this ball by

80

00:03:31,680 --> 00:03:29,110

working a time forward set of solutions

81

00:03:34,289 --> 00:03:31,690

from the past into the present or you

82

00:03:35,550 --> 00:03:34,299

could take the future solution where it

83

00:03:37,590 --> 00:03:35,560

happens in the future and run it

84

00:03:40,110 --> 00:03:37,600

backward in time and get the exact same

85

00:03:42,060 --> 00:03:40,120

result and this is also true in quantum

86

00:03:46,460 --> 00:03:42,070

mechanics both of these basic theories

87

00:03:49,140 --> 00:03:46,470

are deterministic but our everyday

88

00:03:51,390 --> 00:03:49,150

expression or feeling about time is not

89

00:03:54,270 --> 00:03:51,400

that way we noticed that in fact there

90

00:03:56,580 --> 00:03:54,280

is an arrow of time the the idea of the

91

00:03:59,310 --> 00:03:56,590

arrow of time was first proposed back

92

00:04:00,599 --> 00:03:59,320

about 1927 by Arthur Eddington one of

93

00:04:02,759 --> 00:04:00,609

the contemporary contemporaries of

94

00:04:04,590 --> 00:04:02,769

Einstein and there have been a number of

95

00:04:07,259 --> 00:04:04,600

arrows of time that have been proposed

96

00:04:09,539 --> 00:04:07,269

you have the cosmological arrow which

97

00:04:11,900 --> 00:04:09,549

indicates the direction of expansion of

98

00:04:14,940 --> 00:04:11,910

the universe but the cosmological arrow

99

00:04:17,180 --> 00:04:14,950

also has embedded in it in a sense or as

100

00:04:20,009 --> 00:04:17,190

in the initial conditions a very low

101
00:04:22,890 --> 00:04:20,019
entropy for the original configuration

102
00:04:25,020 --> 00:04:22,900
of the universe the one that more or

103
00:04:26,219 --> 00:04:25,030
less tempers and structures our everyday

104
00:04:29,130 --> 00:04:26,229
experience is what's called the

105
00:04:30,690 --> 00:04:29,140
thermodynamic arrow which is which is

106
00:04:31,330 --> 00:04:30,700
conditioned by the second law of

107
00:04:33,370 --> 00:04:31,340
thermodynamics

108
00:04:35,140 --> 00:04:33,380
the entropy change of any spontaneous

109
00:04:38,290 --> 00:04:35,150
process in the universe is always

110
00:04:40,570 --> 00:04:38,300
greater than or equal to zero this in

111
00:04:43,450 --> 00:04:40,580
turn probably conditions the radiation

112
00:04:45,159 --> 00:04:43,460
arrow of time and the personal

113
00:04:47,710 --> 00:04:45,169

psychological arrow of time that all of

114

00:04:50,379 --> 00:04:47,720

us experience as our experience sense

115

00:04:52,000 --> 00:04:50,389

that time moves forward other area

116

00:04:53,439 --> 00:04:52,010

arrows have been proposed for instance

117

00:04:56,950 --> 00:04:53,449

the wavefunction collapse but that's

118

00:05:00,520 --> 00:04:56,960

model dependent and then some very

119

00:05:04,840 --> 00:05:00,530

subtle subatomic processes like K on

120

00:05:07,330 --> 00:05:04,850

decay which have also been implicated so

121

00:05:08,379 --> 00:05:07,340

in in looking at the arrow of time one

122

00:05:10,090 --> 00:05:08,389

should think about the difference

123

00:05:12,610 --> 00:05:10,100

between what's a reversible and an

124

00:05:14,409 --> 00:05:12,620

irreversible process so a reversible

125

00:05:16,870 --> 00:05:14,419

process would be something like this a

126

00:05:18,790 --> 00:05:16,880

ball being thrown in the air if I throw

127

00:05:20,800 --> 00:05:18,800

it up and it comes down if I reverse

128

00:05:22,840 --> 00:05:20,810

that process it comes up and comes down

129

00:05:25,050 --> 00:05:22,850

and you can't tell whether the time is

130

00:05:28,570 --> 00:05:25,060

coming forward or backward for this ball

131

00:05:30,640 --> 00:05:28,580

because both of them are physically

132

00:05:33,100 --> 00:05:30,650

reasonable in either direction you can't

133

00:05:36,969 --> 00:05:33,110

tell but there are some processes like

134

00:05:39,340 --> 00:05:36,979

52-card pick up which indeed are time

135

00:05:42,100 --> 00:05:39,350

asymmetric so if you take something like

136

00:05:43,750 --> 00:05:42,110

a deck of cards it is possible that if I

137

00:05:45,670 --> 00:05:43,760

flip this deck of cards it will land in

138

00:05:47,529 --> 00:05:45,680

a perfect stack on the floor in front of

139

00:05:49,540 --> 00:05:47,539

me and then all the molecules reverse

140

00:05:52,120 --> 00:05:49,550

their direction and the stack will come

141

00:05:55,029 --> 00:05:52,130

back into my hand but that never happens

142

00:05:56,980 --> 00:05:55,039

I can do this for 10,000 times the age

143

00:05:58,629 --> 00:05:56,990

of the universe and you will never see

144

00:06:01,810 --> 00:05:58,639

this happen that is an irreversible

145

00:06:04,570 --> 00:06:01,820

process and this is conditioned by the

146

00:06:06,370 --> 00:06:04,580

second law of thermodynamics the change

147

00:06:11,290 --> 00:06:06,380

