Getting to Space and Capturing Experiments Data; A Multicolored Process

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Introduction

- Getting to Space briefing **to** NASA
  - What s wrong with this picture
  - Am I bringing Coals to Newcastle ?
    - > **Hopefully not!**
- Show how we fly experiments
- Show new ventures that are in the offing
- Will focus on Working Across Cultures

Who are we?

- Our group at Aerospace supports:
  - DoD Space Test Program (STP)
  - R&D Space & Missile Operations (RDSMO)
- Based in Albuquerque
  - Subgroup at Johnson SFC
- Composed of 22 program office types
  - Plus 6 from engineering matrix support
    - > From El Segundo

What Does STP Do

- DOD Program, managed by USAF
- Provides Support to a Prioritized List of Experiments
- Has about $55M Budget
- Services for reimbursable programs

10 Missions per Year

What Does STP Do for Experiments?

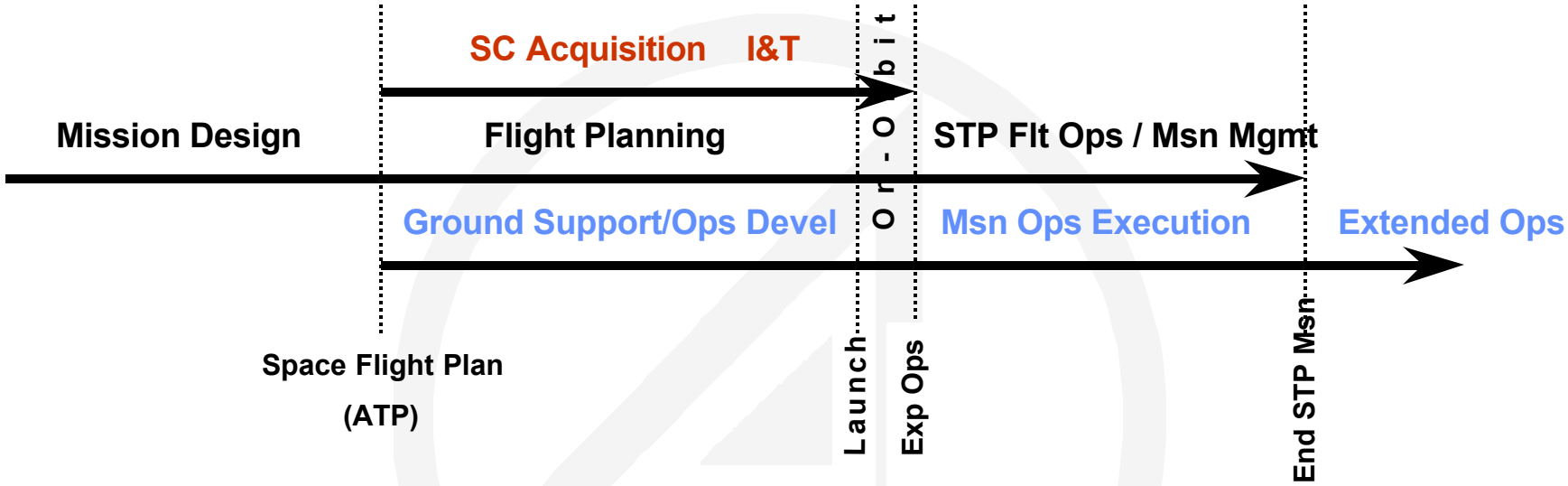
- Depends on what the experiments need:
  - Operations support
  - Launch support
  - Short ride to space (1 week)
    - > With or without power, attitude etc.
  - Long ride to space (>1 week; 1 year)
    - > With or without power, attitude etc.
  - Any combination of the above

STP Manifesting Truisms

- Must be on prioritized list to get STP funds
  - Funds are **NOT** for Experiment Development
- All things being equal, higher ranked experiments fly first.
- All things are never equal...
  - Payload Requirements & Spacecraft Capabilities
  - Schedule & Flight Opportunities *(e.g. Shuttle)*
  - Funding
  - Experiment Synergy

