



HUBBLE
hangouts

1
00:00:03,750 --> 00:00:01,910
thing now there we go

2
00:00:05,749 --> 00:00:03,760
okay

3
00:00:07,749 --> 00:00:05,759
hello everybody uh my name is tony

4
00:00:09,430 --> 00:00:07,759
darnell i work at the space telescope

5
00:00:11,270 --> 00:00:09,440
science institute i'm the social media

6
00:00:13,910 --> 00:00:11,280
manager here and

7
00:00:15,350 --> 00:00:13,920
this week at the institute we have

8
00:00:16,870 --> 00:00:15,360
something rather interesting we're

9
00:00:19,670 --> 00:00:16,880
trying kind of a bit of an experiment

10
00:00:22,230 --> 00:00:19,680
here uh because today tomorrow and

11
00:00:26,310 --> 00:00:22,240
wednesday we're having a workshop on the

12
00:00:27,990 --> 00:00:26,320
orion nebula and this workshop is

13
00:00:30,150 --> 00:00:28,000

designed to kind of in

14

00:00:32,150 --> 00:00:30,160

present some of the things that about

15

00:00:33,510 --> 00:00:32,160

the orion nebula what do we know about

16

00:00:36,470 --> 00:00:33,520

it what you know what are some

17

00:00:39,030 --> 00:00:36,480

long-standing uh issues that we're maybe

18

00:00:40,869 --> 00:00:39,040

finding more things out about uh what

19

00:00:42,869 --> 00:00:40,879

are the

20

00:00:45,190 --> 00:00:42,879

uh new what's the latest research what's

21

00:00:47,510 --> 00:00:45,200

the new research out there uh regarding

22

00:00:51,110 --> 00:00:47,520

this very famous nebula if you don't

23

00:00:52,869 --> 00:00:51,120

know what the orion nebula is uh then

24

00:00:54,790 --> 00:00:52,879

not only are you in the right place

25

00:00:56,630 --> 00:00:54,800

you're gonna find out what they

26

00:00:58,790 --> 00:00:56,640

what that is but also the cutting edge

27

00:01:01,830 --> 00:00:58,800

research is being done here so with me

28

00:01:03,270 --> 00:01:01,840

today uh ho is is one is my co-host he's

29

00:01:05,109 --> 00:01:03,280

always out here

30

00:01:07,510 --> 00:01:05,119

sharing these hangouts with me is uh

31

00:01:10,149 --> 00:01:07,520

scott lewis from know the cosmos hi

32

00:01:12,630 --> 00:01:10,159

scott how's it going tony i i prefer

33

00:01:15,350 --> 00:01:12,640

cohort instead of co-hosts all right we

34

00:01:17,749 --> 00:01:15,360

get up just in trouble cohort yeah yeah

35

00:01:19,429 --> 00:01:17,759

so all right so cohort now i was going

36

00:01:22,070 --> 00:01:19,439

to call this a hubble hangout but

37

00:01:23,030 --> 00:01:22,080

because this particular topic is more

38

00:01:24,469 --> 00:01:23,040

about

39

00:01:26,870 --> 00:01:24,479

research done by a lot of other things

40

00:01:28,310 --> 00:01:26,880

besides hubble kind of you know

41

00:01:30,070 --> 00:01:28,320

just i didn't bring it up this time but

42

00:01:33,109 --> 00:01:30,080

usually we we call these under the

43

00:01:36,149 --> 00:01:33,119

moniker of hubble hangouts um and so

44

00:01:38,710 --> 00:01:36,159

with us today are some astronomers

45

00:01:40,630 --> 00:01:38,720

attending the workshop dr massimo

46

00:01:42,870 --> 00:01:40,640

roberto from the space telescope science

47

00:01:44,789 --> 00:01:42,880

institute and lynn hildebrand from

48

00:01:46,630 --> 00:01:44,799

caltech hi guys

49

00:01:48,230 --> 00:01:46,640

hello hi

50

00:01:50,230 --> 00:01:48,240

so massimo why don't you why don't you

51
00:01:51,510 --> 00:01:50,240
start us off by telling us a little bit

52
00:01:53,270 --> 00:01:51,520
about this workshop what are you hoping

53
00:01:54,469 --> 00:01:53,280
to accomplish and why are we doing these

54
00:01:56,310 --> 00:01:54,479
kinds of things

55
00:01:58,069 --> 00:01:56,320
so basically the the story of the

56
00:01:58,950 --> 00:01:58,079
workshop starts

57
00:02:05,510 --> 00:01:58,960
uh

58
00:02:07,590 --> 00:02:05,520
we got approved the hubble treasury

59
00:02:10,630 --> 00:02:07,600
program on the orion nebula

60
00:02:13,190 --> 00:02:10,640
we thought years ago that

61
00:02:15,589 --> 00:02:13,200
the nebula needed to be

62
00:02:19,350 --> 00:02:15,599
investigated in little with the hubble

63
00:02:20,830 --> 00:02:19,360

and the main reason was at the time to

64

00:02:23,750 --> 00:02:20,840

to study to

65

00:02:26,550 --> 00:02:23,760

understand the stellar population of the

66

00:02:28,390 --> 00:02:26,560

cluster you may not know but the orion

67

00:02:31,430 --> 00:02:28,400

nebula which is the spectacular object

68

00:02:33,910 --> 00:02:31,440

in the sky that every every everybody

69

00:02:35,030 --> 00:02:33,920

points the telescope in the first night

70

00:02:37,350 --> 00:02:35,040

after

71

00:02:40,630 --> 00:02:37,360

christmas when you buy it the aerial

72

00:02:42,550 --> 00:02:40,640

nebula is actually uh uh hosts

73

00:02:45,190 --> 00:02:42,560

thousands of young stars of young

74

00:02:46,550 --> 00:02:45,200

forming stars so for astronomers is the

75

00:02:47,830 --> 00:02:46,560

prototype

76

00:02:49,350 --> 00:02:47,840

of

77

00:02:51,910 --> 00:02:49,360

star formation if you want to understand

78

00:02:54,390 --> 00:02:51,920

how stars are formed and actually even

79

00:02:56,630 --> 00:02:54,400

how planets around stars form

80

00:02:58,309 --> 00:02:56,640

the orion nebula is a critical place to

81

00:03:00,790 --> 00:02:58,319

grow so we pointed the hubble we had

82

00:03:03,190 --> 00:03:00,800

this monster program more than 100

83

00:03:05,190 --> 00:03:03,200

orbits which means a lot of time

84

00:03:07,830 --> 00:03:05,200

and we observed the orion nebula with

85

00:03:10,390 --> 00:03:07,840

all the imagers on board of the hubble

86

00:03:12,550 --> 00:03:10,400

at the time was acs with p2 and nickmas

87

00:03:14,949 --> 00:03:12,560

so in the optical uv in the infrared

88

00:03:17,110 --> 00:03:14,959

really the full power of hubble was

89

00:03:19,430 --> 00:03:17,120

spent there this is the largest program

90

00:03:20,229 --> 00:03:19,440

ever dedicated to star formation

91

00:03:22,869 --> 00:03:20,239

and

92

00:03:24,949 --> 00:03:22,879

we got the data one of you may know the

93

00:03:26,790 --> 00:03:24,959

spectacular the red big red picture of

94

00:03:29,830 --> 00:03:26,800

the orion nebula is one of the

95

00:03:31,910 --> 00:03:29,840

bi-products that of this survey

96

00:03:34,869 --> 00:03:31,920

took some years to put together the data

97

00:03:36,309 --> 00:03:34,879

to clean up the catalogue to write a

98

00:03:38,309 --> 00:03:36,319

number of papers

99

00:03:40,390 --> 00:03:38,319

now everything is basically out is

100

00:03:42,070 --> 00:03:40,400

public we have released everything to

101
00:03:44,630 --> 00:03:42,080
the public so the idea of the workshop

102
00:03:46,949 --> 00:03:44,640
is to bring here the leading experts

103
00:03:48,309 --> 00:03:46,959
those that are working actively on orion

104
00:03:50,070 --> 00:03:48,319
right now

105
00:03:51,750 --> 00:03:50,080
to discuss the status of our

106
00:03:53,830 --> 00:03:51,760
understanding what we have learned from

107
00:03:55,190 --> 00:03:53,840
from these and other programs that are

108
00:03:56,309 --> 00:03:55,200
being carried out that have been

109
00:03:58,229 --> 00:03:56,319
completed

110
00:04:00,789 --> 00:03:58,239
and you know sort of

111
00:04:03,350 --> 00:04:00,799
plan the next steps to to share ideas

112
00:04:04,470 --> 00:04:03,360
the way science work we discuss and in

113
00:04:10,550 --> 00:04:04,480

the

114

00:04:12,390 --> 00:04:10,560

plans each one comes with new new ideas

115

00:04:13,429 --> 00:04:12,400

and new plans so it's a brainstorming

116

00:04:15,830 --> 00:04:13,439

session

117

00:04:17,509 --> 00:04:15,840

uh on the line of uh the work that has

118

00:04:19,270 --> 00:04:17,519

been done in these years with the hubble

119

00:04:20,949 --> 00:04:19,280

so is it is it hubble centered then i

120

00:04:22,710 --> 00:04:20,959

mean you said you you mentioned a bunch

121

00:04:24,710 --> 00:04:22,720

of instruments which i should clarify

122

00:04:26,310 --> 00:04:24,720

what they were the acs the advanced

123

00:04:28,550 --> 00:04:26,320

camera for survey the advanced camera

124

00:04:30,390 --> 00:04:28,560

for surveys uh nick moss was an older

125

00:04:31,830 --> 00:04:30,400

camera that was on hubble uh these are

126

00:04:33,909 --> 00:04:31,840

all cameras that you're talking about

127

00:04:36,469 --> 00:04:33,919

imaging cameras and now we have wide

128

00:04:38,950 --> 00:04:36,479

field camera three the uh what i guess

129

00:04:40,629 --> 00:04:38,960

they call it with c3 around here um so

130

00:04:42,390 --> 00:04:40,639

all of these observations are all the

131

00:04:44,150 --> 00:04:42,400

workshops is based around observations

132

00:04:45,670 --> 00:04:44,160

done by hubble

133

00:04:48,070 --> 00:04:45,680

no there are of course

134

00:04:51,510 --> 00:04:48,080

data taken with many other uh

135

00:04:54,070 --> 00:04:51,520

many other observatories telescopes

136

00:04:55,189 --> 00:04:54,080

from the ground and from space x-rays

137

00:04:57,110 --> 00:04:55,199

infrared

138

00:04:59,030 --> 00:04:57,120

and especially tomorrow we will hear a

139

00:05:00,950 --> 00:04:59,040

lot about these

140

00:05:03,350 --> 00:05:00,960

these other observations

141

00:05:06,070 --> 00:05:03,360

on the other hand let me say that orion

142

00:05:07,510 --> 00:05:06,080

is a region especially good for the

143

00:05:10,230 --> 00:05:07,520

hubble because

144

00:05:12,310 --> 00:05:10,240

it's sort of a an exception in the field

145

00:05:14,950 --> 00:05:12,320

that normally when stars form they are

146

00:05:17,350 --> 00:05:14,960

embedded and shrouded in the molecular

147

00:05:21,270 --> 00:05:17,360

cloud in the neutral dense

148

00:05:23,029 --> 00:05:21,280

uh obscure material uh dark clouds but

149

00:05:24,950 --> 00:05:23,039

in the case of orion what happened is

150

00:05:27,270 --> 00:05:24,960

that there are giant stars that they've

151
00:05:29,110 --> 00:05:27,280
blown out the material so they have made

152
00:05:30,070 --> 00:05:29,120
possible for us to see through this

153
00:05:31,270 --> 00:05:30,080
cloud

154
00:05:33,110 --> 00:05:31,280
so we see

155
00:05:36,310 --> 00:05:33,120
we basically have a unique opportunity

156
00:05:38,230 --> 00:05:36,320
here well a rare opportunity to see

157
00:05:39,670 --> 00:05:38,240
star formation uh

158
00:05:41,270 --> 00:05:39,680
from an exceptional point of view

159
00:05:43,670 --> 00:05:41,280
basically everything has been opened to

160
00:05:44,950 --> 00:05:43,680
our view so the hubble can go through

161
00:05:50,070 --> 00:05:44,960
uh

162
00:05:51,830 --> 00:05:50,080
which is the strength of the telescope

163
00:05:53,909 --> 00:05:51,840

so it's sort of an ideal situation for

164

00:05:56,550 --> 00:05:53,919

us to see something extremely young but

165

00:05:58,550 --> 00:05:56,560

already exposed to our view also this is

166

00:06:00,150 --> 00:05:58,560

why hubble is central for orion in

167

00:06:02,390 --> 00:06:00,160

particular

168

00:06:03,990 --> 00:06:02,400

so i before so thank you madison that

169

00:06:05,510 --> 00:06:04,000

was wonderful i want to so that's the

170

00:06:06,710 --> 00:06:05,520

that's the workshop that's what's going

171

00:06:07,990 --> 00:06:06,720

on this week and this is some of the

172

00:06:09,670 --> 00:06:08,000

reasons why they're having it we're

173

00:06:12,309 --> 00:06:09,680

gonna get into a little bit more of this

174

00:06:14,070 --> 00:06:12,319

later but before i do i need to

175

00:06:16,070 --> 00:06:14,080

let you guys know how you can interact

176

00:06:18,390 --> 00:06:16,080

with us i forgot to mention that as i

177

00:06:20,150 --> 00:06:18,400

always do i just want to jump in and

178

00:06:21,830 --> 00:06:20,160

start talking about whatever it is where

179

00:06:24,390 --> 00:06:21,840

we the topic is whenever i do these

180

00:06:26,150 --> 00:06:24,400

hangouts if you want to ask us questions

181

00:06:28,870 --> 00:06:26,160

we would encourage you to do so you can

182

00:06:30,870 --> 00:06:28,880

also leave comments uh on the youtube

183

00:06:32,790 --> 00:06:30,880

channel where this on our on space

184

00:06:34,150 --> 00:06:32,800

telescope uh our hubble site channel's

185

00:06:36,710 --> 00:06:34,160

youtube channel where i'm looking at the

186

00:06:39,110 --> 00:06:36,720

comments from where this video is being

187

00:06:42,070 --> 00:06:39,120

streamed uh also the event plate the

188

00:06:44,550 --> 00:06:42,080

event page the google plus event page uh

189

00:06:45,430 --> 00:06:44,560

and we are also monitoring facebook and

190

00:06:47,990 --> 00:06:45,440

uh

191

00:06:50,550 --> 00:06:48,000

twitter as well of the hashtag hubble

192

00:06:52,469 --> 00:06:50,560

hangouts so we hope you will give us

193

00:06:53,830 --> 00:06:52,479

some questions leave us some comments

194

00:06:55,029 --> 00:06:53,840

and uh

195

00:06:57,270 --> 00:06:55,039

we'll look forward to getting to some of

196

00:06:59,350 --> 00:06:57,280

that stuff a little bit later on

197

00:07:00,550 --> 00:06:59,360

and there's also a little square along

198

00:07:03,990 --> 00:07:00,560

the bottom

199

00:07:07,029 --> 00:07:04,000

that i haven't and nobody knows who this

200

00:07:09,909 --> 00:07:07,039

guy is his name is michael hi michael

201
00:07:12,790 --> 00:07:09,919
hello your last name my name's uh mike

202
00:07:14,629 --> 00:07:12,800
rector and i am an amateur astro

203
00:07:17,749 --> 00:07:14,639
photographer i

204
00:07:20,629 --> 00:07:17,759
just set up my telescope with my digital

205
00:07:23,110 --> 00:07:20,639
camera and take long exposure pictures

206
00:07:25,589 --> 00:07:23,120
to just get nebula and

207
00:07:27,589 --> 00:07:25,599
galaxies and star clusters

208
00:07:29,430 --> 00:07:27,599
so i'm told that those who watch the

209
00:07:30,950 --> 00:07:29,440
virtual star parties on a regular basis

210
00:07:32,710 --> 00:07:30,960
uh probably know your name is that

211
00:07:34,629 --> 00:07:32,720
correct you're yeah i've been on there a

