



John F. Kennedy Space Center



# 2011 Calpoly CubeSat Workshop

## ELaNa

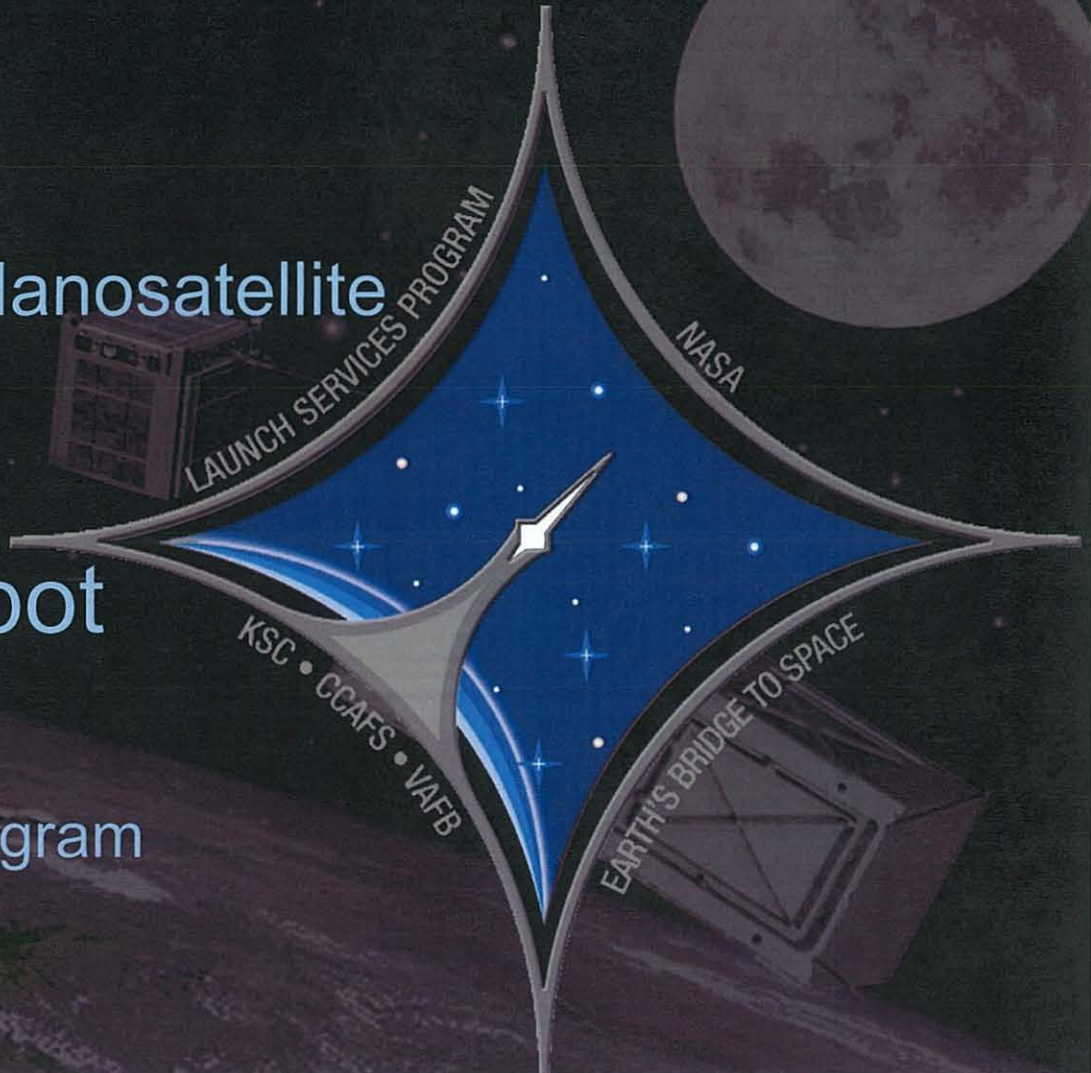
Educational Launch of Nanosatellite

Garrett Skrobot

Mission Manager

Launch Services Program

NASA





John F. Kennedy Space Center

