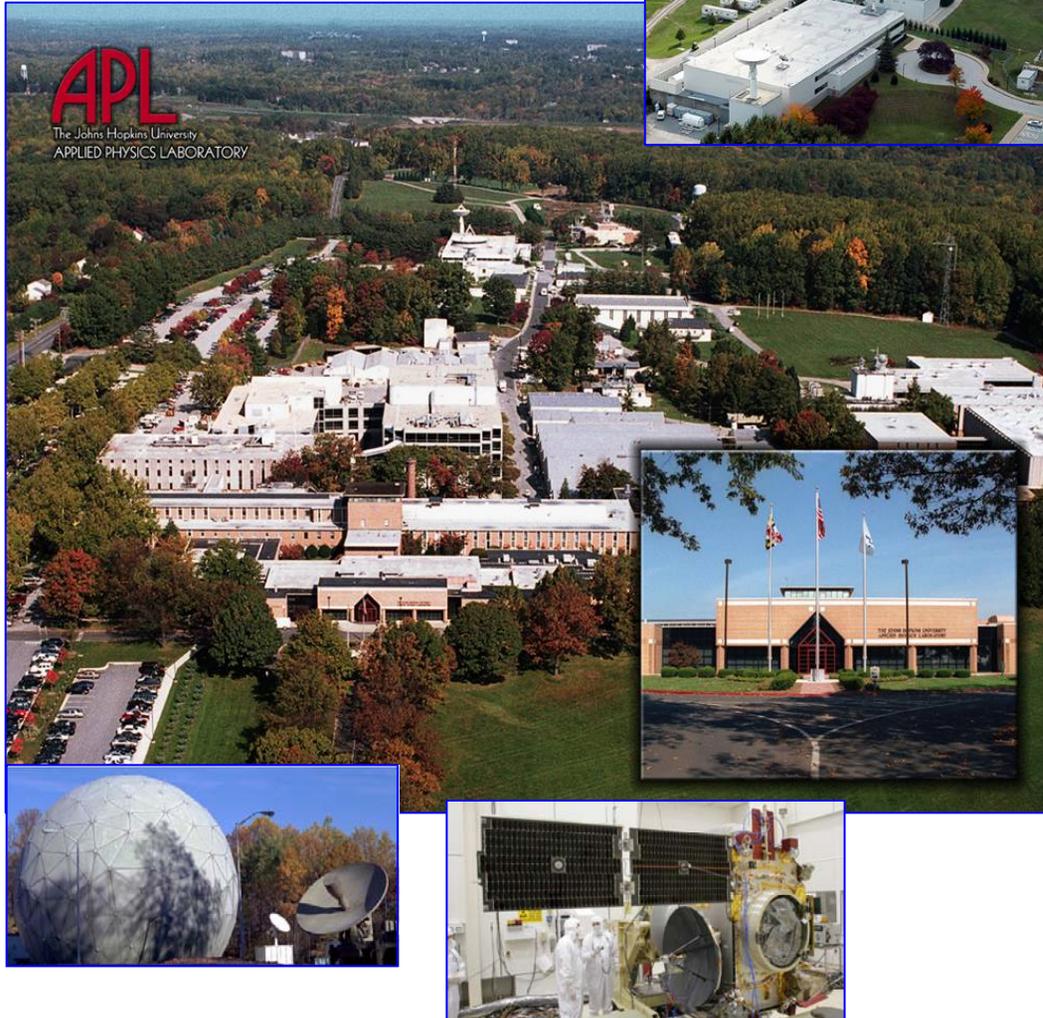


# JHU/APL CubeSat Initiatives

***Andy Lewin***  
***19 April 2007***

**APL**  
*The Johns Hopkins University*  
APPLIED PHYSICS LABORATORY

# Who is JHU/APL?



- **Not-for-profit University research and development laboratory**
  - DoD chartered “University Affiliated Research Center” (UARC)
  - Founded 1942 (in space since 1957)
- **Staffing: 4,200+ employees (70% scientists & engineers)**
- **Business areas:**
  - Air & Missile Defense
  - Biomedicine
  - Civilian Space**
  - Homeland Protection
  - Infocentric Operations
  - National Security Space**
  - Precision Engagement
  - Science & Technology
  - Strategic Systems
  - Undersea Warfare
  - Warfare Analysis