212
00:07:37,430 --> 00:07:34,639
few times it's one of our contest

213
00:07:39,350 --> 00:07:37,440

winners from last may he uh we had a

214

00:07:41,990 --> 00:07:39,360

photo contest of astrophotography and

215

00:07:45,189 --> 00:07:42,000

mike actually won with the pleiades yeah

216

00:07:47,350 --> 00:07:45,199

really great shot yeah your audio seems

217

00:07:49,189 --> 00:07:47,360

a little bit low to me scott um i can

218

00:07:51,670 --> 00:07:49,199

turn out my game yeah

219

00:07:52,710 --> 00:07:51,680

yeah a little better that's much better

220

00:07:54,390 --> 00:07:52,720

thank you

221

00:07:57,270 --> 00:07:54,400

i'm normally too loud so i had to turn

222

00:08:00,150 --> 00:07:57,280

it down a little bit tell me about it

223

00:08:03,589 --> 00:08:01,749

all right so welcome michael it's good

224

00:08:06,230 --> 00:08:03,599

do you so in your imaging efforts with

225

00:08:08,309 --> 00:08:06,240

your telescope uh

226

00:08:10,469 --> 00:08:08,319

have you done much with the orion nebula

227

00:08:12,950 --> 00:08:10,479

uh yes i have i actually sent a picture

228

00:08:14,230 --> 00:08:12,960

of orion to scott

229

00:08:16,070 --> 00:08:14,240

ah

230

00:08:18,469 --> 00:08:16,080

i'm sure so scott will get that up for

231

00:08:20,390 --> 00:08:18,479

us hopefully in a little bit so uh so

232

00:08:22,790 --> 00:08:20,400

that's cool all right well welcome and

233

00:08:24,309 --> 00:08:22,800

so um hopefully you'll be able to

234

00:08:27,110 --> 00:08:24,319

provide some insight from an amateur

235

00:08:28,710 --> 00:08:27,120

perspective as well as uh uh you know

236

00:08:29,830 --> 00:08:28,720

maybe if we get if we have some time

237

00:08:31,270 --> 00:08:29,840

toward the end of it we could talk a

238

00:08:33,909 --> 00:08:31,280

little bit about what's involved in

239

00:08:35,509 --> 00:08:33,919

astrophotography and uh how can a

240

00:08:37,509 --> 00:08:35,519

beginner get started because i think the

241

00:08:40,630 --> 00:08:37,519

orion nebula probably one of the better

242

00:08:43,269 --> 00:08:40,640

better targets so there's there's mike's

243

00:08:44,710 --> 00:08:43,279

orion right there which is beautiful

244

00:08:45,750 --> 00:08:44,720

wow that's amazing

245

00:08:48,070 --> 00:08:45,760

yep

246

00:08:51,750 --> 00:08:48,080

that's amazing and where are you out of

247

00:08:53,750 --> 00:08:51,760

mike i'm from uh plattsburgh new york

248

00:08:56,470 --> 00:08:53,760

about 40 minutes south of canada near

249

00:08:58,550 --> 00:08:56,480

lake champlain okay so you have better

250

00:09:00,630 --> 00:08:58,560

skies than i do here in los angeles uh

251
00:09:02,710 --> 00:09:00,640
yeah just a little bit

252
00:09:03,590 --> 00:09:02,720
or better than we have in baltimore i'm

253
00:09:07,670 --> 00:09:03,600
sure

254
00:09:10,310 --> 00:09:07,680
yeah most likely that's fantastic

255
00:09:12,070 --> 00:09:10,320
okay so uh so lynn i'd like to i'd like

256
00:09:13,990 --> 00:09:12,080
to get you in on this discussion a

257
00:09:15,910 --> 00:09:14,000
little bit so what is what were your

258
00:09:16,949 --> 00:09:15,920
reasons for um attending the workshop

259
00:09:18,230 --> 00:09:16,959
and can you tell us a little bit about

260
00:09:20,070 --> 00:09:18,240
what some of your interests are your

261
00:09:23,030 --> 00:09:20,080
research interests

262
00:09:26,389 --> 00:09:23,040
sure uh orion is uh you know just an

263
00:09:28,389 --> 00:09:26,399

iconic region not only for amateurs and

264

00:09:31,430 --> 00:09:28,399

astrophotography and you know the

265

00:09:33,590 --> 00:09:31,440

general uh interests but also for

266

00:09:37,110 --> 00:09:33,600

professional astronomers at at a deep

267

00:09:39,030 --> 00:09:37,120

level uh it has been looked at uh

268

00:09:41,910 --> 00:09:39,040

basically with every new technology

269

00:09:43,910 --> 00:09:41,920

we've had for centuries and uh the talk

270

00:09:46,230 --> 00:09:43,920

i gave this morning at this at this

271

00:09:49,030 --> 00:09:46,240

conference outlined uh where we've gone

272

00:09:51,670 --> 00:09:49,040

basically from uh you know drawings in

273

00:09:54,470 --> 00:09:51,680

the uh you know early

274

00:09:56,310 --> 00:09:54,480

days of and early years of the telescope

275

00:09:58,550 --> 00:09:56,320

uh you know right up through

276

00:09:59,990 --> 00:09:58,560

photographs the first photograph

277

00:10:02,389 --> 00:10:00,000

uh that were taken

278

00:10:05,030 --> 00:10:02,399

and uh you know on through the the

279

00:10:07,750 --> 00:10:05,040

decades to our

280

00:10:09,190 --> 00:10:07,760

big space telescopes both optical

281

00:10:11,509 --> 00:10:09,200

wavelengths the hubble

282

00:10:12,870 --> 00:10:11,519

infrared wavelengths the spitzer space

283

00:10:17,910 --> 00:10:12,880

telescope

284

00:10:20,230 --> 00:10:17,920

herschel which is a mid-infrared

285

00:10:21,990 --> 00:10:20,240

observatory wise also a mid-infrared

286

00:10:24,470 --> 00:10:22,000

observatory

287

00:10:27,590 --> 00:10:24,480

as well as a lot of ground-based data

288

00:10:29,030 --> 00:10:27,600

at long wavelengths from the millimeter

289

00:10:32,069 --> 00:10:29,040

submillimeter

290

00:10:34,630 --> 00:10:32,079

and radio wavelengths anywhere any place

291

00:10:37,030 --> 00:10:34,640

in the electromagnetic spectrum uh that

292

00:10:40,230 --> 00:10:37,040

is interesting or is technologically

293

00:10:42,310 --> 00:10:40,240

interesting uh is uh applicable to orion

294

00:10:44,790 --> 00:10:42,320

it's it's just an amazing

295

00:10:47,430 --> 00:10:44,800

confluence of the nebula the stars that

296

00:10:49,910 --> 00:10:47,440

are forming the molecular gas that is

297

00:10:53,110 --> 00:10:49,920

there the planets that are forming there

298

00:10:54,870 --> 00:10:53,120

uh so my particular interest has has

299

00:10:56,389 --> 00:10:54,880

mostly been in the stellar population so

300

00:10:58,870 --> 00:10:56,399

trying to understand

301
00:11:01,190 --> 00:10:58,880
uh when uh you know we rattle a cloud

302
00:11:04,389 --> 00:11:01,200
around a molecular cloud what what falls

303
00:11:06,069 --> 00:11:04,399
out in terms of of a stellar population

304
00:11:07,430 --> 00:11:06,079
and in orion

305
00:11:09,190 --> 00:11:07,440
can you tell us real briefly what am i

306
00:11:10,470 --> 00:11:09,200
what you mean by molecular cloud we want

307
00:11:27,509 --> 00:11:10,480
to

308
00:11:35,110 --> 00:11:32,230
so uh in interstellar space uh there are

309
00:11:36,630 --> 00:11:35,120
uh you know there are particles uh there

310
00:11:39,190 --> 00:11:36,640
is gas

311
00:11:42,710 --> 00:11:39,200
uh and uh there are different densities

312
00:11:45,350 --> 00:11:42,720
and temperatures of that gas and

313
00:11:46,710 --> 00:11:45,360

there's there can be hot gas that is

314

00:11:49,829 --> 00:11:46,720

quite diffuse

315

00:11:53,350 --> 00:11:49,839

uh molecular clouds are regions of very

316

00:11:56,470 --> 00:11:53,360

cold gas uh very dense gas out of which

317

00:11:58,389 --> 00:11:56,480

stars are forming or will soon form

318

00:12:00,550 --> 00:11:58,399

and um it's

319

00:12:01,990 --> 00:12:00,560

as the name implies molecular cloud is a

320

00:12:04,470 --> 00:12:02,000

cloud uh

321

00:12:05,190 --> 00:12:04,480

cool enough where molecules can survive

322

00:12:08,790 --> 00:12:05,200

so

323

00:12:11,030 --> 00:12:08,800

uh molecular hydrogen uh h₂ in in

324

00:12:14,150 --> 00:12:11,040

chemistry uh format

325

00:12:15,829 --> 00:12:14,160

uh is is the most dominant molecule uh

326

00:12:18,230 --> 00:12:15,839

but we observe all kinds of molecules

327

00:12:20,310 --> 00:12:18,240

carbon monoxide um

328

00:12:21,509 --> 00:12:20,320

methane um

329

00:12:25,110 --> 00:12:21,519

all kinds of

330

00:12:26,550 --> 00:12:25,120

any any combinations of uh s's and o's

331

00:12:28,069 --> 00:12:26,560

and n's and

332

00:12:31,030 --> 00:12:28,079

and

333

00:12:33,590 --> 00:12:31,040

the periodic table you know

334

00:12:36,069 --> 00:12:33,600

in in these dense cold clouds

335

00:12:37,430 --> 00:12:36,079

so basically it's a it's a cloud that's

336

00:12:40,069 --> 00:12:37,440

cool enough that allows some of these

337

00:12:42,790 --> 00:12:40,079

atoms to form to form molecules okay

338

00:12:44,629 --> 00:12:42,800

exactly when they get hot the molecules

339

00:12:46,550 --> 00:12:44,639

uh

340

00:12:49,030 --> 00:12:46,560

dissociate so they become their

341

00:12:51,590 --> 00:12:49,040

constituent you know h₂ molecular

342

00:12:53,590 --> 00:12:51,600

hydrogen will become regular h

343

00:12:57,190 --> 00:12:53,600

atomic hydrogen

344

00:12:59,590 --> 00:12:57,200

is that important in star formation

345

00:13:01,670 --> 00:12:59,600

uh well it's the it's when you're when

346

00:13:03,990 --> 00:13:01,680

an individual star is formed it's the

347

00:13:04,949 --> 00:13:04,000

the first thing that happens in these

348

00:13:06,629 --> 00:13:04,959

cold

349

00:13:09,190 --> 00:13:06,639

molecular clouds

350

00:13:12,150 --> 00:13:09,200

is as the the uh what's called a

351
00:13:13,750 --> 00:13:12,160
protostar is in the process of of

352
00:13:16,389 --> 00:13:13,760
collapsing out of the molecular gas and

353
00:13:19,590 --> 00:13:16,399
forming uh it heats up and starts to

354
00:13:22,949 --> 00:13:19,600
dissociate the surrounding molecular gas

355
00:13:25,509 --> 00:13:22,959
uh and uh then ionizes it removes gets

356
00:13:27,509 --> 00:13:25,519
even hotter removes electrons and and

357
00:13:29,110 --> 00:13:27,519
and so on in this in this process of

358
00:13:31,269 --> 00:13:29,120
star formation

359
00:13:32,870 --> 00:13:31,279
so wait so wait the the molecular cloud

360
00:13:35,030 --> 00:13:32,880
starts to come together and then heats

361
00:13:37,430 --> 00:13:35,040
up as it as the protostar is formed and

362
00:13:39,750 --> 00:13:37,440
then at what and then at some point it

363
00:13:41,110 --> 00:13:39,760

turns on

364

00:13:43,829 --> 00:13:41,120

and correct

365

00:13:45,350 --> 00:13:43,839

and switches to uh

366

00:13:47,190 --> 00:13:45,360

stripping stripping those molecules

367

00:13:49,750 --> 00:13:47,200

apart as well as even the electrons

368

00:13:53,030 --> 00:13:49,760

around the hydrogen right right so in

369

00:13:57,030 --> 00:13:53,040

particular in the uh in the orion nebula

370

00:13:59,350 --> 00:13:57,040

uh there are some very massive stars uh

371

00:14:01,990 --> 00:13:59,360

so in excess of

372

00:14:03,990 --> 00:14:02,000

a few tens of solar masses 20 30 40

373

00:14:08,389 --> 00:14:04,000

times the mass of the sun

374

00:14:10,389 --> 00:14:08,399

and these are hot and luminous stars

375

00:14:13,030 --> 00:14:10,399

and so they're putting out a lot of a

376

00:14:15,030 --> 00:14:13,040

lot of energy and they are the ones that

377

00:14:17,350 --> 00:14:15,040

are in fact responsible for creating

378

00:14:20,389 --> 00:14:17,360

this uh nebula that we see because the

379

00:14:22,310 --> 00:14:20,399

stars themselves are uh

380

00:14:23,990 --> 00:14:22,320

interacting with the interstellar medium

381

00:14:25,750 --> 00:14:24,000

and making it making it light up the way

382

00:14:27,430 --> 00:14:25,760

we the way we see it

383

00:14:29,509 --> 00:14:27,440

okay scott can you put up that image

384

00:14:30,710 --> 00:14:29,519

again uh from michael

385

00:14:33,110 --> 00:14:30,720

yeah absolutely

386

00:14:34,870 --> 00:14:33,120

back up here so yeah let's take a look

387

00:14:37,110 --> 00:14:34,880

at that so this this this is the

388

00:14:39,030 --> 00:14:37,120

quintessential uh

389

00:14:40,150 --> 00:14:39,040

icon we're used to seeing when it comes

390

00:14:42,790 --> 00:14:40,160

to uh

391

00:14:45,189 --> 00:14:42,800

uh the orion nebula and

392

00:14:47,670 --> 00:14:45,199

can you describe to us here what how

393

00:14:49,269 --> 00:14:47,680

first of all there's there's like a

394

00:14:50,550 --> 00:14:49,279

there's the big nebula part that i'm

395

00:14:52,150 --> 00:14:50,560

that i've always looked at where the

396

00:14:53,910 --> 00:14:52,160

trapezium is and things like that and

397

00:14:56,069 --> 00:14:53,920

then there's often the lower right or

398

00:15:00,790 --> 00:14:56,079

lower left i'm sorry some other clouds

399

00:15:01,750 --> 00:15:00,800

and stuff so how big is this thing

400

00:15:07,509 --> 00:15:01,760

it's

401

00:15:09,110 --> 00:15:07,519

what is yeah what is called 10^4

402

00:15:12,470 --> 00:15:09,120

yeah it's it's what's called a giant

403

00:15:13,350 --> 00:15:12,480

molecular cloud uh so that has a mass of

404

00:15:15,430 --> 00:15:13,360

about

405

00:15:16,470 --> 00:15:15,440

a few hundred thousand times the mass of

406

00:15:19,030 --> 00:15:16,480

the sun

407

00:15:21,670 --> 00:15:19,040

and so if you think of turning all of

408

00:15:23,509 --> 00:15:21,680

that mass into stars and if each of the

409

00:15:24,710 --> 00:15:23,519

stars had a mass of

410

00:15:26,629 --> 00:15:24,720

one

411

00:15:29,350 --> 00:15:26,639

solar mass you know you would make 10 to

412

00:15:30,949 --> 00:15:29,360

5 stars you'd make a lot of stars a few

413

00:15:33,670 --> 00:15:30,959

hundred thousand stars now we don't

414

00:15:35,750 --> 00:15:33,680

think that there is a 100 percent

415

00:15:38,230 --> 00:15:35,760

efficiency in converting gas to stars so

416

00:15:39,030 --> 00:15:38,240

the the stellar mass is much less but

417

00:15:41,990 --> 00:15:39,040

the

418

00:15:44,310 --> 00:15:42,000

entire star-forming region is uh let's

419

00:15:45,269 --> 00:15:44,320

see oh about a factor of

420

00:15:47,269 --> 00:15:45,279

40

421

00:15:49,670 --> 00:15:47,279

larger than just that small region

422

00:15:51,430 --> 00:15:49,680

that's that's shown and so there's a a

423

00:15:53,189 --> 00:15:51,440

lot of the orion nebula

424

00:15:55,670 --> 00:15:53,199

there's a lot more we're not even seeing

