



JOHN F. KENNEDY SPACE CENTER



CubeSat Missions to LEO and Beyond

CubeSat Workshop 2015

Garrett Skrobot

ELaNa Project Manager

Launch Services Program

NASA



CubeSat Missions Manifest

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LV Provider	FY 2015	FY 2016	FY 2017
NASA 		 MarCO Mar 2016 InSight (AV) 2/2*	 ELaNa XIV Nov 2016 JPSS-1 (DII) 3/TBD*
NASA ISS 		 ELaNa IX TBD TBD NR/2*	 ELaNa NET July 2017 ICESat-2 (DII) 3/TBD*
NRO 	 ELaNa XI 5/6/15 AFSPC-5 (AV) 2/1*	 ELaNa XII NET Aug 2015 NROL-55 (AV) 2/4*	
ORS 		 ELaNa VII NET Oct 2015 ORS-4 (SS) 1/2*	
Commercial		 ELaNa XIII Dec 2015 FORMOSAT-5 N/R/2*	 ELaNa NET Oct 2016 NR/4

ELaNa I Mar 4, 2011 - 1 P-PODs 3 CubeSats
 ELaNa III 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

SPL Manifested

ELaNa Manifested
 In Work

Launched	Manifested	Un-Assigned
37	21	55

* # Dispensers/# CubeSats



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Recent Launches



ELaNa V



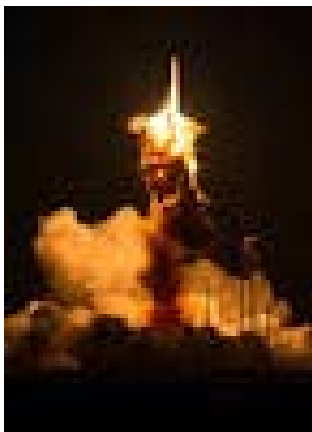
- All-Star/THEIA Colorado
- PhoneSat 2.5 AMES
- TSAT –TESTSat-Lite Taylor University
- KickSat: Cornell University
- SporeSat AMES

ELaNa X



- FIREBIRD-2 Montana State University
- GRIFEX University of Michigan
- ExoCube Cal Poly

ELaNa VIII



- RACE (CHARM) JPL





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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) Colorado, Boulder
- STMSat-1 St, Thomas More Cathedral School

ELaNa XIII – December 2015 – Falcon 9

- ISARA - JPL
- E. Coli AntiMicrobialSat - ARC





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CubeSats Going to Mars!

