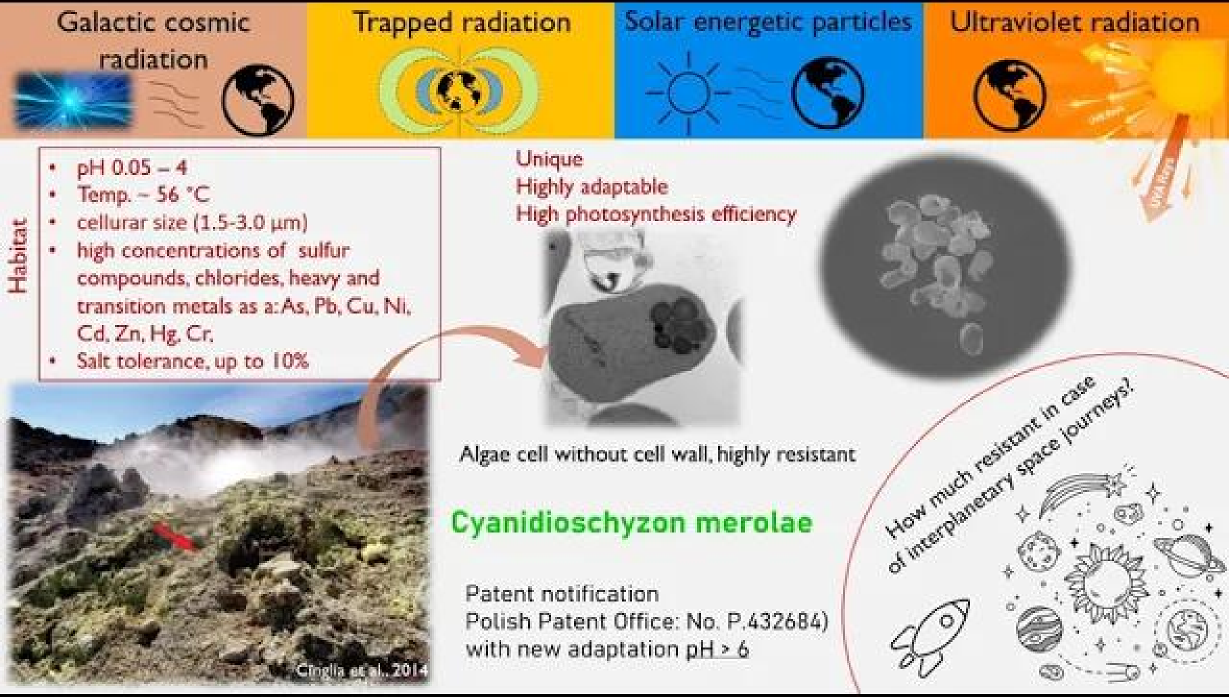
Galactic cosmic radiation
Trapped radiation
Solar energetic particles
Ultraviolet radiation
Habitat
• pH 0.05 – 4
• Temp. ~ 56 °C
• cellurar size (1.5-3.0 μm)
• high concentrations of sulfur compounds, chlorides, heavy and transition metals as a: As, Pb, Cu, Ni, Cd, Zn, Hg, Cr,
• Salt tolerance, up to 10%
Unique
Highly adaptable
High photosynthesis efficiency
Algae cell without cell wall, highly resistant
Cyanidioschyzon merolae
Patent notification
Polish Patent Office: No. P.432684)
with new adaptation pH > 6
How much resistant in case of interplanetary space journeys?
Cinglia et al., 2014

