



1
00:00:01,233 --> 00:00:05,233
[musical tones]
[electric sounds of data]

2
00:00:16,733 --> 00:00:22,066
Welcome to the 2015
NASA Ames Summer Series.

3
00:00:22,066 --> 00:00:25,633
Throughout history,
we have looked around us,

4
00:00:25,633 --> 00:00:28,900
both here on Earth
and out in the universe,

5
00:00:28,900 --> 00:00:32,366
to start understanding
where we are,

6
00:00:32,366 --> 00:00:35,900
where we came from,
and where we're going.

7
00:00:35,900 --> 00:00:37,733
The more we have explored,

8
00:00:37,733 --> 00:00:41,400
the more we have learned
about ourselves.

9
00:00:41,400 --> 00:00:42,900
Today's seminar,

10
00:00:42,900 --> 00:00:47,000
entitled "A Cosmic End:
From the Earth to the Universe,"

11
00:00:47,000 --> 00:00:52,433

will be presented
by Father Dr. José Funes.

12
00:00:52,433 --> 00:00:56,333
He is the Director
of the Vatican Observatory

13
00:00:56,333 --> 00:00:59,733
and received degrees--

14
00:00:59,733 --> 00:01:01,733
both a bachelor's degree
in philosophy

15
00:01:01,733 --> 00:01:05,900
from the University
of Del Salvador in Argentina,

16
00:01:05,900 --> 00:01:08,566
followed by a bachelor's degree
in theology

17
00:01:08,566 --> 00:01:11,400
from the
Pontifical Gregorian University

18
00:01:11,400 --> 00:01:13,433
in Rome.

19
00:01:13,433 --> 00:01:17,566
He has also received degrees--
a master's degree in astronomy

20
00:01:17,566 --> 00:01:21,233
from the
Universidad Nacional de Córdoba

21
00:01:21,233 --> 00:01:22,733
in Argentina

22

00:01:22,733 --> 00:01:25,233

and a doctorate

from the University of Padua

23

00:01:25,233 --> 00:01:27,433

in Italy.

24

00:01:27,433 --> 00:01:31,633

He joined

the Vatican Observatory in 2000

25

00:01:31,633 --> 00:01:33,400

and, in 2006,

26

00:01:33,400 --> 00:01:36,666

became the director

of the Observatory.

27

00:01:43,066 --> 00:01:47,233

He has led, conducted,

and worked

28

00:01:47,233 --> 00:01:50,400

with numerous conferences

29

00:01:50,400 --> 00:01:52,633

and research meetings.

30

00:01:52,633 --> 00:01:57,066

He has many

scientific publications

31

00:01:57,066 --> 00:02:00,566

and is continuously working

both on research

32

00:02:00,566 --> 00:02:03,666

and leading

the Vatican Observatory.

33

00:02:03,666 --> 00:02:07,800

Please join me in welcoming
Father Dr. José Funes.

34

00:02:07,800 --> 00:02:10,800

[applause]

35

00:02:18,500 --> 00:02:20,566

Good morning, everyone.

36

00:02:20,566 --> 00:02:25,233

Thank you, Dr. Cohen,
for this very nice presentation,

37

00:02:25,233 --> 00:02:28,766

and thank you for inviting me
to be here.

38

00:02:28,766 --> 00:02:31,866

It's a real pleasure
to be with you this morning

39

00:02:31,866 --> 00:02:34,900

and I also would like
to thank Monica Ebert

40

00:02:34,900 --> 00:02:38,866

for arranging all the details
for the talk.

41

00:02:38,866 --> 00:02:41,066

First of all,

42

00:02:41,066 --> 00:02:44,700

I would like
to tell you one thing

43

00:02:44,700 --> 00:02:46,133

before telling a story.

44

00:02:46,133 --> 00:02:48,433

You already realize that.

45

00:02:48,433 --> 00:02:50,933

This is what I used
to tell my students

46

00:02:50,933 --> 00:02:52,733

when I used to teach

47

00:02:52,733 --> 00:02:54,733

an introductory course
in astronomy

48

00:02:54,733 --> 00:02:57,033

at the University of Arizona.

49

00:02:57,033 --> 00:03:02,733

The greatest challenge
you will face in my class,

50

00:03:02,733 --> 00:03:05,700

it is not math, not physics.

51

00:03:05,700 --> 00:03:07,266

It is my accent.

52

00:03:07,266 --> 00:03:09,133

- So...

[laughter]

53

00:03:09,133 --> 00:03:12,566

I have a strong
Spanish, Argentinean accent.

54

00:03:12,566 --> 00:03:14,600

I will try to do my best.

55

00:03:14,600 --> 00:03:17,466

So, eh...

56

00:03:17,466 --> 00:03:20,766

But this is what is important,
I wanted to say.

57

00:03:20,766 --> 00:03:25,133

When I was a kid,
about 12 years old

58

00:03:25,133 --> 00:03:28,000

in Argentina, in Córdoba--

59

00:03:28,000 --> 00:03:29,766

That's the time
when kids start to think

60

00:03:29,766 --> 00:03:34,766

about becoming astronomer,
ecologist, geologist, etcetera.

61

00:03:34,766 --> 00:03:38,633

So I was inspired by NASA.

62

00:03:38,633 --> 00:03:42,666

It was the golden age
of the exploration of space,

63

00:03:42,666 --> 00:03:45,466

and a classmate
passed to me a list

64

00:03:45,466 --> 00:03:48,866

with the addresses
of all NASA centers.

65

00:03:48,866 --> 00:03:52,733

So, with my very rough English,

66

00:03:52,733 --> 00:03:54,833

I haven't made
much progress,

67

00:03:54,833 --> 00:03:58,066

but I wrote the letter,

68

00:03:58,066 --> 00:04:01,066

and I asked my father
to type that letter,

69

00:04:01,066 --> 00:04:04,400

and I sent it
to one of the NASA centers

70

00:04:04,400 --> 00:04:06,033

asking for material.

71

00:04:06,033 --> 00:04:11,200

So they send me materials
about the Apollo mission...

72

00:04:11,200 --> 00:04:14,233

other NASA missions,

73

00:04:14,233 --> 00:04:15,400

and at the end, it says,

74

00:04:15,400 --> 00:04:17,133

"If you want to receive
more material,

75

00:04:17,133 --> 00:04:21,600

send this money
to this address."

76

00:04:21,600 --> 00:04:24,400

We were poor in Argentina.
I still--We are poor.

77

00:04:24,400 --> 00:04:28,066

So I didn't have the money,
the dollars to send it to NASA,

78

00:04:28,066 --> 00:04:30,566

so I try a different center--
NASA center.

79

00:04:30,566 --> 00:04:31,933

[laughter]

80

00:04:31,933 --> 00:04:35,033

You know, when you don't have
many resources,

81

00:04:35,033 --> 00:04:36,400

you have to be creative,

82

00:04:36,400 --> 00:04:40,900

So, at the end, I got a lot
of material from NASA,

83

00:04:40,900 --> 00:04:45,233

and I remember always looking
forward

84

00:04:45,233 --> 00:04:50,066

the postman to bring the mail
to my house,

85

00:04:50,066 --> 00:04:54,833

and I remember these
brown packages coming from NASA.

86

00:04:54,833 --> 00:05:00,433

So I am inspired
by your work, and I hope--

87

00:05:00,433 --> 00:05:03,633
this is my wish for NASA
and people working at NASA--

88

00:05:03,633 --> 00:05:08,366
that you continue
to inspire next generations.

89

00:05:08,366 --> 00:05:12,733
So, eh, let's see
what inspire me

90

00:05:12,733 --> 00:05:15,300
for this talk.

91

00:05:15,300 --> 00:05:18,700
As the Director
of the Vatican Observatory,

92

00:05:18,700 --> 00:05:21,400
I'm a member of the
Pontifical Academy of Sciences,

93

00:05:21,400 --> 00:05:24,666
and, more or less,
I presented this talk

94

00:05:24,666 --> 00:05:26,733
in that meeting,

95

00:05:26,733 --> 00:05:28,400
and there was something

96

00:05:28,400 --> 00:05:31,066
that caught my attention
in the booklet,

97

00:05:31,066 --> 00:05:33,100

and it said,
"Human curiosity

98
00:05:33,100 --> 00:05:36,766
is the driving force
for scientific development

99
00:05:36,766 --> 00:05:39,166
in which belief systems
and philosophies

100
00:05:39,166 --> 00:05:41,000
still have their valid place."

101
00:05:41,000 --> 00:05:43,000
So curiosity
is the driving force

102
00:05:43,000 --> 00:05:47,233
for our research for this talk
and also for curiosity.

103
00:05:47,233 --> 00:05:50,400
I couldn't--
not thinking curiosity.

104
00:05:50,400 --> 00:05:52,733
And, of course,
this is a selfie.

105
00:05:52,733 --> 00:05:56,566
[laughter]

106
00:05:56,566 --> 00:06:01,566
Also in the address
Pope Francis gave

107
00:06:01,566 --> 00:06:04,400
to the academicians,
he said,

108

00:06:04,400 --> 00:06:05,566

"To the scientist,

109

00:06:05,566 --> 00:06:08,233

and especially

to the Christian scientist,

110

00:06:08,233 --> 00:06:11,566

corresponds the attitude

to examine the future

111

00:06:11,566 --> 00:06:13,833

of humanity and the Earth."

112

00:06:13,833 --> 00:06:16,366

And I would add,

"And the universe."

113

00:06:16,366 --> 00:06:20,333

And we have seen these days

this concern of the Pope

114

00:06:20,333 --> 00:06:23,833

for the future of the Earth

with the recent document--

115

00:06:23,833 --> 00:06:26,766

papal document, the encyclical.

116

00:06:26,766 --> 00:06:29,666

So, before entering

into this subject,

117

00:06:29,666 --> 00:06:33,566

I would like to, if I can,

118

00:06:33,566 --> 00:06:36,133

the \$1 million answer--

119

00:06:36,133 --> 00:06:38,400

question, sorry.

This is...

120

00:06:38,400 --> 00:06:40,700

You can give me later

one dollar million, too,

121

00:06:40,700 --> 00:06:42,000

for the answer.

122

00:06:42,000 --> 00:06:45,166

So why the Vatican

is interested in astronomy?

123

00:06:45,166 --> 00:06:47,533

And the short answer

is, "Who knows?"

124

00:06:47,533 --> 00:06:49,666

[laughter]

125

00:06:49,666 --> 00:06:51,566

But I need to tell you a story.

126

00:06:51,566 --> 00:06:54,900

Otherwise it's difficult

to explain why the Vatican

127

00:06:54,900 --> 00:06:57,233

is interested in astronomy.

128

00:07:00,233 --> 00:07:04,400

Here we have these Popes.

129

00:07:04,400 --> 00:07:09,133

This is Pope Gregory XIII,

who reformed the calendar

130
00:07:09,133 --> 00:07:11,766
that we use today.

131
00:07:11,766 --> 00:07:16,400
This is Pope Leo XIII,

132
00:07:16,400 --> 00:07:19,066
who, in 1891,

133
00:07:19,066 --> 00:07:23,033
founded
the Vatican Observatory.

134
00:07:23,033 --> 00:07:25,733
This is Pope Pius XI.

135
00:07:25,733 --> 00:07:27,700
With him,
the Observatory moved

136
00:07:27,700 --> 00:07:30,933
from the Vatican
to Castel Gandolfo.

137
00:07:30,933 --> 00:07:35,966
This is the papal residence
for the summer.

138
00:07:35,966 --> 00:07:40,066
In 2009, we move...

139
00:07:40,066 --> 00:07:43,200
from the Palace of the Pope.

