John F. Kennedy Space Center

ELaNa

Educational Launch of Nanosatellite

LAUNCH SERVICES PROGRAM

"Science, Technology, Engineering, and Mathematics"

"Launching Education into Space"

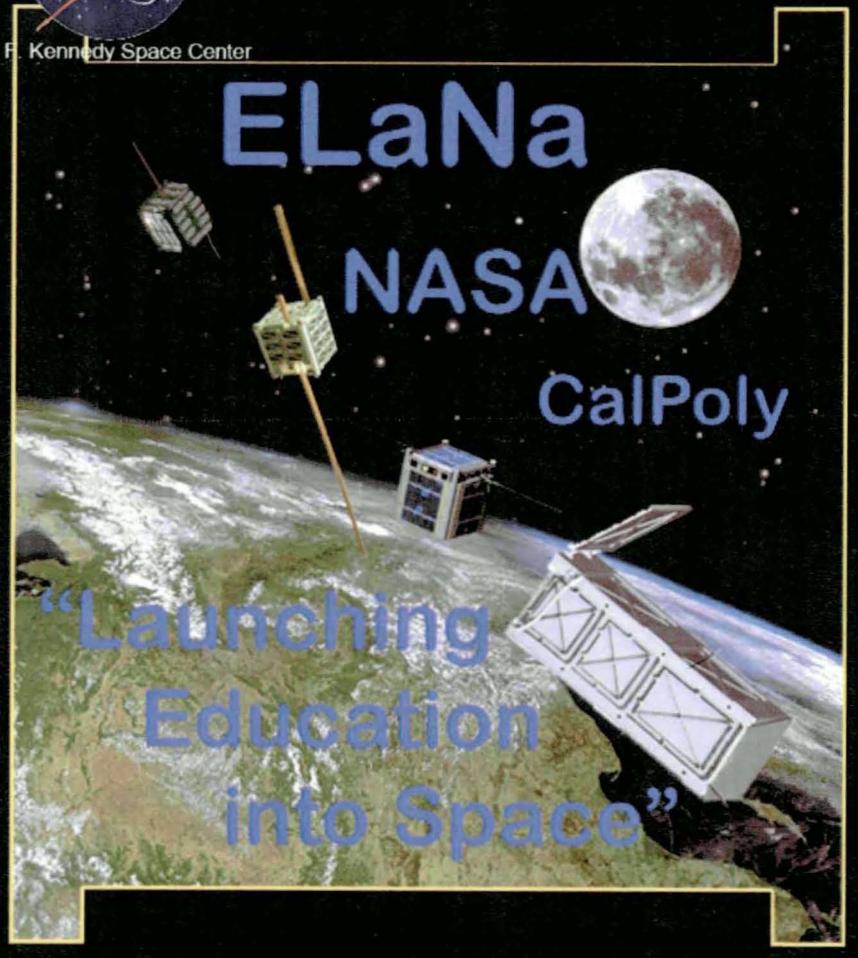
NASA

John F. Kennedy Space Center

ELaNa

NASA

CalPoly



"Launching Education into Space"

CUBESAT

California Polytechnic State University

PRIME

EXPLORER

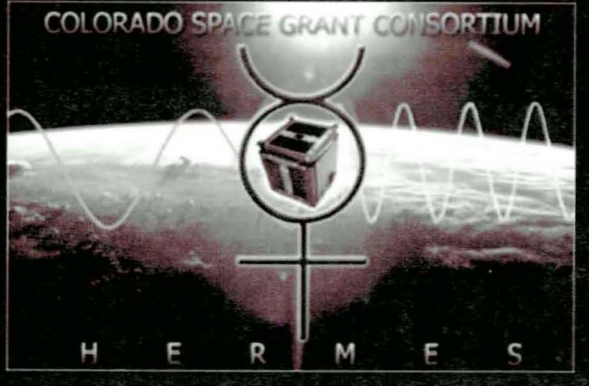
SPACE SCIENCE AND ENGINEERING LABORATORY