1
00:00:04,789 --> 00:00:03,429
interplanetary travel has always

2
00:00:07,110 --> 00:00:04,799
interested people

3
00:00:09,270 --> 00:00:07,120
but still a little is known about impact

4
00:00:12,150 --> 00:00:09,280
of cosmic radiation on human and

5
00:00:14,070 --> 00:00:12,160
other organisms since we want to return

6
00:00:15,910 --> 00:00:14,080
to the moon and explore mars

7
00:00:18,950 --> 00:00:15,920
we have to think about protection of

8
00:00:20,630 --> 00:00:18,960
human body but also organisms which will

9
00:00:24,150 --> 00:00:20,640
help us survive in long

10
00:00:26,230 --> 00:00:24,160
journey hello to all participants

11
00:00:28,230 --> 00:00:26,240
my name is eva borowska and i'm

12
00:00:30,790 --> 00:00:28,240
representing university of warsaw

13
00:00:32,790 --> 00:00:30,800

with magdalena wabovska from roswell

14
00:00:33,430 --> 00:00:32,800
university of science and technology in

15
00:00:35,910 --> 00:00:33,440
poland

16
00:00:38,630 --> 00:00:35,920
today we would like to present red algae

17
00:00:40,709 --> 00:00:38,640
as a source of efficient photosynthesis

18
00:00:41,830 --> 00:00:40,719
under gamma radiation during space

19
00:00:47,510 --> 00:00:41,840
exploration

20
00:00:52,229 --> 00:00:50,389
in the picture from nasa you can see a

21
00:00:55,350 --> 00:00:52,239
different type of waves and

22
00:00:58,470 --> 00:00:55,360
radiation which is the most important

23
00:01:01,750 --> 00:00:58,480
for our existence

24
00:01:04,630 --> 00:01:01,760
on earth if we are

25
00:01:05,590 --> 00:01:04,640
talking about ultraviolet radiation

26
00:01:09,109 --> 00:01:05,600
x-rays

27
00:01:12,230 --> 00:01:09,119
and gamma waves including

28
00:01:13,590 --> 00:01:12,240
ionizing radiation we wanted to use one

29
00:01:17,749 --> 00:01:13,600
of the most popular

30
00:01:24,469 --> 00:01:17,759
gamma waves which the source was

31
00:01:29,670 --> 00:01:26,710
in the filter we would like to present

32
00:01:31,910 --> 00:01:29,680
interaction of ionizing radiation with

33
00:01:32,710 --> 00:01:31,920
ionizing radiation depends on type of

34
00:01:35,030 --> 00:01:32,720
passing

35
00:01:37,270 --> 00:01:35,040
through structural materials such as

36
00:01:39,830 --> 00:01:37,280
metal makes it brittle

37
00:01:40,870 --> 00:01:39,840
and can weaken the material if the

38
00:01:43,590 --> 00:01:40,880

radiation's

39
00:01:46,310 --> 00:01:43,600
intensity is great enough it can also

40
00:01:49,190 --> 00:01:46,320
damage electronic equipment

41
00:01:50,550 --> 00:01:49,200
so we can distinguish few types of

42
00:01:53,910 --> 00:01:50,560
ionizing radiation

43
00:01:54,789 --> 00:01:53,920
it's alpha beta gamma and neutral

44
00:01:58,069 --> 00:01:54,799
particles

45
00:02:01,109 --> 00:01:58,079
which interact less ionize indirectly

46
00:02:03,350 --> 00:02:01,119
and penetrate further but as well as

47
00:02:05,590 --> 00:02:03,360
gamma radiation is a type of ionizing

48
00:02:06,389 --> 00:02:05,600
radiation that has an impact on cell

49
00:02:09,669 --> 00:02:06,399
structure

50
00:02:11,110 --> 00:02:09,679
like dna proteins lipids and membrane

51
00:02:13,589 --> 00:02:11,120
conformation

52
00:02:14,390 --> 00:02:13,599
when ionizing radiation interacts with

53
00:02:20,150 --> 00:02:14,400
cells

54
00:02:23,350 --> 00:02:20,160
the body can repair a cell

55
00:02:25,510 --> 00:02:23,360
however if many are damaged or die

