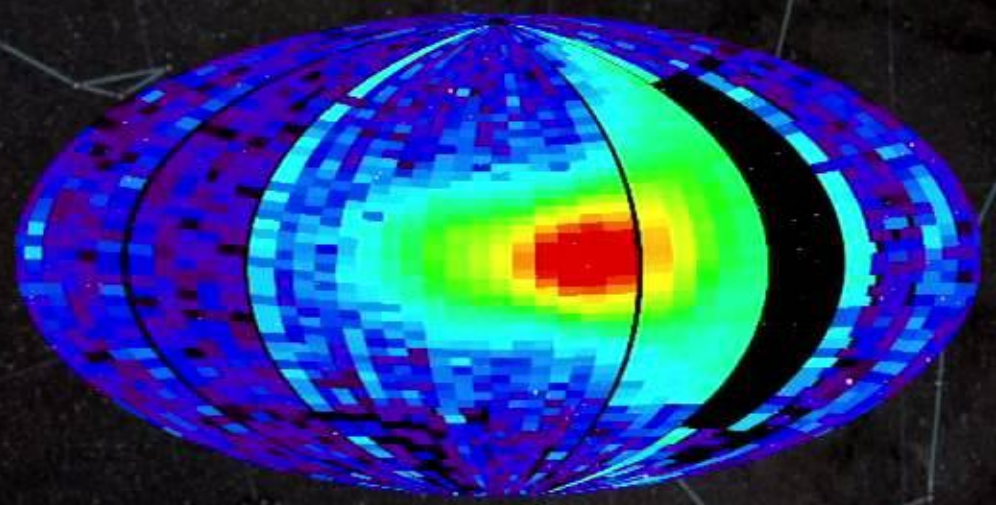
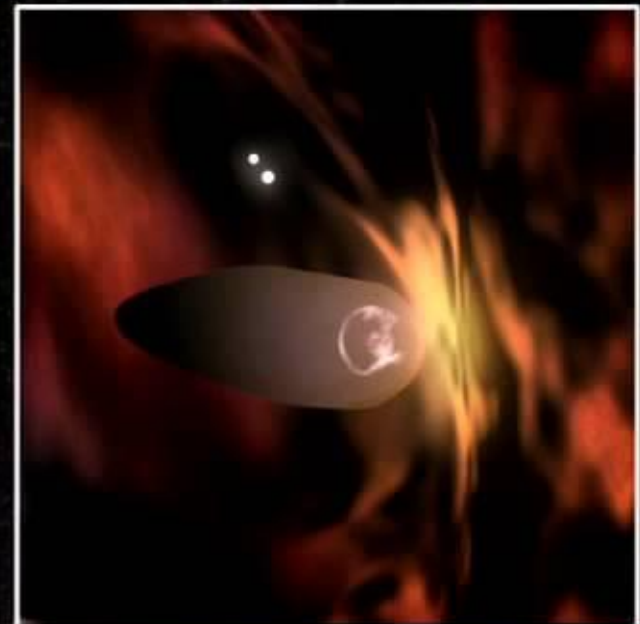


Inflow of the
Interstellar Wind
X



Scorpio



1
00:00:01,849 --> 00:00:12,860
>>> BEYOND THE GALAXY IS THE
VAST EMPTY VASTNESS OF SPACE.

2
00:00:12,860 --> 00:00:13,860
EMPTY?

3
00:00:13,860 --> 00:00:15,549
NOT QUITE.

4
00:00:15,549 --> 00:00:19,940
ACROSS THE MILKY WAY, THE
ENORMOUS DISTANCES FROM STAR TO

5
00:00:19,940 --> 00:00:24,050
STAR ARE FILLED WITH MATTER.

6
00:00:24,050 --> 00:00:25,050
WHAT IS IT?

7
00:00:25,050 --> 00:00:27,160
FROM WHERE DID IT COME?

8
00:00:27,160 --> 00:00:34,899
NEW SAMPLINGS BY NASA'S IBEX
SPACECRAFT REVEAL MORE ABOUT THE

9
00:00:34,899 --> 00:00:39,989
NATURE OF THIS MATTER, MATTER
THAT IS THE BASIS FOR STARS,

10
00:00:39,989 --> 00:00:48,999
PLANETS AND EVEN, US HUMANS.

11
00:00:48,999 --> 00:01:02,109
>>> GOOD AFTERNOON.

12
00:01:02,109 --> 00:01:06,579

I'M DWAYNE BROWN WITH THE OFFICE
OF COMMUNICATIONS AND WELCOME TO

13

00:01:06,579 --> 00:01:08,700

NASA HEADQUARTERS.

14

00:01:08,700 --> 00:01:12,820

TODAY YOU WILL HEAR AND LEARN
ABOUT THE ANATOMY OF ALL

15

00:01:12,820 --> 00:01:14,920

GALACTIC NEIGHBORHOOD.

16

00:01:14,920 --> 00:01:23,770

THE INFORMATION IS AVAILABLE ON
THE WEB AT NASA.GOV/IBEX AND

17

00:01:23,770 --> 00:01:28,970

ALSO VIA TWITTER, FACEBOOK,
YOUTUBE AND OTHER SOCIAL MEDIA

18

00:01:28,970 --> 00:01:29,970

SITES.

19

00:01:29,970 --> 00:01:32,939

WE'LL HAVE BRIEF PRESENTATIONS
FROM OUR PRESENTERS AND THEN

20

00:01:32,939 --> 00:01:36,630

OPEN IT UP FOR QUESTIONING
STARTING HERE IN WASHINGTON AND

21

00:01:36,630 --> 00:01:37,630

GO TO OUR PHONE LINES.

22

00:01:37,630 --> 00:01:39,899

WE HAVE A LOT TO COVER.

23

00:01:39,899 --> 00:01:43,039

LET'S GET STARTED AND LET ME
FIRST INTRODUCE YOU TO TODAY'S

24

00:01:43,039 --> 00:01:44,350

SPEAKERS.

25

00:01:44,350 --> 00:01:52,140

FIRST UP, DAVE McCOCAS, IBEX,
PRINCIPAL INVESTIGATOR AND

26

00:01:52,140 --> 00:01:56,219

ASSISTANT VICE PRESIDENT OF THE
SPACE SCIENCE AND ENGINEERING

27

00:01:56,219 --> 00:02:02,250

DIVISION, SOUTHWEST RESEARCH
INSTITUTE, SAN ANTONIO, TEXAS.

28

00:02:02,250 --> 00:02:08,619

PRISCILLA FRISCH, DEPARTMENT OF
ASTRONOMY AND ASTROPHYSICS,

29

00:02:08,619 --> 00:02:11,510

UNIVERSITY OF CHICAGO.

30

00:02:11,510 --> 00:02:17,500

EBERHARD MÖBIUS, SPACE SCIENCE
CENTER AND DEPARTMENT OF

31

00:02:17,500 --> 00:02:21,580

PHYSICS, UNIVERSITY OF NEW
HAMPSHIRE AND WHO'S CURRENTLY

32

00:02:21,580 --> 00:02:26,000

VISITING PROFESSOR AT THE SPACE
SCIENCE AND APPLICATION'S GROUP

33

00:02:26,000 --> 00:02:31,330

LOS ALAMOS LABORATORY.

34

00:02:31,330 --> 00:02:38,100

AND SETH REDFIELD, ASSISTANT
PROFESSOR, WESLEYAN UNIVERSITY

35

00:02:38,100 --> 00:02:40,040

IN MIDDLETOWN, CONNECTICUT.

36

00:02:40,040 --> 00:02:43,170

WITH THAT, I'LL TOSS IT TO DAVE.

37

00:02:43,170 --> 00:02:44,690

>> THANK YOU VERY MUCH, DWAYNE.

38

00:02:44,690 --> 00:02:50,220

WE'RE INCREDIBLY EXCITED TO TELL
YOU ABOUT SOME OBSERVATIONS.

39

00:02:50,220 --> 00:02:58,150

SOMETHING THAT DIDN'T COME FROM
OUR SUN OR OUR EARTH BUT OTHER

40

00:02:58,150 --> 00:03:02,320

PARTS OF THE GALAXY AND WE'RE
MAKING THESE FIRST MEASUREMENTS

41

00:03:02,320 --> 00:03:06,360

WITH THE IBEX INTERSTELLAR
BOUNDARY MISSION.

42

00:03:06,360 --> 00:03:10,330

THIS MATERIAL, THIS ALIEN
INTERSTELLAR MATERIAL IS THE

43

00:03:10,330 --> 00:03:13,990

STUFF THAT STARS AND PLANETS AND
PEOPLE AND ALL OF US ARE MADE

44

00:03:13,990 --> 00:03:14,990

OF.

45

00:03:14,990 --> 00:03:17,150

SO IT'S VERY IMPORTANT TO BE
MEASURING IT DIRECTLY.

46

00:03:17,150 --> 00:03:21,400

A NUMBER OF THESE SPECIES FOR
THE FIRST TIME.

47

00:03:21,400 --> 00:03:23,840

ALL OF THESE RESULTS ARE COMING
OUT TODAY IN A SET OF SIX PAPERS

48

00:03:23,840 --> 00:03:27,420

IN A SUPPLEMENT TO THE ASTRO
PHYSICAL JOURNAL, TIME TO GO

49

00:03:27,420 --> 00:03:31,410

WITH THIS PRESS CONFERENCE AND
BEFORE WE GET INTO THAT, I THINK

50

00:03:31,410 --> 00:03:35,370

WE NEED TO GIVE YOU A LITTLE BIT
OF BACKGROUND SO I'LL START WITH

51

00:03:35,370 --> 00:03:40,490

THE HELIUS SPHERES.

52

00:03:40,490 --> 00:03:45,230

THE SOLAR WIND IS A MILLION FILE
AN HOUR THAT BLOWS FROM THE SUN

53

00:03:45,230 --> 00:03:48,530

IN ALL DIRECTIONS ALL THE TIME
AND IT BASICALLY INFLATES A

54

00:03:48,530 --> 00:03:54,220

BUBBLE IN THE LOCAL PART OF THE
BUBBLE AND THE HELIAS SPHERES IS

55
00:03:54,220 --> 00:04:03,730
NOTHING MORE THAN THE GREEK WORD
FOR SUN AND FEAR SPHERE AND

56
00:04:03,730 --> 00:04:08,780
IRRELEVANT PROTECTS THE
INTERSOLAR SYSTEM FROM DANGEROUS

57
00:04:08,780 --> 00:04:12,490
GALACTIC COSMIC RAYS THE
MAJORITY OF WHICH WOULD COME

58
00:04:12,490 --> 00:04:15,140
INTO THE PLANETS AND THE INNER
PART OF THE SOLAR SYSTEM IF IT

59
00:04:15,140 --> 00:04:18,549
WASN'T FOR THE STRUCTURE OUT
THERE ABOUT 100 TIMES FURTHER

60
00:04:18,549 --> 00:04:23,260
OUT THERE THAN THE SUN IS FROM
THE EARTH, THE HELIOSPHERIC

61
00:04:23,260 --> 00:04:25,860
BOUNDARIES.