140
00:07:43,200 --> 00:07:44,733
That used to be my office.
[chuckles]

141

00:07:44,733 --> 00:07:46,233

- It was very nice.

[laughter]

142

00:07:46,233 --> 00:07:50,633

We had a wonderful residence,
now our headquarters.

143

00:07:50,633 --> 00:07:52,800

Here it is.

You see the gardens.

144

00:07:52,800 --> 00:07:56,400

And because the history
of the Vatican Observatory

145

00:07:56,400 --> 00:07:58,800

is similar to the history
of other observatories

146

00:07:58,800 --> 00:08:00,233

around the world,

147

00:08:00,233 --> 00:08:04,400

we escaped to Arizona
looking for dark skies.

148

00:08:04,400 --> 00:08:06,933

So, in the '80s,
the Vatican--

149

00:08:06,933 --> 00:08:09,266

a group of Jesuits
from the Vatican Observatory

150

00:08:09,266 --> 00:08:10,566

arrived in Tucson,

151

00:08:10,566 --> 00:08:12,566

and we have
a very good collaboration

152
00:08:12,566 --> 00:08:13,766
with the University of Arizona.

153
00:08:13,766 --> 00:08:15,500
This is
the Department of Astronomy,

154
00:08:15,500 --> 00:08:16,900
Steward Observatory.

155
00:08:16,900 --> 00:08:20,400
And this is
the Vatican Telescope

156
00:08:20,400 --> 00:08:23,400
on Mount Graham.

157
00:08:23,400 --> 00:08:27,400
This is Pope Benedict

158
00:08:27,400 --> 00:08:31,233
holding a meteorite
from Mars...

159
00:08:31,233 --> 00:08:36,566
and the "L'Osservatore Romano,"
the Vatican newspaper,

160
00:08:36,566 --> 00:08:38,833
published this picture

161
00:08:38,833 --> 00:08:42,100
on the first page
of the newspaper

162
00:08:42,100 --> 00:08:43,466

with this headline--

163

00:08:43,466 --> 00:08:45,900

"Mars in the hands of the Pope."

164

00:08:45,900 --> 00:08:49,300

[laughter]

165

00:08:49,300 --> 00:08:54,400

This is my desk, the desk
of the Director, and here it is.

166

00:08:54,400 --> 00:08:57,233

Pope Benedict sign,

167

00:08:57,233 --> 00:09:00,733

and I explain to him
that here...

168

00:09:00,733 --> 00:09:03,233

there is the signatures--

169

00:09:03,233 --> 00:09:04,933

maybe this is
a unique document--

170

00:09:04,933 --> 00:09:09,900

the signatures
of all popes since Pius XI

171

00:09:09,900 --> 00:09:11,900

to John Paul II,

172

00:09:11,900 --> 00:09:14,733

and I am telling him
that with his signature

173

00:09:14,733 --> 00:09:17,400

and with the blessing

of the new facilities,

174

00:09:17,400 --> 00:09:19,233
the Vatican Observatory

175

00:09:19,233 --> 00:09:22,900
is starting a new stage

176

00:09:22,900 --> 00:09:26,200
in the history
of the Observatory.

177

00:09:26,200 --> 00:09:27,900
Just a clarification--

178

00:09:27,900 --> 00:09:30,300
this is not a Vatican check.

179

00:09:30,300 --> 00:09:35,566
I'm not asking the Pope
to sign a check for me.

180

00:09:35,566 --> 00:09:38,833
So this is our place.
As you see, it's very nice.

181

00:09:38,833 --> 00:09:41,233
The Jesuits used to say...

182

00:09:41,233 --> 00:09:44,833
[speaking Latin]

183

00:09:44,833 --> 00:09:47,300
"If you have a garden
with a library,

184

00:09:47,300 --> 00:09:49,400
there is nothing you will lack."

185

00:09:49,400 --> 00:09:51,733

So we have a wonderful garden

186

00:09:51,733 --> 00:09:56,133

and a wonderful library
with antique books too.

187

00:09:56,133 --> 00:09:59,933

So, as Pope Benedict said
to the participants

188

00:09:59,933 --> 00:10:01,566

of a colloquium
we organized

189

00:10:01,566 --> 00:10:03,733

for the
International Year of Astronomy,

190

00:10:03,733 --> 00:10:05,100

he said that,

191

00:10:05,100 --> 00:10:07,300

"As you know,
the history of the Observatory

192

00:10:07,300 --> 00:10:12,733

is in a very real way linked
to the figure of Galileo,

193

00:10:12,733 --> 00:10:15,100

the controversies
which surrounded his research,

194

00:10:15,100 --> 00:10:17,933

and the Church's attempt
to attain a correct

195

00:10:17,933 --> 00:10:20,600

and fruitful understanding
of the relationship

196

00:10:20,600 --> 00:10:23,666
between science and religion."

197

00:10:23,666 --> 00:10:27,533
In few words,
Thanks to Galileo, I'm here,

198

00:10:27,533 --> 00:10:31,066
and thanks to Galileo,
the Vatican Observatory

199

00:10:31,066 --> 00:10:36,233
contributes a little bit
to the research in the world.

200

00:10:36,233 --> 00:10:38,866
Among our precious things,
our little treasure,

201

00:10:38,866 --> 00:10:43,533
we have this astrolabe
from the 16th century,

202

00:10:43,533 --> 00:10:45,733
and we have also--

203

00:10:45,733 --> 00:10:49,300
This is one example
of the antique books.

204

00:10:49,300 --> 00:10:52,066
This is from Father--

205

00:10:52,066 --> 00:10:55,566
He was a Jesuit--
Giovanni Battista Riccioli.

206
00:10:57,166 --> 00:10:59,566
This book is from 1651,

207
00:10:59,566 --> 00:11:05,433
and you see two systems
are weighted.

208
00:11:05,433 --> 00:11:10,133
This is the Copernican System
and the Tycho Brahe System,

209
00:11:10,133 --> 00:11:13,533
and the pictures show
at the time for the Jesuits,

210
00:11:13,533 --> 00:11:18,266
at least for this Jesuit,
the Tycho Brahe was heavier.

211
00:11:18,266 --> 00:11:21,400
It had better foundation.

212
00:11:21,400 --> 00:11:23,633
Just a curiosity.

213
00:11:25,266 --> 00:11:29,066
What is our mission?

214
00:11:29,066 --> 00:11:30,233
As our colleagues,

215
00:11:30,233 --> 00:11:32,600
our deepest desire
is to be on the frontier

216
00:11:32,600 --> 00:11:34,733
of astronomical research,

217

00:11:34,733 --> 00:11:38,333
and we try to address
these questions as you do too.

218

00:11:38,333 --> 00:11:41,600
Are we alone in the universe?
Are there other Earths?

219

00:11:41,600 --> 00:11:45,166
How do stars and planets
form and evolve?

220

00:11:45,166 --> 00:11:46,700
How do galaxies
form and evolve?

221

00:11:46,700 --> 00:11:50,266
What is dark matter
and dark energy?

222

00:11:50,266 --> 00:11:52,333
What do we know
about the universe

223

00:11:52,333 --> 00:11:53,966
in its first instants?

224

00:11:53,966 --> 00:11:56,266
Are there many universes?

225

00:11:56,266 --> 00:11:58,766
So these are
some of the questions

226

00:11:58,766 --> 00:12:00,533
that, uh, inspires us.

227

00:12:01,900 --> 00:12:05,266
We also have a lab
of meteorites.

228

00:12:05,266 --> 00:12:07,900

We have about 1,000 pieces,

229

00:12:07,900 --> 00:12:11,566

and this is

the Martian meteorite

230

00:12:11,566 --> 00:12:16,066

that the Pope was holding

in his hands.

231

00:12:17,300 --> 00:12:18,933

There is also in the Vatican,

232

00:12:18,933 --> 00:12:21,166

the Pontifical Academy

of Sciences.

233

00:12:21,166 --> 00:12:24,966

And in 2009,

we organized a meeting

234

00:12:24,966 --> 00:12:27,900

on astrobiology

that had a good impact.

235

00:12:30,733 --> 00:12:32,233

This is--

236

00:12:32,233 --> 00:12:35,733

I like very much this quotation.

I'm not going to read it all,

237

00:12:35,733 --> 00:12:38,933

but Cardinal Lajolo--

238

00:12:38,933 --> 00:12:41,133

he was the head

of the Vatican estate

239

00:12:41,133 --> 00:12:42,233
at the time.

240

00:12:42,233 --> 00:12:45,400
He said that
about astrobiology...

241

00:12:47,366 --> 00:12:52,800
He discussed
the task of searching life

242

00:12:52,800 --> 00:12:56,833
and intelligent life
"demands scientific integrity

243

00:12:56,833 --> 00:12:59,833
and an intense
and indispensable case

244

00:12:59,833 --> 00:13:03,733
of a vast multi-disciplinary
research."

245

00:13:03,733 --> 00:13:05,700
For those of you,
you know better than me

246

00:13:05,700 --> 00:13:09,733
that astrobiology requires

247

00:13:09,733 --> 00:13:11,433
to be an expert in many fields,

248

00:13:11,433 --> 00:13:15,466
which is something
that is very difficult.

249

00:13:15,466 --> 00:13:16,966
He continues.

250
00:13:16,966 --> 00:13:19,766
"In research, the scientist
must also be allowed

251
00:13:19,766 --> 00:13:22,066
the possibility
to walk paths

252
00:13:22,066 --> 00:13:26,200
which do not always lead
to the positive results."

253
00:13:26,200 --> 00:13:30,133
Sometimes our research...

254
00:13:30,133 --> 00:13:32,566
we don't arrive to results,

255
00:13:32,566 --> 00:13:37,066
and the community,
our countries,

256
00:13:37,066 --> 00:13:41,900
should allow us the possibility
even to fail

257
00:13:41,900 --> 00:13:44,733
in our research in our projects.

258
00:13:45,800 --> 00:13:50,766
Not always
we may have a result.

259
00:13:50,766 --> 00:13:54,566
I remember when I was doing
my PhD in astronomy in Padua,

260
00:13:54,566 --> 00:13:56,166
in my community.

261
00:13:56,166 --> 00:13:59,133
I was living
with other Jesuits.

262
00:13:59,133 --> 00:14:02,900
I was the only astronomer,
the only one doing research,

263
00:14:02,900 --> 00:14:06,566
and almost every day,
they would ask me,

264
00:14:06,566 --> 00:14:08,666
"What did you discover today?"

265
00:14:08,666 --> 00:14:12,400
And it's not always easy
to answer that question.

266
00:14:14,233 --> 00:14:17,966
This meeting had
a lot of impact

267
00:14:17,966 --> 00:14:20,566
in the media at the time.

268
00:14:22,666 --> 00:14:24,566
You'll see
the "Washington Post," "Time,"

269
00:14:24,566 --> 00:14:28,333
ABC News, "USA Today"...

270
00:14:28,333 --> 00:14:32,400
"E.T. Phone Rome: Vatican Looks
for Signs of Alien Life."

271

00:14:32,400 --> 00:14:35,400

What is important

272

00:14:35,400 --> 00:14:38,166

beyond these, um...

273

00:14:38,166 --> 00:14:42,366

headlines is that the Vatican

274

00:14:42,366 --> 00:14:45,566

is encouraging

275

00:14:45,566 --> 00:14:47,400

cutting-edge research,

276

00:14:47,400 --> 00:14:49,900

because astrobiology,

277

00:14:49,900 --> 00:14:51,933

already we have that discipline

278

00:14:51,933 --> 00:14:55,500

for 20 years or so.