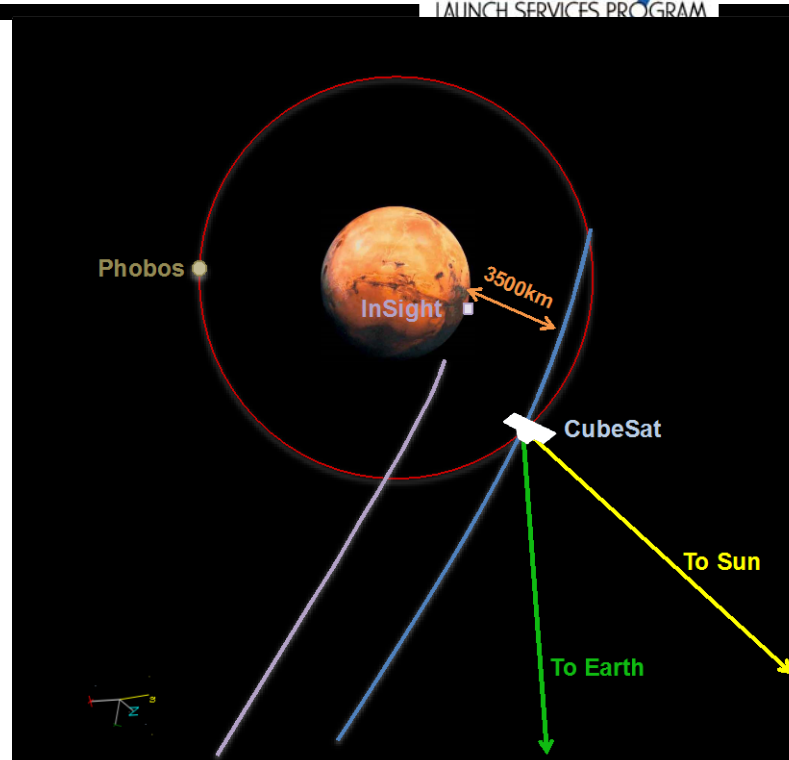


Mars Cube One (MarCO)

- 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)
- Contains Freon Propulsion system
- Using the Atlas 401 ABC system to mount MarCO onto the Centaur
- Launch is scheduled for March 4, 2016 with a 27 day window



A Technology Capability Demonstration of communications relay system for Mars assets especially for critical events such as InSight EDL

Independent Travel

Fly by Mars

*Imaging &
Radio Science*

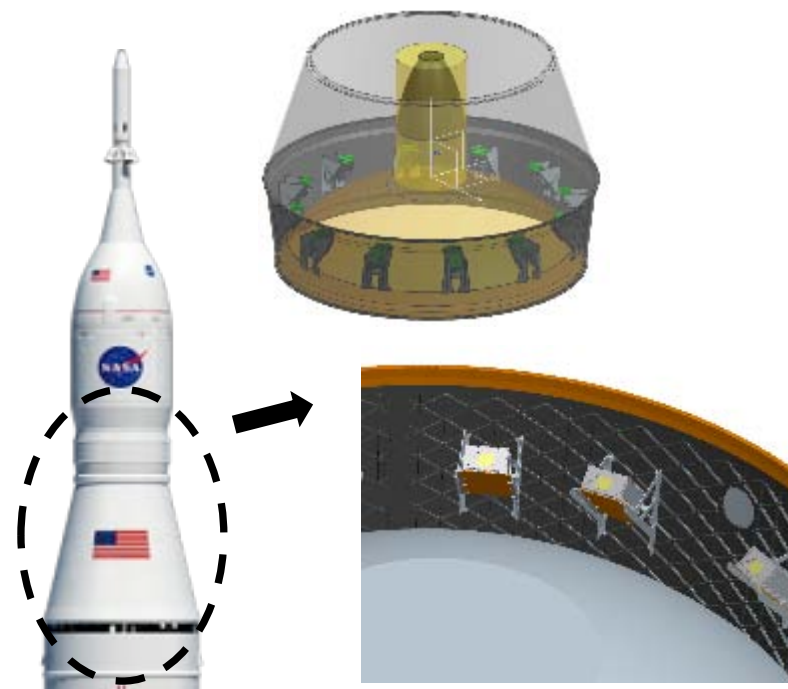


SLS EM-1



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





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ISS and Nano Launcher



- Using 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 or two launches (each with a 30 kg minimum payload mass or greater)
 - » Launch NLT June 15, 2018
 - » Potential excess performance for Ride-Share





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Mission of Opportunities



LAUNCH SERVICES PROGRAM

FY16

Potential ISS
Flights



FY17



*Commercial
24U - LEO*



*VCLS 24U
LEO*



ICESat-2



*TESS 18U
BLEO*

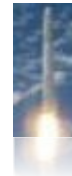
*Government
24U - LEO*



FY18

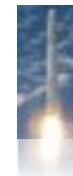


FY19



*Commercial
24U - LEO*

FY20



*SWOT
Mars 2020
PACE*



Summary



ELaNa				
# of Selected CubeSat Missions	# of CubeSats Missions Manifested	# of Unassigned CubeSats Missions	# of CubeSats Missions Launched	# of U Launched
106	15	55	36	62

U's Launched					Manifested
2011	2012	2013	2014	2015	2015
11	9	18	15	9	39

- **Averaging U launched – 13.8 U per year**



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Questions