62
00:04:25,860 --> 00:04:29,290
SO IT'S ESPECIALLY IMPORTANT
REGION FOR US AS SPACE-FARING

63
00:04:29,290 --> 00:04:31,460
PEOPLE BECAUSE WHEN YOU GET AWAY
FROM THE EARTH AND THE

64
00:04:31,460 --> 00:04:34,140
PROTECTION OF THE EARTH'S
ATMOSPHERE THESE COSMIC RAYS ARE

65

00:04:34,140 --> 00:04:37,500
MORE IMPORTANT AND MORE
DANGEROUS.

66
00:04:37,500 --> 00:04:41,780
SO MOVING ON TO THE NEXT MOVIE,
WHAT YOU'LL SEE IS THE IBEX

67
00:04:41,780 --> 00:04:46,470
SPACECRAFT LAUNCHED IN 2008,
OCTOBER OF 2008.

68
00:04:46,470 --> 00:04:48,300
IT'S ONLY ABOUT THREE FEET
ACROSS.

69
00:04:48,300 --> 00:04:51,400
A FOOT AND A HALF HIGH AND IT
WEIGHS ABOUT 200 POUNDS.

70
00:04:51,400 --> 00:04:54,040
IT'S A VERY SMALL SPACECRAFT.

71
00:04:54,040 --> 00:04:57,070
IT POINTS AT THE SUN AND THE
BLUE PANELS YOU SEE ON THE FRONT

72
00:04:57,070 --> 00:04:59,140
WITH SOLAR LIKE YOU HAVE ON THE
ROOF OF SOME HOUSES.

73
00:04:59,140 --> 00:05:01,910
THAT'S WHERE WE GET OUR POWER
FROM AND WE LOOK OUT THE TWO

74
00:05:01,910 --> 00:05:05,850
SIDES WITH THESE VERY, VERY
SENSITIVE CAMERAS WHICH ARE ABLE

75
00:05:05,850 --> 00:05:09,510

TO DETECT NEUTRAL PARTICLES
COMING IN FROM THE FAR, FAR EDGE

76

00:05:09,510 --> 00:05:11,500
OF THE SOLAR SYSTEM.

77

00:05:11,500 --> 00:05:16,320
AND SO, THAT'S IBEX, PART OF THE
EXPLORER PROGRAM HERE IN THE

78

00:05:16,320 --> 00:05:22,900
HELIO PHYSICS DIVISION AND THIS
IS THE LEAST EXPENSIVE MISSION.

79

00:05:22,900 --> 00:05:26,960
A TREMENDOUS AMOUNT OF SCIENCE
WE'RE GETTING OUT OF THIS VERY

80

00:05:26,960 --> 00:05:27,960
SMALL SPACECRAFT.

81

00:05:27,960 --> 00:05:31,890
MY NEXT MOVIE, YOU'LL GET AN
IDEA OF WHAT IT LOOKS LIKE FROM

82

00:05:31,890 --> 00:05:32,890
THE OUTSIDE OF THE GALAXY.

83

00:05:32,890 --> 00:05:36,710
THIS IS AN ARTIST RENDITION BUT
AS WE ZOOM IN YOU'LL SEE US COME

84

00:05:36,710 --> 00:05:41,010
IN PAST THE BILLIONS OF STARS
THAT MAKE UP THE GALAXY AND

85

00:05:41,010 --> 00:05:44,210
WE'RE ABOUT HALFWAY OUT IN ONE
OF THE SPIRAL ARMS AND YOU CAN

86

00:05:44,210 --> 00:05:48,830

SEE OUR HELIOS SPHERES AS IT
MOVES PAST THE WIND.

87

00:05:48,830 --> 00:05:51,350

LET'S RIDE ALONG WITH THE
PARTICLES THAT ARE HEADED

88

00:05:51,350 --> 00:05:55,220

TOWARDS THE NOSE OF THE HELIOS
SPHERE.

89

00:05:55,220 --> 00:05:59,730

WE GET TO IT AND THE BOUNDARY
PUSHES AWAY THE PARTICLES AND

90

00:05:59,730 --> 00:06:01,950

THEY'RE LOST BUT THE NEUTRAL
PARTICLES ARE NOT AFFECTED BY

91

00:06:01,950 --> 00:06:06,169

THE MAGNETIC FIELD AND THEY CAN
COME DIRECTLY INTO THE SPHERE.

92

00:06:06,169 --> 00:06:10,070

SOME FLY IN PAST THE PLANETS AND
MOON TOWARDS THE EARTH AND A

93

00:06:10,070 --> 00:06:16,360

VERY FEW COME DIRECTLY INTO THE
SPACECRAFT AND THAT'S AFTER 30

94

00:06:16,360 --> 00:06:22,030

YEARS AND IS 15 BILLION MILE
HOLE IN ONE.

95

00:06:22,030 --> 00:06:25,890

WITH THAT, WE'LL MOVE ON AND
PRISCILLA WILL TELL US ABOUT THE

96

00:06:25,890 --> 00:06:27,790

LOCAL PART OF THE GALAXY.

97

00:06:27,790 --> 00:06:31,669

>> I'M GOING TO TALK ABOUT
INTERSTELLAR CLOUDS.

98

00:06:31,669 --> 00:06:36,950

INNER STELLAR CLOUDS ARE CLOUDS
OF BETWEEN STARS.

99

00:06:36,950 --> 00:06:41,930

THE IBEX EXAM MINUTES THE LOW
DENSITY TENUOUS CLOUDS SO IT'S

100

00:06:41,930 --> 00:06:45,889

DIFFERENT THAN THE CLOUDS FROM
ORION.

101

00:06:45,889 --> 00:06:50,790

SO WE'LL START OUR JOURNEY INTO
THE GALACTIC NEIGHBORHOOD FROM

102

00:06:50,790 --> 00:06:52,730

OUR MILKY WAY GALAXY.

103

00:06:52,730 --> 00:06:57,930

WE'LL SEE SPIRAL ARMS FULL OF
GIANT, DENSE CLOUDS, MASSES OF

104

00:06:57,930 --> 00:06:59,920

STARS AND DUST.

105

00:06:59,920 --> 00:07:02,640

AND NEXT SLIDE, HE'S.

106

00:07:02,640 --> 00:07:10,110

ORION NEBULA IS NOTHING LIKE
AROUND THE SUN BUT IN A CLUED

107

00:07:10,110 --> 00:07:12,730

LIKE THIS CLOUDS ARE BORN AND
THEY ARE SUPER NOVA.

108

00:07:12,730 --> 00:07:20,050

AND YOU SEE THESE BEAUTIFUL ARCS
AND BUBBLES HAVE THAT BEEN BLOWN

109

00:07:20,050 --> 00:07:26,580

BY THE WINDS OF BRAND NEW STARS
INSIDE THE ORION NEBULA.

110

00:07:26,580 --> 00:07:31,360

THIS IS THE DEBRIS OF A SUPER
NOVA EXPLOSION THAT HAPPENED

111

00:07:31,360 --> 00:07:35,040

1,000 YEARS AGO AND OBSERVED BY
YOUR ANCESTORS AND CALLED THE

112

00:07:35,040 --> 00:07:39,150

CRAB SUPER NOVA EXPLOSIONS AND
WHEN THE CRAB EXPLODED IT CASTS

113

00:07:39,150 --> 00:07:43,090

MANY OF THE ELEMENTS THAT THE
IBEX OBSERVED INTO SPACE.

114

00:07:43,090 --> 00:07:47,790

THE PERIODIC TABLE SHOWS YOU THE
HYDROGEN, HELIUM, OXYGEN AND

115

00:07:47,790 --> 00:07:50,690

NEON THAT IBEX IS OBSERVING
RIGHT NOW.

116

00:07:50,690 --> 00:07:54,729

THE FIRST DIRECT MEASUREMENTS OF
INNER STELLAR MATERIAL MADE

117

00:07:54,729 --> 00:07:57,500
WITHOUT A TELESCOPE.

118

00:07:57,500 --> 00:08:00,320
THE ANIMATION, PLEASE?

119

00:08:00,320 --> 00:08:03,500
NOW WE'RE GOING TO LEAVE THE
DENSE CLOUDS BEHIND US AND

120

00:08:03,500 --> 00:08:07,410
JOURNEY INTO THE VERY TENUOUS
SORT OF FLUFFY INNER STELLAR

121

00:08:07,410 --> 00:08:10,150
CLOUDS THAT SURROUND THE SUN
RIGHT NOW.

122

00:08:10,150 --> 00:08:14,510
WE'RE ACTUALLY IN A COMPLEX OF
CLOUDS AND THEY HAVE NAMES.

123

00:08:14,510 --> 00:08:17,010
SETH HAS NAMED SOME OF THEM.

124

00:08:17,010 --> 00:08:20,260
WE'RE RIGHT AT THE EDGE OF WHAT
WE CALL THE LOCAL CLOUD.

125

00:08:20,260 --> 00:08:23,470
THAT'S THE BRIGHT YELLOW DOT IN
THE CENTER OF THE FIGURE AND YOU

126

00:08:23,470 --> 00:08:26,080
CAN SEE WE'RE MOVING WITH
RESPECT TO THESE CLOUDS.

127

00:08:26,080 --> 00:08:29,270

THE YELLOW ARROW SHOWS THE
DIRECTION OF THE SUN'S MOTION.

128

00:08:29,270 --> 00:08:33,190
NOW, BECAUSE OF THIS MOTION,
INNER STELLAR GAS AND DEATH ARE

129

00:08:33,190 --> 00:08:42,849
BLOWN THROUGH THE HELIOSPHERES
AND DUST AND GAS ARE BLOWN

130

00:08:42,849 --> 00:08:48,149
THROUGH BUT IBEX ONLY MEASURES
THE GAS COMPONENT, OF COURSE.

131

00:08:48,149 --> 00:08:51,800
YOU SEE WE'RE AT THE EDGE OF
CLOUD AND ONE OF THE REASONS WE

132

00:08:51,800 --> 00:08:57,459
KNOW WE'RE AT THE EDGE OF THE
CLOUD IS THE NEXT CLOUD OVER IS

133

00:08:57,459 --> 00:09:02,120
IN FRONT OF THE GALACTIC CENTER
CALLED THE G CLOUD AND THE STAR

134

00:09:02,120 --> 00:09:06,660
ALPHA IS BEHIND THE G CLOUD AND
WHEN WE LOOK AT ALPHA CENTORI WE

135

00:09:06,660 --> 00:09:17,470
DON'T SEE THE EDGE OF THE LOCAL
CLOUD SO WE KNOW WE'RE AT THE

136

00:09:17,470 --> 00:09:18,529
EDGE.

