
NAVAL RESEARCH
ORATORY
NASA
Charles

1
00:00:08,629 --> 00:00:06,630
hi i'm jd harrington public affairs

2
00:00:10,230 --> 00:00:08,639
officer for nasa's astrophysics division

3
00:00:11,830 --> 00:00:10,240
in washington dc

4
00:00:14,150 --> 00:00:11,840
i'd like to welcome you to today's

5
00:00:16,470 --> 00:00:14,160
google plus hangout we will discuss

6
00:00:18,550 --> 00:00:16,480
findings on an extraordinary gamma ray

7
00:00:20,550 --> 00:00:18,560
burst that happened earlier this year

8
00:00:23,189 --> 00:00:20,560
this was a once in a century watershed

9
00:00:25,029 --> 00:00:23,199
event made all the better by having a

10
00:00:27,589 --> 00:00:25,039
large array of nasa telescopes and

11
00:00:29,669 --> 00:00:27,599
ground-based observatories that seen it

12
00:00:32,430 --> 00:00:29,679
on april 27th this gamma-ray burst

13
00:00:35,030 --> 00:00:32,440

explosion was designated grb

14
00:00:37,030 --> 00:00:35,040
1304 27a

15
00:00:40,389 --> 00:00:37,040
was basically a blast of light from a

16
00:00:42,229 --> 00:00:40,399
dying star in a distant galaxy now it

17
00:00:43,590 --> 00:00:42,239
tops the chart as one of the brightest

18
00:00:46,549 --> 00:00:43,600
we've ever seen

19
00:00:48,470 --> 00:00:46,559
a trio a trio of nasa satellites working

20
00:00:51,110 --> 00:00:48,480
in concert with ground-based robotic

21
00:00:53,270 --> 00:00:51,120
telescopes captured never-before-seen

22
00:00:55,350 --> 00:00:53,280
details that challenge our current

23
00:00:57,430 --> 00:00:55,360
theoretical understandings of how

24
00:00:59,349 --> 00:00:57,440
gamma-ray bursts work

25
00:01:01,830 --> 00:00:59,359
before we begin though and we get to our

26
00:01:03,670 --> 00:01:01,840
panel of experts a few housekeeping

27
00:01:05,429 --> 00:01:03,680
duties are in order we have five

28
00:01:07,990 --> 00:01:05,439
panelists joining us today which will

29
00:01:10,310 --> 00:01:08,000
give a brief rundown of their expertise

30
00:01:11,750 --> 00:01:10,320
in this area and how they were involved

31
00:01:13,990 --> 00:01:11,760
of course we would love to get your

32
00:01:16,390 --> 00:01:14,000
participation in today's event as well

33
00:01:19,670 --> 00:01:16,400
and you can submit questions on nasa's

34
00:01:23,030 --> 00:01:19,680
facebook account nasa's google plus page

35
00:01:25,109 --> 00:01:23,040
and via twitter by using the hashtag ask

36
00:01:27,109 --> 00:01:25,119
nasa now this media telecom will be

37
00:01:29,590 --> 00:01:27,119
limited to one hour

38
00:01:31,830 --> 00:01:29,600

today's panelists include charles dermer

39
00:01:34,149 --> 00:01:31,840
an astrophysicist at the naval research

40
00:01:36,390 --> 00:01:34,159
laboratory in washington dc

41
00:01:40,230 --> 00:01:36,400
he's also the corresponding author of

42
00:01:42,550 --> 00:01:40,240
the fermi lac and gbm papers in the

43
00:01:44,630 --> 00:01:42,560
science journal that came out yesterday

44
00:01:46,469 --> 00:01:44,640
we also have tom estrin an

45
00:01:49,510 --> 00:01:46,479
astrophysicist from the los alamos

46
00:01:51,749 --> 00:01:49,520
national laboratory in new mexico he's

47
00:01:54,630 --> 00:01:51,759
the lead author of the raptor paper in

48
00:01:56,550 --> 00:01:54,640
yesterday's science journal we have rob

49
00:01:57,910 --> 00:01:56,560
priest an associate professor of

50
00:01:59,429 --> 00:01:57,920
astrophysicist

51
00:02:01,590 --> 00:01:59,439
astrophysics at the university of

52
00:02:03,990 --> 00:02:01,600
alabama in huntsville in huntsville

53
00:02:05,910 --> 00:02:04,000
alabama alabama now rob is the lead

54
00:02:08,869 --> 00:02:05,920
author of the fermi gmb

55
00:02:10,469 --> 00:02:08,879
gbm paper and a co-author on the fermi

56
00:02:13,910 --> 00:02:10,479
lab paper

57
00:02:16,070 --> 00:02:13,920
we also have john piero tagliaferri

58
00:02:18,390 --> 00:02:16,080
he's an astrophysicist at the breira

59
00:02:19,830 --> 00:02:18,400
observatory in italy he's also a

60
00:02:22,070 --> 00:02:19,840
co-author of the swift paper in the

61
00:02:23,910 --> 00:02:22,080
science journal and the new star paper

62
00:02:27,190 --> 00:02:23,920
in fj

63
00:02:29,110 --> 00:02:27,200

and our last panelist is sylvia zoo an

64
00:02:31,670 --> 00:02:29,120
astrophysicist at the university of

65
00:02:34,229 --> 00:02:31,680
maryland at college park sylvia is the

66
00:02:36,470 --> 00:02:34,239
co-author of the fermi gpm paper and

67
00:02:39,350 --> 00:02:36,480
corresponding author of the fermi lac

68
00:02:41,350 --> 00:02:39,360
uh paper both in the science journal

69
00:02:43,670 --> 00:02:41,360
now i i

70
00:02:44,790 --> 00:02:43,680
i i'm going to ask the panel panelists

71
00:02:47,270 --> 00:02:44,800
to give us just a little bit of a

72
00:02:48,949 --> 00:02:47,280
background on themselves and trying to

73
00:02:50,470 --> 00:02:48,959
keep it down to a minute or so before we

74
00:02:53,990 --> 00:02:50,480
get into the questions and answers so

75
00:02:57,830 --> 00:02:55,990
hi everybody i'm chuck dermer from the

76
00:03:00,630 --> 00:02:57,840
naval research laboratory

77
00:03:03,350 --> 00:03:00,640
nrl is a 90 year old laboratory that is

78
00:03:06,309 --> 00:03:03,360
involved in basic research discovery and

79
00:03:09,110 --> 00:03:06,319
invention for science technology

80
00:03:11,830 --> 00:03:09,120
and uh defense applications

81
00:03:14,229 --> 00:03:11,840
what i do is support ongoing research

82
00:03:15,350 --> 00:03:14,239
and detector technology that is used not

83
00:03:17,110 --> 00:03:15,360
only for

84
00:03:19,910 --> 00:03:17,120
terrestrial applications but to look at

85
00:03:21,750 --> 00:03:19,920
the stars and the cosmos on that i'm

86
00:03:23,830 --> 00:03:21,760
most interested in high energy radiation

87
00:03:25,990 --> 00:03:23,840
physics from blazars gamma-ray bursts

88
00:03:28,309 --> 00:03:26,000

pulsars neutron stars all sorts of

89
00:03:30,789 --> 00:03:28,319
exciting objects that radiate the very

90
00:03:32,149 --> 00:03:30,799
highest energy radiations and

91
00:03:33,830 --> 00:03:32,159
if you want to look at some of my

92
00:03:35,990 --> 00:03:33,840
technical writings i've written a book

93
00:03:38,070 --> 00:03:36,000
with government on the high energy

94
00:03:40,070 --> 00:03:38,080
radiations from black holes

95
00:03:42,630 --> 00:03:40,080
glad to be here

96
00:03:45,030 --> 00:03:42,640
thanks tom nick thanks charles next

97
00:03:47,270 --> 00:03:45,040
we'll go to a top

98
00:03:49,430 --> 00:03:47,280
yes i'm tom vestrand i'm an

99
00:03:50,789 --> 00:03:49,440
astrophysicist at los alamos national

100
00:03:53,670 --> 00:03:50,799
laboratory

101
00:03:55,990 --> 00:03:53,680
i'm the principal investigator for

102
00:03:58,869 --> 00:03:56,000
the raptor network of telescopes which

103
00:04:01,670 --> 00:03:58,879
are ground-based robotic telescopes

104
00:04:04,149 --> 00:04:01,680
that monitor the night sky and look for

105
00:04:06,149 --> 00:04:04,159
things that go bump in the night

106
00:04:07,589 --> 00:04:06,159
and one of the spectacular things we

107
00:04:08,789 --> 00:04:07,599
found that went bumping the night was

108
00:04:10,550 --> 00:04:08,799
this

109
00:04:12,949 --> 00:04:10,560
very interesting

110
00:04:14,470 --> 00:04:12,959
optical flash from this gamma ray burst

111
00:04:15,350 --> 00:04:14,480
and i'd like to tell you a little about

112
00:04:17,670 --> 00:04:15,360
it

113
00:04:19,030 --> 00:04:17,680

about that today

114
00:04:20,150 --> 00:04:19,040
thanks all right

115
00:04:25,749 --> 00:04:20,160
thanks bob

116
00:04:31,270 --> 00:04:29,270
i'm rob freeze uh i'm the professor of

117
00:04:33,670 --> 00:04:31,280
space science at the university of

118
00:04:35,270 --> 00:04:33,680
alabama huntsville which is a

119
00:04:37,189 --> 00:04:35,280
research

120
00:04:40,230 --> 00:04:37,199
university

121
00:04:45,990 --> 00:04:43,270
a co-investigator in the

122
00:04:49,189 --> 00:04:46,000
gamma-ray burst monitor for glast called

123
00:04:50,710 --> 00:04:49,199
gbm and uh we triggered on this

124
00:04:52,629 --> 00:04:50,720
event in uh

125
00:04:55,189 --> 00:04:52,639
april 27th

126
00:04:57,749 --> 00:04:55,199
and sent uh messages all throughout the

127
00:04:58,469 --> 00:04:57,759
world and uh

128
00:05:01,749 --> 00:04:58,479
we

129
00:05:03,590 --> 00:05:01,759
saw some interesting uh behavior in the

130
00:05:07,110 --> 00:05:03,600
first pulse of the burst and led to a

131
00:05:09,110 --> 00:05:07,120
nice paper on science thank you

132
00:05:10,550 --> 00:05:09,120
thanks rob and now we'll go to uh john

133
00:05:11,749 --> 00:05:10,560
piero

134
00:05:13,670 --> 00:05:11,759
hello

135
00:05:15,029 --> 00:05:13,680
my name is jean-pierre taylor ferry i'm

136
00:05:17,029 --> 00:05:15,039
an astrophysicist at the blair

137
00:05:20,469 --> 00:05:17,039
observatory in milan in italy which is

138
00:05:21,990 --> 00:05:20,479

250 years old institute

139
00:05:23,830 --> 00:05:22,000
my scientific interests are in high

140
00:05:25,990 --> 00:05:23,840
energy mission of celestial object in

141
00:05:27,909 --> 00:05:26,000
particular i is a mission of gamma

142
00:05:29,189 --> 00:05:27,919
reversed in blazer

143
00:05:31,270 --> 00:05:29,199
i'm also

144
00:05:32,790 --> 00:05:31,280
working on the development of new x-ray

145
00:05:35,350 --> 00:05:32,800
telescopes

146
00:05:36,950 --> 00:05:35,360
and i'm dpi of the italian participation

147
00:05:38,390 --> 00:05:36,960
to the swift mission and the reason we

148
00:05:39,350 --> 00:05:38,400
have participated in this mission is

149
00:05:41,430 --> 00:05:39,360
because

150
00:05:45,110 --> 00:05:41,440
my institute provided the mirror for the

151
00:05:45,990 --> 00:05:45,120
x-ray telescope of waldo swift

152
00:05:48,310 --> 00:05:46,000
thanks

153
00:05:50,629 --> 00:05:48,320
and silvia

154
00:05:52,870 --> 00:05:50,639
hi i'm sylvia zoo from the university of

155
00:05:54,710 --> 00:05:52,880
maryland i'm a grad student which is why

156
00:05:56,230 --> 00:05:54,720
my shelves have less textbooks than

157
00:05:57,510 --> 00:05:56,240
everyone else's chelsea or fewer

158
00:05:59,350 --> 00:05:57,520
textbooks

159
00:06:01,270 --> 00:05:59,360
and i um

160
00:06:03,189 --> 00:06:01,280
i study the high energy emission from

161
00:06:05,590 --> 00:06:03,199
gamma-ray bursts with the fermi large

162
00:06:07,189 --> 00:06:05,600
area telescope and thanks to like rob

163
00:06:09,430 --> 00:06:07,199

said the gbm triggered on this first so

164
00:06:10,469 --> 00:06:09,440
when the gbm first saw it it said hey

165
00:06:12,950 --> 00:06:10,479
let's take a look at this burst for

166
00:06:14,230 --> 00:06:12,960
longer and so the spacecraft went and

167
00:06:15,909 --> 00:06:14,240
looked at the spurs for a long time and

168
00:06:18,870 --> 00:06:15,919
thanks to the gbm triggering the lat was

169
00:06:21,189 --> 00:06:18,880
able to see it for a long time as well

170
00:06:23,430 --> 00:06:21,199
all right thanks sylvia uh as i

171
00:06:25,270 --> 00:06:23,440
mentioned uh just to make sure that we

172
00:06:27,029 --> 00:06:25,280
uh are on the same sheet of music here

173
00:06:29,670 --> 00:06:27,039
i'd like to start with the basics if you

174
00:06:31,590 --> 00:06:29,680
would um as i mentioned earlier three

175
00:06:33,670 --> 00:06:31,600
nasa spacecraft as other as well as

176
00:06:35,990 --> 00:06:33,680
other ground-based telescopes caught

177
00:06:38,150 --> 00:06:36,000
this gamma-ray burst so i'd like to

178
00:06:40,070 --> 00:06:38,160
start out basically with explaining what

179
00:06:48,390 --> 00:06:40,080
a gamma-ray burst is who can take that

180
00:06:52,710 --> 00:06:50,230
i'm not sure you're asking but uh i

181
00:06:55,670 --> 00:06:52,720
certainly have a standard answer to that

182
00:06:57,590 --> 00:06:55,680
a gamma ray burst as the name implies is

183
00:07:00,070 --> 00:06:57,600
a transient flash of gamma rays from

184
00:07:02,469 --> 00:07:00,080
some random direction in space

185
00:07:04,469 --> 00:07:02,479
after decades of research we found out

186
00:07:06,390 --> 00:07:04,479
that those gamma rays come from the

187
00:07:08,390 --> 00:07:06,400
birth of a black hole in most cases

188
00:07:10,230 --> 00:07:08,400

