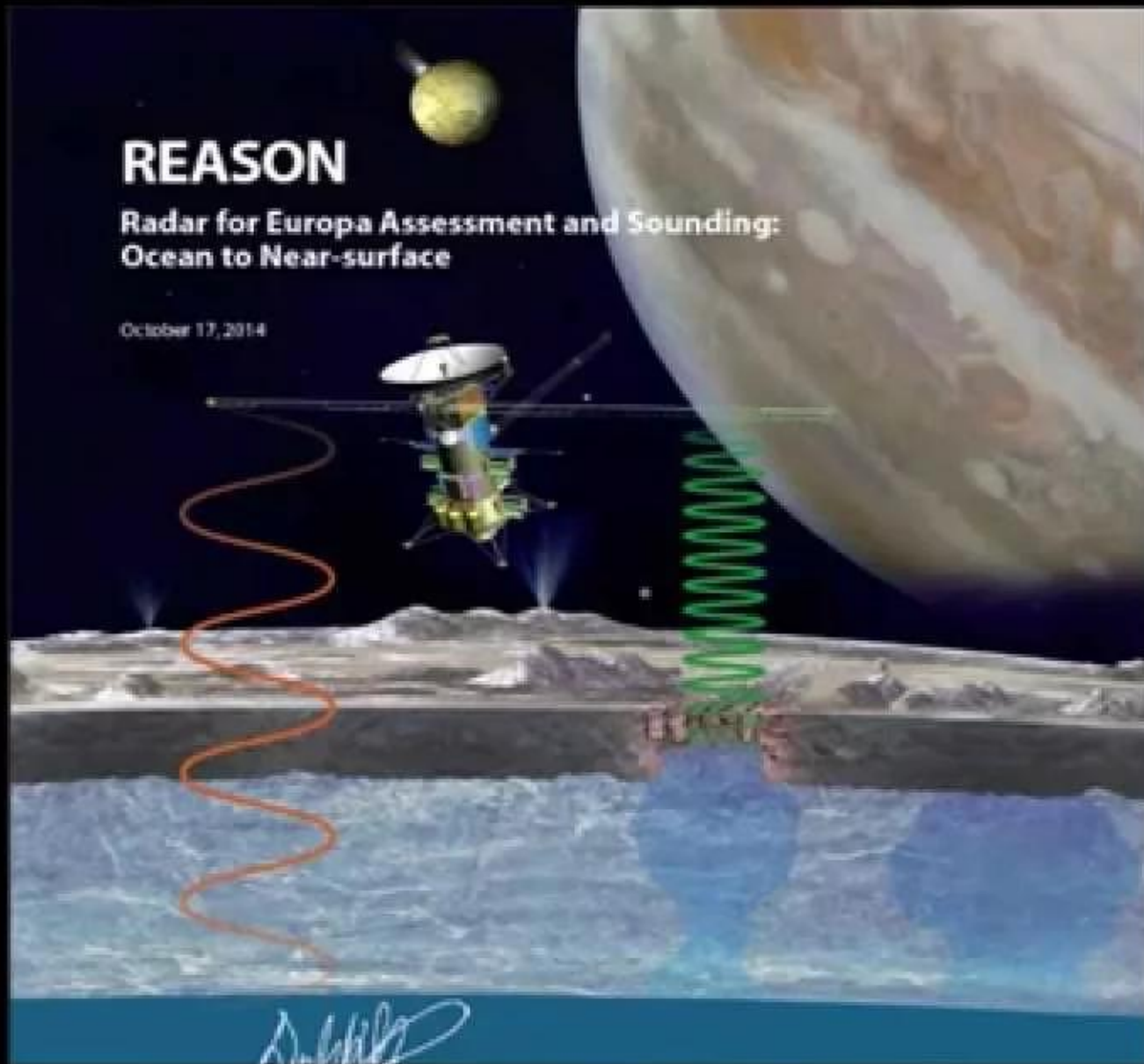


## REASON

Radar for Europa Assessment and Sounding:  
Ocean to Near-surface

October 17, 2014

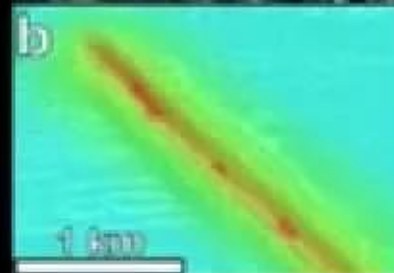


## Ice Penetrating Radar

Radar for Europa Assessment and  
Sounding: Ocean to Near-surface  
(REASON, Dr. Donald Blankenship)

## Thermal Imager

Europa Thermal Emission Imaging  
System (E-THEMIS, Dr. Philip  
Christensen)



1  
00:00:01,630 --> 00:00:05,430  
GOOD AFTERNOON, MY NAME IS  
FELICIA CHOU WITH THE OFFICE OF

2  
00:00:05,430 --> 00:00:08,139  
COMMUNICATIONS AND WELCOME TO  
NASA HEADQUARTERS.

3  
00:00:08,139 --> 00:00:10,620  
NASA HAS SELECTED SCIENCE  
INSTRUMENTS FOR THE EUROPA

4  
00:00:10,620 --> 00:00:13,460  
MISSION AS PART OF OUR  
COMMITMENT TO EXPLORE THE SOLAR

5  
00:00:13,460 --> 00:00:16,359  
SYSTEM AND BEYOND.  
TO BETTER UNDERSTAND THE

6  
00:00:16,359 --> 00:00:19,449  
UNIVERSE AND SEARCH FOR LIFE  
AMONG THE STARS.

7  
00:00:19,449 --> 00:00:22,829  
WE WILL HAVE BRIEF PRESENTATIONS  
FROM OUR PARTICIPANTS AND THEN

8  
00:00:22,829 --> 00:00:25,579  
TAKE QUESTIONS FROM THE  
AUDIENCE, THE PHONE LINES AND

9  
00:00:25,579 --> 00:00:28,439  
SOCIAL MEDIA.  
TO ASK A QUESTION USING SOCIAL

10  
00:00:28,439 --> 00:00:35,640  
MEDIA, PLEASE USE #ASKNASA.  
TODAY'S PARTICIPANTS ARE CURT

11  
00:00:35,640 --> 00:00:37,970  
NIEBUR, EUROPA PROGRAM  
SCIENTIST.

12  
00:00:37,970 --> 00:00:44,900  
JIM GREEN, DIRECTOR OF THE  
PLANETARY SCIENCE DIVISION.

13  
00:00:44,900 --> 00:00:48,370  
AND TO OFFICIALLY START US OFF,  
HERE IS JOHN GRUNSFELD,

14  
00:00:48,370 --> 00:00:51,200  
ASSOCIATE ADMINISTRATOR FOR THE  
SCIENCE MISSION DIRECTORATE.

15  
00:00:51,200 --> 00:00:53,940  
JOHN?  
>> THANK YOU VERY MUCH, FELICIA.

16  
00:00:53,940 --> 00:00:59,930  
WE'RE ON OUR WAY TO EUROPA.  
OUR MISSION IS TO INNOVATE,

17  
00:00:59,930 --> 00:01:06,319  
EXPLORE, DISCOVER AND INSPIRE.  
WE'RE TRYING TO ANSWER THE BIG

18  
00:01:06,319 --> 00:01:08,179  
QUESTIONS, WHERE DID WE COME  
FROM?

19  
00:01:08,179 --> 00:01:11,499  
WHERE ARE WE GOING?  
AND ARE WE ALONE?

20  
00:01:11,499 --> 00:01:14,999  
THESE WE TRANSLATE INTO SCIENCE  
QUESTIONS.

21

00:01:14,999 --> 00:01:20,039

EVER SINCE THE 11 FLY BYES BY  
THE GALILEO MISSION, WE HAVE

22

00:01:20,039 --> 00:01:26,409

BEEN INTRIGUED BY THE MOON OF  
JUPITER.

23

00:01:26,409 --> 00:01:29,679

SCIENTISTS HAVE SCRUTINIZED  
THESE IMAGES TO INCREDIBLE

24

00:01:29,679 --> 00:01:33,819

DETAIL AND DETERMINED THAT  
EUROPA HARBOURS A DEEP SALTY

25

00:01:33,819 --> 00:01:36,389

OCEAN BELOW A THICK MANTLE OF  
ICE.

26

00:01:36,389 --> 00:01:41,020

THE IMAGES SHOW A CRACK EVEN  
TORTURED SURFACE.

27

00:01:41,020 --> 00:01:50,259

I JUST LOST MY NOTES.  
ONE OF THE AMAZING FEATURES OF

28

00:01:50,259 --> 00:01:54,109

EUROPA IS THAT WE SEE VERY FEW  
CRATERS INDICATING IT'S A YOUNG

29

00:01:54,109 --> 00:01:57,579

SURFACE, SOMETHING IS CAUSING IT  
TO BE TURNED OVER.

30

00:01:57,579 --> 00:02:00,719

THE AGE IS PERHAPS ONLY 50  
MILLION YEARS.

31  
00:02:00,719 --> 00:02:04,709  
TIDAL FORCES FROM JUPITER MUST  
BE CAUSING SOME DYNAMICS THAT

32  
00:02:04,709 --> 00:02:08,690  
RESULT IN THE SURFACE BEING IN  
CONTACT WITH THAT UNDERSEA

33  
00:02:08,690 --> 00:02:11,560  
OCEAN.  
RECENTLY OBSERVATIONS FROM

34  
00:02:11,560 --> 00:02:14,470  
HUBBLE SPACE TELESCOPE, YOU KNEW  
I HAD TO GET HUBBLE IN THERE

35  
00:02:14,470 --> 00:02:19,030  
SOMEHOW, DETECT WHAT MAY BE  
PLUMES OF WATER SHOOTING OUT

36  
00:02:19,030 --> 00:02:21,220  
FROM UNDER THE SURFACE OF  
EUROPA.

37  
00:02:21,220 --> 00:02:24,250  
THIS MAY BE PART OF THE  
MECHANISM THAT HELPS RESURFACE

38  
00:02:24,250 --> 00:02:27,260  
EUROPA.  
EUROPA IS JUST ONE OF MANY ICY

39  
00:02:27,260 --> 00:02:31,360  
MOONS IN OUR SOLAR SYSTEM THAT  
ARE LIKELY SITES OF SUB-SURFACE

40  
00:02:31,360 --> 00:02:34,510  
OCEANS.  
FOR EUROPA, THAT OCEAN MAY HAVE

41  
00:02:34,510 --> 00:02:38,030  
BEEN IN EXISTENCE FOR BILLIONS  
OF YEARS SINCE THE CREATION OF

42  
00:02:38,030 --> 00:02:41,570  
THE SOLAR SYSTEM.  
IN THAT OCEAN, OF COURSE, IS

43  
00:02:41,570 --> 00:02:45,640  
WATER, SALTY WATER, ORGANICS AND  
LIKELY SOURCES OF HEAT, SUCH AS

44  
00:02:45,640 --> 00:02:47,870  
UNDERSEA VENTS THAT WE SEE HERE  
ON EARTH.

45  
00:02:47,870 --> 00:02:51,840  
ALL OF THOSE COMPONENTS ARE THE  
KIND OF CONTRIBUTORS THAT WE

46  
00:02:51,840 --> 00:02:56,560  
BELIEVE ARE NECESSARY  
INGREDIENTS FOR LIFE TO EMERGE.

47  
00:02:56,560 --> 00:02:59,800  
THE INSTRUMENTS WE'RE ANNOUNCING  
TODAY ARE THE RESULT OF

48  
00:02:59,800 --> 00:03:03,310  
INVESTMENTS WE'VE MADE OVER THE  
LAST FEW YEARS IN TECHNOLOGY TO

49  
00:03:03,310 --> 00:03:07,640  
HELP INTERROGATE THE ICY BODIES  
IN OUR SOLAR SYSTEM.

50  
00:03:07,640 --> 00:03:10,920  
THE COMPLIMENT OF INSTRUMENTS  
WE'VE SELECTED ARE COMPELLING

51  
00:03:10,920 --> 00:03:14,720  
AND WILL RESULT IN A MISSION  
THAT IS EVERY BIT AS IMPRESSIVE

52  
00:03:14,720 --> 00:03:17,930  
IN MY OPINION AS THE CASSINI  
MISSION TO SATURN OR THE

53  
00:03:17,930 --> 00:03:21,580  
PREVIOUS GALILEO MISSION TO  
JUPITER AND ITS MOONS.

54  
00:03:21,580 --> 00:03:24,220  
THE MISSION DESIGN IS STILL  
BEING STUDIED BUT WE WANTED TO

55  
00:03:24,220 --> 00:03:26,230  
GET A HEAD START ON THE  
INSTRUMENTS AS THEY ARE OFTEN

56  
00:03:26,230 --> 00:03:28,680  
THE LONG POLES IN THE  
DEVELOPMENT OF SOMETHING AS

57  
00:03:28,680 --> 00:03:33,010  
COMPLEX AS A MISSION TO EUROPA.  
JIM GREEN WILL COVER THE SCIENCE

58  
00:03:33,010 --> 00:03:35,860  
IN SOME DETAIL, CURT WILL GO  
OVER THE INSTRUMENTS WE'VE

59  
00:03:35,860 --> 00:03:38,000  
SELECTED.  
I'M INCREDIBLY EXCITED ABOUT

60  
00:03:38,000 --> 00:03:41,150  
THIS BIG STEP FORWARD IN THE  
QUEST TO LEARN MORE ABOUT OUR

61  
00:03:41,150 --> 00:03:45,370  
SOLAR SYSTEM AND THE SEARCH FOR  
LIFE BEYOND EARTH.