137

00:09:18,529 --> 00:09:23,600
PLEASE START THE ANIMATION.

138

00:09:23,600 --> 00:09:29,029

WE CHANGE CLOUDS EVERY 45,000
YEARS AND HAVE BEEN AN A LOCAL

139

00:09:29,029 --> 00:09:33,930

CLOUD FOR 45 YEARS AND THE DATA
INDICATES WE'LL LEAVE IT IN THE

140

00:09:33,930 --> 00:09:39,269

NEXT FEW THOUSAND YEARS AND WHEN
WE LEAVE IT, THE INSTRUMENT ON

141

00:09:39,269 --> 00:09:41,809

IBEX WILL MEASURE SOMETHING
DIFFERENT BUT WE DON'T KNOW

142

00:09:41,809 --> 00:09:46,519

WHAT.

143

00:09:46,519 --> 00:09:55,930

SO EBERHARD?

144

00:09:55,930 --> 00:10:00,769

>> LET ME REMIND YOU, THE SOLAR
WIND INFLATES THE BUBBLE, HELIS

145

00:10:00,769 --> 00:10:08,019

SPHERE AND WITH THAT, THE
DANGEROUS COSMIC RAYS BUT THE

146

00:10:08,019 --> 00:10:12,389

NEUTRALS PUNCH RIGHT THROUGH IT
AND THEY MAKE IT ALL THE WAY TO

147

00:10:12,389 --> 00:10:13,740

THE EARTH.

148

00:10:13,740 --> 00:10:19,910

HERE, IBEX CATCHES THIS WIND AND
I MUST SAY PERSONALLY, THAT'S

149

00:10:19,910 --> 00:10:21,559

WHAT EXCITES ME THE MOST.

150

00:10:21,559 --> 00:10:24,900

THAT'S THE PART OF IBEX THAT I
WAS LOOKING FORWARD TO WHEN WE

151

00:10:24,900 --> 00:10:26,629

STARTED IBEX.

152

00:10:26,629 --> 00:10:34,709

NOW, TO VIEW THIS, LET'S TAKE
THE NEXT SLIDE AND WE BOUGHT THE

153

00:10:34,709 --> 00:10:40,949

ENTERPRISE NOW, WHICH BRINGS US
FAR AWAY FROM THE SUN AND NOW WE

154

00:10:40,949 --> 00:10:46,579

SEE THIS AND WHEN WE LOOK UP AND
WE SEE THE INTERSTELLAR WIND AS

155

00:10:46,579 --> 00:10:51,779

A BRIGHT SPOTLIGHT BECKONING US
FROM A SCORPIO.

156

00:10:51,779 --> 00:10:58,480

DO YOU SEE SAGITARRIUS AND LIBRA
TO THE RIGHT IN A VIEW YOU CAN

157

00:10:58,480 --> 00:11:03,679

SEE AROUND MIDNIGHT IN JUNE WHEN
LOOKING SOUTH.

158

00:11:03,679 --> 00:11:07,959

LET'S ANIMATE THAT AND WATCH
BACK TO THE EARTH AND THE VIEW

159

00:11:07,959 --> 00:11:11,899

OPENS UP TO THE ENTIRE SKY.

160

00:11:11,899 --> 00:11:19,230

AND AT EARTH, OUR IBEX WISER
AWAITS THE PARTICLES AND YOU SEE

161

00:11:19,230 --> 00:11:25,779

IT TRANSITIONING TO AN IBEX MAP
WHERE THE BRIGHT RED WINDS COMES

162

00:11:25,779 --> 00:11:28,379

NOW FROM LIBRA.

163

00:11:28,379 --> 00:11:32,059

WHY HAS IT SHIFTED FROM SCORPIO
TO LIBRA.

164

00:11:32,059 --> 00:11:34,149

THE CULPRIT IS THE SUN.

165

00:11:34,149 --> 00:11:40,429

WITH ITS GRAFF TERRIBLE FIELD IT
BENDS THE FLOW AROUND LIKE IF

166

00:11:40,429 --> 00:11:44,529

YOU SHOOT UP A SOCCER BALL
STRAIGHT INTO THE AIR, IT IS

167

00:11:44,529 --> 00:11:49,089

FORCED TO FALL BACK TO THE
GROUND IN THE CURVE.

168

00:11:49,089 --> 00:11:53,860

AND IN THE NEXT VIEW, WE VIEW
THAT FROM A VANTAGE POINT HIGH

169

00:11:53,860 --> 00:11:57,439

UP ABOVE THE NORTH POLE, LOOKING
DOWN.

170

00:11:57,439 --> 00:12:00,839

YOU SEE THE FLOW TO PROJECTRY IS
AWAY AS THEY ARE BENT BY THE

171

00:12:00,839 --> 00:12:01,839

SUN'S GRAVITY.

172

00:12:01,839 --> 00:12:08,189

IBEX, AT SOME POINT A SPINNER
CAN ONLY VIEW THESE WHEN THE

173

00:12:08,189 --> 00:12:11,939

FLOW COMES RIGHT ALONG THE
EARTH'S ORBIT AND THAT HAPPENS

174

00:12:11,939 --> 00:12:16,629

IN EARLY FEBRUARY, ACTUALLY
COMING UP IN A WEEK OR SO, AND

175

00:12:16,629 --> 00:12:21,499

WE'RE EXCITED TO SEE THIS ONE
MORE TIME THIS YEAR AND HOW IT

176

00:12:21,499 --> 00:12:23,019

HAS CHANGED.

177

00:12:23,019 --> 00:12:27,970

NOW THE FLOW TRAJECTORY,
DEPENDING ON THE SPEED, ARE

178

00:12:27,970 --> 00:12:28,970

DIFFERENT.

179

00:12:28,970 --> 00:12:33,699

THE DARKER BLUE IS A SLOWER FLOW
THAT GETS BENT MORE THAN THE

180

00:12:33,699 --> 00:12:37,009

LIGHTER BLUE, WHICH IS FARTHER
AND SHOOTS BY.

181

00:12:37,009 --> 00:12:38,618

NOW IBEX SEES THE LOWER EARLIER
IN THE ORBIT THAN THE FASTER

182

00:12:38,618 --> 00:12:42,370

STUFF, SEES THE SLOWER STUFF
EARLIER IN THE ORBIT THAN THE

183

00:12:42,370 --> 00:12:43,899

FASTER STUFF.

184

00:12:43,899 --> 00:12:50,589

THIS IS OUR ODOMETER WHICH IS
HOW WE NAIL DOWN HOW FAST THE

185

00:12:50,589 --> 00:12:55,639

INTERSTELLAR WIND IS AND THEN
RELATING IT TO AN ASTRONOMICAL

186

00:12:55,639 --> 00:13:00,829

OBSERVATION WE CAN TELL WHICH
ONE OF THE CLOUDS WHICH ACTUALLY

187

00:13:00,829 --> 00:13:02,399

CALL HOME.

188

00:13:02,399 --> 00:13:09,079

THE NEXT VIEW SHOWS THE RESULTS,
THE SPEED UP THE DIRECTION IN

189

00:13:09,079 --> 00:13:11,199

LONGITUDE TO THE SIDE.

190

00:13:11,199 --> 00:13:17,499

AND OUR NEW RESULTS TAKEN WITH

THE TWO DIFFERENT WAYS OF USING

191

00:13:17,499 --> 00:13:25,769

THIS SPEEDOMETER SHOWS US WHERE
WE ARE, COMPARED TO THE OLD

192

00:13:25,769 --> 00:13:29,749

RESULTS IT'S A LITTLE SLOW HER A
DIFFERENT DIRECTION.

193

00:13:29,749 --> 00:13:31,850

THAT'S THE BLUE.

194

00:13:31,850 --> 00:13:34,670

BUT THIS SOLVED A PUZZLE.

195

00:13:34,670 --> 00:13:38,239

THE OLD RESULTS DIDN'T REALLY
PUT US INTO ANY OF THE

196

00:13:38,239 --> 00:13:40,010

NEIGHBORING CLOUDS.

197

00:13:40,010 --> 00:13:45,480

BUT WITH THE NEW RESULTS WE'RE
RIGHT IN THE LOCAL CLOUD.

198

00:13:45,480 --> 00:13:47,709

ISN'T MOTHER NATURE AMAZING?

199

00:13:47,709 --> 00:13:53,899

TO PROVIDE US WITH A SPEEDOMETER
JUST FOR FREE.

200

00:13:53,899 --> 00:13:59,069

AND THIS NEW RESULT HAS SOME
INTERESTING CONSEQUENCES.

201

00:13:59,069 --> 00:14:03,540

ALSO, THE PRESSURE ON THE NOSE
OF THE HELIX SPHERE IS LESS THAN

202

00:14:03,540 --> 00:14:06,339

WE THOUGHT BEFORE.

203

00:14:06,339 --> 00:14:11,500

SETH WILL TAKE THIS UP LATER BUT
BEFORE WE GO THERE, LET'S TURN

204

00:14:11,500 --> 00:14:16,559

TO ANOTHER CAPABILITY OF IBEX,
NAMELY, TO ALSO SOUGHT OUT THE

205

00:14:16,559 --> 00:14:19,230

ELEMENTS OF THIS FLOW.

206

00:14:19,230 --> 00:14:24,069

AND IBEX HAS SEEN HYDROGEN,
OXYGEN AND NEON FOR THE FIRST

207

00:14:24,069 --> 00:14:40,259

TIME, IN ADDITION TO HELIUM,
WHICH WE'VE SEEN BEFORE.

208

00:14:40,259 --> 00:14:45,839

THERE'S LESS OXYGEN COMPARED TO
NEON IN OUR NEIGHBORHOOD THAN IN

209

00:14:45,839 --> 00:14:48,570

THE SUN AND THE MILKY WAY.

210

00:14:48,570 --> 00:14:51,869

THAT LEAVES US WITH A PUZZLE FOR
NOW.

211

00:14:51,869 --> 00:14:56,120

COULD IT BE THAT SOME OF THE
OXYGEN WHICH IS SO CRUCIAL FOR

212

00:14:56,120 --> 00:15:00,689

LIFE ON EARTH IS LOCKED UP IN
THE COSMIC DUST?

213

00:15:00,689 --> 00:15:04,160

OR DOES IT TELL US HOW
DIFFERENT, ACTUALLY, OUR

214

00:15:04,160 --> 00:15:08,799

NEIGHBORHOOD IS COMPARED TO THE
SUN'S BIRTH PLACE?

215

00:15:08,799 --> 00:15:15,309

ONLY TIME, SOME MORE DATA FROM
IBEX, AND I CAN TELL YOU EARLY

216

00:15:15,309 --> 00:15:17,970

EXCITING WORK WILL TELL US.

217

00:15:17,970 --> 00:15:20,760

SETH, WHAT'S YOUR TAKE ON THIS?