there's still some argumentation

189
00:07:11,589 --> 00:07:10,240
but this was only possible through the

190
00:07:14,550 --> 00:07:11,599
development of

191
00:07:16,550 --> 00:07:14,560
new ways of looking because you have to

192
00:07:18,390 --> 00:07:16,560
reorient your spacecraft very quickly to

193
00:07:19,270 --> 00:07:18,400
see these gamma-ray bursts

194
00:07:20,710 --> 00:07:19,280
and so

195
00:07:22,790 --> 00:07:20,720
there's a new astronomy that's been

196
00:07:25,029 --> 00:07:22,800
brewing over the last decades where you

197
00:07:26,870 --> 00:07:25,039
have this rapid response that made

198
00:07:30,870 --> 00:07:26,880
possible all the great discoveries about

199
00:07:33,830 --> 00:07:30,880
this particular burst field here today

200
00:07:35,270 --> 00:07:33,840
all right thanks uh charles um

201
00:07:36,790 --> 00:07:35,280
there's going to be a lot of interest i

202
00:07:38,870 --> 00:07:36,800
think from people that want to know

203
00:07:40,390 --> 00:07:38,880
whether there could be any damage from a

204
00:07:41,830 --> 00:07:40,400
grb

205
00:07:44,309 --> 00:07:41,840
as a matter of fact we got one query

206
00:07:46,629 --> 00:07:44,319
already that says if the gamma-ray burst

207
00:07:49,189 --> 00:07:46,639
had been pointed directly at earth how

208
00:07:55,350 --> 00:07:49,199
much damage could be done

209
00:07:59,990 --> 00:07:57,909
well it really depends on how far away

210
00:08:01,270 --> 00:08:00,000
this gamma reverses and again we're

211
00:08:03,589 --> 00:08:01,280
already assuming that it's pointed at

212
00:08:06,150 --> 00:08:03,599
earth which is a very uh kind of

213
00:08:08,230 --> 00:08:06,160

unlikely already um

214
00:08:10,869 --> 00:08:08,240
with a gamma ray burst uh with the gamma

215
00:08:13,350 --> 00:08:10,879
is coming in you the atmosphere is

216
00:08:15,670 --> 00:08:13,360
mostly opaque to gamma rays and so it

217
00:08:17,189 --> 00:08:15,680
absorbs the gamma rays uh which normally

218
00:08:18,629 --> 00:08:17,199
gamma ray bursts are really far away

219
00:08:20,710 --> 00:08:18,639
they're you know far outside of our

220
00:08:21,510 --> 00:08:20,720
galaxy um

221
00:08:22,309 --> 00:08:21,520
so

222
00:08:26,070 --> 00:08:22,319
um

223
00:08:27,189 --> 00:08:26,080
so chances are that's not that's going

224
00:08:29,350 --> 00:08:27,199
to be far enough that it's not going to

225
00:08:31,029 --> 00:08:29,360
really affect us if you had a gamma ray

226
00:08:32,790 --> 00:08:31,039
burst for instance in our galaxy which

227
00:08:34,949 --> 00:08:32,800
we're pretty sure uh is not going to

228
00:08:36,709 --> 00:08:34,959
happen um but if you happen to have a

229
00:08:37,990 --> 00:08:36,719
gamma reverse position in our galaxy

230
00:08:40,949 --> 00:08:38,000
pointed at us

231
00:08:42,949 --> 00:08:40,959
uh you would you would get um possibly

232
00:08:45,670 --> 00:08:42,959
electromagnetic pulses that might damage

233
00:08:48,070 --> 00:08:45,680
some uh electronics um you would get a

234
00:08:48,949 --> 00:08:48,080
lot of ionizing radiation um and you

235
00:08:51,269 --> 00:08:48,959
would

236
00:08:53,750 --> 00:08:51,279
um and in the long term um the gamma

237
00:08:55,509 --> 00:08:53,760
rays would start to destroy the ozone in

238
00:08:57,430 --> 00:08:55,519

the earth on the earth so then you'd

239
00:08:58,550 --> 00:08:57,440
have more um other radiation coming

240
00:09:02,070 --> 00:08:58,560
through as well

241
00:09:03,990 --> 00:09:02,080
um and it would affect the uh nitrogen

242
00:09:06,790 --> 00:09:04,000
and create nitro nitrogen oxides in the

243
00:09:08,150 --> 00:09:06,800
earth uh earth's atmosphere which would

244
00:09:09,990 --> 00:09:08,160
which is a sort of brownish color would

245
00:09:11,750 --> 00:09:10,000
lead to like a nuclear winter basically

246
00:09:13,829 --> 00:09:11,760
uh but short answer is that's not going

247
00:09:16,470 --> 00:09:13,839
to happen

248
00:09:18,870 --> 00:09:16,480
okay i appreciate it sylvia

249
00:09:21,430 --> 00:09:18,880
can somebody explain maybe you chuck why

250
00:09:25,829 --> 00:09:21,440
is it important for us to study

251
00:09:29,110 --> 00:09:27,670
that's a good question but

252
00:09:30,949 --> 00:09:29,120
since it's a kind of a rhetorical

253
00:09:33,110 --> 00:09:30,959
question i would just ask what was the

254
00:09:34,710 --> 00:09:33,120
importance of discovering or studying

255
00:09:36,870 --> 00:09:34,720
uranium physics which was the most

256
00:09:39,509 --> 00:09:36,880
esoteric type of particle physics in the

257
00:09:41,750 --> 00:09:39,519
1920s what was the importance of just

258
00:09:44,070 --> 00:09:41,760
understanding the reactions that take

259
00:09:46,310 --> 00:09:44,080
place in the center of the sun

260
00:09:47,750 --> 00:09:46,320
the nuclear burning reactions well we

261
00:09:49,269 --> 00:09:47,760
don't have that

262
00:09:51,829 --> 00:09:49,279
you don't have to have an answer to that

263
00:09:53,430 --> 00:09:51,839

we all know it changed the world

264
00:09:55,350 --> 00:09:53,440
there's no reason to think this is going

265
00:09:57,670 --> 00:09:55,360
to change the world but on the other

266
00:09:59,670 --> 00:09:57,680
hand it's a fascinating system because

267
00:10:01,590 --> 00:09:59,680
it's an engine an engine that converts

268
00:10:04,550 --> 00:10:01,600
one type of energy to another it's the

269
00:10:06,790 --> 00:10:04,560
most efficient type of engine and it's

270
00:10:10,389 --> 00:10:06,800
an explosion and so whenever you do

271
00:10:12,949 --> 00:10:10,399
explosion physics you learn something uh

272
00:10:15,829 --> 00:10:12,959
that may and hopefully in many cases may

273
00:10:16,949 --> 00:10:15,839
not ever be used in terms of humanity

274
00:10:20,069 --> 00:10:16,959
but we

275
00:10:23,430 --> 00:10:20,079
but it has intrinsic interest that could

276
00:10:25,030 --> 00:10:23,440
be applicable at some point for example

277
00:10:26,310 --> 00:10:25,040
the particle beams

278
00:10:28,630 --> 00:10:26,320
for the acceleration of the highest

279
00:10:30,870 --> 00:10:28,640
energy cosmic rays so we don't know

280
00:10:32,230 --> 00:10:30,880
that's what makes basic research

281
00:10:34,550 --> 00:10:32,240
we're just trying to understand

282
00:10:36,310 --> 00:10:34,560
something for the very intrinsic

283
00:10:37,910 --> 00:10:36,320
interest of knowing about it

284
00:10:40,630 --> 00:10:37,920
and maybe we'll have applications down

285
00:10:43,190 --> 00:10:40,640
the line but in the present day

286
00:10:45,190 --> 00:10:43,200
it gives us a greater appreciation of

287
00:10:46,470 --> 00:10:45,200
all the activity that goes on in nature

288
00:10:50,069 --> 00:10:46,480

which is

289
00:10:51,030 --> 00:10:50,079
a good use all by itself

290
00:10:52,310 --> 00:10:51,040
okay

291
00:10:54,230 --> 00:10:52,320
uh

292
00:10:56,230 --> 00:10:54,240
there's a tremendous amount of energy

293
00:10:59,110 --> 00:10:56,240
that comes out of these uh gamma ray

294
00:11:01,190 --> 00:10:59,120
bursts do we know the source of this

295
00:11:03,430 --> 00:11:01,200
energy what where do we think it comes

296
00:11:10,630 --> 00:11:03,440
from

297
00:11:16,069 --> 00:11:12,630
anyone

298
00:11:17,750 --> 00:11:16,079
well i'll uh pipe up here and and say

299
00:11:21,509 --> 00:11:17,760
that uh

300
00:11:23,110 --> 00:11:21,519
in large part we don't really know

301
00:11:23,829 --> 00:11:23,120
and uh

302
00:11:25,829 --> 00:11:23,839
the

303
00:11:26,949 --> 00:11:25,839
beauty of having a very bright burst

304
00:11:30,389 --> 00:11:26,959
like uh

305
00:11:32,550 --> 00:11:30,399
1304 27a is that

306
00:11:35,509 --> 00:11:32,560
we can study its

307
00:11:36,470 --> 00:11:35,519
uh properties in great detail

308
00:11:38,790 --> 00:11:36,480
and

309
00:11:41,430 --> 00:11:38,800
compare that with theoretical

310
00:11:43,030 --> 00:11:41,440
predictions like made by

311
00:11:44,230 --> 00:11:43,040
dr dermer

312
00:11:47,590 --> 00:11:44,240
and

313
00:11:50,949 --> 00:11:47,600

see how everything fares

314
00:11:52,790 --> 00:11:50,959
with respect to the observation

315
00:11:55,670 --> 00:11:52,800
and so uh

316
00:11:57,269 --> 00:11:55,680
we know one thing very clearly that the

317
00:11:59,509 --> 00:11:57,279
gamma ray bursts can have

318
00:12:01,590 --> 00:11:59,519
convert energy very efficiently into

319
00:12:04,790 --> 00:12:01,600
into gamma rays directly

320
00:12:06,389 --> 00:12:04,800
and that seems to be uh the the crux of

321
00:12:08,629 --> 00:12:06,399
the matter and nature seems to be able

322
00:12:11,350 --> 00:12:08,639
to do it quite naturally we have some

323
00:12:13,750 --> 00:12:11,360
ideas magnetic fields can

324
00:12:15,269 --> 00:12:13,760
through the synchrotron mechanism can

325
00:12:18,389 --> 00:12:15,279
efficiently convert

326
00:12:20,870 --> 00:12:18,399
energy into radiation but

327
00:12:22,870 --> 00:12:20,880
we have to compare these ideas with the

328
00:12:25,750 --> 00:12:22,880
the observations in many cases they fall

329
00:12:27,269 --> 00:12:25,760
flat

330
00:12:28,790 --> 00:12:27,279
appreciate it

331
00:12:30,870 --> 00:12:28,800
i think we're going to give this one to

332
00:12:33,110 --> 00:12:30,880
uh john pierro if we can

333
00:12:35,269 --> 00:12:33,120
now i know scientists study the x-tray

334
00:12:38,150 --> 00:12:35,279
afterglow of gamma-ray bursts but what

335
00:12:41,110 --> 00:12:38,160
do they learn from doing this

336
00:12:42,870 --> 00:12:41,120
well um the actually the capability of

337
00:12:44,949 --> 00:12:42,880
studying gamma reversal in the x-ray

338
00:12:46,790 --> 00:12:44,959

band is crucial in fact it's thanks to

339
00:12:49,190 --> 00:12:46,800
the exhale observation that we were able

340
00:12:51,750 --> 00:12:49,200
to identify the first afterglow

341
00:12:53,990 --> 00:12:51,760
associated to gamma ray birth by doing

342
00:12:55,910 --> 00:12:54,000
this we find it we got the good position

343
00:12:57,750 --> 00:12:55,920
and we could follow it in the optical

344
00:12:59,350 --> 00:12:57,760
and find the optical counterpart and the

345
00:13:02,150 --> 00:12:59,360
reshift and therefore

346
00:13:03,670 --> 00:13:02,160
for instance we could uh immediately

347
00:13:04,790 --> 00:13:03,680
prove that these objects were extra

348
00:13:06,949 --> 00:13:04,800
galactic

349
00:13:08,470 --> 00:13:06,959
and by getting the position and the

350
00:13:10,470 --> 00:13:08,480
aggressive we got the flux and

351
00:13:12,949 --> 00:13:10,480
luminosity and therefore we understood a

352
00:13:13,990 --> 00:13:12,959
very extremely powerful object

353
00:13:18,230 --> 00:13:14,000
and so

354
00:13:19,590 --> 00:13:18,240
x-ray have opened up a very good window

355
00:13:21,670 --> 00:13:19,600
and also

356
00:13:23,430 --> 00:13:21,680
most if if we turn in the after glow

357
00:13:25,590 --> 00:13:23,440
which is what is coming after the

358
00:13:27,190 --> 00:13:25,600
explosion of the gamma ray burst most of

359
00:13:28,949 --> 00:13:27,200
the ancient afterglow is going in the

360
00:13:30,150 --> 00:13:28,959
x-ray band then there is the optical in

361
00:13:32,069 --> 00:13:30,160
the radio

362
00:13:34,389 --> 00:13:32,079
but

363
00:13:36,069 --> 00:13:34,399

essentially 99 percent of the gamma ray

364
00:13:37,190 --> 00:13:36,079
bursts have an after glow in the x-ray

365
00:13:39,430 --> 00:13:37,200
band

366
00:13:41,509 --> 00:13:39,440
while in the optical only 60 to 70

367
00:13:43,910 --> 00:13:41,519
percent have an africa counterpart and

368
00:13:45,829 --> 00:13:43,920
we call it dark for instance gamma ray

369
00:13:47,110 --> 00:13:45,839
burst because we confined the optical

370
00:13:49,269 --> 00:13:47,120
counterpart

371
00:13:51,670 --> 00:13:49,279
so the xa ban is the most effective way

372
00:13:54,230 --> 00:13:51,680
to get a position and to find the

373
00:13:56,629 --> 00:13:54,240
afterglow and follow the light curves

374
00:13:58,949 --> 00:13:56,639
and then to give this very important

375
00:14:00,230 --> 00:13:58,959
information to the other band for people

376
00:14:04,310 --> 00:14:00,240
to follow on

377
00:14:09,030 --> 00:14:06,870
appreciate the answer uh

378
00:14:10,949 --> 00:14:09,040