62  
00:03:45,370 --> 00:03:50,740  
LET ME QUOTE JOHN F. KENNEDY  
FROM 1961 ON THE EXPLORATION OF

63  
00:03:50,740 --> 00:03:53,490  
SPACE.  
THIS IS THE NEW OCEAN.

64  
00:03:53,490 --> 00:03:56,760  
AND I BELIEVE THE UNITED STATES  
MUST SAIL ON IT AND BE IN

65  
00:03:56,760 --> 00:04:01,210  
POSITION SECOND TO NONE.  
EUROPA, HERE WE COME.

66  
00:04:01,210 --> 00:04:04,300  
JIM?  
>> THANK YOU VERY MUCH, JOHN.

67  
00:04:04,300 --> 00:04:08,800  
EUROPA IS JUST SUCH A FABULOUS  
MOON OF JUPITER.

68  
00:04:08,800 --> 00:04:12,640  
IN FACT, MUCH OF WHAT JOHN  
DESCRIBED CAN BE SEEN IN OUR

69  
00:04:12,640 --> 00:04:16,000  
FIRST GRAPHIC OF THIS BEAUTIFUL  
MOON.

70  
00:04:16,000 --> 00:04:18,590  
SO AS YOU CAN SEE, VERY FEW  
CRATERS.

71  
00:04:18,590 --> 00:04:24,220  
IT HAS THESE BROWN AREAS OR WHAT  
WE CALL BROWN GUNK FOR THE LACK

72  
00:04:24,220 --> 00:04:29,190  
OF KNOWLEDGE OF WHAT THEY ARE.  
IN ADDITION TO THAT THE BROWN

73  
00:04:29,190 --> 00:04:33,820  
ILLUSTRATES THE CRACKS IN THE  
MOON WHERE WE BELIEVE THE

74  
00:04:33,820 --> 00:04:37,940  
SUB-SURFACE OCEAN MUST BE  
COMMUNICATING WITH THE SURFACE.

75  
00:04:37,940 --> 00:04:40,500  
SO THIS IS, INDEED, A FABULOUS  
BODY.

76  
00:04:40,500 --> 00:04:42,960  
AS JOHN MENTIONED, WE'VE BEEN  
STUDYING IT FOR A NUMBER OF

77  
00:04:42,960 --> 00:04:47,889  
YEARS WITH ONLY A FEW PASSES BY  
THE GALILEO SPACECRAFT WHICH WAS

78  
00:04:47,889 --> 00:04:53,500  
ORBITING JUPITER IN THE '90s.  
SINCE THEN WE'VE BEEN INTRIGUED

79  
00:04:53,500 --> 00:04:57,700  
BY THIS BODY.  
EUROPA WAS FIRST DISCOVERED BY

80  
00:04:57,700 --> 00:05:02,130  
GALILEO IN 1610.  
HE NEVER HAD THE EYES THAT WE

81  
00:05:02,130 --> 00:05:05,280  
CURRENTLY HAVE IN LOOKING AND  
SEEING THIS MOON FROM THE

82  
00:05:05,280 --> 00:05:08,310  
GALILEO SPACECRAFT NAMED AFTER  
HIM.

83  
00:05:08,310 --> 00:05:12,850  
NOW, WE ARE IN THE PURSUIT OF  
TRYING TO UNDERSTAND HOW THICK

84  
00:05:12,850 --> 00:05:16,030  
THAT ICE SHELL IS.  
WE KNOW THAT THERE'S AN

85  
00:05:16,030 --> 00:05:19,730  
UNDERCRUST OCEAN.  
IN FACT THAT OCEAN MIGHT BE

86  
00:05:19,730 --> 00:05:23,970  
SIGNIFICANT IN TERMS OF HAVING  
MORE THAN TWICE THE WATER THAT

87  
00:05:23,970 --> 00:05:28,030  
WE HAVE ON THIS PLANET.  
AND AFTER 5 BILLION YEARS, WITH

88  
00:05:28,030 --> 00:05:32,850  
CONDITIONS LIKE THAT, INDEED IT  
COULD BE A VERY HABITABLE PLACE

89  
00:05:32,850 --> 00:05:36,950  
IF LIFE, INDEED, STARTED ON THAT  
BODY MANY BILLIONS OF YEARS AGO.

90  
00:05:36,950 --> 00:05:39,960  
SO, WHAT IS UNDERNEATH THAT ICE  
CRUST?

91  
00:05:39,960 --> 00:05:44,540  
WELL, WE CAN ONLY IMAGINE BUT WE  
HAVE, I THINK, SOME REALLY GOOD

92  
00:05:44,540 --> 00:05:48,210  
IDEAS AND PLENTY OF EVIDENCE TO  
INDICATE THAT WHAT I'M GOING TO

93  
00:05:48,210 --> 00:05:54,130  
TELL YOU ABOUT NEXT IS TRUE.  
IF I CAN HAVE MY SECOND GRAPHIC.

94  
00:05:54,130 --> 00:06:01,669  
IN THIS PARTICULAR GRAPHIC, WHAT  
WE SEE IS THE MOON IO, AND

95  
00:06:01,669 --> 00:06:06,180  
EUROPA ARE IN THE BACKGROUND.  
WE BELIEVE SOMETHING LIKE THE

96  
00:06:06,180 --> 00:06:11,410  
SURFACE OF IO MUST BE AT THE  
BOTTOM OF THE OCEAN IN EUROPA.

97  
00:06:11,410 --> 00:06:16,550  
SO, THIS IS REALLY EXCITING.  
IO IS SUFFERING THE SAME TIDAL

98  
00:06:16,550 --> 00:06:20,760  
FORCES EUROPA IS, THOUGH SEVERAL  
ORDERS OF MAGNITUDE MORE

99  
00:06:20,760 --> 00:06:25,740  
EXTENSIVE BECAUSE IT'S SO CLOSE  
TO THE PLANET JUPITER.

100  
00:06:25,740 --> 00:06:31,480  
THESE HYDRO THERMAL VENTS REALLY  
MUST REPRESENT THE VOLCANOS THAT

101  
00:06:31,480 --> 00:06:40,130  
WE SEE ON IO IF, INDEED, EUROPA  
HAS AN OCEAN THAT IS STRADDLING

102  
00:06:40,130 --> 00:06:44,990  
THE ENTIRE BODY.  
THE HYDROTHERMAL VENTS AT THE

103  
00:06:44,990 --> 00:06:49,110  
BOTTOM OF THE IMAGE ARE OUR OWN  
FROM OUR EARTH.

104  
00:06:49,110 --> 00:06:53,080  
WE KNOW THEY ARE FULL OF EARTH.  
THEY BRING UP NUTRIENTS, AND

105  
00:06:53,080 --> 00:06:56,100  
THOSE CIRCULATE THROUGH THE  
OCEAN.

106  
00:06:56,100 --> 00:06:59,370  
SO HOW DO WE KNOW THERE ARE  
HYDROTHERMAL VENTS THERE?

107  
00:06:59,370 --> 00:07:02,850  
IN MY NEXT GRAPHIC, WE BELIEVE  
THERE'S SOME REALLY GOOD

108  
00:07:02,850 --> 00:07:06,660  
INDICATIONS OF THAT.  
SO AT THE VERY BOTTOM OF THIS

109  
00:07:06,660 --> 00:07:09,360  
GRAPHIC WE SEE WHAT A  
HYDROTHERMAL VENT MIGHT LOOK

110  
00:07:09,360 --> 00:07:15,330  
LIKE, LIKE THESE VOLCANIC  
ERUPTIONS THAT WE HAVE ON IO

111

00:07:15,330 --> 00:07:17,729

MUST BE AT THE BOTTOM OF THE  
OCEAN.

112

00:07:17,729 --> 00:07:21,740

THIS IS CAUSING THE WATER TO BE  
HEATED, MASSIVE CIRCULATION

113

00:07:21,740 --> 00:07:26,389

GOING ON.  
THAT HEAT MUST GO ALL THE WAY UP

114

00:07:26,389 --> 00:07:30,130

TO THE CRUST ITSELF.  
NOW, WE DON'T REALLY KNOW HOW

115

00:07:30,130 --> 00:07:33,040

THICK THE CRUST IS.  
WE BELIEVE IT'S ON THE ORDER OF

116

00:07:33,040 --> 00:07:38,729

SOMETIMES TEN KILOMETERS, BUT IN  
ACTUALITY IT MAY BE ONLY A FEW

117

00:07:38,729 --> 00:07:42,080

KILOMETERS IN SPOTS.  
IN FACT WE BELIEVE THE CRACKS

118

00:07:42,080 --> 00:07:46,470

MAY OPEN AND CLOSE BASED ON  
TIDAL FORCES, FORCING WATER BACK

119

00:07:46,470 --> 00:07:50,800

OUT ON TO THE SURFACE.  
SO, AS WE SEE HERE IN THIS

120

00:07:50,800 --> 00:07:55,229

PARTICULAR GRAPHIC, THAT HEAT IS  
TRANSFERRED TO THE TOP OF THE

121  
00:07:55,229 --> 00:08:00,770  
ICE SHELF.  
THE OCEAN MAY BE AS DEEP AS 100

122  
00:08:00,770 --> 00:08:04,169  
KILOMETERS.  
IF I HAVE THE NEXT GRAPHIC,

123  
00:08:04,169 --> 00:08:07,800  
PLEASE.  
HERE WE SEE THE TOP OF THE

124  
00:08:07,800 --> 00:08:11,509  
SURFACE, THE ICE CRUST.  
AND WHAT WE SEE IN THE CENTER IS

125  
00:08:11,509 --> 00:08:14,960  
WHAT WE CALL A CHAOS REGION.  
WE BELIEVE THERE'S GOOD

126  
00:08:14,960 --> 00:08:19,380  
INDICATION THAT RIGHT BELOW THIS  
CHAOS REGION IS SOME OF THESE

127  
00:08:19,380 --> 00:08:22,110  
HYDRO THERMAL VENTS.  
IT'S VERY CONSISTENT WITH OUR

128  
00:08:22,110 --> 00:08:28,490  
MODEL OF THE OCEAN BEING HEATED  
FROM BELOW, BREAKING UP THE ICE,

129  
00:08:28,490 --> 00:08:31,850  
AND IN THE COLD ENVIRONMENT THAT  
THE SURFACE OF EUROPA IS

130  
00:08:31,850 --> 00:08:36,770  
EXPERIENCING, IT ICES OVER AND  
PRODUCES THESE CHAOS PATTERNS.

131

00:08:36,770 --> 00:08:41,640

WE ALSO SEE THE DISCOLORATION OF  
THESE PARTICULAR AREAS.

132

00:08:41,640 --> 00:08:46,510

INDICATING THERE MAY BE  
ORGANICS, NUTRIENTS THAT IS

133

00:08:46,510 --> 00:08:51,510

SULFUR CERTAINLY THAT IS FILLING  
THESE REGIONS, AND DISCOLORATION

134

00:08:51,510 --> 00:08:56,990

IS SHOWING THIS.  
ON THE LOWER PANEL ON THE RIGHT

135

00:08:56,990 --> 00:09:01,020

SIDE IS ANOTHER PROCESS WE ALSO  
BELIEVE IS GOING ON.

136

00:09:01,020 --> 00:09:05,020

THIS IS CALLED SUBDUCTION.  
THIS IS WHERE AT A PARTICULAR

137

00:09:05,020 --> 00:09:09,370

CRACK THERE MAY BE ONE PLATE  
THAT IS MOVING UNDER ANOTHER

138

00:09:09,370 --> 00:09:14,930

PLATE.  
ALSO PRODUCING HEAT AND ALSO

139

00:09:14,930 --> 00:09:19,420

BEING ABLE TO PRODUCE PLUMES.  
AS YOU SEE IN THE UPPER RIGHT

140

00:09:19,420 --> 00:09:23,880

CORNER, THIS IS TAKEN FROM  
HUBBLE DATA.

141

00:09:23,880 --> 00:09:29,520

WE HAVE INDICATION THAT THERE  
ARE PLUMES AT EUROPA, AND HUBBLE

142

00:09:29,520 --> 00:09:34,050

HAS BEEN OBSERVING EUROPA NOW  
FOR A SIGNIFICANT PERIOD OF TIME

143

00:09:34,050 --> 00:09:37,790

IN SEARCH OF WHAT ARE THE  
REASONS THAT THESE PLUMS ARE

144

00:09:37,790 --> 00:09:40,580

OCCURRING?  
SO, THIS IS, INDEED,

145

00:09:40,580 --> 00:09:42,190

TREMENDOUSLY EXCITING  
OPPORTUNITY.

146

00:09:42,190 --> 00:09:47,060

A TIME FOR US WHAT I'D LIKE DO  
NOW IS SWITCH TO A LITTLE MOVIE.

147

00:09:47,060 --> 00:09:51,910

AS JOHN MENTIONED, WE HAVE  
STARTED THE PROCESS OF

148

00:09:51,910 --> 00:09:55,910

ANNOUNCING OUR INSTRUMENTS FOR A  
MULTIPLE FLYBY MISSION OF

149

00:09:55,910 --> 00:09:59,410

EUROPA.  
THIS PARTICULAR MOVIE, ONCE WE

150

00:09:59,410 --> 00:10:05,700

GET HER STARTED, SLOWS OUR  
CONCEPT OF OUR SPACECRAFT FLYING

151  
00:10:05,700 --> 00:10:09,300  
BY EUROPA.  
IT'S ACTUALLY ORBITING JUPITER.

