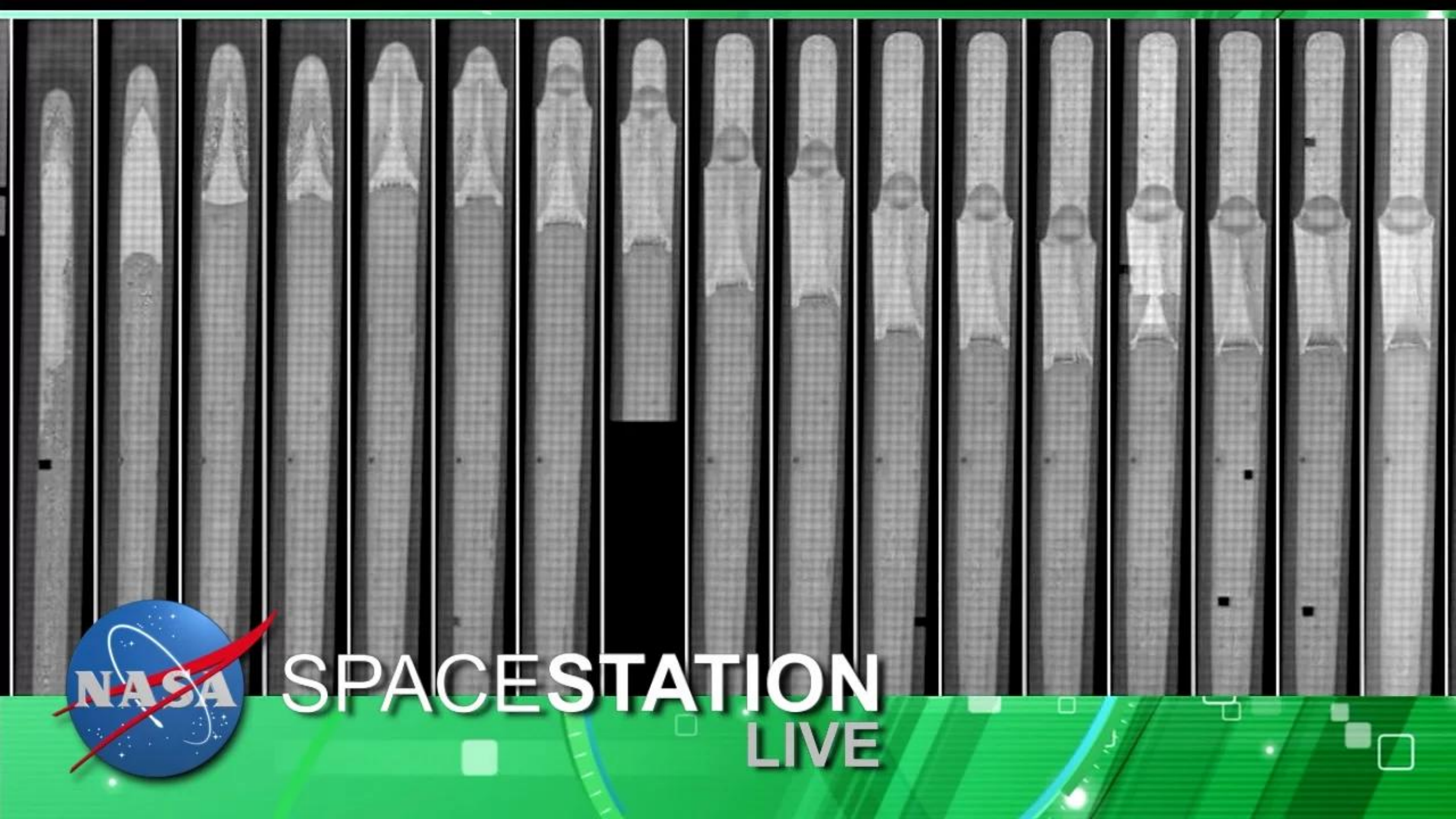
NASA
SPACESTATION
LIVE

1
00:00:15,990 --> 00:00:13,990
scientists are looking to use heat pipes

2
00:00:17,990 --> 00:00:16,000
ins to distribute cooling fluid instead

3
00:00:20,230 --> 00:00:18,000
of mechanical pumps not just on orbit

4
00:00:22,470 --> 00:00:20,240
but also here on earth now this study on

5
00:00:24,470 --> 00:00:22,480
the space station is called constrained

6
00:00:26,150 --> 00:00:24,480
vapor bubble and what is learned could

7
00:00:27,189 --> 00:00:26,160
lead to better designs of high-tech

8
00:00:29,029 --> 00:00:27,199
devices

9
00:00:30,870 --> 00:00:29,039
our space station colleague and

10
00:00:32,630 --> 00:00:30,880
commentator lori meigs caught up with

11
00:00:34,389 --> 00:00:32,640
the co-investigators to learn more about

12
00:00:36,470 --> 00:00:34,399
this study

13
00:00:39,190 --> 00:00:36,480

one way to describe it is well first it

14
00:00:41,990 --> 00:00:39,200
has two aspects it has a basic science

15
00:00:45,510 --> 00:00:42,000
interfacial phenomena study and it's

16
00:00:47,510 --> 00:00:45,520
also an applied study so just quickly to

17
00:00:50,229 --> 00:00:47,520
give you some idea if you take a

18
00:00:52,869 --> 00:00:50,239
capillary tube on earth put it in a

19
00:00:55,189 --> 00:00:52,879
liquid the liquid does not go up the

20
00:00:57,990 --> 00:00:55,199
capillary tube very far

21
00:01:00,389 --> 00:00:58,000
in our case we have a capillary tube

22
00:01:02,869 --> 00:01:00,399
that has a square cross section with

23
00:01:05,030 --> 00:01:02,879
sharp corners in that case the fluid

24
00:01:07,590 --> 00:01:05,040
would go further up the capillary tube

25
00:01:10,310 --> 00:01:07,600
but not very far on earth

26
00:01:12,390 --> 00:01:10,320
because of gravity

27
00:01:13,910 --> 00:01:12,400
now if you were to take this into

28
00:01:15,590 --> 00:01:13,920
microgravity

29
00:01:18,390 --> 00:01:15,600
all of a sudden it doesn't have to

30
00:01:20,550 --> 00:01:18,400
overcome gravity and it would keep going

31
00:01:23,190 --> 00:01:20,560
until it emptied the bottle

32
00:01:24,630 --> 00:01:23,200
now that fluid can flow towards a heat

33
00:01:29,510 --> 00:01:24,640
source

34
00:01:31,749 --> 00:01:29,520
you get evaporation

35
00:01:34,789 --> 00:01:31,759
where you get the cooling

36
00:01:37,270 --> 00:01:34,799
now in our device it's closed and it's

37
00:01:39,749 --> 00:01:37,280
under filled so you have a vapor bubble