MONTANA STATE UNIVERSITY

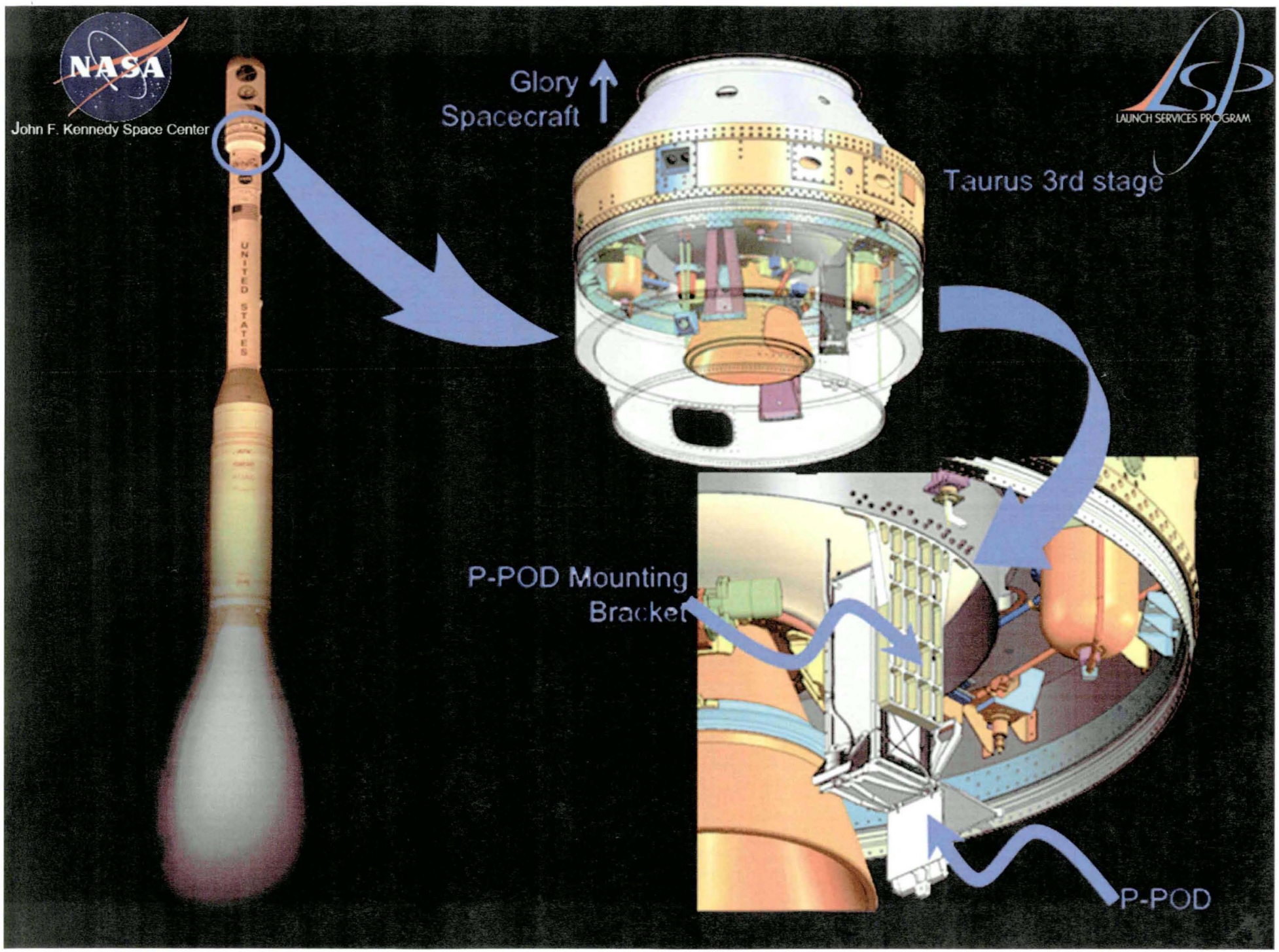
LAUNCH SERVICES PROGRAM

KySat™

COLORADO SPACE GRANT CONSORTIUM



H E R M E S


NASA
John F. Kennedy Space Center
LAUNCH SERVICES PROGRAM
Glory
Spacecraft
Taurus 3rd stage
P-POD Mounting
Bracket
P-POD