# ELaNa



## Educational Launch of Nanosatellite



*"Science. Technology. Engineering. and Mathematics"*



*"Launching Education into Space"*



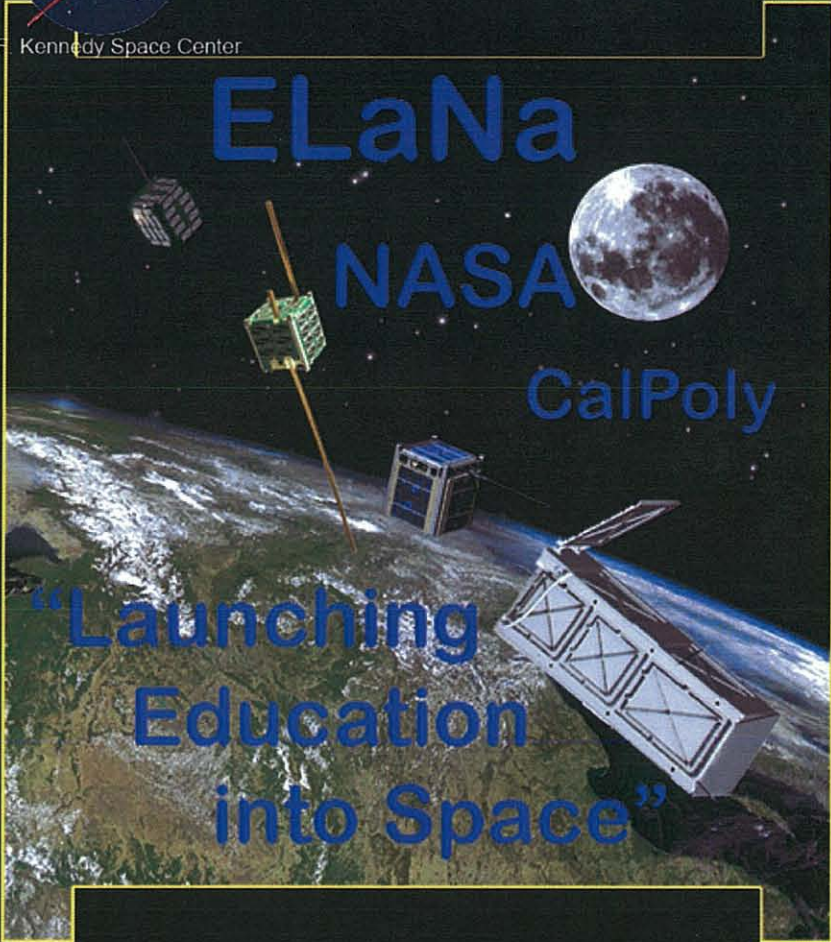
John F. Kennedy Space Center

ELaNa

NASA

CalPoly

“Launching Education into Space”



