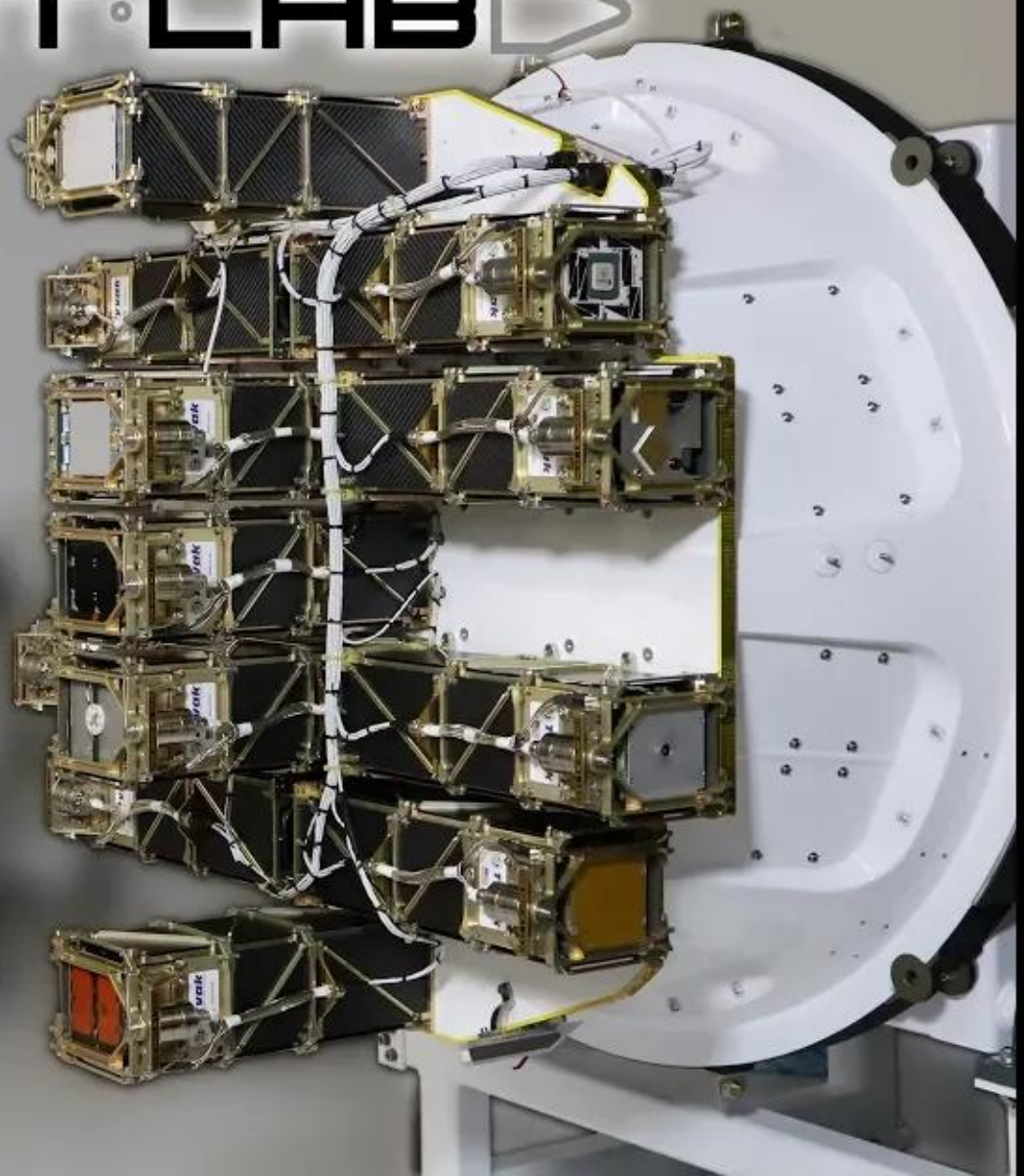
ROCKET LAB

NASA's Venture Class Launch of ELaNa XIX



1
00:00:20,240 --> 00:00:25,540
On a remote peninsula in the South Pacific,
a rocket and 10 small satellites are about

2
00:00:25,540 --> 00:00:28,800
to launch a new era in spaceflight.