56
00:02:28,150 --> 00:02:25,520
the body may not be able to replace the

57
00:02:29,110 --> 00:02:28,160
cells fast enough causing radiation

58
00:02:33,589 --> 00:02:29,120
poisoning

59
00:02:36,869 --> 00:02:33,599
and death before we present

60
00:02:39,990 --> 00:02:36,879
our organisms algae which are

61
00:02:42,790 --> 00:02:40,000
eukaryotic organisms we would like to

62
00:02:44,949 --> 00:02:42,800
show also prokaryotic organisms

63
00:02:48,309 --> 00:02:44,959

resistant

64
00:02:51,670 --> 00:02:48,319
against ionizing radiation and

65
00:02:54,150 --> 00:02:51,680
uv radiation so the first one is

66
00:02:54,869 --> 00:02:54,160
diinococcus radiodurans with rapid dna

67
00:02:58,070 --> 00:02:54,879
repair

68
00:03:01,910 --> 00:02:58,080
mechanisms which were detected in

69
00:03:05,030 --> 00:03:01,920
atmosphere and has

70
00:03:08,149 --> 00:03:05,040
the possibility to survive even

71
00:03:11,350 --> 00:03:08,159
after dose of 5 000 grays

72
00:03:14,229 --> 00:03:11,360
and one dose 15 000 grays

73
00:03:15,270 --> 00:03:14,239
still some bacteria can reproduce in

74
00:03:18,550 --> 00:03:15,280
parallel

75
00:03:21,750 --> 00:03:18,560
uh human lethal doses it's

76
00:03:23,030 --> 00:03:21,760
uh 10 000 milligrams and for escherichia

77
00:03:26,630 --> 00:03:23,040
coli bacteria

78
00:03:29,750 --> 00:03:26,640
60 000 milligrams the second

79
00:03:31,270 --> 00:03:29,760
organisms are cyanobacteria from driest

80
00:03:34,309 --> 00:03:31,280
place on earth

81
00:03:38,710 --> 00:03:34,319
and with high protective

82
00:03:41,589 --> 00:03:38,720
efficiency against high uv radiation

83
00:03:43,030 --> 00:03:41,599
so they called heroes idiopsis and

84
00:03:46,070 --> 00:03:43,040
producing specific

85
00:03:51,350 --> 00:03:46,080
pigments as staton psytonamine

86
00:03:57,270 --> 00:03:54,390
in atacama desert unique dance matrix

87
00:03:58,550 --> 00:03:57,280
within the eps extracellular polymorphic

88
00:04:01,429 --> 00:03:58,560

substance

89
00:04:02,550 --> 00:04:01,439
and allow for surviving the clouds in

90
00:04:05,869 --> 00:04:02,560
the low temperature

91
00:04:07,350 --> 00:04:05,879
harsh liquids and uv radiation so

92
00:04:10,070 --> 00:04:07,360
grossitopsies

93
00:04:11,990 --> 00:04:10,080
the unique cyanobacteria with high uv

94
00:04:15,589 --> 00:04:12,000
resistance

95
00:04:19,509 --> 00:04:15,599
can create the specific homes and

96
00:04:23,670 --> 00:04:19,519
survive inside them still

97
00:04:26,950 --> 00:04:25,790
in space exploration we can

98
00:04:30,390 --> 00:04:26,960
differentiate

99
00:04:33,270 --> 00:04:30,400
a few types of rotation galactic cosmic

100
00:04:34,390 --> 00:04:33,280
radiation created during supernova solar

101
00:04:36,710 --> 00:04:34,400
cosmic radiation

102
00:04:37,749 --> 00:04:36,720
primarily from solar wind and solar

103
00:04:41,430 --> 00:04:37,759
flares and

104
00:04:42,550 --> 00:04:41,440
the red lesion trapped in the vampires

105
00:04:45,189 --> 00:04:42,560
around earth

106
00:04:47,670 --> 00:04:45,199
and of course ultraviolet radiation

107
00:04:50,950 --> 00:04:47,680
earth's magmatic fields

108
00:04:53,510 --> 00:04:50,960
keeps our planet safe from most in

109
00:04:54,790 --> 00:04:53,520
ionizing radiation including galactic

110
00:04:57,350 --> 00:04:54,800
cosmic radiation and

111
00:04:58,310 --> 00:04:57,360