152  
00:10:09,300 --> 00:10:15,040  
MULTIPLE FLY-BYES CAN ALLOW US  
TO GET A COMPLETE PICTURE OF

153  
00:10:15,040 --> 00:10:19,670  
EUROPA.  
ALSO THE OPPORTUNITY OF FLYING

154  
00:10:19,670 --> 00:10:23,649  
THROUGH ONE OF THE PLUMES.  
THE INSTRUMENTS WE'LL TALK ABOUT

155  
00:10:23,649 --> 00:10:28,770  
TODAY INDEED SET THE STAGE FOR  
WHAT EUROPA LOOKS LIKE IN GREAT

156  
00:10:28,770 --> 00:10:32,899  
DETAIL ON ITS SURFACE.  
IT TELLS US ABOUT HOW THICK THE

157  
00:10:32,899 --> 00:10:36,529  
ICE IS.  
IT TELLS US, PERHAPS, HOW THE

158  
00:10:36,529 --> 00:10:40,720  
UNDER ICE CRUST OCEAN IS  
COMMUNICATING WITH THE SURFACE

159  
00:10:40,720 --> 00:10:45,070  
THROUGH THESE PLUMES AND ALLOWS  
US TO MAKE THESE DETAILED

160  
00:10:45,070 --> 00:10:48,270  
MEASUREMENTS OVER A LONG PERIOD  
OF TIME.

161

00:10:48,270 --> 00:10:51,790

AND SO TO UNDERSTAND WHAT WE'VE  
SELECTED AND TALK ABOUT EACH OF

162

00:10:51,790 --> 00:10:55,200

THE INSTRUMENTS, LET ME TURN IT  
OVER TO CURT NIEBUR.

163

00:10:55,200 --> 00:10:57,490

CURT?

>> THANKS, JIM.

164

00:10:57,490 --> 00:11:00,970

WE RECEIVED 33 PROPOSALS FROM  
PEOPLE INTERESTED IN BUILDING

165

00:11:00,970 --> 00:11:03,470

INSTRUMENTS FOR THIS MISSION.  
TODAY WE'RE ANNOUNCING THE

166

00:11:03,470 --> 00:11:06,250

SELECTION OF NINE OF THOSE TO  
FLY ON THE SPACECRAFT WE

167

00:11:06,250 --> 00:11:10,100

EVENTUALLY SEND TO EUROPA.  
ALL OF THESE INSTRUMENTS ARE

168

00:11:10,100 --> 00:11:15,310

DESIGNED TO INCREASE OUR LIMITED  
KNOWLEDGE OF EUROPA AND PROBING

169

00:11:15,310 --> 00:11:19,940

THE BIG QUESTION, IS EUROPA  
HABITABLE?

170

00:11:19,940 --> 00:11:22,050

THAT'S A DIFFICULT QUESTION TO  
ANSWER.

171

00:11:22,050 --> 00:11:25,640

THESE INSTRUMENTS ALL PURSUE A  
DIFFERENT ASPECT OF THAT BIG

172

00:11:25,640 --> 00:11:27,930

QUESTION.

SO, IF I COULD HAVE THE FIRST

173

00:11:27,930 --> 00:11:30,950

SLIDE, PLEASE.

THE FIRST TWO INSTRUMENTS THAT

174

00:11:30,950 --> 00:11:39,649

WE'LL BE TALKING ABOUT ARE A  
MAGNETOMETER, THEY PROVIDE A

175

00:11:39,649 --> 00:11:50,480

POWERFUL AND USEFUL DATA SET.

WHAT THEY DO, MEANS WE CAN TAKE

176

00:11:50,480 --> 00:11:56,209

AN MRI OF THE INTERIOR STRUCTURE  
OF EUROPA WITHOUT ACCESSING IT.

177

00:11:56,209 --> 00:12:00,640

WHAT THEY CAN DO, IF YOU LOOK AT  
THE PART ON THE LOWER RIGHT,

178

00:12:00,640 --> 00:12:05,399

THAT COMPLEX DIAGRAM THAT  
INDICATES IF WE'RE CLEVER IN

179

00:12:05,399 --> 00:12:08,839

WHEN AND WHERE WE TAKE THOSE  
MEASUREMENTS WHAT WE CAN DO AS

180

00:12:08,839 --> 00:12:13,830

WE FLY BY EUROPA IS FIND OUT HOW  
DEEP THAT GLOBAL OCEAN IS AND

181  
00:12:13,830 --> 00:12:18,170  
HOW SALTY IT IS.  
WE CAN DO ALL OF THAT WITHOUT

182  
00:12:18,170 --> 00:12:21,110  
CRACKING OVER THE CRUST AND  
DIPPING OUR INSTRUMENTS INTO THE

183  
00:12:21,110 --> 00:12:23,519  
OCEAN.  
JUST AS A DOCTOR CAN SEE WHAT'S

184  
00:12:23,519 --> 00:12:27,380  
GOING ON INSIDE YOUR BODY BY  
USING AN MRI.

185  
00:12:27,380 --> 00:12:30,519  
NEXT SLIDE, PLEASE.  
THE NEXT INSTRUMENT I WANT TO

186  
00:12:30,519 --> 00:12:32,890  
TALK ABOUT IS A SPECIAL CAMERA  
WE CALL AN INFRARED

187  
00:12:32,890 --> 00:12:36,750  
SPECTROMETER.  
THIS DOESN'T TAKE PICTURES OF

188  
00:12:36,750 --> 00:12:39,230  
THE SURFACE.  
INSTEAD IT ACQUIRES SOMETHING WE

189  
00:12:39,230 --> 00:12:44,180  
CALL SPECTRA, THOSE SQUIGGLE EYE  
LINES ON THE RIGHT-HAND SIDE.

190  
00:12:44,180 --> 00:12:49,830  
THEY ARE BEAUTIFUL THINGS.  
THEY ARE NOT RANDOM.

191  
00:12:49,830 --> 00:12:54,589  
THEY ARE UNIQUE FINGERPRINTS  
THAT CAN TELL US WHAT MATERIALS

192  
00:12:54,589 --> 00:12:59,120  
ARE ON THE SURFACE OF EUROPA.  
IF WE KNOW A CERTAIN MATERIAL,

193  
00:12:59,120 --> 00:13:02,649  
SAY TABLE SALT HAS A SQUIGGLY  
LINE OF A CERTAIN SHAPE, A

194  
00:13:02,649 --> 00:13:07,160  
FINGER PRINT OF A CERTAIN SHAPE  
AND THIS INSTRUMENT SHOWS US

195  
00:13:07,160 --> 00:13:10,959  
THAT FINGERPRINT ON EUROPA, WHAT  
WE KNOW IS THAT TABLE SALT

196  
00:13:10,959 --> 00:13:15,250  
EXISTS ON EUROPA.  
BY CATALOGING THE SURFACE, WE

197  
00:13:15,250 --> 00:13:19,910  
CAN GET A NEAR GLOBAL MAP OF THE  
STUFF THAT POPULATES EUROPA'S

198  
00:13:19,910 --> 00:13:22,269  
SURFACE.  
WE CAN KNOW WHAT IT IS MADE OUT

199  
00:13:22,269 --> 00:13:24,120  
OF.  
WE CAN DO THAT FOR ALMOST THE

200  
00:13:24,120 --> 00:13:26,839  
ENTIRE SURFACE.  
THE REASON THAT'S IMPORTANT IS

201  
00:13:26,839 --> 00:13:30,029  
BECAUSE OF THAT BROWNISH GUNK  
THAT JIM MENTIONED.

202  
00:13:30,029 --> 00:13:32,390  
THAT'S OUR STATE OF THE ART TERM  
FOR IT.

203  
00:13:32,390 --> 00:13:35,510  
BROWN GUNK.  
WE DON'T KNOW WHAT IT IS.

204  
00:13:35,510 --> 00:13:39,890  
WE HAVE A LOT OF EDUCATED  
GUESSES, BUT THEY'RE JUST THAT.

205  
00:13:39,890 --> 00:13:43,510  
GUESSES.  
WE NEED ACTUAL DATA TO NAIL THIS

206  
00:13:43,510 --> 00:13:46,519  
MATERIAL DOWN.  
THIS MATERIAL IS IMPORTANT.

207  
00:13:46,519 --> 00:13:51,230  
AS YOU SEE IN THE MIDDLE  
PICTURE, THAT BROWNISH GUNK IS

208  
00:13:51,230 --> 00:13:55,970  
ASSOCIATED WITH THE ABSOLUTE  
NEWEST, YOUNGEST AREAS ON

209  
00:13:55,970 --> 00:13:58,990  
EUROPA'S SURFACE.  
THESE ARE AREAS WHERE WE THINK

210  
00:13:58,990 --> 00:14:03,190  
WATER IS ERUPTING ON TO THE  
SURFACE LIKE LAVA ERUPTS ON TO

211

00:14:03,190 --> 00:14:08,089

THE SURFACE OF EARTH.

THIS BROWNISH GUNK IS BEING

212

00:14:08,089 --> 00:14:12,390

CARRIED IN THE WATER.

IF WE FIND OUT WHAT WHAT IS, WE

213

00:14:12,390 --> 00:14:17,370

CAN FIND OUT WHAT IS BEING CARRY

IN THE WATERS OF EUROPE PA.

214

00:14:17,370 --> 00:14:21,990

THAT'S AN IMPORTANT ANSWER IF WE

NEED TO FIND OUT IF THIS PLACE

215

00:14:21,990 --> 00:14:31,190

IS INHABITABLE.

THE NEXT SLIDE IS TWO CAMERAS, A

216

00:14:31,190 --> 00:14:39,300

WIDE ANGLE CAMERA, IT PROVIDES

IMAGES IN COLOR, AND A NARROW

217

00:14:39,300 --> 00:14:43,269

ANGLE CAMERA THAT PROVIDES HIGH

RESOLUTION IMAGES.

218

00:14:43,269 --> 00:14:47,029

THIS IS REALLY A CRITICAL

INSTRUMENT FOR THIS MISSION.

219

00:14:47,029 --> 00:14:50,600

THE BEST PICTURES WE HAVE OF

EUROPA ARE FROM GALILEO, THE

220

00:14:50,600 --> 00:14:55,200

MISSION JOHN MENTIONED.

GALILEO WAS A PHENOMENAL MISSION

221

00:14:55,200 --> 00:14:58,630

AND IS THE MISSION THAT REVEALED  
TO US THAT THERE'S A GLOBAL

222

00:14:58,630 --> 00:15:01,980

OCEAN ON EUROPA.  
BUT WE OFTEN OVERLOOK THE SIMPLE

223

00:15:01,980 --> 00:15:06,320

FACT THAT GALILEO ONLY FLEW BY  
EUROPA ABOUT 11 TIMES.

224

00:15:06,320 --> 00:15:11,870

IT DID NOT GET A LOT OF PICTURES  
OF EUROPA.

225

00:15:11,870 --> 00:15:15,519

WHEN YOU SUM ALL THOSE PICTURES  
UP, WE'VE ONLY SEEN ABOUT 10% OF

226

00:15:15,519 --> 00:15:19,660

THE SURFACE OF EUROPA AT A  
RESOLUTION OF 200 METERS OR

227

00:15:19,660 --> 00:15:23,769

BETTER THAT MEANS THERE'S A LOT  
OF TERRAIN WE DON'T HAVE GOOD

228

00:15:23,769 --> 00:15:27,649

PICTURES OF.  
WE HAVE SPENT THE PAST 15 YEARS

229

00:15:27,649 --> 00:15:32,389

PORING OVER THOSE SMALL NUMBER  
OF PICTURES OVER AND OVER AGAIN

230

00:15:32,389 --> 00:15:35,339

FOR TWO REASONS.  
FIRST OF ALL, BECAUSE THEY'RE

231

00:15:35,339 --> 00:15:38,880

THE ONLY PICTURES WE HAVE.  
SECOND OF ALL, BECAUSE THEY ARE

232

00:15:38,880 --> 00:15:42,060

SUCH FASCINATING PICTURES.  
YOU SEE EXAMPLES OF SOME OF

233

00:15:42,060 --> 00:15:44,779

THOSE ON THE SLIDE.  
IN THE CENTER YOU SEE A PICTURE

234

00:15:44,779 --> 00:15:48,550

OF AN AREA THAT LOOKS LIKE A  
CRACKED UP JIGSAW PUZZLE.

235

00:15:48,550 --> 00:15:52,279

WE SEE REGIONS ON EUROPA WHERE  
THERE ARE HUGE BLOCKS, TENS OF

236

00:15:52,279 --> 00:15:56,050

KILOMETERS ACROSS THAT LOOK LIKE  
ICEBERGS THAT HAVE BEEN MELTED

237

00:15:56,050 --> 00:16:00,290

OUT, ROTATED AND SHIFTED.  
YOU CAN LOOK AT THIS PICTURE AND

238

00:16:00,290 --> 00:16:03,459

REASSEMBLE THAT JIGSAW PUZZLE  
AND PUT THOSE PIECES BACK

239

00:16:03,459 --> 00:16:06,550

TOGETHER, BUT SOMETHING CAUSED  
THEM TO SHIFT.

240

00:16:06,550 --> 00:16:09,730

WE SEE IN THE LOWER LEFT HAND  
CORNER ICEBERGS THAT ARE

241

00:16:09,730 --> 00:16:14,310

KILOMETERS HIGH WITH SHEER  
VERTICAL CLIFFS.

242

00:16:14,310 --> 00:16:17,560

IN THE UPPER RIGHT CORNER YOU  
SEE THE ODD RIDGES THAT ARE

243

00:16:17,560 --> 00:16:20,240

UBIQUITOUS ON EUROPA.  
THEY ARE EVERYWHERE.

244

00:16:20,240 --> 00:16:26,470

THEY LOOK SIMILAR TO THE MID  
OCEAN SPREAD RIDGES ON EARTH.