279

00:14:55,500 --> 00:14:57,566

It's an important science,

280

00:14:57,566 --> 00:14:59,333

an important research,

281

00:14:59,333 --> 00:15:01,233

and the Vatican organizing

282

00:15:01,233 --> 00:15:03,200

and hosting

this kind of meeting

283

00:15:03,200 --> 00:15:06,900

is considering this
an important part of science.

284

00:15:08,333 --> 00:15:10,666

One important--
very important activity

285

00:15:10,666 --> 00:15:12,500

we have
at the Vatican Observatory

286

00:15:12,500 --> 00:15:15,266

are our Summer Schools.

287

00:15:15,266 --> 00:15:18,400

We have--Every two years,
grad students come in

288

00:15:18,400 --> 00:15:20,500

from all over the world,
literally.

289

00:15:20,500 --> 00:15:22,933

In the last Summer School,
we have 25 students

290

00:15:22,933 --> 00:15:24,566

from 22 countries.

291

00:15:24,566 --> 00:15:26,900

There you see
the audience we had

292

00:15:26,900 --> 00:15:28,933

with Pope Benedict.

293

00:15:28,933 --> 00:15:32,700

And the next Summer School

will be next year

294

00:15:32,700 --> 00:15:35,533
on water in the solar system
and beyond.

295

00:15:35,533 --> 00:15:38,433
So, if you're a student
or you know students,

296

00:15:38,433 --> 00:15:41,733
of course, encourage them
to apply for the school.

297

00:15:41,733 --> 00:15:44,166
It's a great experience.

298

00:15:44,166 --> 00:15:48,166
With John Paul II,
the Observatory

299

00:15:48,166 --> 00:15:51,300
had a great influence
in studies

300

00:15:51,300 --> 00:15:54,200
that not only involved science,
but also philosophy

301

00:15:54,200 --> 00:15:57,166
and theology.

302

00:15:57,166 --> 00:16:01,666
So let's go to the talk,
and let's...

303

00:16:01,666 --> 00:16:05,900
The universe--
Let's quote the universe.

304

00:16:05,900 --> 00:16:08,800

"In the beginning
is my end."

305

00:16:08,800 --> 00:16:11,400

In fact, it's not
the universe.

306

00:16:11,400 --> 00:16:15,433

It is T.S. Eliot.

307

00:16:15,433 --> 00:16:18,133

Or better,
is the universe talking

308

00:16:18,133 --> 00:16:22,066

through T.S. Eliot?

309

00:16:22,066 --> 00:16:24,933

In the initial conditions
of the universe,

310

00:16:24,933 --> 00:16:29,900

there somehow
is determined the end.

311

00:16:32,066 --> 00:16:35,133

So these are the questions
that humanity

312

00:16:35,133 --> 00:16:39,033

has posed along centuries.

313

00:16:39,033 --> 00:16:41,733

Where are we?
Where did we come from?

314

00:16:41,733 --> 00:16:44,800

Where are we going?

315

00:16:44,800 --> 00:16:48,500

And, fortunately,
scientists are not the only ones

316

00:16:48,500 --> 00:16:51,066

to raise those questions.

317

00:16:51,066 --> 00:16:54,833

This is--I'm not an expert
in arts and fine arts,

318

00:16:54,833 --> 00:16:58,166

but this is a painting
by Paul Gauguin

319

00:16:58,166 --> 00:17:00,233

and with this title--

320

00:17:00,233 --> 00:17:03,200

"Where are we?

Where did we come from?

321

00:17:03,200 --> 00:17:05,233

Where are we going?"

322

00:17:05,233 --> 00:17:09,500

So there are different
approaches to the beginning

323

00:17:09,500 --> 00:17:11,566

and to the end
of the universe.

324

00:17:11,566 --> 00:17:14,000

Science is just one of them.

325

00:17:16,333 --> 00:17:19,500

So, as scientists,

our starting point

326

00:17:19,500 --> 00:17:21,833
is the observed universe.

327

00:17:21,833 --> 00:17:25,033
We can only think the past
and the future of the universe

328

00:17:25,033 --> 00:17:27,300
from its present
and from the data

329

00:17:27,300 --> 00:17:30,633
we have collected
and interpreted.

330

00:17:30,633 --> 00:17:34,333
We test our ideas
with a reality check.

331

00:17:34,333 --> 00:17:38,000
I won't discuss
in this presentation

332

00:17:38,000 --> 00:17:42,100
any biological evolution
or technical development

333

00:17:42,100 --> 00:17:46,066
because it
exceeds my knowledge.

334

00:17:47,866 --> 00:17:51,400
So I would like to say that...

335

00:17:51,400 --> 00:17:54,633
we are a species
with long eyes,

336

00:17:54,633 --> 00:17:58,900
and Galileo Galilei
is our forefather.

337

00:18:02,666 --> 00:18:07,066
We use telescopes
to reach where our eyes...

338

00:18:09,200 --> 00:18:11,900
Do not allow us to see.

339

00:18:13,900 --> 00:18:17,600
In Arizona,
you, of course, know Kitt Peak,

340

00:18:17,600 --> 00:18:19,300
the National Observatory.

341

00:18:19,300 --> 00:18:22,433
There was a treaty
between the U.S. Government

342

00:18:22,433 --> 00:18:25,866
and Tohono O'odham tribe,

343

00:18:25,866 --> 00:18:29,066
and the Tohono O'odham tribe--

344

00:18:29,066 --> 00:18:31,066
they don't have a word
for "astronomers."

345

00:18:31,066 --> 00:18:33,866
So they use these words--

346

00:18:33,866 --> 00:18:36,866
"the people with long eyes."

347

00:18:36,866 --> 00:18:39,566

We are people
with long eyes,

348

00:18:39,566 --> 00:18:43,466

and telescopes are part,
somehow, of ourselves.

349

00:18:43,466 --> 00:18:48,733

And with the data that
we collect from the telescope,

350

00:18:48,733 --> 00:18:51,400

we can try to understand
the beginning

351

00:18:51,400 --> 00:18:53,700

and the end of the universe.

352

00:18:53,700 --> 00:18:58,300

So what we know
is that, um...

353

00:18:58,300 --> 00:19:00,900

there is experimental data
confirming the Big Bang.

354

00:19:00,900 --> 00:19:05,766

Briefly, we know
the expansion of the universe,

355

00:19:05,766 --> 00:19:07,333

Hubble's law.

356

00:19:07,333 --> 00:19:10,566

The cosmic background radiation,

357

00:19:10,566 --> 00:19:13,733

and we know also
that the Big Bang theory

358

00:19:13,733 --> 00:19:15,066
correctly predicts

359

00:19:15,066 --> 00:19:17,233
the cosmic abundance
of hydrogen,

360

00:19:17,233 --> 00:19:20,233
helium,
and other light elements.

361

00:19:21,333 --> 00:19:23,200
We also know
that this universe

362

00:19:23,200 --> 00:19:26,500
is accelerating
in expansion

363

00:19:26,500 --> 00:19:29,933
and the Nobel Prize
was given in 2009

364

00:19:29,933 --> 00:19:33,900
for this discovery
to Saul Perlmutter,

365

00:19:33,900 --> 00:19:37,333
Brian Schmidt, and Adam Riess.

366

00:19:37,333 --> 00:19:41,400
So we know that...

367

00:19:41,400 --> 00:19:45,400
the year after
the data from Planck

368

00:19:45,400 --> 00:19:46,900

that the age of the universe

369

00:19:46,900 --> 00:19:50,900
is about 13.8 million years

370

00:19:50,900 --> 00:19:53,066
and that the universe

371

00:19:53,066 --> 00:19:56,733
is made of basically
dark matter,

372

00:19:56,733 --> 00:19:59,866
about 70%.

373

00:19:59,866 --> 00:20:03,533
But any matter, normal matter,
as you say, about 5%

374

00:20:03,533 --> 00:20:07,866
and dark energy, about 68%.

375

00:20:09,400 --> 00:20:13,166
We know that the universe
is expanding,

376

00:20:13,166 --> 00:20:17,233
and it's accelerating,

377

00:20:17,233 --> 00:20:20,100
and if we know

378

00:20:20,100 --> 00:20:23,533
that this is the present
of the universe,

379

00:20:23,533 --> 00:20:26,033
this is what we can observe.

380

00:20:26,033 --> 00:20:28,733

There are different possibilities

381

00:20:28,733 --> 00:20:33,466

for the past and for the future of the universe.

382

00:20:33,466 --> 00:20:35,933

From the data we have collected,

383

00:20:35,933 --> 00:20:41,900

we know that we live in an accelerating universe

384

00:20:41,900 --> 00:20:45,900

and in the oldest possibility scenario

385

00:20:45,900 --> 00:20:48,633

according to the data we know.

386

00:20:50,633 --> 00:20:55,100

I like to compare the age of the universe

387

00:20:55,100 --> 00:20:59,900

with other time scales for the rest of the talk.

388

00:20:59,900 --> 00:21:06,400

So one cosmic year is equal,

389

00:21:06,400 --> 00:21:08,400

for the sake of this presentation,

390

00:21:08,400 --> 00:21:10,900
to 14 billion solar years.

391

00:21:15,133 --> 00:21:17,900
What we can say
about our future?

392

00:21:19,800 --> 00:21:23,766
Of course,
the predictions will depend

393

00:21:23,766 --> 00:21:26,566
on the time scale that we use.

394

00:21:28,500 --> 00:21:31,766
Let's talk
about a little bit of art,

395

00:21:31,766 --> 00:21:35,233
even though it's not my field.

396

00:21:35,233 --> 00:21:39,166
It is very challenging
to make any prediction

397

00:21:39,166 --> 00:21:40,700
for the future,

398

00:21:40,700 --> 00:21:43,900
and particularly
regarding to the Earth,

399

00:21:43,900 --> 00:21:46,900
there are
four geological processes

400

00:21:46,900 --> 00:21:50,433
that determine the shape
of the surface of the Earth.

401

00:21:50,433 --> 00:21:54,666

They impact the cratering,
the volcanism, tectonics,

402

00:21:54,666 --> 00:21:56,900

and erosion.

403

00:21:56,900 --> 00:21:59,900

We need also
to take into consideration--

404

00:21:59,900 --> 00:22:03,566

into account the change
in the atmosphere and the oceans

405

00:22:03,566 --> 00:22:07,233

and the dynamic evolution
of the Earth/Moon System.

406

00:22:07,233 --> 00:22:10,066

So things are very complex.

407

00:22:11,466 --> 00:22:16,900

Just in one slide,
I am resuming, hopefully,

408

00:22:16,900 --> 00:22:21,066

about 14 billion years
of story or more

409

00:22:21,066 --> 00:22:23,233

in 50 minutes.

410

00:22:23,233 --> 00:22:26,566

So you will forgive me
if I miss something

411

00:22:26,566 --> 00:22:29,400

or I don't give enough details,

412

00:22:29,400 --> 00:22:32,366

but sometimes it's good
to have a whole picture,

413

00:22:32,366 --> 00:22:33,900

a big picture.

414

00:22:33,900 --> 00:22:35,600

The image of the Earth
in 3 billion years,

415

00:22:35,600 --> 00:22:40,566

about 0.2 cosmic years,
is of a declining world.

416

00:22:40,566 --> 00:22:44,400

In 8 billion years,
0.6 cosmic years,

417

00:22:44,400 --> 00:22:46,566

the Sun will become
a red giant,

418

00:22:46,566 --> 00:22:48,766

expanding to the present orbit
of the Earth.