solar cosmic radiation but of course in

112
00:05:02,310 --> 00:04:58,320
outer space

113
00:05:02,950 --> 00:05:02,320

we are not protected so we would like to

114
00:05:05,909 --> 00:05:02,960
present

115
00:05:08,310 --> 00:05:05,919
red microalgae of the order cyanidalis

116
00:05:09,590 --> 00:05:08,320
occur in various extreme environments

117
00:05:11,990 --> 00:05:09,600
mostly on volcanic

118
00:05:12,790 --> 00:05:12,000
areas such as yellowstone park atacama

119
00:05:15,270 --> 00:05:12,800
desert

120
00:05:16,070 --> 00:05:15,280
campivle grey in italy new zealand and

121
00:05:18,230 --> 00:05:16,080
iceland

122
00:05:19,670 --> 00:05:18,240
and of course many types many other

123
00:05:22,310 --> 00:05:19,680
types of

124
00:05:23,430 --> 00:05:22,320
volcanic grounds they are characterized

125
00:05:25,830 --> 00:05:23,440
by low ph

126
00:05:27,430 --> 00:05:25,840
high temperatures the presence of heavy

127
00:05:29,110 --> 00:05:27,440
metals ions

128
00:05:30,629 --> 00:05:29,120
variable salinity and high

129
00:05:33,909 --> 00:05:30,639
concentrations

130
00:05:34,790 --> 00:05:33,919
of carbon dioxide and sulfates these

131
00:05:36,550 --> 00:05:34,800
organisms

132
00:05:39,189 --> 00:05:36,560
are the link between primary

133
00:05:42,070 --> 00:05:39,199
cyanobacteria and the first primitive

134
00:05:42,710 --> 00:05:42,080
eukaryotic cells which were subjected to

135
00:05:45,990 --> 00:05:42,720
the harsh

136
00:05:48,390 --> 00:05:46,000
conditions that privileged on

137
00:05:50,629 --> 00:05:48,400
earth during deformation of its

138
00:05:53,270 --> 00:05:50,639

atmosphere

139
00:05:54,550 --> 00:05:53,280
what we have achieved in a laboratory or

140
00:05:58,230 --> 00:05:54,560
in laboratory on these

141
00:06:01,430 --> 00:05:58,240
organisms um it was adapted

142
00:06:03,749 --> 00:06:01,440
them to high

143
00:06:05,029 --> 00:06:03,759
ph with the same efficiency of

144
00:06:07,110 --> 00:06:05,039
photosynthesis

145
00:06:08,629 --> 00:06:07,120
what means that they are very unique

146
00:06:11,110 --> 00:06:08,639
very highly adaptable

147
00:06:12,629 --> 00:06:11,120
and with a high photosynthesis

148
00:06:16,469 --> 00:06:12,639
efficiency

149
00:06:19,510 --> 00:06:16,479
what is more algae cells are without

150
00:06:20,390 --> 00:06:19,520
cell wall still they are highly

151
00:06:23,670 --> 00:06:20,400
resistance

152
00:06:27,590 --> 00:06:23,680
against of their different harsh

153
00:06:34,550 --> 00:06:30,710
in preliminary data we would like to pre

154
00:06:36,950 --> 00:06:34,560
present um the sounds of synergism

155
00:06:39,350 --> 00:06:36,960
but in the experiment we were tested

156
00:06:42,309 --> 00:06:39,360
also green algae coco mixer

157
00:06:43,749 --> 00:06:42,319
but this algae has not so efficient

158
00:06:47,110 --> 00:06:43,759
photosynthesis

159
00:06:50,230 --> 00:06:47,120
so we reject this

160
00:06:53,749 --> 00:06:50,240
strain before

161
00:06:56,390 --> 00:06:53,759
experiment culture were transferred to a

162
00:06:58,390 --> 00:06:56,400
right experimental cultural flask made

163
00:07:02,790 --> 00:06:58,400

of a polystyrene

164
00:07:05,350 --> 00:07:02,800
with liquid media conditions

165
00:07:07,510 --> 00:07:05,360
and then transported immediately to

166
00:07:09,670 --> 00:07:07,520
institute of nuclear chemistry and

167
00:07:12,070 --> 00:07:09,680
technology in warsaw