245

00:16:26,470 --> 00:16:30,970

RIDGES THAT ARE PULLING APART  
FROM ONE ANOTHER IN THIS CASE, AS

246

00:16:30,970 --> 00:16:33,260

WATER COULD BE ERUPTING FROM  
BELOW AND PUSHING THE CRUST

247

00:16:33,260 --> 00:16:36,180

APART.  
THESE ARE THE THINGS WE'VE SEEN

248

00:16:36,180 --> 00:16:40,240

BY LOOKING AT 10% OF THE SURFACE  
OF EUROPA.

249

00:16:40,240 --> 00:16:44,170

THE INSTRUMENT WE SELECTED TODAY  
WILL COVER ALMOST 90% OF THE

250

00:16:44,170 --> 00:16:48,389

SURFACE AT 50 METER RESOLUTION.  
IF WE HAVE SEEN SUCH AMAZING

251

00:16:48,389 --> 00:16:52,550

THINGS ON 10% OF THE SURFACE,  
IT'S HARD TO IMAGINE THE AMAZING

252

00:16:52,550 --> 00:16:56,930

THINGS WE WILL SEE WHEN WE LOOK  
AT THE REST OF EUROPA AT EVEN

253

00:16:56,930 --> 00:17:01,950

BETTER RESOLUTION.  
NEXT SLIDE, PLEASE.

254

00:17:01,950 --> 00:17:05,199

AS JOHN MENTIONED, WE THINK  
EUROPA HAS A YOUNG SURFACE

255

00:17:05,199 --> 00:17:08,040

BECAUSE THERE ARE NOT A LOT OF  
CRATERS.

256

00:17:08,040 --> 00:17:11,100

IF IT'S YOUNG, IT MUST BE VERY  
ACTIVE.

257

00:17:11,100 --> 00:17:13,929

SOMETHING IS CAUSING THAT  
SURFACE TO RENEW ITSELF.

258

00:17:13,929 --> 00:17:17,069

THE NEXT TWO INSTRUMENTS HELP  
INVESTIGATE THAT ACTIVITY.

259

00:17:17,069 --> 00:17:20,910

SOMETHING IS CAUSING THE SURFACE  
OF EUROPA TO TURN OVER, GENERATE

260

00:17:20,910 --> 00:17:23,970

NEW SURFACE.  
WHAT THE ICE PENETRATING RADAR

261  
00:17:23,970 --> 00:17:27,380  
ON THE LEFT DOES IS ALLOW US TO  
SEE UNDERNEATH THE SURFACE OF

262  
00:17:27,380 --> 00:17:29,710  
EUROPA.  
WE CAN PROBE IT IN THREE

263  
00:17:29,710 --> 00:17:32,179  
DIMENSIONS.  
IT ALLOWS US TO SEE THE

264  
00:17:32,179 --> 00:17:34,600  
STRUCTURES, LAYERS OF THE ICE  
UNDERNEATH.

265  
00:17:34,600 --> 00:17:38,059  
SEE HOW THE LAYERS HAVE SHIFTED,  
BENT, TWISTED.

266  
00:17:38,059 --> 00:17:42,280  
THIS MEANS WE CAN SEE HOW THEY  
ORIENTED AND GET A BETTER IDEA

267  
00:17:42,280 --> 00:17:45,010  
OF HOW THEY CHANGED THROUGH  
TIME.

268  
00:17:45,010 --> 00:17:50,400  
THIS RADAR IS ALSO VERY GOOD AT  
DETECTING SUBSURFACE WATER.

269  
00:17:50,400 --> 00:17:53,470  
WE HAVE STRONG EVIDENCE THAT  
THERE ARE LAKES UNDERNEATH THE

270  
00:17:53,470 --> 00:17:57,230  
ICE CRUST ON EUROPA JUST AS WE  
HAVE FOUND OVER THE PAST DECADE

271

00:17:57,230 --> 00:18:01,450  
OR SO IN ANTARCTICA ON EARTH.  
WE THINK THESE LAKES ARE

272

00:18:01,450 --> 00:18:05,750  
INCREDIBLY COMMON ON EUROPA.  
THIS RADAR WILL BE ABLE TO

273

00:18:05,750 --> 00:18:09,280  
IDENTIFY THOSE LAKES, TELL US  
WHERE THEY ARE, HOW BIG THEY

274

00:18:09,280 --> 00:18:11,900  
ARE, HOW MUCH WATER THEY  
CONTAIN.

275

00:18:11,900 --> 00:18:14,910  
THIS IS IMPORTANT BECAUSE THESE  
LAKES ARE LIKELY VERY CLOSE TO

276

00:18:14,910 --> 00:18:17,309  
THE SURFACE.  
WHICH MAKES THEM EASIER TO

277

00:18:17,309 --> 00:18:19,990  
STUDY.  
THE OTHER INSTRUMENT ON THE

278

00:18:19,990 --> 00:18:24,330  
SLIDE IS THE THERMAL IMAGERY.  
THIS IS OUR HEAT DETECTOR.

279

00:18:24,330 --> 00:18:27,620  
THIS IS IMPORTANT BECAUSE IF  
THERE'S ACTIVITY GOING ON IN THE

280

00:18:27,620 --> 00:18:31,350  
SURFACE OF EUROPA, THAT ACTIVITY  
IS ASSOCIATED WITH HEAT.

281

00:18:31,350 --> 00:18:36,770

THAT IS WHAT IS POWERING THE  
ENGINE THAT'S ON RATING HERE.

282

00:18:36,770 --> 00:18:39,669

FINDING THE RELATIVE HOT SPOTS  
CAN HELP US UNDERSTAND WHERE AND

283

00:18:39,669 --> 00:18:44,000

HOW EUROPA'S SURFACE IS ACTIVE.  
HOT SPOTS BEING A FAIRLY

284

00:18:44,000 --> 00:18:47,780

RELATIVE TERM.  
EUROPA'S SURFACE IS ABOUT MINUS

285

00:18:47,780 --> 00:18:51,760

160 DEGREES CELSIUS.  
WE ARE LOOKING FOR AREAS THAT

286

00:18:51,760 --> 00:18:55,200

ARE JUST A COUPLE OF DEGREES  
WARMER THAN THAT.

287

00:18:55,200 --> 00:18:57,850

SO WE'RE STILL TALKING VERY  
FRIGID TEMPERATURES.

288

00:18:57,850 --> 00:19:01,150

SO THIS IS AN INCREDIBLY  
SENSITIVE INSTRUMENT.

289

00:19:01,150 --> 00:19:05,210

BUT CONVERSELY, THERE MIGHT BE  
AREAS ON EUROPA, SUCH AS WHERE

290

00:19:05,210 --> 00:19:09,330

PLUMES ARE ERUPTING, OR WHERE  
THERE IS ACTIVE ERUPTIONS OF

291

00:19:09,330 --> 00:19:14,650

WATER THAT MIGHT BE 100 OR 150  
DEGREES WARMER THAN THAT.

292

00:19:14,650 --> 00:19:17,049

AND THIS INSTRUMENT WILL DO A  
VERY GOOD JOB OF PINPOINTING

293

00:19:17,049 --> 00:19:19,600

THOSE REGIONS.  
SOME OF WHICH COULD BE VERY

294

00:19:19,600 --> 00:19:21,210

SMALL.  
THAT'S WHAT YOU SEE IN THAT

295

00:19:21,210 --> 00:19:24,160

SIMULATED IMAGE ON THE LOWER  
RIGHT HAND IMAGE.

296

00:19:24,160 --> 00:19:28,330

THAT'S AN IMAGE OF ONE OF THOSE  
SPREADING RIDGES ON EUROPA ALONG

297

00:19:28,330 --> 00:19:30,860

WITH WHAT WE THINK COULD BE THE  
EAT SIGNATURE, THE THERMAL

298

00:19:30,860 --> 00:19:34,590

SIGNATURE AS IT ERUPTS NEW  
MATERIAL ON TO THE SURFACE.

299

00:19:34,590 --> 00:19:40,360

THIS THERMAL IMAGEER CAN SPOT  
THAT ACTIVITY VERY PRECISELY.

300

00:19:40,360 --> 00:19:44,500

NEXT SLIDE, PLEASE.  
NEXT WE COME TO OUR NEXT TWO

301  
00:19:44,500 --> 00:19:47,130  
INSTRUMENTS THAT ARE COMPOSITION  
INSTRUMENTS.

302  
00:19:47,130 --> 00:19:50,350  
THESE PROVIDE DETAILED  
INFORMATION ON THE COMPOSITION

303  
00:19:50,350 --> 00:19:53,570  
OF EUROPA USING A DIFFERENT  
TECHNIQUE THAN THE INFRARED

304  
00:19:53,570 --> 00:19:58,000  
SPECTROMETER.  
THE INFRARED SPECTROMETER IS

305  
00:19:58,000 --> 00:20:00,350  
LOOKING AT THE ENTIRE SURFACE OF  
EUROPA.

306  
00:20:00,350 --> 00:20:04,250  
WHAT THESE INSTRUMENTS DO IS  
INGEST SAMPLES OF EUROPA THAT

307  
00:20:04,250 --> 00:20:08,080  
HAVE BEEN BLASTED INTO SPACE AND  
DIRECTLY MEASURE THEM.

308  
00:20:08,080 --> 00:20:15,100  
THE FIRST IS CALLED MASS SPECS.  
THIS SAMPLES THE ATMOSPHERE OF

309  
00:20:15,100 --> 00:20:18,280  
EUROPA.  
BUT THE ATMOSPHERE OF EUROPA IS

310  
00:20:18,280 --> 00:20:20,940  
A MISNOMER.  
EUROPA DOESN'T HAVE AN

311

00:20:20,940 --> 00:20:22,770

ATMOSPHERE.

IT'S A VACUUM.

312

00:20:22,770 --> 00:20:26,850

THE MATERIALS AROUND EUROPA ARE

THE MATERIALS FROM THE SURFACE

313

00:20:26,850 --> 00:20:28,520

THAT HAVE BEEN LOFTED INTO

SPACE.

314

00:20:28,520 --> 00:20:33,130

WHAT THIS INSTRUMENT DOES IS

ANALYZE THE COMPOSITION OF THOSE

315

00:20:33,130 --> 00:20:37,990

SURFACE SAMPLES, THOSE GASES TO

AN INCREDIBLY PRECISE DEGREE.

316

00:20:37,990 --> 00:20:41,000

BETTER THAN WE EVER HAVE WITH

ANY OTHER MISSION.

317

00:20:41,000 --> 00:20:45,400

SIMILARLY, THE SECOND INSTRUMENT

DOES ABOUT THE SAME THING,

318

00:20:45,400 --> 00:20:48,630

INSTEAD OF WORKING WITH GASES,

IT'S WORKING WITH DUST.

319

00:20:48,630 --> 00:20:53,950

IT'S WORKING WITH ROCK AND ICE

THAT HAVE BEEN BLASTED OFF THE

320

00:20:53,950 --> 00:20:58,380

SURFACE OF EUROPA AND LOFTED UP

TO WHERE THE SPACECRAFT IS AT.

321

00:20:58,380 --> 00:21:01,220

WORKING TOGETHER WITH THESE TWO  
INSTRUMENTS, YOU CAN MEASURE THE

322

00:21:01,220 --> 00:21:06,360

SURFACE COMPOSITION OF EUROPA  
WITHOUT HAVING TO LAND ON

323

00:21:06,360 --> 00:21:09,700

EUROPA, WHICH IS A POWERFUL  
TECHNIQUE FOR US.

324

00:21:09,700 --> 00:21:13,030

BUT THE REAL POWER OF THESE TWO  
INSTRUMENTS, AS SHOWN IN THE

325

00:21:13,030 --> 00:21:17,740

CENTER PICTURE, A DIAGRAM  
DENOTING SOME CHEMISTRY THAT

326

00:21:17,740 --> 00:21:24,070

OCCURRED ON THE HYDROTHERMAL  
VENTS ON EARTH'S OCEAN FLOORS.

327

00:21:24,070 --> 00:21:28,220

WHEN SAMPLES DOWN THERE ARE  
LAUNCHED TO THE SPACECRAFT,

328

00:21:28,220 --> 00:21:32,780

THESE INSTRUMENTS ARE POWERFUL  
ENOUGH AND PRECISE ENOUGH THAT

329

00:21:32,780 --> 00:21:36,950

THEY CAN ACTUALLY FROM ORBIT  
TEACH US ABOUT THE CHEMISTRY

330

00:21:36,950 --> 00:21:41,169

HAPPENING AT THE BOTTOM OF  
EUROPA'S OCEAN, WITHOUT HAVING

331

00:21:41,169 --> 00:21:44,870

TO DIVE INTO THAT OCEAN.

THESE ARE TECHNIQUES WE'VE USED

332

00:21:44,870 --> 00:21:48,289

SUCCESSFULLY ON THE CASSINI

MISSION TO UNDERSTAND OCEANS AND

333

00:21:48,289 --> 00:21:51,570

PLUMES.

THE INSTRUMENTS WE'LL BE TAKING

334

00:21:51,570 --> 00:21:56,950

ON EUROPA ARE SEVERAL GENERATION

MORE ADVANCED THAN THE CASSINI

335

00:21:56,950 --> 00:22:03,240

MISSION.

FINALLY, WE HAVE OUR PLUME

336

00:22:03,240 --> 00:22:06,130

HUNTER.

AN ULTRAVIOLET SPECTROGRAPH.

337

00:22:06,130 --> 00:22:12,360

THESE WILL FIND THE PLUMES THAT

WE DISCOVERED AND ARE SO

338

00:22:12,360 --> 00:22:14,900

INTERESTED IN.

EVERY INSTRUMENT THAT WE ARE

339

00:22:14,900 --> 00:22:21,289

FLYING DOES PLUME SCIENCE, BUT

THIS IS THE INSTRUMENT DESIGNED

340

00:22:21,289 --> 00:22:25,410

TO HUNT THEM DOWN AND TELL US

WHERE THEY'RE AT.