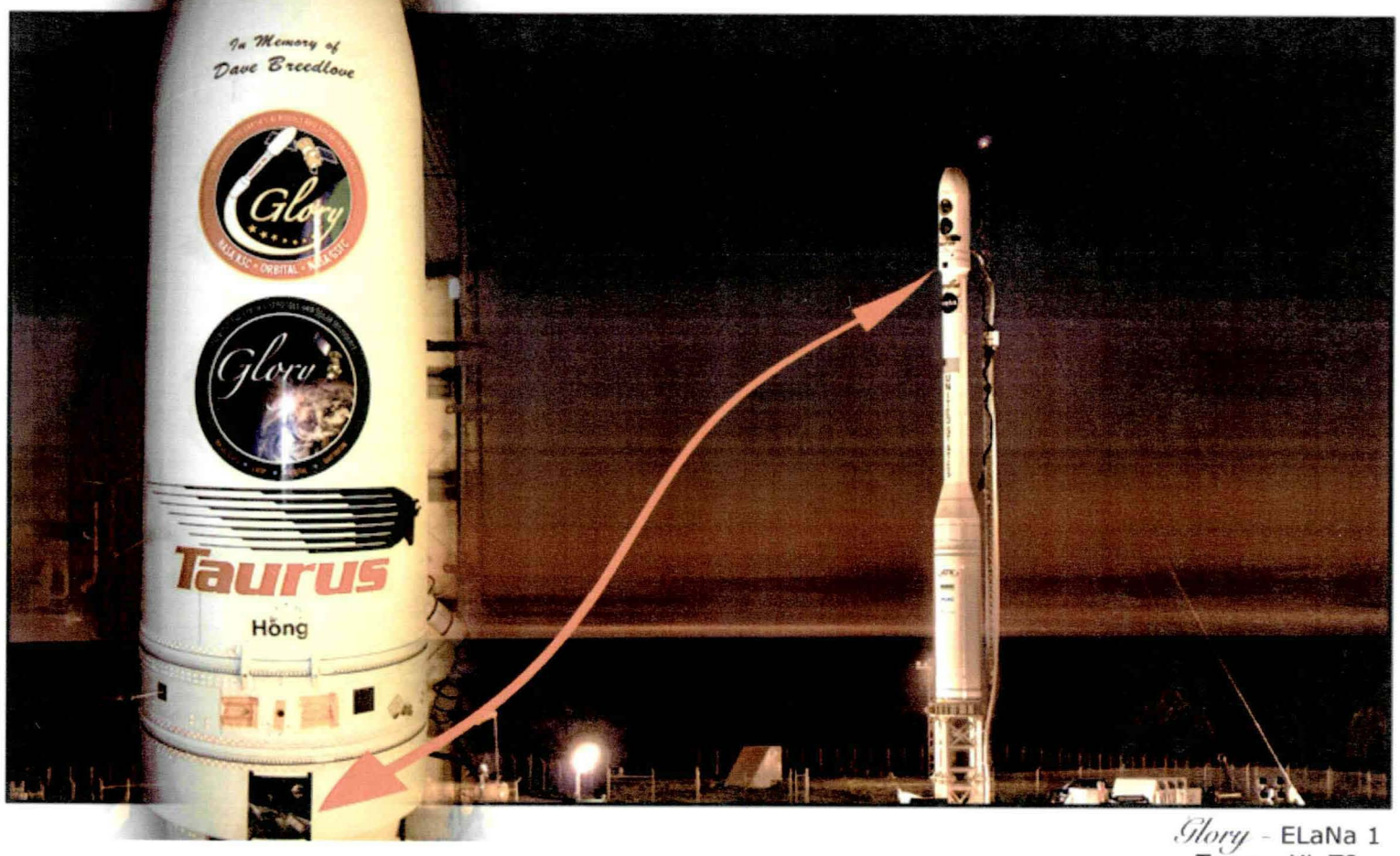
John F. Kennedy Space Center

LAUNCH SERVICES PROGRAM

Glory - ELaNa 1
Taurus XL T9

John F. Kennedy Space Center

LAUNCH SERVICES PROGRAM



Glory - ELaNa 1
Taurus XL T9

NASA

John F. Kennedy Space Center

Stage 2/3 Coast

Stage-2 Separation
T = 314.7 sec
h = 369.4 km
Vi = 6483 m/s
R = 1057 km

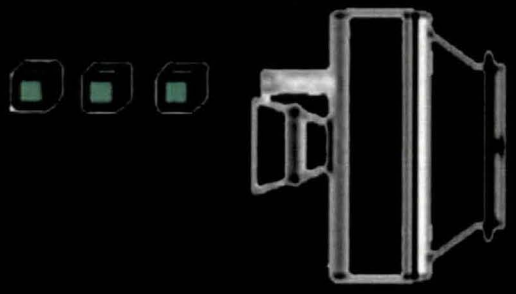
Stage-3 Burnout
T = 669.9
h = 640
Vi = 75 m/s
R = 63 km

Stage-3 Ignition
T = 5 7.7
h =
Vi =
R =

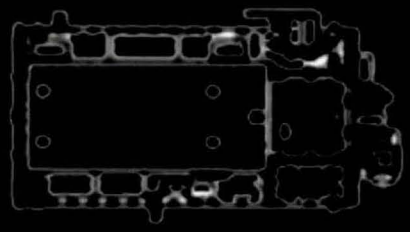
Glory Separation
T = 784.9 sec
h = 640.8 km
Vi = 7537 m/s
R = 3960 km

