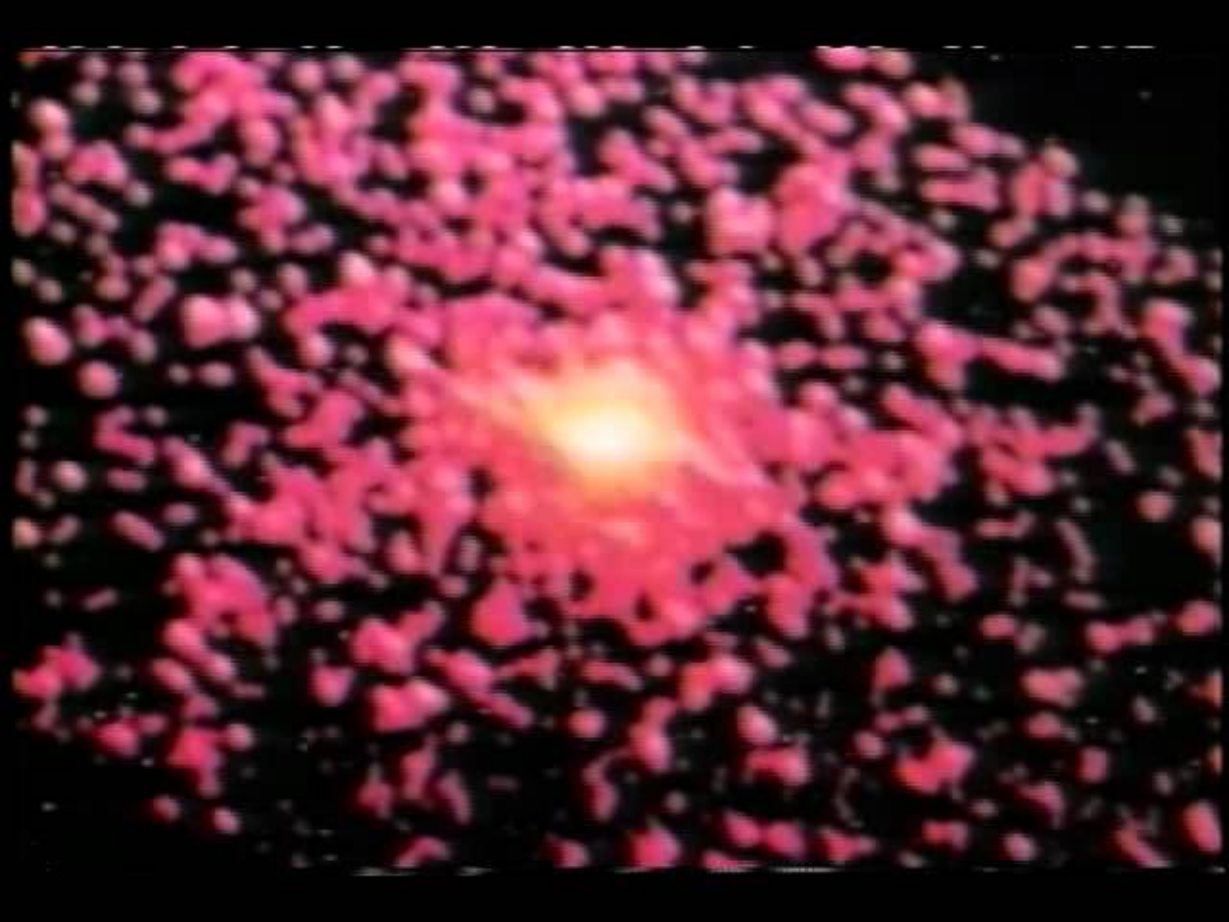

1
00:00:42,950 --> 00:00:40,150
in february of 1987

2
00:00:46,389 --> 00:00:42,960
astronomers looking at the nearby galaxy

3
00:00:50,869 --> 00:00:46,399
called the large magellanic cloud

4
00:00:56,709 --> 00:00:53,350
a supernova explosion

5
00:00:58,790 --> 00:00:56,719
the spectacular death of the star

6
00:01:02,150 --> 00:00:58,800
astronomers around the world have

7
00:01:04,789 --> 00:01:02,160
eagerly studied supernova 1987 a with

8
00:01:07,270 --> 00:01:04,799
sensitive telescopes hoping to learn

9
00:01:10,390 --> 00:01:07,280
what will happen to the expanding debris

10
00:01:12,310 --> 00:01:10,400
and the fiery core of the star

11
00:01:14,789 --> 00:01:12,320
has the inner core collapsed as

12
00:01:18,310 --> 00:01:14,799
scientists expect into a tiny dense

13
00:01:21,990 --> 00:01:18,320

pulsing neutron star at the center

14
00:01:25,109 --> 00:01:22,000
in the exploding gas in giant supernovas

15
00:01:28,469 --> 00:01:25,119
in hundreds of millions of stars

16
00:01:30,950 --> 00:01:28,479
in huge spiraling galaxies

17
00:01:32,789 --> 00:01:30,960
in distant quasars whose light has been

18
00:01:34,230 --> 00:01:32,799
traveling to us since the beginning of

19
00:01:36,550 --> 00:01:34,240
the universe

20
00:01:38,630 --> 00:01:36,560
in these fantastic objects

21
00:01:40,710 --> 00:01:38,640
astronomers have learned that great

22
00:01:43,429 --> 00:01:40,720
forces heat gasses to extreme

23
00:01:44,630 --> 00:01:43,439
temperatures above tens of millions of

24
00:01:46,870 --> 00:01:44,640
degrees

25
00:01:49,670 --> 00:01:46,880
causing them to emit massive amounts of

26
00:01:53,910 --> 00:01:51,670
the space shuttle will carry sensitive

27
00:01:55,590 --> 00:01:53,920
new telescopes into orbit to study the

28
00:01:57,830 --> 00:01:55,600
cosmos

29
00:02:00,389 --> 00:01:57,840
one telescope measures x-rays emitted

30
00:02:02,789 --> 00:02:00,399
from supernovas quasars and other high

31
00:02:04,550 --> 00:02:02,799
energy targets in space

32
00:02:07,190 --> 00:02:04,560
priceless new information from this

33
00:02:09,430 --> 00:02:07,200
broadband x-ray telescope will help

34
00:02:20,830 --> 00:02:09,440
scientists uncover more pieces in the

35
00:02:26,390 --> 00:02:24,150
universe go for main engine start

36
00:02:28,150 --> 00:02:26,400
four three two

37
00:02:29,110 --> 00:02:28,160
one

38
00:02:35,750 --> 00:02:29,120

and

39
00:02:40,550 --> 00:02:38,470
in the spring of 1990 the space shuttle

40
00:02:43,030 --> 00:02:40,560
columbia will lift off on a special

41
00:02:45,350 --> 00:02:43,040
mission called astro one

42
00:02:46,949 --> 00:02:45,360
dedicated to scientific observations of

43
00:02:49,430 --> 00:02:46,959
our universe

44
00:02:51,350 --> 00:02:49,440
once in orbit four new telescopes will

45
00:02:52,589 --> 00:02:51,360
be operated from the shuttle's payload

46
00:02:56,550 --> 00:02:52,599
bay

47
00:02:59,509 --> 00:02:56,560
bbxrt the broadband x-ray telescope

48
00:03:01,910 --> 00:02:59,519