341

00:22:25,410 --> 00:22:28,280

THIS INSTRUMENT USES THE SAME  
TECHNIQUE THAT THE RUBBLE SPACE

342

00:22:28,280 --> 00:22:32,190

TELESCOPE USED TO FIRST FIND  
EVIDENCE OF THE PLUMES, AS WE

343

00:22:32,190 --> 00:22:36,190

ARE FLYING NEAR AND FAR FROM  
EUROPA, IT WILL IDENTIFY WHERE

344

00:22:36,190 --> 00:22:40,030

THE PLUMES ARE, HOW ACTIVE THEY  
ARE, WHAT KIND OF MATERIALS THEY

345

00:22:40,030 --> 00:22:43,490

ARE SPEWING INTO SPACE AND HOW  
THEY VARY WITH TIME.

346

00:22:43,490 --> 00:22:46,400

ADDRESS JOHN MENTIONED, WE'RE  
ALREADY SEEING EVIDENCE THAT

347

00:22:46,400 --> 00:22:51,510

THESE PLUMES CHANGE WITH TIME.  
THEY START, STOP, MOVE, START UP

348

00:22:51,510 --> 00:22:53,549

AGAIN.  
THE DYNAMICS OF THESE PLUMES ARE

349

00:22:53,549 --> 00:22:56,960

VERY COMPLICATED, WE DON'T  
UNDERSTAND THEM YET.

350

00:22:56,960 --> 00:23:00,330

BRINGING ALONG AN INSTRUMENT  
THAT CAN OBSERVE THOSE PLUMES

351

00:23:00,330 --> 00:23:03,750

AND GIVE US AN UNDERSTANDING AS  
TO WHY AND WHERE THEY POP UP IS

352

00:23:03,750 --> 00:23:08,470

INCREDIBLY VALUABLE.  
NEXT SLIDE, PLEASE.

353

00:23:08,470 --> 00:23:10,960

SO THIS IS A WONDERFUL SET OF  
INSTRUMENTS.

354

00:23:10,960 --> 00:23:15,130

BUT RECALL THAT THE BIG QUESTION  
THAT THIS MISSION NEEDS TO

355

00:23:15,130 --> 00:23:20,980

ANSWER, IS EUROPA HABITABLE IN  
POSING BIG QUESTIONS LIKE THAT

356

00:23:20,980 --> 00:23:24,419

IS VERY EASY.  
BUT ANSWERING THEM IS MUCH MORE

357

00:23:24,419 --> 00:23:26,650

DIFFICULT.  
SO WHAT WE NEED TO DO TO ANSWER

358

00:23:26,650 --> 00:23:33,210

THAT BIG QUESTION IS BREAK IT  
INTO MORE MANAGEABLE CHUNKS.

359

00:23:33,210 --> 00:23:35,890

SMALLER QUESTIONS THAT WE CAN  
ANSWER DEFINITELY.

360

00:23:35,890 --> 00:23:38,660

THOSE ARE THE QUESTIONS LISTED  
HERE.

361

00:23:38,660 --> 00:23:41,799

THESE ARE THE QUESTIONS THAT THE  
NEXT MISSION TO EUROPA MUST

362

00:23:41,799 --> 00:23:44,870

ANSWER.

ONCE WE HAVE DEFINITIVE ANSWERS

363

00:23:44,870 --> 00:23:49,100

TO THESE QUESTIONS, WE CAN  
ATTACK THE BIGGER QUESTION OF IS

364

00:23:49,100 --> 00:23:52,520

EUROPA HABITABLE?

ONCE WE KNOW HOW DEEP AND SALTY

365

00:23:52,520 --> 00:23:56,610

THAT OCEAN S WE CAN GET A BETTER  
UNDERSTANDING OF INHABITABLE.

366

00:23:56,610 --> 00:23:59,690

ONCE WE KNOW HOW THICK THE ICE  
SHELL IS AND TO WHAT EXTENT IT

367

00:23:59,690 --> 00:24:02,820

COMMUNICATES WITH THE OCEAN AND  
BRINGS MATERIAL UP TO THE

368

00:24:02,820 --> 00:24:05,960

SURFACE AND BACK DOWN TO THE  
WATER, WE CAN HAVE A BETTER

369

00:24:05,960 --> 00:24:09,100

UNDERSTANDING OF WHETHER OR NOT  
EUROPA IS INHABITABLE.

370

00:24:09,100 --> 00:24:15,130

ONCE WE UNDERSTAND HOW ACTIVE  
THE ICE SHELL IS, WE CAN BETTER

371

00:24:15,130 --> 00:24:18,490

UNDERSTAND INHABITABILITY.  
ONCE WE UNDERSTAND WHAT THAT

372

00:24:18,490 --> 00:24:23,000

UBIQUITOUS BROWN GUNK IS, WE CAN  
UNDERSTAND WHAT ONE OF THE

373

00:24:23,000 --> 00:24:26,510

DIRECT COMPONENTS OF THAT OCEAN  
IS.

374

00:24:26,510 --> 00:24:30,260

ALL OF THESE THINGS FEED INTO  
THE INHABITABILITY QUESTION.

375

00:24:30,260 --> 00:24:33,000

ONE OF THE MOST RECENT QUESTIONS  
WE'VE BEGUN STRUGGLING TO

376

00:24:33,000 --> 00:24:37,010

ANSWER, WHERE ARE THOSE PLUMES?  
WHAT'S IN THEM?

377

00:24:37,010 --> 00:24:41,679

ARE THEY REALLY DELIVERING  
SAMPLES OF THE OCEAN TO US IN

378

00:24:41,679 --> 00:24:46,390

SPACE THAT WE CAN EASILY ACCESS?  
IF THAT'S THE CASE, HOW CAN WE

379

00:24:46,390 --> 00:24:48,510

GET AT THEM?  
WHAT KIND OF MEASUREMENTS CAN WE

380

00:24:48,510 --> 00:24:51,809

TAKE ON THEM?  
THIS PAYLOAD WILL ANSWER ALL OF

381

00:24:51,809 --> 00:24:55,880

THESE QUESTIONS AND TAKE GREAT  
STRIDES FORWARD IN UNDERSTANDING

382

00:24:55,880 --> 00:25:01,120

THE INHABITABILITY OF EUROPA.  
>> THANK YOU, CURT.

383

00:25:01,120 --> 00:25:03,570

NOW LET'S GO INTO THE Q & A  
SESSION.

384

00:25:03,570 --> 00:25:09,890

IF YOU'D LIKE TO ASK A QUESTION  
USING SOCIAL MEDIA, PLEASE

385

00:25:09,890 --> 00:25:14,679

USE †#ASKNASA.  
LET'S SEE IF THERE ARE ANY

386

00:25:14,679 --> 00:25:18,289

QUESTIONS FROM THE AUDIENCE.  
OKAY.

387

00:25:18,289 --> 00:25:26,820

PLEASE WAIT FOR THE MIC AND SAY  
YOUR NAME.

388

00:25:26,820 --> 00:25:29,940

>> MY NAME IS KATIE.  
HI.

389

00:25:29,940 --> 00:25:36,030

SO IF YOU WERE ABLE TO DETECT  
ANY FORM OF LIFE WHAT WOULD BE

390

00:25:36,030 --> 00:25:39,919

THE NEXT STEPS THAT YOU WOULD  
TAKE IN OBSERVING EUROPA?

391

00:25:39,919 --> 00:25:49,850

>> I WOULD IMMEDIATELY RETIRE.  
I'VE BEEN TELLING EVERYONE,

392

00:25:49,850 --> 00:25:52,510

ANSWERING THAT BIG QUESTION IS  
THERE LIFE IN THE UNIVERSE

393

00:25:52,510 --> 00:25:56,770

REALLY STARTS FROM UNDERSTANDING  
IF THERE'S LIFE IN THE SOLAR

394

00:25:56,770 --> 00:25:59,230

SYSTEM.  
EUROPA IS ONE OF THOSE CRITICAL

395

00:25:59,230 --> 00:26:05,020

AREAS WHERE WE BELIEVE THAT THE  
ENVIRONMENT IS JUST PERFECT FOR

396

00:26:05,020 --> 00:26:07,490

THE POTENTIAL DEVELOPMENT OF  
LIFE.

397

00:26:07,490 --> 00:26:12,480

SO THIS MISSION WILL BE THAT  
STEP THAT HELPS US UNDERSTAND

398

00:26:12,480 --> 00:26:16,690

THE ENVIRONMENT AND HOPEFULLY  
GIVE US AN INDICATION OF HOW

399

00:26:16,690 --> 00:26:19,070

INHABITABLE THE ENVIRONMENT CAN  
BE.

400

00:26:19,070 --> 00:26:25,320

IF WE FIND LIFE OR INDICATIONS  
OF LIFE THAT WILL BE AN ENORMOUS

401  
00:26:25,320 --> 00:26:28,809  
STEP FORWARD.  
OUR UNDERSTANDING OF OUR PLACE

402  
00:26:28,809 --> 00:26:31,470  
IN THE UNIVERSE.  
IF THERE'S LIFE IN THE SOLAR

403  
00:26:31,470 --> 00:26:36,929  
SYSTEM, IN EUROPA, IT MUST BE  
EVERYWHERE IN OUR GALAXY.

404  
00:26:36,929 --> 00:26:41,480  
PERHAPS EVEN IN THE UNIVERSE.  
UNDERSTANDING THESE QUESTIONS

405  
00:26:41,480 --> 00:26:47,289  
ARE IMPORTANT.  
THEY HAVE REAL MAJOR

406  
00:26:47,289 --> 00:26:50,280  
IMPLICATIONS TO OUR  
UNDERSTANDING OF OUR PLACE IN

407  
00:26:50,280 --> 00:26:53,250  
THE SOLAR SYSTEM AND IN THE  
UNIVERSE.

408  
00:26:53,250 --> 00:26:57,980  
>> NATHAN ROSS.  
YOU MENTIONED CHAOS REGIONS.

409  
00:26:57,980 --> 00:27:02,410  
COULD YOU GO INTO DETAIL ON  
THOSE?

410  
00:27:02,410 --> 00:27:06,299  
>> IN THE ONE GRAPHIC WHERE WE  
SAW THE SURFACE OF EUROPA, THE

411

00:27:06,299 --> 00:27:13,909

CHAOS REGION.

THE THIRD GRAPHIC THERE.

412

00:27:13,909 --> 00:27:17,360

WHAT WE'RE SEEING, WE BELIEVE

WHAT'S UNDERNEATH THAT CHAOS

413

00:27:17,360 --> 00:27:23,070

REGION, PERHAPS A MELTED LAKE

REGION.

414

00:27:23,070 --> 00:27:28,490

BELOW THAT IT'S BEING HEATED BY

PERHAPS HYDRO THERMAL VENT AT A

415

00:27:28,490 --> 00:27:33,090

DEPTH THAT WE DON'T REALLY KNOW.

DEPENDS ON HOW HOT THE THERMAL

416

00:27:33,090 --> 00:27:38,620

VENT IS AND HOW CLOSE IT IS TO

THE ICE CRUST.

417

00:27:38,620 --> 00:27:46,250

AS CURT MENTIONED, WE WANT TO

TARGET THESE REGIONS, FLY OVER,

418

00:27:46,250 --> 00:27:53,090

SEE THESE BROKEN UP ICE SHEETS,

CREATING THESE CHAOS REGIONS.

419

00:27:53,090 --> 00:27:59,159

SEE, INDEED, IF PERHAPS THERE'S

A LAKE UNDERNEATH IT.

420

00:27:59,159 --> 00:28:03,630

EITHER COMPLETELY OPEN TO THE

OCEAN BELOW OR MAYBE THERE'S A

421

00:28:03,630 --> 00:28:10,140

BOTTOM TO THEM.

THIS GRAPHIC PROPOSES AN UNDER

422

00:28:10,140 --> 00:28:17,610

ICE THIN CRUST OF MELTED WATER.

>> THANKS, JIM.

423

00:28:17,610 --> 00:28:20,570

LET'S GO TO THE PHONE LINES AND

THEN SOCIAL MEDIA.

424

00:28:20,570 --> 00:28:23,180

FIRST ON THE LINE, IRENE KLOTZ

FROM REUTERS.

425

00:28:23,180 --> 00:28:25,970

>> Caller: THANK YOU VERY MUCH.

I HAVE SEVERAL QUESTIONS.

426

00:28:25,970 --> 00:28:32,710

THE FIRST IS, JIM, IF YOU COULD

MAYBE GIVE US AN OVERVIEW OF THE

427

00:28:32,710 --> 00:28:37,559

FUNDING FOR THE EUROPA MISSION.

NASA REQUESTED VERY MUCH MORE

428

00:28:37,559 --> 00:28:40,640

MONEY AND DOES CONGRESS SEEM TO

BE INTERESTED IN PUTTING IT

429

00:28:40,640 --> 00:28:46,140

TOWARDS IT AND THE TIMETABLE FOR

LAUNCHING AND THE STATUS OF THE

430

00:28:46,140 --> 00:28:51,500

PROPOSAL TO PUT A LANDER ON IT.

ALSO MAYBE A LITTLE RUN DOWN OF

431

00:28:51,500 --> 00:28:55,270

HOW MUCH THE NINE INSTRUMENTS  
PLUS THE TECHNOLOGY

432

00:28:55,270 --> 00:29:00,150

DEMONSTRATION, THE TENTH RUN  
THAT BY NOW IS SLATED FOR THE

433

00:29:00,150 --> 00:29:04,529

ORBITER, FOR THE CLIPPER, HOW  
MUCH NASA WILL BE SPENDING ON

434

00:29:04,529 --> 00:29:06,210

ALL THOSE.  
THANKS.