419

00:22:48,766 --> 00:22:52,066

The Sun will span--

420

00:22:52,066 --> 00:22:54,733

that expands will expel
a considerable part

421

00:22:54,733 --> 00:22:56,966

of its mass into space,

422

00:22:56,966 --> 00:22:59,633

and when the Sun expands
to the current orbit

423

00:22:59,633 --> 00:23:01,733
of the Earth,

424

00:23:01,733 --> 00:23:04,166
the Earth itself
will have moved

425

00:23:04,166 --> 00:23:06,366
to almost twice
its current distance

426

00:23:06,366 --> 00:23:08,233
from the Sun.

427

00:23:10,300 --> 00:23:12,866
Another thing that we need
to take into account

428

00:23:12,866 --> 00:23:16,033
is the threat
of near-Earth objects

429

00:23:16,033 --> 00:23:18,366
that might hit the Earth,

430

00:23:18,366 --> 00:23:22,400
and this is just a plot

431

00:23:22,400 --> 00:23:26,900
where you have the frequency
for impacts

432

00:23:26,900 --> 00:23:30,100
and the size of the impactor.

433

00:23:30,100 --> 00:23:33,366

The craters
are ten times larger,

434
00:23:33,366 --> 00:23:38,233
and you see how often
we may get these events

435
00:23:38,233 --> 00:23:39,900
on Earth.

436
00:23:42,033 --> 00:23:46,733
Just a recall
of what happened recently...

437
00:23:46,733 --> 00:23:48,400
in Russia.

438
00:23:51,566 --> 00:23:54,800
We have records
that these things really happen.

439
00:23:54,800 --> 00:23:59,400
And this is a simulation
from ESA.

440
00:23:59,400 --> 00:24:02,400
For you may remember in--

441
00:24:02,400 --> 00:24:03,733
[loud bang]

442
00:24:03,733 --> 00:24:04,933
Sorry.

443
00:24:04,933 --> 00:24:07,000
[volume decreases]

444
00:24:07,000 --> 00:24:13,300
What happened

when the Levy-Shoemaker Comet,

445

00:24:13,300 --> 00:24:18,233

in different fragments,
hit Jupiter.

446

00:24:18,233 --> 00:24:20,233

So I'm sure you know--

447

00:24:20,233 --> 00:24:23,366

all these images
are very well known to you.

448

00:24:25,066 --> 00:24:30,233

So what can we say
about the solar neighborhood?

449

00:24:30,233 --> 00:24:33,533

A nearby star could pass by
about three light-years

450

00:24:33,533 --> 00:24:36,400

from the Sun.

451

00:24:36,400 --> 00:24:39,833

This event could happen
every 100,000 years.

452

00:24:39,833 --> 00:24:41,066

The Sun--

453

00:24:41,066 --> 00:24:42,766

Also, another possibility is

454

00:24:42,766 --> 00:24:46,000

that likely it's going
to encounter a molecular cloud

455

00:24:46,000 --> 00:24:49,166

maybe once or twice
in one billion years,

456

00:24:49,166 --> 00:24:53,466
and the gravitational pull
would cause a shower of comets

457

00:24:53,466 --> 00:24:55,233
that would result--

458

00:24:55,233 --> 00:24:59,700
may well increase the impact
rate for these comets.

459

00:25:03,366 --> 00:25:05,833
Supernova threat...

460

00:25:05,833 --> 00:25:09,233
We also may suffer,

461

00:25:09,233 --> 00:25:12,000
if we are still here...

462

00:25:12,000 --> 00:25:15,066
that a supernova occurs

463

00:25:15,066 --> 00:25:19,866
within 100, 200 light-years
from the Sun

464

00:25:19,866 --> 00:25:24,033
every 100 or 200 million years.

465

00:25:24,033 --> 00:25:27,166
This is likely
to have a noticeable effect

466

00:25:27,166 --> 00:25:29,400
on the solar system.

467

00:25:33,200 --> 00:25:35,900

Our galaxy...

468

00:25:35,900 --> 00:25:40,300

We know that galaxies
are composed by gas, dust,

469

00:25:40,300 --> 00:25:44,200

stars, and dark matter.

470

00:25:44,200 --> 00:25:48,400

In galaxies,
we have the rotation.

471

00:25:48,400 --> 00:25:53,133

We can say that one galaxy year
is about 0.01 cosmic year,

472

00:25:53,133 --> 00:25:59,066

and we have this cycling
of stars, gas, and dust

473

00:25:59,066 --> 00:26:03,233

that occurs within our galaxy.

474

00:26:03,233 --> 00:26:08,400

We know that galaxies

475

00:26:08,400 --> 00:26:11,633

also form cluster of galaxies,

476

00:26:11,633 --> 00:26:14,733

and they form and evolve,

477

00:26:14,733 --> 00:26:19,400

and we know
from galaxy evolution

478

00:26:19,400 --> 00:26:24,800

that there are two time scales
in the evolution of galaxies.

479

00:26:24,800 --> 00:26:29,233

Galaxies are tracers
of the cosmic evolution

480

00:26:29,233 --> 00:26:32,066

in the last 13 billion years,

481

00:26:32,066 --> 00:26:36,233

and there are, like, two clocks

482

00:26:36,233 --> 00:26:40,400

shaping galaxies.

483

00:26:40,400 --> 00:26:43,400

There we have time--

484

00:26:43,400 --> 00:26:46,066

a redshift here

485

00:26:46,066 --> 00:26:50,766

and looking back time here.

486

00:26:50,766 --> 00:26:54,566

This is the clock
of cosmic evolution

487

00:26:54,566 --> 00:26:56,500

for the whole universe.

488

00:26:56,500 --> 00:27:03,300

And then we have the time
that the clock--

489

00:27:03,300 --> 00:27:07,233

that it's given us,
the stellar time,

490
00:27:07,233 --> 00:27:10,233
related to the evolution
of stars.

491
00:27:10,233 --> 00:27:14,900
For a star with one solar mass,
like our Sun,

492
00:27:14,900 --> 00:27:18,766
this is the span life
for the stars.

493
00:27:18,766 --> 00:27:23,066
When the stars become
more massive,

494
00:27:23,066 --> 00:27:26,566
they live shorter lives.

495
00:27:29,966 --> 00:27:35,400
This diagram
from Kormendy & Kennicutt

496
00:27:35,400 --> 00:27:38,166
show us different factors
that intervene

497
00:27:38,166 --> 00:27:42,066
in the formation and evolution
of galaxies.

498
00:27:42,066 --> 00:27:46,933
You have here
internal processes

499
00:27:46,933 --> 00:27:48,233
on this side,

500

00:27:48,233 --> 00:27:52,066

and on the right side,
you have external processes.

501

00:27:52,066 --> 00:27:55,900

So inside the galaxy,

502

00:27:55,900 --> 00:27:58,166

you have star formation,

503

00:27:58,166 --> 00:28:01,733

gas recycling,

504

00:28:01,733 --> 00:28:06,400

and the supernova production.

505

00:28:06,400 --> 00:28:09,066

And then on the...

506

00:28:09,066 --> 00:28:10,400

Here, you have also

507

00:28:10,400 --> 00:28:13,700

interaction with other galaxies
through mergers.

508

00:28:13,700 --> 00:28:16,900

For example, on the top,

509

00:28:16,900 --> 00:28:19,066

you have fast processes,

510

00:28:19,066 --> 00:28:20,566

and on the bottom,

511

00:28:20,566 --> 00:28:26,400

you have low processes.

512

00:28:29,400 --> 00:28:33,733

You have the collapse of gas
that will form the galaxy,

513

00:28:33,733 --> 00:28:38,400

and then you have
very long-term processes.

514

00:28:40,066 --> 00:28:42,866

What we call "secular evolution"

515

00:28:42,866 --> 00:28:47,733

that is driven by bars...

516

00:28:47,733 --> 00:28:51,233

dark matter, and other things
in the galaxy.

517

00:28:52,933 --> 00:28:58,066

So, in this video,
it shows in the time...

518

00:28:59,666 --> 00:29:01,733

Of a...

519

00:29:04,000 --> 00:29:07,366

Of a cosmic year,
about 14 billion years,

520

00:29:07,366 --> 00:29:12,333

the evolution and formation
and transformation of galaxies.

521

00:29:12,333 --> 00:29:18,400

So this is what happened
in about one cosmic year.

522

00:29:18,400 --> 00:29:21,400

[epic music]

523

00:29:27,900 --> 00:29:30,633

I think you know
the story, so...

524

00:29:30,633 --> 00:29:34,233

The other thing that we know

525

00:29:34,233 --> 00:29:37,566

is the star-formation history
of the universe.

526

00:29:39,400 --> 00:29:43,400

Here, again, you have
the star formation, red,

527

00:29:43,400 --> 00:29:45,500

in the universe
versus time.

528

00:29:45,500 --> 00:29:48,533

This is the present
of the universe.

529

00:29:48,533 --> 00:29:54,066

So, in the future,
the universe will form

530

00:29:54,066 --> 00:29:55,866

less and less stars.

531

00:29:55,866 --> 00:30:00,166

The universe was
very much effective

532

00:30:00,166 --> 00:30:02,233

in forming stars

533

00:30:02,233 --> 00:30:06,033
between 1 billion
and 3 billion years

534
00:30:06,033 --> 00:30:09,233
from the present.

535
00:30:11,566 --> 00:30:17,333
With Robert Kennicutt,
some years ago in a team,

536
00:30:17,333 --> 00:30:19,900
we tried to study

537
00:30:19,900 --> 00:30:23,000
the star formation
in the local universe,

538
00:30:23,000 --> 00:30:24,400
because at the time,

539
00:30:24,400 --> 00:30:29,566
this wasn't a very well known
part of the diagram.

540
00:30:29,566 --> 00:30:32,733
We tried to add
some points here.

541
00:30:32,733 --> 00:30:35,800
So...

542
00:30:35,800 --> 00:30:38,266
what is going to happen
with galaxies?

543
00:30:38,266 --> 00:30:40,900
In about 10 to 100 years

544

00:30:40,900 --> 00:30:43,366
or 10 to 90 cosmic years,

545

00:30:43,366 --> 00:30:46,866
galaxies will fade
into the darkness.

546

00:30:46,866 --> 00:30:50,700
Cluster of galaxies will
become cluster of black holes.

547

00:30:50,700 --> 00:30:54,233
Finally, black holes
will evaporate.

548

00:30:57,666 --> 00:30:59,233
In the very distant future,

549

00:30:59,233 --> 00:31:02,400
the universe eventually
will be shredded,

550

00:31:02,400 --> 00:31:03,666
what is called the "Big Rip."

551

00:31:03,666 --> 00:31:07,400
The universe could not have
a single, final end,

552

00:31:07,400 --> 00:31:10,233
but multiple ends.

553

00:31:10,233 --> 00:31:13,133
The universe is going
toward a final state

554

00:31:13,133 --> 00:31:16,000
of cold and darkness,
thermal death,

555

00:31:16,000 --> 00:31:18,066

which says that the universe

556

00:31:18,066 --> 00:31:21,233

will go toward a state
of maximum entropy--

557

00:31:21,233 --> 00:31:23,833

what is called
the "Big Freeze."

558

00:31:23,833 --> 00:31:26,066

The long-term scenario,

559

00:31:26,066 --> 00:31:30,066

with everything in the universe
dying gradually,

560

00:31:30,066 --> 00:31:34,566

will be obviously hostile
to life.

561

00:31:34,566 --> 00:31:39,566

This is not a very promising
future for us, I guess.

562

00:31:39,566 --> 00:31:41,933

Using again
the words of the poet--

563

00:31:41,933 --> 00:31:45,366

"This is the way
the world ends.