MONTANA STATE UNIVERSITY



SPACE SCIENCE AND ENGINEERING LABORATORY

KySat™

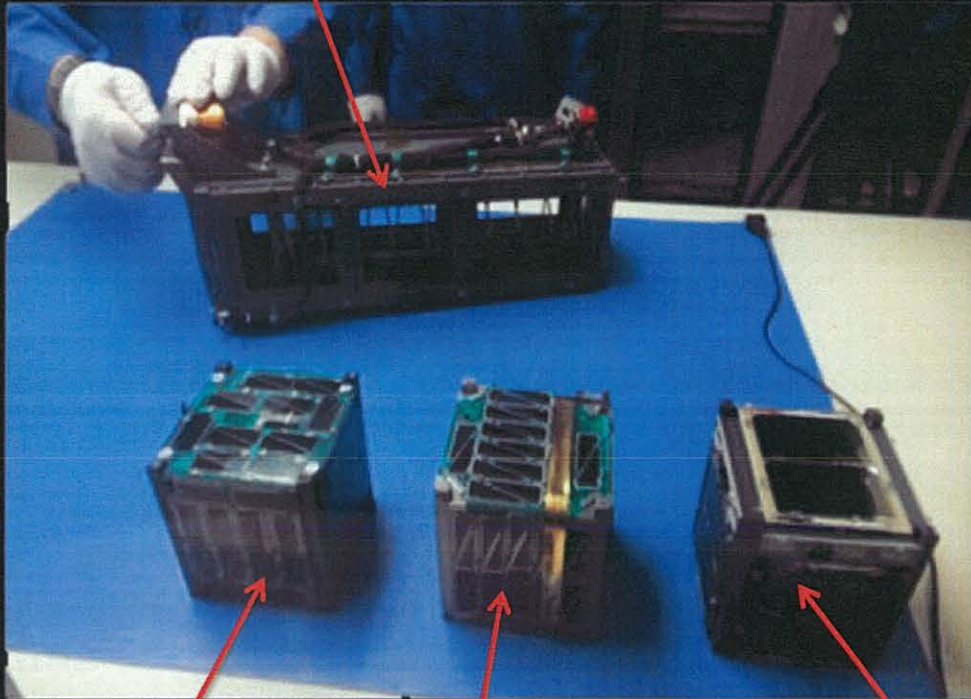




John F. Kennedy Space Center



# ELaNa I Flight P-POD



HERMES

KySat

Explorer 1 [PRIME]