425

00:15:58,710 --> 00:15:55,680

there's a whole lot more that is uh that

426

00:16:00,790 --> 00:15:58,720

uh you know some of the uh observatories

427

00:16:03,590 --> 00:16:00,800

that have performed all sky imaging

428

00:16:05,829 --> 00:16:03,600

surveys so two mass is one and wise is

429

00:16:08,150 --> 00:16:05,839

another these are infrared imaging

430

00:16:11,030 --> 00:16:08,160

surveys uh you can get a look at the the

431

00:16:13,430 --> 00:16:11,040

entirety of this orion region and in

432

00:16:14,790 --> 00:16:13,440

fact um there are many famous pictures

433

00:16:18,230 --> 00:16:14,800

from from astronomers of the

434

00:16:21,829 --> 00:16:18,240

constellation of orion uh with uh you

435

00:16:23,829 --> 00:16:21,839

know various elements of of

436

00:16:25,509 --> 00:16:23,839

uh throughout it and all of that is

437

00:16:27,990 --> 00:16:25,519

actually part of the same uh

438

00:16:29,430 --> 00:16:28,000

star-forming episode that you know may

439

00:16:31,430 --> 00:16:29,440

have occurred over

440

00:16:34,710 --> 00:16:31,440

you know over a few tens of millions of

441

00:16:36,550 --> 00:16:34,720

years whereas the orion nebula and other

442

00:16:39,189 --> 00:16:36,560

small condensations like it throughout

443

00:16:40,470 --> 00:16:39,199

the molecular clouds are star formation

444

00:16:41,350 --> 00:16:40,480

events that have occurred in only the

445

00:16:44,069 --> 00:16:41,360

past

446

00:16:46,069 --> 00:16:44,079

one or two or three million years

447

00:16:48,949 --> 00:16:46,079

but it's just a small but the most

448

00:16:51,030 --> 00:16:48,959

dramatic uh piece of of star formation

449

00:16:53,990 --> 00:16:51,040

in this in this entire region

450

00:16:56,389 --> 00:16:54,000

and also something fascinating is uh

451
00:16:58,150 --> 00:16:56,399
you need a bit of fantasy but think that

452
00:17:00,550 --> 00:16:58,160
in the field of the

453
00:17:02,629 --> 00:17:00,560
of the picture uh if you will take the

454
00:17:05,350 --> 00:17:02,639
picture from the orion nebula

455
00:17:06,630 --> 00:17:05,360
in in our direction and

456
00:17:09,110 --> 00:17:06,640
take a picture of the sun and

457
00:17:11,110 --> 00:17:09,120
surrounding will be basically empty with

458
00:17:13,750 --> 00:17:11,120
really a few stars a few you know 10

459
00:17:15,189 --> 00:17:13,760
stars 20 stars with nothing a lot of

460
00:17:17,750 --> 00:17:15,199
empty space

461
00:17:19,750 --> 00:17:17,760
but if we look at the orion nebula the

462
00:17:21,990 --> 00:17:19,760
density of stars in that region is

463
00:17:24,870 --> 00:17:22,000

amazingly high at the center you will

464

00:17:27,029 --> 00:17:24,880

have you know tens of thousands of stars

465

00:17:27,829 --> 00:17:27,039

where you will have only one around the

466

00:17:30,230 --> 00:17:27,839

sun

467

00:17:32,150 --> 00:17:30,240

uh in fact there are not tens of

468

00:17:35,270 --> 00:17:32,160

thousands but you know five thousand

469

00:17:36,870 --> 00:17:35,280

stars easily are uh

470

00:17:39,510 --> 00:17:36,880

members of the neighborhood of the of

471

00:17:41,909 --> 00:17:39,520

the star forming event

472

00:17:42,950 --> 00:17:41,919

in the field of the picture so it's

473

00:17:46,549 --> 00:17:42,960

extremely

474

00:17:48,150 --> 00:17:46,559

so inside that that image that that

475

00:17:50,230 --> 00:17:48,160

scott had out before there's five

476
00:17:52,310 --> 00:17:50,240
thousand stars in that that area alone

477
00:17:54,470 --> 00:17:52,320
we know three thousand in the inner

478
00:17:57,110 --> 00:17:54,480
region and then there is star formation

479
00:17:59,270 --> 00:17:57,120
along the filament or is a ball is a

480
00:18:01,990 --> 00:17:59,280
round number because we don't have a

481
00:18:03,909 --> 00:18:02,000
complete census because when this

482
00:18:04,710 --> 00:18:03,919
nebula are

483
00:18:09,909 --> 00:18:04,720
when

484
00:18:11,350 --> 00:18:09,919
cannot penetrate with our telescope we

485
00:18:14,470 --> 00:18:11,360
need infrared

486
00:18:16,470 --> 00:18:14,480
radiation to go to go in this dark you

487
00:18:18,549 --> 00:18:16,480
know like the dark filament that you see

488
00:18:20,070 --> 00:18:18,559

here now in the center we need infrared

489

00:18:22,630 --> 00:18:20,080

telescopes and even with infrared

490

00:18:24,549 --> 00:18:22,640

telescopes it starts to get very hard to

491

00:18:25,830 --> 00:18:24,559

look at the very faint sources that are

492

00:18:27,590 --> 00:18:25,840

certainly there

493

00:18:29,669 --> 00:18:27,600

but we are talking about i don't know

494

00:18:32,789 --> 00:18:29,679

three four five thousand image stars in

495

00:18:37,270 --> 00:18:32,799

this uh in this field uh is uh is is i

496

00:18:42,950 --> 00:18:39,029

around the sun in the same volume you

497

00:18:46,870 --> 00:18:42,960

will see you know tens a few

498

00:18:48,950 --> 00:18:46,880

so the um so this is glowing or it's

499

00:18:51,350 --> 00:18:48,960

this this nebula is glowing because of

500

00:18:53,190 --> 00:18:51,360

those five thousand some odd stars

501
00:18:56,230 --> 00:18:53,200
because of only one

502
00:18:58,870 --> 00:18:56,240
only one only one

503
00:19:01,430 --> 00:18:58,880
monster there is a monster in the middle

504
00:19:03,430 --> 00:19:01,440
makes 95 percent of the glow

505
00:19:06,150 --> 00:19:03,440
there is a monster we call

506
00:19:08,390 --> 00:19:06,160
one orion

507
00:19:09,190 --> 00:19:08,400
the technical name

508
00:19:10,870 --> 00:19:09,200
yeah

509
00:19:12,470 --> 00:19:10,880
so so there's only one star that's

510
00:19:13,909 --> 00:19:12,480
responsible for all this glowing here

511
00:19:16,870 --> 00:19:13,919
there is one there are

512
00:19:20,070 --> 00:19:16,880
there are you know five six seven uh big

513
00:19:23,590 --> 00:19:20,080

stars in comparison of to the sun

514

00:19:25,830 --> 00:19:23,600

uh but one is bigger among the biggest

515

00:19:28,549 --> 00:19:25,840

and this one makes i think the the last

516

00:19:31,190 --> 00:19:28,559

number i heard was 95 percent

517

00:19:32,710 --> 00:19:31,200

uh of the entire uh radiation coming

518

00:19:35,110 --> 00:19:32,720

from the from the background from the

519

00:19:36,310 --> 00:19:35,120

from the nebula this diffused blue and

520

00:19:39,430 --> 00:19:36,320

red light

521

00:19:41,590 --> 00:19:39,440

is actually reprocessed light uh is

522

00:19:43,430 --> 00:19:41,600

reflected light from from from the big

523

00:19:45,669 --> 00:19:43,440

one that is there at the center

524

00:19:46,950 --> 00:19:45,679

okay hey scott you were doing something

525

00:19:49,190 --> 00:19:46,960

a while ago i think it was with

526

00:19:51,750 --> 00:19:49,200

stellarium or something like that what

527

00:19:54,390 --> 00:19:51,760

did you have up i had a stellarium up so

528

00:19:56,470 --> 00:19:54,400

i can show i wonder if yeah if you could

529

00:19:58,230 --> 00:19:56,480

put that back up again and we for those

530

00:20:01,510 --> 00:19:58,240

of you who don't know

531

00:20:03,350 --> 00:20:01,520

where in the sky the orion nebula is uh

532

00:20:06,870 --> 00:20:03,360

scott's got a picture here

533

00:20:09,750 --> 00:20:06,880

of the orion the constellation of orion

534

00:20:11,990 --> 00:20:09,760

right and the belt are these the those

535

00:20:13,510 --> 00:20:12,000

three stars those three horizontal stars

536

00:20:16,549 --> 00:20:13,520

are the are the belt

537

00:20:19,270 --> 00:20:16,559

of uh orion but hanging down on the

538

00:20:21,669 --> 00:20:19,280

sword from orion's belt

539

00:20:24,310 --> 00:20:21,679

is these these the this also this sort

540

00:20:26,230 --> 00:20:24,320

of semi vertical row it's more of a

541

00:20:27,830 --> 00:20:26,240

cattywampus row uh kind of off to the

542

00:20:29,909 --> 00:20:27,840

diagonal there we you should use

543

00:20:31,830 --> 00:20:29,919

caddywomp that's much more fatty well it

544

00:20:33,669 --> 00:20:31,840

is jargon but i have you know i have to

545

00:20:36,070 --> 00:20:33,679

explain that jargon and i so i try to

546

00:20:38,149 --> 00:20:36,080

minimize it so it's kind of cattywampus

547

00:20:40,149 --> 00:20:38,159

there but in that middle area there it's

548

00:20:42,230 --> 00:20:40,159

real kind it's kind of fuzzy now on a

549

00:20:43,990 --> 00:20:42,240

clear dark night

550

00:20:46,390 --> 00:20:44,000

you can't be in the city

551
00:20:48,230 --> 00:20:46,400
but on a clear dark night you can see

552
00:20:51,270 --> 00:20:48,240
that with your naked eye you can it'll

553
00:20:53,510 --> 00:20:51,280
appear basically as a as a fuzz or a sm

554
00:20:54,870 --> 00:20:53,520
fuzzy patch or a smudge up in the sky

555
00:20:56,390 --> 00:20:54,880
but you can see it and a pair of

556
00:20:58,310 --> 00:20:56,400
binoculars actually bring out some

557
00:21:00,070 --> 00:20:58,320
pretty decent detail

558
00:21:02,870 --> 00:21:00,080
so

559
00:21:03,750 --> 00:21:02,880
uh massimo and and lynn the

560
00:21:05,350 --> 00:21:03,760
this

561
00:21:06,870 --> 00:21:05,360
can you tell us what the difference is

562
00:21:10,070 --> 00:21:06,880
between the orion

563
00:21:11,909 --> 00:21:10,080

nebula and the orion nebula complex what

564

00:21:13,990 --> 00:21:11,919

do they mean when they say that

565

00:21:18,630 --> 00:21:14,000

or molecular cloud complex i guess they

566

00:21:24,230 --> 00:21:21,270

so you know if you zoom in really close

567

00:21:25,990 --> 00:21:24,240

on that image or or another good one uh

568

00:21:27,909 --> 00:21:26,000

like it you'll see what are called the

569

00:21:29,190 --> 00:21:27,919

trapezium stars and that's because there

570

00:21:31,510 --> 00:21:29,200

are four

571

00:21:35,029 --> 00:21:31,520

bright bright stars in there that are

572

00:21:36,870 --> 00:21:35,039

visible in just the the smallest uh

573

00:21:39,190 --> 00:21:36,880

telescopes so that's called the

574

00:21:42,149 --> 00:21:39,200

trapezium and the inner part of this is

575

00:21:43,750 --> 00:21:42,159

called the trapezium cluster if you go

576

00:21:45,110 --> 00:21:43,760

out a little bit kind of like the view

577

00:21:48,149 --> 00:21:45,120

you have now

578

00:21:50,630 --> 00:21:48,159

uh what is there in the nebula is called

579

00:21:55,990 --> 00:21:50,640

the orion nebula

580

00:21:58,789 --> 00:21:56,000

uh but then if you uh zoom out quite a

581

00:22:00,710 --> 00:21:58,799

bit on the other um you know the large

582

00:22:02,310 --> 00:22:00,720

scale image that showed the

583

00:22:04,549 --> 00:22:02,320

the constellation

584

00:22:07,270 --> 00:22:04,559

uh and i guess maybe we don't have at

585

00:22:09,029 --> 00:22:07,280

the at the ready a map of the dust or

586

00:22:11,430 --> 00:22:09,039

the molecular gas or anything like that

587

00:22:13,270 --> 00:22:11,440

but there are other ways of um

588

00:22:14,310 --> 00:22:13,280

viewing at other wavelengths than

589

00:22:16,549 --> 00:22:14,320

optical

590

00:22:18,310 --> 00:22:16,559

this area of the sky and what you'll see

591

00:22:20,310 --> 00:22:18,320

is a big

592

00:22:22,630 --> 00:22:20,320

patch of dust

593

00:22:25,350 --> 00:22:22,640

if this is viewed in maybe the wise

594

00:22:27,430 --> 00:22:25,360

satellite or the iras satellite

595

00:22:30,789 --> 00:22:27,440

images where we're seeing the dust

596

00:22:34,789 --> 00:22:30,799

instead of the stars uh you'll see a big

597

00:22:36,070 --> 00:22:34,799

swath of this area uh covered in in dust

598

00:22:38,630 --> 00:22:36,080

and gas

599

00:22:42,630 --> 00:22:38,640

and that is what's referred to as the

600

00:22:44,950 --> 00:22:42,640

orion molecular clouds and so it extends

601
00:22:48,310 --> 00:22:44,960
the orion cluster the trapezium the

602
00:22:51,270 --> 00:22:48,320
orion nebula the orion cluster is uh the

603
00:22:54,149 --> 00:22:51,280
northern part of one of these clouds

604
00:22:55,750 --> 00:22:54,159
that extends way down to the south and

605
00:22:57,270 --> 00:22:55,760
then there's another a piece of the

606
00:22:59,590 --> 00:22:57,280
cloud that extends way up to the north

607
00:23:01,430 --> 00:22:59,600
and it really does cover the full

608
00:23:03,190 --> 00:23:01,440
uh nearly the full extent of the orion

609
00:23:04,470 --> 00:23:03,200
constellation almost all the way up to

610
00:23:06,549 --> 00:23:04,480
betelgeuse

611
00:23:09,350 --> 00:23:06,559
uh looking at it on the sky in the upper

612
00:23:10,870 --> 00:23:09,360
left and uh all the way down to let's

613
00:23:12,470 --> 00:23:10,880

see is it rigel or

614

00:23:13,750 --> 00:23:12,480

all right

615

00:23:15,430 --> 00:23:13,760

i don't know the bottom layer is the

616

00:23:16,710 --> 00:23:15,440

only one i don't know the other bright

617

00:23:18,470 --> 00:23:16,720

the other bright one down there yeah

618

00:23:28,630 --> 00:23:18,480

that molecular cloud extends

619

00:23:33,110 --> 00:23:30,149

yeah so the whole constellation is

620

00:23:35,430 --> 00:23:33,120

covered on the that's that's side which

621

00:23:36,390 --> 00:23:35,440

is the eastern eastern

622

00:23:39,029 --> 00:23:36,400

side

623

00:23:41,990 --> 00:23:39,039

uh is covered by this molecular gas

624

00:23:43,669 --> 00:23:42,000

and then even across the belt uh below

625

00:23:46,070 --> 00:23:43,679

the belt there's another star called

626
00:23:48,710 --> 00:23:46,080
sigma ori which is a small one there's a

627
00:23:51,510 --> 00:23:48,720
cluster of young stars around that

628
00:23:53,510 --> 00:23:51,520
um i don't know if you're zooming in

629
00:23:55,270 --> 00:23:53,520
maybe we can find if we can find sigma

630
00:23:56,070 --> 00:23:55,280
ori there's a cluster of young stars

631
00:23:58,630 --> 00:23:56,080
there

632
00:24:01,190 --> 00:23:58,640
uh and then also way up in the north uh

633
00:24:04,149 --> 00:24:01,200
lambda ori which is kind of the head

634
00:24:05,750 --> 00:24:04,159
of orion again there's a big cluster of

635
00:24:08,310 --> 00:24:05,760