38
00:01:42,870 --> 00:01:39,759

in there so the liquid is in the corner

39
00:01:45,910 --> 00:01:42,880
the vapor bubble is in the central part

40
00:01:48,550 --> 00:01:45,920
so at the hot end you get evaporation

41
00:01:50,789 --> 00:01:48,560
vapor flows down the center the vapor

42
00:01:54,069 --> 00:01:50,799
bubble to the cold end where it

43
00:01:56,709 --> 00:01:54,079
condenses and then is sucked back the

44
00:02:00,230 --> 00:01:56,719
big thing for microgravity in fact even

45
00:02:03,190 --> 00:02:00,240
on earth is you do not need a pump

46
00:02:06,469 --> 00:02:03,200
so you can have a cooling device

47
00:02:09,510 --> 00:02:06,479
evaporation condensation to cool

48
00:02:13,030 --> 00:02:09,520
something like a computer or some heat

49
00:02:14,309 --> 00:02:13,040
source in a satellite without a pump

50
00:02:16,150 --> 00:02:14,319
so you don't have to worry about the

51
00:02:18,150 --> 00:02:16,160
pump breaking down you don't have to

52
00:02:20,070 --> 00:02:18,160
worry about putting the pump up in

53
00:02:22,150 --> 00:02:20,080
microgravity

54
00:02:24,390 --> 00:02:22,160
and it wasn't as you thought right some

55
00:02:26,229 --> 00:02:24,400
surprising results oh yeah yeah there

56
00:02:28,229 --> 00:02:26,239
were a lot of mathematical models that

57
00:02:30,630 --> 00:02:28,239
have been developed to explain heat pipe

58
00:02:33,030 --> 00:02:30,640
performance but all the models are in

59
00:02:35,750 --> 00:02:33,040
essence approximations to what would

60
00:02:38,309 --> 00:02:35,760
occur and so when we ran the experiment

61
00:02:40,790 --> 00:02:38,319
in microgravity we got a lot of

62
00:02:43,270 --> 00:02:40,800
unexpected results on one hand several

63
00:02:44,710 --> 00:02:43,280

years ago we observed boiling in a heat

64
00:02:47,270 --> 00:02:44,720
pipe that shouldn't have actually

65
00:02:49,990 --> 00:02:47,280
existed at the extent that we

66
00:02:52,150 --> 00:02:50,000
observed it and then this past year we

67
00:02:53,990 --> 00:02:52,160
sort of finally understood what the

68
00:02:55,110 --> 00:02:54,000
images were that were coming down from

69
00:02:58,470 --> 00:02:55,120
iss

70
00:03:01,110 --> 00:02:58,480
in our experiment as you put more heat

71
00:03:02,830 --> 00:03:01,120
into a heat pipe all the models and

72
00:03:05,030 --> 00:03:02,840
people's experience from measure and

73
00:03:07,990 --> 00:03:05,040
temperatures says that the hot end

74