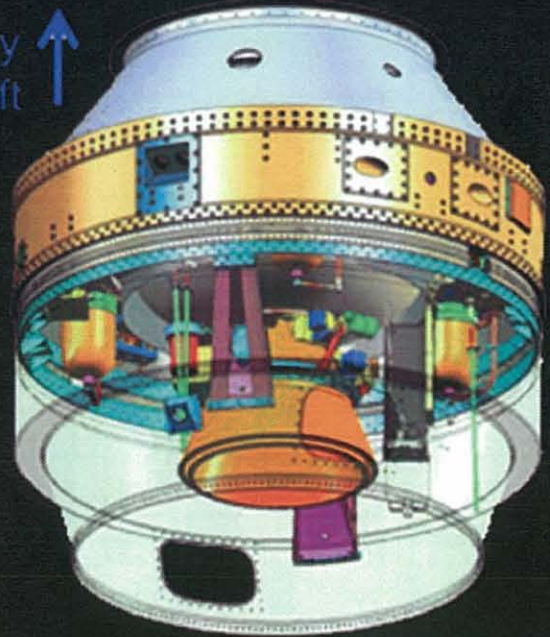


John F. Kennedy Space Center

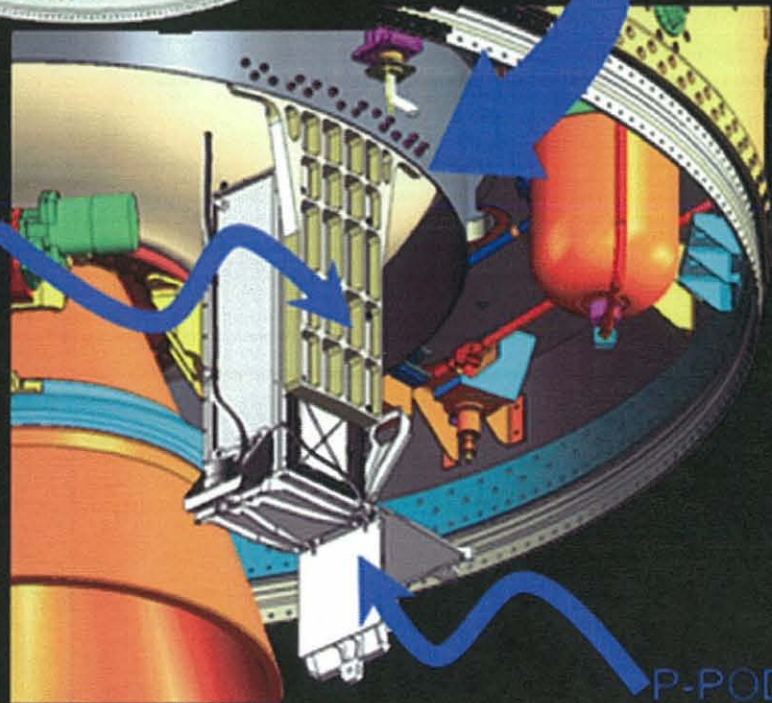
Glory  
Spacecraft ↑



Taurus 3rd stage



P-POD Mounting  
Bracket



P-POD



John F. Kennedy Space Center

ASPT SERVICES PROGRAM





John F. Kennedy Space Center



*Glory* - ELaNa 1  
Taurus XL T9



John F. Kennedy Space Center



*Glory* - ELaNa 1  
Taurus XL T9





John F. Kennedy Space Center



### Stage 2/3 Coast



### Stage-2 Separation

$T = 314.7 \text{ sec}$   
 $h = 369.4 \text{ km}$   
 $V_i = 6483 \text{ m/s}$   
 $R = 1057 \text{ km}$

### Stage-3 Burnout

$T = 669.9 \text{ sec}$   
 $h = 640.8 \text{ km}$   
 $V_i = 7537 \text{ m/s}$   
 $R = 3960 \text{ km}$

### Stage-3 Ignition

$T = 577.7 \text{ sec}$   
 $h = 640.8 \text{ km}$   
 $V_i = 7537 \text{ m/s}$   
 $R = 3960 \text{ km}$

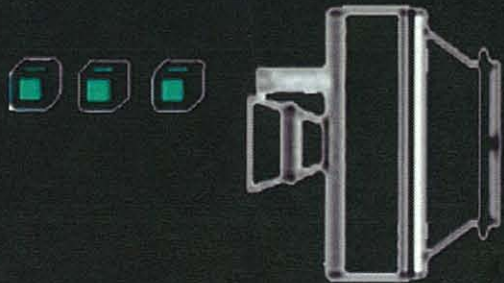
### Glory Separation

$T = 784.9 \text{ sec}$   
 $h = 640.8 \text{ km}$   
 $V_i = 7537 \text{ m/s}$   
 $R = 3960 \text{ km}$

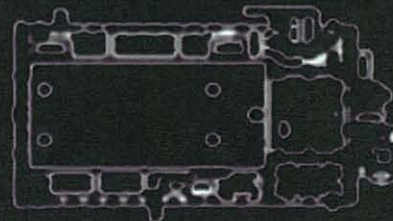
### Cubesat Deployment

$T = 794.9 \text{ sec}$   
 $h = 640.9 \text{ km}$   
 $V_i = 7537 \text{ m/s}$   
 $R = 4029 \text{ km}$