analyzes x-rays emitted by extremely hot

49
00:03:02,830 --> 00:03:01,920
and energetic stars and galaxies in

50
00:03:05,670 --> 00:03:02,840
distant

51
00:03:08,309 --> 00:03:05,680
space three other telescopes mounted

52
00:03:10,390 --> 00:03:08,319
together on a pointing platform examine

53
00:03:12,630 --> 00:03:10,400
ultraviolet light emitted from nearby

54
00:03:15,509 --> 00:03:12,640
objects in our solar system and from

55
00:03:17,670 --> 00:03:15,519
stars and distant galaxies

56
00:03:18,550 --> 00:03:17,680
these telescopes must be operated in

57
00:03:20,630 --> 00:03:18,560
space

58
00:03:23,430 --> 00:03:20,640
because the earth's atmosphere prevents

59
00:03:25,270 --> 00:03:23,440
most radiation including x-rays and

60
00:03:27,110 --> 00:03:25,280
ultraviolet light from reaching the

61
00:03:29,190 --> 00:03:27,120
ground

62
00:03:31,110 --> 00:03:29,200
the visible light that we can see is a

63
00:03:33,990 --> 00:03:31,120

surprisingly small portion of the

64
00:03:35,589 --> 00:03:34,000
radiation that is emitted in space

65
00:03:37,670 --> 00:03:35,599
we know that massive amounts of

66
00:03:40,229 --> 00:03:37,680
radiation are emitted in the invisible

67
00:03:43,430 --> 00:03:40,239
portion of the electromagnetic spectrum

68
00:03:45,430 --> 00:03:43,440
including ultraviolet light and x-rays

69
00:03:47,270 --> 00:03:45,440
each type of radiation provides

70
00:03:48,630 --> 00:03:47,280
different clues about the nature of the

71
00:03:51,110 --> 00:03:48,640
object

72
00:03:53,429 --> 00:03:51,120
the broadband x-ray telescope studies

73
00:03:55,830 --> 00:03:53,439
radiation emitted in a large portion of

74
00:03:59,030 --> 00:03:55,840
the x-ray spectrum which has never been

75
00:04:02,229 --> 00:03:59,040
studied before in great detail

76
00:04:03,990 --> 00:04:02,239
for example bbxrt can detect which

77
00:04:07,830 --> 00:04:04,000
chemical elements are present in an

78
00:04:08,789 --> 00:04:07,840
x-ray source such as oxygen magnesium

79
00:04:10,949 --> 00:04:08,799
silicon

80
00:04:13,670 --> 00:04:10,959
sulfur and calcium

81
00:04:17,030 --> 00:04:13,680
elements that are abundant in space and

82
00:04:20,469 --> 00:04:17,040
essential to life on earth

83
00:04:22,629 --> 00:04:20,479
bbxrt is the first x-ray telescope used

84
00:04:25,590 --> 00:04:22,639
in space that can detect the presence of

85
00:04:27,830 --> 00:04:25,600
iron in a broad variety of targets

86
00:04:30,150 --> 00:04:27,840
because iron is one of the most abundant

87
00:04:32,390 --> 00:04:30,160
elements in the universe its presence in

88
00:04:34,870 --> 00:04:32,400

an x-ray source provides tell-tale

89
00:04:38,150 --> 00:04:34,880
evidence about that object for example

90
00:04:40,710 --> 00:04:38,160
its size temperature how old it is

91
00:04:46,469 --> 00:04:40,720
whether it rotates and at what speed and

92
00:04:50,710 --> 00:04:48,310
the dream of building and launching a

93
00:04:53,670 --> 00:04:50,720
broadband x-ray telescope into space

94