Cubesat Deployment
T = 794.9 sec
h = 640.9 km
Vi = 7537 m/s
R = 4029 km

CubeSats

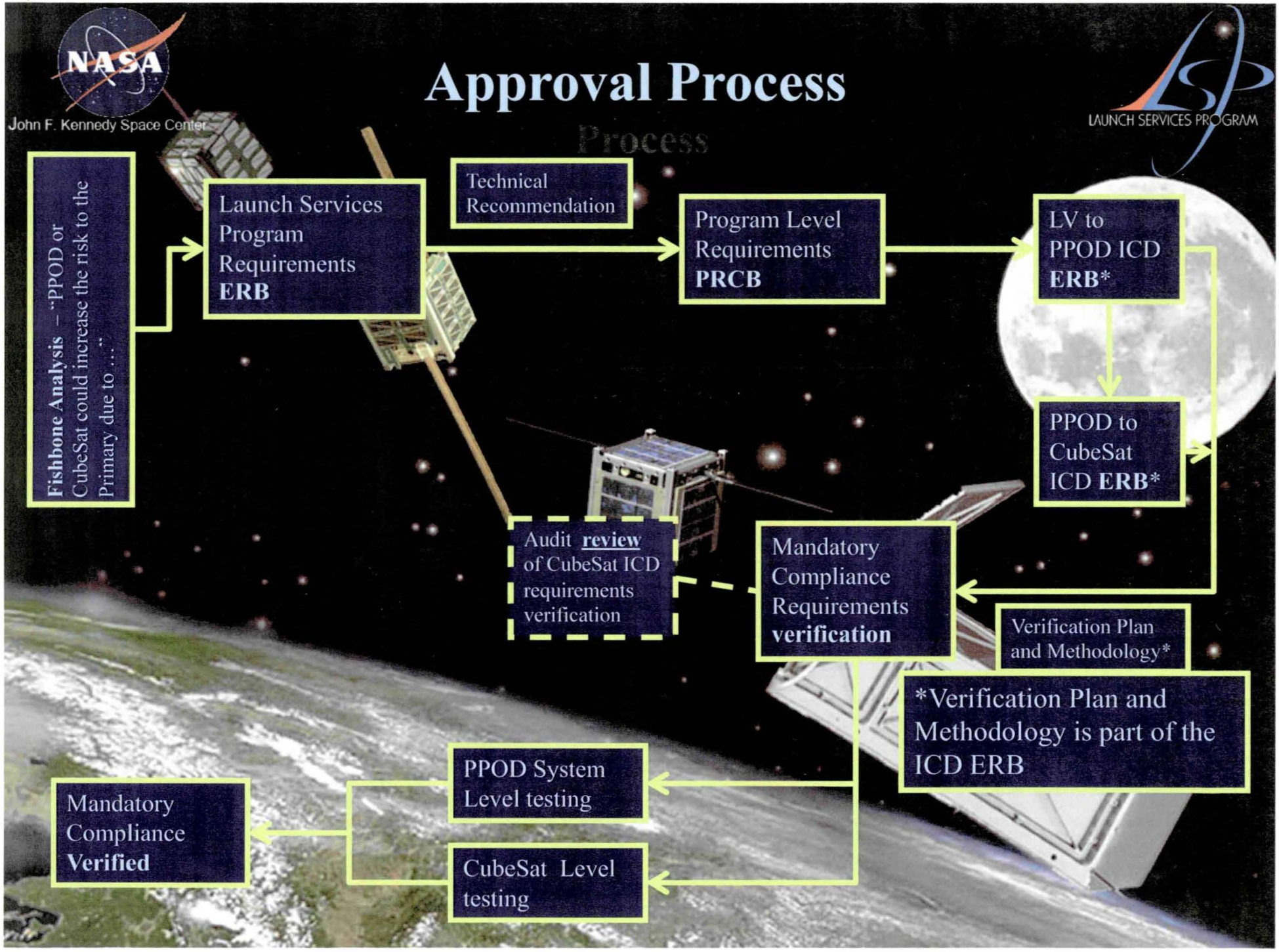


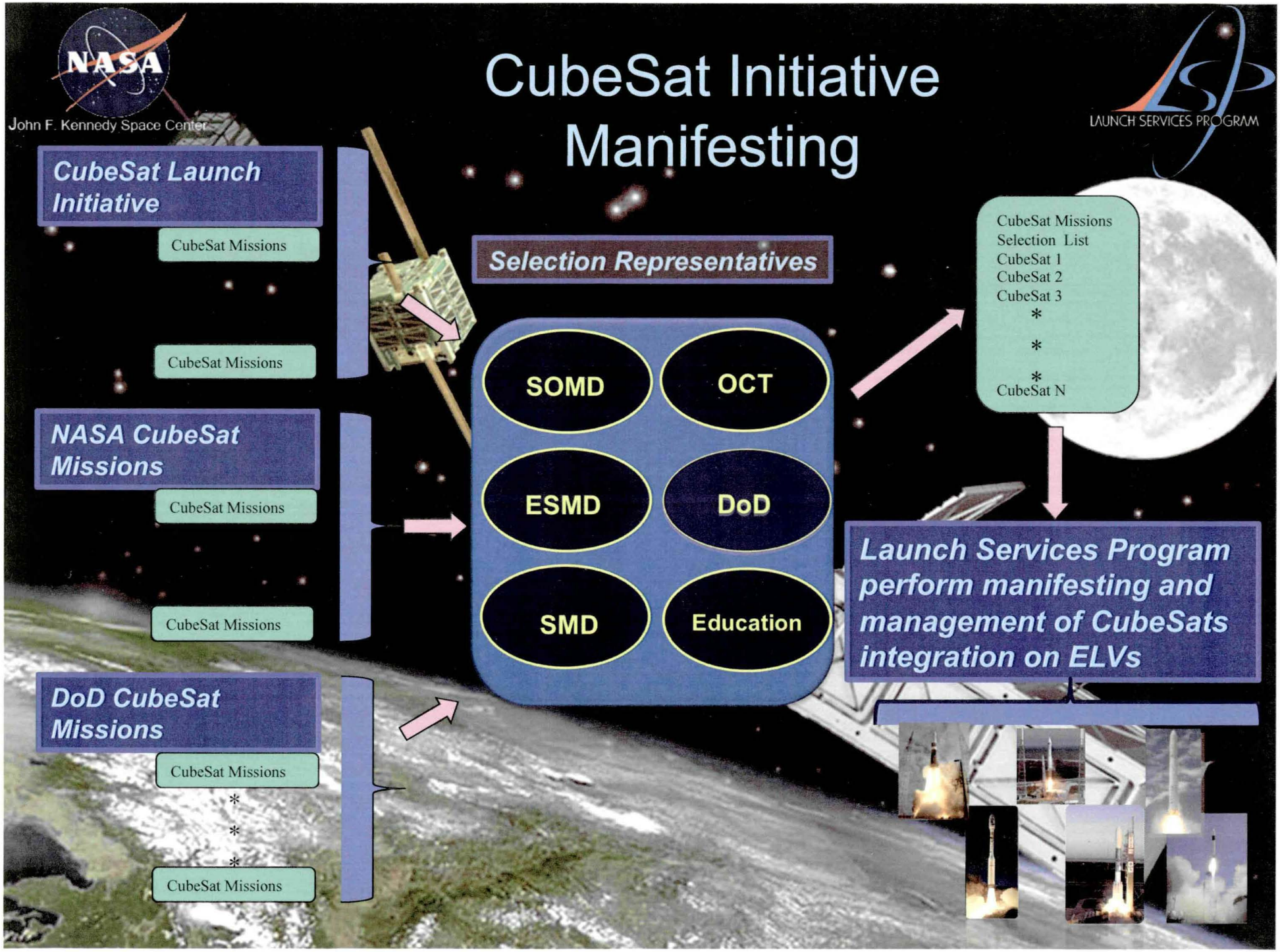
Glory



This Happened!
The Cubes Separated


NASA
John F. Kennedy Space Center
LAUNCH SERVICES PROGRAM
Approval Process
LSP P-POD CoFR Process
This process has been pre-briefed to the following
SOMD – July 1, 2009
SMD – August 4, 2009
OCE (charts only) – October 16, 2009
OSMA – October 28, 2009
Approved
Special FPB - January 6, 2010