in entropy for any spontaneous process

148

00:06:13,990 --> 00:06:11,300

is never less than zero so this is the

149

00:06:15,909 --> 00:06:14,000

arrow the in a sense the master arrow of

150

00:06:22,990 --> 00:06:15,919

our experience although other ones have

151

00:06:24,640 --> 00:06:23,000

been proposed now in terms of at the

152

00:06:26,469 --> 00:06:24,650

foundational level at the quantum

153

00:06:29,290 --> 00:06:26,479

mechanical basis of quantum mechanical

154

00:06:32,500 --> 00:06:29,300

base a number of quantum models do admit

155

00:06:34,570 --> 00:06:32,510

the possibility of reverse arrow of time

156

00:06:36,909 --> 00:06:34,580

in other words processes which you could

157

00:06:39,450 --> 00:06:36,919

call retro causal these go back more

158

00:06:43,570 --> 00:06:39,460

than 60 years to cost on devote

159

00:06:46,779 --> 00:06:43,580

Beauregarde and the two that I find

160

00:06:49,240 --> 00:06:46,789

most compelling are the transactional

161

00:06:51,399 --> 00:06:49,250

which was developed by 1986 by John's

162

00:06:53,469 --> 00:06:51,409

Kramer and the two state vector

163

00:06:57,520 --> 00:06:53,479

formalism which was developed by her

164

00:07:00,640 --> 00:06:57,530

onif Bergman and label which about fifty

165

00:07:02,649 --> 00:07:00,650

years ago for illustration purposes I'd

166

00:07:03,959 --> 00:07:02,659

like to discuss simply the transactional

167

00:07:07,360 --> 00:07:03,969

because it's the most intuitive

168

00:07:09,070 --> 00:07:07,370

developed by Kramer based on John

169

00:07:12,459 --> 00:07:09,080

wheeler and Richard Feynman's model of

170

00:07:14,800 --> 00:07:12,469

electrodynamics in 1945 this model is

171

00:07:16,899 --> 00:07:14,810

quite nice in the sense that it it

172

00:07:23,709 --> 00:07:16,909

solves many of the ontological and

173

00:07:25,029 --> 00:07:23,719

epistemological Heian interpretation for

174

00:07:28,390 --> 00:07:25,039

instance the wave function is

175

00:07:30,189 --> 00:07:28,400

ontologically real in the transactional

176

00:07:31,689 --> 00:07:30,199

model whereas in the copenhagen model

177

00:07:33,399 --> 00:07:31,699

it's simply epistemic it's a

178

00:07:35,200 --> 00:07:33,409

mathematical structure that tells you

179

00:07:38,769 --> 00:07:35,210

about information about a system not

180

00:07:40,899 --> 00:07:38,779

about its reality it also the retro

181

00:07:42,879 --> 00:07:40,909

causal model also gives some meaning to

182

00:07:47,200 --> 00:07:42,889

the wave function the standard wave

183

00:07:49,330 --> 00:07:47,210

function ψ is given by a as a

184

00:07:51,189 --> 00:07:49,340

wave which means a wave that

185

00:07:52,930 --> 00:07:51,199

goes from the past into the future this

186

00:07:55,269 --> 00:07:52,940

would be the ket and standard Dirac

187

00:07:56,950 --> 00:07:55,279

notation and the advanced wave which

188

00:07:59,680 --> 00:07:56,960

goes from the future into the past would

189

00:08:02,829 --> 00:07:59,690

be psystar the complex conjugate or the

190

00:08:04,809 --> 00:08:02,839

bra what the present amounts to is a

191

00:08:07,600 --> 00:08:04,819

handshake agreement between the future

192

00:08:10,269 --> 00:08:07,610

and the past such that it is logically

193

00:08:13,180 --> 00:08:10,279

consistent and in in tune with all the

194

00:08:14,950 --> 00:08:13,190

conservation laws what's interesting

195

00:08:16,869 --> 00:08:14,960

about the transactional model is that

196

00:08:20,019 --> 00:08:16,879

since it admits both a forward and and

197

00:08:23,350 --> 00:08:20,029

advanced wave of equal stature on equal

198

00:08:25,170 --> 00:08:23,360

footing in doing this you solve the most

199

00:08:27,790 --> 00:08:25,180

pernicious problems in quantum mechanics

200

00:08:31,089 --> 00:08:27,800

quantum mechanics is renowned for its

201
00:08:33,130 --> 00:08:31,099
paradoxes things like the EPR paradox

202
00:08:36,630 --> 00:08:33,140
cruisers cat the wheeler delayed choice

203
00:08:39,610 --> 00:08:36,640
put dearly on wheelers delayed choice

204
00:08:41,259 --> 00:08:39,620
problem the big nurse friends and on and

205
00:08:44,769 --> 00:08:41,269
on and on there are more than a dozen or

206
00:08:46,650 --> 00:08:44,779
more standard problems in quantum

207
00:08:50,470 --> 00:08:46,660
mechanics which are called paradoxes

208
00:08:53,949 --> 00:08:50,480
virtually all of these in fact Kramer

209
00:08:56,610 --> 00:08:53,959
claims all of these can be resolved

210
00:09:00,510 --> 00:08:56,620
effortlessly by taking the

211
00:09:02,700 --> 00:09:00,520
advanced wave seriously so this talk is

212
00:09:05,220 --> 00:09:02,710
really about taking time seriously

213
00:09:07,769 --> 00:09:05,230

looking at the equations of physics at

214

00:09:11,940 --> 00:09:07,779

face value trusting what they say and

215

00:09:13,650 --> 00:09:11,950

the and and the dividend for this is