sylvia i think this one hears from you

379
00:14:12,550 --> 00:14:10,959
uh we got a question about

380
00:14:15,030 --> 00:14:12,560
uh people relate

381
00:14:17,509 --> 00:14:15,040
this amount of energy or more even to

382
00:14:19,189 --> 00:14:17,519
atomic bombs how many atomic bombs worth

383
00:14:20,870 --> 00:14:19,199
of energy do you think came from this

384
00:14:23,910 --> 00:14:20,880
type of explosion if you were to try and

385
00:14:27,030 --> 00:14:25,350
so i guess it depends on what type of

386
00:14:29,110 --> 00:14:27,040
atomic bomb you're asking about in first

387
00:14:31,110 --> 00:14:29,120
place uh but i did a little

388
00:14:32,790 --> 00:14:31,120

i asked you know did a little wikipedia

389
00:14:35,350 --> 00:14:32,800
to see what sort of atomic bombs we

390
00:14:37,990 --> 00:14:35,360
might be talking about um and

391
00:14:39,990 --> 00:14:38,000
the most powerful hydrogen bomb for

392
00:14:44,629 --> 00:14:40,000
instance that was ever released on earth

393
00:14:47,509 --> 00:14:44,639
um released um see about 50 megatons of

394
00:14:50,069 --> 00:14:47,519
tnt uh like the equivalent energy of uh

395
00:14:51,990 --> 00:14:50,079
tnt um and so but that what that means

396
00:14:55,030 --> 00:14:52,000
is you would still need about 10 to the

397
00:14:57,750 --> 00:14:55,040
30 of these bombs to create the amount

398
00:15:00,230 --> 00:14:57,760
of energy um that was released by this

399
00:15:02,710 --> 00:15:00,240
gamma-ray burst uh over the entire

400
00:15:04,710 --> 00:15:02,720
sort of over the entire process

401
00:15:06,790 --> 00:15:04,720
and uh i believe that is either

402
00:15:08,389 --> 00:15:06,800
anonymian or quintillion depending after

403
00:15:11,030 --> 00:15:08,399
using short scale or long scale so i

404
00:15:15,750 --> 00:15:11,040
learned some new words today

405
00:15:16,629 --> 00:15:15,760
okay now do grbs like this typically

406
00:15:18,310 --> 00:15:16,639
uh

407
00:15:19,990 --> 00:15:18,320
concentrate all their energy in one

408
00:15:28,949 --> 00:15:20,000
direction are they somewhat

409
00:15:31,990 --> 00:15:30,069
oh no no i wasn't sure if that was

410
00:15:34,150 --> 00:15:32,000
continuation but it's not so good so

411
00:15:36,470 --> 00:15:34,160
this is tom's restaurant so yeah we

412
00:15:38,870 --> 00:15:36,480
believe that the radiation from these

413
00:15:41,829 --> 00:15:38,880

explosions is highly directional it's

414
00:15:43,350 --> 00:15:41,839
highly beamed so in this particular case

415
00:15:45,750 --> 00:15:43,360
the beam had to be

416
00:15:47,990 --> 00:15:45,760
pointing directly towards us these are

417
00:15:51,030 --> 00:15:48,000
relatively narrow beams measured in a

418
00:15:56,470 --> 00:15:51,040
few degrees or so so it's a very finely

419
00:15:58,949 --> 00:15:57,430
okay

420
00:16:01,110 --> 00:15:58,959
um i'd like to talk a little bit about

421
00:16:02,790 --> 00:16:01,120
the the individual spacecraft and how

422
00:16:04,470 --> 00:16:02,800
they were involved in this

423
00:16:06,230 --> 00:16:04,480
um so we're going to start i think with

424
00:16:08,870 --> 00:16:06,240
charles and fermi

425
00:16:10,870 --> 00:16:08,880
um how did i know one of these

426
00:16:13,189 --> 00:16:10,880
spacecraft i'm not sure which one was

427
00:16:15,269 --> 00:16:13,199
actually targeting this area and caught

428
00:16:17,990 --> 00:16:15,279
this gamma ray burst

429
00:16:19,829 --> 00:16:18,000
before during and after so

430
00:16:22,389 --> 00:16:19,839
um

431
00:16:23,910 --> 00:16:22,399
what kind of information do we glean

432
00:16:27,590 --> 00:16:23,920
when something can see it across the

433
00:16:28,790 --> 00:16:27,600
entire spectrum of the event happening

434
00:16:30,949 --> 00:16:28,800
oh

435
00:16:33,350 --> 00:16:30,959
it's the difference between a monocolor

436
00:16:36,069 --> 00:16:33,360
and technicolor once you have multiple

437
00:16:37,829 --> 00:16:36,079
observatories you can correlate one type

438
00:16:40,550 --> 00:16:37,839

of light coming out with another you can

439
00:16:42,790 --> 00:16:40,560
see how they each behave separately

440
00:16:45,110 --> 00:16:42,800
uh it didn't it just gives you so much

441
00:16:47,030 --> 00:16:45,120
more information but for your specific

442
00:16:49,189 --> 00:16:47,040
point i'm most deeply involved with the

443
00:16:50,710 --> 00:16:49,199
fermi gamma-ray space telescope like

444
00:16:52,629 --> 00:16:50,720
sylvia and rob

445
00:16:54,629 --> 00:16:52,639
are and that has two main instruments a

446
00:16:57,269 --> 00:16:54,639
large area telescope and also a

447
00:16:59,509 --> 00:16:57,279
gamma-ray burst monitor for

448
00:17:01,350 --> 00:16:59,519
searching for gamma-ray bursts so it has

449
00:17:03,829 --> 00:17:01,360
all sky directionality except to the

450
00:17:05,590 --> 00:17:03,839
extent that the earth blocks it so as a

451
00:17:07,069 --> 00:17:05,600
consequence fortunately the earth wasn't

452
00:17:10,309 --> 00:17:07,079
blocking during

453
00:17:11,669 --> 00:17:10,319
130427a when it went off it was detected

454
00:17:13,750 --> 00:17:11,679
and it allowed

455
00:17:15,750 --> 00:17:13,760
by onboard

456
00:17:17,669 --> 00:17:15,760
triggering and response to slew the

457
00:17:19,029 --> 00:17:17,679
entire spacecraft to follow it except

458
00:17:21,590 --> 00:17:19,039
for those periods when the earth was

459
00:17:22,710 --> 00:17:21,600
blocking but yeah the use of multiple

460
00:17:25,029 --> 00:17:22,720
telescopes

461
00:17:26,789 --> 00:17:25,039
like jean-pierro's said

462
00:17:28,870 --> 00:17:26,799
we wouldn't have the imaging to even

463
00:17:31,669 --> 00:17:28,880

know what the counterpart was without

464
00:17:34,870 --> 00:17:31,679
the highly detailed follow-up of the

465
00:17:37,830 --> 00:17:34,880
x-rays and the optical

466
00:17:38,950 --> 00:17:37,840
so are you saying basically that each uh

467
00:17:40,470 --> 00:17:38,960
telescope

468
00:17:42,630 --> 00:17:40,480
aspect that looks at this brings

469
00:17:46,070 --> 00:17:42,640
different perspective on it as far as

470
00:17:47,350 --> 00:17:46,080
what the electromagnetic spectrum

471
00:17:50,230 --> 00:17:47,360
it's more than the electromagnetic

472
00:17:52,310 --> 00:17:50,240
spectrum we're we're in a decade that's

473
00:17:55,110 --> 00:17:52,320
starting to open up multi-messenger

474
00:17:56,230 --> 00:17:55,120
astronomy gravitational waves neutrinos

475
00:17:58,150 --> 00:17:56,240
so we're going even beyond

476
00:18:00,070 --> 00:17:58,160
electromagnetic for this burst we're

477
00:18:02,549 --> 00:18:00,080
still in the electromagnetic channels

478
00:18:04,549 --> 00:18:02,559
and even within those channels we're

479
00:18:07,029 --> 00:18:04,559
getting all this information that is

480
00:18:09,669 --> 00:18:07,039
correlated it shows that they behave in

481
00:18:11,750 --> 00:18:09,679
different ways which we interpret then

482
00:18:12,950 --> 00:18:11,760
to try to build this model of our gamma

483
00:18:14,789 --> 00:18:12,960
ray burst

484
00:18:16,470 --> 00:18:14,799
in such a way to explain these various

485
00:18:19,350 --> 00:18:16,480
behaviors we think there's this engine

486
00:18:21,669 --> 00:18:19,360
exploding it drives out a jet plows into

487
00:18:24,230 --> 00:18:21,679
the medium it makes another separate

488
00:18:26,310 --> 00:18:24,240

high energy radiation component and and

489
00:18:28,070 --> 00:18:26,320
this is a consequence this is only

490
00:18:29,270 --> 00:18:28,080
possible by having these multiple

491
00:18:32,310 --> 00:18:29,280
detectors looking at different

492
00:18:32,320 --> 00:18:35,750
all right um

493
00:18:40,870 --> 00:18:38,390
john pierro uh can one of these

494
00:18:43,750 --> 00:18:40,880
gamma-ray bursts happen in our galaxy

495
00:18:45,270 --> 00:18:43,760
is that possible oh yes so sure

496
00:18:47,750 --> 00:18:45,280
i mean um

497
00:18:49,990 --> 00:18:47,760
it is difficult to to quantify how many

498
00:18:50,950 --> 00:18:50,000
bursts one can expect but

499
00:18:52,630 --> 00:18:50,960
we can

500
00:18:54,950 --> 00:18:52,640
think that there could be one gamma

501
00:18:57,510 --> 00:18:54,960
reverse like this one every

502
00:18:58,390 --> 00:18:57,520
i don't know between 100 million years

503
00:19:02,950 --> 00:18:58,400
or

504
00:19:06,070 --> 00:19:02,960
there will be one gamma burst associated

505
00:19:08,789 --> 00:19:06,080
to uh 10 to minus 14 to minus 5

506
00:19:10,470 --> 00:19:08,799
1 bc supernova and we expect one of

507
00:19:12,470 --> 00:19:10,480
these every

508
00:19:13,669 --> 00:19:12,480
i don't know few hundred years in our

509
00:19:14,470 --> 00:19:13,679
galaxy

510
00:19:17,190 --> 00:19:14,480
so

511
00:19:19,350 --> 00:19:17,200
these numbers are still you know quite

512
00:19:22,310 --> 00:19:19,360
uncertain but the order of magnitude is

513
00:19:25,350 --> 00:19:22,320

that we can expect one of each every 100

514
00:19:26,310 --> 00:19:25,360
million years

515
00:19:27,830 --> 00:19:26,320
thanks

516
00:19:29,990 --> 00:19:27,840
uh let's pull rob into the discussion

517
00:19:32,470 --> 00:19:30,000
here a little bit uh how frequent are

518
00:19:33,830 --> 00:19:32,480
these kinds of grbs

519
00:19:35,590 --> 00:19:33,840
how many of them have been observed for

520
00:19:36,710 --> 00:19:35,600
instance

521
00:19:39,750 --> 00:19:36,720
well we

522
00:19:41,669 --> 00:19:39,760
have a good idea from the orbiting uh

523
00:19:43,350 --> 00:19:41,679
compton gamma-ray observatory in which

524
00:19:46,150 --> 00:19:43,360
there was an experiment called the burst

525
00:19:48,310 --> 00:19:46,160
and transient source experiment batsy

526
00:19:51,270 --> 00:19:48,320
that was an all-sky monitor

527
00:19:57,029 --> 00:19:51,280
in low-earth orbit in the 90s

528
00:20:00,950 --> 00:19:57,990
we

529
00:20:04,230 --> 00:20:00,960
uh with batsy saw the entire sky

530
00:20:05,270 --> 00:20:04,240
in gamma rays and we could see

531
00:20:07,510 --> 00:20:05,280
with a

532
00:20:09,510 --> 00:20:07,520
very good depth

533
00:20:11,830 --> 00:20:09,520
nearly the entire universe of gamma ray

534
00:20:13,669 --> 00:20:11,840
bursts and so we can

535
00:20:16,630 --> 00:20:13,679
peg a number about

536
00:20:18,630 --> 00:20:16,640
one per day per universe

537
00:20:21,510 --> 00:20:18,640
that's taking into account that some of

538
00:20:22,950 --> 00:20:21,520

the sky is is blocked and extrapolating

539
00:20:25,110 --> 00:20:22,960
from the blockage

540
00:20:26,710 --> 00:20:25,120
so the universe provides us one per day

541
00:20:30,870 --> 00:20:26,720
but we don't know where it's going to be

542
00:20:34,710 --> 00:20:32,789
all right once again i'd like to remind

543
00:20:36,310 --> 00:20:34,720
everyone that's watching

544
00:20:38,149 --> 00:20:36,320
that you can take part in active

545
00:20:40,310 --> 00:20:38,159
participation of this google hangout by

546
00:20:43,669 --> 00:20:40,320
sending your questions to the nasa

547
00:20:46,630 --> 00:20:43,679
facebook account to our google hangout

548
00:20:48,870 --> 00:20:46,640
page and also via twitter on by using

549
00:20:51,590 --> 00:20:48,880
the hashtag ask nasa

550
00:20:53,350 --> 00:20:51,600
uh sylvia how can these gamma ray births

551
00:20:57,270 --> 00:20:53,360
actually affect us here on earth or can

552
00:21:00,549 --> 00:20:59,270
they can if they're right in our

553
00:21:02,310 --> 00:21:00,559
neighborhood if they're right in the

554
00:21:03,990 --> 00:21:02,320
milky way but as john piero just

555
00:21:05,590 --> 00:21:04,000
discussed um

556
00:21:08,070 --> 00:21:05,600
it

557
00:21:09,830 --> 00:21:08,080
we can sort of put a number on maybe or

558
00:21:11,830 --> 00:21:09,840
an upper limit on maybe how many we

559
00:21:13,909 --> 00:21:11,840
might expect and it turns out we don't

560
00:21:16,549 --> 00:21:13,919
expect really to see one in our milky

561
00:21:17,909 --> 00:21:16,559
way um and but if they're close enough i

562
00:21:19,990 --> 00:21:17,919
mean again they could be you know they

563
00:21:21,590 --> 00:21:20,000

could affect the um they could affect

564
00:21:24,230 --> 00:21:21,600
the atmosphere by creating sort of more

565
00:21:25,590 --> 00:21:24,240