435

00:29:06,210 --> 00:29:09,299

>> LET ME SEE IF I CAN GO  
THROUGH ALL OF THOSE AND PASS

436

00:29:09,299 --> 00:29:16,140

OFF A FEW TO MY COLLEAGUES HERE.  
>> ONE OF YOUR FIRST QUESTIONS

437

00:29:16,140 --> 00:29:21,500

INDEED WAS WHAT ABOUT THE  
MISSION ITSELF?

438

00:29:21,500 --> 00:29:24,120

AS WE ANNOUNCED IN FEBRUARY,  
AFTER THE PRESIDENT DELIVERED

439

00:29:24,120 --> 00:29:29,950

HIS BUDGET TO CONGRESS.  
WE HAVE FUNDED THE EUROPA

440

00:29:29,950 --> 00:29:35,360

MISSION OUT OVER THE FIVE-YEAR  
BUDGET THAT THE PRESIDENT

441

00:29:35,360 --> 00:29:38,570

PROVIDES.

THIS IS A TREMENDOUS OPPORTUNITY

442

00:29:38,570 --> 00:29:42,049

FOR US TO REALLY GET SERIOUS,  
COMPLETE OUR INITIAL STUDIES,

443

00:29:42,049 --> 00:29:48,190

AND MOVE THE MISSION IN WHAT WE  
CALL FORMULATION.

444

00:29:48,190 --> 00:29:52,460

IT'S NOT ONLY IMPORTANT TO KNOW  
THAT WE'RE MOVING TOWARDS THAT

445

00:29:52,460 --> 00:29:56,169

AND THE INSTRUMENT SELECTION IS  
THE START OF THAT PROCESS.

446

00:29:56,169 --> 00:30:00,380

BUT OUR PLANS ARE TO HAVE THIS  
KEY DECISION POINT OF STARTING

447

00:30:00,380 --> 00:30:04,460

THE FORMULATION BEFORE THE END  
OF THIS FISCAL YEAR.

448

00:30:04,460 --> 00:30:06,169

HOW MUCH IS THE TOTAL MISSION  
COST?

449

00:30:06,169 --> 00:30:10,020

THAT, I THINK, WAS YOUR NEXT  
QUESTION.

450

00:30:10,020 --> 00:30:14,980

WE HAVE SOME MISSION CONCEPTS,  
BASIC MISSION CONCEPTS THAT

451

00:30:14,980 --> 00:30:20,710

WE'RE EXPLORING IN GREAT DETAIL  
THAT MEAN THE MISSION PERHAPS IS

452

00:30:20,710 --> 00:30:23,970

ON THE ORDER OF \$2 BILLION  
WITHOUT THE LAUNCH VEHICLE IN

453

00:30:23,970 --> 00:30:28,270

THAT NEIGHBORHOOD.  
WHAT'S IMPORTANT TO UNDERSTAND

454

00:30:28,270 --> 00:30:32,000

IS THAT NOW THAT WE MADE THE  
SELECTION OF THE INSTRUMENTS,

455

00:30:32,000 --> 00:30:36,720

WE'LL BEGIN THE ACCOMMODATIONS  
ON OUR MISSION CONCEPT.

456

00:30:36,720 --> 00:30:41,860

WE'LL MOVE THE WHOLE ACTIVITY  
INTO FORMULATION AND GET REALLY

457

00:30:41,860 --> 00:30:45,029

SERIOUS ABOUT ALL ASPECTS OF THE  
MISSION.

458

00:30:45,029 --> 00:30:48,559

WE WON'T REALLY HAVE A DETAILED  
UNDERSTANDING OF WHAT THAT COST

459

00:30:48,559 --> 00:30:53,059

PROFILE IS UNTIL WE ARE FURTHER  
ALONG IN THE PROCESS.

460

00:30:53,059 --> 00:30:58,779

SO, TO ANOTHER ONE OF YOUR  
QUESTIONS, HOW MUCH IS THE

461

00:30:58,779 --> 00:31:03,990

INSTRUMENTS?

WHAT HAVE WE SELECTED COSTING?

462

00:31:03,990 --> 00:31:07,390

FOR THAT, LET ME TURN IT OVER TO

CURT NIEBUR TO GIVE YOU AN IDEA

463

00:31:07,390 --> 00:31:12,309

OF THE COST ON THE INSTRUMENTS.

>> SO, OVER THE NEXT YEAR OR SO,

464

00:31:12,309 --> 00:31:14,980

WE'LL BE SPENDING ABOUT \$10

MILLION TOTAL ON THE

465

00:31:14,980 --> 00:31:17,529

INSTRUMENTS.

OVER THE NEXT THREE YEARS IT

466

00:31:17,529 --> 00:31:22,710

COMES TO ABOUT 100 MILLION, \$110

MILLION TOTAL ON THE

467

00:31:22,710 --> 00:31:24,250

INSTRUMENTS.

THAT WILL GET US TO THE POINT

468

00:31:24,250 --> 00:31:27,330

WHERE WE REACH A KEY DECISION

POINT WHERE WE DECIDE IF WE'RE

469

00:31:27,330 --> 00:31:30,409

GOING TO CONTINUE ON WITH THE

INSTRUMENTS, IF SOME OF THEM ARE

470

00:31:30,409 --> 00:31:34,380

NO LONGER READY AND NEED TO ARE

VISIT THEM.

471

00:31:34,380 --> 00:31:37,330

BUT IN ABOUT THREE YEARS WE'LL  
BE READY TO COMMIT TO THE FULL

472

00:31:37,330 --> 00:31:42,969

COST ESTIMATE FOR THOSE  
INSTRUMENTS.

473

00:31:42,969 --> 00:31:45,020

>> ONE MORE QUESTION FROM THE  
PHONE LINES BEFORE GOING TO

474

00:31:45,020 --> 00:31:50,270

SOCIAL MEDIA.  
JEFF FAUST FROM SPACE NEWS.

475

00:31:50,270 --> 00:31:54,409

JEFF?  
>> Caller: I WANTED TO POSE A

476

00:31:54,409 --> 00:31:58,059

QUESTION TO IRENE, THE HOUSE IS  
PUSHING A FAIRLY AGGRESSIVE

477

00:31:58,059 --> 00:32:00,919

SCHEDULE IN ITS APPROPRIATIONS  
BILL SEEKING TO LAUNCH THE

478

00:32:00,919 --> 00:32:05,570

EUROPA MISSION BY 2022.  
IS IT REASONABLE THAT THESE

479

00:32:05,570 --> 00:32:10,890

INSTRUMENTS SELECTED TODAY WOULD  
BE READY FOR FLIGHT BY 2022?

480

00:32:10,890 --> 00:32:14,520

THANKS.  
>> GIVEN THE SCHEDULES THAT THE

481

00:32:14,520 --> 00:32:17,200

INSTRUMENTS PROVIDED US AND THE  
TIME THEY NEED, THEY CAN BE

482

00:32:17,200 --> 00:32:21,570

READY IN THE EARLY 2020s.  
THAT'S ALSO DEPENDING UPON HOW

483

00:32:21,570 --> 00:32:25,570

MUCH MONEY IS IN THE BUDGET FOR  
US TO GIVE THEM FOR THAT WORK.

484

00:32:25,570 --> 00:32:28,970

>> OKAY.  
WE'LL TAKE ONE MORE QUESTION

485

00:32:28,970 --> 00:32:31,539

FROM THE PHONE LINES.  
THIS IS FROM MIKE WAHL OF

486

00:32:31,539 --> 00:32:34,019

SPACE.COM.  
MIKE?

487

00:32:34,019 --> 00:32:47,710

>> THANKS FOR DOING THIS.  
COULD ANY OF THESE INSTRUMENTS

488

00:32:47,710 --> 00:32:54,690

THEORETICALLY FIND SOME SIGNS OF  
ALIEN LIFE IF ANY DOES EXIST ON

489

00:32:54,690 --> 00:32:57,440

EUROPA?  
IF THAT'S THE CASE, WHAT SORTS

490

00:32:57,440 --> 00:33:03,739

OF THINGS COULD IT BE CAPABLE OF  
PICKING UP?

491

00:33:03,739 --> 00:33:08,799

>> THAT'S A GREAT QUESTION.  
THEY COULD FIND INDICATIONS OF

492

00:33:08,799 --> 00:33:12,070

LIFE, BUT THEY'RE NOT LIFE  
DETECTORS.

493

00:33:12,070 --> 00:33:15,149

IN DISCUSSING THIS QUESTION OVER  
THE PAST SEVERAL MONTHS WHAT

494

00:33:15,149 --> 00:33:19,960

BECAME CLEAR IS THAT WE DON'T  
HAVE A LIFE DETECTOR.

495

00:33:19,960 --> 00:33:22,720

WE CURRENTLY DON'T EVEN HAVE  
CONSENSUS AMONG THE SCIENTIFIC

496

00:33:22,720 --> 00:33:26,260

COMMUNITY AS WHAT WE WOULD  
MEASURE THAT WOULD TELL

497

00:33:26,260 --> 00:33:29,510

EVERYBODY WITH CONFIDENCE THIS  
THING YOU'RE LOOKING AT IS

498

00:33:29,510 --> 00:33:32,679

ALIVE.  
SO, BUILDING A LIFE DETECTOR IS

499

00:33:32,679 --> 00:33:35,270

INCREDIBLY DIFFICULT.  
WE'RE NOT REALLY SURE HOW GO

500

00:33:35,270 --> 00:33:38,590

ABOUT BUILDING IT YET.  
BUT IT'S SOMETHING THAT HAS

501  
00:33:38,590 --> 00:33:45,070  
RECEIVED NEW INVESTIGATION, AND  
THAT'S SOMETHING WE WILL BE

502  
00:33:45,070 --> 00:33:52,399  
POKING INTO IN THE NEAR FUTURE.  
>> THANKS, CURT.

503  
00:33:52,399 --> 00:33:56,869  
NEXT QUESTION IS FROM KEN  
KRAEMER FROM UNIVERSE TODAY.

504  
00:33:56,869 --> 00:34:00,080  
>> Caller: THANK YOU FOR TAKING  
MY QUESTION AND DOING THIS

505  
00:34:00,080 --> 00:34:03,940  
BRIEFING.  
I HAVE A FEW QUESTIONS ABOUT THE

506  
00:34:03,940 --> 00:34:07,899  
SCIENCE INSTRUMENTS.  
ONE, I WONDERED, DEPENDING ON

507  
00:34:07,899 --> 00:34:11,239  
THE BUDGET, YOU COULD ADD MORE?  
ALSO, WONDERING ON THE MASS

508  
00:34:11,239 --> 00:34:21,989  
SPEC, CAN YOU TALK ABOUT WHAT IS  
THE MAX RANGE IT CAN DETECT?

509  
00:34:21,989 --> 00:34:28,940  
IS THERE A KYRO ANALYZER, AND  
HOW LONG ARE THE SPACE FLIGHTS?

510  
00:34:28,940 --> 00:34:31,639  
>> THE ISSUE WITH THE NUMBER OF  
INSTRUMENTS IS NOT REALLY MONEY,

511

00:34:31,639 --> 00:34:33,889

IT'S REAL ESTATE ON THE  
SPACECRAFT.

512

00:34:33,889 --> 00:34:41,989

YOU HAVE TO ROOM TO BOLT THEM  
ON, THE MASS AVAILABLE, AND THE

513

00:34:41,989 --> 00:34:46,489

POWER AVAILABLE TO TURN THEM ON.  
THOSE ARE THE PRIMARY

514

00:34:46,489 --> 00:34:51,019

CONSIDERATIONS THAT DRIVE THE  
SIZE OF THE PAYLOAD.

515

00:34:51,019 --> 00:34:55,989

YOU ASKED ABOUT THE MASS  
SPECTROMETER, THIS MEASURES FROM

516

00:34:55,989 --> 00:35:01,789

1 TO 1,000 DALTONS.  
THE CASSINI MASS SPECTROMETER IS

517

00:35:01,789 --> 00:35:07,640

BETWEEN 50 AND 100 DALTONS.  
THE MASS RESOLUTION OF THIS MASS

518

00:35:07,640 --> 00:35:13,489

SPECTROMETER IS PHENOMENAL.  
IT'S INCREDIBLY CAPABLE MASS

519

00:35:13,489 --> 00:35:18,339

SPECTROMETER.  
YOUR LAST QUESTION†-- WHAT WAS

520

00:35:18,339 --> 00:35:28,700

THE LAST QUESTION?  
ABOUT THE FLY-BY S, HOW MANY

521  
00:35:28,700 --> 00:35:30,809  
WOULD BE DOING.  
>> RIGHT NOW THE BASELINE

522  
00:35:30,809 --> 00:35:35,259  
MISSION WE'RE LOOKING AT ABOUT  
45 FLYBYS OF EUROPA.

523  
00:35:35,259 --> 00:35:39,229  
>> THANKS, CURT.  
NOW LET'S TAKE SOME QUESTIONS

524  
00:35:39,229 --> 00:35:44,039  
FROM SOCIAL MEDIA.  
HERE IS JASON TOWNSEND.

525  
00:35:44,039 --> 00:35:47,180  
WHAT KIND OF QUESTIONS ARE WE  
GETTING ON SOCIAL MEDIA TODAY,

526  
00:35:47,180 --> 00:35:50,940  
JASON?  
>> A WIDE VARIETY.

527  
00:35:50,940 --> 00:35:53,809  
CASEY DRYER ASKS HOW DOES THE  
MASS RESOLUTION OF MASS

528  
00:35:53,809 --> 00:35:58,739  
SPECTROMETER COMPARE TO CASSINI  
AND WHAT CAN THIS DETECT THAT

529  
00:35:58,739 --> 00:36:08,369  
CASSINI CAN'T?  
>> I WON'T BORE YOU WITH THE

530  
00:36:08,369 --> 00:36:12,729  
NUMBERS.  
THERE'S NOT MUCH OF A

531

00:36:12,729 --> 00:36:14,359

COMPARISON.