00:04:55,590 --> 00:04:53,680
began more than 12 years ago here at

95
00:04:57,430 --> 00:04:55,600
nasa's goddard space flight center in

96
00:04:59,670 --> 00:04:57,440
greenbelt maryland

97
00:05:02,070 --> 00:04:59,680
over 40 satellites have been built and

98
00:05:03,830 --> 00:05:02,080
tested at goddard countless others have

99
00:05:05,590 --> 00:05:03,840
been managed by nasa's greenbelt

100
00:05:07,749 --> 00:05:05,600
facility

101
00:05:10,070 --> 00:05:07,759
in the late 1970s

102
00:05:11,990 --> 00:05:10,080
dr peter cerlamitsos working in

103
00:05:14,230 --> 00:05:12,000
goddard's high energy astrophysics

104
00:05:16,710 --> 00:05:14,240
laboratory developed a light and

105
00:05:18,629 --> 00:05:16,720
inexpensive mirror sufficiently smooth

106
00:05:21,510 --> 00:05:18,639
to reflect x-rays

107
00:05:24,469 --> 00:05:21,520
it was made from shiny aluminum foil

108
00:05:26,390 --> 00:05:24,479
coated with acrylic and gold the mirrors

109
00:05:28,550 --> 00:05:26,400
were nested together in a housing to

110
00:05:30,469 --> 00:05:28,560
provide the large surface area needed to

111
00:05:32,950 --> 00:05:30,479
gather x-rays

112
00:05:34,870 --> 00:05:32,960
these foil mirrors made the telescope

113
00:05:36,790 --> 00:05:34,880

light enough to be carried into space on

114
00:05:38,469 --> 00:05:36,800
the shuttle

115
00:05:41,029 --> 00:05:38,479
once the telescope was approved for

116
00:05:43,670 --> 00:05:41,039
flight teams of up to 100 goddard

117
00:05:45,670 --> 00:05:43,680
scientists engineers and technicians

118
00:05:47,749 --> 00:05:45,680
worked for five years to build the

119
00:05:50,469 --> 00:05:47,759
instrument and a unique reusable

120
00:05:52,710 --> 00:05:50,479
pointing system for the telescope

121
00:05:55,830 --> 00:05:52,720
payload manager frank volpe describes

122
00:05:57,909 --> 00:05:55,840
the challenges of building the telescope

123
00:06:01,189 --> 00:05:57,919
when you fly in the orbiter the the key

124
00:06:02,870 --> 00:06:01,199
most criteria is to make sure it's safe

125
00:06:05,510 --> 00:06:02,880
so we have gone through extensive

126
00:06:07,749 --> 00:06:05,520
testing and design to ensure that in no

127
00:06:09,749 --> 00:06:07,759
way jeopardize the health and safety of

128
00:06:11,990 --> 00:06:09,759
the crew and the orbiter

129
00:06:15,189 --> 00:06:12,000
to that extent you also must make sure

130
00:06:17,830 --> 00:06:15,199
that it is its limits of weight

131
00:06:19,909 --> 00:06:17,840
and power and thermal requirements all

132
00:06:22,309 --> 00:06:19,919
within the constraints of the orbiter

133
00:06:24,309 --> 00:06:22,319
itself we had to take some

134
00:06:26,230 --> 00:06:24,319
exceptional uh

135
00:06:28,309 --> 00:06:26,240
steps to ensure that

136
00:06:30,710 --> 00:06:28,319
the thermal systems remained within its

137
00:06:33,110 --> 00:06:30,720
limits at one end of the telescope

138
00:06:35,670 --> 00:06:33,120

we have elements operating at a very

139
00:06:36,629 --> 00:06:35,680
