

John F. Kennedy Space Center



LAUNCH SERVICES PROGRAM

# “Developing New Tools for the ELaNa”

## Garrett Skrobot

ELaNa Mission Manager  
Launch Services Program

NASA

### Small Sat 2016

Launch Services Program

**ELaNa**  
NASA  
GSLI

“Launching CubeSats”

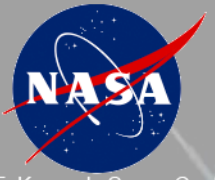
www.nasa.gov

Educational Launch of Nanosatellite

NASA CubeSat Launch Initiative

NOT READY TO LAUNCH YOUR SPACECRAFT?

Start building your own satellite!



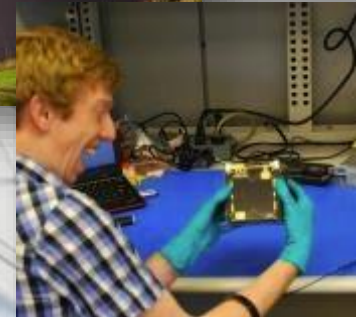
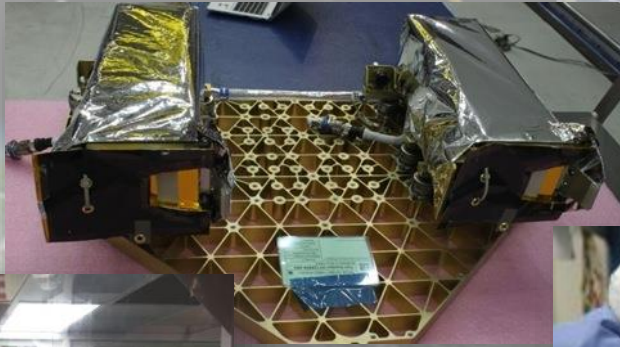
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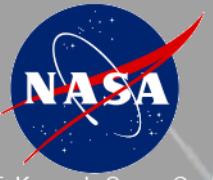
# What's going on!



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





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# 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**

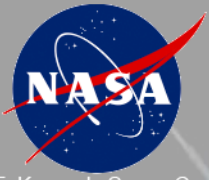


**ElaNa IX – OA-4**  
December 6, 2015

**May 16, 2016**

- MinXSS(HiLite) Colorado, Boulder**
- STMSat-1 St. Thomas More Cathedral School**
- CADRE – U of Michigan**





# CubeSat Missions Manifest



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LV Provider	FY 2016	FY 2017	FY 2018
<b>NASA</b> 		 ELaNa XIV 1/20/17 JPSS-1 (DII) 5*	 ELaNa XVIII 10/31/17 ICESat-2 (DII) 3*  MarCO May 2018 InSight (AV) 2*
<b>NASA ISS</b> 	 ELaNa XVII 12/30/16 OA-7 5*	 ELaNa 22 6/1/17 SPX-12 6*	 ELaNa XVI TBD TBD 1*
<b>NRO</b> 			
<b>ORS/STP</b>  		 ELaNa XV 3/1/17 (U/R) STP-2 3*	
<b>Commercial</b>	 ELaNa XIII NET Dec 2016 FORMOSAT-5 2*	 ELaNa XIX June 2017 VCLS (RL) 14*	 ELaNa XX Dec 2017 VCLS (VG) 18*  ELaNa 21 Mar 2018 VCLS (FF) 13*



SPL Manifested

July 2016



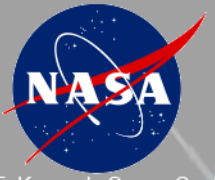
ELaNa Manifested

\* # CubeSat Missions



In Work

Launched	Manifested	Un-Assigned
46	53	21



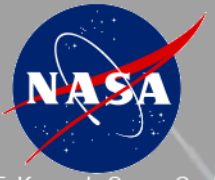
# Upcoming ELaNa Launches



## 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**





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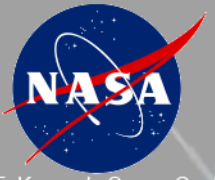
# Upcoming ELaNa Launches



## 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**





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# Upcoming ELaNa Launches

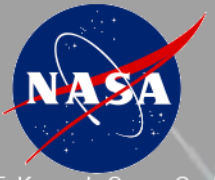


## NASA CubeSat Missions scheduled for launch

### – ELaNa XIX (NET June, 2017)

- » **CeREs - GSFC**
- » **ANDESITE – Boston University**
- » **SFT-1 – West Virginia University/ NASA IV&V**
- » **CHOMPPTT – 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**





# ELaNa and CSLI Score Card



## 2015 CubeSat Launch Initiative Missions

Selected	Awaiting Manifest	Manifested	Launched	ELaNa Missions Launched
106	53	16	37	9

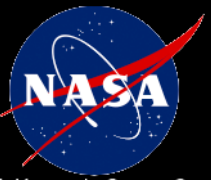
## 2016 CubeSat Launch Initiative Missions

Selected	Awaiting Manifest	Manifested	Launched	ELaNa Missions Launched
130/121	21	53	46	12

## Total U-Class Payloads (Cubes) Readiness

2015	2016	2017	2018	2019	2020
13	21	27	7	1	1





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# ELaNa – *The Next Logical Step*

From 2011 Workshop

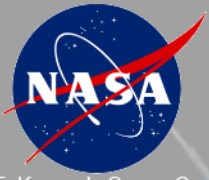
## *Have our own Nano-Launcher*



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.