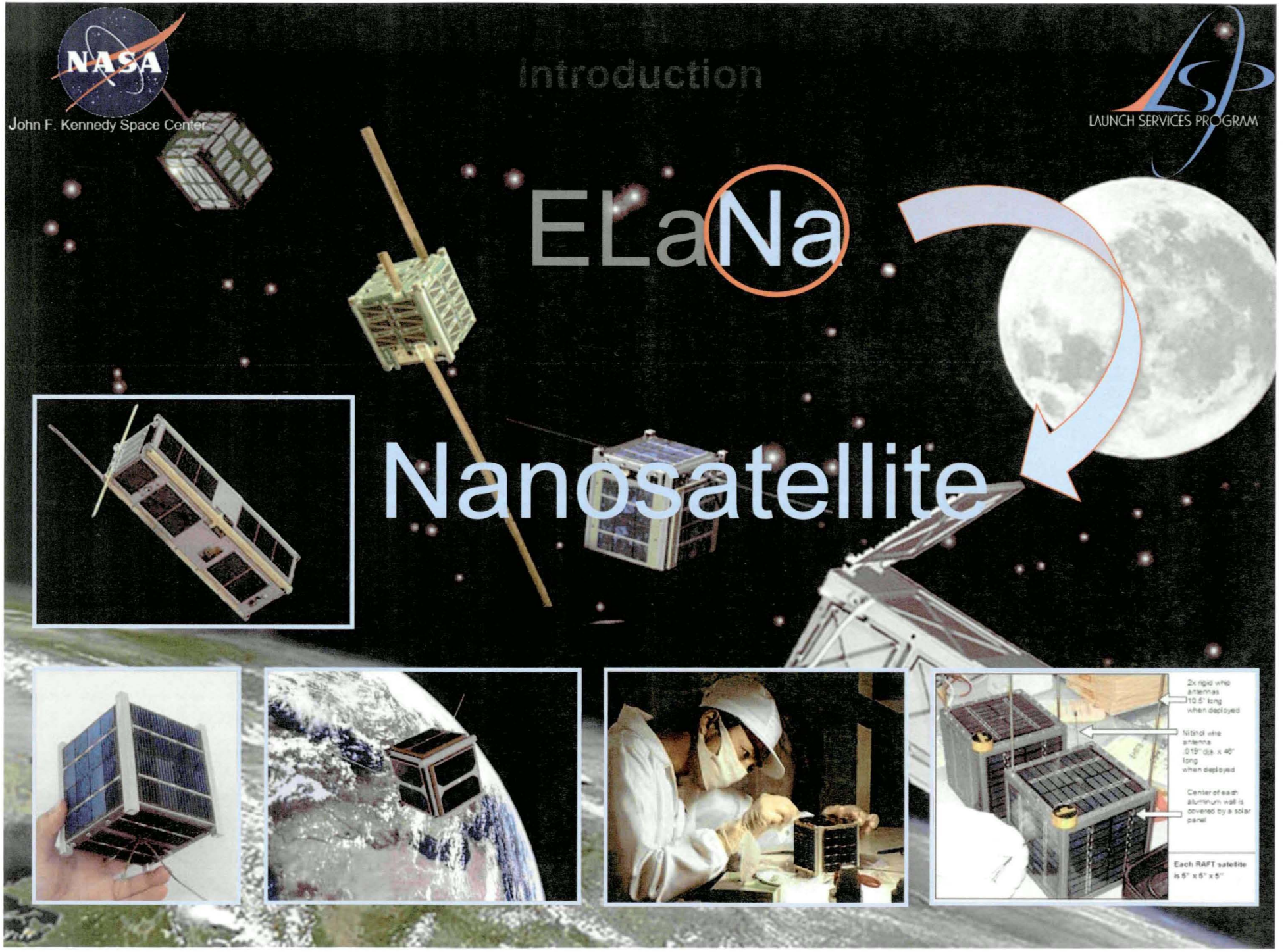

NASA
John F. Kennedy Space Center
Approval Process
Process
LAUNCH SERVICES PROGRAM
Fishbone Analysis – "PPOD or CubeSat could increase the risk to the Primary due to …"
Launch Services Program Requirements ERB
Technical Recommendation
Program Level Requirements PRCB
LV to PPOD ICD ERB*
PPOD to CubeSat ICD ERB*
Audit review of CubeSat ICD requirements verification
Mandatory Compliance Requirements verification
Verification Plan and Methodology*
*Verification Plan and Methodology is part of the ICD ERB
PPOD System Level testing
CubeSat Level testing
Mandatory Compliance Verified