very cold temperature around 40 degrees

140
00:06:38,950 --> 00:06:36,639
kelvin

141
00:06:40,629 --> 00:06:38,960
at other places on the telescope and the

142
00:06:43,029 --> 00:06:40,639
payload we have

143
00:06:44,309 --> 00:06:43,039
boxes that like to operate near room

144
00:06:46,629 --> 00:06:44,319
temperature

145
00:06:48,309 --> 00:06:46,639
once the telescope was built it was

146
00:06:50,309 --> 00:06:48,319
lowered into the two-axis pointing

147
00:06:52,629 --> 00:06:50,319
system structure

148
00:06:54,550 --> 00:06:52,639
during the integration and testing phase

149
00:06:56,230 --> 00:06:54,560
the complex electronic systems

150
00:06:58,469 --> 00:06:56,240
controlling the telescope and the

151
00:07:00,550 --> 00:06:58,479
support structure were wired together

152
00:07:02,309 --> 00:07:00,560
and repeatedly checked

153
00:07:05,270 --> 00:07:02,319
blankets were attached to achieve the

154
00:07:08,070 --> 00:07:05,280
required thermal insulation in space

155
00:07:10,710 --> 00:07:08,080
vibration acoustics and thermal vacuum

156
00:07:12,629 --> 00:07:10,720
tests were conducted on the telescope to

157
00:07:14,309 --> 00:07:12,639
simulate conditions encountered during

158
00:07:16,230 --> 00:07:14,319
the mission

159
00:07:18,629 --> 00:07:16,240
some of the shuttle astronauts shown

160
00:07:20,790 --> 00:07:18,639
here in their anti-contamination suits

161
00:07:22,390 --> 00:07:20,800
came to goddard to get a first-hand look

162
00:07:24,629 --> 00:07:22,400
at the new telescope that they will

163
00:07:26,790 --> 00:07:24,639

carry into orbit

164
00:07:29,430 --> 00:07:26,800
goddard scientists have carefully chosen

165
00:07:30,790 --> 00:07:29,440
the x-ray sources that the bbxrt will

166
00:07:33,110 --> 00:07:30,800
observe

167
00:07:36,469 --> 00:07:33,120
these unusually hot and energetic

168
00:07:39,270 --> 00:07:36,479
targets vary from tiny neutron stars

169
00:07:45,189 --> 00:07:39,280
drawing gas from a larger companion star

170
00:07:51,510 --> 00:07:48,710
a prime bbxrt target is a supernova

171
00:07:55,749 --> 00:07:51,520
remnant the exploded outer shell of a

172
00:07:58,390 --> 00:07:55,759
star which occupies vast areas in space

173
00:08:01,110 --> 00:07:58,400
the outer edges heated to extreme

174
00:08:03,589 --> 00:08:01,120
temperatures by shock waves emit

175
00:08:05,070 --> 00:08:03,599
millions of x-rays

176
00:08:08,070 --> 00:08:05,080
in these regions

177
00:08:10,309 --> 00:08:08,080
bbxrt can detect the presence of heavy

178
00:08:13,510 --> 00:08:10,319
elements such as iron and many other

179
00:08:16,150 --> 00:08:13,520
elements that make up our own bodies

180
00:08:17,830 --> 00:08:16,160
by studying the supernova the x-ray

181
00:08:19,990 --> 00:08:17,840
telescope will contribute new

182
00:08:23,589 --> 00:08:20,000
information about how these important

183
00:08:26,950 --> 00:08:23,599
elements are manufactured inside stars

184
00:08:28,629 --> 00:08:26,960
bbxrt principal investigator dr peter

185
00:08:30,869 --> 00:08:28,639