THE MASS SPECTROMETER FOR

532

00:36:14,359 --> 00:36:19,609

CASSINI WAS EXCELLENT FOR WHEN

IT WAS BUILT, THE EARLY 1990s.

533

00:36:19,609 --> 00:36:23,369

THE MASS SPECTROMETER WE

SELECTED TODAY IS VERY ADVANCED,

534

00:36:23,369 --> 00:36:26,489

AND IT HAS BENEFITTED FROM A

SIGNIFICANT INVESTMENT FROM NASA

535

00:36:26,489 --> 00:36:32,160

OVER THE PAST FOUR YEARS.

SO THE MASS RESOLUTION FOR WHAT

536

00:36:32,160 --> 00:36:36,940

WE SELECTED BLOWS EVERYTHING

ELSE OUT OF THE WATER.

537

00:36:36,940 --> 00:36:42,829

THAT'S WHY WE SELECTED IT.

>> NEXT QUESTION COMES FROM

538

00:36:42,829 --> 00:36:46,769

JASON MAJOR WHO ASKS WHAT ARE

THE ANTICIPATED LAUNCH DATE FOR

539

00:36:46,769 --> 00:36:49,099

THE EUROPA MISSION?

HOW LONG WOULD THE TRIP TAKE?

540

00:36:49,099 --> 00:36:55,459

HOW LONG COULD THE MISSION RUN?

>> RIGHT NOW, ONCE WE MOVE INTO

541

00:36:55,459 --> 00:37:00,400

FORMULATION, WE EXPECT IT TO BE  
LAUNCHED IN THE 2020s.

542

00:37:00,400 --> 00:37:03,630

WHETHER IT'S MID OR EARLY OR  
LATER.

543

00:37:03,630 --> 00:37:08,200

THAT NEEDS TO BE WORKED OUT  
BASED ON A MUCH FIRMER COST

544

00:37:08,200 --> 00:37:12,099

ESTIMATE AND A PROFILE THAT  
WOULD SUPPORT IT.

545

00:37:12,099 --> 00:37:15,229

THAT'S WHAT FORMULATION IS ALL  
ABOUT.

546

00:37:15,229 --> 00:37:17,660

PUTTING ALL THOSE RESOURCES  
TOGETHER AND GETTING SERIOUS

547

00:37:17,660 --> 00:37:20,259

ABOUT A MAJOR DESIGN AS WE MOVE  
FORWARD.

548

00:37:20,259 --> 00:37:23,430

>> ALL RIGHT.

THIS NEXT QUESTION COMES FROM

549

00:37:23,430 --> 00:37:26,529

TWITTER USER BRADLEY.

WHAT DROVE THE DECISION TO GO

550

00:37:26,529 --> 00:37:29,190

STRAIGHT TO A NINE-INSTRUMENT  
MISSION COMPLIMENT AND SKIP A

551  
00:37:29,190 --> 00:37:37,119  
PHASE A?  
>> ORIGINALLY WE CONSIDERED A

552  
00:37:37,119 --> 00:37:39,390  
TWO-STEP PROCESS.  
WHICH MEANS IF YOU'RE GOING TO

553  
00:37:39,390 --> 00:37:44,019  
FLY ONE CAMERA YOU SELECT TWO OR  
THREE OR FOUR OF THEM.

554  
00:37:44,019 --> 00:37:47,140  
AND YOU GIVE THEM SOME MONEY AND  
TIME TO DO SOME WORK TO REDUCE

555  
00:37:47,140 --> 00:37:49,049  
THEIR RISK.  
ADDRESS THE TECHNICAL

556  
00:37:49,049 --> 00:37:51,680  
CHALLENGES.  
WHAT WE FOUND WHEN WE REVIEWED

557  
00:37:51,680 --> 00:37:55,049  
THESE PROPOSALS IS IN EVERY  
CATEGORY OF INSTRUMENT THAT WE

558  
00:37:55,049 --> 00:37:59,069  
WANTED TO FLY, ONE WAS READY TO  
GO NOW.

559  
00:37:59,069 --> 00:38:02,049  
IN MOST CASE THERE'S WERE MORE  
THAN ONE THAT WERE READY TO GO

560  
00:38:02,049 --> 00:38:03,509  
NOW.  
SO WE DIDN'T HAVE ANY

561

00:38:03,509 --> 00:38:06,170  
INSTRUMENTS THAT NEEDED  
ADDITIONAL WORK.

562

00:38:06,170 --> 00:38:09,950  
WE HAD INSTRUMENTS READY TO MOVE  
INTO FORMULATION NOW WITH A HIGH

563

00:38:09,950 --> 00:38:12,839  
DEGREE OF CONFIDENCE THEY WOULD  
BE READY FOR FLIGHT IN THE

564

00:38:12,839 --> 00:38:15,400  
2020s.  
>> I THINK PART OF THAT IS

565

00:38:15,400 --> 00:38:18,749  
BECAUSE WE DID INVEST OVER THE  
PAST FEW YEARS IN A TECHNOLOGY

566

00:38:18,749 --> 00:38:23,469  
PROGRAM FOR ICY WORLDS TO BE  
READY FOR THIS NEXT STEP.

567

00:38:23,469 --> 00:38:27,209  
WE FOUND THAT'S BEEN HIGHLY  
VALUABLE AND ALLOWED US TO GO TO

568

00:38:27,209 --> 00:38:33,069  
A ONE-STEP PROCESS.  
>> NEXT QUESTION FROM THE

569

00:38:33,069 --> 00:38:36,729  
USTREAM USER, SERGIO.  
ARE LASER COMMUNICATIONS GOING

570

00:38:36,729 --> 00:38:41,190  
TO BE USED IN THIS MISSION?  
CURRENTLY THE BASELINE MISSION

571

00:38:41,190 --> 00:38:46,999

DOES NOT USE LASER COMMUNICATION  
THAT WOULD BE DEEP SPACE OPTICAL

572

00:38:46,999 --> 00:38:49,559

COME.  
REALLY DEEP.

573

00:38:49,559 --> 00:38:51,809

WE TESTED IT FROM HERE TO THE  
MOON.

574

00:38:51,809 --> 00:38:57,259

WE HAVE NOT TESTED DEEP SPACE  
OPTICAL COM FROM HERE TO MARS.

575

00:38:57,259 --> 00:39:02,339

JUPITER IS AT FIVE ASTRONOMICAL  
UNITS AWAY, THE EARTH IS ONE

576

00:39:02,339 --> 00:39:08,719

ASTRONOMICAL UNIT AWAY.  
WE HAVE A LOT OF WORK TO DO TO

577

00:39:08,719 --> 00:39:13,119

UTILIZE OPTICAL COMMUNICATION  
FOR THE OUTER PLANET DARE

578

00:39:13,119 --> 00:39:17,019

MISSIONS.  
THAT'S A WONDERFUL†SET OF

579

00:39:17,019 --> 00:39:26,390

TECHNOLOGIES WE WOULD LOVE, AND  
MISS DIRECTORATE IS WORKING WITH

580

00:39:26,390 --> 00:39:31,420

US IN THIS AREA, BUT THE NEXT  
STOP IS PROBABLY MARS RATHER

581

00:39:31,420 --> 00:39:34,049

THAN EUROPA FOR DEEP SPACE  
OPTICAL COM.

582

00:39:34,049 --> 00:39:39,069

>> ONE OF THE CHALLENGES TO KEEP  
IN MIND WHEN WE GO DO EUROPA IS

583

00:39:39,069 --> 00:39:49,319

JUPITER'S MAG IN THEIC FIELD  
IS†-- THERE'S A JUPITER WIND.

584

00:39:49,319 --> 00:39:53,259

AS WE LOOK AT TECHNOLOGIES TO  
SUPPORT THE MISSION, WE WANT TO

585

00:39:53,259 --> 00:39:57,019

TAKE LOW-RISK ON THE SPACECRAFT,  
SO THAT WE CAN PUT MOST OF OUR

586

00:39:57,019 --> 00:40:00,119

EFFORT INTO THE INSTRUMENTS  
WHICH ALSO HAVE TO SURVIVE IN

587

00:40:00,119 --> 00:40:04,119

THAT HIGH RADIATION ENVIRONMENT.  
LASER COM IS PROBABLY EARLY FOR

588

00:40:04,119 --> 00:40:07,640

EUROPA.

>> THANKS, LET'S TAKE TWO

589

00:40:07,640 --> 00:40:12,989

QUESTIONS FROM PHONE LINES.  
THE FIRST QUESTION WE HAVE IS

590

00:40:12,989 --> 00:40:16,890

FROM MIKE DELFIORE FROM POPULAR  
MECHANICS.

591

00:40:16,890 --> 00:40:23,430

MIKE?

>> Caller: I WANTED TO FOLLOW UP

592

00:40:23,430 --> 00:40:24,949

ON THE MISSION DURATION, THE LENGTH.

593

00:40:24,949 --> 00:40:27,039

YOU MENTIONED 45 FLYBYS.  
HOW LONG MIGHT IT TAKE?

594

00:40:27,039 --> 00:40:32,150

I'M ALSO INTERESTED IN WHERE THE INSTRUMENTS ARE BEING BUILT AND

595

00:40:32,150 --> 00:40:36,739

WHEN THEY WILL START BEING BUILT.

596

00:40:36,739 --> 00:40:40,039

>> MISSION DURATION, ONCE WE GET TO JUPITER, WE'LL SPEND ABOUT

597

00:40:40,039 --> 00:40:44,239

2½ YEARS DOING THOSE 45 FLYBYS.

598

00:40:44,239 --> 00:40:49,369

AT THE FASTEST PACE, A FLYBY EVERY TWO, TWO TO THREE WEEKS.

599

00:40:49,369 --> 00:40:51,809

IN TERMS OF WHERE THE INSTRUMENTS ARE BEING BUILT IT

600

00:40:51,809 --> 00:40:54,579

RUNS THE GAMUT.  
IT SPANS THE COUNTRY.

601  
00:40:54,579 --> 00:40:58,479  
WE HAVE INSTRUMENTS BEING BUILT  
ON THE WEST COAST AT NASA

602  
00:40:58,479 --> 00:41:00,739  
CENTERS.  
WE HAVE INSTRUMENTS BEING BUILT

603  
00:41:00,739 --> 00:41:06,279  
AT†-- IN UNIVERSITY LABS.  
INSTRUMENTS BEING BUILT IN

604  
00:41:06,279 --> 00:41:11,579  
FEDERAL RESEARCH LABS AS WELL.  
IT REALLY SPANS THE COUNTRY.

605  
00:41:11,579 --> 00:41:14,869  
WHEN WILL THEY BE BUILT?  
AS FAR AS I'M CONCERNED, THEY

606  
00:41:14,869 --> 00:41:18,660  
START TOMORROW.  
THEY WILL BE WORKING VERY HARD

607  
00:41:18,660 --> 00:41:22,420  
EVERY SINGLE DAY UNTIL WE GET  
THIS MISSION TO THE LAUNCHPAD.

608  
00:41:22,420 --> 00:41:24,949  
THEN THEY WILL START WORKING  
HARDER, THEN WE NEED TO START

609  
00:41:24,949 --> 00:41:27,859  
FLYING THESE INSTRUMENTS AND  
FLYING THEM.

610  
00:41:27,859 --> 00:41:33,069  
>> ONE THING TO UNDERSTAND ABOUT  
THE ARCHITECTURE IS THE MULTIPLE

611  
00:41:33,069 --> 00:41:36,630  
FLYBY CONCEPT.  
THIS PARTICULAR MISSION WE ARE

612  
00:41:36,630 --> 00:41:40,369  
MOVING TOWARDS TO STAY OUT OF  
THE RADIATION BELT AND ONLY BE

613  
00:41:40,369 --> 00:41:48,809  
IN IT AS WE NEED TO, ACTUALLY  
ORBITS JUPITER ITSELF.

614  
00:41:48,809 --> 00:41:53,190  
AS IT FLIES BY, IT TAKES A  
MASSIVE AMOUNT OF DATA.

615  
00:41:53,190 --> 00:41:57,180  
AS IT MOVES OUT OF THE RADIATION  
BELT AND IS CLEAR, IT THEN

616  
00:41:57,180 --> 00:42:01,369  
BEGINS TO SEND THAT DATA BACK IN  
FULL RESOLUTION.

617  
00:42:01,369 --> 00:42:05,910  
THIS IS REALLY A SPECTACULAR WAY  
OF MANAGING THE DATA.

618  
00:42:05,910 --> 00:42:09,459  
IT ALLOWS THE SCIENTIST TO GET  
ALL THE DETAILS TO TEASE OUT

619  
00:42:09,459 --> 00:42:15,910  
EVERYTHING WE WANT.  
IT ALLOWS THE PLUME CHASER TO

620  
00:42:15,910 --> 00:42:20,130  
CONTINUE TO LOOK AT EUROPA AND  
FIND POTENTIAL PLUMES THAT ON

621

00:42:20,130 --> 00:42:24,019

THE NEXT PASS WE COULD  
POTENTIALLY FLY THROUGH.

622

00:42:24,019 --> 00:42:30,479

SO THE ARCHITECTURE IS SET SUCH  
THAT WE MAXIMIZE THAT TIME WHEN

623

00:42:30,479 --> 00:42:34,380

WE'RE AWAY FROM EUROPA BY  
GETTING SET UP AND ALIGNING

624

00:42:34,380 --> 00:42:39,309

OURSELVES AGAIN FOR THE NEXT FLY  
BY TO MAXIMIZE THE SCIENCE THAT

625

00:42:39,309 --> 00:42:43,059

WE WANT TO DO.