218

00:15:20,760 --> 00:15:22,560

>> THANK YOU.

219

00:15:22,560 --> 00:15:26,119

MY JOB IS TO PROVIDE A LITTLE
PERSPECTIVE FROM SOMEONE OUTSIDE

220

00:15:26,119 --> 00:15:28,519

OF THE IBEX TEAM.

221

00:15:28,519 --> 00:15:31,649

AND TO TALK A LITTLE BIT ABOUT
THE BROADER IMPLICATIONS OF

222

00:15:31,649 --> 00:15:32,889

THESE RESULTS.

223

00:15:32,889 --> 00:15:37,240

AND LET ME BEGIN BY SAYING HOW
EXCITED IT IS THAT WE KNOW WHERE

224

00:15:37,240 --> 00:15:42,939

THE SUN IS LOCATED, NOW RELATIVE
TO THESE INTERSTELLAR CLOUDS.

225

00:15:42,939 --> 00:15:46,709

SO MUCH OF WHAT WE DO AND WE
EXPLORE THE COSMOS IS TRY TO PUT

226

00:15:46,709 --> 00:15:52,509

OURSELVES IN CONTEXT, OURSELVES,
THE EARTH, THE SUN, AND IBEX HAS

227

00:15:52,509 --> 00:15:56,199

DONE THIS WITH THIS NEW
DISCOVERY.

228

00:15:56,199 --> 00:16:01,699

WITH MY FIRST SLIDE, I SHOW TWO
IMAGES THAT YOU'VE SEEN BEFORE

229

00:16:01,699 --> 00:16:06,009

ON THE LEFT IS A VIEW THAT
PRISCILLA SHOWED AND IT'S A VIEW

230

00:16:06,009 --> 00:16:09,889

OF THIS COLLECTION OF
INTERSTELLAR CLOUDS, RIGHT

231

00:16:09,889 --> 00:16:10,889

AROUND THE SUN.

232

00:16:10,889 --> 00:16:16,540

THEY'RE ALL MOVING WITH THEIR
OWN UNIQUE MOTIONS.

233

00:16:16,540 --> 00:16:19,869

AND THE TWO NEARER CLOUDS, THE
LOCAL CLOUDS AND G CLOUDS WE'VE

234

00:16:19,869 --> 00:16:25,480

KNOWN FOR SOME TIME THAT THERE'S
A DISCREPANCY BETWEEN THE MOTION

235

00:16:25,480 --> 00:16:28,920

THAT WE OBSERVED FOR THESE
CLOUDS BY LOOKING AT NEARBY

236

00:16:28,920 --> 00:16:34,440

STARS AND THE OLD RESULTS OF
ATOMS STREAMING INTO THE SOLAR

237

00:16:34,440 --> 00:16:35,440

SYSTEM.

238

00:16:35,440 --> 00:16:38,629

THERE'S A DISCREPANCY THAT WE
COULDN'T EXPLAIN.

239

00:16:38,629 --> 00:16:43,210

THESE NEW IBEX MEASUREMENTS
MATCH THE MOTIONS THAT WE

240

00:16:43,210 --> 00:16:48,019

OBSERVED FROM STARS TO A LOCAL
CLOUD PERFECTLY AND WHAT IT DOES

241

00:16:48,019 --> 00:16:55,070

IS IT PINPOINTS OUR LOCATION
INSIDE THE LOCAL CLOUD.

242

00:16:55,070 --> 00:16:59,629

WE'RE VERY NEAR THE EDGE BUT NOW
WE KNOW THAT WE'RE IN THE LOCAL

243

00:16:59,629 --> 00:17:05,140

CLOUD AND LOCATION IS REALLY
IMPORTANT, BECAUSE THE HELIOS

244

00:17:05,140 --> 00:17:11,709
SPHERE IS THE OUTWARD SOLAR WIND
AND THE COMPRESSION FROM THE GAS

245

00:17:11,709 --> 00:17:13,589
AND DUST THAT SURROUND IT.

246

00:17:13,589 --> 00:17:16,949
SO IF YOU'RE IN A DIFFERENT
INTERSTELLAR MEDIUM ENVIRONMENT

247

00:17:16,949 --> 00:17:19,390
YOU'RE GOING TO CREATED A
DIFFERENT HELIOSPHERE

248

00:17:19,390 --> 00:17:21,850
CONSTRUCTION.

249

00:17:21,850 --> 00:17:29,700
AND IT CHANGES WITH TIME AS IT
PASSES INTO A DENSE INTERSTELLAR

250

00:17:29,700 --> 00:17:32,029
CLOUD IT WILL BE COMPRESSED AND
VERY SMALL.

251

00:17:32,029 --> 00:17:36,529
AND AS IT MOVES INTO ANOTHER
CLOUD, IT WILL EXPAND OUT AGAIN

252

00:17:36,529 --> 00:17:40,580
AND THIS HAS CONSEQUENCES FOR
SHIELDING US FROM THESE

253

00:17:40,580 --> 00:17:43,940
DANGEROUS GALACTIC COSMIC RAYS.

254

00:17:43,940 --> 00:17:48,820

SO LEARNING ABOUT THE
HELIOSPHERE TODAY HELPS US

255

00:17:48,820 --> 00:17:52,470

UNDERSTAND IT AS IT WAS IN THE
PAST AND HOW IT WOULD BE IN THE

256

00:17:52,470 --> 00:17:53,470

FUTURE.

257

00:17:53,470 --> 00:17:56,909

NOW WE KNOW WHERE WE ARE AND
WHERE WE'RE COMING FROM AND WE

258

00:17:56,909 --> 00:18:04,980

KNOW WHERE WE'RE GOING.

259

00:18:04,980 --> 00:18:18,049

THIS COMPRESSION IS SO CHAMPION
THAT WE THINK THAT MOST IF NOT

260

00:18:18,049 --> 00:18:21,860

ALL STARS HAVE A STRUCTURE
THAT'S ANALOGOUS TO THE HELIO

261

00:18:21,860 --> 00:18:25,600

SPHERE AND THOSE WE CALL ASTRO
SPHERES.

262

00:18:25,600 --> 00:18:32,460

AND IN MY NEXT SLIDE I SHOW
SEVERAL EXAMPLES OF THESE.

263

00:18:32,460 --> 00:18:37,990

THESE ARE VERY DRAMATIC EXAMPLES
OF STARS MOVING THROUGH A DENSE

264

00:18:37,990 --> 00:18:44,299

INTERSTELLAR MEDIUM OR STARS WE
VERY, VERY STRONG SOLAR WINDS.

265

00:18:44,299 --> 00:18:46,450

AND THE IMAGE ON THE BOTTOM IS
PARTICULARLY STRIKING.

266

00:18:46,450 --> 00:18:48,169

IT LOOKS LIKE A COMMENT.

267

00:18:48,169 --> 00:18:53,679

THE STAR IS MOVING SO QUICKLY
YOU CAN SEE THE WEAK OF ITS

268

00:18:53,679 --> 00:18:59,460

AFTERS SPHERE BEING SPREAD OUT,
KIND OF LIKE A JET TRAIL FROM A

269

00:18:59,460 --> 00:19:02,870

JUMBO JET FLYING OVERHEAD.

270

00:19:02,870 --> 00:19:06,409

AND BECAUSE OF THE GREAT
DIVERSITY OF STARS AND THE

271

00:19:06,409 --> 00:19:09,519

INCREDIBLE DIVERSITY OF
DIFFERENT INTERSTELLAR MEDIUM

272

00:19:09,519 --> 00:19:14,559

ENVIRONMENTS, THE NUMBER OF
CONFIGURATIONS THAT YOU CAN HAVE

273

00:19:14,559 --> 00:19:15,559

IS ENDLESS.

274

00:19:15,559 --> 00:19:21,060

WE'RE GOING TO BE PRESENTED WITH
THIS VAST ZOO OF SPHERES AND THE

275

00:19:21,060 --> 00:19:27,880

GOLD STANDARD WITH WHICH WE'RE
GOING TO STUDY THESE ASTROSPHERE

276

00:19:27,880 --> 00:19:37,200

SO WE NEED TO
EVALUATE THESE

277

00:19:37,200 --> 00:19:38,710

OTHER STRUCTURES.

278

00:19:38,710 --> 00:19:45,000

ON FINALLY, ON MY LAST SLIDE I
WANTED TO TALK ABOUT THE

279

00:19:45,000 --> 00:19:48,870

IMPLICATIONS OF THESE
DISCOVERIES IN THE FUTURE.

280

00:19:48,870 --> 00:19:54,090

AND I SHOW, I ZOOM IN, AGAIN,
INTO OUR VERY LOCAL COSMIC

281

00:19:54,090 --> 00:19:57,289

NEIGHBORHOOD, YOU CAN SEE THE
LOCAL CLOUD AND THE G-CLOUD

282

00:19:57,289 --> 00:20:03,130

THERE AND I INDICATED THE
LOCATION OF KNOWN DETECTED ASTRO

283

00:20:03,130 --> 00:20:04,130

SPHERES.

284

00:20:04,130 --> 00:20:08,140

SO UNLIKE THE REALLY DRAMATIC
EXAMPLES I SHOWED IN THE FIRST

285

00:20:08,140 --> 00:20:14,039

SLIDE, FINDING ASTROSPHERE IN
THE SUN IS DIFFICULT AND IT'S

286

00:20:14,039 --> 00:20:18,440
BEEN IN THE LAST 10 OR 15 YEARS
WE'VE BEEN ABLE TO REFINE THE

287

00:20:18,440 --> 00:20:21,630
TECHNIQUES AND FIND THE
INSTRUMENTATION WITH WHICH TO

288

00:20:21,630 --> 00:20:26,539
MAKE THESE DISCOVERIES SO IN
THIS VERY LOCAL VOLUME, WHERE

289

00:20:26,539 --> 00:20:30,460
THERE ARE ABOUT 100 STARS, WE
KNOW OF ABOUT TEN THAT HAVE

290

00:20:30,460 --> 00:20:31,559
ASTROSPHERES.

291

00:20:31,559 --> 00:20:38,070
ALPHA CENTAURI, HAS AN ASTRO
SPHERE AROUND IT AND WE'RE

292

00:20:38,070 --> 00:20:45,140
DISCOVERING THESE PLANETS AND A
INDICATED THE LOCATION OF STARS

293

00:20:45,140 --> 00:20:47,710
THAT HAVE HAD PLANETS DISCOVERED
AROUND THEM.

294

00:20:47,710 --> 00:20:51,779
AND WE KNOW OF AT LEAST TWO
CASES WHERE WE DISCOVERED BOTH A

295

00:20:51,779 --> 00:20:56,179
PLANETARY SYSTEM AND AN

ASTROSPHERE AROUND IT AND THESE

296

00:20:56,179 --> 00:21:01,950

ARE THE TRUE ANALOGS TO OUR
SOLAR SYSTEM AWHERE WE HAVE A

297

00:21:01,950 --> 00:21:06,930

HELIOSPHERE THAT PROTECTS US
FROM GALACTIC COSMIC RAYS ON

298

00:21:06,930 --> 00:21:08,640

EARTH AND OTHER PLANETS.