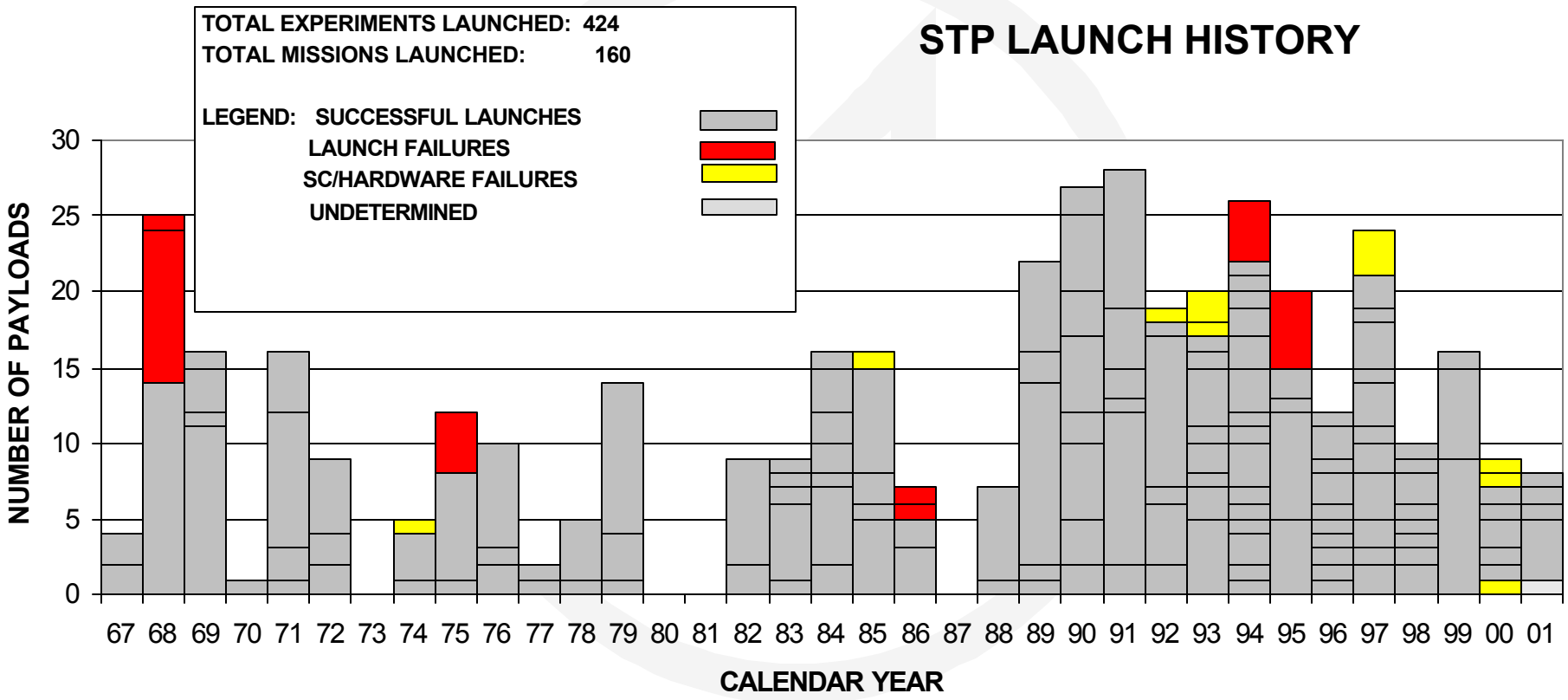
Target o Opportunity is o ten dominant actor

Current Status (Summer 02)