of a uh by changing the

566
00:21:29,110 --> 00:21:25,600
contents of the atmosphere a little bit

567
00:21:30,789 --> 00:21:29,120
by interacting with the atmosphere um

568
00:21:32,630 --> 00:21:30,799
and i guess that would be the the main

569
00:21:33,990 --> 00:21:32,640
problem is if you lose the ozone layer

570
00:21:35,669 --> 00:21:34,000
for instance and then you get a lot of

571
00:21:38,710 --> 00:21:35,679
radiation coming in at once that's what

572
00:21:39,990 --> 00:21:38,720
you would be worried about

573
00:21:42,470 --> 00:21:40,000
all right we have a question here from

574
00:21:44,710 --> 00:21:42,480
ask nasa um are there any future

575
00:21:47,350 --> 00:21:44,720
missions with updated detectives and

576
00:21:51,830 --> 00:21:47,360
technology playing for gamma-ray burst

577
00:21:51,840 --> 00:21:57,990
anything you know of anyway

578
00:22:03,909 --> 00:22:00,789
i take that as uh we're not sure yet

579
00:22:05,590 --> 00:22:03,919
raw priest here uh

580
00:22:07,110 --> 00:22:05,600
it's

581
00:22:10,390 --> 00:22:07,120
we're in kind of a climate where we

582
00:22:12,630 --> 00:22:10,400
don't really anticipate uh

583
00:22:14,710 --> 00:22:12,640
new missions in in

584
00:22:17,270 --> 00:22:14,720
high energy astrophysics

585
00:22:20,149 --> 00:22:17,280
to that extent as a dedicated

586
00:22:21,510 --> 00:22:20,159
burst uh mission we have two

587
00:22:23,750 --> 00:22:21,520
uh

588
00:22:26,310 --> 00:22:23,760

excellent observatories which

589
00:22:29,590 --> 00:22:26,320
are still in uh orbit around the earth

590
00:22:31,190 --> 00:22:29,600
that have a good lifetime that's swift

591
00:22:33,590 --> 00:22:31,200
and fermi

592
00:22:34,710 --> 00:22:33,600
uh so right now we're not anticipating a

593
00:22:38,549 --> 00:22:34,720
follow-on

594
00:22:40,789 --> 00:22:38,559
uh dedicated to gamma-ray bursts

595
00:22:42,470 --> 00:22:40,799
there will be one in europe

596
00:22:44,470 --> 00:22:42,480
launched by the french people together

597
00:22:46,470 --> 00:22:44,480
with chinese they are expected to launch

598
00:22:49,830 --> 00:22:46,480
a mission called swamp

599
00:22:52,710 --> 00:22:49,840
in maybe 2016 2015 if there is an

600
00:22:57,110 --> 00:22:55,510
appreciate that um one of the questions

601
00:22:59,430 --> 00:22:57,120
we got from uh

602
00:23:01,830 --> 00:22:59,440
our one of our facebook pages is is

603
00:23:07,510 --> 00:23:01,840
there a program in place to find a way

604
00:23:11,909 --> 00:23:08,870
let's just say that there have been lots

605
00:23:14,230 --> 00:23:11,919
of attempts to look at repetition

606
00:23:16,390 --> 00:23:14,240
and uh

607
00:23:18,310 --> 00:23:16,400
but we we seem to have an understanding

608
00:23:20,310 --> 00:23:18,320
of the sort of stars that will lead to a

609
00:23:22,710 --> 00:23:20,320
gamma ray burst they're high mass they

610
00:23:24,630 --> 00:23:22,720
drive off lots of wind they're very

611
00:23:26,870 --> 00:23:24,640
bright and luminous they're so called

612
00:23:29,590 --> 00:23:26,880
wolf ray attack stars we have one in the

613
00:23:30,470 --> 00:23:29,600

galaxy eta carina that could blow at any

614
00:23:32,230 --> 00:23:30,480
time

615
00:23:34,390 --> 00:23:32,240
but since they

616
00:23:36,549 --> 00:23:34,400
by any time we mean within ten thousand

617
00:23:38,310 --> 00:23:36,559
hundred thousand years and there's no no

618
00:23:40,390 --> 00:23:38,320
guarantee at ocarina will be a gamma-ray

619
00:23:42,870 --> 00:23:40,400
burst but that's what would be the

620
00:23:44,789 --> 00:23:42,880
signatures of actually finding what

621
00:23:47,110 --> 00:23:44,799
might turn out to be a gamma-ray burst

622
00:23:48,870 --> 00:23:47,120
progenitor star but

623
00:23:50,390 --> 00:23:48,880
but typically they're at such large

624
00:23:53,270 --> 00:23:50,400
distances that we can't even see

625
00:23:55,029 --> 00:23:53,280
individual stars so

626
00:23:56,149 --> 00:23:55,039
the likelihood of any sort of program

627
00:24:02,630 --> 00:23:56,159
like that

628
00:24:06,549 --> 00:24:04,470
well we have another question here is

629
00:24:08,390 --> 00:24:06,559
there a possibility i love these

630
00:24:10,710 --> 00:24:08,400
questions is there a possibility that

631
00:24:12,950 --> 00:24:10,720
this gamma-ray burst is a result of

632
00:24:18,549 --> 00:24:12,960
a matter antimatter annihilation

633
00:24:23,590 --> 00:24:20,789
maybe i'm the only person here who made

634
00:24:25,510 --> 00:24:23,600
a model of math matter anti-matter

635
00:24:28,470 --> 00:24:25,520
activity on it as a gamma-ray burst and

636
00:24:30,470 --> 00:24:28,480
the short answer is no basically if you

637
00:24:33,350 --> 00:24:30,480
drive matter into anti-matter it's like

638
00:24:37,269 --> 00:24:33,360

when you drop a drop of water onto a hot

639
00:24:39,909 --> 00:24:37,279
pan or oil it makes this sizzling

640
00:24:41,909 --> 00:24:39,919
layer between the two uh

641
00:24:44,630 --> 00:24:41,919
the two types of matter and so you can't

642
00:24:46,149 --> 00:24:44,640
get lots of emission in a matter

643
00:24:49,029 --> 00:24:46,159
anti-matter scenario because they just

644
00:24:51,269 --> 00:24:49,039
drive each other apart so anti-matter

645
00:24:53,350 --> 00:24:51,279
matter except for comets in the solar

646
00:24:54,870 --> 00:24:53,360
system which is what i was playing with

647
00:24:57,830 --> 00:24:54,880
won't work and of course that model is

648
00:24:59,110 --> 00:24:57,840
completely ruled out

649
00:25:01,430 --> 00:24:59,120
okay

650
00:25:03,190 --> 00:25:01,440
um tom let's let's bring you in maybe

651
00:25:04,950 --> 00:25:03,200
you know the answer to this one uh

652
00:25:07,669 --> 00:25:04,960
question is is there a star map

653
00:25:13,510 --> 00:25:07,679
available that pinpoints the locations

654
00:25:16,549 --> 00:25:14,950
so you don't know maybe someone else

655
00:25:17,909 --> 00:25:16,559
does

656
00:25:18,789 --> 00:25:17,919
so this is tom

657
00:25:21,909 --> 00:25:18,799
um

658
00:25:23,350 --> 00:25:21,919
yeah we've plotted out the locations of

659
00:25:25,430 --> 00:25:23,360
gamma-ray bursts

660
00:25:27,110 --> 00:25:25,440
and it's isotropic they come from any

661
00:25:28,789 --> 00:25:27,120
direction in the sky

662
00:25:30,549 --> 00:25:28,799
and of course as was mentioned earlier

663
00:25:32,470 --> 00:25:30,559

we don't know when they're going to come

664
00:25:35,190 --> 00:25:32,480
so that's the challenge of bringing

665
00:25:36,870 --> 00:25:35,200
building observatories that can find

666
00:25:38,230 --> 00:25:36,880
these things in any direction at any

667
00:25:39,990 --> 00:25:38,240
time

668
00:25:41,750 --> 00:25:40,000
you know when about one per day will

669
00:25:44,149 --> 00:25:41,760
happen but the challenge is you don't

670
00:25:45,990 --> 00:25:44,159
know when and you don't know where

671
00:25:49,110 --> 00:25:46,000
could and so there's no sweet spot to

672
00:25:53,190 --> 00:25:50,950
okay

673
00:25:55,350 --> 00:25:53,200
i'd like to get back to the

674
00:25:57,430 --> 00:25:55,360
synergy of having multiple space

675
00:25:58,870 --> 00:25:57,440
telescopes and ground assets working

676
00:26:02,549 --> 00:25:58,880
with this

677
00:26:05,110 --> 00:26:02,559
when one of these assets sees a grb

678
00:26:06,789 --> 00:26:05,120
what's the notification process to bring

679
00:26:10,149 --> 00:26:06,799
all the other ones online to look at

680
00:26:13,350 --> 00:26:10,159
that same general vicinity

681
00:26:16,870 --> 00:26:13,360
well this is rob preece um

682
00:26:19,590 --> 00:26:16,880
what happens is a uh dedicated server in

683
00:26:24,950 --> 00:26:19,600
the at goddard space flight center sends

684
00:26:28,870 --> 00:26:24,960
out notices to subscribing astronomers

685
00:26:31,029 --> 00:26:28,880
we have uh an onboard trigger for fermi

686
00:26:32,149 --> 00:26:31,039
and also for the swift

687
00:26:35,430 --> 00:26:32,159
bat

688
00:26:37,430 --> 00:26:35,440

instrument and uh

689
00:26:39,269 --> 00:26:37,440
each of these is hooked into this

690
00:26:41,430 --> 00:26:39,279
service and it

691
00:26:43,909 --> 00:26:41,440
sends multiple messages of refined

692
00:26:46,230 --> 00:26:43,919
localizations on the sky out to

693
00:26:48,070 --> 00:26:46,240
interested astronomers like tom

694
00:26:49,669 --> 00:26:48,080
and some some

695
00:26:50,710 --> 00:26:49,679
folks like tom

696
00:26:53,110 --> 00:26:50,720
have

697
00:26:55,590 --> 00:26:53,120
robotic telescopes that actually respond

698
00:26:58,390 --> 00:26:55,600
to these messages autonomously maybe he

699
00:27:04,789 --> 00:27:01,190
yeah so we have robotic telescopes that

700
00:27:07,990 --> 00:27:04,799
pick up these messages off the internet

701
00:27:09,669 --> 00:27:08,000
in real time and rapidly slew

702
00:27:11,750 --> 00:27:09,679
to the position of the localized

703
00:27:13,110 --> 00:27:11,760
gamma-ray burst in fact that was what

704
00:27:14,390 --> 00:27:13,120
was done here with the raptor t

705
00:27:17,110 --> 00:27:14,400
telescopes

706
00:27:19,430 --> 00:27:17,120
but the fastest that's ever been done

707
00:27:21,830 --> 00:27:19,440
is something like it takes

708
00:27:23,750 --> 00:27:21,840
about 10 seconds or so

709
00:27:26,149 --> 00:27:23,760
so you miss one of the interesting

710
00:27:28,710 --> 00:27:26,159
observational challenges is to pick up

711
00:27:30,549 --> 00:27:28,720
those first 10 seconds of a gamma ray

712
00:27:32,870 --> 00:27:30,559
burst in the optical

713
00:27:34,950 --> 00:27:32,880

and this particular event we were lucky

714
00:27:36,470 --> 00:27:34,960
we had a full sky monitor that was

715
00:27:39,110 --> 00:27:36,480
looking at the position that the gamma

716
00:27:41,269 --> 00:27:39,120
ray burst happened at even before

717
00:27:43,029 --> 00:27:41,279
the explosion occurred

718
00:27:44,549 --> 00:27:43,039
and this particular event was bright

719
00:27:47,190 --> 00:27:44,559
enough that we could see it in these

720
00:27:49,750 --> 00:27:47,200
persistent full sky monitors to actually

721
00:27:51,510 --> 00:27:49,760
make measurements of this before even

722
00:27:52,710 --> 00:27:51,520
the world's fastest newing telescopes

723
00:27:53,990 --> 00:27:52,720
could get there

724
00:27:56,070 --> 00:27:54,000
so that's one of the things that's

725
00:27:58,389 --> 00:27:56,080
really exciting about this event is that

726
00:28:03,590 --> 00:27:58,399
we got it from before all the way

727
00:28:06,470 --> 00:28:04,950
now uh

728
00:28:08,230 --> 00:28:06,480
john piero if i could target this

729
00:28:10,870 --> 00:28:08,240
question toward you

730
00:28:13,029 --> 00:28:10,880
as i mentioned earlier uh once in a

731
00:28:14,310 --> 00:28:13,039
century event but i think that was my

732
00:28:17,029 --> 00:28:14,320
own uh

733
00:28:21,430 --> 00:28:17,039
uh comment there how often can we expect

734
00:28:23,669 --> 00:28:21,440
to see a gamma ray burst of this size

735
00:28:26,230 --> 00:28:23,679
okay i think the uh the real question is

736
00:28:28,789 --> 00:28:26,240
how often can we see of this malignancy

737
00:28:31,909 --> 00:28:28,799
and distance because

738
00:28:33,750 --> 00:28:31,919

this burst is quite very uh

739
00:28:35,269 --> 00:28:33,760
remote of this bird is quite high but

740
00:28:36,950 --> 00:28:35,279
it's a typical amino acid that we

741
00:28:39,350 --> 00:28:36,960
usually see in gamma ray birds that will

742
00:28:41,590 --> 00:28:39,360
detect a ratio one and two

743
00:28:43,590 --> 00:28:41,600
what is unusual for this gamma reverse

744
00:28:46,389 --> 00:28:43,600
is that it has the same luminosity but

745
00:28:49,350 --> 00:28:46,399
it was very nearby we call it harassing

746
00:28:51,350 --> 00:28:49,360
the translating distance it is at 0.3

747
00:28:53,909 --> 00:28:51,360
and that's why it was so the flux that

748
00:28:57,269 --> 00:28:53,919
we received from this source was all so

749
00:28:59,750 --> 00:28:57,279
much higher than any other one

750
00:29:02,630 --> 00:28:59,760
so to have a burst of this luminosity at

751
00:29:05,190 --> 00:29:02,640
this this we expect one every 60 years

752
00:29:07,110 --> 00:29:05,200
or so this is what we can infer the from