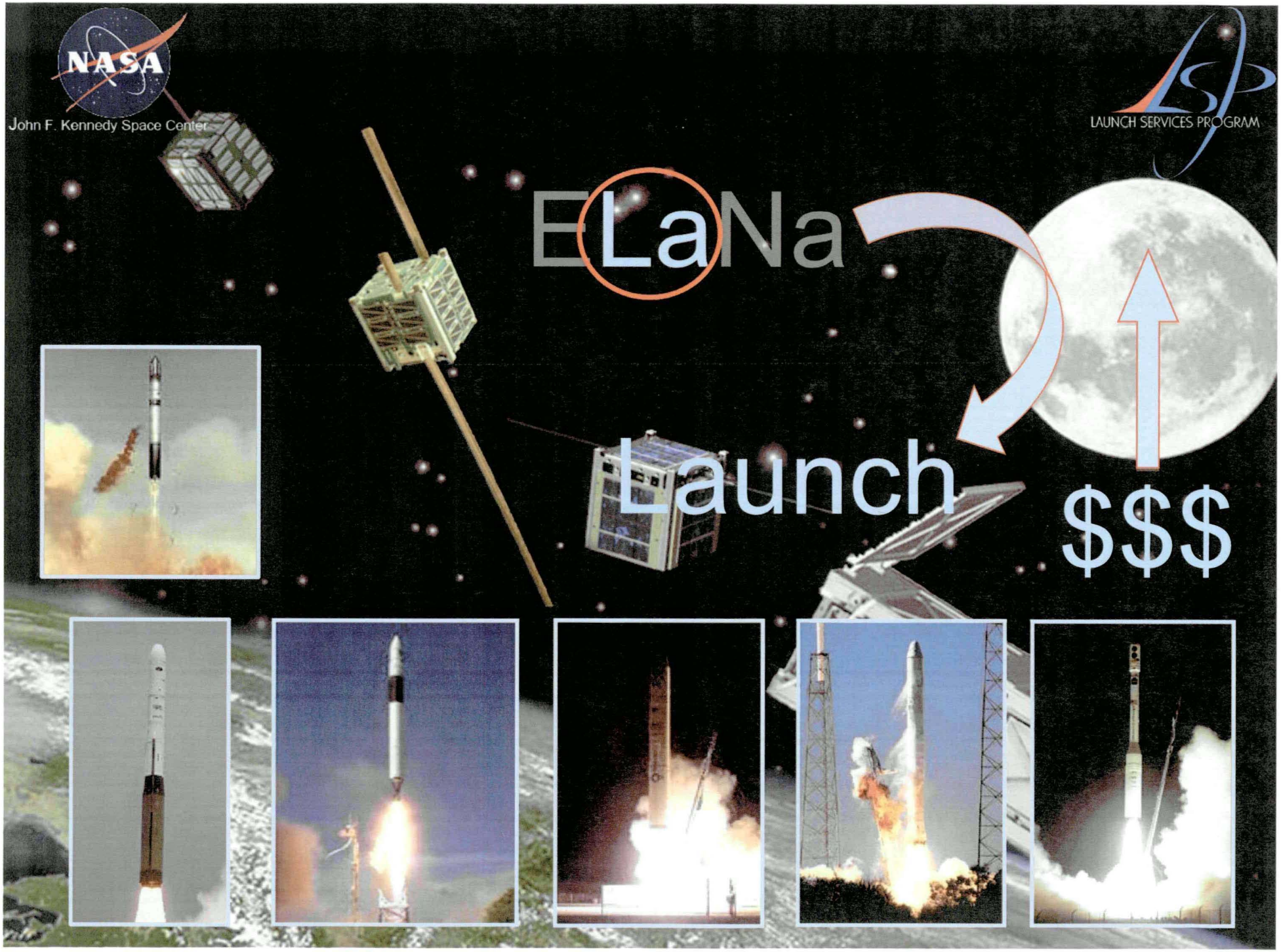

NASA
John F. Kennedy Space Center
CubeSat Initiative Manifesting
LAUNCH SERVICES PROGRAM
CubeSat Launch Initiative
CubeSat Missions
CubeSat Missions
NASA CubeSat Missions
CubeSat Missions
CubeSat Missions
DoD CubeSat Missions
CubeSat Missions
*
*
*
CubeSat Missions
Selection Representatives
SOMD
OCT
ESMD
DoD
SMD
Education
CubeSat Missions Selection List
CubeSat 1
CubeSat 2
CubeSat 3
*
*
*
CubeSat N
Launch Services Program perform manifesting and management of CubeSats integration on ELVs

John F. Kennedy Space Center

LAUNCH SERVICES PROGRAM

Let's take a look at ELaNa


NASA
John F. Kennedy Space Center
Introduction
LAUNCH SERVICES PROGRAM
ELaNa
Nanosatellite
2x rigid whip antennas 10.5" long when deployed
Nitinol wire antenna .019" dia. x 46" long when deployed
Center of each aluminum wall is covered by a solar panel
Each RAFT satellite is 5" x 5" x 5"


NASA
John F. Kennedy Space Center
LAUNCH SERVICES PROGRAM
ELaNa
Launch
$$$

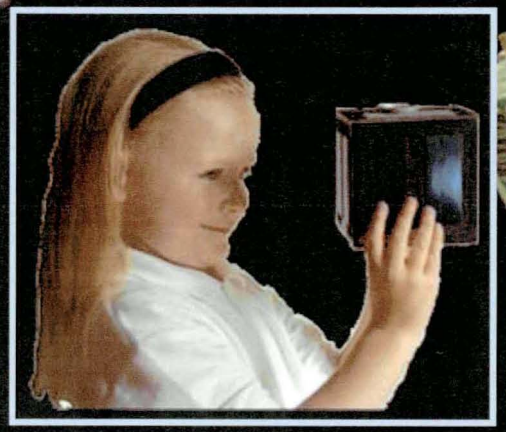
John F. Kennedy Space Center

LAUNCH SERVICES PROGRAM

Introduction

ELaNa

Educational



John F. Kennedy Space Center

LAUNCH SERVICES PROGRAM

Was ELaNa I a Success?