299

00:21:08,640 --> 00:21:14,120

WHILE WE HAVE ANOTHER EXAMPLE
WHERE THAT STAR WITH ITS OWN

300

00:21:14,120 --> 00:21:18,960

ASTROSPHERE IS PROTECTING THE
PLANETARY SYSTEM AROUND THAT

301

00:21:18,960 --> 00:21:19,960

PARTICULAR STAR.

302

00:21:19,960 --> 00:21:25,970

AND IN THE NEXT TEN YEARS OR SO,
I THINK WE'LL OPENING UP NEW

303

00:21:25,970 --> 00:21:29,169

RESEARCH AREAS AND WE'LL HAVE
NEW QUESTIONS THAT WE COULD WANT

304

00:21:29,169 --> 00:21:33,370

HAVE ADDRESSED 10 OR 15 YEARS
AGO.

305

00:21:33,370 --> 00:21:35,300

ALL THESE THINGS ARE COMING
TOGETHER.

306

00:21:35,300 --> 00:21:40,190

WE'RE FIND PLAQUE NETS AND WE'RE
FINDING ASTROSPHERE AND

307

00:21:40,190 --> 00:21:48,330

UNDERSTANDING ALL OF THIS SO I
THINK WE'LL BE ATTING HOW THIS

308

00:21:48,330 --> 00:21:56,250

AND HOW THIS IMPACTS HOW THINGS
HAPPEN ON PLANETS AND IN

309

00:21:56,250 --> 00:22:02,230

PARTICULAR, COULD AFFECT THE
HABITABILITY OF THESE PLANETS.

310

00:22:02,230 --> 00:22:05,570

SO WITH THAT I'LL PASS IT BACK
TO DAVE.

311

00:22:05,570 --> 00:22:08,810

>> THANK YOU, SETH.

312

00:22:08,810 --> 00:22:13,461

TODAY WE'RE AMOUNTSING THESE
FIRST OBSERVATIONS OF THE DIRECT

313

00:22:13,461 --> 00:22:17,950

OBSERVATIONS OF INTERSTELLAR
MATERIAL, HYDROGEN, OXYGEN AND

314

00:22:17,950 --> 00:22:20,370

NEON, QUANTITATIVE MEASUREMENTS
OF THOSE TO JOIN PREVIOUS

315

00:22:20,370 --> 00:22:25,610

MEASUREMENTS MADE BEFORE OF
HELIUM AND THESE ARE IMPORTANT

316

00:22:25,610 --> 00:22:27,679
ELEMENTS TO KNOW QUANTITATIVELY.

317
00:22:27,679 --> 00:22:31,980
THE BUILDING BLOCKS OF STARS,
PLANETS AND PEOPLE SO IT'S VERY

318
00:22:31,980 --> 00:22:34,059
IMPORTANT TO KNOW ABOUT HIM.

319
00:22:34,059 --> 00:22:38,139
WE DISCOVERED THIS BIG PUZZLE
THAT THE MATTER OUTSIDE OF OUR

320
00:22:38,139 --> 00:22:41,289
SOLAR SYSTEM DOESN'T LOOK LIKE
THE MATERIAL INSIDEh-- FROM THE

321
00:22:41,289 --> 00:22:44,159
SUN AND THE SOLAR SYSTEM OR
ACROSS THE GALAXY ON AVERAGE AS

322
00:22:44,159 --> 00:22:45,159
FAR AS WE KNOW.

323
00:22:45,159 --> 00:22:48,990
AND IT SEEMS TO BE DEFICIENT IN
OXYGEN COMPARED TO NEON WHICH

324
00:22:48,990 --> 00:22:51,920
LEAVES US WITH THE BIG QUESTION,
THE PUZZLE.

325
00:22:51,920 --> 00:22:54,121
IS IT REALLY SUCH A DIFFERENT
REGION THAT WE HAPPEN TO BE IN

326
00:22:54,121 --> 00:22:56,340
RIGHT NOW, UNREPRESENTATIVE IN
SOME WAY?

327

00:22:56,340 --> 00:22:59,250

VERY DIFFERENT FROM WHERE THE
SUN WAS FORMED?

328

00:22:59,250 --> 00:23:02,429

OR IS THAT LIFE-GIVING OXYGEN
LOCKED UP IN OTHER THINGS?

329

00:23:02,429 --> 00:23:05,679

LOCKED UP, PERHAPS, IN DUST OR
ICES?

330

00:23:05,679 --> 00:23:08,870

THAT FLOAT AROUND THROUGH THE
INTERSTELLAR MEDIUM?

331

00:23:08,870 --> 00:23:11,259

AND FINALLY, WE'VE CAUGHT THIS
INTERSTELLAR WIND AND MEASURED

332

00:23:11,259 --> 00:23:13,910

THE SPEED AND IT'S NOT AS FAST
AS WE THOUGHT IT WAS GOING ANDS

333

00:23:13,910 --> 00:23:18,220

THAT HAS A VERY IMPORTANT LOW
INDICATION BECAUSE THE PRESSURE

334

00:23:18,220 --> 00:23:20,159

IS LESS.

335

00:23:20,159 --> 00:23:23,210

THE HELIOSPHERE IS MORE
DOMINATED BY THE EXTERNAL

336

00:23:23,210 --> 00:23:26,880

MAGNETIC FIELD AND LESS BY THE
FLOWING IN MATERIAL THAN WE

337

00:23:26,880 --> 00:23:27,880

EXPECTED.

338

00:23:27,880 --> 00:23:29,660

THAT HAS IMPORTANT IMPLICATIONS
FOR WHAT THE HELIOSPHERE

339

00:23:29,660 --> 00:23:33,559

STRUCTURE IS LIKE AND FOR
ANSWERING QUESTIONS ABOUT HOW

340

00:23:33,559 --> 00:23:36,840

EXACTLY THE HELIOSPHERE DOES
THIS CRITICAL SHIELDING OF

341

00:23:36,840 --> 00:23:37,840

COSMIC RADIATION.

342

00:23:37,840 --> 00:23:41,509

AND I GUESS I'D ADD ON A
PERSONAL NOTE I'M DELIGHTED THAT

343

00:23:41,509 --> 00:23:45,190

WE WERE ABLE TO DO THISSY ONE OF
THE SMALLEST, FASTEST AND

344

00:23:45,190 --> 00:23:48,880

LEAST-EXPENSIVE THINGS NASA
DOES, THE SMALL EXPLORER AND

345

00:23:48,880 --> 00:23:50,889

WITH THAT, DWAYNE, WE'D LOVE TO
TAKE SOME QUESTIONS.

346

00:23:50,889 --> 00:23:57,159

>> CONGRATULATIONS TO THE TEAM
AND EBERHARD, I REALLY ENJOYED

347

00:23:57,159 --> 00:24:05,070

THE ENTERPRISE TEST YOU PUT IN
HERE.

348

00:24:05,070 --> 00:24:08,299
FOR THE QUESTION AND ANSWER
PERIOD, WE'RE GOING TO START

349

00:24:08,299 --> 00:24:12,100
HERE IN WASHINGTON AND IF YOU
CAN WAIT FOR THE MIC AND GIVE

350

00:24:12,100 --> 00:24:15,120
YOUR NAME AND AFFILIATION AND
POSE YOUR QUESTION.

351

00:24:15,120 --> 00:24:21,309
>> MY NAME IS ABDULLAH AND I'M
FROMh-- MY QUESTION IS FOR

352

00:24:21,309 --> 00:24:25,470
ANYONE THAT WOULD LIKE TO GIVE
THEIR INSIGHT.

353

00:24:25,470 --> 00:24:27,520
OF ALL THE DISCOVERIES, IF YOU
WERE TO POINT OUT ONE DISCOVERY

354

00:24:27,520 --> 00:24:29,940
THAT WOULD HAVE THE MOST IMPACT
ON SCIENCE IN THE NEXT FIVE

355

00:24:29,940 --> 00:24:33,470
YEARS, WHAT WOULD THAT BE?

356

00:24:33,470 --> 00:24:37,369
THANK YOU.

357

00:24:37,369 --> 00:24:39,250
>> THAT'S A GREAT QUESTION.

358

00:24:39,250 --> 00:24:41,669

I THINK WE'LL PROBABLY ANSWER IT
WITH TWO OR THREE DIFFERENT

359

00:24:41,669 --> 00:24:46,059

ANSWERS BECAUSE WE MAY FEEL
INDIVIDUALLY THAT YOU KNOW,

360

00:24:46,059 --> 00:24:47,629

DIFFERENT ONE IS THE MOST
IMPORTANT ONE.

361

00:24:47,629 --> 00:24:49,640

SETH, WHAT'S YOUR TAKE ON THAT?

362

00:24:49,640 --> 00:24:58,480

>> I THINK THE DISCOVERY OF
OTHER PLANETS COUPLED WITH OUR

363

00:24:58,480 --> 00:25:07,440

UNDERSTANDING OF THE IMPACT
THESE GALACTIC COULD HAVE ON

364

00:25:07,440 --> 00:25:11,330

PLANETS THEMSELVES OR EVEN THE
EMERGENCE OF LIFE OR EVOLUTION

365

00:25:11,330 --> 00:25:14,649

OF SUBLIFE, IS REALLY
FASCINATING.

366

00:25:14,649 --> 00:25:19,799

AND I'M REALLY EXCITED BY THESE
CONNECTIONS BETWEEN THINGS HERE

367

00:25:19,799 --> 00:25:22,179

IN OUR WORLD, ON PLANET EARTH.

368

00:25:22,179 --> 00:25:25,919

THINGS THAT ARE HAPPENING WITH
THE FLOW OF GAS AND DUST.

369

00:25:25,919 --> 00:25:29,020

WHAT IT'S DOING TO OUR GALAXY.

370

00:25:29,020 --> 00:25:34,740

THERE ARE CONNECTIONS THIS THAT
WE HAVEN'T EXPLORED FULLY.

371

00:25:34,740 --> 00:25:39,740

AND NOW, WITH THESE RESULTS FROM
IBEX AND THESE OTHER

372

00:25:39,740 --> 00:25:44,799

DISCOVERIES, THEY'RE ALL COMING
TOGETHER INTO A REALLY

373

00:25:44,799 --> 00:25:47,149

INTERESTING TOPIC.

374

00:25:47,149 --> 00:25:55,720

>> I WOULD LIKE TO ADD, THAT
THERE MUST BE BASICALLY AROUND

375

00:25:55,720 --> 00:25:59,769

EVERY STAR IN THIS GALAXY, THERE
MUST BE PLANETS, SO THERE'S NO

376

00:25:59,769 --> 00:26:02,230

EVIDENCE\h-- THERE'S NEW EVIDENCE
FOR THAT.

