

1  
00:00:00,000 --> 00:00:09,320  
let me give a brief abstract to the talk

2  
00:00:05,219 --> 00:00:11,849  
rather than start into the sequence of

3  
00:00:09,320 --> 00:00:16,350  
PowerPoint slides if you look up

4  
00:00:11,849 --> 00:00:18,899  
textbooks on physics you'll find decay

5  
00:00:16,350 --> 00:00:21,810  
rates of the radioactive elements listed

6  
00:00:18,899 --> 00:00:25,259  
and you'll be told that these are

7  
00:00:21,809 --> 00:00:28,049  
constants nothing nothing changes the

8  
00:00:25,260 --> 00:00:33,660  
decay rate of any of these radioactive

9  
00:00:28,050 --> 00:00:39,210  
elements well my colleagues here

10  
00:00:33,659 --> 00:00:41,429  
function and etc Purdue University have

11  
00:00:39,210 --> 00:00:43,350  
realized that there's contradictory

12  
00:00:41,429 --> 00:00:46,799  
evidence of this at least three

13  
00:00:43,350 --> 00:00:50,370  
laboratories who have carried out not a

14  
00:00:46,799 --> 00:00:52,828  
year studies of several elements

15  
00:00:50,369 --> 00:00:55,288  
radioactive elements have found annual

16  
00:00:52,829 --> 00:01:00,210  
variations in the decay rates these

17  
00:00:55,289 --> 00:01:04,140  
elements there they there thurs

18  
00:01:00,210 --> 00:01:07,680  
interpretation was that this must be due

19  
00:01:04,140 --> 00:01:11,118  
to the varying distance between the

20  
00:01:07,680 --> 00:01:13,350  
Earth and the Sun that there's some

21  
00:01:11,118 --> 00:01:16,140  
particles or some other effect coming

22  
00:01:13,349 --> 00:01:18,000  
from the Sun that therefore varies with

23  
00:01:16,140 --> 00:01:20,579  
the variation of distance of the Earth

24  
00:01:18,000 --> 00:01:22,319  
and the Sun and is at this point that I

25  
00:01:20,579 --> 00:01:27,118  
came into the picture and joined them

26  
00:01:22,319 --> 00:01:29,609  
and I have concluded that is not the

27  
00:01:27,118 --> 00:01:33,650  
case that there is something else going

28  
00:01:29,609 --> 00:01:36,599  
on and that it really is due to a

29

00:01:33,650 --> 00:01:39,509  
process that I have involved neutrinos

30  
00:01:36,599 --> 00:01:42,419  
solar neutrinos or is closely related to

31  
00:01:39,509 --> 00:01:47,899  
solar neutrinos so now I'll try to give

32  
00:01:42,420 --> 00:01:53,090  
you the evidence for that conclusion

33  
00:01:47,899 --> 00:01:53,090  
well this is a one of the typical

34  
00:01:53,420 --> 00:01:58,579  
radioactive decays as involved from

35  
00:01:55,500 --> 00:02:00,780  
radium to actinium giving off an

36  
00:01:58,578 --> 00:02:03,029  
electron this is one of the processes

37  
00:02:00,780 --> 00:02:06,750  
that was involved i think by the PTP

38  
00:02:03,030 --> 00:02:08,318  
experiment alfred there to kinda came

39  
00:02:06,750 --> 00:02:11,408  
mainly alpha decay

40  
00:02:08,318 --> 00:02:14,619  
which of a nucleus will lose two protons

41  
00:02:11,408 --> 00:02:17,229  
two neutrons or beta decay in which the

42  
00:02:14,620 --> 00:02:21,280  
nucleus loses an electron and the others

43  
00:02:17,229 --> 00:02:24,098

as well and will this doesn't matter to

44

00:02:21,280 --> 00:02:25,930

us as the one the experiments carries at

45

00:02:24,098 --> 00:02:29,919

Brookhaven National Laboratory a very

46

00:02:25,930 --> 00:02:34,379

distinguished laboratory dealing with

47

00:02:29,919 --> 00:02:39,248

radium and they had silicon as a

48

00:02:34,378 --> 00:02:46,388