564

00:31:45,366 --> 00:31:47,133

This is the way
the world ends.

565

00:31:47,133 --> 00:31:49,400

This is the way
the world ends,

566
00:31:49,400 --> 00:31:52,933
not with a bang,
but a whimper."

567
00:31:52,933 --> 00:31:54,800
T.S. Eliot.

568
00:31:54,800 --> 00:31:56,400
So, at this point, this is,

569
00:31:56,400 --> 00:31:59,166
until here, more or less,

570
00:31:59,166 --> 00:32:01,233
what we can say

571
00:32:01,233 --> 00:32:03,133
from the scientific point
of view.

572
00:32:03,133 --> 00:32:06,133
You can correct me
on many things,

573
00:32:06,133 --> 00:32:10,500
but it's very difficult
to say what is going to be

574
00:32:10,500 --> 00:32:13,500
the Earth, the Sun,
our galaxy,

575
00:32:13,500 --> 00:32:16,233
and the universe as a whole.

576
00:32:18,333 --> 00:32:21,733

The beginning of this seminar

577

00:32:21,733 --> 00:32:25,133
was like going into a flight

578

00:32:25,133 --> 00:32:27,066
with all these indications,

579

00:32:27,066 --> 00:32:30,400
and I hope we are going to have
a safe landing

580

00:32:30,400 --> 00:32:31,900
after this talk.

581

00:32:31,900 --> 00:32:33,900
But...

582

00:32:33,900 --> 00:32:37,400
this has been
a scientific voyage

583

00:32:37,400 --> 00:32:39,566
to the end of the universe,

584

00:32:39,566 --> 00:32:44,233
but it is also
on a spiritual journey

585

00:32:44,233 --> 00:32:49,400
to the final frontier
of our existential frontier.

586

00:32:53,233 --> 00:32:54,566
"Final frontier"--

587

00:32:54,566 --> 00:32:56,833
I'm sure you already had
the background.

588

00:32:56,833 --> 00:32:59,933

"Star Trek," no?

589

00:32:59,933 --> 00:33:02,533

I'm a "Star Trek" fan.

590

00:33:02,533 --> 00:33:06,000

So, eh...

591

00:33:06,000 --> 00:33:08,500

emptiness and questions.

592

00:33:08,500 --> 00:33:11,900

At this point of my talk--

593

00:33:11,900 --> 00:33:16,066

When I prepared this talk,
I would say...

594

00:33:16,066 --> 00:33:19,800

that it was also
a spiritual experience

595

00:33:19,800 --> 00:33:21,900

to prepare this talk,

596

00:33:21,900 --> 00:33:25,500

because, somehow...

597

00:33:25,500 --> 00:33:30,233

I think Fried Nietzsche
here summarized quite well

598

00:33:30,233 --> 00:33:34,300

what was my feelings.

599

00:33:34,300 --> 00:33:37,400

"When you look long
into the abyss..."

600
00:33:37,400 --> 00:33:39,500
Could be
this empty universe...

601
00:33:39,500 --> 00:33:42,400
"The abyss looks into you."

602
00:33:42,400 --> 00:33:48,166
Or put in the words
of the Bible,

603
00:33:48,166 --> 00:33:52,066
"A vast emptiness,
Qoheleth says, an immense void,

604
00:33:52,066 --> 00:33:55,733
everything is empty."

605
00:33:55,733 --> 00:33:58,900
So is this the last word?

606
00:34:00,366 --> 00:34:02,066
I don't know.

607
00:34:04,566 --> 00:34:08,400
As we are used,
maybe we have some kind

608
00:34:08,400 --> 00:34:11,566
of second episode.

609
00:34:13,500 --> 00:34:15,066
I would like to say

610
00:34:15,066 --> 00:34:18,933
what might happen perhaps

with life.

611

00:34:18,933 --> 00:34:20,966

Life is resilient.

612

00:34:20,966 --> 00:34:24,900

We have many proofs of that.

613

00:34:24,900 --> 00:34:27,366

We have proved,
you know better than me,

614

00:34:27,366 --> 00:34:30,433

in the extremophiles
that are able to live

615

00:34:30,433 --> 00:34:34,066

in very hard conditions
for life--

616

00:34:35,533 --> 00:34:37,900

We see sometimes flowers

617

00:34:37,900 --> 00:34:41,900

in places that we don't expect
to see them.

618

00:34:41,900 --> 00:34:45,066

And this is...

619

00:34:45,066 --> 00:34:50,133

The gardens
in the Papal Summer Gardens

620

00:34:50,133 --> 00:34:52,300

in Castel Gandolfo.

621

00:34:52,300 --> 00:34:56,300

They used to be the house

of the Emperor Domitian,

622

00:34:56,300 --> 00:34:59,233

who build his villa there.

623

00:35:01,600 --> 00:35:05,533

And, you know...

624

00:35:05,533 --> 00:35:07,400

not many years ago,

625

00:35:07,400 --> 00:35:10,466

only about 2,000 years ago,

626

00:35:10,466 --> 00:35:14,300

people used to live here...

627

00:35:14,300 --> 00:35:17,566

not with this there,

living right there,

628

00:35:17,566 --> 00:35:21,066

but there are so many trees

629

00:35:21,066 --> 00:35:24,900

that are living

in these stones.

630

00:35:27,000 --> 00:35:29,833

I would like to say a word

about astrobiology

631

00:35:29,833 --> 00:35:31,566

from a different point of view.

632

00:35:31,566 --> 00:35:34,200

I think for you, I hope,

it's going to be new,

633

00:35:34,200 --> 00:35:37,833

and this is from a Jesuit,
Father Angelo Secchi.

634

00:35:37,833 --> 00:35:41,900

I'm going to say in a second
who he was.

635

00:35:41,900 --> 00:35:48,800

He wrote this
in the late 1800s.

636

00:35:48,800 --> 00:35:50,733

"What to think of these stars

637

00:35:50,733 --> 00:35:53,733

without any doubt
to our Sun..."

638

00:35:53,733 --> 00:35:56,066

I will say that's astrophysics.

639

00:35:56,066 --> 00:35:57,400

"Destined like the Sun

640

00:35:57,400 --> 00:35:59,833

to keep alive
an enormous quantity

641

00:35:59,833 --> 00:36:01,733

of creatures of every kind?"

642

00:36:01,733 --> 00:36:03,666

Biology.

643

00:36:03,666 --> 00:36:06,766

"Those immense regions
must be inhabited

644
00:36:06,766 --> 00:36:09,500
by intelligent beings
endowed with reason,

645
00:36:09,500 --> 00:36:13,200
capable to know, love,
and honor the Creator,

646
00:36:13,200 --> 00:36:15,966
and perhaps these inhabitants
of the stars

647
00:36:15,966 --> 00:36:18,066
are more faithful than us

648
00:36:18,066 --> 00:36:20,066
to the duties
of acknowledgement

649
00:36:20,066 --> 00:36:24,000
towards who draw them
from nothing.

650
00:36:24,000 --> 00:36:25,800
We want to hope
that among them,

651
00:36:25,800 --> 00:36:30,033
there were not those unlucky
that, in their pride,

652
00:36:30,033 --> 00:36:32,733
deny the existence
of the Creator."

653
00:36:32,733 --> 00:36:34,833
And I will say
that's theology fiction

654

00:36:34,833 --> 00:36:36,400
because he's speculating.

655
00:36:36,400 --> 00:36:37,533
We don't know that.

656
00:36:37,533 --> 00:36:42,000
We need first proof.

657
00:36:42,000 --> 00:36:43,700
So who was Father Secchi?

658
00:36:43,700 --> 00:36:46,566
He was an Italian astronomer,
a Jesuit.

659
00:36:46,566 --> 00:36:49,433
He was
the Director of the Observatory

660
00:36:49,433 --> 00:36:50,566
of the Roman College,

661
00:36:50,566 --> 00:36:54,133
which today is
Gregorian University.

662
00:36:54,133 --> 00:36:57,733
He was one of the pioneers
in astronomical spectroscopy

663
00:36:57,733 --> 00:37:00,900
and was one
of the first scientists to state

664
00:37:00,900 --> 00:37:03,033
that the Sun was a star.

665
00:37:03,033 --> 00:37:07,366

He collected 4,000
stellar spectrograms,

666
00:37:07,366 --> 00:37:10,800
developed the first system
of stellar classification,

667
00:37:10,800 --> 00:37:14,900
and discovered carbon stars.

668
00:37:14,900 --> 00:37:19,733
And I also would like
to quote Martin Rees

669
00:37:19,733 --> 00:37:24,966
about our position
in the cosmos today.

670
00:37:24,966 --> 00:37:28,433
"The wider cosmos
has a potential future

671
00:37:28,433 --> 00:37:30,733
that could even be infinite,

672
00:37:30,733 --> 00:37:34,566
but will these vast expanses
of time be filled with life

673
00:37:34,566 --> 00:37:38,733
or as empty as the Earth's
first sterile seas?

674
00:37:38,733 --> 00:37:44,066
The choice may depend on us,
this century."

675
00:37:44,066 --> 00:37:47,866
"The most crucial location
in space and time,

676

00:37:47,866 --> 00:37:53,233

apart from the Big Bang itself,
could be here and now."

677

00:37:55,366 --> 00:37:57,933

I have some questions.

678

00:37:57,933 --> 00:38:02,300

If our location in the universe
is crucial for life,

679

00:38:02,300 --> 00:38:05,633

all life will end with Earth?

680

00:38:05,633 --> 00:38:09,333

Is life a common phenomenon?

681

00:38:09,333 --> 00:38:11,733

What will happen with life

682

00:38:11,733 --> 00:38:13,900

in trillions

and trillions of years

683

00:38:13,900 --> 00:38:15,633

when the universe fades?

684

00:38:15,633 --> 00:38:17,933

Is there other universes?

685

00:38:17,933 --> 00:38:21,100

Will life survive

in those place?

686

00:38:21,100 --> 00:38:23,733

Is there any

other questions?

687
00:38:25,333 --> 00:38:29,400
An incomplete thought.

688
00:38:32,433 --> 00:38:36,566
I'm quoting here
Pope Francis giving an address

689
00:38:36,566 --> 00:38:40,066
to the professor
of theology and philosophy

690
00:38:40,066 --> 00:38:42,400
at the Gregorian University.

691
00:38:44,333 --> 00:38:46,233
"The theologian
who is satisfied

692
00:38:46,233 --> 00:38:50,566
with his complete
and conclusive thought

693
00:38:50,566 --> 00:38:52,733
is mediocre.

694
00:38:52,733 --> 00:38:56,233
The good theologian
and philosopher has an open--

695
00:38:56,233 --> 00:38:59,666
that is,
an incomplete thought,

696
00:38:59,666 --> 00:39:02,300
always open
to the maius of God

697
00:39:02,300 --> 00:39:05,900
and of the truth,

always in development."

698

00:39:07,400 --> 00:39:10,100

And I would change
a little bit the wording,

699

00:39:10,100 --> 00:39:13,833

and I would say, um...

700

00:39:13,833 --> 00:39:16,066

"The scientist
who is satisfied

701

00:39:16,066 --> 00:39:20,233

with his or her complete
and conclusive thought

702

00:39:20,233 --> 00:39:21,633

is mediocre.

703

00:39:21,633 --> 00:39:23,900

The good scientist
has an open--

704

00:39:23,900 --> 00:39:26,233

that is, an incomplete thought,

705

00:39:26,233 --> 00:39:29,166

always open to the maius
of the truth,

706

00:39:29,166 --> 00:39:32,233

always in development."