## CubeSats



## Glory



This Happened!  
The Cubes Separated





John F. Kennedy Space Center

Introduction



# Let's take a look at ELaNa

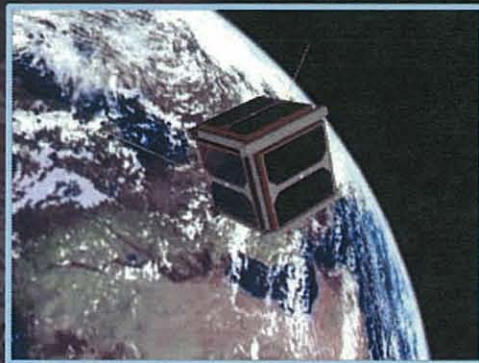


John F. Kennedy Space Center



# ELaNa

# Nanosatellite





John F. Kennedy Space Center



E **La** Na



Launch



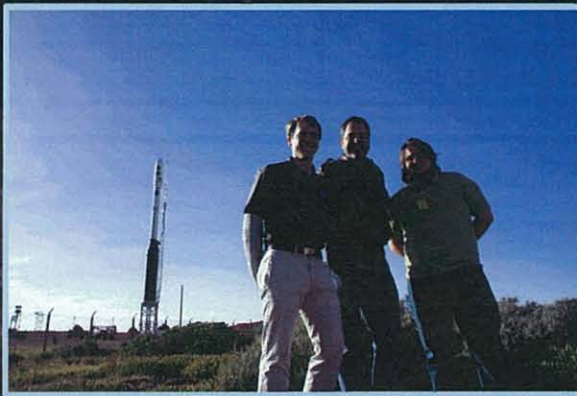
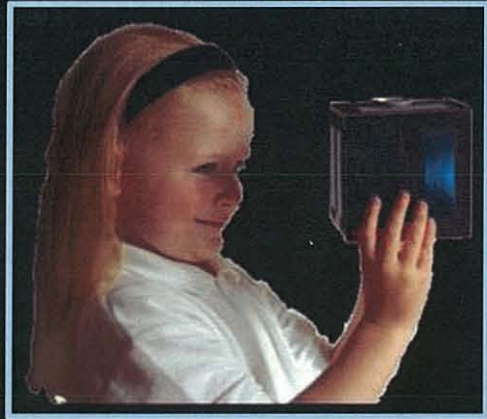


John F. Kennedy Space Center



ELaNa

Educational





John F. Kennedy Space Center



# Was ELaNa I a Success?

First NASA Selected  
CubeSat mission



Annual Call for  
CubeSats

Approval to fly on  
Glory



Lead the way to launch  
on other NASA vehicle

The design and build  
of CubeSat



Lessons Learned applied  
to future mission

Educational experience of  
working through a NASA  
Integration cycle



Students are prepared to  
enter the aerospace  
workforce



John F. Kennedy Space Center

Introduction



# What's Planned for the Future



John F. Kennedy Space Center



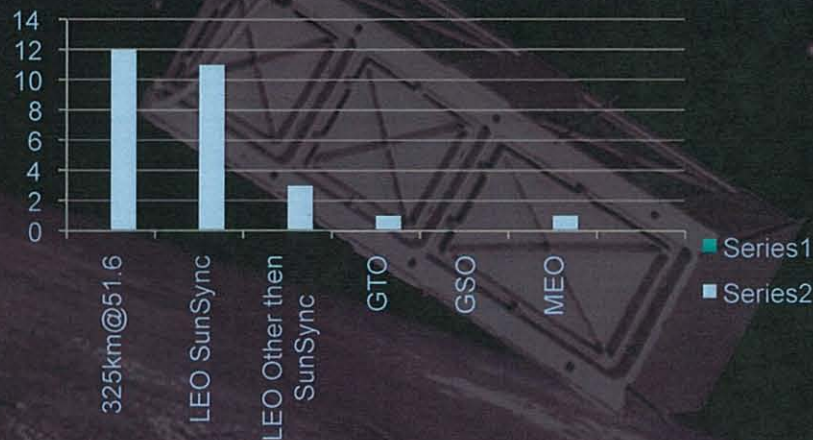
# Number of CubeSats

First Selection	First Initiative	Second Initiative	Prior Selected	Total	First Flight	Still to Fly
4	12	20	1	37	3	34