young stars

636
00:24:10,549 --> 00:24:08,320
there and then also off to the

637
00:24:13,269 --> 00:24:10,559
the west there isn't any molecular gas

638
00:24:16,710 --> 00:24:13,279

but there's a whole group of um kind of

639

00:24:18,070 --> 00:24:16,720

high mass not uh not as high masses are

640

00:24:20,070 --> 00:24:18,080

and young as are forming in the

641

00:24:22,070 --> 00:24:20,080

trapezium cluster but there's a whole

642

00:24:24,149 --> 00:24:22,080

group of um

643

00:24:25,830 --> 00:24:24,159

you know maybe a hundred or so you know

644

00:24:27,430 --> 00:24:25,840

also somewhat massive stars they're a

645

00:24:30,230 --> 00:24:27,440

little bit older more like 10 million

646

00:24:31,830 --> 00:24:30,240

years old instead of 1 million years old

647

00:24:33,909 --> 00:24:31,840

so this whole constellation is filled

648

00:24:37,430 --> 00:24:33,919

with with young stars and you know as

649

00:24:39,510 --> 00:24:37,440

we've said the the most uh dramatic

650

00:24:41,110 --> 00:24:39,520

visible part uh to us is the orion

651

00:24:43,669 --> 00:24:41,120

nebula cluster but if you look in the

652

00:24:45,830 --> 00:24:43,679

the infrared uh and the dust and the

653

00:24:47,750 --> 00:24:45,840

molecular gas this whole thing just just

654

00:24:49,190 --> 00:24:47,760

lights up with uh with young stars and

655

00:24:51,190 --> 00:24:49,200

young star club and

656

00:24:53,269 --> 00:24:51,200

if i cannot lean this morning was making

657

00:24:55,269 --> 00:24:53,279

a very interesting point that i i i

658

00:24:57,510 --> 00:24:55,279

realized maybe i knew it but i i you

659

00:24:58,830 --> 00:24:57,520

know you forget but she reminded

660

00:25:00,950 --> 00:24:58,840

everybody that

661

00:25:03,110 --> 00:25:00,960

orion from the point of view of the

662

00:25:05,750 --> 00:25:03,120

constellation you know just the drawing

663

00:25:09,110 --> 00:25:05,760

that you make in the sky of the warrior

664

00:25:10,950 --> 00:25:09,120

with the belt the sword

665

00:25:13,350 --> 00:25:10,960

everything you see when you draw the

666

00:25:15,510 --> 00:25:13,360

exactly basically everything is at the

667

00:25:18,630 --> 00:25:15,520

same distance is an amazing

668

00:25:19,830 --> 00:25:18,640

constellation is no you these are random

669

00:25:23,029 --> 00:25:19,840

drawings

670

00:25:25,269 --> 00:25:23,039

but uh if you look at the ursa maya or

671

00:25:27,029 --> 00:25:25,279

any other constellation you know stars

672

00:25:29,029 --> 00:25:27,039

bright fade

673

00:25:30,710 --> 00:25:29,039

they're far away one from the other but

674

00:25:32,630 --> 00:25:30,720

in the case of orion they are more or

675

00:25:35,909 --> 00:25:32,640

less all at the same distance about 400

676

00:25:38,390 --> 00:25:35,919

500 parsec or 1500 light years so is

677

00:25:40,070 --> 00:25:38,400

there all basically the same plane

678

00:25:43,430 --> 00:25:40,080

every match everything is at the same

679

00:25:46,310 --> 00:25:43,440

distance and we is everything is is a

680

00:25:48,950 --> 00:25:46,320

monster is the closest giant star

681

00:25:51,750 --> 00:25:48,960

formation event that happened a few

682

00:25:55,110 --> 00:25:51,760

million years ago and uh

683

00:25:57,909 --> 00:25:55,120

so we see like a distribution of ages we

684

00:25:59,990 --> 00:25:57,919

understand some area from like 10

685

00:26:02,950 --> 00:26:00,000

million years or something like five or

686

00:26:04,310 --> 00:26:02,960

ion the nebula is the most recent is one

687

00:26:06,950 --> 00:26:04,320

million years actually there is that

688

00:26:08,870 --> 00:26:06,960

formation even right now

689

00:26:12,230 --> 00:26:08,880

in the nebula but

690

00:26:15,190 --> 00:26:12,240

but in general is like this uh this uh i

691

00:26:17,590 --> 00:26:15,200

don't know this event this not imagine

692

00:26:20,470 --> 00:26:17,600

imagining the

693

00:26:23,029 --> 00:26:20,480

the burst of stars

694

00:26:25,430 --> 00:26:23,039

at in that place of the sky that

695

00:26:27,590 --> 00:26:25,440

happened nearly simultaneously

696

00:26:29,590 --> 00:26:27,600

wow so i didn't really know that about

697

00:26:31,669 --> 00:26:29,600

the uh about the constellation so you're

698

00:26:33,430 --> 00:26:31,679

telling me that the stars in the

699

00:26:35,669 --> 00:26:33,440

constellation itself

700

00:26:37,350 --> 00:26:35,679

uh the the major stars that make up the

701
00:26:41,029 --> 00:26:37,360
constellation were more or less the same

702
00:26:43,110 --> 00:26:41,039
distance away from us yeah you know

703
00:26:45,830 --> 00:26:43,120
the stars that are being worn are this

704
00:26:47,510 --> 00:26:45,840
complex affects the stars like uh

705
00:26:49,590 --> 00:26:47,520
beetlejuice and rigel and they're

706
00:26:51,269 --> 00:26:49,600
they're like affected by this right

707
00:26:53,669 --> 00:26:51,279
they are affected and actually if you go

708
00:26:55,990 --> 00:26:53,679
with the right uh instruments if you do

709
00:26:58,230 --> 00:26:56,000
i don't know for example in the h alpha

710
00:27:00,950 --> 00:26:58,240
or in the or in or in

711
00:27:03,909 --> 00:27:00,960
100 micron there's different tracers but

712
00:27:06,710 --> 00:27:03,919
you can see spectacular pictures of the

713
00:27:09,430 --> 00:27:06,720

giant rings which are the remnants of

714

00:27:11,350 --> 00:27:09,440

supernova that exploded in

715

00:27:13,430 --> 00:27:11,360

very recently you can you can we can

716

00:27:16,390 --> 00:27:13,440

still see the explosion

717

00:27:18,310 --> 00:27:16,400

you know the material being blown away

718

00:27:20,549 --> 00:27:18,320

and and when you see this giant

719

00:27:22,630 --> 00:27:20,559

supernova normally they are associated

720

00:27:24,789 --> 00:27:22,640

the recent star formation because

721

00:27:26,310 --> 00:27:24,799

giant stars have a short life and tend

722

00:27:29,350 --> 00:27:26,320

to explode as

723

00:27:34,630 --> 00:27:29,360

a supernova type 2 supernovae so it's we

724

00:27:37,830 --> 00:27:35,990

collection of

725

00:27:39,269 --> 00:27:37,840

of uh of of uh

726

00:27:41,510 --> 00:27:39,279

phenomenology

727

00:27:43,750 --> 00:27:41,520

associated to star formation

728

00:27:46,710 --> 00:27:43,760

large mass small mass

729

00:27:49,590 --> 00:27:46,720

is there in this place in this part of

730

00:27:51,269 --> 00:27:49,600

the sky so far for astronomy is a

731

00:27:52,470 --> 00:27:51,279

fantastic

732

00:27:55,669 --> 00:27:52,480

region

733

00:27:58,070 --> 00:27:55,679

let's ask our astrophotographer he's has

734

00:28:00,710 --> 00:27:58,080

taken h alpha images

735

00:28:04,149 --> 00:28:00,720

uh no i've never well i mean my camera

736

00:28:06,470 --> 00:28:04,159

is modified so it can get better h alpha

737

00:28:09,510 --> 00:28:06,480

but i don't have actual specific filters

738

00:28:10,630 --> 00:28:09,520

for it yeah that can be expensive

739

00:28:11,669 --> 00:28:10,640

yeah

740

00:28:13,750 --> 00:28:11,679

you can see

741

00:28:16,389 --> 00:28:13,760

in h alpha images of this region you can

742

00:28:19,830 --> 00:28:16,399

see what's called barnard's loop it's a

743

00:28:22,070 --> 00:28:19,840

it's a big loop uh off to the the east

744

00:28:24,149 --> 00:28:22,080

side of the cluster and then also uh

745

00:28:26,549 --> 00:28:24,159

around lambda ori to the north again

746

00:28:28,870 --> 00:28:26,559

there's a big h alpha

747

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

uh piece that you know you just see in

748

00:28:33,909 --> 00:28:31,679

these uh fantastic images of the entire

749

00:28:36,710 --> 00:28:33,919

en entire constellation and each alpha

750

00:28:38,070 --> 00:28:36,720

filter is a good investment yeah

751
00:28:40,070 --> 00:28:38,080
for christmas

752
00:28:42,549 --> 00:28:40,080
one of these days soon hopefully one of

753
00:28:44,230 --> 00:28:42,559
these days one of my other astronomers

754
00:28:46,389 --> 00:28:44,240
uh this is from paul stewart this is

755
00:28:47,269 --> 00:28:46,399
also an h alpha plus um

756
00:28:49,110 --> 00:28:47,279
with

757
00:28:50,870 --> 00:28:49,120
the the rest of the spectrum here but

758
00:28:52,230 --> 00:28:50,880
this is taken from new zealand actually

759
00:28:53,909 --> 00:28:52,240
so actually let me just say real quick

760
00:28:55,750 --> 00:28:53,919
scott massimo if you want

761
00:28:57,590 --> 00:28:55,760
if this image doesn't appear big on your

762
00:28:59,350 --> 00:28:57,600
screen you can just click on one of the

763
00:29:00,310 --> 00:28:59,360

little icons to get it bigger up on your

764

00:29:01,669 --> 00:29:00,320

screen and you'll be able to get a

765

00:29:03,430 --> 00:29:01,679

better look i don't know if you're

766

00:29:05,269 --> 00:29:03,440

trying to squint down at the thumbnail

767

00:29:07,110 --> 00:29:05,279

or not so

768

00:29:08,230 --> 00:29:07,120

i just wanted to say that

769

00:29:10,230 --> 00:29:08,240

there's a little film strip on the

770

00:29:11,510 --> 00:29:10,240

bottom if you click on whichever image

771

00:29:12,549 --> 00:29:11,520

you want to see it'll make it large on

772

00:29:13,750 --> 00:29:12,559

your screen

773

00:29:16,870 --> 00:29:13,760

do you see you see what i'm talking

774

00:29:19,750 --> 00:29:18,470

massimo

775

00:29:21,110 --> 00:29:19,760

yep

776

00:29:22,230 --> 00:29:21,120

i was trying to say that you know in

777

00:29:23,830 --> 00:29:22,240

case

778

00:29:26,230 --> 00:29:23,840

you when you're looking at this at this

779

00:29:28,149 --> 00:29:26,240

hangout if when scott shows a picture

780

00:29:29,750 --> 00:29:28,159

and it's not big on your mac on your

781

00:29:32,149 --> 00:29:29,760

screen just click on it and it'll make

782

00:29:33,430 --> 00:29:32,159

it big okay you know but i i think i

783

00:29:35,190 --> 00:29:33,440

don't know lynn but

784

00:29:44,310 --> 00:29:35,200

with a glimpse we can immediately you

785

00:29:47,750 --> 00:29:45,510

looking at the thumbnail so i just

786

00:29:50,230 --> 00:29:47,760

wanted to clear that up

787

00:29:51,350 --> 00:29:50,240

so okay we know the corner

788

00:29:52,950 --> 00:29:51,360

okay

789

00:29:54,789 --> 00:29:52,960

so uh

790

00:29:56,549 --> 00:29:54,799

this looks a lot different than the

791

00:29:58,230 --> 00:29:56,559

other one i mean in terms of colors and

792

00:30:00,870 --> 00:29:58,240

things like that you said uh tell me

793

00:30:02,789 --> 00:30:00,880

again what it was so this is uh taken by

794

00:30:06,149 --> 00:30:02,799

paul stewart who's out of new zealand

795

00:30:09,350 --> 00:30:06,159

and he this these are 822nd

796

00:30:12,230 --> 00:30:09,360

it's an lrgb and also eight seconds

797

00:30:15,029 --> 00:30:12,240

excuse me eight shots of 300 seconds in

798

00:30:17,430 --> 00:30:15,039

hydrogen alpha so he took these and

799

00:30:19,029 --> 00:30:17,440

stacked them on there and as he likes to

800

00:30:21,190 --> 00:30:19,039

call himself the correctly oriented

801
00:30:22,470 --> 00:30:21,200
astronomer since he's upside down to us

802
00:30:24,310 --> 00:30:22,480
but um

803
00:30:26,310 --> 00:30:24,320
constellation after all

804
00:30:28,630 --> 00:30:26,320
but yeah so this is showing the

805
00:30:29,830 --> 00:30:28,640
difference in the the different colors

806
00:30:31,269 --> 00:30:29,840
and the structures you're able to see

807
00:30:33,110 --> 00:30:31,279
when you are looking at these different

808
00:30:35,430 --> 00:30:33,120
wavelengths so hydrogen alpha is

809
00:30:37,430 --> 00:30:35,440
something that's going to be more red to

810
00:30:39,110 --> 00:30:37,440
us than what we would see in the regular

811
00:30:40,389 --> 00:30:39,120
optical light that we see with our eyes

812
00:30:42,070 --> 00:30:40,399
all the time

813
00:30:44,070 --> 00:30:42,080

yes okay

814

00:30:47,590 --> 00:30:44,080

so um okay let me go back to something

815

00:30:49,350 --> 00:30:47,600

you said earlier on you said that um you

816

00:30:51,350 --> 00:30:49,360

you were one of your one of your uh

817

00:30:53,990 --> 00:30:51,360

areas of interest is stellar populations

818

00:30:54,789 --> 00:30:54,000

in the in the orion nebula so

819

00:30:59,350 --> 00:30:54,799

what

820

00:31:00,310 --> 00:30:59,360

and uh

821

00:31:01,669 --> 00:31:00,320

uh

822

00:31:03,029 --> 00:31:01,679

you know tell us a little bit about what

823

00:31:04,950 --> 00:31:03,039

you're finding when you look for these

824

00:31:06,470 --> 00:31:04,960

stellar populations

825

00:31:08,870 --> 00:31:06,480

sure so some of the interesting things

826

00:31:10,789 --> 00:31:08,880

about the the stars in the orion nebula

827

00:31:12,549 --> 00:31:10,799

are as we've said there are these couple

828

00:31:14,389 --> 00:31:12,559

of massive stars that you know kind of

829

00:31:15,990 --> 00:31:14,399

create all the havoc that make the orion

830

00:31:18,870 --> 00:31:16,000

nebula beautiful

831

00:31:19,630 --> 00:31:18,880

uh but there's uh an entire

832

00:31:22,630 --> 00:31:19,640

uh

833

00:31:25,990 --> 00:31:22,640

distribution of masses that go down all

834

00:31:28,149 --> 00:31:26,000

the way from these few tens maybe uh you

835

00:31:30,789 --> 00:31:28,159

know 40 45 solar masses for the most

836

00:31:33,029 --> 00:31:30,799

massive one down to one solar mass which

837

00:31:35,430 --> 00:31:33,039

the mass of our sun

838

00:31:38,389 --> 00:31:35,440

with more of these lower mass stars than

839

00:31:40,549 --> 00:31:38,399

there are higher mass stars and then the

840

00:31:41,750 --> 00:31:40,559

distribution just keeps going down all

841

00:31:46,070 --> 00:31:41,760

the way

842

00:31:48,070 --> 00:31:46,080

about a tenth of a solar mass so ten

843

00:31:50,310 --> 00:31:48,080

percent of the mass of the sun

844

00:31:52,230 --> 00:31:50,320

is uh considered right around the limit

845

00:31:54,789 --> 00:31:52,240

for which uh stars

846

00:31:56,310 --> 00:31:54,799