216

00:09:15,530 --> 00:09:13,660

that you solve some of the most

217

00:09:18,030 --> 00:09:15,540

pernicious problems in quantum mechanics

218

00:09:21,510 --> 00:09:18,040

so let's take a look at what happens in

219

00:09:23,579 --> 00:09:21,520

a in a standard problem associated with

220

00:09:25,920 --> 00:09:23,589

the transactional interpretation so

221

00:09:27,540 --> 00:09:25,930

let's consider what it takes to see the

222

00:09:29,940 --> 00:09:27,550

star Betelgeuse in the constellation

223

00:09:31,740 --> 00:09:29,950

Orion the constellation Orion is kind of

224

00:09:33,630 --> 00:09:31,750

set out here here are the three stars

225

00:09:35,820 --> 00:09:33,640

over the belt on the top right hand

226

00:09:38,370 --> 00:09:35,830

corner or the shoulder of Orion is the

227

00:09:41,280 --> 00:09:38,380

star Betelgeuse the distance about 500

228

00:09:43,079 --> 00:09:41,290

to 525 a years away here's a spacetime

229

00:09:46,650 --> 00:09:43,089

diagram where time is on this axis

230

00:09:48,750 --> 00:09:46,660

spaces on this axis so the way through

231

00:09:50,490 --> 00:09:48,760

the transactional model the way you see

232

00:09:54,900 --> 00:09:50,500

light from Betelgeuse on a starry night

233

00:09:59,130 --> 00:09:54,910

is in the following way the star emits a

234

00:10:02,010 --> 00:09:59,140

wave in to along the light cone

235

00:10:02,699 --> 00:10:02,020

in the direction of the present and when

236

00:10:05,010 --> 00:10:02,709

it gets here

237

00:10:07,110 --> 00:10:05,020

there is a choice made to offer a

238

00:10:09,810 --> 00:10:07,120

response wave which comes back from the

239

00:10:12,480 --> 00:10:09,820

from the future backward to the star

240

00:10:15,150 --> 00:10:12,490

this is done a temporarily when this

241

00:10:17,730 --> 00:10:15,160

occurs if there's a stochastic choice

242

00:10:19,500 --> 00:10:17,740

and a transaction is undergone whereby

243

00:10:21,090 --> 00:10:19,510

the whereby the standard observed

244

00:10:23,250 --> 00:10:21,100

quantities conserved quantities like

245

00:10:24,750 --> 00:10:23,260

energy and momentum are transacted and

246

00:10:27,240 --> 00:10:24,760

when all of all agreements have been

247

00:10:30,150 --> 00:10:27,250

made and handshake has been reached you

248

00:10:31,920 --> 00:10:30,160

suddenly see the photon and so you you

249

00:10:34,380 --> 00:10:31,930

have the you have the and

250

00:10:37,350 --> 00:10:34,390

advance wave on equal footing and this

251
00:10:39,990 --> 00:10:37,360
handshake then is creates the present

252
00:10:41,850 --> 00:10:40,000
but what's but what is what what is

253
00:10:44,400 --> 00:10:41,860
different from what everyone from what

254
00:10:48,540 --> 00:10:44,410
most scientists presume is that the

255
00:10:49,769 --> 00:10:48,550
future wave now exists now when it comes

256
00:10:51,720 --> 00:10:49,779
to emission and absorption

257
00:10:54,630 --> 00:10:51,730
they are simply time reverse processes

258
00:10:56,040 --> 00:10:54,640
so emission going forward in time is

259
00:10:58,620 --> 00:10:56,050
equal to absorption going backward in

260
00:11:00,660 --> 00:10:58,630
time and vice-versa so one could eat

261
00:11:03,030 --> 00:11:00,670
just as easily take some take the

262
00:11:05,819 --> 00:11:03,040
advanced wave as the offer wave coming

263
00:11:07,560 --> 00:11:05,829

back in time and the response wave

264

00:11:09,490 --> 00:11:07,570

coming from the past if you would have a

265

00:11:13,840 --> 00:11:09,500

truly symmetric

266

00:11:15,370 --> 00:11:13,850

symmetric theory so experiments in retro

267

00:11:17,380 --> 00:11:15,380

causation actually go back quite a ways

268

00:11:19,240 --> 00:11:17,390

or can be interpreted as such for

269

00:11:22,060 --> 00:11:19,250

instance a wheelers daily choice back in

270

00:11:24,670 --> 00:11:22,070

1984 was was pretty much sewn up in

271

00:11:26,020 --> 00:11:24,680

about 2007 by Jacques Adal there have

272

00:11:27,700 --> 00:11:26,030

been a number of human studies which can

273

00:11:31,300 --> 00:11:27,710

be interpreted in terms of retro causal

274

00:11:34,690 --> 00:11:31,310

behavior mostly well and these in this

275

00:11:37,330 --> 00:11:34,700

case in terms of precognition a number

276

00:11:39,160 --> 00:11:37,340

of conferences have now been convened at

277

00:11:41,230 --> 00:11:39,170

my university to discuss the issue of

278

00:11:44,950 --> 00:11:41,240

retro causation and a number of speakers

279

00:11:49,830 --> 00:11:44,960

in this room have attended to try to

280

00:11:52,630 --> 00:11:49,840

shore up these ideas so a hypothesis

281

00:11:54,970 --> 00:11:52,640

remote-viewing precognition can be

282

00:11:57,100 --> 00:11:54,980

explained at least in part by retro

283

00:11:59,920 --> 00:11:57,110

causal influences between the viewers

284

