
PAO
POSN 4732

1
00:00:04,950 --> 00:00:02,389
so right now here in mission control

2
00:00:07,190 --> 00:00:04,960
houston i'm being joined by ken balweg

3
00:00:09,669 --> 00:00:07,200
and ken is the project manager for

4
00:00:11,990 --> 00:00:09,679
vasimer which is a next generation

5
00:00:13,589 --> 00:00:12,000
plasma rocket so ken thank you so much

6
00:00:15,190 --> 00:00:13,599
for being here today and why don't you

7
00:00:17,189 --> 00:00:15,200
tell us a little bit about what the

8
00:00:18,710 --> 00:00:17,199
vasmer project is

9
00:00:19,590 --> 00:00:18,720
okay thanks dan thanks for having me

10
00:00:21,670 --> 00:00:19,600
here

11
00:00:25,349 --> 00:00:21,680
vasmir stands for variable specific

12
00:00:26,710 --> 00:00:25,359
impulse magnetoplasma rocket

13
00:00:27,990 --> 00:00:26,720

yes it is that's why we shorten it to

14
00:00:29,509 --> 00:00:28,000
vasmir

15
00:00:31,349 --> 00:00:29,519
as you said we have long duration

16
00:00:33,270 --> 00:00:31,359
flights planned but the purpose of

17
00:00:35,350 --> 00:00:33,280
asmere is to shorten those flights it's

18
00:00:36,790 --> 00:00:35,360
a very high power electric propulsion

19
00:00:38,790 --> 00:00:36,800
plasma rocket

20
00:00:39,910 --> 00:00:38,800
mostly other electric propulsion systems

21
00:00:41,110 --> 00:00:39,920
that are being developed are on the

22
00:00:45,270 --> 00:00:41,120
order of

23
00:00:47,510 --> 00:00:45,280
5 10 20 maybe 50 kilowatts vasmir in its

24
00:00:50,470 --> 00:00:47,520
current experimental stage is at 200

25
00:00:53,189 --> 00:00:50,480
kilowatts and we have goals to go up to

26
00:00:54,630 --> 00:00:53,199
megawatt sorts of ranges now of course

27
00:00:56,709 --> 00:00:54,640
the problem with that is you need a lot

28
00:00:58,310 --> 00:00:56,719
of power you know megawatt is a lot of

29
00:01:02,470 --> 00:00:58,320
power for instance the space station has

30
00:01:04,229 --> 00:01:02,480
240 kilowatts of solar panels on it so

31
00:01:05,750 --> 00:01:04,239
it would use you know 200 kilowatts

32
00:01:06,710 --> 00:01:05,760
would use up a significant portion of

33
00:01:07,750 --> 00:01:06,720
that

34
00:01:09,590 --> 00:01:07,760
um

35
00:01:11,270 --> 00:01:09,600
but what vasmir is doing what the

36
00:01:13,429 --> 00:01:11,280
company at astra is doing is trying to

37
00:01:15,350 --> 00:01:13,439
develop this rocket to show that it can

38
00:01:16,550 --> 00:01:15,360

achieve steady-state operations thermal

39
00:01:18,310 --> 00:01:16,560
operations

40
00:01:20,469 --> 00:01:18,320
they've already achieved plasma

41
00:01:21,910 --> 00:01:20,479
operations that are very well known it

42
00:01:23,109 --> 00:01:21,920
becomes steady state in the order of

43
00:01:24,789 --> 00:01:23,119
milliseconds

44
00:01:26,710 --> 00:01:24,799
and they've done thousands and thousands

45
00:01:27,910 --> 00:01:26,720
of firings so this is a pretty well

46
00:01:29,990 --> 00:01:27,920
advanced technology that they're

47
00:01:32,310 --> 00:01:30,000
developing okay and uh one of the things

48
00:01:34,469 --> 00:01:32,320
you mentioned is the the whole idea of

49
00:01:36,710 --> 00:01:34,479
this is to make those long duration

50
00:01:38,390 --> 00:01:36,720
missions shorter now how does this

51
00:01:41,270 --> 00:01:38,400
rocket you know differ from just our

52
00:01:42,870 --> 00:01:41,280
standard chemical propelled rockets how

53
00:01:44,870 --> 00:01:42,880
is it going to do that how is it going

54
00:01:46,389 --> 00:01:44,880
to make it shorter well a typical

55
00:01:47,990 --> 00:01:46,399
chemical rocket

56
00:01:50,149 --> 00:01:48,000
is very powerful is a lot of stored

57
00:01:52,469 --> 00:01:50,159
energy between the oxidizer and the fuel

58
00:01:54,550 --> 00:01:52,479
so it's a lot of power that's expended

59
00:01:55,910 --> 00:01:54,560
very quickly as you lift off the launch

60