are considered stars that is they're uh

847

00:31:57,830 --> 00:31:56,320

they they burn

848

00:31:58,710 --> 00:31:57,840

hydrogen

849

00:32:00,470 --> 00:31:58,720

right

850

00:32:02,630 --> 00:32:00,480

exactly they burn hydrogen fuel in their

851

00:32:04,470 --> 00:32:02,640

in their center and are self

852

00:32:07,269 --> 00:32:04,480

luminous and can live for billions of

853

00:32:08,310 --> 00:32:07,279

years uh but the mass spectrum keeps

854

00:32:10,789 --> 00:32:08,320

going

855

00:32:12,950 --> 00:32:10,799

uh and uh into what's called the brown

856

00:32:15,190 --> 00:32:12,960

dwarf regime so those are objects that

857

00:32:16,950 --> 00:32:15,200

are not massive enough so that the

858

00:32:19,350 --> 00:32:16,960

centers are hot enough and dense enough

859

00:32:22,230 --> 00:32:19,360

that they'll burn hydrogen undergo

860

00:32:25,110 --> 00:32:22,240

fusion and become a main sequence star

861

00:32:27,190 --> 00:32:25,120

so those brown dwarfs will just

862

00:32:28,870 --> 00:32:27,200

as they they form like stars but then

863

00:32:32,149 --> 00:32:28,880

they just continue to

864

00:32:34,230 --> 00:32:32,159

cool and and contract and never

865

00:32:36,549 --> 00:32:34,240

stabilize themselves as as hydrogen

866

00:32:38,549 --> 00:32:36,559

burning and there are

867

00:32:40,470 --> 00:32:38,559

you know at some there's a

868

00:32:42,389 --> 00:32:40,480

as i said a mass spectrum or

869

00:32:45,029 --> 00:32:42,399

distribution of masses where there are

870

00:32:47,190 --> 00:32:45,039

more low mass stars than high mass stars

871

00:32:48,950 --> 00:32:47,200

and then somewhere

872

00:32:51,430 --> 00:32:48,960

probably above

873

00:32:54,230 --> 00:32:51,440

seemingly above the brown dwarf

874

00:32:56,470 --> 00:32:54,240

limit this mass spectrum turns over and

875

00:32:59,190 --> 00:32:56,480

so there are you know there are brown

876

00:33:00,789 --> 00:32:59,200

dwarfs down there uh but there are fewer

877

00:33:03,430 --> 00:33:00,799

of them than there are stars this has

878

00:33:04,789 --> 00:33:03,440

been kind of a uh topic that's gone back

879

00:33:07,830 --> 00:33:04,799

and forth as what's the true

880

00:33:09,430 --> 00:33:07,840

distribution uh as as as i said earlier

881

00:33:11,830 --> 00:33:09,440

you know shake up a molecular cloud and

882

00:33:13,750 --> 00:33:11,840

form stars you know what what falls out

883

00:33:15,750 --> 00:33:13,760

uh there's been some debate

884

00:33:18,070 --> 00:33:15,760

observational you know how we convert

885

00:33:19,509 --> 00:33:18,080

the things that we observe into

886

00:33:21,909 --> 00:33:19,519

something like a mass right it's not

887

00:33:24,310 --> 00:33:21,919

very easy uh to measure the mass or the

888

00:33:25,669 --> 00:33:24,320

age for a star we have techniques so we

889

00:33:27,830 --> 00:33:25,679

can measure its temperature we can

890

00:33:29,909 --> 00:33:27,840

measure how bright it is but you know we

891

00:33:31,909 --> 00:33:29,919

can't weigh it or uh you know carbon

892

00:33:34,230 --> 00:33:31,919

dated or something like that like we do

893

00:33:36,070 --> 00:33:34,240

for more familiar objects here on earth

894

00:33:37,509 --> 00:33:36,080

uh so it's a bit of a challenge of you

895

00:33:39,909 --> 00:33:37,519

know going between

896

00:33:42,149 --> 00:33:39,919

uh you know converting what we observe

897

00:33:44,230 --> 00:33:42,159

into into using our understanding of

898

00:33:46,710 --> 00:33:44,240

stellar evolution and theory to convert

899

00:33:48,789 --> 00:33:46,720

things into a mass so uh for for a time

900

00:33:50,149 --> 00:33:48,799

there was some you know kind of debate

901
00:33:51,909 --> 00:33:50,159
about you know how many brown dwarfs

902
00:33:54,950 --> 00:33:51,919
there were versus stars and it's pretty

903
00:33:57,110 --> 00:33:54,960
clear in the orion nebula and in most

904
00:33:58,630 --> 00:33:57,120
other star-forming regions now that this

905
00:33:59,990 --> 00:33:58,640
mass spectrum turns over and so there

906
00:34:01,509 --> 00:34:00,000
are fewer brown dwarfs than there are

907
00:34:03,430 --> 00:34:01,519
stars but they're still they're still

908
00:34:04,950 --> 00:34:03,440
there and about 20 percent of all

909
00:34:07,990 --> 00:34:04,960
objects are probably

910
00:34:10,389 --> 00:34:08,000
brown dwarfs about 80 percent are stars

911
00:34:13,909 --> 00:34:10,399
wow and how are those mostly found in

912
00:34:18,230 --> 00:34:13,919
the uh infrared the brown dwarfs

913
00:34:19,829 --> 00:34:18,240

bro uh yes yeah um laughing

914

00:34:21,669 --> 00:34:19,839

i'm laughing because you are talking

915

00:34:24,470 --> 00:34:21,679

about our next i mean

916

00:34:26,470 --> 00:34:24,480

lynn and i are working on uh on to

917

00:34:27,829 --> 00:34:26,480

exactly solve this problem using hubble

918

00:34:29,430 --> 00:34:27,839

in the infrared

919

00:34:31,349 --> 00:34:29,440

oh okay all right so you're going to

920

00:34:33,669 --> 00:34:31,359

answer that question then right are you

921

00:34:36,470 --> 00:34:33,679

going to be able to see them in

922

00:34:38,149 --> 00:34:36,480

very soon we'll have a precise senses

923

00:34:44,310 --> 00:34:38,159

okay

924

00:34:49,190 --> 00:34:46,230

no but there is an interesting if i can

925

00:34:52,230 --> 00:34:49,200

there is an interesting uh

926

00:34:55,030 --> 00:34:52,240

problem here which fascinates me

927

00:34:57,510 --> 00:34:55,040

uh all these stars are actually only the

928

00:35:00,069 --> 00:34:57,520

only very few and the the largest one

929

00:35:02,630 --> 00:35:00,079

are burning hydrogen

930

00:35:04,390 --> 00:35:02,640

we have these thousands of stars and

931

00:35:06,390 --> 00:35:04,400

they are not burning hydrogen they are

932

00:35:07,670 --> 00:35:06,400

so young that they are still

933

00:35:10,150 --> 00:35:07,680

preparing

934

00:35:12,950 --> 00:35:10,160

the the hydrogen burning they still need

935

00:35:15,190 --> 00:35:12,960

to to to shrink in size to raise their

936

00:35:18,150 --> 00:35:15,200

internal temperature eventually they

937

00:35:20,470 --> 00:35:18,160

will burn either number will take 50 000

938

00:35:22,630 --> 00:35:20,480

years 100 000 years the smaller stars

939

00:35:24,950 --> 00:35:22,640

will take a lot of time actually the

940

00:35:26,390 --> 00:35:24,960

smaller smaller will never reach that

941

00:35:29,270 --> 00:35:26,400

point and these are what we call the

942

00:35:30,390 --> 00:35:29,280

brown dwarfs so the interesting question

943

00:35:32,310 --> 00:35:30,400

is that

944

00:35:34,470 --> 00:35:32,320

even if there is something here that

945

00:35:36,390 --> 00:35:34,480

will happen in the far future in

946

00:35:37,829 --> 00:35:36,400

hundreds of thousands of years

947

00:35:41,430 --> 00:35:37,839

it is like

948

00:35:43,510 --> 00:35:41,440

if nature regulates itself so to have

949

00:35:46,470 --> 00:35:43,520

the majority of stars

950

00:35:49,109 --> 00:35:46,480

basically at the at this magic crossing

951
00:35:50,950 --> 00:35:49,119
point between burning or not burning so

952
00:35:54,150 --> 00:35:50,960
there is something here that sort of

953
00:35:56,390 --> 00:35:54,160
regulates most of the stars are born

954
00:35:58,470 --> 00:35:56,400
just there which is a fascinating point

955
00:36:01,030 --> 00:35:58,480
how do they know what will happen in 100

956
00:36:04,310 --> 00:36:01,040
000 years so this is an open problem we

957
00:36:06,310 --> 00:36:04,320
think that maybe other type of

958
00:36:08,550 --> 00:36:06,320
nuclear burning like burning deuterium

959
00:36:10,950 --> 00:36:08,560
may have something to do but this is an

960
00:36:13,910 --> 00:36:10,960
interesting question why why does most

961
00:36:16,630 --> 00:36:13,920
of the stars form just at the mass where

962
00:36:19,190 --> 00:36:16,640
they will eventually burn hydrogen it's

963
00:36:20,630 --> 00:36:19,200

it's a is a curiosity and an interesting

964

00:36:23,109 --> 00:36:20,640

problem

965

00:36:25,829 --> 00:36:23,119

why would most of the stars being that

966

00:36:27,910 --> 00:36:25,839

are born in this nebula

967

00:36:29,270 --> 00:36:27,920

if the mass just doesn't get that point

968

00:36:31,510 --> 00:36:29,280

where they start to burn that's what

969

00:36:33,750 --> 00:36:31,520

most of the stars are right most of the

970

00:36:35,829 --> 00:36:33,760

stars like to walk on the fine line so

971

00:36:38,390 --> 00:36:35,839

to speak which is which is interesting

972

00:36:40,390 --> 00:36:38,400

why they don't overdo on one side or the

973

00:36:42,550 --> 00:36:40,400

other but stay on the line okay so

974

00:36:43,910 --> 00:36:42,560

here's where i'm at

975

00:36:47,670 --> 00:36:43,920

they're like johnny cash and they just

976

00:36:50,390 --> 00:36:47,680

walk the line what exactly yeah okay

977

00:36:53,030 --> 00:36:50,400

yeah okay all right there's one here

978

00:36:55,109 --> 00:36:53,040

that was it that was the only one okay

979

00:36:56,870 --> 00:36:55,119

um so i

980

00:36:58,390 --> 00:36:56,880

i guess i'm still

981

00:37:00,870 --> 00:36:58,400

i'm sorry massimo i'm still trying to

982

00:37:02,230 --> 00:37:00,880

understand that statement of because i

983

00:37:04,230 --> 00:37:02,240

thought lynn said that there were there

984

00:37:06,069 --> 00:37:04,240

was a distribution of stars out there

985

00:37:09,829 --> 00:37:06,079

and that the brown dwarfs and the were

986

00:37:11,670 --> 00:37:09,839

like 20 right and then there were but

987

00:37:14,310 --> 00:37:11,680

you're saying the majority of stars that

988

00:37:17,270 --> 00:37:14,320

you're seeing in the orion nebula are

989

00:37:20,150 --> 00:37:17,280

those stars that are just massive enough

990

00:37:23,510 --> 00:37:20,160

for hydrogen to kick in or exactly

991

00:37:25,349 --> 00:37:23,520

exactly and but hydrogen to kick in the

992

00:37:27,510 --> 00:37:25,359

future

993

00:37:29,670 --> 00:37:27,520

so there is something the way the masses

994

00:37:31,270 --> 00:37:29,680

of the stars are produced are

995

00:37:33,589 --> 00:37:31,280

distributed

996

00:37:36,230 --> 00:37:33,599

that sort of regulates them

997

00:37:38,230 --> 00:37:36,240

at that point and this is it's not only

998

00:37:40,710 --> 00:37:38,240

orion it's a general is a general

999

00:37:42,150 --> 00:37:40,720

relation so this is a is an interesting

1000

00:37:43,750 --> 00:37:42,160

problem that tells us that there is

1001
00:37:44,790 --> 00:37:43,760
something there that we need to clearly

1002
00:37:46,470 --> 00:37:44,800
understand

1003
00:37:48,150 --> 00:37:46,480
oh yeah that wow that's that's a

1004
00:37:50,470 --> 00:37:48,160
fascinating idea i didn't even thank you

1005
00:37:52,710 --> 00:37:50,480
i didn't realize that um i want to just

1006
00:37:54,710 --> 00:37:52,720
take a moment here and ask you massimo

1007
00:37:56,230 --> 00:37:54,720
did you want to grab another person to

1008
00:37:57,190 --> 00:37:56,240
come in or do you want to just keep

1009
00:37:58,790 --> 00:37:57,200
going because i've got some more

1010
00:38:00,950 --> 00:37:58,800
questions if you want me i can get up

1011
00:38:02,390 --> 00:38:00,960
but we have we have other guests here so

1012
00:38:04,390 --> 00:38:02,400
i can

1013
00:38:05,910 --> 00:38:04,400

let me give you an opportunity and while

1014

00:38:07,750 --> 00:38:05,920

i do that lynn if you could just stay

1015

00:38:10,150 --> 00:38:07,760

there you can go grab somebody let me

1016

00:38:12,630 --> 00:38:10,160

just let me just thank lynn for for uh

1017

00:38:15,030 --> 00:38:12,640

participating and and uh

1018

00:38:17,109 --> 00:38:15,040

and then then you can go if you want to

1019

00:38:18,710 --> 00:38:17,119

but you can stay in a hangout too we

1020

00:38:19,670 --> 00:38:18,720

like uh we'd like you to stay if you

1021

00:38:21,190 --> 00:38:19,680

want to

1022

00:38:22,710 --> 00:38:21,200

so uh

1023

00:38:25,589 --> 00:38:22,720

did you did you give a talk already

1024

00:38:28,069 --> 00:38:25,599

today lynn i did i gave uh the opening

1025

00:38:30,390 --> 00:38:28,079

talk this morning the first one and uh

1026

00:38:31,510 --> 00:38:30,400

that's that's sort of fun because uh

1027

00:38:33,270 --> 00:38:31,520

well as some of the conference

1028

00:38:35,589 --> 00:38:33,280

organizers uh

1029

00:38:38,630 --> 00:38:35,599

told me i'm i'm old enough now to give

1030

00:38:43,829 --> 00:38:41,109

so i've been working in this field uh

1031

00:38:46,230 --> 00:38:43,839

for long enough that uh you know i have

1032

00:38:48,310 --> 00:38:46,240

uh you know some connections uh to

1033

00:38:50,310 --> 00:38:48,320

people you know earlier generations of

1034

00:38:52,230 --> 00:38:50,320

uh of astronomers you know kind of have

1035

00:38:53,829 --> 00:38:52,240

some some corporate knowledge so to

1036

00:38:55,430 --> 00:38:53,839

speak or some long-term knowledge and so

1037

00:38:56,790 --> 00:38:55,440

i was able to give uh you know what i

1038

00:38:59,510 --> 00:38:56,800

thought was a pretty good

1039

00:39:01,030 --> 00:38:59,520

overview of uh you know early studies

1040

00:39:02,230 --> 00:39:01,040

you know that what i mentioned before

1041

00:39:04,390 --> 00:39:02,240

the just

1042

00:39:06,390 --> 00:39:04,400

long time hundreds of years fascination

1043

00:39:09,349 --> 00:39:06,400

that humanity has had with with the

1044

00:39:11,670 --> 00:39:09,359

orion nebula uh region you know from

1045

00:39:12,870 --> 00:39:11,680

before we had telescopes this just milky

1046

00:39:14,310 --> 00:39:12,880

distribution

1047

00:39:16,710 --> 00:39:14,320

uh that you referred to that you can see

1048

00:39:18,630 --> 00:39:16,720

with your your plain eye to the early

1049

00:39:20,710 --> 00:39:18,640

telescope drawings up through these

1050

00:39:22,950 --> 00:39:20,720

various stages of technology you know

1051

00:39:24,790 --> 00:39:22,960

we've always always gone back to