00:12:02,110 --> 00:11:59,930

future and present selves so in the

285

00:12:05,350 --> 00:12:02,120

transactional model one would have the

286

00:12:08,950 --> 00:12:05,360

future self here sending back a wave

287

00:12:11,050 --> 00:12:08,960

into the past getting a response wave of

288

00:12:13,930 --> 00:12:11,060

getting getting a response way back and

289

00:12:16,060 --> 00:12:13,940

if a transaction is complete one has one

290

00:12:19,120 --> 00:12:16,070

has effectively information transfer

291

00:12:21,760 --> 00:12:19,130

from the future into the past no energy

292

00:12:24,520 --> 00:12:21,770

is transferred necessarily this is this

293

00:12:27,900 --> 00:12:24,530

can be this would be a effectively a

294

00:12:31,840 --> 00:12:27,910

correlation so you have science I star

295

00:12:34,120 --> 00:12:31,850

so this model on which which Patricia

296

00:12:36,640 --> 00:12:34,130

Cyrus and I have have worked on has

297

00:12:38,770 --> 00:12:36,650

three three assumptions first of all you

298

00:12:41,140 --> 00:12:38,780

take seriously the time symmetry in the

299

00:12:42,970 --> 00:12:41,150

equations of physics no longer do you

300

00:12:45,160 --> 00:12:42,980

you follow the idea that there's simply

301
00:12:47,740 --> 00:12:45,170
causality there should be also retro

302
00:12:50,440 --> 00:12:47,750
causality in the equations to honor the

303
00:12:52,360 --> 00:12:50,450
equations themselves if you do that then

304
00:12:54,520 --> 00:12:52,370
it follows that you can also apply the

305
00:12:56,470 --> 00:12:54,530
second law back in time with a caveat

306
00:12:59,470 --> 00:12:56,480
because the second law does have a

307
00:13:01,090 --> 00:12:59,480
loophole in it and third are their

308
00:13:03,700 --> 00:13:01,100
quantum correlates to consciousness

309
00:13:04,690 --> 00:13:03,710
because this this model presumes some

310
00:13:06,280 --> 00:13:04,700
sort of quantum correlative

311
00:13:09,670 --> 00:13:06,290
consciousness which allows these

312
00:13:11,680 --> 00:13:09,680
transactions to occur so is the brain

313
00:13:13,540 --> 00:13:11,690

quantum mechanical in nature in some

314

00:13:15,070 --> 00:13:13,550

respects well at the microscopic level

315

00:13:16,960 --> 00:13:15,080

it has to be because it's made out of

316

00:13:19,360 --> 00:13:16,970

out of atoms and molecules there's no

317

00:13:21,040 --> 00:13:19,370

real question about that but as one

318

00:13:23,420 --> 00:13:21,050

moves up to the meso scopic scale to the

319

00:13:26,329 --> 00:13:23,430

size scales of microtubules and synapse

320

00:13:28,910 --> 00:13:26,339

it's been argued such by by Stuart

321

00:13:30,769 --> 00:13:28,920

Hameroff Roger Penrose and others but

322

00:13:34,249 --> 00:13:30,779

there's a good deal of controversy along

323

00:13:37,309 --> 00:13:34,259

these lines but it is it is plausible at

324

00:13:39,470 --> 00:13:37,319

the macroscopic scale perhaps but by no

325

00:13:43,309 --> 00:13:39,480

means has this been shown to be true

326

00:13:44,990 --> 00:13:43,319

however I would argue that the best

327

00:13:46,309 --> 00:13:45,000

evidence that there are quantum

328

00:13:50,179 --> 00:13:46,319

correlates to consciousness is

329

00:13:52,460 --> 00:13:50,189

precognition itself because if this

330

00:13:54,110 --> 00:13:52,470

model is reasonable and a classical

331

00:13:56,600 --> 00:13:54,120

model as far as I can tell would not

332

00:13:58,970 --> 00:13:56,610

allow this if we want to work within the

333

00:14:01,639 --> 00:13:58,980

paradigm of quantum mechanics then the

334

00:14:02,869 --> 00:14:01,649

very existence of precognition indicates

335

00:14:04,699 --> 00:14:02,879

that you have quantum correlates of

336

00:14:09,199 --> 00:14:04,709

consciousness will allow which would

337

00:14:11,269 --> 00:14:09,209

allow moving this hypothesis forward but

338

00:14:14,269 --> 00:14:11,279

then there is the famous veil of the

339

00:14:17,449 --> 00:14:14,279

second law and the second law as many of

340

00:14:19,550 --> 00:14:17,459

you know is considered the ultimate law

341

00:14:22,639 --> 00:14:19,560

of fit of nature at least according to

342

00:14:24,319 --> 00:14:22,649

Eddington but what you're basically

343

00:14:26,329 --> 00:14:24,329

doing is playing probability in loose

344

00:14:30,139 --> 00:14:26,339

terms so if you look at the number of

345

00:14:32,030 --> 00:14:30,149

microstates that correspond to a system

346

00:14:33,650 --> 00:14:32,040

out of equilibrium it constantly

347

00:14:37,220 --> 00:14:33,660

increases in time this is the number of

348

00:14:39,980 --> 00:14:37,230

ways in which the system can can't exist

349

00:14:42,019 --> 00:14:39,990

in and this is the time coordinate so

350

00:14:43,730 --> 00:14:42,029

the thermodynamic arrow presumably works

351

00:14:45,499 --> 00:14:43,740

in the following fashion if one