377

00:26:02,230 --> 00:26:07,309

SO IF YOU PUT THAT OUT THERE,
THAT HAS TO BE OTHER LIFE OUT

378

00:26:07,309 --> 00:26:13,910

THERE, NOT LOOKING LIKE US\h-- IN
""STAR TREK"" THEY\h-- THEY LOOK

379

00:26:13,910 --> 00:26:19,789

LIKE US BUT THERE MUST BE
INTELLIGENT LIFE OUT THERE AND

380

00:26:19,789 --> 00:26:25,529

MAYBE WE CAN COMMUNICATE BUT
WITH THIS LONG DISTANCE IT'S A

381

00:26:25,529 --> 00:26:27,789

LONG, DROWN-OUT DISCUSSION.

382

00:26:27,789 --> 00:26:34,320

AND I THINK THAT'S REALLY
PROFOUND NOT TO HAVE JUST THE OF

383

00:26:34,320 --> 00:26:40,669

LIFE ON EARTH, BECAUSE
SPECIES\h-- IT'S LIFE AS WE KNOW

384

00:26:40,669 --> 00:26:45,120

IT HERE AND WHO KNOWS WHAT IS
ALL OUT THERE?

385

00:26:45,120 --> 00:26:48,970

>> I GUESS I WOULD HAVE TO SAY,
I'M NOT SURE THERE IS LIFE OUT

386

00:26:48,970 --> 00:26:52,179

THERE, I DON'T KNOW ONE WAY OR
THE OTHER BUT I KNOW THESE

387

00:26:52,179 --> 00:26:56,230

ASTROSPHERES WILL PROVIDE A VERY
IMPORTANT PART OF THE PROCESS IF

388

00:26:56,230 --> 00:26:59,041

THERE IS LIFE FOR THE FORMATION
OF LIFE BECAUSE THEY PROVIDE

389

00:26:59,041 --> 00:27:01,980

THIS CRITICAL SHIELDING AND
THAT'S THE PART THAT WE'VE

390

00:27:01,980 --> 00:27:05,200

REALLY BEEN STUDYING AND WE'RE
ABLE TO DO QUANTITATIVELY NOW

391

00:27:05,200 --> 00:27:07,039

WITH MEASUREMENTS FROM IBEX.

392

00:27:07,039 --> 00:27:08,179

PRISCILLA?

393

00:27:08,179 --> 00:27:11,610

>> I THINK UNDERSTANDING OUR
GALACTIC ENVIRONMENT INCLUDING

394

00:27:11,610 --> 00:27:14,179

THE HELIOSPHERE AND ASTRO
SPHERES ARE PROBABLY THE MOST

395

00:27:14,179 --> 00:27:17,950

EXCITING THING IBEX IS DOING BUT
I THINK THE ONE THAT WILL HAVE

396

00:27:17,950 --> 00:27:21,590

THE WIDEST IMMY OCCASION
SCIENTIFICALLY IS THE NEON TO

397

00:27:21,590 --> 00:27:23,920

OXYGEN RATIO.

398

00:27:23,920 --> 00:27:27,279

THE NEON TO OXYGEN RATIO IS
DIRECTLY TELLING US ABOUT ONE OF

399

00:27:27,279 --> 00:27:31,429

THE MOST MYSTERIOUS ELEMENTS IN

OUR NEIGHBORHOOD OF THE GALAXY

400

00:27:31,429 --> 00:27:32,860

WHICH IS OXYGEN.

401

00:27:32,860 --> 00:27:36,820

WHEN WE LOOK AT THE STARS WE
DON'T SEE ENOUGH OXYGEN AND SO

402

00:27:36,820 --> 00:27:40,580

WE ASSUMED THAT THAT OXYGEN IS
ON INTERSTELLAR\h-- BUT WE CAN'T

403

00:27:40,580 --> 00:27:43,000

OBSERVE IT ON INTERSTELLAR DUST
GRAINS.

404

00:27:43,000 --> 00:27:46,929

SOME GRAINS HAVE WATER ICE ON
THEM BUT NOT HAVE MANY SO THE

405

00:27:46,929 --> 00:27:49,539

MYSTERY IS\h-- WHERE IS THE
OXYGEN?

406

00:27:49,539 --> 00:27:55,309

AND THE IBEX MEASUREMENT ARE
GIVING US THE OXYGEN ABUNDANCE

407

00:27:55,309 --> 00:27:58,899

IN INTERSTELLAR CLOUD WHERE WE
PROBABLY, HOPEFULLY SOON, WILL

408

00:27:58,899 --> 00:28:01,429

HAVE THE BEST SET OF INFORMATION
THAT WE CAN HAVE ON ANY

409

00:28:01,429 --> 00:28:05,870

INTERSTELLAR CLOUD SO AS FAR AS
SCIENTIFIC IMPLICATIONS THE NEON

410

00:28:05,870 --> 00:28:10,289

TO OXYGEN RATIO WHICH IS TELLING
US ABOUT THE INTERSTELLAR DUST

411

00:28:10,289 --> 00:28:12,519

IS GOING TO ASSESS A HUGE RANGE
OF ASTRONOMERS.

412

00:28:12,519 --> 00:28:16,370

SO MANY ASTRONOMICAL QUESTIONS
HINGE ON THINGS LIKE THAT.

413

00:28:16,370 --> 00:28:17,370

>> SO THERE YOU GO.

414

00:28:17,370 --> 00:28:18,860

THAT'S OUR ONE-PERSON TAKE ON
THAT.

415

00:28:18,860 --> 00:28:19,860

>> ERIC?

416

00:28:19,860 --> 00:28:26,910

>> I GUESS MY QUESTION IS FOR
DAVE.

417

00:28:26,910 --> 00:28:28,480

WE HAVE THESE TWO PIECES OF
NEWS.

418

00:28:28,480 --> 00:28:33,629

ONE, THE HELIUM\h-- SORRY, THE
NEON AND OXYGEN RATIOS BUT ALSO,

419

00:28:33,629 --> 00:28:36,759

IT SEEMS YOU'RE SAYING THAT
THESE RESULTS ARE AFFECTING OUR

420

00:28:36,759 --> 00:28:41,190
PICTURE OF NOT ONLY WHERE WE ARE
IN THE LOCAL CLOUD BUT THE SHAPE

421
00:28:41,190 --> 00:28:43,289
OF THE HELIOSPHERE AND I WAS
HOPING YOU COULD PUT UP THE

422
00:28:43,289 --> 00:28:47,860
SLIDE AGAIN WHICH HAS ME
PERPLEXED AND EXPLAIN WHAT IT IS

423
00:28:47,860 --> 00:28:51,700
THAT YOU MEASURED AND HOW IT'S
AFFECTING OUR PICTURE OF WHERE

424
00:28:51,700 --> 00:28:54,559
WE ARE IN THE LOCAL CLOUD AND
WHAT THE CHANGES ARE?

425
00:28:54,559 --> 00:28:55,559
>> SURE.

426
00:28:55,559 --> 00:28:58,010
>> THE NEW PICTURE OF WHAT THE
HELIOSPHERE LOOKS LIKE?

427
00:28:58,010 --> 00:29:00,179
>> GREAT QUESTION, ERIC, THANKS.

428
00:29:00,179 --> 00:29:03,759
GO BACK TO THAT GRAPHIC AND I
SEE THEY HAVE IT UP ALREADY.

429
00:29:03,759 --> 00:29:07,120
THIS IS THE STRUCTURE AS WE'VE
TRIED TO UNDERSTAND IT OVER THE

430
00:29:07,120 --> 00:29:10,019
LAST FIVE OR TEN YEARS OR SO.

431

00:29:10,019 --> 00:29:12,380

AND WE KNOW ABOUT THE
TERMINATION SHOT BECAUSE THE

432

00:29:12,380 --> 00:29:16,840

VOYAGER SPACECRAFT CROSSED THE
TERMINATION AND THEY'RE BEYOND

433

00:29:16,840 --> 00:29:20,999

THE TERMINATION SHOCK WHICH IS
BASICALLY THE BOUNDARY BETWEEN

434

00:29:20,999 --> 00:29:24,360

THE SOLAR MATERIAL ON THE INSIDE
AND THE GALACTIC MATERIAL ON THE

435

00:29:24,360 --> 00:29:25,360

OUTSIDE.

436

00:29:25,360 --> 00:29:27,240

WHAT WE'VE LEARNED IS THIS
INTERSTELLAR MEDIUM YOU SEE ON

437

00:29:27,240 --> 00:29:33,470

THE RIGHT FLOWING IN, IS
ACTUALLY MOVING ENOUGH SLOWER

438

00:29:33,470 --> 00:29:37,860

THAT THAT PRESSURE IS ABOUT 20
TO 25% LESS THAN WE THOUGHT IT

439

00:29:37,860 --> 00:29:39,639

WAS BEFORE.

440

00:29:39,639 --> 00:29:43,110

AND ONE OF THE THINGS WE LEARNED
EARLIER FROM IBEX WITH THE IBEX

441

00:29:43,110 --> 00:29:47,960
RIBBON WAS THE IMPORTANCE OF THE
EXTERNAL MAGNETIC FIELD.

442
00:29:47,960 --> 00:29:50,399
AND WE THOUGHT, WELL, ALMOST
EVERYTHING IS DRIVEN BY THIS

443
00:29:50,399 --> 00:29:53,630
FLOWING PRESSURE AND THEN WE
LEARNED WITH THE EARLIER RESULTS

444
00:29:53,630 --> 00:29:57,169
FROM IBEX KNOW THAT'S IMPORTANT
BUT ALSO IMPORTANT IS THIS

445
00:29:57,169 --> 00:30:01,010
EXTERNAL MAGNETIC FIELD AND NOW
WE KNOW THE FLOW IS EVEN LESS,

446
00:30:01,010 --> 00:30:04,070
25% LESS PRESSURE WHICH MAKES
THE EXTERNAL MAGNETIC FIELD

447
00:30:04,070 --> 00:30:09,029
COMPONENTS EVEN MORE IMPORTANT
SO MY PICTURE OF THE HELIO

448
00:30:09,029 --> 00:30:12,330
SPHERE IS THAT IT'S EVEN MORE
COMPRESSED BY THE EXTERNAL FIELD

449
00:30:12,330 --> 00:30:16,610
AND LESS DRIVEN BY THE
IN-FLOWING PRESSURE AND I'M NOT

450
00:30:16,610 --> 00:30:19,480
SURE TODAY THAT SHOCKS THAT
WE'VE BEEN DRAWING IN FOR

451

00:30:19,480 --> 00:30:21,330
DECADES, EXISTS AT ALL.

452
00:30:21,330 --> 00:30:22,700
EVEN THOSE FLOW PRINTS.