>> THANKS JIM.

626

00:42:43,059 --> 00:42:46,569

ONE MORE QUESTION FROM THE PHONE  
LINES.

627

00:42:46,569 --> 00:42:52,209

THIS IS IRENE FROM REUTERS.

>> Caller: THANKS, COULD YOU

628

00:42:52,209 --> 00:42:57,160

ELABORATE A BIT ON WHAT YOU  
WOULD CONSIDER INDICATIONS OF

629

00:42:57,160 --> 00:43:00,769

LIFE WITH THE SUITE OF  
INSTRUMENTS SELECTED?

630

00:43:00,769 --> 00:43:05,759

WHAT SORTS OF THINGS MIGHT BE  
INDICATIVE OF LIFE?

631

00:43:05,759 --> 00:43:10,839

ALSO, IS THERE ROOM ON BOARD THE  
SPACECRAFT FOR ALL NINE OF THESE

632

00:43:10,839 --> 00:43:16,819

INSTRUMENTS TO FLY OR WOULD SOME  
NEED TO BE ELIMINATED?

633

00:43:16,819 --> 00:43:19,079

>> I'LL TAKE YOUR EASIER  
QUESTION FIRST.

634

00:43:19,079 --> 00:43:20,940

YES, THERE'S ROOM ON THE  
SPACECRAFT FOR ALL NINE

635

00:43:20,940 --> 00:43:25,099

INSTRUMENTS WE SELECTED.  
THAT WAS ONE OF THE CRITERIA WE

636

00:43:25,099 --> 00:43:27,180

LOOKED AT WHEN WE MADE THE  
SELECTIONS.

637

00:43:27,180 --> 00:43:30,229

YOUR FIRST QUESTION ABOUT WHAT  
ARE SOME OF THE POSSIBLE SIGNS

638

00:43:30,229 --> 00:43:33,729

OF LIFE WE MIGHT BE ABLE TO  
DETECT, IT'S A DIFFICULT

639

00:43:33,729 --> 00:43:37,579

QUESTION.  
BECAUSE WE'RE NOT SURE WHAT

640

00:43:37,579 --> 00:43:40,309

THOSE SIGNS WOULD BE.  
IT WOULD BE WONDERFUL IF WE

641

00:43:40,309 --> 00:43:42,789

COULD SEE CHLOROPHYLL LIKE YOU  
SEE IN EARTH PLANTS.

642

00:43:42,789 --> 00:43:44,869

BUT WE'RE NOT GOING TO BE SEEING  
CHLOROPHYLL.

643

00:43:44,869 --> 00:43:47,680

MOTHER NATURE WILL NOT BE THAT  
KIND TO US.

644

00:43:47,680 --> 00:43:50,900

IT WOULD BE GREAT TO SEE  
FOSSILIZED BONES STICKING UP OUT

645

00:43:50,900 --> 00:43:55,619

OF THE SURFACE.  
THAT'S NOT GOING TO HAPPEN.

646

00:43:55,619 --> 00:44:01,180

FINDING LIFE IS NUANCED,  
DELICATE, DIFFICULT TO DO.

647

00:44:01,180 --> 00:44:05,239

EVEN IF YOU GO OUT TO A LAKE OR  
EARTH'S OCEAN AND GRAB A SCOOP

648

00:44:05,239 --> 00:44:11,299

OF WATER, SIGNS OF LIFE DON'T  
IMMEDIATELY JUMP OUT AT YOU.

649

00:44:11,299 --> 00:44:14,359

IT'S GOING TO TAKE SOME VERY  
SMART PEOPLE SITTING AROUND

650

00:44:14,359 --> 00:44:17,959

WORKING TOGETHER OVER THE NEXT  
COUPLE OF YEARS TO BUILD UPON

651  
00:44:17,959 --> 00:44:21,799  
THE WORK THAT'S ALREADY BEEN  
DONE TO EDUCATE US IN THIS AREA.

652  
00:44:21,799 --> 00:44:24,839  
>> THANK YOU.  
NOW LET'S TAKE A FEW QUESTIONS

653  
00:44:24,839 --> 00:44:26,779  
FROM SOCIAL MEDIA.  
JASON?

654  
00:44:26,779 --> 00:44:29,099  
>> SURE.  
TWITTER USER DAVE ASKS ARE THERE

655  
00:44:29,099 --> 00:44:33,599  
ANY INSTRUMENTS FROM THIS  
PAYLOAD THAT COULD WORK FROM THE

656  
00:44:33,599 --> 00:44:38,079  
ISIS†JUICE MISSION?  
>> YES, THERE ARE.

657  
00:44:38,079 --> 00:44:41,749  
THE ULTRAVIOLET INSTRUMENT WE  
SELECTED IS A CONTRIBUTION THAT

658  
00:44:41,749 --> 00:44:44,559  
NASA IS ALSO MAKING TO THE JUICE  
PAYLOAD.

659  
00:44:44,559 --> 00:44:48,249  
THEY'RE SIMILAR INSTRUMENTS.  
SO THERE IS OVERLAP AMONG BOTH

660  
00:44:48,249 --> 00:44:51,660  
OF THE PAYLOADS.  
THEY COMPLIMENT EACH OTHER

661  
00:44:51,660 --> 00:44:53,519  
STRONGLY.  
IT'S IMPORTANT TO KEEP IN MIND

662  
00:44:53,519 --> 00:44:58,739  
THAT THE JUICE MISSION IS  
FOCUSED ON GANAMEDE AND

663  
00:44:58,739 --> 00:45:08,150  
CALLISTO.  
WE WILL BE FLYING BY EUROPA 45

664  
00:45:08,150 --> 00:45:13,420  
TIMES OR MORE.  
>> THIS NEXT QUESTION COMES FROM

665  
00:45:13,420 --> 00:45:17,069  
DR. LEO HERE WHO ASKED WHAT KIND  
OF PROPULSION AND CRAFT WILL

666  
00:45:17,069 --> 00:45:20,539  
TAKE THE INSTRUMENTS MENTIONED  
TO EUROPA?

667  
00:45:20,539 --> 00:45:24,459  
ADDITIONALLY CROW ASKS WHAT WILL  
BE THE POWER SOURCE FOR THE

668  
00:45:24,459 --> 00:45:29,709  
SPACECRAFT?  
>> THE SPACECRAFT WILL BE SOLAR

669  
00:45:29,709 --> 00:45:32,799  
POWERED.  
WE WILL HAVE SOLAR PANELS ON

670  
00:45:32,799 --> 00:45:36,180  
THIS MISSION, LIKE WE DO FOR THE  
JUNO MISSION WHICH WILL REACH

671

00:45:36,180 --> 00:45:42,829

JUPITER IN ABOUT A YEAR.

IT WILL BE CHEMICAL PROPULSION.

672

00:45:42,829 --> 00:45:46,180

STANDARD PROPULSION SYSTEMS THAT

NASA USES FOR THE MAJORITY OF

673

00:45:46,180 --> 00:45:50,579

ITS SCIENCE MISSIONS.

WE WILL BURN THE ENGINE HARD,

674

00:45:50,579 --> 00:45:53,369

HOT, AND GET THERE AS FAST AS WE

CAN.

675

00:45:53,369 --> 00:45:56,739

>> THE NEXT QUESTION FROM

TWITTER USER RYAN.

676

00:45:56,739 --> 00:46:00,109

IS ANYTHING ACTUALLY LANDING?

IF SO, WILL IT BE ABLE TO SEND A

677

00:46:00,109 --> 00:46:08,529

PROBE INTO THE OCEAN?

>> AT THIS STAGE, WE ARE DOING

678

00:46:08,529 --> 00:46:13,789

SOME STUDIES, VERY ELEMENTARY

STUDIES ABOUT LANDING MISSIONS.

679

00:46:13,789 --> 00:46:18,440

IN PLANETARY SCIENCE WE MAKE A

VERY IMPORTANT PROGRESSION OF

680

00:46:18,440 --> 00:46:22,239

FLYBY, ORBIT, LAND, ROVE, RETURN

SAMPLES.

681

00:46:22,239 --> 00:46:27,069

WE DO THAT IN A DELIBERATE WAY.  
THOUGH GALILEO GAVE US THE

682

00:46:27,069 --> 00:46:31,469

TANTALIZING GLIMPSES OF WHAT  
EUROPA IS LIKE, THE MULTIPLE

683

00:46:31,469 --> 00:46:37,670

FLYBYS WILL GIVE US A GLOBAL  
UNDERSTANDING.

684

00:46:37,670 --> 00:46:41,529

TO BE ABLE TO GET DOWN TO THE  
SURFACE IS A HUGE STEP AFTER

685

00:46:41,529 --> 00:46:45,299

THAT.  
WE DON'T REALLY KNOW IN ANY

686

00:46:45,299 --> 00:46:51,999

DETAIL ABOUT HOW HARD IT IS TO  
LAND ON A VERY CORRUGATED

687

00:46:51,999 --> 00:46:54,660

SURFACE OR WHERE WE WOULD NEED  
TO GO.

688

00:46:54,660 --> 00:46:57,779

WE HAVE AN EXTENSIVE AMOUNT OF  
RESEARCH TO DO IN THAT

689

00:46:57,779 --> 00:47:00,890

PARTICULAR AREA.  
THOUGH WE'RE STUDYING THAT AT

690

00:47:00,890 --> 00:47:03,989

MOMENT, THE RESULTS OF THOSE  
STUDIES WON'T BE KNOWN TO US

691  
00:47:03,989 --> 00:47:07,709  
UNTIL LATER THIS YEAR.  
>> I THINK IT'S IMPORTANT TO

692  
00:47:07,709 --> 00:47:11,339  
KEEP IN MIND, I MENTIONED THAT  
GALILEO GAVE US A LIMITED AMOUNT

693  
00:47:11,339 --> 00:47:13,729  
OF PICTURES OF THE SURFACE OF  
EUROPA.

694  
00:47:13,729 --> 00:47:16,539  
WE ACTUALLY DON'T KNOW WHAT THE  
SURFACE OF EUROPA LOOKS LIKE AT

695  
00:47:16,539 --> 00:47:23,959  
THE SCALE OF THIS TABLE, IF IT'S  
SMOOTH, ROUGH, FULL OF SPIKES

696  
00:47:23,959 --> 00:47:27,430  
WITHOUT KNOWING WHAT THE SURFACE  
EVEN LOOKS LIKE, IT'S DIFFICULT

697  
00:47:27,430 --> 00:47:30,410  
TO DESIGN A LANDER THAT COULD  
SURVIVE.

698  
00:47:30,410 --> 00:47:33,740  
THAT'S SOMETHING WE HAVE TO TAKE  
INTO ACCOUNT AS WELL.

699  
00:47:33,740 --> 00:47:38,390  
>> FOLLOWING UP ON THAT, ANOTHER  
USER ASKS WILL THERE BE ANY

700  
00:47:38,390 --> 00:47:43,069  
ROBOTIC MISSION TO EUROPA IN THE  
FUTURE TO EXPLORE LIFE?

701

00:47:43,069 --> 00:47:50,849

>> YEAH, IT WOULD BE GREAT TO  
THINK THE RESULTS FROM THIS

702

00:47:50,849 --> 00:47:55,699

PARTICULAR WOULD LEAD IN THE  
NEXT DECADE TO NEW AND EXCITING

703

00:47:55,699 --> 00:47:58,719

CONCEPTS ABOUT POTENTIALLY  
GETTING UNDERNEATH THE ICE

704

00:47:58,719 --> 00:48:02,339

SHELL.  
ONCE AGAIN, WE NEED TO REALLY

705

00:48:02,339 --> 00:48:10,799

MAKE THOSE METHODOICAL STEPS TO  
DETERMINE IF THIS BODY CAN BE

706

00:48:10,799 --> 00:48:15,799

PENETRATED IN A WAY TO GET UNDER  
THE ICE SHELL.

707

00:48:15,799 --> 00:48:20,309

THAT'S, INDEED, IN THE DISTANT  
FUTURE.

708

00:48:20,309 --> 00:48:23,739

>> LAST QUESTION FROM JASON  
MAJOR, WOULD THIS EUROPA MISSION

709

00:48:23,739 --> 00:48:26,609

BE ABLE TO ACQUIRE INFORMATION  
ON OTHER MOONS AND JUPITER AS

710

00:48:26,609 --> 00:48:32,829

WELL?  
>> IT CAN.

711

00:48:32,829 --> 00:48:36,880

THESE INSTRUMENTS ARE FAIRLY  
VERSATILE.

712

00:48:36,880 --> 00:48:39,799

THEY'RE VERY MUCH DESIGNED TO  
OPERATE ON THAT THAT FLYBY MODE

713

00:48:39,799 --> 00:48:45,660

JIM MENTIONED THIS IS THE MF  
MISSION.

714

00:48:45,660 --> 00:48:49,079

IF WE CHOOSE TO POINT THE  
SPACECRAFT AT OTHER TARGETS LIKE

715

00:48:49,079 --> 00:48:53,519

GANYMEDE OR CALISTO, THESE  
INSTRUMENTS WOULD WORK THERE AS

716

00:48:53,519 --> 00:48:56,880

WELL.  
THAT'S ALL THE TIME WE HAVE LEFT

717

00:48:56,880 --> 00:48:58,869

FOR TODAY.  
KEEP THOSE QUESTIONS COMING

718

00:48:58,869 --> 00:49:02,689

WITH #ASKNASA.  
ALL THE INFORMATION YOU HEARD

719

00:49:02,689 --> 00:49:06,739

TODAY AND MORE IS AVAILABLE AT  
GO.NASA.GOLF/EUROPANEWS.

720

00:49:06,739 --> 00:49:12,689

THANK YOU ALL.  
ALL THE PANELISTS FOR JOINING