00:03:09,830 --> 00:03:08,000
should actually dry out of and b and the

75
00:03:12,229 --> 00:03:09,840
liquid should be removed basically from

76
00:03:15,430 --> 00:03:12,239
the dry end and what we observed up on

77
00:03:17,350 --> 00:03:15,440
iss was exactly the opposite behavior we

78
00:03:19,830 --> 00:03:17,360
started to suck liquid all the way up

79
00:03:21,030 --> 00:03:19,840
and basically we flooded the hot end

80
00:03:22,949 --> 00:03:21,040
if all we did was measure the

81
00:03:25,670 --> 00:03:22,959
temperature profile to temperature

82
00:03:27,430 --> 00:03:25,680
profiles indistinguishable between dry

83
00:03:30,149 --> 00:03:27,440
out and this flooding phenomena so it

84
00:03:32,309 --> 00:03:30,159
was only in going into microgravity and

85
00:03:34,390 --> 00:03:32,319
actually being able to map the entire

86
00:03:36,309 --> 00:03:34,400
liquid vapor interface that we could

87
00:03:38,630 --> 00:03:36,319
observe this phenomena and then

88
00:03:40,470 --> 00:03:38,640

understand the underlying interfacial

89
00:03:42,710 --> 00:03:40,480
phenomena and fluid mechanics that

90
00:03:43,589 --> 00:03:42,720
actually gave rise to why this would

91
00:03:46,390 --> 00:03:43,599
flood

92
00:03:48,550 --> 00:03:46,400
so as a professor you're thinking oh

93
00:03:50,149 --> 00:03:48,560
are you are you excited that you that it

94
00:03:52,470 --> 00:03:50,159
didn't do what you thought it it would

95
00:03:54,550 --> 00:03:52,480
do or are you

96
00:03:56,550 --> 00:03:54,560
um kind of disappointed that it wasn't

97
00:03:58,390 --> 00:03:56,560
as you thought well let's see it's very

98
00:04:00,550 --> 00:03:58,400
complicated emotionally first we were

99
00:04:02,309 --> 00:04:00,560
angry because when we observed it and it

100
00:04:04,070 --> 00:04:02,319
wasn't what we expected we thought the

101
00:04:06,789 --> 00:04:04,080
people that built it contaminated the

102
00:04:08,630 --> 00:04:06,799
device and the experiment was worthless

103
00:04:10,309 --> 00:04:08,640
then once we really understood that that

104
00:04:12,149 --> 00:04:10,319
wasn't the case of course you get

105
00:04:14,229 --> 00:04:12,159
excited to observe something that that

106
00:04:15,830 --> 00:04:14,239
no one had really predicted before and

107
00:04:17,590 --> 00:04:15,840
still can't really predict now

108
00:04:19,189 --> 00:04:17,600
mathematically so

109
00:04:20,870 --> 00:04:19,199
so how does that translate to us on

110