EELV 06	Coriolis	11-02	ISS		TSX-5	6-00
>IOMI / IMAGE	STS (5 flights)	02	> MISSE	8-01	MTI	3-00
>ESPA	SAVE (on DSP-23)	8-03	Kodiak Star	9-01	POGS-II	12-99
>TechSat-21	C/NOFS	11-03	> PICOSat		POAM-III	3-98
>STPSat-1	CloudSat	4-04	> PCSat		FORTE	8-97
>NPSat	Cosmic	2Q05	> Sapphire		RADCAL	6-93
VALPE	CMEWS (on				TEX	4-90
STS (4 CY03 flights)	NASA STEREO)	11-05				
DSP on STS-xxx						

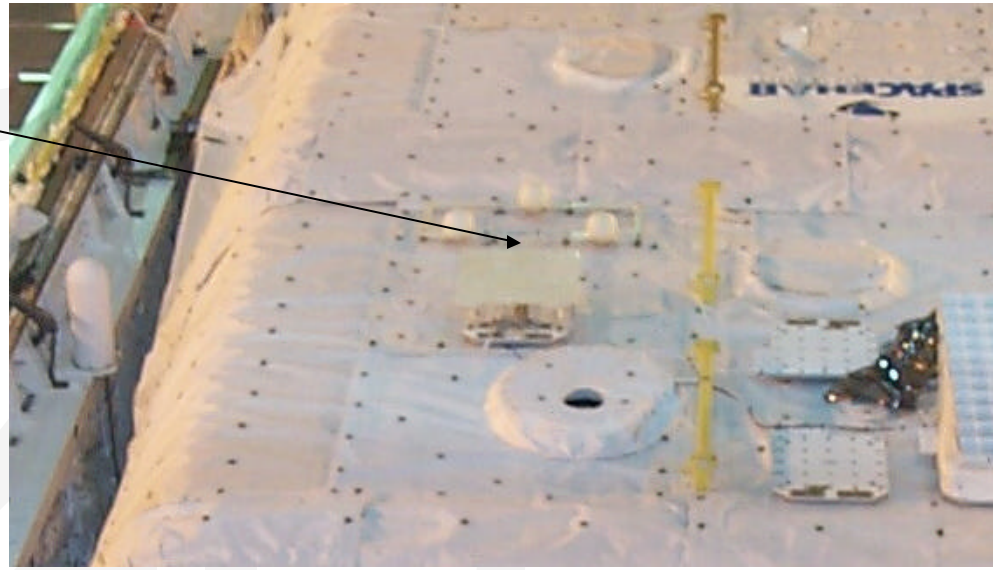
So What Has been Done?



How Was It Done?

- Finding All Ride Share Possibilities
- Finding Co-operative Agreements with Other Agencies