standard and this is the paper they

49

00:02:39,248 --> 00:02:49,299

published in 1986 in which they give

50

00:02:46,389 --> 00:02:51,790

their measurement of the half-life and

51

00:02:49,299 --> 00:02:53,169

if they know what they're after was

52

00:02:51,789 --> 00:02:59,250

getting a more accurate measurement of

53

00:02:53,169 --> 00:03:03,699

the half-life of silicon but they found

54

00:02:59,250 --> 00:03:07,329

that the measurements showed a very

55

00:03:03,699 --> 00:03:10,209

clear annual variation of a fraction of

56

00:03:07,329 --> 00:03:12,729

a percent and of course this makes you

57

00:03:10,209 --> 00:03:14,378

very worried because you know that the

58

00:03:12,729 --> 00:03:16,900  
temperature of laboratory there is

59

00:03:14,378 --> 00:03:20,918  
between summer and winter you know that

60

00:03:16,900 --> 00:03:22,180  
the radon flux there is annually for

61

00:03:20,919 --> 00:03:25,329  
similar because the temperature

62

00:03:22,180 --> 00:03:27,909  
variations and so that the immediate

63

00:03:25,329 --> 00:03:32,560  
conclusion is that your is contamination

64

00:03:27,908 --> 00:03:36,030  
in your experiments and that is not a

65

00:03:32,560 --> 00:03:39,489  
rule variation it's a just an apparent

66

00:03:36,030 --> 00:03:42,688  
12 to 22 environmental effects but they

67

00:03:39,489 --> 00:03:44,590  
make careful studies and they could not

68

00:03:42,688 --> 00:03:47,258  
convince themselves that were the case

69

00:03:44,590 --> 00:03:48,759  
it was left as an open question that

70

00:03:47,258 --> 00:03:52,809  
there appears to be an annual variation

71

00:03:48,758 --> 00:03:56,888  
they could not explain and here is a

72  
00:03:52,810 --> 00:04:00,039  
plot of their data and the blue points

73  
00:03:56,889 --> 00:04:04,079  
are their measurements and either five

74  
00:04:00,039 --> 00:04:09,399  
point average and the red curve is

75  
00:04:04,079 --> 00:04:11,319  
appropriately scaled representation of

76  
00:04:09,400 --> 00:04:13,359  
the distance of the earth-sun distance

77  
00:04:11,318 --> 00:04:15,310  
and if you look carefully you'll notice

78  
00:04:13,359 --> 00:04:17,408  
they're not quite in phase and that's a

79  
00:04:15,310 --> 00:04:18,858  
very important point which will come

80  
00:04:17,408 --> 00:04:21,348  
back to later on

81  
00:04:18,858 --> 00:04:24,318  
another experiment of an even longer

82  
00:04:21,348 --> 00:04:28,908  
time scale I think almost 20 years Carol

83  
00:04:24,319 --> 00:04:33,169  
in Germany and they were studying radium

84  
00:04:28,908 --> 00:04:36,199  
and they found a variation of a fraction

85  
00:04:33,168 --> 00:04:40,549  
of a percent a similar variation an

86

00:04:36,199 --> 00:04:43,968  
annual variation and here amines it's a

87  
00:04:40,550 --> 00:04:46,098  
very impressive curve showing again the

88  
00:04:43,968 --> 00:04:47,569  
blue points are their data are their

89  
00:04:46,098 --> 00:04:49,848  
measurements of the other decay rates

90  
00:04:47,569 --> 00:04:52,669  
and the red curve is the earth-sun

91  
00:04:49,848 --> 00:04:54,378  
distance so it looks at first sight as

92  
00:04:52,668 --> 00:04:57,709  
if there really is a correlation between

93  
00:04:54,379 --> 00:05:00,439  
earth-sun distance and the decay rate

94  
00:04:57,709 --> 00:05:03,489  
and that led the Purdue scientists to

95  
00:05:00,439 --> 00:05:06,919  