cerlemitsos

186
00:08:34,230 --> 00:08:30,879
everything we learn from it is telltale

187
00:08:36,230 --> 00:08:34,240
evidence of what was inside the star

188
00:08:38,310 --> 00:08:36,240

you know how we're going to study what

189
00:08:40,709 --> 00:08:38,320
the star is forming inside we're waiting

190
00:08:43,029 --> 00:08:40,719
for it to spew this matter out in the

191
00:08:45,430 --> 00:08:43,039
interstellar space and therefore

192
00:08:47,990 --> 00:08:45,440
from the pieces out there we see the

193
00:08:50,470 --> 00:08:48,000
x-ray emission that tells us what was

194
00:08:53,190 --> 00:08:50,480
forming the star what how much iron how

195
00:08:56,030 --> 00:08:53,200
much silicon and so forth

196
00:08:59,030 --> 00:08:56,040
as the exploded outer shell of supernova

197
00:09:02,070 --> 00:08:59,040
1987a dissipates into space

198
00:09:04,790 --> 00:09:02,080
it may be possible for bbxrt to observe

199
00:09:06,310 --> 00:09:04,800
the existence of a neutron star at the

200
00:09:08,470 --> 00:09:06,320
center

201
00:09:10,790 --> 00:09:08,480
neutron stars are formed during a

202
00:09:13,430 --> 00:09:10,800
supernova explosion when the inner

203
00:09:15,269 --> 00:09:13,440
region of a star collapses into a tiny

204
00:09:17,829 --> 00:09:15,279
core

205
00:09:20,710 --> 00:09:17,839
pulsars are neutron stars that rotate

206
00:09:22,870 --> 00:09:20,720
extremely quickly some as fast as one

207
00:09:25,030 --> 00:09:22,880
thousand times a second

208
00:09:27,670 --> 00:09:25,040
they emit light and x-rays in

209
00:09:29,430 --> 00:09:27,680
searchlight beams making them appear to

210
00:09:31,430 --> 00:09:29,440
blink on and off

211
00:09:33,750 --> 00:09:31,440
scientists believe that neutron stars

212
00:09:36,070 --> 00:09:33,760
are unimaginably dense

213
00:09:41,110 --> 00:09:36,080

one teaspoonful of matter from a neutron

214
00:09:43,430 --> 00:09:41,120
star would weigh over a billion tons

215
00:09:46,150 --> 00:09:43,440
many neutron stars are often paired with

216
00:09:48,710 --> 00:09:46,160
a much larger companion star

217
00:09:51,430 --> 00:09:48,720
in this binary star system the tiny

218
00:09:54,310 --> 00:09:51,440
neutron star exerts an extremely strong

219
00:09:56,470 --> 00:09:54,320
gravitational pull which draws gas from

220
00:09:58,790 --> 00:09:56,480
the companion star

221
00:10:01,110 --> 00:09:58,800
the gas flows into an accretion disk

222
00:10:03,030 --> 00:10:01,120
around the neutron star

223
00:10:06,069 --> 00:10:03,040
as it approaches the star

224
00:10:09,750 --> 00:10:06,079
the gas is heated to millions of degrees

225
00:10:11,670 --> 00:10:09,760
and emits large amounts of x-rays

226
00:10:13,750 --> 00:10:11,680
in some systems

227
00:10:18,470 --> 00:10:13,760
the gas flows onto the pole of the

228
00:10:20,389 --> 00:10:18,480
neutron star along its magnetic field

229
00:10:22,630 --> 00:10:20,399
scientists believe that some binary

230
00:10:25,990 --> 00:10:22,640
systems may contain a mysterious black