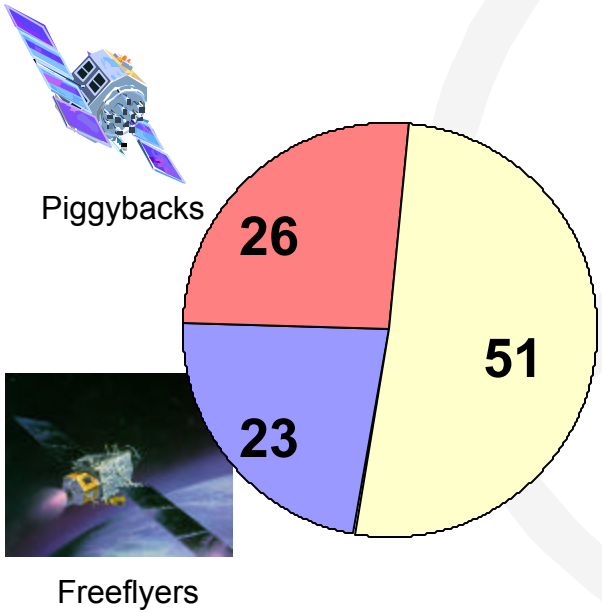
Some Fit Well on Shuttle



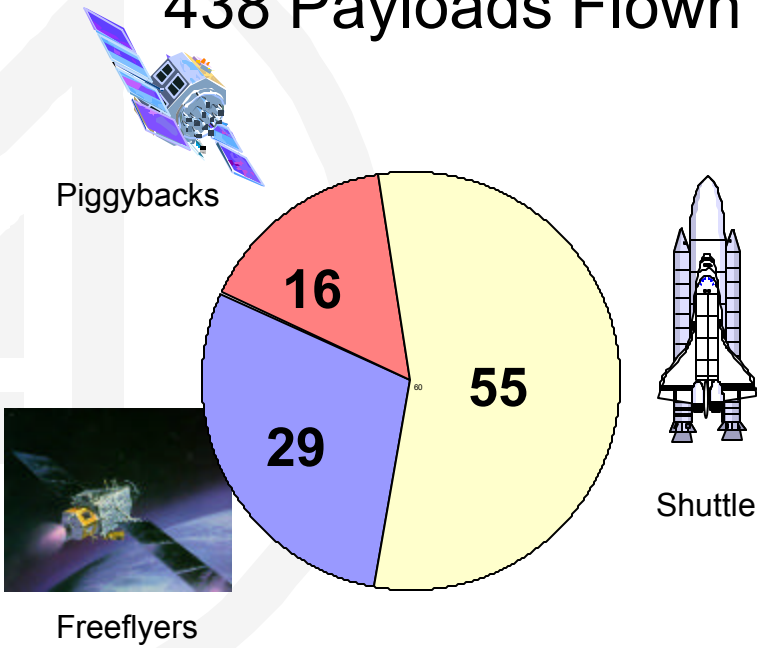
- MSTRS Experiment
- SpaceHab mounted
- RF Environment in Bay & RF Source Geo-Location
- Data-Sharing of RF Environment Lead to Greater Cooperation and Increased Experiment Time
- NASA JSC performed considerable extra effort to ensure operational compatibility
- NASA allowed Shuttle to Perform 15Deg. Roll Maneuver to Collect Data from Additional Ground Sources

STP Modes of Spaceflight
1965 - 2000

140 Missions Flown



438 Payloads Flown

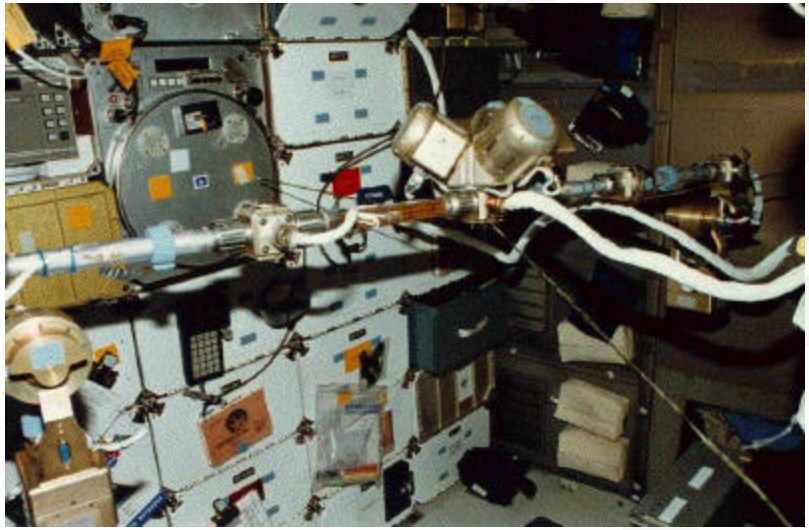


Taking Payloads to Higher Orbits

- Aerospace conceived requirements for a Shuttle-compatible small propulsion stage
  - To take payloads to longer life orbits
- AFRL has several SBIRs to develop concept
- STP will likely submit the stage as an experiment to fly on Shuttle
- Would provide SHELS-compatible system
  - That could be used by NASA & DoD to take payloads to different orbits (e.g. 125Kg from 190nm to 380nm)

Some Fit Well on ISS

MIDDECK ACTIVE CONTROL EXPERIMENT REFLIGHT (MACE-II)



Mission

Demonstrate and validate advanced adaptive learning algorithms as a means for controlling and/or removing external disturbances on a payload
STS-106 (8 Sep 00)
OPS (Jan 01 Dec 01)
Retrieval (Jan 02)