707

00:39:32,233 --> 00:39:35,566

And to conclude,
I would like to end

708

00:39:35,566 --> 00:39:38,566

with incomplete matters,

709

00:39:38,566 --> 00:39:42,800

and then we can talk
about this.

710

00:39:42,800 --> 00:39:44,266

We do not agree
about the origin

711

00:39:44,266 --> 00:39:48,466

and the definition of life
and intelligent life.

712

00:39:48,466 --> 00:39:52,266

We do not know
how to define a civilization.

713

00:39:52,266 --> 00:39:57,233

We don't know about dark matter
and dark energy.

714

00:39:57,233 --> 00:40:00,566

We are still missing
a theory of everything

715

00:40:00,566 --> 00:40:03,266

that may combine
general relativity

716

00:40:03,266 --> 00:40:05,933

and quantum mechanics
and the Standard Model

717

00:40:05,933 --> 00:40:09,966

And, of course,
the list is incomplete,

718

00:40:09,966 --> 00:40:13,500

and this presentation

is incomplete.

719

00:40:13,500 --> 00:40:15,100

Thank you very much.

720

00:40:15,100 --> 00:40:18,100

[applause]

721

00:40:24,400 --> 00:40:26,566

We have time
for a few questions.

722

00:40:26,566 --> 00:40:28,733

If you have a question,
please stand up.

723

00:40:28,733 --> 00:40:30,400

Go to the middle aisle.

724

00:40:30,400 --> 00:40:32,133

There's a microphone.
Stand there.

725

00:40:32,133 --> 00:40:34,100

Be succinct
with your question

726

00:40:34,100 --> 00:40:37,400

and move away
from the microphone.

727

00:40:48,233 --> 00:40:49,733

So let me ask a question

728

00:40:49,733 --> 00:40:55,133

till someone gets
the energy to move up and ask.

729

00:40:55,133 --> 00:40:56,833

I actually think
and I concur

730
00:40:56,833 --> 00:40:59,366
with the point
of looking out there

731
00:40:59,366 --> 00:41:03,233
for learning more
about ourselves.

732
00:41:05,566 --> 00:41:08,900
Is there any parts
of the Vatican Observatory

733
00:41:08,900 --> 00:41:10,900
that looks at...

734
00:41:14,733 --> 00:41:19,400
Life in terms of us going
and exploring other planets

735
00:41:19,400 --> 00:41:23,066
and how that sits
within that arena?

736
00:41:25,700 --> 00:41:28,733
That is a good question,
and...

737
00:41:28,733 --> 00:41:30,233
I would like to say

738
00:41:30,233 --> 00:41:33,900
that the Observatory
is a small group.

739
00:41:33,900 --> 00:41:40,133
With employees and scientists,
religious personnel,

740
00:41:40,133 --> 00:41:43,733
we are no more
than around 20 people.

741
00:41:43,733 --> 00:41:45,733
So...

742
00:41:45,733 --> 00:41:49,733
if we play for a moment,
I don't know...

743
00:41:49,733 --> 00:41:52,733
Passing from the cosmic years
of NASA

744
00:41:52,733 --> 00:41:56,500
to our few numbers
at the Vatican Observatory,

745
00:41:56,500 --> 00:41:58,733
the difference is huge.

746
00:42:00,233 --> 00:42:03,733
However,
the Vatican Observatory

747
00:42:03,733 --> 00:42:07,233
considers that the search
of life in the universe

748
00:42:07,233 --> 00:42:09,400
is an important thing.

749
00:42:11,600 --> 00:42:14,700
In 2005,
the Observatory organized--

750
00:42:14,700 --> 00:42:17,400

Father Coyne at the time
was the Director--

751
00:42:17,400 --> 00:42:22,133
organized a Summer School
on astrobiology.

752
00:42:22,133 --> 00:42:27,033
In 2007,
we organized a meeting on...

753
00:42:27,033 --> 00:42:30,900
a school, again,
on interstellar planets--

754
00:42:30,900 --> 00:42:33,233
round dwarves.

755
00:42:33,233 --> 00:42:39,233
In 2009,
we organized this workshop--

756
00:42:39,233 --> 00:42:40,733
Study Week they call it--

757
00:42:40,733 --> 00:42:44,366
at the Pontifical Academy
of Sciences,

758
00:42:44,366 --> 00:42:49,233
and the next school,
as I said,

759
00:42:49,233 --> 00:42:53,600
will be on water
in the solar system and beyond.

760
00:42:53,600 --> 00:42:55,066
So this is to say that,

761
00:42:55,066 --> 00:42:59,066
though we are not
strictly involved

762
00:42:59,066 --> 00:43:01,466
in the search of life
in the universe--

763
00:43:01,466 --> 00:43:05,900
We don't have a lab for that
or the resources.

764
00:43:05,900 --> 00:43:09,233
We collaborate,
and we bring together

765
00:43:09,233 --> 00:43:14,866
scientist students
that are experts in the field

766
00:43:14,866 --> 00:43:18,900
and that they can help us
to understand better

767
00:43:18,900 --> 00:43:21,566
the search of life
in the universe.

768
00:43:24,100 --> 00:43:26,566
I have to say that my training,

769
00:43:26,566 --> 00:43:28,233
scientific training
was in galaxies,

770
00:43:28,233 --> 00:43:29,566
nearby galaxies,

771
00:43:29,566 --> 00:43:32,700

but becoming
Director of the Observatory,

772
00:43:32,700 --> 00:43:36,000
you realize that
there is something else

773
00:43:36,000 --> 00:43:38,400
out there rather than galaxies,

774
00:43:38,400 --> 00:43:42,733
and you pay attention
to other important topics.

775
00:43:42,733 --> 00:43:45,400
This is, I think,
one important topic,

776
00:43:45,400 --> 00:43:47,066
not only for science,

777
00:43:47,066 --> 00:43:52,900
but also, from a philosophical
and religious approach,

778
00:43:52,900 --> 00:43:57,333
we can learn a lot,
even from the search itself,

779
00:43:57,333 --> 00:44:01,233
even we don't arrive
to positive results.

780
00:44:04,133 --> 00:44:06,900
Thank you so much
for the talk.

781
00:44:06,900 --> 00:44:08,900
One of the things
I wondered about was,

782

00:44:08,900 --> 00:44:11,133

you have probably
a time-allocation committee

783

00:44:11,133 --> 00:44:13,666

for the time
on your telescopes,

784

00:44:13,666 --> 00:44:16,233

and you'll have some priority

785

00:44:16,233 --> 00:44:18,933

for what observations are made
with that telescope.

786

00:44:18,933 --> 00:44:22,533

Could you tell us
what programs you emphasize

787

00:44:22,533 --> 00:44:24,400

with your observations

788

00:44:24,400 --> 00:44:28,300

and how that addresses some
of the questions you brought up?

789

00:44:31,266 --> 00:44:33,566

We have our telescope.

790

00:44:33,566 --> 00:44:36,066

75% is Vatican telescope,

791

00:44:36,066 --> 00:44:38,233

and 25%...

792

00:44:41,200 --> 00:44:43,800

Belongs
to the University of Arizona.

793

00:44:43,800 --> 00:44:45,233

The programs--

794

00:44:45,233 --> 00:44:48,400

we have, I will say,
quite a strong group

795

00:44:48,400 --> 00:44:51,233

on the solar system.

796

00:44:51,233 --> 00:44:54,200

I consider them...

797

00:44:54,200 --> 00:44:57,733

Brother Bob Macke
and Brother Guy Consolmagno--

798

00:44:57,733 --> 00:45:00,900

you may know him--

799

00:45:00,900 --> 00:45:04,733

do research with meteorites.

800

00:45:04,733 --> 00:45:09,400

And also, we have
Father Kikwaya from Congo,

801

00:45:09,400 --> 00:45:11,233

who is using our telescope

802

00:45:11,233 --> 00:45:13,900

and other telescopes
and other cameras

803

00:45:13,900 --> 00:45:18,233

for the search
of near-Earth objects.

804
00:45:20,433 --> 00:45:23,566
We also studied...

805
00:45:26,233 --> 00:45:29,600
Nearby stars
that are similar to our Sun,

806
00:45:29,600 --> 00:45:32,233
and this is related
to the search,

807
00:45:32,233 --> 00:45:35,966
somehow or other, the search
of life in the universe.

808
00:45:35,966 --> 00:45:39,733
Father Corbally
does this kind of research.

809
00:45:41,700 --> 00:45:44,733
Also, I've been using
the telescope

810
00:45:44,733 --> 00:45:49,066
for star formation
in nearby galaxies.

811
00:45:51,233 --> 00:45:55,166
This is for the use
of the telescope.

812
00:45:55,166 --> 00:45:57,233
Of course, you need
the other telescope

813
00:45:57,233 --> 00:46:00,233
to address those questions,

814
00:46:00,233 --> 00:46:02,233

but from
the theoretical point of view,

815
00:46:02,233 --> 00:46:07,400
also, we have Father Gionti,
an Italian,

816
00:46:07,400 --> 00:46:11,300
who is doing research
on string theory

817
00:46:11,300 --> 00:46:12,866
and quantum gravity,

818
00:46:12,866 --> 00:46:17,233
just to show you that there is
the other side of our research.

819
00:46:17,233 --> 00:46:23,100
Again, we do not cover
all the fields.

820
00:46:23,100 --> 00:46:27,733
We try to be as much
as we can

821
00:46:27,733 --> 00:46:31,733
involved in the research
with our colleagues,

822
00:46:31,733 --> 00:46:34,300
and we have
several collaborations.

823
00:46:34,300 --> 00:46:37,733
And the scientific meetings

824
00:46:37,733 --> 00:46:40,733
that we have organized
and the schools

825

00:46:40,733 --> 00:46:43,900
is always a way

826

00:46:43,900 --> 00:46:47,066
to learn from our colleagues.

827

00:46:47,066 --> 00:46:49,766
We learned a lot
from organizing these things

828

00:46:49,766 --> 00:46:54,733
and sharing
their research interests.

829

00:46:58,566 --> 00:47:02,166
I see that your talk shows
that the Vatican Observatory

830

00:47:02,166 --> 00:47:05,500
has potentially
a very long planning horizon

831

00:47:05,500 --> 00:47:07,366
in terms of thinking
about the future,

832

00:47:07,366 --> 00:47:10,900
and I wonder
if the Vatican Observatory

833

00:47:10,900 --> 00:47:14,066
has considered a time
in the future

834

00:47:14,066 --> 00:47:16,566
when you would move
into space telescopes

835

00:47:16,566 --> 00:47:18,566
for observation

836
00:47:18,566 --> 00:47:21,233
and if you have given
any thought possibility

837
00:47:21,233 --> 00:47:25,866
to promoting or sponsoring

838
00:47:25,866 --> 00:47:29,000
some form of space telescope.

839
00:47:29,000 --> 00:47:31,366
Thank you.

840
00:47:31,366 --> 00:47:33,400
Before I forget,

841
00:47:33,400 --> 00:47:35,700
we have a Website
that is in progress.

842
00:47:35,700 --> 00:47:38,333
We have renewed the Website,

843
00:47:38,333 --> 00:47:43,233
but if you go to the homepage,
you can download,

844
00:47:43,233 --> 00:47:46,400
if you have some probl--
I don't think solve it--

845
00:47:46,400 --> 00:47:51,066
if you need some kind
of sleeping aid to download.

846
00:47:51,066 --> 00:47:54,566

- I'm kidding.
[light laughter]

847
00:47:54,566 --> 00:47:58,000
It's very interesting,
I should say.

848
00:47:58,000 --> 00:48:00,900
You have the annual report
of the Vatican Observatory.