352

00:14:48,650 --> 00:14:45,509

considers the present moment you have a

353

00:14:50,929 --> 00:14:48,660

number of microstates or associated or

354

00:14:54,650 --> 00:14:50,939

complexions associated with it and if

355

00:14:56,870 --> 00:14:54,660

one looks at the present state it can in

356

00:14:59,150 --> 00:14:56,880

principle communicate with let's say an

357

00:15:01,220 --> 00:14:59,160

offer wave into the future in multiple

358

00:15:04,610 --> 00:15:01,230

ways because presumably there are more

359

00:15:06,559 --> 00:15:04,620

ways for it to move forward into more

360

00:15:08,870 --> 00:15:06,569

into more possible States because of the

361

00:15:11,499 --> 00:15:08,880

increase in entropy then going backward

362

00:15:14,629 --> 00:15:11,509

and so normally you would see time going

363

00:15:17,870 --> 00:15:14,639

forward and your experience is moving in

364

00:15:19,939 --> 00:15:17,880

that direction likewise when you have

365

00:15:23,660 --> 00:15:19,949

wavefunction collapse decoherence can be

366

00:15:28,059 --> 00:15:23,670

looked at in loosely as a quantum

367

00:15:31,610 --> 00:15:28,069

version of the second law however

368

00:15:34,040 --> 00:15:31,620

imagine a following situation let's

369

00:15:37,310 --> 00:15:34,050

consider having a future state of the

370

00:15:39,230 --> 00:15:37,320

brain being completely unique you know

371

00:15:40,940 --> 00:15:39,240

the organization of neurons that gives

372

00:15:44,090 --> 00:15:40,950

rise to a thought and again nobody knows

373

00:15:45,769 --> 00:15:44,100

really what what corresponds to a memory

374

00:15:48,380 --> 00:15:45,779

or a thought and this is one of the the

375

00:15:50,690 --> 00:15:48,390

principal lacunae of the of the of the

376

00:15:52,490 --> 00:15:50,700

theory and in science but if that's the

377

00:15:55,400 --> 00:15:52,500

case and this is a unique wave function

378

00:15:57,980 --> 00:15:55,410

if it sends waves both into the forward

379

00:15:59,449 --> 00:15:57,990

into the waves into the future

380

00:16:01,550 --> 00:15:59,459

and it advanced waves backwards

381

00:16:03,320 --> 00:16:01,560

if this is a unique completely unique

382

00:16:04,970 --> 00:16:03,330

wave function in the universe there is

383

00:16:07,820 --> 00:16:04,980

nothing to absorb it as it moves

384

00:16:10,670 --> 00:16:07,830

backward along its its path into the

385

00:16:12,949 --> 00:16:10,680

past when it reaches the past it can

386

00:16:14,720 --> 00:16:12,959

encounter the an identical set of

387

00:16:17,360 --> 00:16:14,730

neurons after all it is the same brain

388

00:16:19,040 --> 00:16:17,370

and both of these both of these are

389

00:16:22,130 --> 00:16:19,050

energized by biochemical processes

390

00:16:24,530 --> 00:16:22,140

therefore it has the energy and to to

391

00:16:26,420 --> 00:16:24,540

change it can send an advanced wave

392

00:16:29,690 --> 00:16:26,430

forward and if a handshake agreement is

393

00:16:31,840 --> 00:16:29,700

agreed to then you have a transmission

394

00:16:34,490 --> 00:16:31,850

or a change

395

00:16:36,980 --> 00:16:34,500

created by in the future into the past

396

00:16:37,760 --> 00:16:36,990

this would correspond to a precognitive

397

00:16:39,740 --> 00:16:37,770

event

398

00:16:41,960 --> 00:16:39,750

this requires specificity of the wave

399

00:16:43,699 --> 00:16:41,970

function and again as I mentioned what

400

00:16:45,650 --> 00:16:43,709

it takes to have a thought is still an

401
00:16:47,540 --> 00:16:45,660
open question however this is plausible

402
00:16:50,410 --> 00:16:47,550
from the point of view that quantum

403
00:16:54,530 --> 00:16:50,420
information does use the idea of

404
00:16:57,800 --> 00:16:54,540
isolation of particular wave function

405
00:16:59,690 --> 00:16:57,810
within Hilbert space to guarantee lack

406
00:17:02,000 --> 00:16:59,700
of decoherence this is these are called

407
00:17:05,419 --> 00:17:02,010
decoherence free subspaces so this idea

408
00:17:07,669 --> 00:17:05,429
has has currency and quantum information

409
00:17:11,660 --> 00:17:07,679
already though not at the level of the

410
00:17:14,929 --> 00:17:11,670
brain of course so if if one can explain

411
00:17:18,829 --> 00:17:14,939
and if in fact a precognition is a form

412
00:17:20,840 --> 00:17:18,839
of Retro causation that satisfies second

413
00:17:23,750 --> 00:17:20,850

law constraints because after all what

414

00:17:27,140 --> 00:17:23,760

happens back here is you responding to

415

00:17:28,940 --> 00:17:27,150

your future precognitive event you would

416

00:17:30,919 --> 00:17:28,950

have entropy being produced at this

417

00:17:34,580 --> 00:17:30,929

location so this satisfies the second

418

00:17:36,730 --> 00:17:34,590

law and it also satisfies the

419

00:17:39,200 --> 00:17:36,740

constraints of quantum mechanics as well

