“Developing New Tools for the ELaNa”

Garrett Skrobot
ELaNa Mission Manager
Launch Services Program
NASA

Small Sat 2016
What’s going on!

“ELaNa is moving forward, launching CubeSat missions for CubeSat Launch Initiative (CLSI) and Science Projects!”
ELaNa Launches Since Last Workshop

**ELaNa XII – NROL-55**  
Oct 8, 2015  
AMSAT Fox-1  
Radio Amateur Satellite Corporation  
BisonSat Salish Kootenai College  
ARC University of Alaska – Fairbanks  
LMRST-Sat JPL

**ELaNa VII – ORS4**  
Oct 29, 2015  
Argus - Saint Louis University  
PrintSat Montana State University

**ELaNa IX – OA-4**  
December 6, 2015  
May 16, 2016  
MinXSS(HiLite) Colorado, Boulder  
STMSat-1 St. Thomas More Cathedral School  
CADRE – U of Michigan
# CubeSat Missions Manifest
(NASA Internal Only)

<table>
<thead>
<tr>
<th>LV Provider</th>
<th>FY 2016</th>
<th>FY 2017</th>
<th>FY 2018</th>
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<tbody>
<tr>
<td><strong>NASA</strong></td>
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<tr>
<td></td>
<td><img src="image1" alt="ELaNa XIV" /> 1/20/17 JPSS-1 (DII) 5°</td>
<td><img src="image2" alt="ELaNa XVIII" /> 10/31/17 ICESat-2 (DII) 3°</td>
<td><img src="image3" alt="MarCO" /> May 2018 InSight (AV) 2°</td>
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<td><strong>NASA ISS</strong></td>
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<td><img src="image4" alt="ELaNa XVII" /> 12/30/16 OA-7 5°</td>
<td><img src="image5" alt="ELaNa 22" /> 6/1/17 SPX-12 6°</td>
<td><img src="image6" alt="ELaNa XVI" /> TBD TBD 1°</td>
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<td><strong>NRO</strong></td>
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<td><img src="image7" alt="ELaNa XV" /> 3/1/17 (U/R) STP-2 3°</td>
<td><img src="image8" alt="ELaNa XIX" /> June 2017 VCLS (RL) 14°</td>
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<tr>
<td><strong>ORS/STP</strong></td>
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<td><img src="image9" alt="ELaNa XIII" /> NET Dec 2016 FORMOSAT-5 2°</td>
<td><img src="image10" alt="ELaNa X" /> Dec 2017 VCLS (VG) 18°</td>
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<td><strong>Commercial</strong></td>
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<td><img src="image11" alt="ELaNa Manifested" /> June 2017 VCLS (RL) 14°</td>
<td><img src="image12" alt="ELaNa XIX" /> June 2017 VCLS (RL) 14°</td>
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<tr>
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<tr>
<td>46</td>
<td>53</td>
<td>21</td>
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</table>

* # CubeSat Missions
Upcoming ELaNa Launches

NASA CubeSat Missions scheduled for launch

- ELaNa XIII (NET Oct, 2016)
  » ISARA – JPL
  » EcAMSat – Ames

- ELaNa XVII (NET December, 2016)
  » IceCube - GSFC
  » CXBN-2 Morehead State University/Kentucky Space
  » HARP – University of Maryland, Baltimore County
  » OPEN – University of North Dakota
  » CSUNSat-1 California State University, Northridge

- ELaNa XIV (NET Jan, 2017)
  » Golden Eagle-1 – Marquette University
  » RadFxSat – Vanderbilt University/AMSAT
  » EagleSat – Embry Riddle Aeronautical University, Prescott
  » MiRaTa – MIT Lincoln Laboratory
  » Buccaneer - Australian Defense Science and Technology Organization
Upcoming ELaNa Launches

NASA CubeSat Missions scheduled for launch

- ELaNa XV (NET March, 2017)
  - ARMADILLO – Texas Spacecraft Laboratory
  - LEO – CalPoly SLO
  - StangSat – Merritt Island High School

- ELaNa 22 (NET June, 2017)
  - ASTERIA - MIT
  - RBLE – GSFS
  - LAICE – University of Illinois at Urbana-Champaign
  - AOSAT – Arizona State University
  - OSIRIS-3U – Pennsylvania State University
  - OPAL – Utah State University
Upcoming ELaNa Launches