conclude that there's some kind of flux

96  
00:05:03,490 --> 00:05:10,129  
that is affecting the decay rate but it

97  
00:05:06,918 --> 00:05:14,139  
falls off the distance from the Sun but

98  
00:05:10,129 --> 00:05:17,379  
if you look carefully at the phase of

99  
00:05:14,139 --> 00:05:20,449  
this annual variation which is shown in

100  
00:05:17,379 --> 00:05:22,639

green and compare that with with the

101

00:05:20,449 --> 00:05:24,528

phase of the earth-sun distance is shown

102

00:05:22,639 --> 00:05:28,939

in red you see they don't quite match

103

00:05:24,528 --> 00:05:30,740

and so this makes one suspect that is

104

00:05:28,939 --> 00:05:35,750

not just the earth-sun distance that is

105

00:05:30,740 --> 00:05:38,088

of influencing this process and my

106

00:05:35,750 --> 00:05:41,810

colleagues applaud you therefore propose

107

00:05:38,088 --> 00:05:43,759

there is some scale of fuel or something

108

00:05:41,810 --> 00:05:46,370

emitted from the Sun well no actually

109

00:05:43,759 --> 00:05:51,919

this was there this was their model

110

00:05:46,370 --> 00:05:56,300

before noticing the phase problem now

111

00:05:51,918 --> 00:06:01,158

their experience carried out by a group

112

00:05:56,300 --> 00:06:07,689

in Italy on dark matter and they were

113

00:06:01,158 --> 00:06:14,360

looking for evidence of dark matter by

114

00:06:07,689 --> 00:06:18,468

the variation of a scintillation

115  
00:06:14,360 --> 00:06:23,930  
detector measurements and they'd knowing

116  
00:06:18,468 --> 00:06:25,908  
the rosti of Earth respect to the the

117  
00:06:23,930 --> 00:06:29,300  
galactic background or a cosmological

118  
00:06:25,908 --> 00:06:31,639  
background they figured that there

119  
00:06:29,300 --> 00:06:34,550  
should be an

120  
00:06:31,639 --> 00:06:36,728  
annual variation with pigs I think

121  
00:06:34,550 --> 00:06:40,400  
sometime in June June too and

122  
00:06:36,728 --> 00:06:44,568  
interestingly enough they they found

123  
00:06:40,399 --> 00:06:46,818  
annual variation and they found that it

124  
00:06:44,569 --> 00:06:48,439  
does indeed peek around that time so

125  
00:06:46,819 --> 00:06:53,569  
here is a correlation here's a

126  
00:06:48,439 --> 00:06:57,169  
comparison of the phases the PTB a

127  
00:06:53,569 --> 00:07:01,759  
German experiment had a maximum January

128  
00:06:57,168 --> 00:07:03,709  
31 whereas the earth-sun distance had

129  
00:07:01,759 --> 00:07:06,528  
its minimum giving a maximum effects

130  
00:07:03,709 --> 00:07:09,109  
from the sun on january three the

131  
00:07:06,528 --> 00:07:12,860  
magnitude affect the sun's axis is

132  
00:07:09,110 --> 00:07:14,900  
tilted reflect ecliptic and you get the

133  
00:07:12,860 --> 00:07:18,550  
best view of the northern hemisphere of

134  
00:07:14,899 --> 00:07:22,038  
the sun on march eight the neutrino flux

135  
00:07:18,550 --> 00:07:24,978  
had been found to vary annually and that

136  
00:07:22,038 --> 00:07:28,668  
peaks around february to the wimps

137  
00:07:24,978 --> 00:07:32,120  
observed by the weekly suspected wimps

138  
00:07:28,668 --> 00:07:35,120  
observed by the da ma group peaks around

139  
00:07:32,120 --> 00:07:39,139  
june two now what you see is that the

140  
00:07:35,120 --> 00:07:41,718  
PTP data sea is closest to the neutrino

141  
00:07:39,139 --> 00:07:43,338  
data and that attracted my attention so

142  