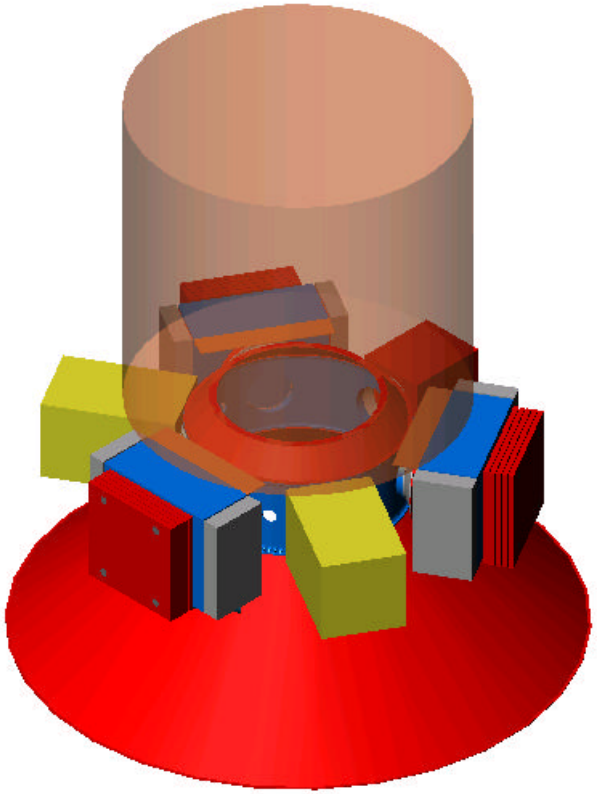
Piggibacks
(Experiments Riding on Another Spacecraft)

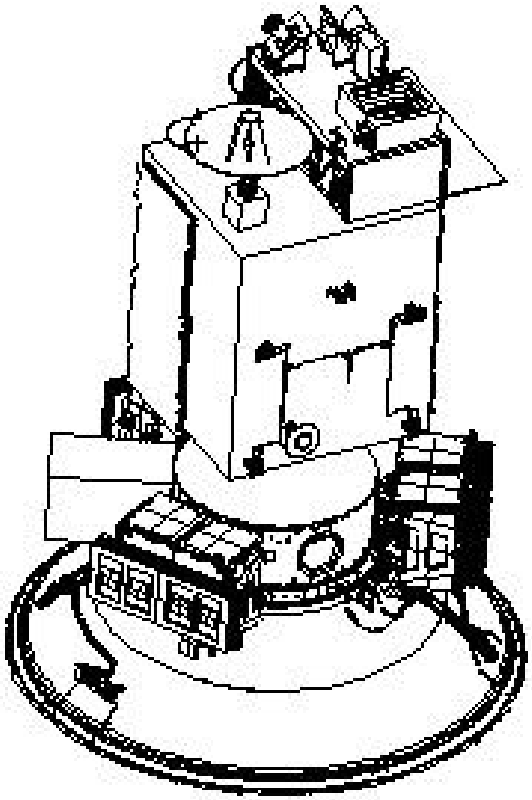
- After Shuttle, very cost effective
- Several examples available
- Most challenging :
  - Integrating the POAM experiment on the French SPOT satellite.
  - Integrating an experiment from the Balkans on the MTI (Sandia) Satellite