420

00:17:40,940 --> 00:17:39,210

if this is possible then I would propose

421

00:17:44,330 --> 00:17:40,950

that one way to studied it and perhaps

422

00:17:46,909 --> 00:17:44,340

to to well certainly detest it is to try

423

00:17:48,530 --> 00:17:46,919

building a precognitive apparatus that

424

00:17:50,810 --> 00:17:48,540

would be a that would be a quantum

425

00:17:53,450 --> 00:17:50,820

device with a large number with

426
00:17:56,450 --> 00:17:53,460
with sufficient complexity that it is

427
00:18:00,110 --> 00:17:56,460
completely specific in other words let's

428
00:18:03,350 --> 00:18:00,120
say unique in the universe and then put

429
00:18:05,930 --> 00:18:03,360
a random input into it such that it can

430
00:18:07,879 --> 00:18:05,940
it can register that send back an offer

431
00:18:09,620 --> 00:18:07,889
wave get a response way back in

432
00:18:13,460 --> 00:18:09,630
principle and if you had something like

433
00:18:15,470 --> 00:18:13,470
a 21 digit number this has in in the in

434
00:18:17,840 --> 00:18:15,480
the random number in the future well a

435
00:18:20,330 --> 00:18:17,850
21 digit number where the digits are 0

436
00:18:22,159 --> 00:18:20,340
to 9 you could take a thousand of those

437
00:18:23,629 --> 00:18:22,169
numbers per second for the age of the

438
00:18:25,159 --> 00:18:23,639

universe and not really expect to get a

439

00:18:27,499 --> 00:18:25,169

repeat so if you had a truly random

440

00:18:29,990 --> 00:18:27,509

number or a large random number here and

441

00:18:32,419 --> 00:18:30,000

you got that information before it was

442

00:18:36,590 --> 00:18:32,429

created in the future you could in

443

00:18:38,980 --> 00:18:36,600

principle kind of validate the

444

00:18:41,360 --> 00:18:38,990

hypothesis that precognition is possible

445

00:18:42,590 --> 00:18:41,370

this Oracle of course would be useful

446

00:18:45,110 --> 00:18:42,600

because it would allow you to push

447

00:18:47,600 --> 00:18:45,120

forward questions associated with the

448

00:18:49,789 --> 00:18:47,610

ontology of quantum mechanics and the

449

00:18:52,310 --> 00:18:49,799

nature of time but also perhaps give

450

00:18:54,289 --> 00:18:52,320

some some legs and support to the idea

451

00:18:56,180 --> 00:18:54,299

of precognition that allow us to study

452

00:19:00,009 --> 00:18:56,190

precognition more carefully might be

453

00:19:02,539 --> 00:19:00,019

able to tweak parameters of the system

454

00:19:05,330 --> 00:19:02,549

ok so again the Oracle would be quantum

455

00:19:07,549 --> 00:19:05,340

mechanical it would be isolated from

456

00:19:10,639 --> 00:19:07,559

decoherence in a way perhaps similar to

457

00:19:12,560 --> 00:19:10,649

decoherence free subspace how they do it

458

00:19:15,619 --> 00:19:12,570

and it would be complex highly specific

459

00:19:18,080 --> 00:19:15,629

wave function so in summary so in

460

00:19:20,450 --> 00:19:18,090

summary physical laws are temporally

461

00:19:22,940 --> 00:19:20,460

symmetric but our experience of reality

462

00:19:26,690 --> 00:19:22,950

is asymmetric asymmetric primarily due

463

00:19:28,759 --> 00:19:26,700

to the second law some quantum models do

464

00:19:30,499 --> 00:19:28,769

admit retro cause causal behavior but

465

00:19:33,320 --> 00:19:30,509

all the basic laws of physics do allow

466

00:19:35,450 --> 00:19:33,330

retro causal events as well there seems

467

00:19:37,549 --> 00:19:35,460

to be experiment very good experimental

468

00:19:42,799 --> 00:19:37,559

support for retro causation largely by

469

00:19:45,019 --> 00:19:42,809

people in this room some some brain

470

00:19:46,369 --> 00:19:45,029

processes are processes are likely

471

00:19:49,399 --> 00:19:46,379

quantum mechanical by the very existence

472

00:19:51,289 --> 00:19:49,409

of things like precognition the second

473

00:19:53,090 --> 00:19:51,299

law apparently can be bi-directional in

474

00:19:55,039 --> 00:19:53,100

time as long as entropy increases with

475

00:19:59,450 --> 00:19:55,049

each event going either into the future

476
00:20:00,619 --> 00:19:59,460
or into the past and precognition could

477
00:20:03,379 --> 00:20:00,629
be quantum mechanically

478
00:20:04,540 --> 00:20:03,389
thermodynamically based and I think it

479
00:20:06,880 --> 00:20:04,550
is time for someone to

480
00:20:11,770 --> 00:20:06,890
we try to build a quantum Oracle to test

481
00:20:14,860 --> 00:20:11,780
some of these hypotheses so this final

482
00:20:17,770 --> 00:20:14,870
board chalkboard is one of the last

483
00:20:21,070 --> 00:20:17,780
emails from Richard shop and I have it

484
00:20:25,500 --> 00:20:21,080
pinned up end over my desk to remind me

485
00:20:29,650 --> 00:20:25,510
humorously of of who'd dick was but also

486
00:20:32,310 --> 00:20:29,660
to inspire me and so thank you for your

487
00:20:32,320 --> 00:20:41,639
[Applause]