753
00:29:08,870 --> 00:29:07,120
the um

754
00:29:10,389 --> 00:29:08,880
country called the luminosity function

755
00:29:13,029 --> 00:29:10,399
of these sources

756
00:29:15,510 --> 00:29:13,039
because we can uh derive from the

757
00:29:17,590 --> 00:29:15,520
luminosity uh how many of them we can

758
00:29:20,630 --> 00:29:17,600
expect in a given part of the volume of

759
00:29:22,549 --> 00:29:20,640
the universe so it is very unique event

760
00:29:26,549 --> 00:29:22,559
i would say one or two pair

761
00:29:29,909 --> 00:29:28,070
thanks john pierro

762
00:29:31,190 --> 00:29:29,919
um

763
00:29:33,350 --> 00:29:31,200

i'm going to throw this one out here i'm

764
00:29:35,830 --> 00:29:33,360
not sure who should take it uh maybe

765
00:29:37,029 --> 00:29:35,840
thomas would you could be yours but

766
00:29:38,549 --> 00:29:37,039
um

767
00:29:40,710 --> 00:29:38,559
what are the characteristics of the

768
00:29:44,389 --> 00:29:40,720
burst observed in light especially in

769
00:29:47,350 --> 00:29:46,310
so the

770
00:29:50,070 --> 00:29:47,360
well

771
00:29:52,070 --> 00:29:50,080
one of the unusual this particular event

772
00:29:53,029 --> 00:29:52,080
that was really interesting to us is

773
00:29:56,549 --> 00:29:53,039
that

774
00:29:59,110 --> 00:29:56,559
we had this bright optical afterglow

775
00:30:01,190 --> 00:29:59,120
that persisted so this is a

776
00:30:03,669 --> 00:30:01,200
optical emission which we'd known about

777
00:30:05,110 --> 00:30:03,679
before we'd known about optical after

778
00:30:06,070 --> 00:30:05,120
glows

779
00:30:08,070 --> 00:30:06,080
but

780
00:30:09,990 --> 00:30:08,080
what was exciting about this particular

781
00:30:12,549 --> 00:30:10,000
one is that it was so bright in the very

782
00:30:14,310 --> 00:30:12,559
highest energy gamma rays and we saw

783
00:30:16,310 --> 00:30:14,320
this link between

784
00:30:19,590 --> 00:30:16,320
what happened in the optical

785
00:30:21,669 --> 00:30:19,600
fading and we saw a very similar fading

786
00:30:23,029 --> 00:30:21,679
of those very highest energy gamma rays

787
00:30:25,190 --> 00:30:23,039
very similar

788
00:30:27,269 --> 00:30:25,200

persistence of those very highest energy

789
00:30:29,269 --> 00:30:27,279
gamma rays normally in the lower energy

790
00:30:31,110 --> 00:30:29,279
gamma rays they only last for something

791
00:30:32,870 --> 00:30:31,120
like a minute or so

792
00:30:34,950 --> 00:30:32,880
but this event went on and on in the

793
00:30:36,470 --> 00:30:34,960
very highest energy gamma rays even

794
00:30:38,149 --> 00:30:36,480
after those lower energy gamma rays

795
00:30:40,870 --> 00:30:38,159
faded away

796
00:30:43,669 --> 00:30:40,880
and that was a really interesting sign

797
00:30:46,549 --> 00:30:43,679
this link between the optical afterglow

798
00:30:49,269 --> 00:30:46,559
which we know is generated as the ejecta

799
00:30:51,830 --> 00:30:49,279
impacts the surrounding material

800
00:30:54,470 --> 00:30:51,840
the link between this optical afterglow

801
00:30:56,870 --> 00:30:54,480
and these very highest energy gamma rays

802
00:30:58,549 --> 00:30:56,880
really clinches this idea that those

803
00:31:01,190 --> 00:30:58,559
very highest energy gamma rays are

804
00:31:03,830 --> 00:31:01,200
generated by this what we call external

805
00:31:05,510 --> 00:31:03,840
shock as that ejecta impacts the

806
00:31:06,950 --> 00:31:05,520
surrounding environment

807
00:31:08,870 --> 00:31:06,960
so that was one of the really exciting

808
00:31:11,269 --> 00:31:08,880
things about this event to see that that

809
00:31:14,950 --> 00:31:12,789
all right appreciate it

810
00:31:16,549 --> 00:31:14,960
uh sylvia we'll target this one question

811
00:31:18,549 --> 00:31:16,559
to you and i'm not sure i can pronounce

812
00:31:21,590 --> 00:31:18,559
the the word and here we'll find out how

813
00:31:26,389 --> 00:31:21,600

does this gamma reverse compare to

814
00:31:29,350 --> 00:31:26,399
the ordovician extinction event

815
00:31:31,269 --> 00:31:29,360
so first you have to convince the uh

816
00:31:32,549 --> 00:31:31,279
convince the people who are studying

817
00:31:34,549 --> 00:31:32,559
the uh history of the earth that the

818
00:31:36,149 --> 00:31:34,559
ordovician event was uh which was a

819
00:31:37,269 --> 00:31:36,159
major extinction event you have to

820
00:31:39,430 --> 00:31:37,279
convince them that this was actually

821
00:31:41,669 --> 00:31:39,440
caused by gamma-ray bursts um i believe

822
00:31:43,350 --> 00:31:41,679
the consensus is that it um it's

823
00:31:45,509 --> 00:31:43,360
probably caused by volcanic activity on

824
00:31:47,350 --> 00:31:45,519
the earth uh which changes you know the

825
00:31:48,389 --> 00:31:47,360
sort of co2 content and contents of the

826
00:31:49,509 --> 00:31:48,399
atmosphere

827
00:31:51,830 --> 00:31:49,519
um

828
00:31:54,149 --> 00:31:51,840
so there's uh

829
00:31:55,669 --> 00:31:54,159
again the order if if the ordovician uh

830
00:31:57,350 --> 00:31:55,679
extinction event was actually caused by

831
00:31:59,590 --> 00:31:57,360
a gamma ray burst it would have been

832
00:32:12,950 --> 00:31:59,600
much closer than this gamma ray burst it

833
00:32:16,389 --> 00:32:14,310
extinction event if available it was

834
00:32:19,110 --> 00:32:16,399
caused by gamma rays

835
00:32:22,070 --> 00:32:19,120
so sorry that was very satisfying but

836
00:32:23,909 --> 00:32:22,080
oh that was great but can i elaborate on

837
00:32:25,669 --> 00:32:23,919
that a bit absolutely

838
00:32:27,509 --> 00:32:25,679

first one shouldn't bring up this

839
00:32:29,190 --> 00:32:27,519
extinction event without mentioning

840
00:32:30,710 --> 00:32:29,200
professor adrian malott of the

841
00:32:33,350 --> 00:32:30,720
university of kansas who was the main

842
00:32:35,269 --> 00:32:33,360
driver behind this idea

843
00:32:38,310 --> 00:32:35,279
and he certainly uh intrigued my

844
00:32:39,190 --> 00:32:38,320
interest in it to around 2005

845
00:32:40,549 --> 00:32:39,200
uh

846
00:32:42,230 --> 00:32:40,559
and and one thing that was most

847
00:32:44,549 --> 00:32:42,240
interesting is that it turns out the

848
00:32:46,310 --> 00:32:44,559
extinction event isn't cataclysmic and

849
00:32:48,789 --> 00:32:46,320
sudden but it extends over some millions

850
00:32:50,710 --> 00:32:48,799
of years and so what i did with a very

851
00:32:52,470 --> 00:32:50,720
talented high school student jeremy

852
00:32:53,669 --> 00:32:52,480
holmes is to look at the fact that you

853
00:32:55,590 --> 00:32:53,679
can have a one-two punch with a

854
00:32:57,590 --> 00:32:55,600
gamma-ray burst first you have the burst

855
00:32:59,909 --> 00:32:57,600
and the high energy photons come and as

856
00:33:02,149 --> 00:32:59,919
sylvia mentioned they burn off the

857
00:33:05,509 --> 00:33:02,159
atmosphere they destroy the ozone layer

858
00:33:08,070 --> 00:33:05,519
all the plankton gets uh

859
00:33:10,149 --> 00:33:08,080
sunburned and die away and then there's

860
00:33:12,149 --> 00:33:10,159
one type of event but then the cosmic

861
00:33:13,909 --> 00:33:12,159
rays start coming and the cosmic rays

862
00:33:16,549 --> 00:33:13,919
have their own impact and

863
00:33:18,549 --> 00:33:16,559

can cause global cooling and in a weird

864
00:33:21,269 --> 00:33:18,559
sense there was some

865
00:33:23,509 --> 00:33:21,279
behavioral extinction that was in accord

866
00:33:25,669 --> 00:33:23,519
with those patterns

867
00:33:27,029 --> 00:33:25,679
but as i mentioned yesterday in the

868
00:33:28,870 --> 00:33:27,039
telecon

869
00:33:30,870 --> 00:33:28,880
since then it's been

870
00:33:32,389 --> 00:33:30,880
more clear that the rate of the type of

871
00:33:33,830 --> 00:33:32,399
gamma ray bursts

872
00:33:36,310 --> 00:33:33,840
in the galaxy

873
00:33:37,269 --> 00:33:36,320
as john piero said are so rare and the

874
00:33:39,590 --> 00:33:37,279
chance that

875
00:33:42,070 --> 00:33:39,600
the direction the beam is pointed toward

876
00:33:44,389 --> 00:33:42,080
us is so unlikely that we think

877
00:33:46,470 --> 00:33:44,399
probably not the case in spite of some

878
00:33:52,230 --> 00:33:46,480
tantalizing suggestions that they could

879
00:33:56,950 --> 00:33:54,310
appreciate it uh getting some good

880
00:33:59,029 --> 00:33:56,960
questions in from our facebook followers

881
00:34:00,710 --> 00:33:59,039
as well as from google hangout uh this

882
00:34:03,830 --> 00:34:00,720
next question i'm not sure who can who

883
00:34:05,990 --> 00:34:03,840
can take it but it is intriguing how big

884
00:34:07,190 --> 00:34:06,000
can a gamma ray burst get are there

885
00:34:09,750 --> 00:34:07,200
upper limits

886
00:34:15,990 --> 00:34:09,760
in theory or in principle to the energy

887
00:34:20,629 --> 00:34:17,990
well there

888
00:34:22,790 --> 00:34:20,639

seem to originate in massive stars so

889
00:34:24,550 --> 00:34:22,800
you have an upper limit depending on the

890
00:34:25,430 --> 00:34:24,560
mass of the star

891
00:34:32,470 --> 00:34:25,440
we're

892
00:34:35,190 --> 00:34:32,480
all this is raw priest here all the

893
00:34:38,310 --> 00:34:35,200
all the energy uh

894
00:34:40,869 --> 00:34:38,320
that that is equivalent to the the rest

895
00:34:42,470 --> 00:34:40,879
mass of the sun is converted into gamma

896
00:34:43,430 --> 00:34:42,480
rays if these are

897
00:34:46,069 --> 00:34:43,440
uh

898
00:34:49,270 --> 00:34:46,079
isotropic events they can't be

899
00:34:51,030 --> 00:34:49,280
there's there's an upper limit to the

900
00:34:53,990 --> 00:34:51,040
amount of matter that can be converted

901
00:34:55,270 --> 00:34:54,000
into directly into the gamma rays and

902
00:34:57,910 --> 00:34:55,280
explosive

903
00:34:58,950 --> 00:34:57,920
uh outflows in the jets

904
00:35:00,630 --> 00:34:58,960
and so

905
00:35:03,430 --> 00:35:00,640
uh

906
00:35:05,190 --> 00:35:03,440
basically the the upper limit is

907
00:35:06,470 --> 00:35:05,200
uh determined by

908
00:35:09,349 --> 00:35:06,480
uh

909
00:35:11,109 --> 00:35:09,359
the size of the star that is

910
00:35:13,589 --> 00:35:11,119
supposed to be the progenitor the

911
00:35:14,710 --> 00:35:13,599
gamma-ray burst

912
00:35:16,870 --> 00:35:14,720
i see

913
00:35:19,270 --> 00:35:16,880

uh charles can you tell us

914
00:35:21,430 --> 00:35:19,280
another basic question i guess but

915
00:35:25,190 --> 00:35:21,440
uh we got a question here on it how does

916
00:35:27,670 --> 00:35:25,200
the gamma-ray burst actually start

917
00:35:29,910 --> 00:35:27,680
sorry okay

918
00:35:31,990 --> 00:35:29,920
first let me also pick up on where tom

919
00:35:33,910 --> 00:35:32,000
was or rob was talking about because

920
00:35:37,109 --> 00:35:33,920
that was an excellent question about the

921
00:35:40,390 --> 00:35:37,119
most energetic memory verse it's not

922
00:35:42,390 --> 00:35:40,400
proven that black holes are the drivers

923
00:35:44,390 --> 00:35:42,400
behind gamma-ray bursts in fact there's

924
00:35:47,109 --> 00:35:44,400
a very powerful

925
00:35:49,430 --> 00:35:47,119
school of thinking that neutron stars

926
00:35:51,349 --> 00:35:49,440
magnetars could also power gamma-ray

927
00:35:52,710 --> 00:35:51,359
bursts and there's lots of

928
00:35:54,790 --> 00:35:52,720
interesting

929
00:35:57,430 --> 00:35:54,800
evidence on that side

930
00:36:00,390 --> 00:35:57,440
of these x-ray plateaus for example that

931
00:36:02,630 --> 00:36:00,400
we see in with a swift telescope

932
00:36:05,349 --> 00:36:02,640
and there though we know that there's an

933
00:36:08,310 --> 00:36:05,359
absolute energy maximum

934
00:36:11,270 --> 00:36:08,320
and in a couple of occasions that energy

935
00:36:13,349 --> 00:36:11,280
maximum is violated and so that supports

936
00:36:15,109 --> 00:36:13,359
the possibility it's a black hole and

937
00:36:18,230 --> 00:36:15,119
then if it's a black if it's a collapse

938
00:36:20,390 --> 00:36:18,240

of a massive core of a massive star

939
00:36:23,349 --> 00:36:20,400
it can be up you know it can be somewhat

940
00:36:24,950 --> 00:36:23,359
larger in terms of absolute energy but

941
00:36:27,430 --> 00:36:24,960
if they take that absolute energy which

942
00:36:29,829 --> 00:36:27,440