231
00:10:28,550 --> 00:10:26,000
hole instead of a neutron star

232
00:10:31,670 --> 00:10:28,560
x-rays are admitted as the swirling hot

233
00:10:33,750 --> 00:10:31,680
gas is drawn into the black hole

234
00:10:36,310 --> 00:10:33,760
the gravitational force exerted by the

235
00:10:38,710 --> 00:10:36,320
black hole is so strong that neither

236
00:10:40,630 --> 00:10:38,720
light nor matter can escape once they

237
00:10:42,710 --> 00:10:40,640
are drawn in

238
00:10:46,790 --> 00:10:42,720

the physical conditions found inside the

239
00:10:48,710 --> 00:10:46,800
black hole are totally unknown

240
00:10:50,870 --> 00:10:48,720
the x-ray telescope will study a

241
00:10:53,509 --> 00:10:50,880
suspected black hole in our galaxy

242
00:10:56,230 --> 00:10:53,519
called cygnus x1

243
00:10:58,550 --> 00:10:56,240
scientists hope bbxrt

244
00:11:01,190 --> 00:10:58,560
will confirm the theory that material is

245
00:11:04,069 --> 00:11:01,200
actually spiraling around the black hole

246
00:11:06,790 --> 00:11:04,079
as it is drawn into it

247
00:11:09,509 --> 00:11:06,800
perhaps none of bbxrt's targets are as

248
00:11:11,509 --> 00:11:09,519
mysterious as the quasars

249
00:11:13,910 --> 00:11:11,519
though they look like stars

250
00:11:16,150 --> 00:11:13,920
quasars are believed to be the center of

251
00:11:17,670 --> 00:11:16,160
distant galaxies formed billions of

252
00:11:20,470 --> 00:11:17,680
years ago

253
00:11:23,990 --> 00:11:20,480
yet a single quasar radiates more energy

254
00:11:26,069 --> 00:11:24,000
than 100 normal galaxies combined

255
00:11:29,430 --> 00:11:26,079
it is believed that quasars may be

256
00:11:31,829 --> 00:11:29,440
powered by a massive black hole

257
00:11:33,670 --> 00:11:31,839
quasars are the furthest objects from

258
00:11:35,750 --> 00:11:33,680
earth ever observed

259
00:11:38,069 --> 00:11:35,760
so the light emitted from them dates

260
00:11:38,949 --> 00:11:38,079
back to a time much closer to the big

261
00:11:41,829 --> 00:11:38,959
bang

262
00:11:43,750 --> 00:11:41,839
the indescribably huge explosion that

263
00:11:45,670 --> 00:11:43,760

scientists believe was the beginning of

264
00:11:49,430 --> 00:11:45,680
the universe

265
00:11:51,509 --> 00:11:49,440
bb xrt co-investigator frank marshall

266
00:11:53,750 --> 00:11:51,519
quasars have been known for i guess more

267
00:11:55,590 --> 00:11:53,760
than 20 years now but it's still not

268
00:11:58,069 --> 00:11:55,600
known what the

269
00:12:00,470 --> 00:11:58,079
real energy generation mechanism

270
00:12:02,710 --> 00:12:00,480
in quasars is but x-rays allow you to

271
00:12:05,110 --> 00:12:02,720
look very close into the central engine

272
00:12:07,269 --> 00:12:05,120
of quasars which is where most of the

273
00:12:09,590 --> 00:12:07,279
action is going on so we'll look very

274
00:12:13,190 --> 00:12:09,600
close to what we think is the black hole

275
00:12:15,509 --> 00:12:13,200
at the at the center of the quasar and

276
00:12:17,750 --> 00:12:15,519