# A tradition of “Firsts” in space since 1958

1958 **Satellite Navigation System**

1961 **Nuclear-powered spacecraft**

1963 Gravity gradient stabilization

1967 Color picture of the full Earth

1972 Drag-compensated satellite

1975 Pulsed plasma thrusters

1982 **Autonomous satellite navigation with GPS**

1984 Artificial comet

1986 **Intercept of a thrusting target in space**

1988 Autonomous target acquisition and track

1996 Hyperspectral Imager in space (MSX)

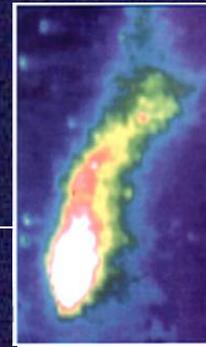
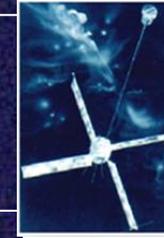
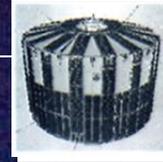
1996 Invention of Polymer Battery

2001 **Landing on an asteroid (NEAR)**

2003 Re-Configurable Self-Repairing Processor (on FEDSAT)

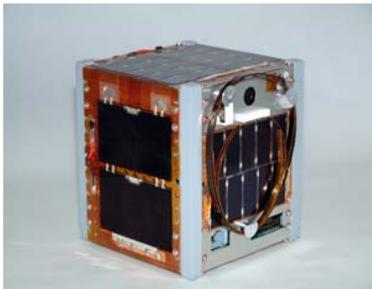
2004 Orbital Mercury exploration mission launched (MESSENGER)

2006 Mission to Pluto (New Horizons)

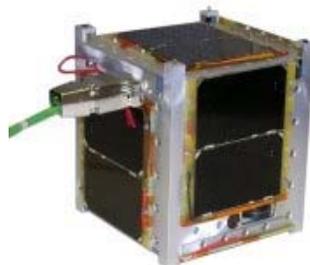


# CubeSat Community Involvement

- JHU/APL recognizes the presence of a vibrant university space community
- In October 2006, APL Space Department management approved a series of initiatives
  - Advocacy for CubeSat/nanosatellite secondary payloads on missions in which APL is involved
  - Support the university space community
  - Sponsor student interns
  - APL CubeSat development



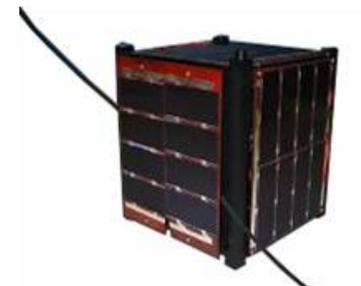
XI-V (U. of Tokyo)



MEROPE (Montana State)



ICE Cube 2 (Cornell)



SEEDS (Nihon U.)

# University Access to Space

- APL is advocating for inclusion of CubeSats and/or nanosatellites on our missions
  - One very promising opportunity in CY08/09
- What can you do to help?
  - Demonstrate technologies/capabilities of interest to the sponsor community
    - Anything that enhances the primary payload's mission is particularly valuable
  - Develop advocacy materials
    - Fact sheets
    - Presentations
    - Risk mitigation descriptions



Flight PPODs from  
Jul 06 DNEPR launch

# Support the University Space Community

- APL space department has agreed to make many of its capabilities available on a low- or no-cost basis
  - Personnel (scientists, engineers, managers) for peer review and advising
  - Environmental test facilities
    - Cost of materials only
    - Non-interference basis with other JHU/APL work
  - Satellite communications facility
    - 5-, 10-, and 18-meter dishes
    - Significantly discounted rate



