CubeSat Missions to LEO and Beyond

CubeSat Workshop 2015

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ELaNa Project Manager
Launch Services Program
NASA
# CubeSat Missions Manifest

<table>
<thead>
<tr>
<th>LV Provider</th>
<th>FY 2015</th>
<th>FY 2016</th>
<th>FY 2017</th>
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<tbody>
<tr>
<td><strong>NASA</strong></td>
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<td></td>
<td><img src="image" alt="MarCO" /> Mar 2016 InSight (AV) 2/2*</td>
<td><img src="image" alt="ELaNa XIV" /> Oct 2016 JPSS-1 (DII) 3/TBD*</td>
<td><img src="image" alt="ELaNa" /> NET July 2017 ICESat-2 (DII) 3/TBD*</td>
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<tr>
<td><strong>NASA ISS</strong></td>
<td><img src="image" alt="ELaNa IX" /> TBD TBD NR/2*</td>
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<td><strong>NRO</strong></td>
<td><img src="image" alt="ELaNa XI" /> 5/6/15 AFSPC-5 (AV) 2/1*</td>
<td><img src="image" alt="ELaNa XII" /> NET Aug 2015 NROL-55 (AV) 2/4*</td>
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<tr>
<td><strong>ORS</strong></td>
<td><img src="image" alt="ELaNa VII" /> NET Oct 2015 ORS-4 (SS) 1/2*</td>
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<tr>
<td><strong>Commercial</strong></td>
<td><img src="image" alt="ELaNa XIII" /> Dec 2015 FORMOSAT-5 N/R/2*</td>
<td><img src="image" alt="ELaNa" /> July 2016 NR/8</td>
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* Dispensers/# CubeSats

**Launches**

- **ELaNa I** Mar 4, 2011 – 1 P-PODs 3 CubeSats
- **ELaNa II** Oct 24, 2011 – 3 P-PODs 5 CubeSats
- **ELaNa VI** Sept 14, 2012 – 3 P-PODs 4 CubeSats
- **ELaNa IV** Nov 19, 2013 – 4.3 P-PODs 11 CubeSats
- **ELaNa II** Dec 5, 2013 – 2 P-PODs 4 CubeSats
- **ELaNa V** Apr 18, 2014 – 4 P-PODs 5 CubeSats
- **ELaNa VIII** Oct 28, 2014 – 1 CubeSat
- **ELaNa X** January 31, 2015 – 3 P-PODs 4 CubeSats

**Un-Assigned**

- **ELaNa VII** NET Oct 2015 ORS-4 (SS) 1/2*
- **ELaNa III** Sept 14, 2012 – 3 P-PODs 4 CubeSats
- **ELaNa IV** Nov 19, 2013 – 4.3 P-PODs 11 CubeSats
- **ELaNa II** Dec 5, 2013 – 2 P-PODs 4 CubeSats

**Launched**

- **37**

**Manifested**

- **21**

**Un-Assigned**

- **55**
Recent Launches

**ELaNa V**
- All-Star/THEIA Colorado
- PhoneSat 2.5 AMES
- TSAT –TESTSat-Lite Taylor University
- KickSat: Cornell University
- SporeSat AMES

**ELaNa VIII**
- RACE (CHARM) JPL

**ELaNa X**
- FIREBIRD-2 Montana State University
- GRIFEX University of Michigan
- ExoCube Cal Poly
Upcoming Launches

ELaNa XIII – May 2015 – Atlas V
  • LightSail-A, AMES

ELaNa XII – August 2015 – Atlas V
  • AMSAT Fox-1 Radio Amateur Satellite Corporation
  • BisonSat Salish Kootenai College
  • ARC University of Alaska – Fairbanks
  • LMRST-Sat JPL

ELaNa VII – October 2015 – Super Strypi
  • Argus - Saint Louis University
  • PrintSat Montana State University

ELaNa IX – Nov 2015 – H2B/Atlas V (ISS)
  • MinXSS(HiLite) St,Thomas More Cathedral School
  • STMSat-1 Colorado, Boulder

ELaNa XIII – December 2015 – Falcon 9
  • ISARA - JPL
  • E. Coli AntiMicrobialSat - ARC
CubeSats Going to Mars!

Mars Cube One (MarCO)

- InSight has no direct-to-Earth link during critical landing phase.
  - MRO to relay EDL data hours later
- MarCO provides bent pipe data relay as a back-up to MRO to enhance InSight mission
- A technical demonstration that proves valuable to future missions

Features

- 2 6U CubeSat spacecraft (for redundancy)
- Continues Freon Propulsion system
- Using the Atlas 401 ABC system to mount MarCO onto the Centaur
- Launch is schedule for March 4, 2016 with a 27 day window
CubeSats Going Beyond Low Earth Orbit

- Current plans are for EM-1 to carry up to 11 6U U-Class Payloads to a beyond low earth orbit
- LSP is working with Marshall Space Center in the procurement and integration services for the EM-1 dispenser and U-Class Payloads
ISS and Nano Launcher

• Awaiting use of ISS as a platform to deploy CubeSats
  – Expected to have 6U of space on selected flights
• Nano-Launcher System is in work for the dedicated launch of CubeSats
  – Sept 2013 a GO launcher launch vehicle was placed on contract to launch three 3U CubeSats in late 2016
  – Venture Class Launch Services
    » The VCLS requirement is for the launch services of U-Class satellites built off of the CubeSat form factor (10 cm x 10 cm x 10 cm) of any combination of U-Class satellites (i.e., 1U, 3U, 6U, 12U, 24U)
    » Minimum orbital altitude of 425km at a launch inclination between 33 and 98 degrees
    » 60 kg minimum payload mass requirement
      • May be met by one or two launches (each with a 30 kg minimum payload mass or greater)
    » Launch NLT June 15, 2018
    » Potential excess performance for Ride-Share
## Summary

### ELaNa

<table>
<thead>
<tr>
<th># of Selected CubeSat Missions</th>
<th># of CubeSats Manifested</th>
<th># of Unassigned CubeSats</th>
<th># of CubeSats Launched</th>
<th># of U Launched</th>
</tr>
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<tbody>
<tr>
<td>106</td>
<td>15</td>
<td>57**</td>
<td>40***</td>
<td>62</td>
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* Reflects the removal of DoD submissions  
** Reflects adjustment for survey responses  
*** Includes LSP and Re-flights

### U’s Launched

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<td>11</td>
<td>9</td>
<td>18</td>
<td>15</td>
<td>9</td>
<td>39</td>
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- **Averaging U launched – 13.8 U per year**
Questions