00:04:22,710 --> 00:04:20,880
earth what what what you have learned

111
00:04:25,110 --> 00:04:22,720
and what you've seen

112
00:04:27,909 --> 00:04:25,120
are there are applications to this

113
00:04:30,469 --> 00:04:27,919

well sure it it makes people rethink

114
00:04:32,230 --> 00:04:30,479
what might be going on in heat pipes

115
00:04:34,310 --> 00:04:32,240
they build since everybody builds a heat

116
00:04:35,990 --> 00:04:34,320
pipe with essentially a metal shell

117
00:04:37,590 --> 00:04:36,000
associated with it and so there may be

118
00:04:39,990 --> 00:04:37,600
flooding that's going on that people

119
00:04:42,550 --> 00:04:40,000
don't understand and it's up to us to

120
00:04:44,710 --> 00:04:42,560
analyze say our data and try and give

121
00:04:46,550 --> 00:04:44,720
them a temperature signal that would say

122
00:04:47,990 --> 00:04:46,560
that yeah your heat pipe is not drying

123
00:04:49,830 --> 00:04:48,000
out your heat pipe

124
00:04:52,390 --> 00:04:49,840
is flooding it can also bring about you

125
00:04:54,790 --> 00:04:52,400
know entirely new kinds of designs for

126
00:04:56,870 --> 00:04:54,800
the internals of heat pipes to prevent

127
00:04:59,670 --> 00:04:56,880
this flooding phenomena occurring and in

128
00:05:02,469 --> 00:04:59,680
cvb2 we tried one of those experiments

129
00:05:04,070 --> 00:05:02,479
by adding a small amount of a component

130
00:05:05,990 --> 00:05:04,080
that had a slightly higher surface

131
00:05:07,749 --> 00:05:06,000
tension and a slightly lower vapor

132
00:05:09,990 --> 00:05:07,759
pressure and it turned out that we could

133
00:05:11,990 --> 00:05:10,000
actually use that kind of process to

134
00:05:13,510 --> 00:05:12,000
sort of break the phenomena that we saw

135
00:05:15,670 --> 00:05:13,520
in cvb1

136
00:05:17,270 --> 00:05:15,680
we hope to fly some more experiments

137
00:05:20,070 --> 00:05:17,280
especially with

138
00:05:21,990 --> 00:05:20,080

higher ratios of liquid mixtures

139
00:05:23,909 --> 00:05:22,000
it's important not only for the

140
00:05:25,909 --> 00:05:23,919
development say of heat pipes but

141
00:05:28,230 --> 00:05:25,919
important for us as chemical engineers

142
00:05:30,469 --> 00:05:28,240
to understand say how the distillation

143
00:05:33,029 --> 00:05:30,479
process works and no one's ever really

144
00:05:35,670 --> 00:05:33,039
looked into distillation with the kind

145
00:05:37,510 --> 00:05:35,680
of characterization ability say that we