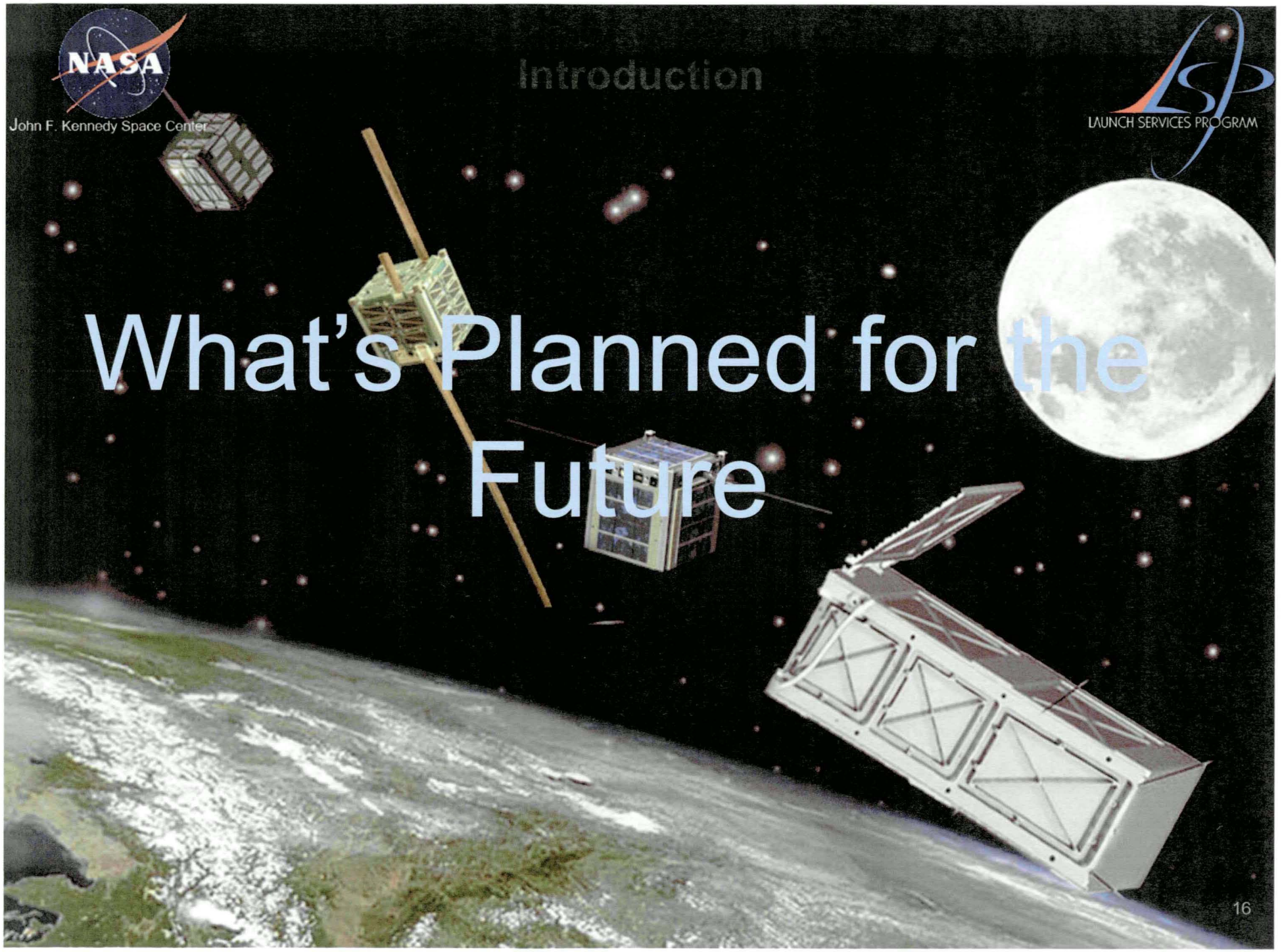
First NASA Selected CubeSat mission → Annual Call for CubeSats