849
00:48:00,900 --> 00:48:04,900
It's very simple--
vaticanobservatory.va,

850
00:48:04,900 --> 00:48:08,333
or you Google
"Vatican Observatory."

851
00:48:08,333 --> 00:48:13,733
And there we have a document
with the scientific priorities

852
00:48:13,733 --> 00:48:17,733
for the next ten years
of the Observatory.

853
00:48:17,733 --> 00:48:21,766
Of course, we are small.

854
00:48:21,766 --> 00:48:24,600
We're not trying
to compete with NASA,

855
00:48:24,600 --> 00:48:27,066
with the European Agency.

856
00:48:27,066 --> 00:48:31,533
But we try
within our possibilities

857

00:48:31,533 --> 00:48:34,133
to be involved in science.

858

00:48:34,133 --> 00:48:37,600
Regarding the question
about how to move

859

00:48:37,600 --> 00:48:40,900
to the next step of telescopes,

860

00:48:40,900 --> 00:48:45,400
I have addressed
these questions with our staff

861

00:48:45,400 --> 00:48:48,566
when we prepare also
that document,

862

00:48:48,566 --> 00:48:52,900
and at the moment, it looks like
it's very difficult

863

00:48:52,900 --> 00:48:57,433
to have, for us,
a 20-meter telescope,

864

00:48:57,433 --> 00:48:59,300
a 30-meter telescope,

865

00:48:59,300 --> 00:49:01,633
though, through the univers--

866

00:49:01,633 --> 00:49:04,733
with a good collaboration
with the University of Arizona,

867

00:49:04,733 --> 00:49:07,066
we may have access

to those telescopes

868

00:49:07,066 --> 00:49:09,566

if we need them
for the research.

869

00:49:09,566 --> 00:49:13,633

What we are doing now,
and this is in progress.

870

00:49:13,633 --> 00:49:17,833

There is a plan for a network
of small telescopes,

871

00:49:17,833 --> 00:49:20,400

2-meter telescopes
in southern Arizona

872

00:49:20,400 --> 00:49:23,533

and this network
is going to be robotized,

873

00:49:23,533 --> 00:49:25,133

and we are doing this--

874

00:49:25,133 --> 00:49:28,900

Our telescope
is being robotized.

875

00:49:28,900 --> 00:49:32,266

Hopefully, in about a year,
we'll be done,

876

00:49:32,266 --> 00:49:34,066

and we are doing this
in collaboration

877

00:49:34,066 --> 00:49:35,866

with the University of Arizona.

878

00:49:35,866 --> 00:49:38,666

So this is, according
to all possibilities,

879

00:49:38,666 --> 00:49:41,766

the way to keep
the telescope updated

880

00:49:41,766 --> 00:49:45,866

and to address questions
that may require

881

00:49:45,866 --> 00:49:49,700

space telescopes
and other big telescopes,

882

00:49:49,700 --> 00:49:53,200

by being collaborating
with a team leaded

883

00:49:53,200 --> 00:49:57,733

by Rob Kennicutt,
and we use Hubble,

884

00:49:57,733 --> 00:49:59,900

Galax, and Spitzer,

885

00:49:59,900 --> 00:50:02,533

so we have access somehow

886

00:50:02,533 --> 00:50:06,566

to the data
that this telescope provides.

887

00:50:09,033 --> 00:50:11,300

Hi. Thank you so much
for making the trip

888

00:50:11,300 --> 00:50:13,866

and making the time
for the presentation.

889

00:50:13,866 --> 00:50:15,366

I was wondering--

890

00:50:15,366 --> 00:50:17,700

and I don't know if this is
beyond the scope of the talk--

891

00:50:17,700 --> 00:50:21,900

I was wondering what you think
the theological implications

892

00:50:21,900 --> 00:50:25,733

of discovering life would be?

893

00:50:27,133 --> 00:50:28,933

I don't know how else
to phrase the question.

894

00:50:28,933 --> 00:50:31,566

Does it broaden it?
Does it make it more magical?

895

00:50:31,566 --> 00:50:33,400

If you could spend
just a couple of minutes

896

00:50:33,400 --> 00:50:35,833

talking about your personal
view, that would be great.

897

00:50:35,833 --> 00:50:36,833

Thanks.

898

00:50:40,233 --> 00:50:45,900

Sometimes I give interviews
to journalists,

899
00:50:45,900 --> 00:50:50,233
and once,
one journalist asked me

900
00:50:50,233 --> 00:50:51,900
the following question...

901
00:50:53,766 --> 00:50:57,066
"Who would be the first person

902
00:50:57,066 --> 00:51:01,966
that you communicate
if you find that there is life

903
00:51:01,966 --> 00:51:04,166
in the universe?

904
00:51:04,166 --> 00:51:06,866
To the Pope?" he said.

905
00:51:06,866 --> 00:51:08,600
And I said, "To my mom."

906
00:51:08,600 --> 00:51:11,600
[laughter]

907
00:51:13,400 --> 00:51:15,400
Being serious now...

908
00:51:18,733 --> 00:51:21,766
First, we need to make sure

909
00:51:21,766 --> 00:51:25,733
that we have discovered life

910
00:51:25,733 --> 00:51:28,566
and that this life, I think--

911
00:51:28,566 --> 00:51:29,900
I'm talking--

912
00:51:29,900 --> 00:51:32,233
I am someone that is not working
in the field,

913
00:51:32,233 --> 00:51:35,400
but I think
we need to be very careful

914
00:51:35,400 --> 00:51:39,133
that if we find life,

915
00:51:39,133 --> 00:51:41,400
that this life

916
00:51:41,400 --> 00:51:44,900
has not been imported
by us before.

917
00:51:46,466 --> 00:51:50,400
That would be, in any case,
a great discovery to find life,

918
00:51:50,400 --> 00:51:53,866
even a very primitive form
of life.

919
00:51:53,866 --> 00:51:58,133
Second,
if there is intelligent life,

920
00:51:58,133 --> 00:52:02,733
I would like to say
that it is already difficult

921
00:52:02,733 --> 00:52:05,733
to find intelligent life

on Earth.

922

00:52:05,733 --> 00:52:08,066

[laughter]

923

00:52:08,066 --> 00:52:09,866

We can imagine to find
intelligent life

924

00:52:09,866 --> 00:52:11,200

in the universe.

925

00:52:11,200 --> 00:52:14,566

Just a joke.

926

00:52:14,566 --> 00:52:18,200

Don't take me too serious.

927

00:52:18,200 --> 00:52:20,766

But it is
a very interesting question,

928

00:52:20,766 --> 00:52:23,233

and I think we--

929

00:52:23,233 --> 00:52:26,233

I'm working on that.
I have some thoughts.

930

00:52:26,233 --> 00:52:30,900

We need to approach
the possibility

931

00:52:30,900 --> 00:52:33,400

of discovering life

932

00:52:33,400 --> 00:52:36,500

from different points of view.

933

00:52:36,500 --> 00:52:39,266

The science point of view,
of course, is important,

934

00:52:39,266 --> 00:52:43,833

but also from a philosophical
or theological point of view.

935

00:52:43,833 --> 00:52:48,466

In my slides,
I said something like...

936

00:52:48,466 --> 00:52:49,733

"We don't know"--

937

00:52:49,733 --> 00:52:52,233

I think.

You can correct me.

938

00:52:52,233 --> 00:52:55,833

"We don't agree on what is life,
how to define life.

939

00:52:55,833 --> 00:53:01,266

If we find life,
what are we searching for?"

940

00:53:01,266 --> 00:53:03,566

And the other point is...

941

00:53:03,566 --> 00:53:04,900

what--

942

00:53:04,900 --> 00:53:06,733

This would the debate for--

943

00:53:06,733 --> 00:53:09,233

I don't want to enter
in this debate now,

944

00:53:09,233 --> 00:53:12,566
but what is civilization?

945

00:53:12,566 --> 00:53:16,100
What do we call
a civilization?

946

00:53:16,100 --> 00:53:22,300
What criteria we use to say
this is a civilized world?

947

00:53:22,300 --> 00:53:26,566
I don't think that we can agree
even on that today.

948

00:53:28,000 --> 00:53:32,733
And in the search
of life itself,

949

00:53:32,733 --> 00:53:38,566
we can learn many things
about ourselves and our origins.

950

00:53:40,433 --> 00:53:44,166
I think there is life
maybe in the universe,

951

00:53:44,166 --> 00:53:46,066
even intelligent life,

952

00:53:46,066 --> 00:53:48,233
but for me, in my opinion,

953

00:53:48,233 --> 00:53:54,200
I think it would be
very difficult to find life.

954

00:53:54,200 --> 00:53:55,900

Maybe intelligent--

955

00:53:55,900 --> 00:53:57,566

Maybe we are right
to find life,

956

00:53:57,566 --> 00:53:59,233

but to find intelligent life

957

00:53:59,233 --> 00:54:02,400

or some kind
of intelligent beings,

958

00:54:02,400 --> 00:54:07,533

E.T.s, would contact us,

959

00:54:07,533 --> 00:54:10,733

but that's my opinion.

960

00:54:15,400 --> 00:54:19,633

Hi. Thanks for coming
and talking to us.

961

00:54:19,633 --> 00:54:21,700

So, kind of similar
to the last--

962

00:54:21,700 --> 00:54:23,766

or touching on it, at least,

963

00:54:23,766 --> 00:54:27,366

I'm interested to hear...

964

00:54:27,366 --> 00:54:31,633

The way that religion is unique
in how it makes truth claims

965

00:54:31,633 --> 00:54:34,433

both about the nature

of the universe itself

966

00:54:34,433 --> 00:54:37,266

as well as how we ought
to live--

967

00:54:37,266 --> 00:54:38,833

the relationship
of those two things

968

00:54:38,833 --> 00:54:41,900

and how, for example,

969

00:54:41,900 --> 00:54:45,966

Galileo, you know,
his discoveries affected...

970

00:54:45,966 --> 00:54:48,000

You know, they were truth claims
about the universe

971

00:54:48,000 --> 00:54:50,900

that affected also
what religion had to say

972

00:54:50,900 --> 00:54:52,733

about how we ought to live.

973

00:54:52,733 --> 00:54:55,700

So, aside from, you know,
whether or not there exists life

974

00:54:55,700 --> 00:54:57,600

on other planets,

975

00:54:57,600 --> 00:54:59,800

the different things
that you're studying,

976

00:54:59,800 --> 00:55:02,133

the questions
that you're pursuing,

977

00:55:02,133 --> 00:55:05,233

what are some areas
that you see

978

00:55:05,233 --> 00:55:07,733

that these unanswered questions
could possibly have

979

00:55:07,733 --> 00:55:11,066

the greatest change
in what the Catholic Church

980

00:55:11,066 --> 00:55:13,166

says about how we ought
to live.

981

00:55:13,166 --> 00:55:14,933

Thank you.

982

00:55:18,366 --> 00:55:20,933

Well, one second intention
of my talk

983

00:55:20,933 --> 00:55:24,300

was just to address
these kind of concerns

984

00:55:24,300 --> 00:55:27,733

or questions or thoughts.

985

00:55:27,733 --> 00:55:31,900

How could
science and religion--

986

00:55:31,900 --> 00:55:33,733

Could they interact?

987

00:55:36,566 --> 00:55:39,866

I'm learning.

988

00:55:39,866 --> 00:55:41,600

I think it's--

989

00:55:41,600 --> 00:55:44,433

Galileo was

a very important event

990

00:55:44,433 --> 00:55:49,566

for the history of

the Catholic Church, of course,

991

00:55:49,566 --> 00:55:54,766

but for the Western culture,

992

00:55:54,766 --> 00:55:58,666

the way we understand

the relationship

993

00:55:58,666 --> 00:56:02,400

between science and religion.