1052

00:39:27,589 --> 00:39:24,800

gone back to orion to test our equipment

1053

00:39:28,950 --> 00:39:27,599

to test our scientific theories about

1054

00:39:30,710 --> 00:39:28,960

things we think we

1055

00:39:33,030 --> 00:39:30,720

uh can conclude from studying other

1056

00:39:33,910 --> 00:39:33,040

regions you know what what does orion

1057

00:39:36,390 --> 00:39:33,920

say

1058

00:39:38,950 --> 00:39:36,400

uh you know so we we just use it as a as

1059

00:39:40,310 --> 00:39:38,960

a test bed and so my talk was the

1060

00:39:42,710 --> 00:39:40,320

introduction to the conference so i had

1061

00:39:44,470 --> 00:39:42,720

a lot of a lot of territory to uh to

1062

00:39:45,670 --> 00:39:44,480

cover and to try to set up some of the

1063

00:39:47,030 --> 00:39:45,680

um

1064

00:39:48,870 --> 00:39:47,040

other scientists who were going to be

1065

00:39:51,030 --> 00:39:48,880

talking about the specific details of

1066

00:39:52,630 --> 00:39:51,040

their of their research no pressure so

1067

00:39:53,589 --> 00:39:52,640

it's a fun talk to prepare

1068

00:39:56,310 --> 00:39:53,599

yeah

1069

00:39:58,069 --> 00:39:56,320

well uh so over the so over the years

1070

00:40:01,589 --> 00:39:58,079

over the millennia we've i often say

1071

00:40:03,750 --> 00:40:01,599

that you know we today uh in in you know

1072

00:40:05,910 --> 00:40:03,760

in the current our current times we are

1073

00:40:08,550 --> 00:40:05,920

kind of in the golden age of astronomy i

1074

00:40:10,790 --> 00:40:08,560

mean we live in a time when we are

1075

00:40:12,069 --> 00:40:10,800

making we are able to see so much of the

1076

00:40:13,430 --> 00:40:12,079

universe and so many different

1077

00:40:14,790 --> 00:40:13,440

wavelengths and now we have space

1078

00:40:17,670 --> 00:40:14,800

telescopes and we have ground-based

1079

00:40:19,190 --> 00:40:17,680

telescopes and and we have uh adaptive

1080

00:40:20,950 --> 00:40:19,200

optics techniques for ground-based

1081

00:40:23,589 --> 00:40:20,960

things uh that we are getting

1082

00:40:25,589 --> 00:40:23,599

unprecedented looks at the sky and so

1083

00:40:27,670 --> 00:40:25,599

one one of the questions i

1084

00:40:29,349 --> 00:40:27,680

might i have a favorite wavelength so i

1085

00:40:32,310 --> 00:40:29,359

wanted to ask you what is your favorite

1086

00:40:34,230 --> 00:40:32,320

wavelength to look at the orion nebula

1087

00:40:36,230 --> 00:40:34,240

my favorite wavelength well

1088

00:40:37,030 --> 00:40:36,240

it's you know it's probably the

1089

00:40:40,470 --> 00:40:37,040

the

1090

00:40:43,270 --> 00:40:40,480

because you know it's just so different

1091

00:40:45,589 --> 00:40:43,280

from what we can see or even just

1092

00:40:47,829 --> 00:40:45,599

extrapolate with our eye the processes

1093

00:40:49,910 --> 00:40:47,839

are are so different there uh you know

1094

00:40:51,589 --> 00:40:49,920

that it's just an entirely entirely new

1095

00:40:53,510 --> 00:40:51,599

look so i knew you were gonna say the

1096

00:40:55,270 --> 00:40:53,520

infrared the infrared is everybody's

1097

00:40:56,950 --> 00:40:55,280

face my favorite too i always say the

1098

00:40:59,190 --> 00:40:56,960

future of astronomy is in the infrared

1099

00:41:00,230 --> 00:40:59,200

that's what i've always said true anyway

1100

00:41:01,829 --> 00:41:00,240

um

1101

00:41:03,510 --> 00:41:01,839

lynn i want to thank you you are more

1102

00:41:04,950 --> 00:41:03,520

than welcome to stay but i see massimo

1103

00:41:07,190 --> 00:41:04,960

has someone with him would you like to

1104

00:41:10,710 --> 00:41:07,200

introduce her i'll i'll scoot over

1105

00:41:13,990 --> 00:41:12,230

and

1106

00:41:14,870 --> 00:41:14,000

thank you lynn

1107

00:41:16,230 --> 00:41:14,880

that was

1108

00:41:17,910 --> 00:41:16,240

elderbrand from

1109

00:41:21,109 --> 00:41:17,920

caltech

1110

00:41:24,870 --> 00:41:21,119

and i found lee hartmann

1111

00:41:27,109 --> 00:41:24,880

hi lee how are you doing lee that's good

1112

00:41:27,990 --> 00:41:27,119

uh and well thank you for joining us so

1113

00:41:30,230 --> 00:41:28,000

i don't know if you know what you've

1114

00:41:32,230 --> 00:41:30,240
been brought in on but this is a

1115

00:41:35,510 --> 00:41:32,240
a hangout on air we are broadcasting

1116

00:41:37,670 --> 00:41:35,520
this on youtube and on uh google plus

1117

00:41:39,750 --> 00:41:37,680
and we are uh

1118

00:41:41,349 --> 00:41:39,760
basically just trying to capture some of

1119

00:41:43,589 --> 00:41:41,359
the things some of the atmosphere that's

1120

00:41:45,190 --> 00:41:43,599
going on with this workshop and and

1121

00:41:46,950 --> 00:41:45,200
bring to the general public some of the

1122

00:41:48,870 --> 00:41:46,960
things that you guys are learning some

1123

00:41:49,750 --> 00:41:48,880
of the talks that you're presenting and

1124

00:41:51,910 --> 00:41:49,760
kind of

1125

00:41:53,589 --> 00:41:51,920
sort of get people going about the

1126

00:41:55,990 --> 00:41:53,599

latest cutting edge research that's

1127

00:41:58,069 --> 00:41:56,000

going on with with orion so

1128

00:42:00,230 --> 00:41:58,079

why don't you uh introduce yourself tell

1129

00:42:03,510 --> 00:42:00,240

us what you're working on tell us why

1130

00:42:06,230 --> 00:42:03,520

you're here at this workshop and uh uh

1131

00:42:07,510 --> 00:42:06,240

and and what brings you with this

1132

00:42:09,910 --> 00:42:07,520

uh

1133

00:42:12,309 --> 00:42:09,920

well part of it actually was many years

1134

00:42:14,150 --> 00:42:12,319

ago when uh lyndon was doing her thesis

1135

00:42:16,230 --> 00:42:14,160

on the orion nebula cluster

1136

00:42:17,430 --> 00:42:16,240

i actually knew her and we we wrote a

1137

00:42:19,589 --> 00:42:17,440

paper together

1138

00:42:21,430 --> 00:42:19,599

um so that that's that was actually the

1139

00:42:22,870 --> 00:42:21,440

start of it um

1140

00:42:25,829 --> 00:42:22,880

and uh

1141

00:42:29,030 --> 00:42:25,839

more generally i'm interested in

1142

00:42:31,430 --> 00:42:29,040

in how stars form and how clusters form

1143

00:42:33,109 --> 00:42:31,440

and you know the orion orion is kind of

1144

00:42:34,230 --> 00:42:33,119

the closest big cluster that we have to

1145

00:42:36,230 --> 00:42:34,240

work with

1146

00:42:37,510 --> 00:42:36,240

and it's particularly interesting

1147

00:42:39,589 --> 00:42:37,520

because

1148

00:42:40,790 --> 00:42:39,599

it's not done forming you know there's

1149

00:42:42,230 --> 00:42:40,800

probably still

1150

00:42:43,349 --> 00:42:42,240

going to be

1151

00:42:45,030 --> 00:42:43,359

um

1152

00:42:46,630 --> 00:42:45,040

well we don't know but it's certainly

1153

00:42:48,230 --> 00:42:46,640

forming stars right right at this

1154

00:42:49,910 --> 00:42:48,240

instant by instant i mean the last

1155

00:42:52,230 --> 00:42:49,920

hundred thousand years

1156

00:42:54,230 --> 00:42:52,240

and uh you know it could actually almost

1157

00:42:55,750 --> 00:42:54,240

double in size by the time it's done

1158

00:42:57,670 --> 00:42:55,760

given the amount of gas that's lying

1159

00:42:59,829 --> 00:42:57,680

around

1160

00:43:01,510 --> 00:42:59,839

so maybe we're seeing kind of like a

1161

00:43:03,430 --> 00:43:01,520

you know cluster halfway or two thirds

1162

00:43:04,150 --> 00:43:03,440

of the way being formed

1163

00:43:05,829 --> 00:43:04,160

so

1164

00:43:07,030 --> 00:43:05,839

you're saying when they level in size

1165

00:43:08,630 --> 00:43:07,040

you mean then the stars that are

1166

00:43:10,150 --> 00:43:08,640

currently there could double in

1167

00:43:11,589 --> 00:43:10,160

size

1168

00:43:13,190 --> 00:43:11,599

well actually when i need to have twice

1169

00:43:15,990 --> 00:43:13,200

as many stars

1170

00:43:17,670 --> 00:43:16,000

now

1171

00:43:19,270 --> 00:43:17,680

yeah okay

1172

00:43:21,349 --> 00:43:19,280

so you said you're interested in how

1173

00:43:22,870 --> 00:43:21,359

stars form and how clusters form is

1174

00:43:25,510 --> 00:43:22,880

there a difference i mean are the are

1175

00:43:27,750 --> 00:43:25,520

they two different

1176
00:43:28,710 --> 00:43:27,760
are the ideas involved in how stars form

1177
00:43:30,230 --> 00:43:28,720
it seem to be would be a little bit

1178
00:43:31,190 --> 00:43:30,240
different than how a cluster would form

1179
00:43:33,270 --> 00:43:31,200
right

1180
00:43:35,270 --> 00:43:33,280
well

1181
00:43:36,710 --> 00:43:35,280
so i think that there's a unifying i

1182
00:43:39,270 --> 00:43:36,720
mean personally i think there's a

1183
00:43:41,109 --> 00:43:39,280
unifying uh theme which is which is

1184
00:43:43,109 --> 00:43:41,119
gravity i mean gravity is ultimately

1185
00:43:46,069 --> 00:43:43,119
responsible for bringing

1186
00:43:48,309 --> 00:43:46,079
for collecting stuff together right and

1187
00:43:49,109 --> 00:43:48,319
that's what holds a star together right

1188
00:43:50,470 --> 00:43:49,119

and

1189

00:43:51,910 --> 00:43:50,480

um

1190

00:43:53,829 --> 00:43:51,920

the star is a little different because

1191

00:43:55,270 --> 00:43:53,839

it's got gas pressure you know it's hot

1192

00:43:57,430 --> 00:43:55,280

and whatever

1193

00:43:59,270 --> 00:43:57,440

uh to that prevents it from collapsing

1194

00:44:00,470 --> 00:43:59,280

down into a you know

1195

00:44:01,829 --> 00:44:00,480

a point

1196

00:44:04,550 --> 00:44:01,839

but uh

1197

00:44:06,150 --> 00:44:04,560

you know the probably i think gravity

1198

00:44:08,069 --> 00:44:06,160

in the same way that gravity pulled the

1199

00:44:09,589 --> 00:44:08,079

gas together to make the sun let's say

1200

00:44:10,550 --> 00:44:09,599

that gravity would do the same thing to

1201

00:44:12,870 --> 00:44:10,560

bring

1202

00:44:14,950 --> 00:44:12,880

gas and stars together in a denser

1203

00:44:16,550 --> 00:44:14,960

concentration which is what we call

1204

00:44:18,230 --> 00:44:16,560

cluster so we were just talking about

1205

00:44:21,270 --> 00:44:18,240

stellar populations a while ago and

1206

00:44:23,109 --> 00:44:21,280

massimo made the point that well uh

1207

00:44:25,910 --> 00:44:23,119

lynn made lynn was telling us the range

1208

00:44:28,309 --> 00:44:25,920

of densities and the and the the range

1209

00:44:30,230 --> 00:44:28,319

of stellar populations within the

1210

00:44:33,270 --> 00:44:30,240

nebula that there were some you know

1211

00:44:35,430 --> 00:44:33,280

stars as big as 50 uh times the solar 50

1212

00:44:37,109 --> 00:44:35,440

solar masses all the way down to brown

1213

00:44:38,390 --> 00:44:37,119

dwarfs and massimo made an interesting

1214

00:44:40,710 --> 00:44:38,400

point that

1215

00:44:41,910 --> 00:44:40,720

most of the stars that they're finding

1216

00:44:45,109 --> 00:44:41,920

are

1217

00:44:48,230 --> 00:44:45,119

enough

1218

00:44:50,470 --> 00:44:48,240

for nuclear fusion to start

1219

00:44:53,510 --> 00:44:50,480

and so this would make this a

1220

00:44:55,589 --> 00:44:53,520

very specific are the is this

1221

00:44:58,309 --> 00:44:55,599

if you think of it as a cluster does

1222

00:45:00,309 --> 00:44:58,319

that make the orion cluster unique or is

1223

00:45:02,069 --> 00:45:00,319

it pretty much how all star clusters are

1224

00:45:04,230 --> 00:45:02,079

because he was saying there's sort of a

1225

00:45:07,109 --> 00:45:04,240

not a bias but a preference something is

1226

00:45:09,270 --> 00:45:07,119

some process is involved to keep it to

1227

00:45:12,150 --> 00:45:09,280

keep the sizes of these small stars the

1228

00:45:14,390 --> 00:45:12,160

way they are just large enough to start

1229

00:45:17,190 --> 00:45:14,400

nuclear fusion

1230

00:45:20,069 --> 00:45:17,200

well so the number of stars

1231

00:45:21,750 --> 00:45:20,079

at each mass

1232

00:45:23,829 --> 00:45:21,760

if you look at it as a probability

1233

00:45:25,990 --> 00:45:23,839

distribution it looks it looks pretty

1234

00:45:28,150 --> 00:45:26,000

similar to other distributions that we

1235

00:45:29,990 --> 00:45:28,160

see so i think there's not a strong

1236

00:45:31,670 --> 00:45:30,000

evidence that orion is different in that

1237

00:45:33,430 --> 00:45:31,680

respect than

1238

00:45:38,390 --> 00:45:33,440

than most other

1239

00:45:42,470 --> 00:45:38,400

if we could get us

1240

00:45:47,030 --> 00:45:42,480

an early typical mass as he says

1241

00:45:51,430 --> 00:45:48,790

say again we lost you

1242

00:45:52,230 --> 00:45:51,440

i think you're back though okay okay we

1243

00:45:53,750 --> 00:45:52,240

must

1244

00:45:56,790 --> 00:45:53,760

oh are you there

1245

00:45:58,470 --> 00:45:56,800

yeah okay sorry we uh we we we dropped

1246

00:45:59,990 --> 00:45:58,480

you for just a second there but uh i

1247

00:46:01,990 --> 00:46:00,000

guess my what might what what i'd like

1248

00:46:03,589 --> 00:46:02,000

to find out is though if we could look

1249

00:46:06,309 --> 00:46:03,599

at

1250

00:46:07,430 --> 00:46:06,319

another orion complex something similar

1251
00:46:08,710 --> 00:46:07,440
to that

1252
00:46:10,230 --> 00:46:08,720
would that be

1253
00:46:11,510 --> 00:46:10,240
a com you think that'd be a common

1254
00:46:13,990 --> 00:46:11,520
occurrence then what we're seeing in

1255
00:46:15,990 --> 00:46:14,000
orion we just happen to be lucky because

1256
00:46:17,829 --> 00:46:16,000
we can see it while it's still going on

1257
00:46:20,710 --> 00:46:17,839
all this star formation but this is

1258
00:46:22,790 --> 00:46:20,720
probably a pretty common way in which

1259
00:46:24,069 --> 00:46:22,800
star star clusters are being born right

1260
00:46:25,670 --> 00:46:24,079
or being formed

1261
00:46:28,150 --> 00:46:25,680
well we think we think so i mean there

1262
00:46:29,910 --> 00:46:28,160
are more mass lots more massive clusters

1263
00:46:31,349 --> 00:46:29,920

there they're farther away so they're

1264

00:46:33,190 --> 00:46:31,359

harder to study

1265

00:46:35,589 --> 00:46:33,200