EELV in 06

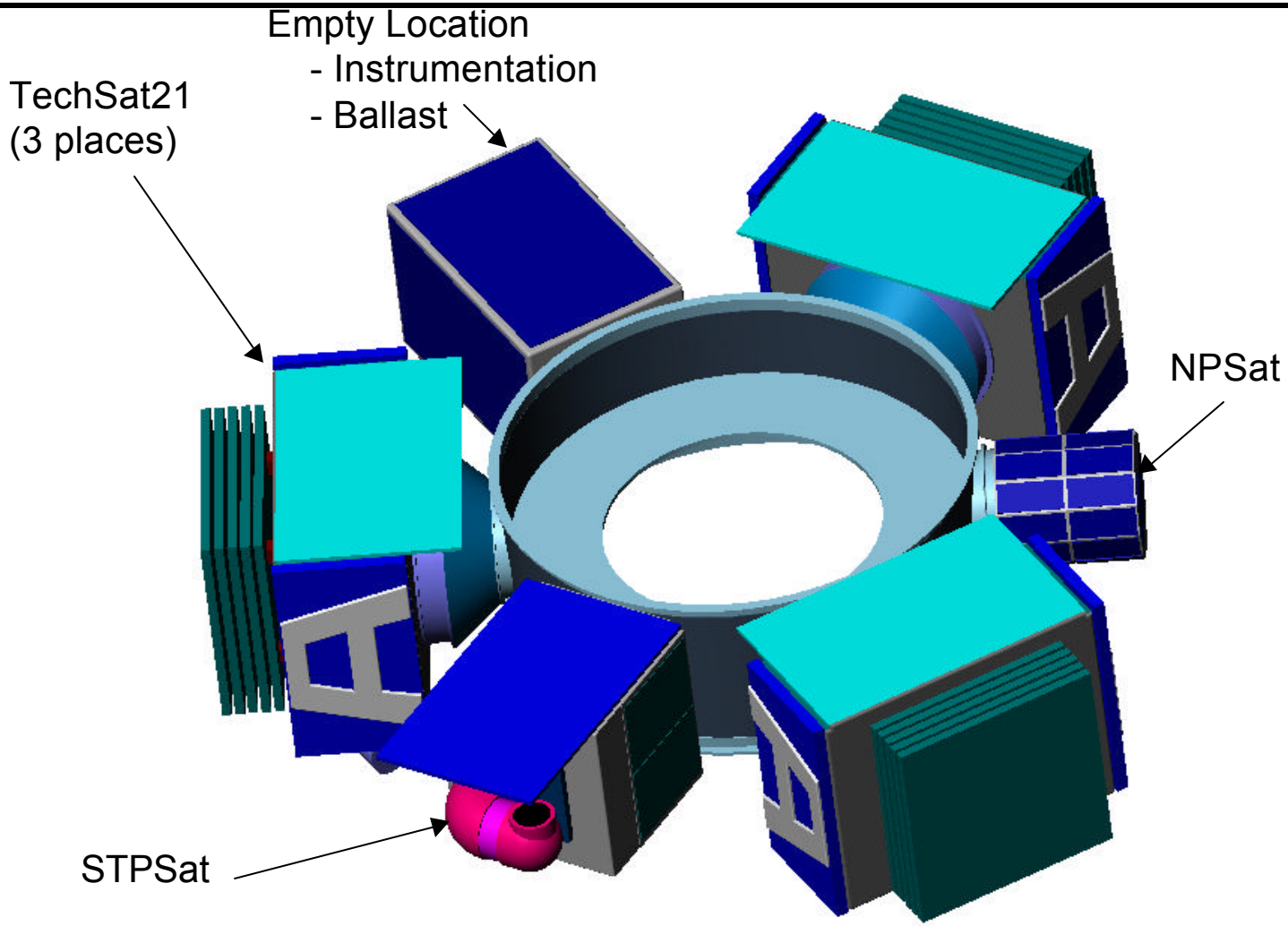
- STP has Delta IV
- Primary Payload is GIFTS/IOMI
  - Joint NASA/NAVY program with an STP experiment (IMAGE)
- Five additional secondary payloads
  - Mounted on EELV Secondary Payload Adapter
    - > Three Techsat 21
    - > STPSat-1
    - > NPSat

Integrated Payload Stack





Secondary Payload Integration Activities



Evolved Expendable Launch Vehicle Secondary Payload Adapter (ESPA)

- A New Delivery System for Small Satellites
- Conceptualized by STP, Aerospace, & AFRL