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# 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**

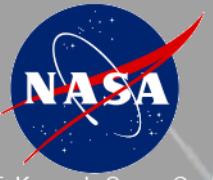


Specification	Alpha 1.0 (Firefly)	Electron (Rocket Lab)	LauncherOne (Virgin Galactic)
Length	23 m	17 m	20 m
Payload Mass	200 kg	150 kg	300 kg
Payload Diameter	1.45 m	1.1 m	1.3 m
Orbit	500 km (Sun Synchronous)	500 km (Sun Synchronous)	500 km (Sun Synchronous)
LV Certification	No certification High risk-tolerant spacecraft		

**For Comparison Only**



<b>Pegasus XL (Orbital)</b>
16.9 m
Up to 443 kg to LEO
1.18 m
Multiple
<b>Certified; Low risk-tolerant spacecraft</b>



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# VCLS Missions

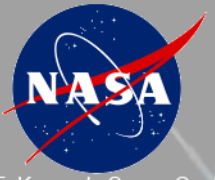


## So where we going with VCLS?

**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**



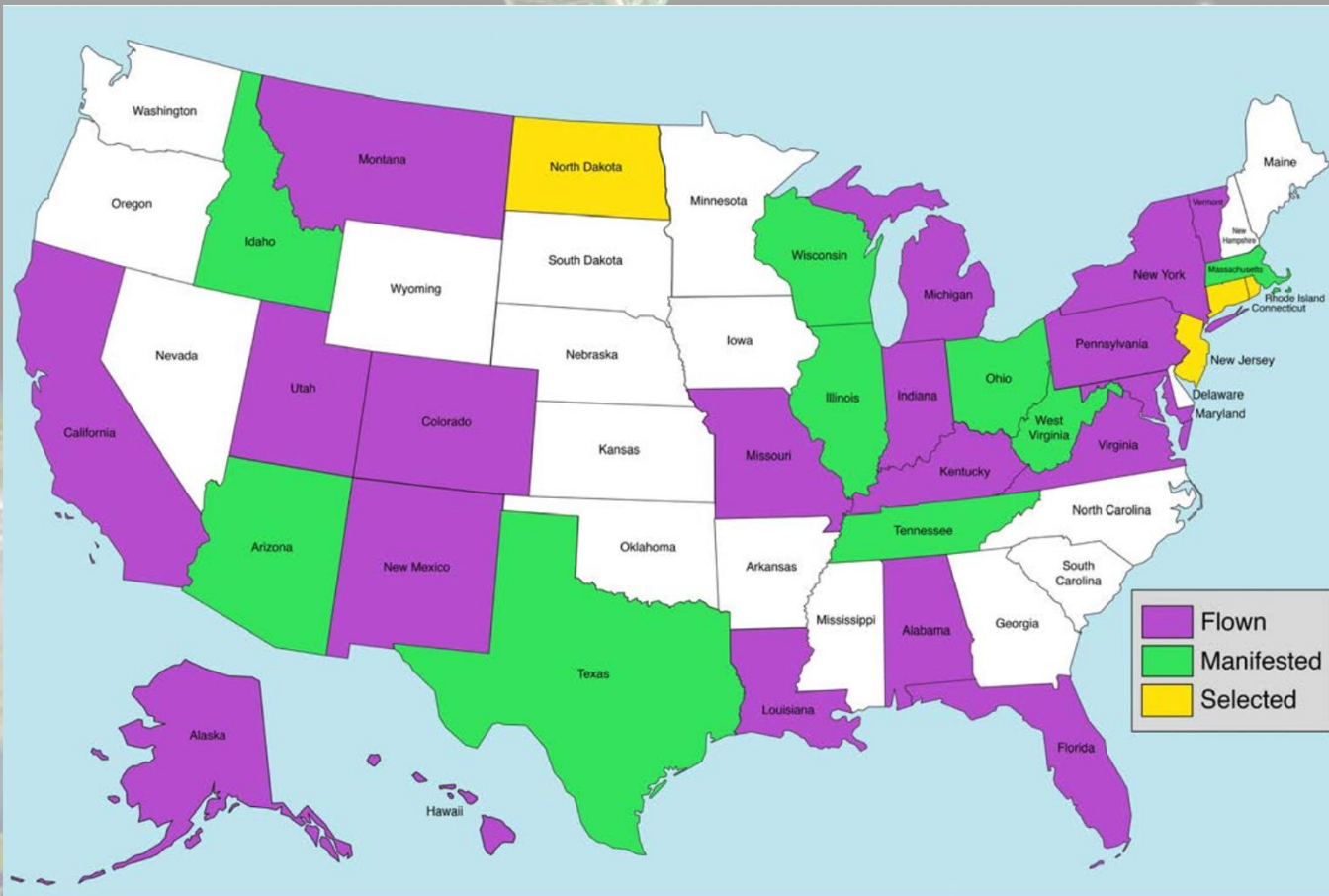
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# White House Maker Initiative



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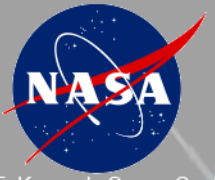
**Goal to broaden NASA's CubeSat Launch Initiative to reach all states by targeting the 20-18 "rookie states" that have had no previous presence in space.**



**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**



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# CubeSat Opportunities 2016



## CubeSat Launch Initiative Announcement of Opportunity

**Award: EELVs rideshare opportunity or ISS deployment opportunity**

**Release Date:** Aug. 4, 2016

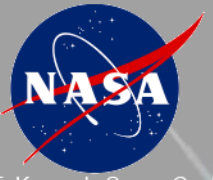
**Proposals Due:** Nov. 22, 2016

**Selection:** Feb. 17, 2016

Provides CubeSat developers access to low-cost pathway to conduct research in the areas of science, exploration, technology development, education or operations.

**Eligibility:** NASA Centers, accredited educational institutions and non-profit organizations

[http://go.nasa.gov/CubeSat\\_initiative](http://go.nasa.gov/CubeSat_initiative)



# 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**