get a measurement of perhaps how the

277
00:12:18,949 --> 00:12:17,760
material is is falling into the into the

278
00:12:21,190 --> 00:12:18,959
quasar

279
00:12:25,030 --> 00:12:21,200
and how large the object the center of

280
00:12:30,790 --> 00:12:27,910
the largest areas bbxrt will study are

281
00:12:32,949 --> 00:12:30,800
clusters of galaxies where hundreds of

282
00:12:35,269 --> 00:12:32,959
galaxies move around each other in their

283
00:12:36,870 --> 00:12:35,279
own gravitational system

284
00:12:39,670 --> 00:12:36,880
previous x-ray instruments have

285
00:12:41,829 --> 00:12:39,680
discovered an extremely hot gas that

286
00:12:43,190 --> 00:12:41,839
covers an enormous region within the

287
00:12:46,069 --> 00:12:43,200
cluster

288
00:12:47,750 --> 00:12:46,079

bbxrt will analyze the chemical makeup

289
00:12:50,470 --> 00:12:47,760
of the gas

290
00:12:52,470 --> 00:12:50,480
clusters of galaxies what is the gas

291
00:12:53,430 --> 00:12:52,480
that is in them how hot it is and what

292
00:12:56,230 --> 00:12:53,440
it is

293
00:12:58,230 --> 00:12:56,240
is it just hydrogen from from the big

294
00:13:00,949 --> 00:12:58,240
bang or is it something that the

295
00:13:02,230 --> 00:13:00,959
galaxies that are going in this cluster

296
00:13:04,629 --> 00:13:02,240
that has

297
00:13:06,069 --> 00:13:04,639
been spewing out and now it's heated up

298
00:13:07,350 --> 00:13:06,079
in the middle of the cluster in

299
00:13:09,829 --> 00:13:07,360
astrophysics this is important

300
00:13:12,310 --> 00:13:09,839
information and instruments like bbxrt

301
00:13:14,150 --> 00:13:12,320
give you that information it's just that

302
00:13:16,550 --> 00:13:14,160
a lot of this information simply does

303
00:13:19,509 --> 00:13:16,560
not exist right now and bbxrt will be

304
00:13:21,590 --> 00:13:19,519
producing this information

305
00:13:23,430 --> 00:13:21,600
the weeks prior to the launch are a time

306
00:13:26,230 --> 00:13:23,440
of great anticipation for the men and

307
00:13:28,629 --> 00:13:26,240
women who work to build a telescope

308
00:13:31,350 --> 00:13:28,639
together with the ultraviolet telescopes

309
00:13:34,870 --> 00:13:31,360
bbxrt is positioned into the shuttle's

310
00:13:37,430 --> 00:13:34,880
payload bay at the kennedy space center

311
00:13:38,949 --> 00:13:37,440
during the mission the x-ray telescope

312
00:13:40,710 --> 00:13:38,959
will be controlled from the goddard

313
00:13:42,550 --> 00:13:40,720

space flight center

314
00:13:44,230 --> 00:13:42,560
several flight simulations are held

315
00:13:46,230 --> 00:13:44,240
prior to launch

316
00:13:48,629 --> 00:13:46,240
many of the scientists and engineers who

317
00:13:50,629 --> 00:13:48,639
built and tested the telescope practiced

318
00:13:52,629 --> 00:13:50,639
the commands and procedures to be used

319
00:13:55,990 --> 00:13:52,639
during the mission you can enable taps

320
00:13:59,350 --> 00:13:56,000
in bbxrt for command at this time

321
00:14:01,750 --> 00:13:59,360