488
00:20:48,549 --> 00:20:45,580

thanks Jen that's really it gets you

489

00:20:54,460 --> 00:20:48,559

thinking we do have a few minutes for

490

00:20:56,230 --> 00:20:54,470

questions so Dan I just have a

491

00:20:58,750 --> 00:20:56,240

suggestion yes

492

00:21:02,380 --> 00:20:58,760

you're the device you were talking about

493

00:21:05,409 --> 00:21:02,390

building is it sort of digital device

494

00:21:07,450 --> 00:21:05,419

intended to be unique there's something

495

00:21:10,029 --> 00:21:07,460

I had thought about many years ago but

496

00:21:15,310 --> 00:21:10,039

seems applicable in this context is the

497

00:21:18,629 --> 00:21:15,320

idea of a crystal that has so many

498

00:21:20,259 --> 00:21:18,639

unique facets to it that it is not

499

00:21:22,629 --> 00:21:20,269

reproducible I mean it would be

500

00:21:24,580 --> 00:21:22,639

completely unique doing something like

501
00:21:27,580 --> 00:21:24,590
sending light through that crystal in

502
00:21:30,220 --> 00:21:27,590
the future and then seeing you know

503
00:21:33,039 --> 00:21:30,230
whether you have a relationship between

504
00:21:35,440 --> 00:21:33,049
the past something that occurs to the

505
00:21:37,240 --> 00:21:35,450
crystal in the past in relation to the

506
00:21:37,990 --> 00:21:37,250
future so I just offer that as a

507
00:21:39,220 --> 00:21:38,000
suggestion

508
00:21:43,360 --> 00:21:39,230
I think the person behind you is

509
00:21:44,590 --> 00:21:43,370
actually trying something like that yes

510
00:21:46,090 --> 00:21:44,600
but I mean it would have to satisfy

511
00:21:47,769 --> 00:21:46,100
certain constraints would have to be

512
00:21:49,870 --> 00:21:47,779
truly unique it would probably have to

513
00:21:52,090 --> 00:21:49,880

be a driven system like our like our

514

00:21:54,159 --> 00:21:52,100

brains are driven such that if you send

515

00:21:55,480 --> 00:21:54,169

back let's say a signal

516

00:21:57,399 --> 00:21:55,490

it could be something similar to what

517

00:21:59,710 --> 00:21:57,409

happens in a laser where if you have if

518

00:22:01,509 --> 00:21:59,720

you have stimulated emission in a laser

519

00:22:04,360 --> 00:22:01,519

a photon moving through the laser cavity

520

00:22:06,970 --> 00:22:04,370

can hit a metastable atom or molecule

521

00:22:08,799 --> 00:22:06,980

and cause it to emit without actually

522

00:22:11,200 --> 00:22:08,809

transferring any energy that photon

523

00:22:13,509 --> 00:22:11,210

continues and yet the atom itself has

524

00:22:15,850 --> 00:22:13,519

stimulated emission so you can you can

525

00:22:19,269 --> 00:22:15,860

in principle calculate the transmission

526

00:22:21,070 --> 00:22:19,279

I should say that the transition rates

527

00:22:23,440 --> 00:22:21,080

between the future in the past using

528

00:22:26,289 --> 00:22:23,450

something like a Fermi golden rule but

529

00:22:28,330 --> 00:22:26,299

what's really missing from this is what

530

00:22:30,460 --> 00:22:28,340

constitutes a thought or an experience

531

00:22:32,379 --> 00:22:30,470

such that when you have a flash of an

532

00:22:34,539 --> 00:22:32,389

auto accident or a flash of a number of

533

00:22:36,850 --> 00:22:34,549

friends face who hasn't visited you yet

534

00:22:38,889 --> 00:22:36,860

what corresponds to that in the brain

535

00:22:40,539 --> 00:22:38,899

and having spoken to a number of

536

00:22:43,810 --> 00:22:40,549

neuroscientists nobody seems to know

537

00:22:46,269 --> 00:22:43,820

what that is that is I think one of the

538

00:22:48,639 --> 00:22:46,279

linchpin lacunae of this entire project

539

00:22:50,760 --> 00:22:48,649

so your crystal may be a good idea but

540

00:22:52,529 --> 00:22:50,770

it has to be pretty unique

541

00:22:58,320 --> 00:22:52,539

in order for it to work not not to

542

00:23:00,539 --> 00:22:58,330

organize Julia so first of all I'm

543

00:23:02,399 --> 00:23:00,549

outing you so when you say a quantum

544

00:23:03,899 --> 00:23:02,409

Oracle are you talking about as a time

545

00:23:05,370 --> 00:23:03,909

machine certain just letting everyone

546

00:23:07,919 --> 00:23:05,380

know he's talking about a time machine

547

00:23:09,570 --> 00:23:07,929

second of all but okay having said that

548

00:23:11,399 --> 00:23:09,580