453
00:30:22,700 --> 00:30:28,190
>> IN MY MIND, THROWING MATERIAL
IS ALSO A COMPRESSING SORT OF

454
00:30:28,190 --> 00:30:33,070
THING, ALONG WITH\h-- WHY ARE YOU
SAYING THAT'S OUR\h-- THAT'S AN

455
00:30:33,070 --> 00:30:35,729
EXTERNAL MAGNETIC FIELD WITH
LESSER INFLOW.

456
00:30:35,729 --> 00:30:37,840
>> THERE ARE TWO DIFFERENT TYPES
OF PRESSURE.

457
00:30:37,840 --> 00:30:40,830
PRESSURE FROM MOVING MATERIAL.

458
00:30:40,830 --> 00:30:44,399
WHEN YOU DRIVE YOUR CAR DOWN THE
STREET, YOU PUSH THROUGH AIR AND

459
00:30:44,399 --> 00:30:47,480
THE FASTER YOU GO THE MORE
PRESSURE IT PUTS BACK ON YOU.

460
00:30:47,480 --> 00:30:49,789
THAT'S THE PRESSURE FROM THE
INTERSTELLAR MEDIUM.

461
00:30:49,789 --> 00:30:52,370
THERE'S ALSO PRESSURE FROM
MAGNETIC FIELD LINES WHICH ARE

462

00:30:52,370 --> 00:30:55,300

LIKE BUNGEE CORDS.

463

00:30:55,300 --> 00:30:58,950

THINK OF HAVING A\h-- PULLING A
BEACH BALL THROUGH A ROOM FILLED

464

00:30:58,950 --> 00:31:01,919

WITH BUNGEE CORDS FROM FLOOR TO
CEILING AND HAVE IT SQUEEZE THE

465

00:31:01,919 --> 00:31:03,659

BEACH BALL AS YOU PULL IT
THROUGH.

466

00:31:03,659 --> 00:31:06,559

BOTH OF THOSE TYPES OF PRESSURE
OCCUR ON THE OUTSIDE OF THE

467

00:31:06,559 --> 00:31:09,059

HELIOSPHERE BUT WHAT WE'VE
LEARNED NOW IS THAT FLOWING

468

00:31:09,059 --> 00:31:13,029

PRESSURE FROM THE INTERSTELLAR
MEDIUM IS MUCH LESS SIGNIFICANT

469

00:31:13,029 --> 00:31:14,629

THAN WE THOUGHT IT WAS BEFORE.

470

00:31:14,629 --> 00:31:17,720

AND THAT MEANS THAT BALANCE
BETWEEN THE TWO IS DIFFERENT AND

471

00:31:17,720 --> 00:31:20,460

THAT COULD HAVE PRETTY
SIGNIFICANT IMPLICATIONS FOR HOW

472

00:31:20,460 --> 00:31:23,700
THE EXTERIOR STRUCTURE OF THAT
INTERACTION REALLY WORKS.

473
00:31:23,700 --> 00:31:26,469
>> SO WHAT IS ITS SHAPE, THEN?

474
00:31:26,469 --> 00:31:29,040
>> THAT'S A GOOD QUESTION
BECAUSE WE DON'T EXACTLY TAKE A

475
00:31:29,040 --> 00:31:30,539
PICTURE OF THE SHAPE.

476
00:31:30,539 --> 00:31:35,480
BUT IT'S PROBABLY A LOT MORE
COMPRESSED ALONG THE FIELD AND

477
00:31:35,480 --> 00:31:38,510
NOT AS BLUNT AS WE THOUGHT.

478
00:31:38,510 --> 00:31:41,629
THE TAIL ON THE BACKSIDE IS
PROBABLY OFFSET.

479
00:31:41,629 --> 00:31:46,320
NOT EXACTLY IN THE ANTI-FLOW
DIRECTION BUT PULL MORE DOWN

480
00:31:46,320 --> 00:31:49,860
TOWARDS THE DIRECTION OF THE
EXTERNAL MAGNETIC FIELD AND THAT

481
00:31:49,860 --> 00:31:51,279
SORT OF THING.

482
00:31:51,279 --> 00:31:57,070
>> ALL RIGHT, WE'RE GOING TO NOW
GO TO THE PHONE LINES.

483

00:31:57,070 --> 00:32:02,440

AND FIRST UP, DENISE CHILD,
SPACE.COM, DENISE?

484

00:32:02,440 --> 00:32:06,909

>> Caller: HI, THANKS FOR TAKING
MY QUESTION.

485

00:32:06,909 --> 00:32:10,369

I THINK THIS IS PROBABLY FOR
DAVE.

486

00:32:10,369 --> 00:32:14,730

I'M WONDERING AS WE'RE GOING
INTO AN INCREASED PHASE OF SOLAR

487

00:32:14,730 --> 00:32:20,231

ACTIVITY HOW YOU THINK THAT WILL
AFFECT THIS REGION AND THE

488

00:32:20,231 --> 00:32:21,610

OBSERVATIONS THAT WE'LL BE ABLE
TO MAKE?

489

00:32:21,610 --> 00:32:24,590

ARE YOU EXPECTING TO SEE MORE
DYNAMIC CHANGES?

490

00:32:24,590 --> 00:32:25,980

>> YEAH.

491

00:32:25,980 --> 00:32:27,210

THAT'S A GREAT QUESTION.

492

00:32:27,210 --> 00:32:28,240

THANK YOU.

493

00:32:28,240 --> 00:32:30,830

SO AS I SAID AT THE START OF

THIS, THE HELIOSPHERE IS

494

00:32:30,830 --> 00:32:34,240

ACTUALLY INFLATED BY THIS
MILLION-MILE-AN-HOUR SOLAR WIND

495

00:32:34,240 --> 00:32:37,659

THAT FLOWS OUT ALL DIRECTIONS IN
SPACE ALL THE TIME FROM THE SUN

496

00:32:37,659 --> 00:32:42,520

AND THIS BALANCE CREATING THE
OUTER HELIO SPHERIC INTERACTION

497

00:32:42,520 --> 00:32:45,570

IS A FUNCTION OF BOTH OF WHAT'S
COMING IN FROM THE OUTSIDE WHICH

498

00:32:45,570 --> 00:32:47,840

IS WHAT WE TALKED ABOUT TODAY
THAT WE HAVE A LOT OF NEW

499

00:32:47,840 --> 00:32:51,019

INFORMATION ON THAT WE DIDN'T
HAVE BEFORE TODAY, AND WHAT'S

500

00:32:51,019 --> 00:32:55,860

PUSHING OUT FROM THE INSIDE
WHICH IS THE SOLAR WIND, SO THE

501

00:32:55,860 --> 00:32:58,710

INCREASING DYNAMIC PRESSURE AND
THE MORE VARIABLE IN THE SOLAR

502

00:32:58,710 --> 00:33:02,860

WIND WILL TRY TO INFLATE THE
HELIOSPHERE A LITTLE MORE,

503

00:33:02,860 --> 00:33:06,120

NORTHEAST TEMPORARILY AND THE

VARIABILITY MEANS THE WHOLE

504

00:33:06,120 --> 00:33:11,149

HELIOSPHERE IS LIKELY TO SORT
OF BREATHE AND VARY AS WE HEAD

505

00:33:11,149 --> 00:33:12,400

INTO SOLAR MAXIMUM.

506

00:33:12,400 --> 00:33:15,159

SO IT WILL BE A DIFFERENT
INTERAX.

507

00:33:15,159 --> 00:33:18,770

THAT'S PRETTY INTERESTING FOR
US, TOO, AND SOMETHING ELSE THAT

508

00:33:18,770 --> 00:33:22,270

WE DIDN'T MENTION BUT IBEX WAS
MOVED INTO A VERY LONG-TERM

509

00:33:22,270 --> 00:33:25,710

STABLE ORBIT LAST SUMMER AND NOW
IS IN A POSITION WHERE WE HAVE

510

00:33:25,710 --> 00:33:29,740

CONSUMABLE HYDROGEN GAS AND LOW
RADIATION ENVIRONMENT WHERE WE

511

00:33:29,740 --> 00:33:33,220

HOPE THAT IBEX WILL LAST FOR
ANOTHER DECADE OR MORE.

512

00:33:33,220 --> 00:33:37,070

SO WE'LL ACTUALLY SEE A SOLAR
CYCLE VARIATION IN THE INFLATION

513

00:33:37,070 --> 00:33:38,809

PRESSURE FROM THE INSIDE.

514

00:33:38,809 --> 00:33:39,830

EBERHARD?

515

00:33:39,830 --> 00:33:44,460

>> I WOULD LIKE TO ADD THE THAT
THAT THE SOLAR CYCLE HAS A

516

00:33:44,460 --> 00:33:50,279

PROFOUND INFLUENCE ON THIS
INTERSTELLAR WIND THAT COMES IN.

517

00:33:50,279 --> 00:33:53,700

IT COMES IN NEUTRAL BUT THE SUN,
WITH ITS ULTRAVIOLET RADIATION,

518

00:33:53,700 --> 00:34:04,220

IONIZES PART OF THE WIND SO IT
ROBS THE ATOMS OF ELECTRONS AND

519

00:34:04,220 --> 00:34:08,230

THEN THE SOLAR WIND SWEEPS THE
CHARGED PARTICLES AWAY.

520

00:34:08,230 --> 00:34:14,010

AND THAT IS DIFFERENT FOR THE
DIFFERENT ELEMENTS AND PRISCILLA

521

00:34:14,010 --> 00:34:17,900

MENTIONED THAT THE SHIELD
BETWEEN OXYGEN AND NEON IS

522

00:34:17,900 --> 00:34:21,690

REALLY KEY MEASUREMENT.

523

00:34:21,690 --> 00:34:26,640

WE CAN TAKE THAT MEASUREMENT
MORE FOR SIZE IF WE CAN REALLY

524

00:34:26,640 --> 00:34:30,300

HONE IN ON THIS LOT ON THE WAY.

525

00:34:30,300 --> 00:34:35,170

IF YOU FOLLOW THAT OVER THE
SOLAR CYCLE IT GIVES YOU A MUCH

526

00:34:35,170 --> 00:34:38,919

MORE PRECISE MEASUREMENT TO DO
THAT.

527

00:34:38,919 --> 00:34:41,660

>> OKAY, WE'RE GOING TO COME
BACK HERE.

528

00:34:41,660 --> 00:34:44,110

ANY OTHER QUESTIONS FROM THE
AUDIENCE?

529

00:34:44,110 --> 00:34:48,940

>> ONE LAST QUESTION FROM ONE OF
OUR MUSEUM'S ON THE NETWORK HERE

530

00:34:48,940 --> 00:34:50,429

AND THEN THIS IS FOR EVERYONE.

531

00:34:50,429 --> 00:34:53,090

SO GET YOUR THINKING CAPS ON
HERE.

532

00:34:53,090 --> 00:34:56,620

IT'S SORT OF A VISIONARY TYPE OF
QUESTION.