astro will be around the clock mission

322
00:14:04,230 --> 00:14:01,760
nearly every orbit the astronauts will

323
00:14:05,990 --> 00:14:04,240
adjust the orientation of the shuttle

324
00:14:08,470 --> 00:14:06,000
then the telescopes will make fine

325
00:14:10,230 --> 00:14:08,480
adjustments toward new targets

326
00:14:12,710 --> 00:14:10,240
for part of the mission all the

327
00:14:14,829 --> 00:14:12,720
telescopes will point at the same target

328
00:14:17,590 --> 00:14:14,839
such as supernova

329
00:14:19,990 --> 00:14:17,600
1987a by comparing simultaneous

330
00:14:22,069 --> 00:14:20,000
information taken in two different bands

331
00:14:24,069 --> 00:14:22,079
of the electromagnetic spectrum

332
00:14:26,550 --> 00:14:24,079
scientists will gain a more complete

333
00:14:29,430 --> 00:14:26,560
understanding of these targets

334
00:14:31,590 --> 00:14:29,440
at other times the x-ray and ultraviolet

335
00:14:32,870 --> 00:14:31,600
telescopes will be pointed at different

336
00:14:34,870 --> 00:14:32,880
targets

337
00:14:37,829 --> 00:14:34,880
all data from the telescopes will be

338
00:14:39,590 --> 00:14:37,839

analyzed over the coming years

339
00:14:42,550 --> 00:14:39,600
what's been exciting about this project

340
00:14:45,350 --> 00:14:42,560
is that science was conceived here

341
00:14:47,269 --> 00:14:45,360
the instrument was developed here the

342
00:14:49,350 --> 00:14:47,279
rest of the payload was developed and

343
00:14:51,990 --> 00:14:49,360
integrated and tested here

344
00:14:53,670 --> 00:14:52,000
and the whole payload will be controlled

345
00:14:55,189 --> 00:14:53,680
from the goddard space flight center

346
00:14:57,189 --> 00:14:55,199
control center

347
00:14:59,590 --> 00:14:57,199
largely we don't know

348
00:15:01,030 --> 00:14:59,600
exactly what we're going to see which is

349
00:15:03,590 --> 00:15:01,040
part of the excitement

350
00:15:05,750 --> 00:15:03,600
the 10 days will produce for us and

351
00:15:07,990 --> 00:15:05,760
discovering exactly what

352
00:15:09,990 --> 00:15:08,000
what we do find because in the past

353
00:15:11,430 --> 00:15:10,000
x-ray astronomy new x-ray astronomy

354
00:15:12,870 --> 00:15:11,440
missions have always produced something

355
00:15:14,949 --> 00:15:12,880
we didn't anticipate

356
00:15:17,110 --> 00:15:14,959
in many circumstances those are the most

357
00:15:19,269 --> 00:15:17,120
have been the most exciting results

358
00:15:24,870 --> 00:15:19,279
and i'm very hopeful that the same will

359
00:15:29,590 --> 00:15:27,670
the broadband x-ray telescope

360
00:15:30,949 --> 00:15:29,600
along with the astro ultraviolet

361
00:15:33,110 --> 00:15:30,959
telescopes

362
00:15:35,430 --> 00:15:33,120
stands ready to deliver brand new

363
00:15:36,470 --> 00:15:35,440

information to scientists all over the

364
00:15:38,829 --> 00:15:36,480
world

365
00:15:41,509 --> 00:15:38,839
about the greatest mysteries in the

366
00:15:43,110 --> 00:15:41,519
universe its origin

367
00:16:27,990 --> 00:15:43,120
its evolution