00:01:58,310 --> 00:01:55,920
pad you will still we will still need

61
00:01:59,590 --> 00:01:58,320
chemical rockets to get off the off the

62
00:02:00,389 --> 00:01:59,600
earth's surface and in the low earth

63
00:02:02,149 --> 00:02:00,399

orbit

64
00:02:04,230 --> 00:02:02,159
um for instance

65
00:02:07,190 --> 00:02:04,240
we measure the rocket's efficiency in

66
00:02:09,510 --> 00:02:07,200
isp or specific impulse

67
00:02:12,150 --> 00:02:09,520
for instance uh the srbs for the shuttle

68
00:02:14,229 --> 00:02:12,160
on the order of 250 seconds is the unit

69
00:02:16,150 --> 00:02:14,239
that is used for it um the space shuttle

70
00:02:17,190 --> 00:02:16,160
main engines are on the order of 450

71
00:02:19,910 --> 00:02:17,200
seconds

72
00:02:22,390 --> 00:02:19,920
vasmir can operate anywhere from 2500

73
00:02:23,670 --> 00:02:22,400
seconds to 10 000 seconds

74
00:02:26,550 --> 00:02:23,680
so as you can see it's an order of

75
00:02:29,030 --> 00:02:26,560
magnitude or two more efficient

76
00:02:30,630 --> 00:02:29,040
than uh than a chemical rocket now what

77
00:02:32,550 --> 00:02:30,640
this means instead of having a lot of

78
00:02:34,070 --> 00:02:32,560
power in a very short time you know on

79
00:02:36,390 --> 00:02:34,080
an order of minutes which you typically

80
00:02:38,949 --> 00:02:36,400
do with chemical rockets vasmir can run

81
00:02:41,990 --> 00:02:38,959
for hours days weeks

82
00:02:43,990 --> 00:02:42,000
very small thrust but for a very long

83
00:02:46,229 --> 00:02:44,000
time so you just keep accelerating your

84
00:02:49,270 --> 00:02:46,239
spacecraft you just kind of consistently

85
00:02:51,350 --> 00:02:49,280
build that speed up and up and i mean

86
00:02:53,030 --> 00:02:51,360
rough estimate about how much could you

87
00:02:54,390 --> 00:02:53,040
actually shorten let's say a trip to

88
00:02:56,229 --> 00:02:54,400

mars

89
00:02:58,149 --> 00:02:56,239
well instead of it taking on the order

90
00:02:59,750 --> 00:02:58,159
of say 10 months to a year it could be

91
00:03:00,630 --> 00:02:59,760
shortened to the order of three or four

92
00:03:03,110 --> 00:03:00,640
months

93
00:03:05,350 --> 00:03:03,120
depending on how much power you have to

94
00:03:06,949 --> 00:03:05,360
deliver now in order to get to those

95
00:03:09,270 --> 00:03:06,959
sort of you know three or four months

96
00:03:11,350 --> 00:03:09,280
sort of times you need megawatts of

97
00:03:13,990 --> 00:03:11,360
power which which implies nuclear

98
00:03:15,750 --> 00:03:14,000
sources okay rather than solar electric

99
00:03:17,750 --> 00:03:15,760
okay and uh why don't you tell us a

100
00:03:19,350 --> 00:03:17,760
little about about a little bit about

101
00:03:21,509 --> 00:03:19,360
some of the testing that's been going on

102
00:03:23,509 --> 00:03:21,519
what stage are you guys in right now you

103
00:03:24,710 --> 00:03:23,519
mentioned i think you're at like a 200

104
00:03:26,229 --> 00:03:24,720
megawatt

105
00:03:27,990 --> 00:03:26,239
stage right now what's what's some of

106
00:03:30,070 --> 00:03:28,000
the testing you guys have been doing

107
00:03:32,229 --> 00:03:30,080
it's 200 kilowatts

108
00:03:33,910 --> 00:03:32,239
sorry i'm getting a little

109
00:03:37,430 --> 00:03:33,920
that would be awesome we get to mars in

110
00:03:38,630 --> 00:03:37,440
a very short time at 200 megawatts um

111
00:03:41,110 --> 00:03:38,640
so the testing we're doing right now

112
00:03:42,630 --> 00:03:41,120
we're characterizing the plume uh and

113
00:03:43,910 --> 00:03:42,640

you know we're looking at plume

114
00:03:45,589 --> 00:03:43,920
characteristics we're also looking at

115
00:03:48,550 --> 00:03:45,599
what's called a throttle table in other

116
00:03:49,910 --> 00:03:48,560
words to to understand exactly what sort

117
00:03:52,789 --> 00:03:49,920
of performance you're going to get at

118
00:03:54,630 --> 00:03:52,799