3
00:00:28,810 --> 00:00:32,390
Rocket Lab’s Electron rocket is a new player
in the space arena.

4
00:00:32,390 --> 00:00:38,510
And those tiny spacecraft, called CubeSats,
represent big dreams.

5
00:00:38,510 --> 00:00:42,920
It's kind of like the pre-eminent, most exciting
mission within the whole company.

6
00:00:42,920 --> 00:00:47,770
The whole team is just incredibly excited
to have that NASA logo on the side of the

7
00:00:47,770 --> 00:00:50,530
vehicle and fly those payloads.

8
00:00:50,530 --> 00:00:54,880
The NASA payload about to launch on the Electron
rocket is called ELaNa-19.

9
00:00:54,880 --> 00:01:02,020
ELaNa stands for Educational Launch of Nanosatellites—part of NASA’s CubeSat Launch Initiative.

10
00:01:02,020 --> 00:01:07,550
This is the agency’s way of providing a
path to space for CubeSats—compact satellites

11
00:01:07,550 --> 00:01:12,939
that pack a lot of science into a package

about the size of a loaf of bread.

12
00:01:12,939 --> 00:01:17,190
Space is no longer just for high-value science
or the intelligence community.

13
00:01:17,190 --> 00:01:21,689
It is a place for a payload that you can create that can get up to space.

14
00:01:21,689 --> 00:01:26,909
Until now, CubeSats have always launched with
larger spacecraft—but flying as a hitchhiker

15
00:01:26,909 --> 00:01:30,369
limited where they could go, and the science
they could do.

16
00:01:30,369 --> 00:01:33,780
That’s what makes this Rocket Lab flight
so historic.

17
00:01:33,780 --> 00:01:38,700
It’s the first time these small satellites
are the stars of their own show, flying on

18
00:01:38,700 --> 00:01:41,170
a rocket designed for their needs.

19
00:01:41,170 --> 00:01:47,090
The ten CubeSats flying on ELaNa-19 were developed
by teams from across the nation, from high

20
00:01:47,090 --> 00:01:50,630
schools and universities to NASA field centers.

21
00:01:50,630 --> 00:01:55,960
DaVinci was developed by a student-led team
at North Idaho STEM Charter Academy.

22

00:01:55,960 --> 00:02:00,649
It’s designed to connect to students around
the world by broadcasting education-related

23
00:02:00,649 --> 00:02:04,329
messages through amateur radio in Morse Code.

24
00:02:04,329 --> 00:02:10,119
It also carries a GlobalStar modem and Arducam,
allowing users to upload digital messages

25
00:02:10,120 --> 00:02:12,840
or see photos of Earth from orbit.

26
00:02:12,840 --> 00:02:19,040
I don’t know if anyone remembers the old
messages on the radio, way back when, but

27
00:02:19,040 --> 00:02:22,370
our goal is to do something like that, where
they have to tune in every week or every other

28
00:02:22,370 --> 00:02:27,540
week to get this new message and decode it
and really dive into that information so that

29
00:02:27,540 --> 00:02:31,800
they develop an interest in space and they
say oh, hey, I can communicate with something

30
00:02:31,800 --> 00:02:33,450
not even on this planet.

31
00:02:33,450 --> 00:02:39,980
RSat was developed by a team of midshipmen
from the U.S. Naval Academy in Annapolis, Maryland.

32
00:02:39,980 --> 00:02:45,620
This crab-like CubeSat has a pair of robotic
arms designed to grab a host satellite and

33
00:02:45,620 --> 00:02:52,380
maneuver around it to take photos—or potentially
even make repairs if a spacecraft isn't working properly.

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00:02:52,380 --> 00:02:58,420
The CubeSat STF-1, or Simulation-to-Flight
1, is a collaboration between the NASA Independent

35
00:02:58,420 --> 00:03:04,370
Verification and Validation Program, with
West Virginia University and small businesses.