NASA CubeSat Missions scheduled for launch

– ELaNa XIX (NET June, 2017)
  » CeREs - GSFC
  » ANDESITE – Boston University
  » SFT-1 – West Virginia University/ NASA IV&V
  » CHOMPTT – University of Florida
  » CubeSail - University of Illinois at Urbana-Champaign
  » NMTSat – New Mexico Institute of Mining and Technology
  » DaVinci – North Idaho STEM Charter Academy
  » RSat – U.S Naval Academy
  » ISX – SRI/CalPoly
  » Shields-1 – Langley Research Center
### 2015 CubeSat Launch Initiative Missions

<table>
<thead>
<tr>
<th>Selected</th>
<th>Awaiting Manifest</th>
<th>Manifested</th>
<th>Launched</th>
<th>ELaNa Missions Launched</th>
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<tr>
<td>106</td>
<td>53</td>
<td>16</td>
<td>37</td>
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### 2016 CubeSat Launch Initiative Missions

<table>
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<th>Selected</th>
<th>Awaiting Manifest</th>
<th>Manifested</th>
<th>Launched</th>
<th>ELaNa Missions Launched</th>
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<td>130/121</td>
<td>21</td>
<td>53</td>
<td>46</td>
<td>12</td>
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### Total U-Class Payloads (Cubes) Readiness

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<td>2015</td>
<td>13</td>
<td>21</td>
<td>27</td>
<td>7</td>
<td>1</td>
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<td>2016</td>
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ELaNa – The Next Logical Step
From 2011 Workshop

Have our own Nano-Launcher

That’s right, have our own dedicated launch vehicle where the CubeSats are now primary

The CubeSat no longer has to abide by the restrictions levied by a primary rideshare.
### Venture Class Launch Services (VCLS)

- **New class of commercial launch vehicle service at KSC, dedicated for U-class satellites**
- **Improved CubeSat manifesting via NASA’s CubeSat Launch Initiative (CSLI)**
- **As reliability is demonstrated, some providers may be appropriate for future less risk-tolerant NASA missions**
- **Milestones-based payment structure; limited LSP insight through milestone reviews**
- **A single demonstration flight was awarded to Firefly, Rocket Lab, and Virgin Galactic**
- **Statement of Work: Minimum 60kg to LEO (425km), orbit inclination 33 to 98 degrees, launch date no later than April 15, 2018**
- **Companies are responsible for LV development costs**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Alpha 1.0 (Firefly)</th>
<th>Electron (Rocket Lab)</th>
<th>LauncherOne (Virgin Galactic)</th>
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<tbody>
<tr>
<td>Length</td>
<td>23 m</td>
<td>17 m</td>
<td>20 m</td>
</tr>
<tr>
<td>Payload Mass</td>
<td>200 kg</td>
<td>150 kg</td>
<td>300 kg</td>
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<tr>
<td>Payload Diameter</td>
<td>1.45 m</td>
<td>1.1 m</td>
<td>1.3 m</td>
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<tr>
<td>Orbit</td>
<td>500 km (Sun Synchronous)</td>
<td>500 km (Sun Synchronous)</td>
<td>500 km (Sun Synchronous)</td>
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<tr>
<td>LV Certification</td>
<td>No certification</td>
<td>High risk-tolerant spacecraft</td>
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So where we going with VCLS?

RocketLab – ELaNa XIX – 14 CubeSat Missions
500km Cir at 85° Inclination
June 2017

Virgin Galactic – ELaNa XX – 18 CubeSats Missions
500km Cir at 90° Inclination
December 2017

FireFly – ELaNa 21 – 10 CubeSat Missions
375km Cir at 55° Inclination
March 2018
White House Maker Initiative

Goal to broaden NASA’s CubeSat Launch Initiative to reach all states by targeting the 2018 “rookie states” that have had no previous presence in space.

Previous CubeSat Launch Initiative selectees are encouraged to partner with and/or mentor organizations from these states.

“will leverage the existing NASA Space Grant network of colleges and universities.”
~ White House Maker Faire Fact Sheet
Path Forward

So what is our Path Forward?

• **Focus on securing ISS and Commercial UCP LEO launches**
  - Contract in place where NASA can procure ISS UCP deployment slots from the ISS through NanoRacks
  - Working to execute a contract for a Commercial Launch Broker (CLB) to provide launch services for UCP
    » CLB will be required to provide the launch service and integration of the UPC for high inclination orbits
    » Expect to have contract in place in of FY17

• **Launch UCP on a dedicated Small Launch Vehicle for those missions with unique orbital requirements**