but you know to the extent that we can

1266

00:46:36,309 --> 00:46:35,599

study them they look you know the

1267

00:46:41,430 --> 00:46:36,319

the

1268

00:46:43,430 --> 00:46:41,440

stars have is pretty much like it is in

1269

00:46:45,670 --> 00:46:43,440

orion as far as we can tell and we talk

1270

00:46:47,910 --> 00:46:45,680

actually this distribution of mass is

1271

00:46:50,710 --> 00:46:47,920

called initial mass fashion and we

1272

00:46:53,030 --> 00:46:50,720

usually attach the word universal

1273

00:46:55,030 --> 00:46:53,040

so there is a at least in the in the

1274

00:46:56,710 --> 00:46:55,040

general uh

1275

00:46:58,309 --> 00:46:56,720

in the general

1276

00:47:00,150 --> 00:46:58,319

type of dependence

1277

00:47:03,270 --> 00:47:00,160

uh

1278

00:47:06,069 --> 00:47:03,280

there is a strong indication for being

1279

00:47:07,190 --> 00:47:06,079

uh on average the same but

1280

00:47:12,069 --> 00:47:07,200

maybe

1281

00:47:14,069 --> 00:47:12,079

large masses you may have situations

1282

00:47:18,790 --> 00:47:14,079

with where there is a variation but it's

1283

00:47:21,510 --> 00:47:18,800

always uh the small number statistic but

1284

00:47:25,190 --> 00:47:21,520

we start at this time

1285

00:47:27,109 --> 00:47:25,200

very well to more or less the same

1286

00:47:29,349 --> 00:47:27,119

okay well we're getting close to the end

1287

00:47:30,870 --> 00:47:29,359

of the time we have but i want to get to

1288

00:47:33,750 --> 00:47:30,880

some of the questions and comments that

1289

00:47:35,829 --> 00:47:33,760

we have that we're seeing um

1290

00:47:38,309 --> 00:47:35,839

but before i do i got to ask you guys

1291

00:47:41,750 --> 00:47:38,319

what about planets well i mean are you

1292

00:47:43,910 --> 00:47:41,760

guys focusing primarily on uh uh star

1293

00:47:45,750 --> 00:47:43,920

forming or uh just star formation and

1294

00:47:48,150 --> 00:47:45,760

stellar populations or is anybody is

1295

00:47:50,390 --> 00:47:48,160

anybody looking at exoplanets and i know

1296

00:47:52,710 --> 00:47:50,400

there's protoplanetary disks in there so

1297

00:47:53,990 --> 00:47:52,720

presumably there's uh some planets that

1298

00:47:56,470 --> 00:47:54,000

might have been formed in there as well

1299

00:47:58,309 --> 00:47:56,480

is any any comments on that that was one

1300

00:47:59,030 --> 00:47:58,319

of the questions i was going to ask too

1301

00:48:00,790 --> 00:47:59,040

oh

1302

00:48:03,270 --> 00:48:00,800

i'm sorry i'm definitely in wait what's

1303

00:48:04,150 --> 00:48:03,280

going to ruin our guests time here oh i

1304

00:48:05,589 --> 00:48:04,160

did

1305

00:48:09,349 --> 00:48:05,599

in fact i'm gonna make that was

1306

00:48:12,630 --> 00:48:09,359

michael's question so you can answer him

1307

00:48:18,870 --> 00:48:15,589

people are are focusing in the exoplanet

1308

00:48:22,150 --> 00:48:18,880

business on closer regions right so

1309

00:48:24,309 --> 00:48:22,160

so uh uh the nearest

1310

00:48:26,309 --> 00:48:24,319

the nearest regions we have to look at

1311

00:48:28,710 --> 00:48:26,319

planets forming in disks

1312

00:48:31,270 --> 00:48:28,720

is basically uh regions that are about

1313

00:48:33,670 --> 00:48:31,280

three times closer than orion

1314

00:48:35,349 --> 00:48:33,680

so it's it's clear that the planets must

1315

00:48:37,990 --> 00:48:35,359

be forming and there must be planets

1316

00:48:38,870 --> 00:48:38,000

around the stars but people are focusing

1317

00:48:43,190 --> 00:48:38,880

on

1318

00:48:45,829 --> 00:48:43,200

uh first because you know they're easier

1319

00:48:47,510 --> 00:48:45,839

to resolve the

1320

00:48:50,230 --> 00:48:47,520

the you know

1321

00:48:52,069 --> 00:48:50,240

the planets or or see a structure in

1322

00:48:55,109 --> 00:48:52,079

their in their disks that are making

1323

00:48:57,190 --> 00:48:55,119

them or if if you really want to

1324

00:48:59,270 --> 00:48:57,200

you know the only far away

1325

00:49:00,470 --> 00:48:59,280

planet survey that there is is kepler

1326

00:49:02,630 --> 00:49:00,480

right

1327

00:49:04,309 --> 00:49:02,640

and that's kind of statistical so those

1328

00:49:05,990 --> 00:49:04,319

are the transits and and we can find

1329

00:49:08,309 --> 00:49:06,000

very small planets

1330

00:49:10,150 --> 00:49:08,319

that go in front of the star right

1331

00:49:11,750 --> 00:49:10,160

but it's very hard to do any

1332

00:49:13,030 --> 00:49:11,760

characterization because they're all far

1333

00:49:13,750 --> 00:49:13,040

away right

1334

00:49:16,950 --> 00:49:13,760

so

1335

00:49:19,430 --> 00:49:16,960

what people are really focusing on

1336

00:49:21,990 --> 00:49:19,440

uh for planets for

1337

00:49:24,390 --> 00:49:22,000

for very very young planets let's say

1338

00:49:26,710 --> 00:49:24,400

uh are regions that are you know at

1339

00:49:28,630 --> 00:49:26,720

least three times closer or or whatever

1340

00:49:32,790 --> 00:49:28,640

just because you know it's hard enough

1341

00:49:36,470 --> 00:49:32,800

as it is you have to consider that

1342

00:49:40,950 --> 00:49:36,480

one a pixel of the best hubble camera

1343

00:49:46,870 --> 00:49:43,990

astronomical units so everything will be

1344

00:49:48,710 --> 00:49:46,880

within a single pixel uh

1345

00:49:50,790 --> 00:49:48,720

and this is the one problem and the

1346

00:49:53,109 --> 00:49:50,800

second problem is that uh to see a

1347

00:49:54,390 --> 00:49:53,119

planet in the disk in that condition you

1348

00:49:56,069 --> 00:49:54,400

probably have to go in the infrared

1349

00:49:58,230 --> 00:49:56,079

because there are the disks that

1350

00:49:59,510 --> 00:49:58,240

typically produce a lot of extinction

1351

00:50:02,309 --> 00:49:59,520

and when you go in the infrared the

1352

00:50:04,790 --> 00:50:02,319

problem with the resolution becomes even

1353

00:50:07,109 --> 00:50:04,800

worse because your natural

1354

00:50:09,510 --> 00:50:07,119

shape of the of the point spread

1355

00:50:10,710 --> 00:50:09,520

function becomes larger and larger so

1356

00:50:13,750 --> 00:50:10,720

you need the

1357

00:50:14,710 --> 00:50:13,760

larger facilities with interferometers

1358

00:50:16,549 --> 00:50:14,720

and

1359

00:50:18,870 --> 00:50:16,559

but then you need also photons with

1360

00:50:20,710 --> 00:50:18,880

interferometers and this is science that

1361

00:50:22,150 --> 00:50:20,720

we need to leave something for our

1362

00:50:24,470 --> 00:50:22,160

children to do

1363

00:50:26,230 --> 00:50:24,480

interferometry is something i know what

1364

00:50:27,910 --> 00:50:26,240

it is i know tony but what do we mean by

1365

00:50:29,990 --> 00:50:27,920

an interferometer i think they're

1366

00:50:32,069 --> 00:50:30,000

fascinating or wonderful but what do you

1367

00:50:34,069 --> 00:50:32,079

mean by an interferometer oh an

1368

00:50:36,150 --> 00:50:34,079

interferometer is basically a big

1369

00:50:40,390 --> 00:50:36,160

telescope where you cut out all the

1370

00:50:42,790 --> 00:50:40,400

glass and you just keep the two extremes

1371

00:50:45,670 --> 00:50:42,800

but the two extremes must work

1372

00:50:47,750 --> 00:50:45,680

like a single piece of a giant telescope

1373

00:50:50,150 --> 00:50:47,760

so all the difficulty which means

1374

00:50:52,230 --> 00:50:50,160

technically to keep them in phase

1375

00:50:54,870 --> 00:50:52,240

otherwise you just have two telescopes

1376

00:50:57,109 --> 00:50:54,880

that get not like two light collectors

1377

00:50:59,270 --> 00:50:57,119

but if you manage to keep them in phase

1378

00:51:01,270 --> 00:50:59,280

like two imagine having a monster

1379

00:51:03,510 --> 00:51:01,280

surface and you just take out all the

1380

00:51:05,510 --> 00:51:03,520

glass still the two pieces at the

1381

00:51:07,670 --> 00:51:05,520

extreme give you an extremely sharp

1382

00:51:10,069 --> 00:51:07,680

image and this is basically the idea

1383

00:51:12,470 --> 00:51:10,079

behind an interferometer right so like

1384

00:51:15,109 --> 00:51:12,480

with arrays like when you have a array

1385

00:51:16,790 --> 00:51:15,119

of telescopes you have larger angular

1386

00:51:19,270 --> 00:51:16,800

resolution but you don't have the light

1387

00:51:21,510 --> 00:51:19,280

gathering power as if it was one big

1388

00:51:23,589 --> 00:51:21,520

mirror correct correct and eventually if

1389

00:51:25,430 --> 00:51:23,599

you have an array so good and you start

1390

00:51:27,349 --> 00:51:25,440

feeling and feeling a feeling you get

1391

00:51:29,270 --> 00:51:27,359

the telescope which exactly

1392

00:51:32,390 --> 00:51:29,280

but when you start taking away at some

1393

00:51:34,549 --> 00:51:32,400

point you have an interferometer right

1394

00:51:35,910 --> 00:51:34,559

okay so michael i i wonder you know i

1395

00:51:37,190 --> 00:51:35,920

want to give you a chance i stole one of

1396

00:51:39,750 --> 00:51:37,200

your questions did you happen to have

1397

00:51:42,150 --> 00:51:39,760

any others that you'd like to ask

1398

00:51:44,710 --> 00:51:42,160

um i was just kind of also curious about

1399

00:51:46,950 --> 00:51:44,720

the trapezium is that like buried within

1400

00:51:49,190 --> 00:51:46,960

the nebula just kind of outside of it

1401
00:51:51,670 --> 00:51:49,200
where where exactly is its placement

1402
00:51:53,990 --> 00:51:51,680
within that nebula so

1403
00:51:55,430 --> 00:51:54,000
people have done a pretty good job

1404
00:51:57,349 --> 00:51:55,440
of of

1405
00:51:59,109 --> 00:51:57,359
getting sort of like a 3d picture of the

1406
00:52:00,150 --> 00:51:59,119
nebula okay

1407
00:52:04,309 --> 00:52:00,160
and so

1408
00:52:05,510 --> 00:52:04,319
if if this is my eye here

1409
00:52:08,309 --> 00:52:05,520
and

1410
00:52:09,430 --> 00:52:08,319
it's clear that there's a lot of stuff

1411
00:52:11,270 --> 00:52:09,440
behind

1412
00:52:12,790 --> 00:52:11,280
okay and then the nebula is sort of in

1413
00:52:13,990 --> 00:52:12,800

front

1414

00:52:16,630 --> 00:52:14,000

towards us

1415

00:52:18,230 --> 00:52:16,640

and people actually in terms of like the

1416

00:52:20,710 --> 00:52:18,240

star that's that's heating up that

1417

00:52:23,190 --> 00:52:20,720

nebula the most theta 1 c ori

1418

00:52:26,069 --> 00:52:23,200

that you can actually estimate

1419

00:52:28,309 --> 00:52:26,079

how far it is from the molecular gas

1420

00:52:30,150 --> 00:52:28,319

from the background stuff

1421

00:52:31,589 --> 00:52:30,160

in terms of how bright the stuff is that

1422

00:52:33,829 --> 00:52:31,599

it's ionizing

1423

00:52:35,829 --> 00:52:33,839

and so i think it's about three tenths

1424

00:52:37,750 --> 00:52:35,839

of a parsec or about what that's one

1425

00:52:40,390 --> 00:52:37,760

white yeah i i remember point one but

1426

00:52:44,470 --> 00:52:40,400

it's more or less the same yeah is it

1427

00:52:46,950 --> 00:52:45,349

but

1428

00:52:48,950 --> 00:52:46,960

it's something like that right so it's

1429

00:52:50,870 --> 00:52:48,960

it's just a in terms of the size of the

1430

00:52:53,030 --> 00:52:50,880

cluster which is a parsec or more from

1431

00:52:54,230 --> 00:52:53,040

the central thing it's just a fraction

1432

00:52:55,109 --> 00:52:54,240

of that

1433

00:52:56,870 --> 00:52:55,119

uh

1434

00:52:58,790 --> 00:52:56,880

in front of this stuff and there's a

1435

00:52:59,430 --> 00:52:58,800

bunch of the cluster that must be behind

1436

00:53:01,670 --> 00:52:59,440

it

1437

00:53:02,710 --> 00:53:01,680

that's only visible in the infrared so

1438

00:53:04,630 --> 00:53:02,720

it's kind of if you could kind of

1439

00:53:06,069 --> 00:53:04,640

picture that like a cluster is maybe i

1440

00:53:08,150 --> 00:53:06,079

don't know two-thirds

1441

00:53:10,790 --> 00:53:08,160

evaporate the gas is coming two-thirds

1442

00:53:12,950 --> 00:53:10,800

revealed by this evaporation of the gas

1443

00:53:14,790 --> 00:53:12,960

which is coming out towards us and maybe

1444

00:53:16,870 --> 00:53:14,800

another third or something right and the

1445

00:53:19,910 --> 00:53:16,880

wall is being pushed more and more with

1446

00:53:21,990 --> 00:53:19,920

time so yeah so basically it's kind of

1447

00:53:23,349 --> 00:53:22,000

eating up all the gas in the area that's

1448

00:53:25,670 --> 00:53:23,359

formed in

1449

00:53:28,150 --> 00:53:25,680

right all the photons all the heat

1450

00:53:29,990 --> 00:53:28,160

coming from the star kind of evaporates

1451

00:53:32,230 --> 00:53:30,000

and has this stuff coming out and it

1452

00:53:34,549 --> 00:53:32,240

makes a big hole in the big bubble and

1453

00:53:36,790 --> 00:53:34,559

we see this wind coming toward us if you

1454

00:53:39,829 --> 00:53:36,800

take the right spectra you see that the

1455

00:53:42,230 --> 00:53:39,839

lines of the gas are blue shifted which

1456

00:53:43,670 --> 00:53:42,240

means coming toward us it's a

1457

00:53:46,710 --> 00:53:43,680

fascinating

1458

00:53:52,390 --> 00:53:48,309

so basically it's kind of revealing

1459

00:53:53,190 --> 00:53:52,400

itself to us we call it a champagne flow

1460

00:53:55,030 --> 00:53:53,200

so

1461

00:53:56,710 --> 00:53:55,040

we wait another half million years we'll

1462

00:53:59,430 --> 00:53:56,720

see the whole thing

1463

00:54:01,510 --> 00:53:59,440

i can't wait little space bubbly

1464

00:54:03,510 --> 00:54:01,520

yeah half a million years i'll be there

1465

00:54:05,750 --> 00:54:03,520

okay so any anything else you haven't

1466

00:54:07,190 --> 00:54:05,760

you have any other questions michael uh

1467

00:54:09,109 --> 00:54:07,200

no get to

1468

00:54:11,910 --> 00:54:09,119

to if you got any other questions out

1469

00:54:14,150 --> 00:54:11,920

there okay well it happens to be where

1470

00:54:16,150 --> 00:54:14,160

we're about we're right out about the

1471

00:54:18,150 --> 00:54:16,160

end of our of our time limit here but uh

1472

00:54:21,270 --> 00:54:18,160