36
00:03:04,370 --> 00:03:10,700
STF-1 will monitor space weather over Earth's
poles and test the durability of new materials

37
00:03:10,700 --> 00:03:11,880
for use in LEDs.

38
00:03:11,880 --> 00:03:17,570
But it's also designed to demonstrate a
simulation and test platform to aid in the

39
00:03:17,570 --> 00:03:20,340
development of future CubeSat missions.

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00:03:20,340 --> 00:03:28,440
These CubeSats show that small satellites have an important and growing role in space exploration.

41
00:03:28,440 --> 00:03:34,400
NASA's Venture Class Launch Service was
created in 2015 to provide CubeSats their

42
00:03:34,410 --> 00:03:39,890
own ride to space… expanding launch and
science opportunities for small satellites,

43
00:03:39,890 --> 00:03:44,230

and sparking a brand-new segment of the space-launch industry.

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00:03:44,230 --> 00:03:49,560
Rocket Lab’s Electron rocket is one of two vehicles NASA selected for Venture Class missions.

45
00:03:49,560 --> 00:03:55,160
It’s smaller and lighter than other launchers in NASA’s stable—but that’s the whole point.

46
00:03:55,160 --> 00:04:00,880
The intent is for Venture Class launches to occur at a rapid pace that match the iteration

47
00:04:00,880 --> 00:04:03,590
and design cycle that CubeSats can go through.

48
00:04:03,590 --> 00:04:08,740
So instead of having a launch for a primary mission once every two years, once every five

49
00:04:08,740 --> 00:04:14,290
years, the real goal is to see Venture Class rockets get to a cadence where they can see

50
00:04:14,290 --> 00:04:16,590
regular access to orbit.

51
00:04:16,590 --> 00:04:22,680
Many of the CubeSats on the ELaNa-19 mission are designed to benefit future missions.

52
00:04:22,680 --> 00:04:26,759
Shields-1 was developed by NASA’s Langley Research Center in Hampton, Virginia.

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00:04:26,759 --> 00:04:34,320
Its objective: to test materials that could be used to shield spacecraft against radiation.

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00:04:34,320 --> 00:04:39,759
This is a radiation effects experiment where
we're looking at the performance of the

55
00:04:39,759 --> 00:04:42,249
materials and the electronics.

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00:04:42,249 --> 00:04:48,830
It would have a potentially large impact for
improving the performance of future spacecraft.

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00:04:48,830 --> 00:04:54,539
NMTSat was built by approximately 50 undergraduate
and graduate students, primarily from New

58
00:04:54,539 --> 00:04:57,500
Mexico Tech in Albuquerque, New Mexico.

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00:04:57,500 --> 00:05:02,930
It's designed to use onboard sensors to
collect data on Earth's magnetic field,

60
00:05:02,930 --> 00:05:07,699
take atmospheric weather measurements, and
carry out an optical beacon experiment.

61
00:05:07,699 --> 00:05:12,180
The next spacecraft was developed by teams
on opposite sides of the country… in Florida

62
00:05:12,180 --> 00:05:13,300
and California.

63
00:05:13,300 --> 00:05:19,710
It's called CHOMPTT, which stands for CubeSat
Handling of Multisystem Precision Time Transfer.

64
00:05:19,710 --> 00:05:24,300

This mission is a collaboration between the
University of Florida in Gainesville and NASA's

65
00:05:24,300 --> 00:05:27,889
Ames Research Center in Mountain View, California.

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00:05:27,889 --> 00:05:33,520
CHOMPTT uses lasers instead of radio waves
to demonstrate new ways to navigate and network

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00:05:33,520 --> 00:05:35,830
satellites in deep space.

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00:05:35,830 --> 00:05:40,639
The Advanced Electrical Bus, or ALBus, was
developed by NASA's Glenn Research Center

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00:05:40,639 --> 00:05:42,569
in Cleveland, Ohio.

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00:05:42,569 --> 00:05:47,270
ALBus will demonstrate shape memory alloy
mechanisms for deployable solar arrays.