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

What's Planned for the Future



NASA CubeSat Initiative

John F. Kennedy Space Center

LAUNCH SERVICES PROGRAM

Number of CubeSats

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

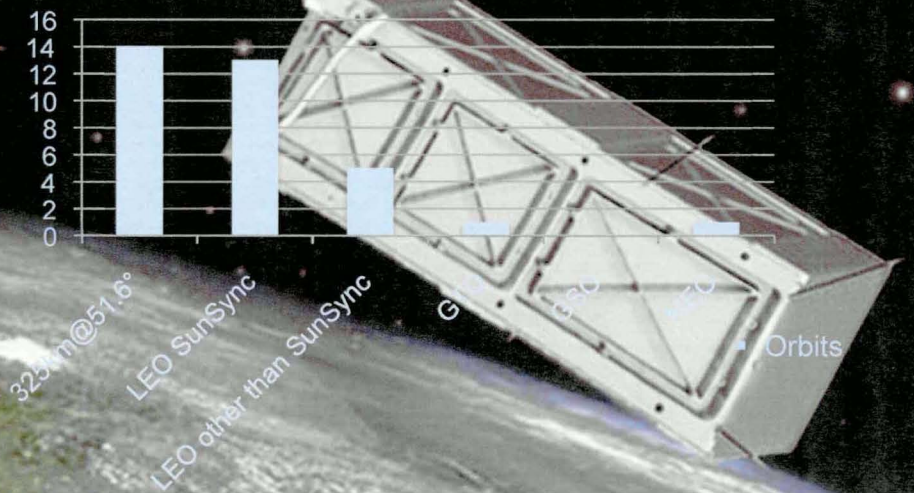
CubeSat by Orbits

325km@51.6°	LEO SunSync	LEO other then SunSync	GTO	GSO	MEO
14	14	5	1	0	1

LEO is a Range of 350km to 650km

Number of CubeSats Manifested

Currently Manifested
26



John F. Kennedy Space Center

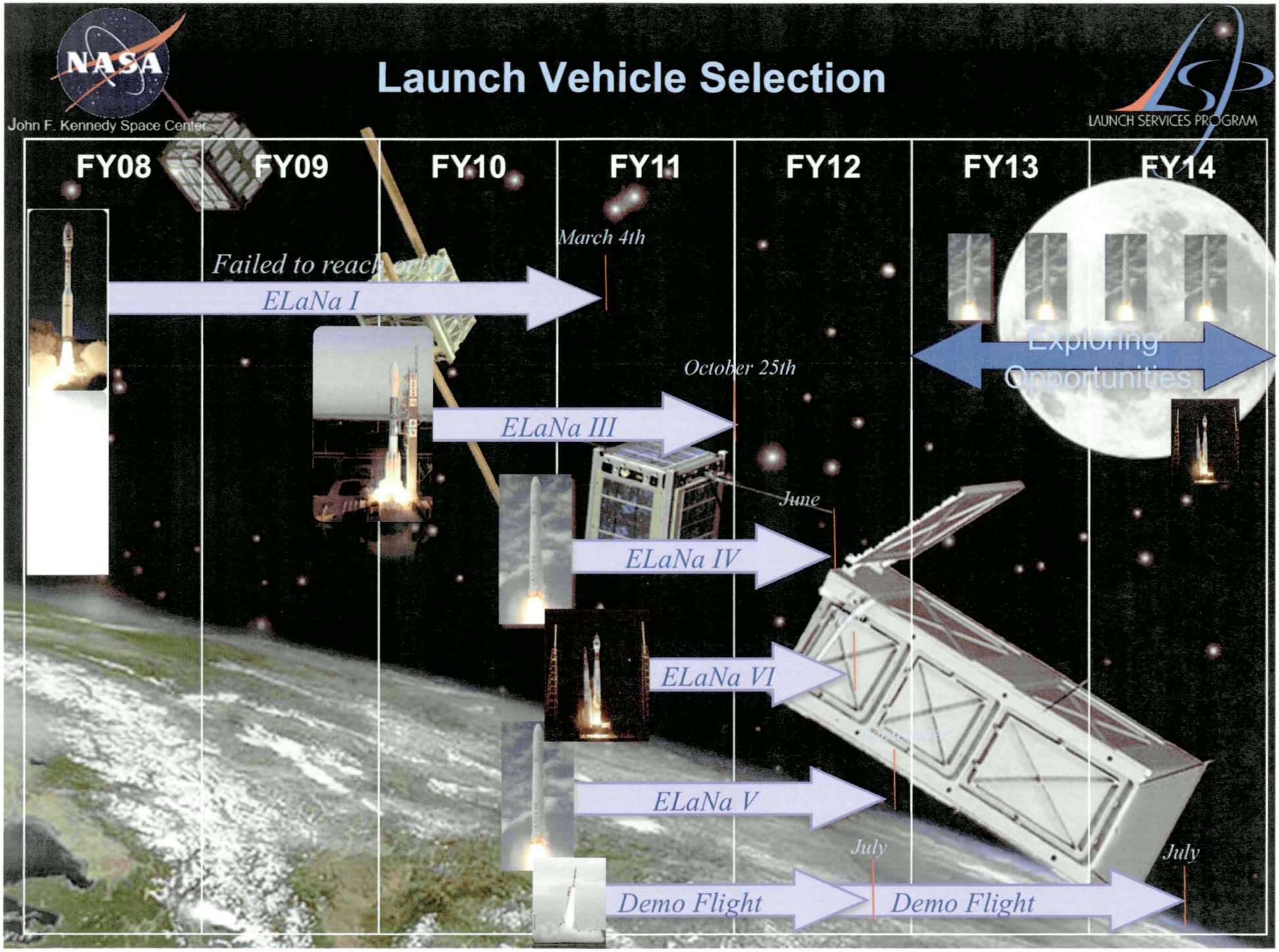
NASA CubeSat Carriers

LAUNCH SERVICES PROGRAM

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







NASA
John F. Kennedy Space Center
Launch Vehicle Selection
LAUNCH SERVICES PROGRAM
FY08
FY09
FY10
FY11
FY12
FY13
FY14
Failed to reach orbit
ELaNa I
March 4th
October 25th
ELaNa III
Exploring Opportunities
June
ELaNa IV
ELaNa VI
ELaNa V
July
July
Demo Flight
Demo Flight


NASA
John F. Kennedy Space Center
LAUNCH SERVICES PROGRAM
Don't rest on your laurels
...don't dwell on failure
Let's Keep Moving Forward!