# CubeSat by Orbits

325km@51.6°	LEO SunSync	LEO other than SunSync	GTO	GSO	MEO
12	11	3	1	0	1

LEO is a Range of 350km to 650km







John F. Kennedy Space Center

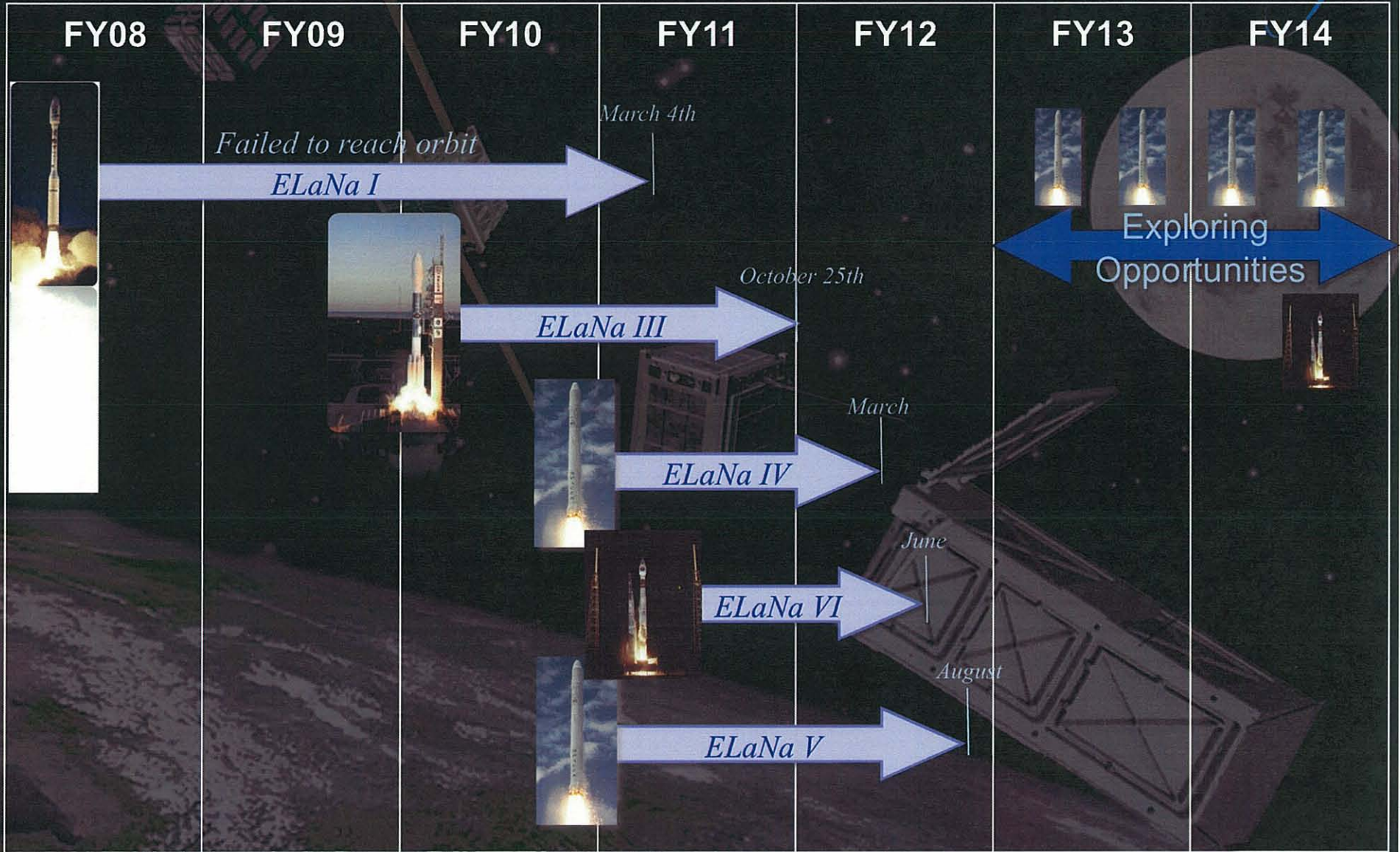


# NASA CubeSat Carriers

Atlas V		Delta IV	Delta II	Taurus XL	Athena	Falcon 9	
Common	ABC	Common	Struts Section	Aft End	Unknown	CRS	Fairing
Studied	In Development	Studied	In Development	Flown	Studying	In Development	Studied



John F. Kennedy Space Center





John F. Kennedy Space Center

## Introduction



Don't rest on your laurels  
...don't dwell on failure

*Let's Keep Moving Forward!*