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00:05:47,270 --> 00:05:52,050
It'll also serve as a pathfinder for high
power-density CubeSats.

72
00:05:52,050 --> 00:05:58,190
The shape memory alloys themselves are a really
good technology because they are low mass,

73
00:05:58,190 --> 00:06:02,080
they can produce low shock, and we can reset
them.

74
00:06:02,100 --> 00:06:06,789
So we can actually reset our mechanisms to
test it again, to deploy to make sure we're

75
00:06:06,789 --> 00:06:08,220
going to have a successful mission.

76
00:06:08,229 --> 00:06:13,330
While the CubeSats are prepared for flight,
their ride—the Electron rocket—begins

77
00:06:13,330 --> 00:06:14,410
to take shape.

78
00:06:14,410 --> 00:06:20,259
Fully assembled, the Electron stands nearly
56 feet tall—a smaller rocket dedicated

79
00:06:20,259 --> 00:06:21,860
to launching small payloads.

80
00:06:21,860 --> 00:06:27,580
It’s a three-stage, carbon composite vehicle,
topped by a payload fairing to protect the

81
00:06:27,580 --> 00:06:29,759
CubeSats during launch.

82
00:06:29,759 --> 00:06:34,270
The Electron’s engines and avionics are
manufactured here in the United States at

83
00:06:34,270 --> 00:06:37,289
Rocket Lab’s facility in Huntington Beach,
California.

84
00:06:37,289 --> 00:06:43,099
In fact, the company’s Rutherford engine
is the first-ever oxygen/kerosene rocket engine

85
00:06:43,099 --> 00:06:45,780
built using 3-D printed main components.

86
00:06:45,780 --> 00:06:50,340
Then they’re sent to Rocket Lab’s facility
in Auckland, New Zealand.

87
00:06:50,340 --> 00:06:55,150
Here, the company puts its engines to the
test before final integration.

88
00:06:55,150 --> 00:07:01,000
It’s also where Rocket Lab manufactures
the vehicle’s stages and payload fairing.

89
00:07:01,000 --> 00:07:07,360
But until the rocket is assembled and tested
in New Zealand, the CubeSats will wait in California.

90
00:07:07,360 --> 00:07:12,240
It will all come together when the spacecraft
arrive from Huntington Beach just a few weeks

91
00:07:12,240 --> 00:07:14,089
before launch.

92
00:07:14,089 --> 00:07:19,589
CubeSail was built by the University of Illinois
at Urbana-Champaign and CU Aerospace.

93
00:07:19,589 --> 00:07:25,629
It carries a 250-meter solar sail ribbon—technology
that’s being evaluated for use on future

94
00:07:25,629 --> 00:07:30,120
spacecraft, such as scientific missions to
interstellar space.

95
00:07:30,120 --> 00:07:34,550
CubeSail is going to be doing a technology
demonstration of the deployment technique

96

00:07:34,550 --> 00:07:39,440
as a steppingstone for even larger missions we have planned down the road, like UltraSail.

97
00:07:39,449 --> 00:07:46,660
The ISX CubeSat, or Ionospheric Scintillation Explorer, is a collaboration between SRI International

98
00:07:46,669 --> 00:07:50,719
and PolySat at Cal Poly, San Luis Obispo, California.

99
00:07:50,719 --> 00:07:55,759
ISX is designed to take a closer look at plasma fluctuations in the upper atmosphere—and

100
00:07:55,759 --> 00:08:00,800
learn more about how they affect radio communications with satellites.

101
00:08:00,800 --> 00:08:04,779
Up next is CeREs, the CubeSat Compact Radiation Belt Explorer.

102
00:08:04,779 --> 00:08:09,559
It was developed by NASA’s Goddard Space Flight Center in Greenbelt, Maryland.

103
00:08:09,559 --> 00:08:15,839
CeREs will fly into Earth’s Van Allen radiation belts to study the high-energy particles streaming

104
00:08:15,839 --> 00:08:20,900
toward the Earth from the Sun, and learn more about how electrons in the radiation belts

105
00:08:20,900 --> 00:08:22,620
are energized and lost.