certain propellant flows certain power

119
00:03:56,070 --> 00:03:54,640
distribution inside the rocket because

120
00:03:58,630 --> 00:03:56,080
it's actually a two-stage rocket you

121
00:04:00,470 --> 00:03:58,640
have a front end that actually ionizes

122
00:04:03,990 --> 00:04:00,480
the propellant typically argon sometimes

123
00:04:06,470 --> 00:04:04,000
krypton uh can actually do hydrogen neon

124
00:04:08,229 --> 00:04:06,480
other we fired many things in it but

125
00:04:09,429 --> 00:04:08,239
typically argon and krypton are our two

126
00:04:12,390 --> 00:04:09,439
main fuels

127
00:04:13,990 --> 00:04:12,400
um so we go at different flow rates we

128
00:04:15,910 --> 00:04:14,000
will put a different amount of power in

129
00:04:17,430 --> 00:04:15,920
the front end that ionizes it and then

130
00:04:20,870 --> 00:04:17,440
on the rear end of the rocket which is

131
00:04:22,790 --> 00:04:20,880
the uh ion synchrotron heating section

132
00:04:25,189 --> 00:04:22,800
we'll change the power in that to see

133
00:04:27,350 --> 00:04:25,199
what the efficiency of the rocket is

134
00:04:28,710 --> 00:04:27,360
okay and you mentioned all these

135
00:04:30,469 --> 00:04:28,720
different types of fuels that you're

136
00:04:32,150 --> 00:04:30,479
able to use i know fuel is always kind

137
00:04:34,550 --> 00:04:32,160
of a huge concern whenever you're

138
00:04:36,390 --> 00:04:34,560

traveling into space especially

139
00:04:37,590 --> 00:04:36,400
on these long-duration missions as fuel

140
00:04:39,350 --> 00:04:37,600
weighs a lot

141
00:04:40,550 --> 00:04:39,360
the more you bring the more you know

142
00:04:42,710 --> 00:04:40,560
more propulsion you're going to need and

143
00:04:45,030 --> 00:04:42,720
things like that how much fuel

144
00:04:47,590 --> 00:04:45,040
you think is is is it all going to be an

145
00:04:49,189 --> 00:04:47,600
overall reduction in fuels so

146
00:04:51,350 --> 00:04:49,199
that's exactly right that's exactly what

147
00:04:52,870 --> 00:04:51,360
we're trying to achieve here because

148
00:04:55,510 --> 00:04:52,880
because the higher fuel efficiency

149
00:04:58,469 --> 00:04:55,520
remember i said isps of you know 2500 to

150
00:04:59,430 --> 00:04:58,479
10 000 you can bring much less fuel than

151
00:05:02,310 --> 00:04:59,440
what you would need if you're going to

152
00:05:03,909 --> 00:05:02,320
do this chemically remember chemically

153
00:05:06,150 --> 00:05:03,919
even the shuttle main engines which are

154
00:05:08,950 --> 00:05:06,160
very efficient you know as it is a

155
00:05:11,590 --> 00:05:08,960
cryogenic oxygen uh liquid hydrogen

156
00:05:12,950 --> 00:05:11,600
system um still only an isp of 450

157
00:05:14,230 --> 00:05:12,960
seconds so you have to bring an awful

158
00:05:15,110 --> 00:05:14,240
lot of fuel to get you from here to

159
00:05:17,189 --> 00:05:15,120
there

160
00:05:19,990 --> 00:05:17,199
vasmir while it uses

161
00:05:21,909 --> 00:05:20,000
fuel at a much lower rate because it's

162
00:05:24,310 --> 00:05:21,919
much more efficient it also needs much

163
00:05:25,990 --> 00:05:24,320

less fuel to do to achieve the same

164
00:05:28,150 --> 00:05:26,000
mission okay

165
00:05:29,749 --> 00:05:28,160
and so what are some of the uh the

166
00:05:31,350 --> 00:05:29,759
future tests that you guys are hoping to

167
00:05:32,469 --> 00:05:31,360
accomplish you know within the next few

168
00:05:34,790 --> 00:05:32,479
years

169
00:05:37,670 --> 00:05:34,800
the key thing the next big step is to

170
00:05:40,070 --> 00:05:37,680
achieve thermal steady state okay

171
00:05:42,230 --> 00:05:40,080
what is that real quick well when you

172
00:05:43,350 --> 00:05:42,240
when you fire up a plasma first of all

173
00:05:44,870 --> 00:05:43,360
it's kind of like these fluorescents

174
00:05:46,469 --> 00:05:44,880
like lights in these rooms you turn it