168
00:07:13,909 --> 00:07:12,080
one place were unpacked and put in

169
00:07:15,830 --> 00:07:13,919
optimal growth conditions

170
00:07:18,070 --> 00:07:15,840
with light and temperature for

171
00:07:21,909 --> 00:07:18,080
activating the photosynthesis

172
00:07:24,950 --> 00:07:21,919
it was around 30 minutes

173
00:07:26,790 --> 00:07:24,960
time of exposure and given doses over

174
00:07:29,029 --> 00:07:26,800
addition in the mini grace

175
00:07:31,749 --> 00:07:29,039
were calculated on the basis of gamma

176
00:07:36,550 --> 00:07:31,759
radiation cobalt 6d source

177
00:07:40,230 --> 00:07:36,560
with power 0.2 353

178
00:07:43,430 --> 00:07:40,240
kilograms per hour with the last

179
00:07:47,070 --> 00:07:43,440
lethal dose for human 10 000 migrates

180
00:07:52,790 --> 00:07:48,390
2.29

181
00:07:56,070 --> 00:07:52,800
minutes after experiment

182
00:07:58,950 --> 00:07:56,080
axonic strain and nonoxenic strain

183
00:08:01,510 --> 00:07:58,960
were transported again at the university

184
00:08:03,670 --> 00:08:01,520
and tested every 24 hours on the

185
00:08:08,390 --> 00:08:03,680
spectroscopy uvvs

186
00:08:10,869 --> 00:08:08,400
uh in optical density 750 nanometers

187
00:08:13,749 --> 00:08:10,879
and then we can assess increase of cells

188
00:08:18,550 --> 00:08:13,759

density grafts for each strains

189
00:08:21,749 --> 00:08:18,560
were done and we can see and the growing

190
00:08:24,950 --> 00:08:21,759
of algae were increasing

191
00:08:29,029 --> 00:08:24,960
in further growth they were not affected

192
00:08:31,670 --> 00:08:29,039
by gamma radiation

193
00:08:32,550 --> 00:08:31,680
ionizing radiation can be destructive to

194
00:08:35,509 --> 00:08:32,560
cells

195
00:08:37,269 --> 00:08:35,519
so in specific conditions such a space

196
00:08:39,670 --> 00:08:37,279
they need to be prevented

197
00:08:40,790 --> 00:08:39,680
from the exterior factors by protective

198
00:08:42,870 --> 00:08:40,800
coatings

199
00:08:43,909 --> 00:08:42,880
gels and hydrogels are one of the

200
00:08:46,470 --> 00:08:43,919
solutions

201
00:08:47,430 --> 00:08:46,480
for growing and storing cells in a safe

202
00:08:50,230 --> 00:08:47,440
manner

203
00:08:51,110 --> 00:08:50,240
but the tips present in these structures

204
00:08:53,590 --> 00:08:51,120
ensure that

205
00:08:54,630 --> 00:08:53,600
cells can grow and proliferate but they

206
00:08:57,350 --> 00:08:54,640
can also provide

207
00:08:58,389 --> 00:08:57,360
protection against accelerated atoms or

208
00:09:01,750 --> 00:08:58,399
particles from

209
00:09:04,710 --> 00:09:01,760
radiation reducing their energy

210
00:09:06,550 --> 00:09:04,720
one such adjective could be silica for

211
00:09:08,710 --> 00:09:06,560
example which has been

212
00:09:11,110 --> 00:09:08,720
investigated by many scientists to

213
00:09:13,750 --> 00:09:11,120

reduce the impact of radiation

214
00:09:15,590 --> 00:09:13,760
many researchers are also interested in

215
00:09:17,750 --> 00:09:15,600
hydrogel composites

216
00:09:18,790 --> 00:09:17,760
as potential radiation productive

217
00:09:21,670 --> 00:09:18,800
coating

218
00:09:22,550 --> 00:09:21,680
this material is lighter than metals and

219
00:09:25,269 --> 00:09:22,560
contains

220
00:09:26,070 --> 00:09:25,279
water in its structure providing not

221
00:09:29,110 --> 00:09:26,080
only a soft

222
00:09:32,310 --> 00:09:29,120