106
00:08:22,620 --> 00:08:26,199

CubeSats go into the cleanroom and do their
standalone processing.

107
00:08:26,199 --> 00:08:31,690
So that's any sort of checkouts, charging – basically,
they’re getting ready to get into that final

108
00:08:31,690 --> 00:08:32,979
package, the dispenser.

109
00:08:32,980 --> 00:08:38,280
That’s the piece of hardware that's actually
going to launch them out into space off of the rocket.

110
00:08:38,280 --> 00:08:42,620
November 2018.

111
00:08:43,360 --> 00:08:48,130
With the Electron rocket ready for final integration
and launch, the CubeSats are shipped from

112
00:08:48,130 --> 00:08:52,579
California all the way to Auckland, New Zealand.

113
00:08:52,579 --> 00:08:58,360
But the Electron rocket elements and all the
ELaNa-19 CubeSats still have to make one more

114
00:08:58,360 --> 00:08:59,980
journey on Earth.

115
00:08:59,980 --> 00:09:07,050
It takes a caravan of trucks about 8 hours
to make the 575-kilometer journey from Auckland

116
00:09:07,050 --> 00:09:12,850
to Rocket Lab’s Launch Complex 1 at Mahia
Peninsula, on the island’s east coast.

117

00:09:12,850 --> 00:09:16,740
But this remote launch site is worth the drive.

118
00:09:16,740 --> 00:09:22,089
So from one single launch site we can launch
all the way to 39 degrees inclination—that's

119
00:09:22,089 --> 00:09:27,960
due east—all the way up to sun-synchronous,
which is about 98 degrees, depending on the altitude.

120
00:09:27,960 --> 00:09:32,440
So that's the widest range of inclinations
available from any launch site in the world.

121
00:09:32,450 --> 00:09:36,770
On the ground at the Mahia launch complex,
the rocket’s stages are carefully brought

122
00:09:36,770 --> 00:09:42,120
together and inspected to ensure everything
is perfect.

123
00:09:42,120 --> 00:09:46,649
The CubeSats are installed on the Electron
payload plate – the interface between the

124
00:09:46,649 --> 00:09:50,560
rocket and the satellites.

125
00:09:50,560 --> 00:09:55,900
Then ELaNa-19 is encapsulated inside the Electron
rocket’s payload fairing, where the CubeSats

126
00:09:55,900 --> 00:09:58,070
will stay until they’re in space.

127
00:09:58,070 --> 00:10:03,370
The entire rocket is manually rolled out to
the launch pad for a rehearsal of the launch

128
00:10:03,370 --> 00:10:06,870
day that’s quickly approaching.

129
00:10:06,870 --> 00:10:12,350
Liftoff is planned for December 12, 2018 – and
the vehicle is ready.

130
00:10:12,350 --> 00:10:17,690
But dangerously strong winds keep the Electron
on the ground for four more days.

131
00:10:17,700 --> 00:10:24,760
Their fortunes change on December 16 when
the winds aloft finally go “green.”

132
00:10:24,760 --> 00:10:26,920
5, 4, 3

133
00:10:26,920 --> 00:10:28,660
Ignition, 2...

134
00:10:34,700 --> 00:10:40,940
The Electron rocket’s nine Rutherford engines
ignite… and history is made.

135
00:10:50,880 --> 00:10:56,500
Less than an hour into the flight, the ELaNa-19
CubeSats are released.

136
00:10:56,500 --> 00:11:01,839
Instead of hitching a ride, these small spacecraft
have a dedicated ride that can deploy each

137
00:11:01,839 --> 00:11:05,950
one to just the right orbit for maximum science.

138
00:11:05,950 --> 00:11:12,330
ELaNa gives students and teachers a low-cost

pathway to space… to test new technologies,

139
00:11:12,330 --> 00:11:18,130
make new discoveries, and create new connections
to each other and the future.

140
00:11:18,130 --> 00:11:24,130
Small satellites, big dreams… and even bigger
potential for future CubeSats needing a Venture