is like the mc squared energy

943
00:36:31,030 --> 00:36:29,839
where m is now the mass of a solar mass

944
00:36:33,750 --> 00:36:31,040
core

945
00:36:37,910 --> 00:36:33,760
and you direct it into a very small jet

946
00:36:40,230 --> 00:36:37,920
you can get very large energies so

947
00:36:42,950 --> 00:36:40,240
there's this very difficult task of

948
00:36:44,790 --> 00:36:42,960
going from the what we see

949
00:36:46,710 --> 00:36:44,800
to what really is

950
00:36:48,069 --> 00:36:46,720
and because it's a beam geometry we're

951
00:36:50,630 --> 00:36:48,079
just looking down the jet we don't know

952
00:36:51,910 --> 00:36:50,640
how big the jet is so that's that's a

953
00:36:55,030 --> 00:36:51,920
tricky

954
00:36:56,390 --> 00:36:55,040
thing to establish but anyway the last

955
00:36:57,190 --> 00:36:56,400
question was really good because it

956
00:36:58,710 --> 00:36:57,200
really

957
00:37:00,390 --> 00:36:58,720
is bearing on

958
00:37:02,310 --> 00:37:00,400
different schools of thought that are

959
00:37:03,829 --> 00:37:02,320
not yet settled so

960
00:37:05,510 --> 00:37:03,839
and now i've already forgot what you

961
00:37:07,109 --> 00:37:05,520
just asked okay

962
00:37:08,390 --> 00:37:07,119
how do these gamma ray bursts actually

963
00:37:12,950 --> 00:37:08,400

start

964
00:37:15,349 --> 00:37:12,960
where you well again

965
00:37:17,030 --> 00:37:15,359
uh you have a massive star

966
00:37:18,790 --> 00:37:17,040
it has fuel

967
00:37:21,589 --> 00:37:18,800
that fuel is burned

968
00:37:23,030 --> 00:37:21,599
and it makes a massive iron core and

969
00:37:25,829 --> 00:37:23,040
that core is

970
00:37:27,589 --> 00:37:25,839
held up by various types of pressure

971
00:37:29,750 --> 00:37:27,599
ultimately it's neutron degeneracy

972
00:37:31,270 --> 00:37:29,760
pressure and but if it becomes too

973
00:37:35,670 --> 00:37:31,280
massive it just collapses to a black

974
00:37:37,589 --> 00:37:35,680
hole and that is this standard pathway

975
00:37:39,750 --> 00:37:37,599
by which we think a gamma-ray burst

976
00:37:41,670 --> 00:37:39,760
proceeds of the long gamma-ray burst

977
00:37:44,310 --> 00:37:41,680
variety there's the second very

978
00:37:46,069 --> 00:37:44,320
important pathway where two neutron

979
00:37:47,270 --> 00:37:46,079
stars are a neutron star in a black hole

980
00:37:48,710 --> 00:37:47,280
coal s

981
00:37:50,470 --> 00:37:48,720
those make short gamma reverse and

982
00:37:52,310 --> 00:37:50,480
that's just as interesting but for the

983
00:37:56,310 --> 00:37:52,320
burst under discussion today it's of the

984
00:37:59,349 --> 00:37:56,320
long type so related to a massive star

985
00:38:01,270 --> 00:37:59,359
okay now is the gamma-ray rate gamma-ray

986
00:38:09,030 --> 00:38:01,280
burst radiation

987
00:38:09,040 --> 00:38:13,270
short answer no

988
00:38:17,349 --> 00:38:14,069

okay

989
00:38:18,550 --> 00:38:17,359
longer answer no

990
00:38:21,750 --> 00:38:18,560
all right

991
00:38:23,990 --> 00:38:21,760
now is there enough energy in such a

992
00:38:28,710 --> 00:38:24,000
burst as the one we just seen in april

993
00:38:36,710 --> 00:38:30,710
another question from our facebook

994
00:38:41,349 --> 00:38:39,270
well this is rob priest again uh

995
00:38:42,069 --> 00:38:41,359
i was just at a conference in kyoto

996
00:38:44,630 --> 00:38:42,079
where

997
00:38:50,870 --> 00:38:47,510
modeling of

998
00:38:53,670 --> 00:38:50,880
fusing into higher element higher atomic

999
00:38:56,790 --> 00:38:53,680
mass elements was uh simulated

1000
00:38:58,390 --> 00:38:56,800
and it seems that uh in

1001
00:39:01,829 --> 00:38:58,400
in to

1002
00:39:05,190 --> 00:39:01,839
a pretty good approximation you can get

1003
00:39:08,230 --> 00:39:05,200
some of the highest elements of uh

1004
00:39:11,030 --> 00:39:08,240
produced in a supernova like out

1005
00:39:14,790 --> 00:39:11,040
outburst like a gamma-ray burst so the

1006
00:39:16,630 --> 00:39:14,800
possibility is yes we can we can produce

1007
00:39:17,670 --> 00:39:16,640
some fraction of the

1008
00:39:20,790 --> 00:39:17,680
the uh

1009
00:39:22,710 --> 00:39:20,800
high atomic mass materials in such

1010
00:39:25,510 --> 00:39:22,720
explosions

1011
00:39:27,430 --> 00:39:25,520
yeah and let me carry on that's a really

1012
00:39:30,230 --> 00:39:27,440
excellent question i don't know where

1013
00:39:31,190 --> 00:39:30,240

these because this bears on the subject

1014
00:39:33,829 --> 00:39:31,200
of

1015
00:39:35,510 --> 00:39:33,839
how a gamma-ray burst and supernova

1016
00:39:37,910 --> 00:39:35,520
are related

1017
00:39:39,670 --> 00:39:37,920
most supernova after they explode they

1018
00:39:42,069 --> 00:39:39,680
form this

1019
00:39:44,790 --> 00:39:42,079
nickel that decays into iron and cobalt

1020
00:39:46,310 --> 00:39:44,800
and powers the supernova light curve

1021
00:39:48,390 --> 00:39:46,320
but for the gamma ray burst there's a

1022
00:39:50,710 --> 00:39:48,400
school of thinking that the core

1023
00:39:53,670 --> 00:39:50,720
collapses directly to a black hole so

1024
00:39:56,470 --> 00:39:53,680
there wouldn't be this supernova

1025
00:39:57,990 --> 00:39:56,480
formation event with a nickel cobalt and

1026
00:40:00,870 --> 00:39:58,000
iron so you have to make that in a

1027
00:40:02,870 --> 00:40:00,880
separate way and indeed people look at

1028
00:40:06,870 --> 00:40:02,880
how to use the gamma-ray burst

1029
00:40:08,790 --> 00:40:06,880
radiations to produce high mass elements

1030
00:40:11,190 --> 00:40:08,800
in order to save this sort of paradigm

1031
00:40:13,190 --> 00:40:11,200
where the black hole is directly formed

1032
00:40:16,710 --> 00:40:13,200
by the collapse of a the core of the

1033
00:40:19,670 --> 00:40:17,910
appreciate it

1034
00:40:21,030 --> 00:40:19,680
um tom i'm going to send this question

1035
00:40:23,349 --> 00:40:21,040
to you

1036
00:40:24,470 --> 00:40:23,359
why shouldn't optical and gamma ray

1037
00:40:26,069 --> 00:40:24,480
light behave

1038
00:40:28,230 --> 00:40:26,079

basically the same

1039
00:40:30,870 --> 00:40:28,240
why is there a difference there

1040
00:40:32,550 --> 00:40:30,880
yeah so

1041
00:40:34,630 --> 00:40:32,560
just because of the energies the

1042
00:40:37,589 --> 00:40:34,640
particles are accelerated to

1043
00:40:39,750 --> 00:40:37,599
so the optical light is generated often

1044
00:40:41,190 --> 00:40:39,760
not always often by lower energy

1045
00:40:43,109 --> 00:40:41,200
particles

1046
00:40:45,430 --> 00:40:43,119
and that may be accelerated in different

1047
00:40:48,470 --> 00:40:45,440
ways from the gamma rays

1048
00:40:50,150 --> 00:40:48,480
uh generating particles um but we see

1049
00:40:53,109 --> 00:40:50,160
sort of two classes of emission

1050
00:40:55,670 --> 00:40:53,119
sometimes we see a very close coupling

1051
00:40:57,910 --> 00:40:55,680
between the variations in the gamma rays

1052
00:40:59,510 --> 00:40:57,920
and the optical we call that prompt

1053
00:41:01,349 --> 00:40:59,520
optical emission

1054
00:41:02,790 --> 00:41:01,359
and because they're so closely coupled

1055
00:41:04,829 --> 00:41:02,800
we think that they're generated by

1056
00:41:06,470 --> 00:41:04,839
exactly the same

1057
00:41:08,710 --> 00:41:06,480
process

1058
00:41:10,390 --> 00:41:08,720
with this other type of optical emission

1059
00:41:12,950 --> 00:41:10,400
which we saw in this particular event

1060
00:41:15,270 --> 00:41:12,960
with the afterglow emission

1061
00:41:17,349 --> 00:41:15,280
that's kind of the glowing embers of the

1062
00:41:20,309 --> 00:41:17,359
explosion if you will

1063
00:41:22,309 --> 00:41:20,319

and that's not necessarily linked to the

1064
00:41:24,470 --> 00:41:22,319
gamma rays in fact in this case it was

1065
00:41:27,190 --> 00:41:24,480
with the very highest energies but not

1066
00:41:29,190 --> 00:41:27,200
at those lower energy gamma rays and

1067
00:41:30,550 --> 00:41:29,200
that's typically what we see are these

1068
00:41:32,870 --> 00:41:30,560
lower energy

1069
00:41:34,790 --> 00:41:32,880
gamma-ray emission in a gamma-ray burst

1070
00:41:36,790 --> 00:41:34,800
normally we talk about that

1071
00:41:39,030 --> 00:41:36,800
and often we will see this optical

1072
00:41:40,950 --> 00:41:39,040
afterglow persisting for a long time

1073
00:41:44,790 --> 00:41:40,960
way after all the gamma rays have faded

1074
00:41:49,589 --> 00:41:47,270
okay can you uh can someone

1075
00:41:52,150 --> 00:41:49,599
another question here from our

1076
00:41:54,470 --> 00:41:52,160
facebook fans can you tell us about

1077
00:41:56,790 --> 00:41:54,480
terrestrial gamma-ray bursts are they

1078
00:42:00,829 --> 00:41:56,800
different per se than uh this camera

1079
00:42:05,990 --> 00:42:03,510
seen well this is raw priests uh

1080
00:42:09,030 --> 00:42:06,000
terrestrial gamma flashes

1081
00:42:11,270 --> 00:42:09,040
are observed by our instrument the gbm

1082
00:42:12,710 --> 00:42:11,280
aboard uh fermi

1083
00:42:14,950 --> 00:42:12,720
and uh

1084
00:42:16,870 --> 00:42:14,960
they're quite different

1085
00:42:20,230 --> 00:42:16,880
they're thought to be uh

1086
00:42:21,270 --> 00:42:20,240
runaway acceleration of electrons in

1087
00:42:23,670 --> 00:42:21,280
very

1088
00:42:25,589 --> 00:42:23,680

high high electric fields at the top of

1089
00:42:28,309 --> 00:42:25,599
thunderstorms

1090
00:42:30,470 --> 00:42:28,319
and uh we have actually seen

1091
00:42:32,390 --> 00:42:30,480
uh traces of

1092
00:42:33,349 --> 00:42:32,400
uh positrons

1093
00:42:36,390 --> 00:42:33,359
uh

1094
00:42:38,870 --> 00:42:36,400
interacting with our detectors and so

1095
00:42:40,470 --> 00:42:38,880
the energies involved are

1096
00:42:43,750 --> 00:42:40,480
high enough to produce pairs of

1097
00:42:45,829 --> 00:42:43,760
electrons and positrons

1098
00:42:46,790 --> 00:42:45,839
so it's a it's a much different purely

1099
00:42:48,870 --> 00:42:46,800
electro

1100
00:42:54,069 --> 00:42:48,880
magnetic phenomena but

1101
00:42:56,870 --> 00:42:55,750
uh okay

1102
00:42:58,390 --> 00:42:56,880
um

1103
00:42:59,750 --> 00:42:58,400
john piero i'm going to target this

1104
00:43:00,550 --> 00:42:59,760
question toward you

1105
00:43:02,950 --> 00:43:00,560
uh

1106
00:43:07,670 --> 00:43:02,960
what do x-rays bring to the table in in

1107
00:43:12,150 --> 00:43:10,309
the gamma day you mean uh

1108
00:43:13,349 --> 00:43:12,160
yeah

1109
00:43:14,870 --> 00:43:13,359
well

1110
00:43:16,470 --> 00:43:14,880
gamma and birds have been detected in

1111
00:43:17,990 --> 00:43:16,480
gamma ray bands or

1112
00:43:20,870 --> 00:43:18,000
they have been discovered the x-ray

1113
00:43:23,430 --> 00:43:20,880

spectrum bring to the bring to the top

1114
00:43:26,870 --> 00:43:23,440
of the x-ray spectrum

1115
00:43:28,710 --> 00:43:26,880
well the x-ray spectrum actually are

1116
00:43:30,950 --> 00:43:28,720
not that eastern at the end because for

1117
00:43:32,870 --> 00:43:30,960
instance we see some evolution in the

1118
00:43:34,950 --> 00:43:32,880
extra spectrum in the early days in the

1119
00:43:37,670 --> 00:43:34,960
first few seconds minutes

1120
00:43:43,109 --> 00:43:37,680
when they were still seeing the dying

1121
00:43:46,870 --> 00:43:45,990
but since then the spectrum is always

1122
00:43:50,710 --> 00:43:46,880
quite

1123
00:43:52,870 --> 00:43:50,720
a slope of 1.8.2 i mean the slope of the

1124
00:43:55,109 --> 00:43:52,880
spectrum doesn't change over

1125
00:43:56,390 --> 00:43:55,119
minutes hours and days stay quite

1126
00:43:58,550 --> 00:43:56,400
constant

1127
00:44:00,150 --> 00:43:58,560
but this is just the band the soft extra

1128
00:44:02,950 --> 00:44:00,160
energy band

1129
00:44:05,829 --> 00:44:02,960
and now we with new stuff we also some

1130
00:44:08,230 --> 00:44:05,839
more information about uh

1131
00:44:11,430 --> 00:44:08,240
analytics energy band that goes from 3

1132
00:44:14,630 --> 00:44:11,440
kv to up to 79 kv

1133
00:44:17,030 --> 00:44:14,640
and even then we found that the spectrum

1134
00:44:20,069 --> 00:44:17,040
is exactly the same from

1135
00:44:21,750 --> 00:44:20,079
0.3 kv that we've seen with exp we swift

1136
00:44:23,589 --> 00:44:21,760
up to 70

1137