Environmental Test Facilities



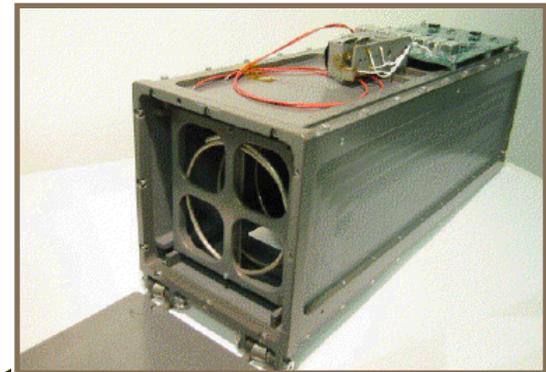
Satellite Communications Facility

# Student Internships

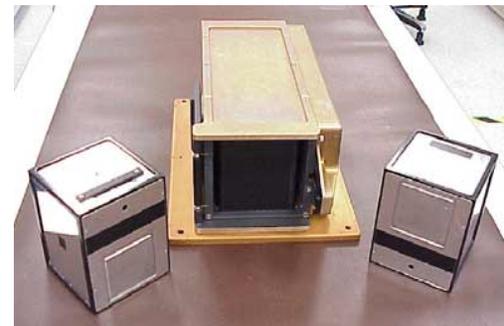
- **APL currently offers student summer internships**
- **APL may link additional summer internships and/or part-time employment to students working on APL CubeSats**

# APL CubeSat Initiatives

- **Objective: Improve access to space for APL-developed technologies**
- **Why CubeSats?**
  - **Best opportunity to establish secondary launch opportunities:**
    - **Proven deployer**
    - **Multiple launches on many different launch vehicles**
    - **Small size and mass**
  - **Well established technical standard**
  - **Emerging community of low-cost university and commercial hardware providers**
- **CubeSats may enable high-value science to be performed by swarms of spacecraft**



PPOD  
Deployer



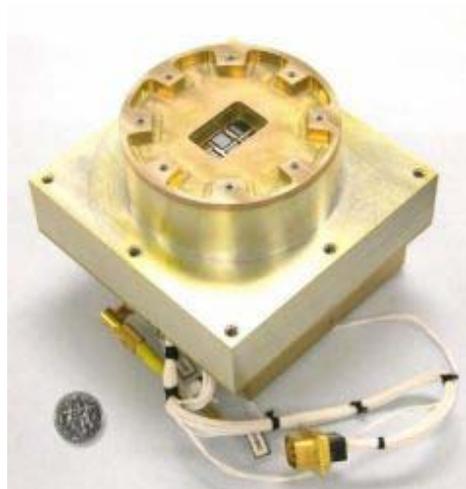
MEPSI (Aerospace Corp.)

# APL CubeSat Implementation Approach

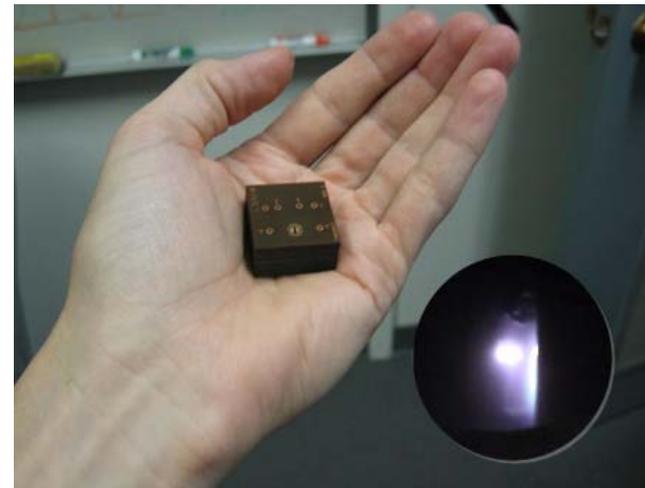
- **Goal:** Perform entire CubeSat missions at a cost that is affordable on modest IR&D funds
- **Approach:** Fly APL payloads on university-built buses
  - APL seeking partnerships with potential CubeSat bus providers
  - APL staff provide mentoring and review to reduce risk and enhance training value for students
  - Seek external sponsors where possible to enable more ambitious projects



**MEMS Thermal Louvers**



**FlAPS (Flat Plasma Spectrometer)**



**Embedded Micro Liquid Pulsed  
Plasma Thruster**