00:07:41,718 --> 00:07:47,810  
i've been studying solar neutrinos for

143

00:07:43,338 --> 00:07:49,819  
quite a few years so what are the

144  
00:07:47,810 --> 00:07:51,620  
possible explanations say of the annual

145  
00:07:49,819 --> 00:07:52,908  
variation one is that there's

146  
00:07:51,620 --> 00:07:55,009  
environmental effects and

147  
00:07:52,908 --> 00:07:57,438  
experimentalists say that now we've been

148  
00:07:55,009 --> 00:07:59,689  
very careful we've ruled that out the

149  
00:07:57,439 --> 00:08:01,550  
other ear is it due to these weakly

150  
00:07:59,689 --> 00:08:03,860  
interacting massive particles that the

151  
00:08:01,550 --> 00:08:06,740  
Italian group claimed to observe but the

152  
00:08:03,860 --> 00:08:10,788  
phases don't agree neutrinos the face is

153  
00:08:06,740 --> 00:08:12,199  
ok but the mechanism is unknown there

154  
00:08:10,788 --> 00:08:17,538  
could be something else of course going

155  
00:08:12,199 --> 00:08:19,848  
on so I decided one needs to do find

156  
00:08:17,538 --> 00:08:21,288  
something else about this data set to

157  
00:08:19,848 --> 00:08:27,639

try to see whether it really is due to

158

00:08:21,288 --> 00:08:31,759

neutrinos or not and I have found that

159

00:08:27,639 --> 00:08:34,788

the neutrino flux is closely correlated

160

00:08:31,759 --> 00:08:36,889

with the total light output from the Sun

161

00:08:34,788 --> 00:08:38,448

called in radiance was a very surprising

162

00:08:36,889 --> 00:08:44,360

rule out resolved with very strong

163

00:08:38,448 --> 00:08:46,009

result and that that has a variation

164

00:08:44,360 --> 00:08:49,899

if there is with a pure frequency of

165

00:08:46,009 --> 00:08:52,759

about 11.1 cycles per year about

166

00:08:49,899 --> 00:08:55,940

30-something days per year different

167

00:08:52,759 --> 00:08:58,879

from the surface rotation rate so what I

168

00:08:55,940 --> 00:09:02,380

did was to take the Iranian data and

169

00:08:58,879 --> 00:09:05,149

compare it with this decay rate data

170

00:09:02,379 --> 00:09:08,179

using the Decatur using the radians as a

171

00:09:05,149 --> 00:09:10,480

proxy for neutrinos and I found that

172  
00:09:08,179 --> 00:09:13,699  
there's a very strong this is a

173  
00:09:10,480 --> 00:09:16,700  
correlation measurement that this curve

174  
00:09:13,700 --> 00:09:19,399  
shows the correlation between the decay

175  
00:09:16,700 --> 00:09:21,560  
rates and the Iranian siz a function of

176  
00:09:19,399 --> 00:09:24,440  
frequency and you see the very sharp

177  
00:09:21,559 --> 00:09:31,549  
peak at eleven point oh eight cycles per

178  
00:09:24,440 --> 00:09:35,630  
year confirming the conjecture that what

179  
00:09:31,549 --> 00:09:39,949  
is affecting the decay rate of these

180  
00:09:35,629 --> 00:09:42,379  
elements is in fact neutrinos and i did

181  
00:09:39,950 --> 00:09:44,778  
a monte carlo calculation to see whether

182  
00:09:42,379 --> 00:09:47,480  
the chance effect and i ran a hundred

183  
00:09:44,778 --> 00:09:49,820  
thousand monte carlo's and not one of

184  
00:09:47,480 --> 00:09:52,639  
them gave a strong a result as the

185  
00:09:49,820 --> 00:09:56,540  
actual data so this this correlation

186

00:09:52,639 --> 00:09:59,629

between a radiance was the proxy for

187

00:09:56,539 --> 00:10:02,019

neutrinos and decay rates really is a

188

00:09:59,629 --> 00:10:02,019

very