massimo are we gonna we're gonna do this

1473

00:54:22,630 --> 00:54:21,280

again tomorrow as you as you wish i mean

1474

00:54:25,829 --> 00:54:22,640

yes i wish

1475

00:54:30,230 --> 00:54:27,750

yeah so massimo will grab a couple more

1476

00:54:32,069 --> 00:54:30,240

people who was uh attending the workshop

1477

00:54:34,710 --> 00:54:32,079

this week and we will do this again

1478

00:54:37,109 --> 00:54:34,720

tomorrow at the same time uh so i hope

1479

00:54:39,670 --> 00:54:37,119

that you will bring your orion questions

1480

00:54:42,390 --> 00:54:39,680

also tomorrow i'm going to bring a

1481

00:54:44,549 --> 00:54:42,400

visualization that frank summers did uh

1482

00:54:47,589 --> 00:54:44,559

uh of the orion nebula to sort of show

1483

00:54:50,710 --> 00:54:47,599

people uh this sort of scientific

1484

00:54:53,430 --> 00:54:50,720

rendering that he did uh of that

1485

00:54:54,950 --> 00:54:53,440

and we will uh we will also have uh

1486

00:54:57,109 --> 00:54:54,960

other people that we can ask questions

1487

00:54:59,670 --> 00:54:57,119

to so i want to thank you lee for for

1488

00:55:01,270 --> 00:54:59,680

joining us for taking time out of uh the

1489

00:55:02,790 --> 00:55:01,280

workshop to just sort of give us a

1490

00:55:04,069 --> 00:55:02,800

little insight into what you guys are

1491

00:55:06,710 --> 00:55:04,079

doing out there

1492

00:55:09,349 --> 00:55:06,720

and massimo this was fun

1493

00:55:11,910 --> 00:55:09,359

thank you my pleasure all right thank

1494

00:55:13,829 --> 00:55:11,920

you to our guest yes

1495

00:55:15,589 --> 00:55:13,839

thank you very much very much

1496

00:55:18,470 --> 00:55:15,599

michael thank you for for joining it was

1497

00:55:20,549 --> 00:55:18,480

a lot of fun having you here and uh we

1498

00:55:22,069 --> 00:55:20,559

will hopefully you're more than welcome

1499

00:55:23,750 --> 00:55:22,079

to come back tomorrow if you'd like to

1500

00:55:27,349 --> 00:55:23,760

hey wait a minute what

1501

00:55:29,109 --> 00:55:27,359

i forgot ian does he was he i just got

1502

00:55:31,349 --> 00:55:29,119

he might be here tomorrow he got hung up

1503

00:55:33,589 --> 00:55:31,359

on a conference call so he might be back

1504

00:55:36,230 --> 00:55:33,599

tomorrow okay good okay good because i

1505

00:55:38,470 --> 00:55:36,240

was like oh my gosh i got i i got so i

1506

00:55:39,990 --> 00:55:38,480

got you covered don't worry i gave mike

1507

00:55:40,790 --> 00:55:40,000

the invite i know you didn't give it to

1508

00:55:42,309 --> 00:55:40,800

him

1509

00:55:44,069 --> 00:55:42,319

yeah

1510

00:55:45,510 --> 00:55:44,079

well you have us you have his email

1511

00:55:47,750 --> 00:55:45,520

address so we're talking about dr you

1512

00:55:49,349 --> 00:55:47,760

know neil he's the uh uh he's from

1513

00:55:51,430 --> 00:55:49,359

discovery news he was going to join us a

1514

00:55:52,549 --> 00:55:51,440

little bit here too but uh i guess he

1515

00:55:54,069 --> 00:55:52,559

couldn't make it because of a conference

1516

00:55:56,870 --> 00:55:54,079

call so hopefully he'll make it next or

1517

00:55:59,829 --> 00:55:58,150

event

1518

00:56:01,430 --> 00:55:59,839

you'll get an invite to the one i'm

1519

00:56:02,710 --> 00:56:01,440

about to create for tomorrow i didn't

1520

00:56:04,789 --> 00:56:02,720

want to spam everybody with all these

1521

00:56:06,390 --> 00:56:04,799

events so i only created one so i'm

1522

00:56:07,750 --> 00:56:06,400

going to create that one next and then

1523

00:56:09,910 --> 00:56:07,760

you'll get an invite i'll be the same

1524

00:56:11,990 --> 00:56:09,920

time we'll talk to two new people about

1525

00:56:14,150 --> 00:56:12,000

the orion nebula plus we'll have a few

1526

00:56:17,390 --> 00:56:14,160

more graphics that we didn't have today

1527

00:56:19,270 --> 00:56:17,400

um i want to thank scott scott lewis for

1528

00:56:21,430 --> 00:56:19,280

knowthecosmos.com thank you very much

1529

00:56:23,270 --> 00:56:21,440

for support you were great with your

1530

00:56:25,190 --> 00:56:23,280

rockstar with getting solarium up there

1531

00:56:27,270 --> 00:56:25,200

thanks for doing that absolutely

1532

00:56:29,109 --> 00:56:27,280

and again michael we look forward to

1533

00:56:31,510 --> 00:56:29,119

seeing you on the virtual star party as

1534

00:56:33,190 --> 00:56:31,520

well as more of your images that wasn't

1535

00:56:35,510 --> 00:56:33,200

that was a stunning orion image it

1536

00:56:36,789 --> 00:56:35,520

really was outstanding work oh wait a

1537

00:56:37,750 --> 00:56:36,799

minute before we go we have a couple

1538

00:56:40,710 --> 00:56:37,760

minutes

1539

00:56:41,750 --> 00:56:40,720

can you give advice to anybody out there

1540

00:56:46,069 --> 00:56:41,760

watching

1541

00:56:48,309 --> 00:56:46,079

who is thinking about maybe um

1542

00:56:49,510 --> 00:56:48,319

getting into astrophotography okay

1543

00:56:51,910 --> 00:56:49,520

they're a beginner they don't know what

1544

00:56:54,069 --> 00:56:51,920

to do they don't know what advice would

1545

00:56:55,829 --> 00:56:54,079

you give somebody who's just about to

1546

00:56:58,230 --> 00:56:55,839

start out let's say they have a

1547

00:57:00,309 --> 00:56:58,240

telescope they've learned the night sky

1548

00:57:02,309 --> 00:57:00,319

they've looked at a few things but now

1549

00:57:04,150 --> 00:57:02,319

they want to take pictures what advice

1550

00:57:07,430 --> 00:57:04,160

would you give them

1551
00:57:10,390 --> 00:57:07,440
a dslr camera will be your best bet and

1552
00:57:13,510 --> 00:57:10,400
um you can get some relatively cheap on

1553
00:57:15,349 --> 00:57:13,520
ebay or amazon um

1554
00:57:17,589 --> 00:57:15,359
adapters so they can hook up to your

1555
00:57:20,069 --> 00:57:17,599
camera or to your telescope and

1556
00:57:22,230 --> 00:57:20,079
basically just practice see what works

1557
00:57:23,829 --> 00:57:22,240
well on what you're trying to image

1558
00:57:26,549 --> 00:57:23,839
well now wait a minute i can't just use

1559
00:57:29,829 --> 00:57:26,559
the dobsonian on this camera oh no no

1560
00:57:31,829 --> 00:57:29,839
well a reflector telescope is what i use

1561
00:57:34,630 --> 00:57:31,839
but i throw it on a well i don't throw

1562
00:57:37,030 --> 00:57:34,640
it i gently place it on a equatorial

1563
00:57:40,950 --> 00:57:39,430

okay but yes so you almost always are

1564

00:57:42,710 --> 00:57:40,960

going to need some way to attract the

1565

00:57:44,390 --> 00:57:42,720

sky because as we all know the earth is

1566

00:57:46,950 --> 00:57:44,400

turning and so you've got to compensate

1567

00:57:49,589 --> 00:57:46,960

for that motion and motor drives

1568

00:57:50,390 --> 00:57:49,599

are definitely needed yes so

1569

00:57:51,990 --> 00:57:50,400

uh

1570

00:57:53,829 --> 00:57:52,000

it is

1571

00:57:56,069 --> 00:57:53,839

generally a pretty difficult thing to do

1572

00:57:57,829 --> 00:57:56,079

and i would highly recommend that you

1573

00:57:59,670 --> 00:57:57,839

get really familiar with your telescope

1574

00:58:02,390 --> 00:57:59,680

before you start it you will almost

1575

00:58:05,430 --> 00:58:02,400

definitely need a stable and sturdy

1576
00:58:06,950 --> 00:58:05,440
mount uh one that is not gonna as you

1577
00:58:08,390 --> 00:58:06,960
walk by it on the ground isn't gonna

1578
00:58:11,190 --> 00:58:08,400
shake so you're looking at something

1579
00:58:12,230 --> 00:58:11,200
pretty beefy uh but most of the off the

1580
00:58:14,150 --> 00:58:12,240
shelf

1581
00:58:15,750 --> 00:58:14,160
what are called go-to telescopes where

1582
00:58:18,549 --> 00:58:15,760
you just kind of type in i want to see

1583
00:58:20,390 --> 00:58:18,559
the orion nebula and it goes

1584
00:58:22,309 --> 00:58:20,400
and it shows you the orion nebula those

1585
00:58:24,309 --> 00:58:22,319
scopes tend to be pretty good for

1586
00:58:27,670 --> 00:58:24,319
hanging a uh

1587
00:58:29,510 --> 00:58:27,680
for hanging a an slr slr off the back of

1588
00:58:32,430 --> 00:58:29,520

is this your scope here yeah that's the

1589

00:58:35,430 --> 00:58:32,440

telescope i use that's an omni

1590

00:58:37,670 --> 00:58:35,440

xlt-150 it's basically a six-inch mirror

1591

00:58:40,470 --> 00:58:37,680

and it's got the equatorial mount with

1592

00:58:42,789 --> 00:58:40,480

aftermarket motor drives on it

1593

00:58:44,710 --> 00:58:42,799

and that's what i hooked my camera up to

1594

00:58:47,349 --> 00:58:44,720

all right so that's nice that's really

1595

00:58:48,829 --> 00:58:47,359

nice good okay so and what what would

1596

00:58:52,950 --> 00:58:48,839

something like that cost

1597

00:58:55,349 --> 00:58:52,960

um somewhere in the range of like 450 to

1598

00:58:57,750 --> 00:58:55,359

500 plus another 100 for the motor

1599

00:58:59,430 --> 00:58:57,760

drives i'm sorry but i got to tell you

1600

00:59:01,430 --> 00:58:59,440

that blows me away because back in the

1601
00:59:06,470 --> 00:59:01,440
day when i was when we're back when i

1602
00:59:07,829 --> 00:59:06,480
used to use hyper uh 2415 film and um

1603
00:59:09,829 --> 00:59:07,839
it was

1604
00:59:12,470 --> 00:59:09,839
the kind of telescope you needed to that

1605
00:59:14,630 --> 00:59:12,480
was at least five grand nowadays were

1606
00:59:16,630 --> 00:59:14,640
you using silver oxide for your film too

1607
00:59:19,510 --> 00:59:16,640
tony yeah well

1608
00:59:21,750 --> 00:59:19,520
glass plates yeah okay i gave the idea

1609
00:59:24,309 --> 00:59:21,760
to edwin hubble

1610
00:59:26,710 --> 00:59:24,319
how old i am

1611
00:59:28,470 --> 00:59:26,720
all right guys well uh that really is

1612
00:59:30,549 --> 00:59:28,480
all of our time i want to thank you guys

1613
00:59:31,910 --> 00:59:30,559

all for watching uh this has been a lot

1614

00:59:33,910 --> 00:59:31,920

of fun we're going to try and do more of

1615

00:59:35,510 --> 00:59:33,920

these throughout the year as the space

1616

00:59:37,109 --> 00:59:35,520

telescope science institute holds more

1617

00:59:39,190 --> 00:59:37,119

of these hangouts i'm going to actually

1618

00:59:40,630 --> 00:59:39,200

try to stream some of the talks in the

1619

00:59:42,549 --> 00:59:40,640

future too but that's that's an

1620

00:59:44,309 --> 00:59:42,559

experiment we do these things here at

1621

00:59:46,870 --> 00:59:44,319

the institute all year long and i want

1622

00:59:48,390 --> 00:59:46,880

to try and bring them out to you in some

1623

00:59:50,710 --> 00:59:48,400

way or another and here we've got all

1624

00:59:53,030 --> 00:59:50,720

the experts on the orion nebula under

1625

00:59:55,109 --> 00:59:53,040

one roof and so we may as well start

1626

00:59:56,870 --> 00:59:55,119

asking them questions

1627

00:59:59,270 --> 00:59:56,880

i hope you guys

1628

01:00:01,750 --> 00:59:59,280

tune in tomorrow i'm looking forward to

1629

01:00:04,470 --> 01:00:01,760

uh doing this again uh also later in the

1630

01:00:05,910 --> 01:00:04,480

week scott and i are doing a hangout

1631

01:00:07,109 --> 01:00:05,920

i think you're going to this one aren't

1632

01:00:08,470 --> 01:00:07,119

you the commentary

1633

01:00:09,990 --> 01:00:08,480

yeah yeah yeah

1634

01:00:11,910 --> 01:00:10,000

i'm sorry i know you can't go to there

1635

01:00:15,670 --> 01:00:11,920

no you can you can volunteer me to do

1636

01:00:20,710 --> 01:00:17,990

on thursday the hubble space telescope

1637

01:00:23,030 --> 01:00:20,720

is going to be releasing its latest

1638

01:00:24,470 --> 01:00:23,040

images of comet ison they were uh

1639

01:00:26,710 --> 01:00:24,480

they're processing that data now and

1640

01:00:28,710 --> 01:00:26,720

they're anticipating it'll be ready

1641

01:00:32,390 --> 01:00:28,720

on thursday and we'll talk about the

1642

01:00:33,990 --> 01:00:32,400

latest uh news from for comet ison they

1643

01:00:35,990 --> 01:00:34,000

actually did the observations on october

1644

01:00:37,589 --> 01:00:36,000

8th and they've been spending all this

1645

01:00:40,549 --> 01:00:37,599

time doing the processing we will

1646

01:00:42,309 --> 01:00:40,559

announce it um on thursday so we'll see

1647

01:00:43,750 --> 01:00:42,319

you then the event for that is already

1648

01:00:45,270 --> 01:00:43,760

out there so hopefully you'll you'll

1649

01:00:46,789 --> 01:00:45,280

click and say you're going

1650

01:00:49,349 --> 01:00:46,799

i'll put that into the event page that

1651
01:00:51,829 --> 01:00:49,359
we're in now so link to that to the next

1652
01:00:54,470 --> 01:00:51,839
event and the commenting event all the

1653
01:00:56,150 --> 01:00:54,480
full scale images that we showed today i

1654
01:00:58,309 --> 01:00:56,160
put that into the google plus event too

1655
01:00:59,910 --> 01:00:58,319
so if you're watching this on youtube go

1656
01:01:01,430 --> 01:00:59,920
look for the hubble space telescope on

1657
01:01:02,870 --> 01:01:01,440
google plus and you'll see our event

1658
01:01:04,710 --> 01:01:02,880
with all the photos that are put in

1659
01:01:07,670 --> 01:01:04,720
there and high quality

1660
01:01:08,789 --> 01:01:07,680
so for mike and paul's uh photos that we

1661
01:01:11,190 --> 01:01:08,799
put out there you'll be able to take a

1662
01:01:12,710 --> 01:01:11,200
look at those in their full glory

1663
01:01:14,069 --> 01:01:12,720

all right awesome thanks for your

1664

01:01:16,470 --> 01:01:14,079

rockstar we're getting that done i can't

1665

01:01:18,390 --> 01:01:16,480

do i am such a crappy multitasker i

1666

01:01:20,150 --> 01:01:18,400

can't i'm actually an octopus so i have

1667

01:01:22,390 --> 01:01:20,160

six other hands

1668

01:01:24,309 --> 01:01:22,400

yeah well i'm glad you were doing it so

1669

01:01:25,910 --> 01:01:24,319

all right hobble huggers i could have

1670

01:01:27,829 --> 01:01:25,920

used the hubble hangout earlier today

1671

01:01:30,870 --> 01:01:27,839

turns out um

1672

01:01:31,750 --> 01:01:30,880

thank you all for watching and as always