ESPA Conceptualization

- Capability to launch multiple small satellites (200 kg) economically
- Foreign secondaries capabilities (e.g.ASAP on Ariane) unavailable to US Military
- Small satellites are increasingly important and capable
  - Inexpensive way to demonstrate new space technology
  - Autonomous Formation Flying of Spacecraft Clusters (e.g. Sparse Aperture)
  - Test prototype operational hardware
- EELV will perform all DoD medium & heavy spacelift
  - Most manifested DoD EELV missions have usable margin
    - > Margins range from 45 kg (99 lbs) to >3628 kg (8000 lbs)
  - Secondary payload capability would take advantage of usable margins

ESPA will utilize excess margin to launch up to six small satellites and the primary payload

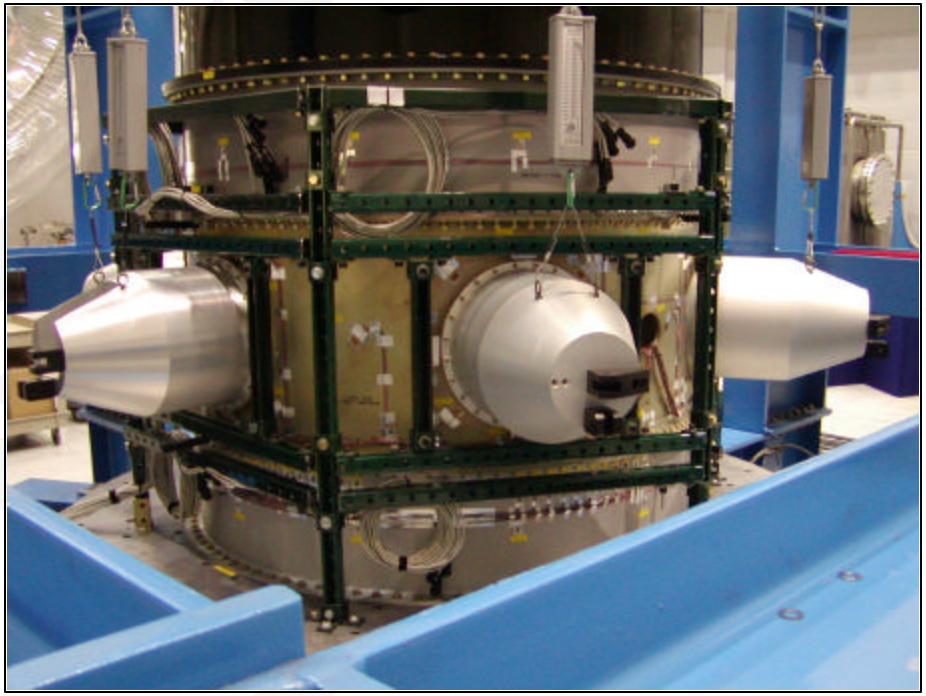
Margins

- EELV Contract is Unique (Launch Service)
- Mass margin allocation being reviewed
- Secondary payloads could form coop agreement with Primary Payload
  - Provide single interface to EELV

ESPA EDU

ESPA Status

- Engineering Development Unit (EDU) load testing completed June 02
- EDU load test final report in work at CSA, Mountain View, CA
- Final report briefing anticipated late-August 02
- Flight unit fabrication underway at Votaw, Santa Fe Springs, CA
- Flight unit currently scheduled for completion & shipment on 21 Oct 02



ESPA EDU in Crusher Load Test Fixture at AFRL, Kirtland AFB, NM

Conclusions for ESPA

- ESPA will be new US capability for secondary payloads
  - Standard Interface
  - Low Cost
  - Low Visibility
- Provides for efficient use of EELV s throw capability
- Some Primary Payloads willing to use ESPA (e.g. DMSP)

Operation Support
JPL CloudSat: Uncertain Beginnings

- JPL Program Constrained by Funding Cap
- Obtained Assistance from STP
  - In Exchange for Data
  - Funding for Operations Support and Orbit Formation Flying
  - Constrained by Funding Cap
- Two Organizations & Two Funding Caps
  - Recipe for Disaster and Acrimony