533

00:34:56,620 --> 00:35:00,270

THE IMPORTANCE INDIVIDUALLY THAT
YOU ALL FEEL OF STUDYING, THIS

534

00:35:00,270 --> 00:35:01,560

TYPE OF SCIENCE.

535

00:35:01,560 --> 00:35:05,580

HELIO SCIENCE AND THE SCIENCE
THAT A IBEX IS DOING AND AS A

536

00:35:05,580 --> 00:35:10,060

HUMAN RACE, SOCIETY, WHY SHOULD
WE CARE AND HOW WILL IT AFFECT

537

00:35:10,060 --> 00:35:11,380

US?

538

00:35:11,380 --> 00:35:14,329

DAVE, I'LL START WITH YOU.

539

00:35:14,329 --> 00:35:15,329

>> I'LL BE HAPPY TO START.

540

00:35:15,329 --> 00:35:19,480

HELIO PHYSICS IS AN INCREDIBLY
INTERESTING FIELD.

541

00:35:19,480 --> 00:35:23,280

IT TIES TOGETHER WHAT'S
HAPPENING ON THE SUN WITH THE

542

00:35:23,280 --> 00:35:26,210

SPACE THAT SURROUNDS OUR EARTH
AND AFFECTS OUR EARTH AND

543

00:35:26,210 --> 00:35:28,490

TECHNOLOGY AND LIFE ON EARTH.

544

00:35:28,490 --> 00:35:31,340

AND EXTENDS ALL THE WAY OUT TO
THIS OUTER BOUNDARIES OF THE

545

00:35:31,340 --> 00:35:32,340

HELIOSPHERE.

546

00:35:32,340 --> 00:35:34,590

HUNDREDS OF TIMES FURTHER AWAY
FROM THE SUN.

547

00:35:34,590 --> 00:35:39,440

SO IT TELLS US THINGS ABOUT THE
PART OF SPACE THAT WE LIVE IN

548

00:35:39,440 --> 00:35:41,660

AND THE INTERACTION OF THAT PART
OF SPACE WITH THE REST OF THE

549

00:35:41,660 --> 00:35:45,520

GALAXY BUT IT TELLS US USEFUL
AND HELPFUL THINGS BECAUSE THESE

550

00:35:45,520 --> 00:35:49,540

INTERACTIONS CAN HAVE AN EFFECT
ON OUR TECHNOLOGICAL SYSTEMS.

551

00:35:49,540 --> 00:35:55,560

LARGE STORMS HAVE BEEN EFFECT ON
OUR GPS AND OTHER SATELLITES.

552

00:35:55,560 --> 00:35:58,820

THE GALACTIC COSMIC RAYS FROM
THE OUTSIDE HAVE AN EFFECT ON

553

00:35:58,820 --> 00:36:02,050

ASTRONAUTS TO GO ON
LONG-DURATION SPACE MISSIONS AND

554

00:36:02,050 --> 00:36:06,050

HOPEFULLY, GO TO MARS AND BEYOND
IN THE LONG RUN.

555

00:36:06,050 --> 00:36:10,140

SO IT'S A VERY INTERESTING FIELD
OF REALLY CORE FUNDAMENTAL

556

00:36:10,140 --> 00:36:12,370

SCIENCE THAT ALSO AFFECTS US
PERSONALLY.

557

00:36:12,370 --> 00:36:15,680

FOR ME, IT'S AN INCREDIBLY
EXCITING FIELD.

558

00:36:15,680 --> 00:36:17,190

THAT'S MY TAKE.

559

00:36:17,190 --> 00:36:18,190

PRISCILLA?

560

00:36:18,190 --> 00:36:19,920

>> WELL, IT'S ALL VERY EXCITING.

561

00:36:19,920 --> 00:36:22,920

I THINK ONE OF THE MOST
INTERESTING, POSSIBLE

562

00:36:22,920 --> 00:36:25,860

IMPLICATIONS IS THAT AS THE SUN
MOVES THROUGH SPACE AND MOVES IN

563

00:36:25,860 --> 00:36:30,350

AND OUT OF INTERSTELLAR CLOUDS,
THE COSMIC RAYS FROM THE EARTH

564

00:36:30,350 --> 00:36:34,450

CHANGES AND THAT'S RECORDED IN
THE RADIO ISOTOPE RECORD THAT

565

00:36:34,450 --> 00:36:37,200

GEOSCIENTISTS ARE MEASURING.

566

00:36:37,200 --> 00:36:41,110

AND SOME DAY MAYBE WE'LL BE ABLE
TO LINK THE SUN'S MOTION THROUGH

567

00:36:41,110 --> 00:36:44,520

INTERSTELLAR CLOUDS WITH THE
GEOLOGICAL RECORD THAT'S TRACING

568

00:36:44,520 --> 00:36:46,370

THE GEOLOGICAL HISTORY OF OUR
EARTH.

569

00:36:46,370 --> 00:36:50,390

I THINK THAT WOULD BE REALLY
EXCITED IF WE COULD EVER DO

570

00:36:50,390 --> 00:36:51,390

THAT.

571

00:36:51,390 --> 00:36:52,390

>> EBERHARD?

572

00:36:52,390 --> 00:36:56,400

>> I FIND IT EXCITING THAT RIGHT
AT OUR FRONT DOORSTEP WE CAN

573

00:36:56,400 --> 00:37:00,770

TAKE A SAMPLE OF THIS
INTERSTELLAR MATTER AROUND US.

574

00:37:00,770 --> 00:37:04,820

AND IF YOU THINK BACK ALL THE
WAY TO THE BIG BANG, THERE WAS

575

00:37:04,820 --> 00:37:10,900

ONLY HYDROGEN AND HELIUM AND
THEN STARS AND SUPER NOVAS.

576

00:37:10,900 --> 00:37:13,230

AND THEN THE HEAVY ELEMENTS.

577

00:37:13,230 --> 00:37:18,270

SO IF YOU IMAGINE THAT WE ARE
MADE OUT OF MATERIAL THAT HAS

578

00:37:18,270 --> 00:37:23,520

COME FROM THE SUPER NOVA AND
THAT'S CONTINUING.

579

00:37:23,520 --> 00:37:28,100

SO 4.5 BILLION YEARS AGO, THE
SUN FORMED OUT OF A SIMILAR

580

00:37:28,100 --> 00:37:33,080

NEBULA AND AT THAT TIME,
SPRINKLED WITH HEAVY ELEMENTS

581

00:37:33,080 --> 00:37:37,550

AND THAT'S CONTINUING AND NOW
WE'RE SAMPLING PART OF THE MILKY

582

00:37:37,550 --> 00:37:39,150

WAY AS IT IS TODAY.

583

00:37:39,150 --> 00:37:44,220

SO WE HAVE THREE NICE POINTS
FROM THE BIG BANG, THE SUN'S

584

00:37:44,220 --> 00:37:47,290

FORMATION TO WHAT IS OUR
ENVIRONMENT.

585

00:37:47,290 --> 00:37:53,600

AND THEN MODELERS CAN GO ON AND
TRACE HOW MATERIAL HAS EVOLVED

586

00:37:53,600 --> 00:37:55,590

OVER TIME IN THE COSMOS.

587

00:37:55,590 --> 00:37:58,790

I FIND THAT FASCINATING.

588

00:37:58,790 --> 00:38:06,940

>> WELL, I THINK HUMANITY HAS
BEEN ASKING, YOU KNOW, THESE

589

00:38:06,940 --> 00:38:11,140

FUNDAMENTAL QUESTIONS SINCE THE
BEGINNING, TRYING TO PUT

590

00:38:11,140 --> 00:38:15,060

OURSELVES MY THIS CONTACT IN THE
COSMOS THAT PROVIDED AN

591

00:38:15,060 --> 00:38:18,160

OPPORTUNITY TO DO THAT.

592

00:38:18,160 --> 00:38:24,120

THESE NEW DISCOVERIES ARE GOING
TO HELP US ADDRESS, YOU KNOW,

593

00:38:24,120 --> 00:38:27,280

HOW UNIQUE OR HOW SPECIAL OUR
HELIOSPHERE.

594

00:38:27,280 --> 00:38:29,810

OTHER CONFIGURATIONS SIMILAR OR
DIFFERENT.

595

00:38:29,810 --> 00:38:35,150

HOW DO THEY INTERACT WITH THE
PLANETS AROUND KNOWS STARS AND

596

00:38:35,150 --> 00:38:36,490

THAT SORT OF THING.

597

00:38:36,490 --> 00:38:41,760

AND ANOTHER NOTE THAT I THINK IS
REALLY NEAT IN THIS ATTEMPT TO

598

00:38:41,760 --> 00:38:47,350

PUT OURSELVES IN THIS COSMIC
CONTEXT IS DESPITE HOW CLOSE

599

00:38:47,350 --> 00:38:51,640
THESE THINGS ARE, THESE CLOSEST
INTERSTELLAR CLOUDS AND THE

600

00:38:51,640 --> 00:38:55,540
HELIOSPHERE, IT'S REALLY
PARTICULARLY DIFFICULT TO STUDY

601

00:38:55,540 --> 00:38:59,680
THEM AND IT'S A REAL ACHIEVEMENT
TO MEASURE THESE INTERSTELLAR

602

00:38:59,680 --> 00:39:00,680
CLOUDS.

603

00:39:00,680 --> 00:39:04,570
TO MEASURE THE HELIOSPHERE IN
THIS SORT OF DETAIL WHEN WE'RE

604

00:39:04,570 --> 00:39:07,140
USED TO THINKING THAT THE
FARTHER AWAY SOMETHING IS, THE

605

00:39:07,140 --> 00:39:08,140
HARDER IT IS.

606

00:39:08,140 --> 00:39:11,680
AND, YOU KNOW, THAT'S TRUE TO
SOME EXTENT BUT THESE ARE REALLY

607

00:39:11,680 --> 00:39:16,460
DIFFICULT MEASUREMENTS AND SO
IT'S REALLY EXCITING TO SEE

608

00:39:16,460 --> 00:39:17,579
THESE RESULTS TODAY.

609

00:39:17,579 --> 00:39:19,510

>> THANK YOU ALL.

610

00:39:19,510 --> 00:39:22,190

AND WITH THAT, WE'LL CLOSE OUT
AND, AGAIN, YOU'VE HEARD THE

611

00:39:22,190 --> 00:39:24,630

ANATOMY OF OUR GALACTIC
NEIGHBORHOOD.

612

00:39:24,630 --> 00:39:27,820

AND, AGAIN, YOU CAN FIND ALL
THIS INFORMATION ON THE INTERNET

613

00:39:27,820 --> 00:39:37,120

AT NASA.GOV/IBEX OR VIA TWITTER,
FACEBOOK, YOUTUBE AND OTHER

614

00:39:37,120 --> 00:39:40,020

SOCIAL MEDIA SITES.