994

00:56:04,233 --> 00:56:08,133

I don't think that...

995

00:56:08,133 --> 00:56:11,200

Again, this is

my personal opinion...

996

00:56:11,200 --> 00:56:13,633

that the discovery of life,

of intelligent life

997

00:56:13,633 --> 00:56:18,433

would have a great impact

in the Catholic faith

998

00:56:18,433 --> 00:56:20,566
or Christian faith.

999

00:56:23,733 --> 00:56:26,833
I think we have...

1000

00:56:26,833 --> 00:56:29,700
Sorry to do some kind
of advertising,

1001

00:56:29,700 --> 00:56:33,300
but I'm still reading it,

1002

00:56:33,300 --> 00:56:37,266
because it was published
last week and I was traveling.

1003

00:56:37,266 --> 00:56:42,900
I started to read the encyclical
by Pope Francis on...

1004

00:56:44,433 --> 00:56:45,600
I'm reading it in Spanish.

1005

00:56:45,600 --> 00:56:48,566
So, on the concern,
I will say

1006

00:56:48,566 --> 00:56:50,933
of the "common house"
or "common home"--

1007

00:56:50,933 --> 00:56:54,933
he used those terms--

1008

00:56:54,933 --> 00:56:57,433
I think it's new
in the approach he has

1009

00:56:57,433 --> 00:57:00,966

to this problem
because he's not...

1010

00:57:00,966 --> 00:57:05,366

He considered the results
coming from science,

1011

00:57:05,366 --> 00:57:08,900

but also he consider
other perspectives--

1012

00:57:08,900 --> 00:57:11,333

from the economic point
of view,

1013

00:57:11,333 --> 00:57:14,700

from ethical point of view,

1014

00:57:14,700 --> 00:57:18,200

from a religious point of view,
but it's quite universal.

1015

00:57:18,200 --> 00:57:20,733

He is trying to reach
not only Catholic,

1016

00:57:20,733 --> 00:57:23,800

but everyone on this Earth.

1017

00:57:23,800 --> 00:57:27,666

I think there
we have a good example,

1018

00:57:27,666 --> 00:57:33,233

a good model
in the way that science...

1019

00:57:35,866 --> 00:57:40,566

Philosophers, or even
people working in culture,

1020

00:57:40,566 --> 00:57:43,066

anthropologists,
for example...

1021

00:57:45,033 --> 00:57:48,233

Religions
from different confessions--

1022

00:57:48,233 --> 00:57:51,733

Christians, Jewish, Muslims.

1023

00:57:51,733 --> 00:57:53,966

I think we need
to move in that way.

1024

00:57:53,966 --> 00:57:57,666

For me, one kind of thing
that I am learning

1025

00:57:57,666 --> 00:58:02,066

in this last year
is that it's important,

1026

00:58:02,066 --> 00:58:04,733

the dialogue
between science and religion,

1027

00:58:04,733 --> 00:58:09,233

but not only in the context
of the Catholic Church,

1028

00:58:09,233 --> 00:58:12,733

in the context of Galileo,

1029

00:58:12,733 --> 00:58:15,233

but also in the context...

1030

00:58:17,933 --> 00:58:20,233

In the dialogue
with other religions.

1031

00:58:21,600 --> 00:58:24,066

I don't know, but in Europe,
this is my impression,

1032

00:58:24,066 --> 00:58:26,366

I don't know much here
in the U.S.,

1033

00:58:26,366 --> 00:58:31,900

but the interreligious dialogue
is urgent.

1034

00:58:31,900 --> 00:58:33,700

It's urgent.

1035

00:58:33,700 --> 00:58:40,600

And maybe science
could be a helpful language

1036

00:58:40,600 --> 00:58:43,733

to help to understand people
from different religions.

1037

00:58:43,733 --> 00:58:45,566

So that's my hope.

1038

00:58:49,733 --> 00:58:52,233

[man clears throat]

I guess I'm the final question.

1039

00:58:52,233 --> 00:58:53,566

It's obvious from your talk,

1040

00:58:53,566 --> 00:58:57,233

you have a great command
of astronomical data,

1041

00:58:57,233 --> 00:59:00,400
and I know from your background,
you believe the Bible

1042

00:59:00,400 --> 00:59:02,333
and the stories
that are painted there,

1043

00:59:02,333 --> 00:59:04,733
and I guess what I wanted
to know was,

1044

00:59:04,733 --> 00:59:08,033
in the book of Revelation,

1045

00:59:08,033 --> 00:59:10,533
the end of the Earth
is predicted

1046

00:59:10,533 --> 00:59:12,600
and also
the creation of a new Earth,

1047

00:59:12,600 --> 00:59:14,266
and I was hoping,
coming into this talk,

1048

00:59:14,266 --> 00:59:15,900
that you would speak

1049

00:59:15,900 --> 00:59:19,000
to that being well-footed
in both of those.

1050

00:59:19,000 --> 00:59:23,366
Do you have any comments on that
that you could share briefly?

1051

00:59:23,366 --> 00:59:25,333

Okay, yes.

1052

00:59:25,333 --> 00:59:30,333

I have to confess

that I had one extra slide.

1053

00:59:30,333 --> 00:59:32,233

I listened to your question,

1054

00:59:32,233 --> 00:59:37,900

but because I didn't want

to make a direct reference

1055

00:59:37,900 --> 00:59:41,033

to the Bible regarding this...

1056

00:59:41,033 --> 00:59:44,033

This is a question

that requires a long answer.

1057

00:59:44,033 --> 00:59:46,833

I'm going to try to be short.

1058

00:59:46,833 --> 00:59:49,933

- I am short.

[laughter]

1059

00:59:54,100 --> 00:59:56,566

The Bible...

1060

00:59:56,566 --> 00:59:58,900

This is for Catholics, so...

1061

00:59:58,900 --> 01:00:02,233

Mainstream Catholics.

1062

01:00:02,233 --> 01:00:05,533

I will say for the Church,
for the authority of the Church,

1063

01:00:05,533 --> 01:00:10,100

the Bible is not
a book of science.

1064

01:00:10,100 --> 01:00:11,400

I repeat--

1065

01:00:11,400 --> 01:00:15,066

the Bible is not
a book of science.

1066

01:00:16,966 --> 01:00:21,233

If we have
scientific questions,

1067

01:00:21,233 --> 01:00:25,566

we shouldn't search the answers
in the Bible.

1068

01:00:27,133 --> 01:00:28,866

What is the Bible?

1069

01:00:28,866 --> 01:00:32,300

The Bible is the book
that we believe.

1070

01:00:32,300 --> 01:00:33,566

I believe in God, yeah?

1071

01:00:33,566 --> 01:00:36,233

I am a scientist,
but I believe in God.

1072

01:00:38,233 --> 01:00:44,766

The Bible is a book
inspired by God,

1073

01:00:44,766 --> 01:00:48,733
written by men and women--

1074

01:00:48,733 --> 01:00:51,500
I don't know--

1075

01:00:51,500 --> 01:00:56,600
that was written
with a language

1076

01:00:56,600 --> 01:01:01,900
that was used
some time 3,000 years ago.

1077

01:01:03,733 --> 01:01:06,400
The sacred authors--

1078

01:01:06,400 --> 01:01:11,233
they didn't know anything
about theory of relativity,

1079

01:01:11,233 --> 01:01:13,900
of quantum physics.

1080

01:01:13,900 --> 01:01:15,233
They didn't--

1081

01:01:15,233 --> 01:01:18,300
They wanted to answer
the big questions that we have.

1082

01:01:18,300 --> 01:01:21,733
Those questions
that I put in the past.

1083

01:01:25,433 --> 01:01:29,200
I will say this--
I will use this image.

1084

01:01:29,200 --> 01:01:33,966

Now people don't write
any more love letters.

1085

01:01:33,966 --> 01:01:36,300

They send emails maybe.

1086

01:01:36,300 --> 01:01:38,233

Old people maybe still...

1087

01:01:38,233 --> 01:01:42,800

or SMS or a message
or iMessage or WhatsApp.

1088

01:01:42,800 --> 01:01:44,766

[light laughter]

1089

01:01:44,766 --> 01:01:48,033

Maybe today you got to go speak
using WhatsApp or Twitter.

1090

01:01:48,033 --> 01:01:49,066

I don't know.

1091

01:01:49,066 --> 01:01:53,333

But I will say, um...

1092

01:01:53,333 --> 01:01:57,700

The Bible
is the letter of love

1093

01:01:57,700 --> 01:02:00,566

that he or she

1094

01:02:00,566 --> 01:02:03,400

has sent to his people,

1095

01:02:03,400 --> 01:02:06,566

to us with a language
that is a language

1096

01:02:06,566 --> 01:02:09,566

of 3,000, 2,000 years ago.

1097

01:02:09,566 --> 01:02:11,033

How do you send that?

1098

01:02:11,033 --> 01:02:15,400

The book of Revelation,
the meaning--

1099

01:02:15,400 --> 01:02:16,900

This is my understanding.

1100

01:02:16,900 --> 01:02:20,866

It's not about the end,
how the universe will end

1101

01:02:20,866 --> 01:02:25,100

in the sense
of what would happen

1102

01:02:25,100 --> 01:02:27,566

to galaxies, to stars,

1103

01:02:27,566 --> 01:02:30,100

but this...

1104

01:02:30,100 --> 01:02:34,200

It give us the sense,
the meaning of human history.

1105

01:02:34,200 --> 01:02:36,600

Where are we going?

1106

01:02:36,600 --> 01:02:39,233

It was written in a time,

1107

01:02:39,233 --> 01:02:42,233

maybe similar to our time,

1108

01:02:42,233 --> 01:02:46,200

in which Christians

were persecuted.

1109

01:02:46,200 --> 01:02:48,733

So St. John...

1110

01:02:50,266 --> 01:02:54,733

He's trying to give hope,

a message of hope,

1111

01:02:54,733 --> 01:02:56,966

to this community

that is suffering

1112

01:02:56,966 --> 01:02:58,933

from persecution,

1113

01:02:58,933 --> 01:03:02,533

and what he's saying is that

God is conducting

1114

01:03:02,533 --> 01:03:05,733

this human history

with all the difficulties

1115

01:03:05,733 --> 01:03:08,733

and with all problems we see

1116

01:03:08,733 --> 01:03:16,233

and that the profound fundamentals

of this history, human history,

1117

01:03:16,233 --> 01:03:20,066

and right now
the history of the universe,

1118
01:03:20,066 --> 01:03:23,066
are in the hands of God.

1119
01:03:23,066 --> 01:03:25,300
This is very difficult
to explain

1120
01:03:25,300 --> 01:03:28,766
and to say
using scientific language,

1121
01:03:28,766 --> 01:03:30,466
because it's a different...

1122
01:03:30,466 --> 01:03:34,066
We need to read the Bible

1123
01:03:34,066 --> 01:03:36,566
with a different language.

1124
01:03:38,733 --> 01:03:42,600
So I will say that
for the book of Revelation.

1125
01:03:42,600 --> 01:03:45,066
Of course,
it's a very complicated book

1126
01:03:45,066 --> 01:03:46,566
with many symbols,

1127
01:03:46,566 --> 01:03:50,400
but in a shorter answer,

1128
01:03:50,400 --> 01:03:53,233
that would be my reply to you.

1129

01:03:55,933 --> 01:04:01,000

So please join me in thanking
Father Dr. José Funes.

1130

01:04:01,000 --> 01:04:04,000

[applause]