00:44:26,390 --> 00:44:23,599
but this is also an impossible

1138
00:44:29,589 --> 00:44:26,400

information as well

1139
00:44:31,030 --> 00:44:29,599
for the for the model interpretation

1140
00:44:32,230 --> 00:44:31,040
all right appreciate it

1141
00:44:34,230 --> 00:44:32,240
sylvia i'd like to talk a little bit

1142
00:44:36,630 --> 00:44:34,240
about fermi if we can can you tell us

1143
00:44:41,589 --> 00:44:36,640
what the lat gamma ray light curves say

1144
00:44:45,670 --> 00:44:43,510
so this gamma ray verse was especially

1145
00:44:47,589 --> 00:44:45,680
uh interesting the lot because

1146
00:44:49,349 --> 00:44:47,599
it was it

1147
00:44:52,069 --> 00:44:49,359
it gave us the opportunity to study

1148
00:44:54,710 --> 00:44:52,079
something that's usually far away um

1149
00:44:55,670 --> 00:44:54,720
uh atom at a sort of relatively close

1150
00:44:58,150 --> 00:44:55,680
distance

1151
00:44:59,430 --> 00:44:58,160
um and this gamma ray versus was within

1152
00:45:01,030 --> 00:44:59,440
the closest five percent of bursts we

1153
00:45:02,710 --> 00:45:01,040
normally see and normally bursts that

1154
00:45:04,950 --> 00:45:02,720
are this close to us are kind of weak

1155
00:45:07,109 --> 00:45:04,960
just because uh weak bursts tend to

1156
00:45:09,270 --> 00:45:07,119
happen more often um and this burst was

1157
00:45:10,630 --> 00:45:09,280
sort of a more uh ordinary verse and i

1158
00:45:11,430 --> 00:45:10,640
think the swift paper actually calls it

1159
00:45:13,030 --> 00:45:11,440
an

1160
00:45:13,990 --> 00:45:13,040
ordinary monster

1161
00:45:16,550 --> 00:45:14,000
um

1162
00:45:19,750 --> 00:45:16,560
so this was exciting in the high energy

1163
00:45:22,470 --> 00:45:19,760

gamma rays just because um

1164
00:45:24,470 --> 00:45:22,480
previously we had a model that um and we

1165
00:45:27,109 --> 00:45:24,480
still have this model um that explains

1166
00:45:29,030 --> 00:45:27,119
the high energy emission very well

1167
00:45:30,309 --> 00:45:29,040
and then we sort of found that with this

1168
00:45:31,670 --> 00:45:30,319
uh with this burst because it was so

1169
00:45:33,030 --> 00:45:31,680
close to us we saw the little bumps and

1170
00:45:34,870 --> 00:45:33,040
wiggles that we

1171
00:45:36,390 --> 00:45:34,880
didn't see before when the bursts were

1172
00:45:38,390 --> 00:45:36,400
farther away from us

1173
00:45:40,150 --> 00:45:38,400
um and so we

1174
00:45:43,510 --> 00:45:40,160
so this um the previous models that we

1175
00:45:44,870 --> 00:45:43,520
had still explained 90 95 percent of

1176
00:45:47,670 --> 00:45:44,880
what we see in the high energy gamma

1177
00:45:51,670 --> 00:45:47,680
rays but we did detect a handful of

1178
00:45:54,630 --> 00:45:51,680
extremely high energy um gamma rays uh

1179
00:45:56,870 --> 00:45:54,640
and for these events we required sort of

1180
00:45:57,910 --> 00:45:56,880
uh we we had to

1181
00:45:59,829 --> 00:45:57,920
um

1182
00:46:01,270 --> 00:45:59,839
think back and maybe try to tweak our

1183
00:46:03,109 --> 00:46:01,280
models a little bit or maybe add on

1184
00:46:05,270 --> 00:46:03,119
another thing or just go back and try to

1185
00:46:06,470 --> 00:46:05,280
think where we uh how we could fill in

1186
00:46:07,910 --> 00:46:06,480
the gaps

1187
00:46:10,309 --> 00:46:07,920
um and because it was again because it

1188
00:46:12,150 --> 00:46:10,319

was so close uh we also observed it for

1189
00:46:13,430 --> 00:46:12,160
20 hours which is over 10 times longer

1190
00:46:15,190 --> 00:46:13,440
than the previous

1191
00:46:16,309 --> 00:46:15,200
um gamma-ray emission high energy

1192
00:46:18,390 --> 00:46:16,319
gamma-ray emission we've seen from the

1193
00:46:20,470 --> 00:46:18,400
burst um and so just overall this burst

1194
00:46:21,910 --> 00:46:20,480
was exciting in uh high-energy gamma

1195
00:46:24,230 --> 00:46:21,920
rays for the fermilat just because it

1196
00:46:25,510 --> 00:46:24,240
was so close and we could really see the

1197
00:46:28,309 --> 00:46:25,520
the little things that we didn't see

1198
00:46:29,829 --> 00:46:28,319
before

1199
00:46:31,349 --> 00:46:29,839
okay uh

1200
00:46:34,309 --> 00:46:31,359
chuck i want to throw this one to you if

1201
00:46:37,109 --> 00:46:34,319
i can now we saw this humongous gamma

1202
00:46:39,349 --> 00:46:37,119
ray burst on april 27

1203
00:46:41,750 --> 00:46:39,359
but how long did it take for that energy

1204
00:46:44,630 --> 00:46:41,760
to actually get to us when do we think

1205
00:46:47,190 --> 00:46:44,640
this thing actually exploded

1206
00:46:48,790 --> 00:46:47,200
oh well yeah

1207
00:46:51,270 --> 00:46:48,800
it's not quite right to say it's it's

1208
00:46:53,430 --> 00:46:51,280
birthday was april 27 2013 that's when

1209
00:46:57,349 --> 00:46:53,440
the light came to us right

1210
00:46:59,910 --> 00:46:57,359
but it was born or it died it depends if

1211
00:47:02,390 --> 00:46:59,920
you if the glass is half empty i guess

1212
00:47:04,470 --> 00:47:02,400
the star died if the glass is half full

1213
00:47:06,150 --> 00:47:04,480

the black hole was born i guess we

1214
00:47:09,109 --> 00:47:06,160
celebrate black hole's birth because

1215
00:47:11,670 --> 00:47:09,119
they're so bright and fantastic events

1216
00:47:13,510 --> 00:47:11,680
but indeed that was like 3.75 billion

1217
00:47:15,910 --> 00:47:13,520
years ago

1218
00:47:18,790 --> 00:47:15,920
the light travel time from

1219
00:47:21,109 --> 00:47:18,800
this burst event to the present epic

1220
00:47:23,190 --> 00:47:21,119
you know the age of the universe is 13.7

1221
00:47:24,710 --> 00:47:23,200
billion years so we call this a young

1222
00:47:26,630 --> 00:47:24,720
burst all the same

1223
00:47:29,190 --> 00:47:26,640
because lots of these bursts take place

1224
00:47:30,870 --> 00:47:29,200
at five and 10 billion years

1225
00:47:32,710 --> 00:47:30,880
and by that time

1226
00:47:34,790 --> 00:47:32,720
by that early time they have to go

1227
00:47:37,030 --> 00:47:34,800
through so much cosmic expansion that

1228
00:47:40,069 --> 00:47:37,040
their signal becomes very weak

1229
00:47:41,829 --> 00:47:40,079
so this by being only a mere few billion

1230
00:47:44,230 --> 00:47:41,839
years old its

1231
00:47:47,030 --> 00:47:44,240
signal is very strong so even though

1232
00:47:48,390 --> 00:47:47,040
it's it's a nearby guy and comparatively

1233
00:47:50,950 --> 00:47:48,400
young

1234
00:47:53,829 --> 00:47:50,960
on all sort of geological time scales

1235
00:47:56,870 --> 00:47:53,839
when the earth you know was 3.75 billion

1236
00:47:58,710 --> 00:47:56,880
years earlier on the earth uh we it

1237
00:48:00,309 --> 00:47:58,720
looked a lot different and indeed the

1238
00:48:01,030 --> 00:48:00,319

whole universe looked a lot different

1239
00:48:03,349 --> 00:48:01,040
but

1240
00:48:05,829 --> 00:48:03,359
that's the long answer

1241
00:48:07,990 --> 00:48:05,839
all right well i guess that prompts the

1242
00:48:09,910 --> 00:48:08,000
uh follow-up question how do you make

1243
00:48:13,030 --> 00:48:09,920
those determinations of how long ago it

1244
00:48:17,990 --> 00:48:14,790
gosh uh

1245
00:48:19,670 --> 00:48:18,000
indeed this is the important question uh

1246
00:48:21,990 --> 00:48:19,680
of how to measure distance which

1247
00:48:23,990 --> 00:48:22,000
pervades all of astronomy but now we

1248
00:48:25,270 --> 00:48:24,000
recognize that the only way to make

1249
00:48:32,470 --> 00:48:25,280
sense of

1250
00:48:32,480 --> 00:48:38,870
did we lose you chuck

1251
00:48:44,390 --> 00:48:40,790
well maybe we did we'll uh we'll see if

1252
00:48:46,630 --> 00:48:44,400
we can get him to uh patch back in here

1253
00:48:48,710 --> 00:48:46,640
next question i have from uh our social

1254
00:48:50,470 --> 00:48:48,720
media venues is

1255
00:48:53,109 --> 00:48:50,480
could a grb

1256
00:48:55,430 --> 00:48:53,119
be considered the extinction event

1257
00:48:56,630 --> 00:48:55,440
that seems to have occurred on mars

1258
00:49:03,990 --> 00:48:56,640
meaning the disappearance of the

1259
00:49:04,000 --> 00:49:07,829
anybody

1260
00:49:13,430 --> 00:49:11,349
i would say no uh it's just uh

1261
00:49:14,630 --> 00:49:13,440
i mean as we said it's very rare event

1262
00:49:17,430 --> 00:49:14,640
and uh

1263
00:49:19,349 --> 00:49:17,440

is very dif i mean the probability that

1264
00:49:23,190 --> 00:49:19,359
gamma reversed explode and the jet is

1265
00:49:24,950 --> 00:49:23,200
pointing towards earth or towards mars

1266
00:49:27,270 --> 00:49:24,960
is very unlikely

1267
00:49:29,109 --> 00:49:27,280
the point that must lost his

1268
00:49:31,910 --> 00:49:29,119
atmosphere is because the gravity of

1269
00:49:33,910 --> 00:49:31,920
mass is not that strong like one we have

1270
00:49:37,670 --> 00:49:33,920
on earth and therefore was not able to

1271
00:49:40,150 --> 00:49:39,349
okay thanks

1272
00:49:42,230 --> 00:49:40,160
uh

1273
00:49:44,710 --> 00:49:42,240
something i'll throw this out to you can

1274
00:49:46,870 --> 00:49:44,720
we assume that it's a gamma-ray burst

1275
00:49:52,790 --> 00:49:46,880
that occurs at the creation as a

1276
00:49:57,349 --> 00:49:54,470
um so

1277
00:49:59,270 --> 00:49:57,359
uh as czech was saying before um

1278
00:50:01,349 --> 00:49:59,280
we it's very likely that all of these

1279
00:50:03,990 --> 00:50:01,359
sort of long gamma ray bursts happen um

1280
00:50:05,910 --> 00:50:04,000
when you have a very massive star uh the

1281
00:50:07,670 --> 00:50:05,920
core of one collapsing to a black hole

1282
00:50:09,589 --> 00:50:07,680
um but there are other

1283
00:50:11,270 --> 00:50:09,599
other uh very prominent models that

1284
00:50:13,750 --> 00:50:11,280
could also explain these gamma reverse

1285
00:50:15,990 --> 00:50:13,760
for instance having a up uh a very

1286
00:50:17,990 --> 00:50:16,000
highly magnetized neutron star a very

1287
00:50:19,109 --> 00:50:18,000
fast spinning neutron star in the middle

1288
00:50:22,630 --> 00:50:19,119

um

1289
00:50:24,549 --> 00:50:22,640
that

1290
00:50:26,309 --> 00:50:24,559
uh each of these gamma reverse would

1291
00:50:27,829 --> 00:50:26,319
lead to a black hole and obviously a lot

1292
00:50:31,349 --> 00:50:27,839
of black holes form without a gamma ray

1293
00:50:32,870 --> 00:50:31,359
burst um just because it takes a sort of

1294
00:50:34,630 --> 00:50:32,880
a very special set of circumstances to

1295
00:50:36,230 --> 00:50:34,640
form a gamma ray burst

1296
00:50:39,510 --> 00:50:36,240
did i answer the question

1297
00:50:42,549 --> 00:50:39,520
i think so okay um

1298
00:50:44,870 --> 00:50:42,559
next question from social media is when

1299
00:50:47,430 --> 00:50:44,880
according to theory would you expect to

1300
00:50:55,430 --> 00:50:47,440
first attack the gravity wave after

1301
00:50:55,440 --> 00:50:59,270
well rob here uh

1302
00:51:03,910 --> 00:51:01,910
detailed modeling of uh

1303
00:51:07,109 --> 00:51:03,920
the uh

1304
00:51:09,990 --> 00:51:07,119
collapse of a massive star into a black

1305
00:51:12,790 --> 00:51:10,000
hole or a neutron star

1306
00:51:15,030 --> 00:51:12,800
tell us that there is a lot of material

1307
00:51:16,630 --> 00:51:15,040
left over that's that's jostling around

1308
00:51:17,750 --> 00:51:16,640
and wiggling and trying to get into the

1309
00:51:19,750 --> 00:51:17,760
black hole

1310
00:51:22,390 --> 00:51:19,760
and that will produce a characteristic

1311
00:51:23,349 --> 00:51:22,400
signature in gravity gravity waves

1312
00:51:27,030 --> 00:51:23,359
uh

1313
00:51:30,069 --> 00:51:29,109

gamma ray radiation and the and the

1314
00:51:32,790 --> 00:51:30,079
optical

1315
00:51:35,030 --> 00:51:32,800
light that we see so they should be

1316
00:51:37,829 --> 00:51:35,040
pretty much simultaneous

1317
00:51:40,390 --> 00:51:37,839
when we uh have the ability to actually

1318
00:51:43,510 --> 00:51:40,400
uh detect gamma-ray radio i mean the

1319
00:51:44,630 --> 00:51:43,520
gravity wave radiation

1320
00:51:46,870 --> 00:51:44,640
okay

1321
00:51:48,230 --> 00:51:46,880
uh john piero i'm going to send this one

1322
00:51:49,190 --> 00:51:48,240
to you

1323
00:51:50,870 --> 00:51:49,200
what

1324
00:51:53,510 --> 00:51:50,880
in this particular gamma reverse that