175
00:05:48,629 --> 00:05:46,479
on boom it's at steady state the

176
00:05:50,870 --> 00:05:48,639
heartbeat but it takes a while for that

177
00:05:52,870 --> 00:05:50,880
bulb to warm up well it's the same thing

178
00:05:55,110 --> 00:05:52,880
with a plasma rocket now we're talking

179
00:05:57,430 --> 00:05:55,120
millions of degrees here it gets very

180
00:05:59,510 --> 00:05:57,440
very warm that plasma is very hot it's

181
00:06:01,510 --> 00:05:59,520
contained by a very strong magnetic

182
00:06:02,629 --> 00:06:01,520
field uh generated by a superconducting

183
00:06:03,990 --> 00:06:02,639
magnet

184
00:06:06,309 --> 00:06:04,000
and um

185
00:06:08,230 --> 00:06:06,319
what happens is over time that plasma

186
00:06:10,150 --> 00:06:08,240
eventually the radiation coming off of

187
00:06:12,390 --> 00:06:10,160
it will soak into the magnet soak into

188
00:06:13,430 --> 00:06:12,400

its surroundings and make it warmer and

189
00:06:15,590 --> 00:06:13,440
warmer to the point where you actually

190
00:06:17,749 --> 00:06:15,600
can't operate it so what we need to do

191
00:06:19,909 --> 00:06:17,759
next is develop the high temperature

192
00:06:22,629 --> 00:06:19,919
heat rejection systems to take that heat

193
00:06:24,550 --> 00:06:22,639
that's coming from that plasma core

194
00:06:26,710 --> 00:06:24,560
outside the engine and radiate it to

195
00:06:28,870 --> 00:06:26,720
space gotcha so

196
00:06:30,870 --> 00:06:28,880
i mean a lot of really complicated stuff

197
00:06:32,469 --> 00:06:30,880
going on right now but the potential for

198
00:06:35,350 --> 00:06:32,479
a huge payoff

199
00:06:37,189 --> 00:06:35,360
yes yes the the complicated stuff is

200
00:06:38,790 --> 00:06:37,199
understanding the plasma physics and

201
00:06:40,469 --> 00:06:38,800
that is well done like i said they've

202
00:06:42,150 --> 00:06:40,479
done thousands and thousands of firings

203
00:06:43,990 --> 00:06:42,160
with all sorts of different propellants

204
00:06:46,469 --> 00:06:44,000
and different durations but it's still

205
00:06:48,550 --> 00:06:46,479
on the order of seconds to minutes

206
00:06:50,790 --> 00:06:48,560
the what we need to do now is just more

207
00:06:52,710 --> 00:06:50,800
the engineering it's it's it is an r d

208
00:06:53,909 --> 00:06:52,720
program it's it's not easy to deal with

209
00:06:55,510 --> 00:06:53,919
these kind of temperatures but it's

210
00:06:57,110 --> 00:06:55,520
things that have been done before it

211
00:06:59,430 --> 00:06:57,120
just needs to be applied to this

212
00:07:01,909 --> 00:06:59,440
particular technology gotcha

213
00:07:03,670 --> 00:07:01,919

and um you also mentioned uh that you've

214
00:07:05,110 --> 00:07:03,680
been involved with a number of other

215
00:07:06,710 --> 00:07:05,120
technologies and things that are going

216
00:07:08,550 --> 00:07:06,720
to help protect our astronauts and

217
00:07:10,469 --> 00:07:08,560
specifically you had mentioned to me

218
00:07:12,390 --> 00:07:10,479
uh radiation shielding

219
00:07:14,309 --> 00:07:12,400
especially which is very important

220
00:07:16,070 --> 00:07:14,319
especially when we're moving out beyond

221
00:07:17,909 --> 00:07:16,080
the protection of earth's magnetosphere

222
00:07:19,830 --> 00:07:17,919
and a lot of people have been reading in

223
00:07:21,110 --> 00:07:19,840
the news lately all the stuff about the

224
00:07:22,870 --> 00:07:21,120
solar flare and how that could

225
00:07:24,629 --> 00:07:22,880
potentially affect astronauts and things

226
00:07:25,749 --> 00:07:24,639
like that so why don't you tell me a

227
00:07:27,830 --> 00:07:25,759
little bit about the work you've been

228
00:07:28,790 --> 00:07:27,840
doing with uh long-term radiation

229
00:07:30,550 --> 00:07:28,800
shielding

230
00:07:32,710 --> 00:07:30,560
okay well this this also fits into

231
00:07:33,749 --> 00:07:32,720