CloudSat: JPL/AF Interactions

- Early involvement of operations organization
- JPL Maintained Team Approach
  - Not US vs. THEM
  - Respect for team members
- Solution Oriented Program
- Proactive vs Reactive
- Respect for Team Members
- Excellent Communications
- Early Delineation of Roles & Responsibilities
- Understanding Other Team s Constraints

CloudSat: Formation Flying

- Mission to be flown from Albuquerque (RSC)
- JPL established formation requirements with other EOS space vehicles
  - Designed maneuvers for initial formation acquisition
- Aerospace (ABQ) worked with RSC to design formation maintenance algorithms
  - Compatible with existing capabilities
- JPL lead engineer fostered cooperative effort
  - Frequent Interactions

Cloudsat: Successful Interactions

- When Budget Cuts were Proposed
  - Greater Communication Between Sides
    - > Not: Look What Those @#%*& Are Doing to Us
  - Made Higher Echelon Aware of Stake
- Flexibility of Positions Shown by Both Organizations
- Work the Bureaucracies
- Understanding of the Processes of the Other Team
- RESULT: Cooperation resulted in minimizing cuts while continuing to meet mission requirements

In Summary

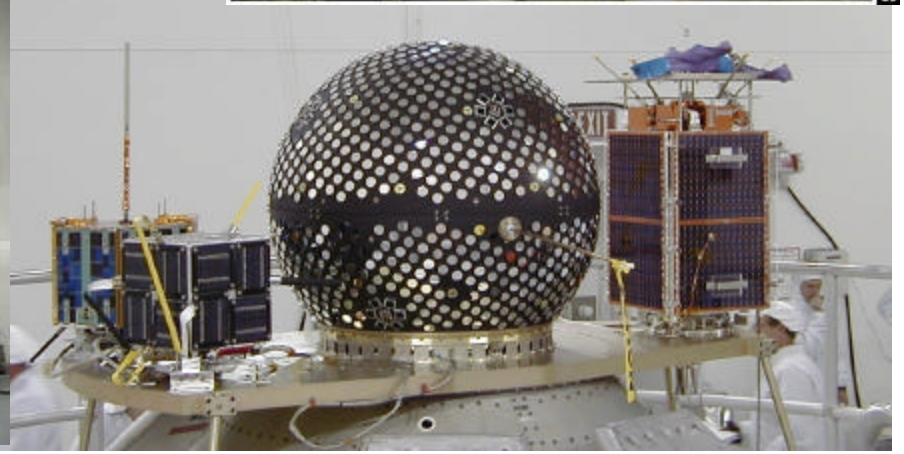
- STP has Successful Record
- Ride Sharing is Cost-Effective
- Ride Share Requires CO-OPERATION
  - Encourage it
- Willingness to Adapt to Other Culture
  - Retaining Essential Parts of Your Culture
- Encourage New Concepts
  - ESPA, IEP, Propulsion Stage
- We don t do it this way, here Has To Be Challenged.

BACKUP

Launch Vehicle Support

- If experiment comes as a space-vehicle
  - Launch Vehicle Selection
    - > SV Mass & Volume
    - > Orbit Requirements
  - Integration
    - > Mechanical & Electrical Interfaces
    - > LV Environments & Coupled Loads
    - > Contamination Control
  - Launch Site Support
    - > Safety: MSPSP, Hazardous Ops
    - > Processing: PPF Selection, Procedure Review, Integrated Testing

KODIAK STAR MISSION



Requirements

- Maintain mechanical and electrical interfaces to prime payload.
  - Replicate EELV standard interface above ESPA
- Primary payload capability
  - maximum 6,803 kg (15,000 lbs)
- Support up to 6 secondary satellites
  - Study by Aerospace Concept Development Center
    - > 181 kg (400 lbs) each
    - > Volume 61x61x97cm (24X24X38)
- Standard Interface to Secondary Payloads
  - 15 Bolt Circle