having said that I would like to I would

549

00:23:13,860 --> 00:23:11,409

like to I would like to issue a warning

550

00:23:15,960 --> 00:23:13,870

in that much of the problem the SSC

551

00:23:18,090 --> 00:23:15,970

faces and I believe this is something

552

00:23:20,700 --> 00:23:18,100

that is right down the alley of SSC and

553

00:23:22,649 --> 00:23:20,710

it can affect our understanding of the

554

00:23:24,090 --> 00:23:22,659

foundations of time the ontology of

555

00:23:25,889 --> 00:23:24,100

quantum mechanics consciousness

556

00:23:27,810 --> 00:23:25,899

precognition all of these things but

557

00:23:29,940 --> 00:23:27,820

when you start using words that have a

558

00:23:32,970 --> 00:23:29,950

lot of baggage carried with them it

559

00:23:33,769 --> 00:23:32,980

works against us in a way so but it is a

560

00:23:36,210 --> 00:23:33,779

time machine

561

00:23:37,980 --> 00:23:36,220

time travel is an awesome word and

562

00:23:46,889 --> 00:23:37,990

should work for us but if you if you go

563

00:23:48,149 --> 00:23:46,899

back can you go back to yeah so here's

564

00:23:49,860 --> 00:23:48,159

what I don't understand about that so

565

00:23:51,810 --> 00:23:49,870

from my reading of transactional

566

00:23:54,060 --> 00:23:51,820

interpretation and I admit I can't I

567

00:23:56,010 --> 00:23:54,070

feel like John Kramer's and it's very

568

00:23:58,769 --> 00:23:56,020

dense so I ended up reading both Kastner

569

00:24:00,299 --> 00:23:58,779

and I think she's excellent right so she

570

00:24:02,490 --> 00:24:00,309

has a possiblest interpretation which is

571

00:24:07,169 --> 00:24:02,500

not exactly the same as John Kramer's

572

00:24:08,789 --> 00:24:07,179

but is that the floor with this kind of

573

00:24:11,519 --> 00:24:08,799

model because people approach her with

574

00:24:13,799 --> 00:24:11,529

his model right number one that's last

575

00:24:15,600 --> 00:24:13,809

meeting she discussed this she sees and

576
00:24:18,000 --> 00:24:15,610
they still don't understand how you see

577
00:24:21,810 --> 00:24:18,010
this but she sees that because it's a

578
00:24:24,690 --> 00:24:21,820
temporal the offer and and the

579
00:24:25,980 --> 00:24:24,700
acceptance wave are a temporal then

580
00:24:28,620 --> 00:24:25,990
they're actually it's like almost like a

581
00:24:30,630 --> 00:24:28,630
third position so it's not between the

582
00:24:32,880 --> 00:24:30,640
present and the future because those are

583
00:24:34,950 --> 00:24:32,890
temporal it's like this so it's like

584
00:24:36,600 --> 00:24:34,960
retro correlative not retro yeah you

585
00:24:38,760 --> 00:24:36,610
know I myself don't really believe in

586
00:24:40,409 --> 00:24:38,770
causation or or retro causation these

587
00:24:41,399 --> 00:24:40,419
are just words that people like as

588
00:24:43,950 --> 00:24:41,409

signposts

589

00:24:46,260 --> 00:24:43,960

I believe in correlations strong

590

00:24:47,549 --> 00:24:46,270

correlations people call causal because

591

00:24:49,620 --> 00:24:47,559

it allows them to build them build a

592

00:24:51,419 --> 00:24:49,630

model and tell a story but in fact the

593

00:24:53,190 --> 00:24:51,429

world's made out of far as I can tell

594

00:24:57,330 --> 00:24:53,200

simply correlations some of which are

595

00:25:03,370 --> 00:25:00,640

okay I waiting for you you may be well I

596

00:25:06,160 --> 00:25:03,380

I actually don't have anything to say

597

00:25:09,010 --> 00:25:06,170

about your talk in and of itself well

598

00:25:11,590 --> 00:25:09,020

what are you doing here I wanted to

599

00:25:14,230 --> 00:25:11,600

commend to your attention in case you

600

00:25:17,620 --> 00:25:14,240

haven't read it maybe you have a book by

601
00:25:21,730 --> 00:25:17,630
Lee Smolin called time reborn published

602
00:25:23,620 --> 00:25:21,740
2013 small enzymatic physicist be a

603
00:25:27,790 --> 00:25:23,630
great SSC member if he weren't afraid of

604
00:25:29,980 --> 00:25:27,800
our reputation but he's he basically got

605
00:25:32,770 --> 00:25:29,990
fed up with conventional interpretations

606
00:25:35,200 --> 00:25:32,780
of time and tried to recast physics in a

607
00:25:41,140 --> 00:25:35,210
way that makes the present moment unique

608
00:25:41,890 --> 00:25:41,150
and important thank you thank you very