superconducting magnets um vasmir is

232
00:07:35,270 --> 00:07:33,759
going to use high temperature

233
00:07:36,390 --> 00:07:35,280
superconducting magnets and we've also

234
00:07:40,150 --> 00:07:36,400
been studying

235
00:07:41,830 --> 00:07:40,160
those for use in radiation shielding now

236
00:07:43,670 --> 00:07:41,840
what we're seeing so far is that we

237
00:07:45,350 --> 00:07:43,680
don't think you can do the radiation

238
00:07:49,189 --> 00:07:45,360

shielding you need for long duration

239
00:07:51,110 --> 00:07:49,199
flight with just passive shielding um

240
00:07:52,790 --> 00:07:51,120
like things like just panels and things

241
00:07:54,469 --> 00:07:52,800
like that you know the people always

242
00:07:56,869 --> 00:07:54,479
think lead well that's not actually a

243
00:07:59,110 --> 00:07:56,879
good thing for it um you know actually

244
00:08:01,749 --> 00:07:59,120
it's very very heavy but still to

245
00:08:02,790 --> 00:08:01,759
effectively shield a module for say

246
00:08:04,550 --> 00:08:02,800
years

247
00:08:06,629 --> 00:08:04,560
uh you you need

248
00:08:09,110 --> 00:08:06,639
on the order of tens to hundreds of tons

249
00:08:11,350 --> 00:08:09,120
of passive shielding that's a lot of uh

250
00:08:13,830 --> 00:08:11,360
mass to lift into orbit

251
00:08:15,670 --> 00:08:13,840
um active radiation shielding using

252
00:08:16,950 --> 00:08:15,680
using a magnetic field just like we're

253
00:08:18,950 --> 00:08:16,960
experiencing right now with earth's

254
00:08:21,029 --> 00:08:18,960
magnetic field we think is going to be a

255
00:08:22,790 --> 00:08:21,039
much better way of doing it much lighter

256
00:08:24,629 --> 00:08:22,800
but it is very complex working with

257
00:08:26,869 --> 00:08:24,639
superconducting magnets is not uh this

258
00:08:28,710 --> 00:08:26,879
is not trivial so we're working on

259
00:08:29,990 --> 00:08:28,720
various concepts of how to configure

260
00:08:31,909 --> 00:08:30,000
these magnets

261
00:08:33,829 --> 00:08:31,919
maybe you know use the magnets together

262
00:08:35,509 --> 00:08:33,839
with passive shielding to optimize the

263
00:08:37,029 --> 00:08:35,519

performance but the first thing you got

264
00:08:39,190 --> 00:08:37,039
to realize is that you're never going to

265
00:08:40,949 --> 00:08:39,200
achieve the sort of radiation levels we

266
00:08:42,949 --> 00:08:40,959
have here on earth earth is very good to

267
00:08:44,070 --> 00:08:42,959
us in shielding us

268
00:08:45,670 --> 00:08:44,080
um

269
00:08:47,750 --> 00:08:45,680
so we've we've got to come up to an

270
00:08:49,350 --> 00:08:47,760
acceptable risk an acceptable level you

271
00:08:51,030 --> 00:08:49,360
know for the amount of time that crew's

272
00:08:52,389 --> 00:08:51,040
going to spend in space you know we know

273
00:08:54,150 --> 00:08:52,399
that you know people live on this earth

274
00:08:56,870 --> 00:08:54,160
at these radiation levels for you know

275
00:08:58,150 --> 00:08:56,880
60 80 you know 90 years

276
00:09:00,070 --> 00:08:58,160
if they're going to be in space for say

277
00:09:02,389 --> 00:09:00,080
two or three years they can accept a

278
00:09:04,630 --> 00:09:02,399
higher level but what that level is is

279
00:09:07,030 --> 00:09:04,640
still to be determined

280
00:09:08,870 --> 00:09:07,040
gotcha so a lot of challenges but a lot

281
00:09:11,350 --> 00:09:08,880
of really exciting cool technology

282
00:09:12,310 --> 00:09:11,360
coming up in the future

283
00:09:14,150 --> 00:09:12,320
yeah

284
00:09:16,150 --> 00:09:14,160
can't wait to see some of it up there in

285
00:09:17,509 --> 00:09:16,160
space and then work well ken thank you

286
00:09:19,670 --> 00:09:17,519
so much for being here and giving us a

287
00:09:21,829 --> 00:09:19,680
look kinda into the future we'll be sure

288
00:09:23,750 --> 00:09:21,839

to follow along and look for that rocket