1325
00:51:56,710 --> 00:51:53,520
we've seen in april what was the beaming

1326
00:51:58,870 --> 00:51:56,720
angle of this burst

1327
00:52:01,829 --> 00:51:58,880
well uh it's difficult to say for

1328
00:52:03,030 --> 00:52:01,839
instance in our paper with the optical

1329
00:52:05,670 --> 00:52:03,040
data

1330
00:52:08,630 --> 00:52:05,680
we we see a break in the light curve

1331
00:52:10,710 --> 00:52:08,640
that we interpreted as the jet break

1332
00:52:13,349 --> 00:52:10,720
if this interpretation is correct then

1333
00:52:15,829 --> 00:52:13,359
we derive an angle of less than three

1334
00:52:17,030 --> 00:52:15,839
degrees

1335
00:52:18,870 --> 00:52:17,040
but

1336
00:52:22,470 --> 00:52:18,880
this break is not

1337
00:52:24,470 --> 00:52:22,480
a clear cut so there are

1338
00:52:27,589 --> 00:52:24,480

a discussion about it

1339
00:52:30,630 --> 00:52:27,599
but usually we have this kind of

1340
00:52:32,870 --> 00:52:30,640
opening angle for this kind of source

1341
00:52:35,910 --> 00:52:32,880
a few degrees

1342
00:52:37,510 --> 00:52:35,920
uh here's another question for you uh

1343
00:52:40,150 --> 00:52:37,520
john viero

1344
00:52:42,549 --> 00:52:40,160
has this gamma-ray burst actually

1345
00:52:46,390 --> 00:52:42,559
changed any of our understandings of how

1346
00:52:51,910 --> 00:52:48,710
about our stars evolved no because i

1347
00:52:53,750 --> 00:52:51,920
mean uh as we said the

1348
00:52:55,910 --> 00:52:53,760
apart from the high energy mission that

1349
00:52:58,790 --> 00:52:55,920
has been seen by latin the coincidence

1350
00:53:00,470 --> 00:52:58,800
of the first viability between the gav

1351
00:53:02,630 --> 00:53:00,480
emission in the optical

1352
00:53:04,470 --> 00:53:02,640
for the rest of the properties of the

1353
00:53:06,710 --> 00:53:04,480
optical and x-ray light curves is very

1354
00:53:08,630 --> 00:53:06,720
similar to the other gamma rebirth so

1355
00:53:10,870 --> 00:53:08,640
it's just telling us what the other

1356
00:53:12,870 --> 00:53:10,880
gamma reversed already told us

1357
00:53:16,230 --> 00:53:12,880
what it is new actually with this burst

1358
00:53:17,910 --> 00:53:16,240
is because it is very nearby it we were

1359
00:53:20,230 --> 00:53:17,920
able to see also the associated

1360
00:53:22,069 --> 00:53:20,240
supernova

1361
00:53:24,150 --> 00:53:22,079
and this is very important because so

1362
00:53:26,470 --> 00:53:24,160
far we have seen supernovae associated

1363
00:53:29,990 --> 00:53:26,480

to long gamma burst only very near by

1364
00:53:32,390 --> 00:53:30,000
gamma ray burst which were much weaker

1365
00:53:34,390 --> 00:53:32,400
so what uniqueness of this burst is that

1366
00:53:36,069 --> 00:53:34,400
it is as bright as the one we usually

1367
00:53:38,069 --> 00:53:36,079
see very far away

1368
00:53:39,910 --> 00:53:38,079
but for those very far away we could not

1369
00:53:43,510 --> 00:53:39,920
see the supernovas or there was a

1370
00:53:45,510 --> 00:53:43,520
discussion about how often we there was

1371
00:53:46,870 --> 00:53:45,520
a supernova associated with a long game

1372
00:53:48,790 --> 00:53:46,880
burst and if

1373
00:53:51,750 --> 00:53:48,800
cosmological gamma reversed our version

1374
00:53:54,150 --> 00:53:51,760
one or two or up even six or seven or

1375
00:53:56,150 --> 00:53:54,160
nine we have scenes of uh there is or no

1376
00:53:57,190 --> 00:53:56,160
supernova and the answer from this burst

1377
00:53:59,109 --> 00:53:57,200
is yes

1378
00:54:01,589 --> 00:53:59,119
all indications now are that all the

1379
00:54:04,150 --> 00:54:01,599
longan vapors are probably

1380
00:54:06,710 --> 00:54:04,160
associated through supernovae

1381
00:54:08,549 --> 00:54:06,720
but this is very important

1382
00:54:09,990 --> 00:54:08,559
all right appreciate it

1383
00:54:11,510 --> 00:54:10,000
we're going to have to wrap up here or

1384
00:54:13,829 --> 00:54:11,520
get close to it what i would like to do

1385
00:54:14,870 --> 00:54:13,839
before we close out completely though is

1386
00:54:17,670 --> 00:54:14,880
i'd like to go to each one of the

1387
00:54:19,750 --> 00:54:17,680
panelists to get a real quick snapshot

1388
00:54:21,829 --> 00:54:19,760

of what they thought the most important

1389
00:54:23,750 --> 00:54:21,839
elements of this gamma reverse finding

1390
00:54:27,829 --> 00:54:23,760
was from their perspective their

1391
00:54:29,430 --> 00:54:27,839
instrument their uh space telescope uh

1392
00:54:30,870 --> 00:54:29,440
unfortunately charles isn't with us

1393
00:54:31,910 --> 00:54:30,880
right now so tom i'm going to start with

1394
00:54:34,390 --> 00:54:31,920
you

1395
00:54:35,910 --> 00:54:34,400
yeah so for me the really exciting thing

1396
00:54:37,750 --> 00:54:35,920
about this event

1397
00:54:39,589 --> 00:54:37,760
was that we saw from so many different

1398
00:54:42,390 --> 00:54:39,599
spacecraft and so many different wave

1399
00:54:44,710 --> 00:54:42,400
bands saw all the richness of phenomena

1400
00:54:46,230 --> 00:54:44,720
that we have in a gamma ray burst we had

1401
00:54:47,589 --> 00:54:46,240
all the right things on orbit we had

1402
00:54:49,030 --> 00:54:47,599
them on the ground we collected the

1403
00:54:51,270 --> 00:54:49,040
observations

1404
00:54:52,870 --> 00:54:51,280
of the spectacular event so it really

1405
00:54:54,470 --> 00:54:52,880
gives us a way to not test our

1406
00:54:56,710 --> 00:54:54,480
understanding

1407
00:54:59,109 --> 00:54:56,720
and as has been said before there are

1408
00:55:00,630 --> 00:54:59,119
interesting twists on our understanding

1409
00:55:02,870 --> 00:55:00,640
they're developing because we're seeing

1410
00:55:04,790 --> 00:55:02,880
all these details and that to me is

1411
00:55:08,230 --> 00:55:04,800
exciting and for many years this will be

1412
00:55:10,150 --> 00:55:08,240
a rosetta stone event to test our ideas

1413
00:55:13,270 --> 00:55:10,160

on

1414
00:55:15,829 --> 00:55:13,280
sounds good appreciate it tom rob

1415
00:55:19,190 --> 00:55:15,839
yes this verse has presented

1416
00:55:22,470 --> 00:55:19,200
a unique opportunity to to test our

1417
00:55:23,829 --> 00:55:22,480
uh our theories for gamma ray bursts and

1418
00:55:27,829 --> 00:55:23,839
it is uh

1419
00:55:28,950 --> 00:55:27,839
met each challenge and and basically

1420
00:55:30,230 --> 00:55:28,960
uh

1421
00:55:31,349 --> 00:55:30,240
destroyed them

1422
00:55:32,390 --> 00:55:31,359
so

1423
00:55:33,670 --> 00:55:32,400
we we

1424
00:55:36,950 --> 00:55:33,680
we are uh

1425
00:55:39,030 --> 00:55:36,960
we're happy to have the opportunity to

1426
00:55:49,910 --> 00:55:39,040
uh

1427
00:55:51,750 --> 00:55:49,920
we're closing out here i was just giving

1428
00:55:52,630 --> 00:55:51,760
everyone a chance to

1429
00:55:54,630 --> 00:55:52,640
give a

1430
00:55:56,390 --> 00:55:54,640
one minute dissertation on what they

1431
00:55:58,470 --> 00:55:56,400
thought the most important elements of

1432
00:56:01,109 --> 00:55:58,480
this finding was so

1433
00:56:03,030 --> 00:56:01,119
with that here's your microphone

1434
00:56:04,950 --> 00:56:03,040
okay sorry

1435
00:56:06,549 --> 00:56:04,960
best laid plans and technology and all

1436
00:56:08,549 --> 00:56:06,559
that stuff especially for theorists you

1437
00:56:11,349 --> 00:56:08,559
know but anyway uh this was just a

1438
00:56:12,950 --> 00:56:11,359

fabulous event it was so ready made

1439
00:56:15,030 --> 00:56:12,960
we could uh

1440
00:56:17,990 --> 00:56:15,040
we had all these telescopes available it

1441
00:56:20,710 --> 00:56:18,000
was the most fluent event ever by which

1442
00:56:23,270 --> 00:56:20,720
i mean the energy per area was the

1443
00:56:23,990 --> 00:56:23,280
greatest that has ever taken place and

1444
00:56:26,069 --> 00:56:24,000
now

1445
00:56:28,150 --> 00:56:26,079
it's challenging all the theories and

1446
00:56:29,910 --> 00:56:28,160
all the way we think about these verse

1447
00:56:32,309 --> 00:56:29,920
so we all get to go back to the drawing

1448
00:56:33,510 --> 00:56:32,319
table and happily in gamma reverse

1449
00:56:35,910 --> 00:56:33,520
studies

1450
00:56:38,549 --> 00:56:35,920
it really can still be paper and pencil

1451
00:56:40,549 --> 00:56:38,559
type physics that can make the big

1452
00:56:42,829 --> 00:56:40,559
inroads into discovery space and this

1453
00:56:47,109 --> 00:56:42,839
was a burst made for the

1454
00:56:48,789 --> 00:56:47,119
occasion thanks charles john piero

1455
00:56:50,309 --> 00:56:48,799
okay uh

1456
00:56:51,829 --> 00:56:50,319
uh fully agree with what already been

1457
00:56:54,150 --> 00:56:51,839
said though just not to repeat the

1458
00:56:55,829 --> 00:56:54,160
things that uh in importance this verse

1459
00:56:58,470 --> 00:56:55,839
is that they gave us so many information

1460
00:57:00,069 --> 00:56:58,480
that for we will have a lot of things to

1461
00:57:01,990 --> 00:57:00,079
work on for

1462
00:57:04,230 --> 00:57:02,000
years to come from one side from the

1463
00:57:05,829 --> 00:57:04,240

other side is that because this burst

1464
00:57:07,750 --> 00:57:05,839
has a lot of similarity with the other

1465
00:57:09,990 --> 00:57:07,760
burst to give us

1466
00:57:11,990 --> 00:57:10,000
one more proof that gamma rippers can be

1467
00:57:15,270 --> 00:57:12,000
used to study the whole universe from

1468
00:57:17,349 --> 00:57:15,280
the backyard up to the very early

1469
00:57:19,349 --> 00:57:17,359
young universe when it was only 200

1470
00:57:21,349 --> 00:57:19,359
million years old because we have seen a

1471
00:57:23,430 --> 00:57:21,359
gamma reverse that when the universe was

1472
00:57:25,670 --> 00:57:23,440
only 500 million years old

1473
00:57:28,309 --> 00:57:25,680
and we now know that when we see a birth

1474
00:57:31,109 --> 00:57:28,319
there a die a star already evolved and

1475
00:57:33,349 --> 00:57:31,119
collapsed and died already so early on

1476
00:57:35,670 --> 00:57:33,359
so i think gamma ray burst and his his

1477
00:57:38,309 --> 00:57:35,680
final proof is very good way also to do

1478
00:57:40,309 --> 00:57:38,319
cosmology not just only the physics of

1479
00:57:45,030 --> 00:57:40,319
gamma reversed

1480
00:57:48,230 --> 00:57:46,390
well most of the good stuff has already

1481
00:57:49,510 --> 00:57:48,240
been said by everyone else uh selfishly

1482
00:57:51,030 --> 00:57:49,520
this verse is important to me because

1483
00:57:51,829 --> 00:57:51,040
now i can write my thesis on it which is

1484
00:57:53,750 --> 00:57:51,839
great

1485
00:57:57,109 --> 00:57:53,760
um but from the high energy gamma-ray

1486
00:57:59,750 --> 00:57:57,119
standpoint um we observed a series of

1487
00:58:01,750 --> 00:57:59,760
record-breaking photons uh photons that

1488
00:58:03,270 --> 00:58:01,760

were gamma rays that were had such high

1489
00:58:05,190 --> 00:58:03,280
energies at such late times that were

1490
00:58:07,030 --> 00:58:05,200
completely unexpected and like people

1491
00:58:10,789 --> 00:58:07,040
have been saying uh this makes us go

1492
00:58:13,190 --> 00:58:10,799
back and figure out um what additions or

1493
00:58:15,030 --> 00:58:13,200
what alternatives we need uh to really

1494
00:58:17,030 --> 00:58:15,040
uh come up with a good model of gamma

1495
00:58:18,309 --> 00:58:17,040
ray bursts

1496
00:58:19,430 --> 00:58:18,319
thanks sylvia

1497
00:58:21,349 --> 00:58:19,440
and that's going to have to do it for

1498
00:58:23,430 --> 00:58:21,359
today's google plus hangout i'd like to

1499
00:58:25,270 --> 00:58:23,440
thank the panelists for their time today

1500
00:58:27,349 --> 00:58:25,280
and as usual we would like to thank you

1501
00:58:28,950 --> 00:58:27,359
for joining us in today's event for more

1502
00:58:31,589 --> 00:58:28,960
information about the findings of this

1503
00:58:34,710 --> 00:58:31,599
gamma-ray burst or any of nasa's many

1504
00:58:37,990 --> 00:58:34,720
programs and projects visit us visit us

1505
00:58:40,390 --> 00:58:38,000
on the web at www.nasa.gov

1506
00:58:42,309 --> 00:58:40,400
or via any of our many social media

1507
00:58:44,230 --> 00:58:42,319
venues such as facebook google plus

1508
00:58:45,670 --> 00:58:44,240
twitter youtube and all