protective material for immobilized

223
00:09:36,350 --> 00:09:32,320
cells but also an etl environment

224
00:09:39,509 --> 00:09:36,360
for their further cultivation

225
00:09:41,350 --> 00:09:39,519
immobilization of cells can be realized

226
00:09:44,630 --> 00:09:41,360
in several ways

227
00:09:45,110 --> 00:09:44,640
one of them is the creation of silicate

228
00:09:52,630 --> 00:09:45,120
gels

229
00:09:55,590 --> 00:09:52,640
facility the silicate contained in the

230
00:09:56,870 --> 00:09:55,600
gel can protect the cells from the

231
00:10:00,550 --> 00:09:56,880
destructive impact

232
00:10:04,310 --> 00:10:00,560
of ionizing radiation and overalls

233
00:10:05,990 --> 00:10:04,320
additionally provides mechanisms we call

234
00:10:09,190 --> 00:10:06,000
protection against cell

235
00:10:11,910 --> 00:10:09,200
damage and the second method involves

236
00:10:13,509 --> 00:10:11,920
blending cells with an alginate solution

237
00:10:17,030 --> 00:10:13,519
then cross-linking

238
00:10:20,150 --> 00:10:17,040

it in a calcium carbonate solution

239
00:10:20,790 --> 00:10:20,160
in this way we are able to provide each

240
00:10:23,829 --> 00:10:20,800
cell

241
00:10:26,230 --> 00:10:23,839
with a protective alginate coating which

242
00:10:28,710 --> 00:10:26,240
acquires its mechanical properties

243
00:10:31,750 --> 00:10:28,720
during the cross-linking process

244
00:10:35,350 --> 00:10:31,760
both methods allow the cells

245
00:10:35,750 --> 00:10:35,360
to grow and proliferate safely providing

246
00:10:38,389 --> 00:10:35,760
them

247
00:10:39,269 --> 00:10:38,399
with the necessary components for

248
00:10:41,509 --> 00:10:39,279
survival

249
00:10:42,310 --> 00:10:41,519
and at the same time removing the

250
00:10:45,350 --> 00:10:42,320
metabolic

251
00:10:49,990 --> 00:10:47,750
for improved life support systems for

252
00:10:53,030 --> 00:10:50,000
astronauts we propose methods

253
00:10:55,269 --> 00:10:53,040
with unique composition of hydrogel and

254
00:10:57,110 --> 00:10:55,279
substances which can protect algae

255
00:10:59,190 --> 00:10:57,120
against ionizing radiation

256
00:11:00,230 --> 00:10:59,200
and make them more efficient in auto

257
00:11:03,430 --> 00:11:00,240
production

258
00:11:06,550 --> 00:11:03,440
by using the 3d bio printer we can adapt

259
00:11:09,750 --> 00:11:06,560
hydrogel to different type of equipment

260
00:11:13,190 --> 00:11:09,760
and immobilized algae in very simple way

261
00:11:16,710 --> 00:11:13,200
as you can see on the picture we

262
00:11:19,750 --> 00:11:16,720
immobilized algae into specific

263
00:11:21,990 --> 00:11:19,760

hydrogel a further study

264
00:11:23,030 --> 00:11:22,000
are also connected to regeneration of

265
00:11:25,509 --> 00:11:23,040
body tissue

266
00:11:26,630 --> 00:11:25,519
by using secondary metabolites

267
00:11:30,550 --> 00:11:26,640
encapsulated

268
00:11:36,949 --> 00:11:33,910
our algae has the possibilities

269
00:11:37,750 --> 00:11:36,959
also to create a biofilm on different

270
00:11:41,030 --> 00:11:37,760
structures

271
00:11:44,710 --> 00:11:41,040
like for example cellulose so it is also

272
00:11:49,350 --> 00:11:44,720
important if we would like to use um

273
00:11:52,069 --> 00:11:49,360
other type of materials to cover them by

274
00:11:53,110 --> 00:11:52,079
algae and still we are looking for

275
00:11:57,190 --> 00:11:53,120
collaborations