Montana Reaches Space (finally!)

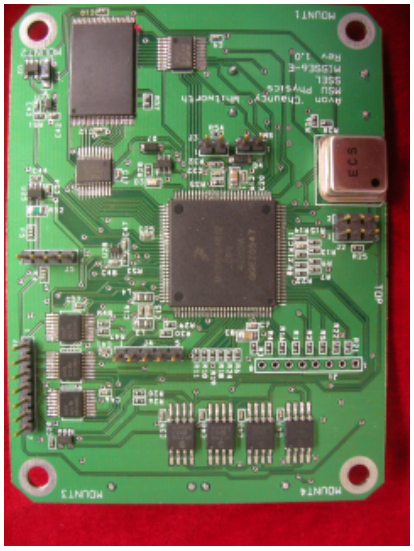
March 2008

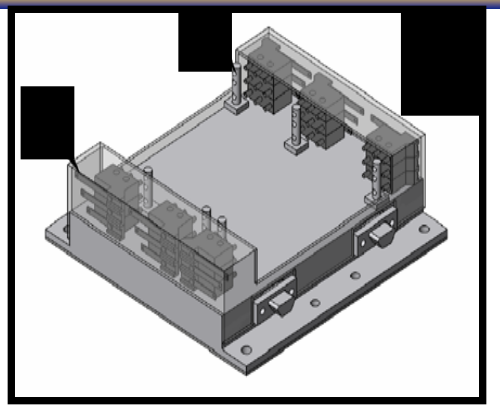
QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

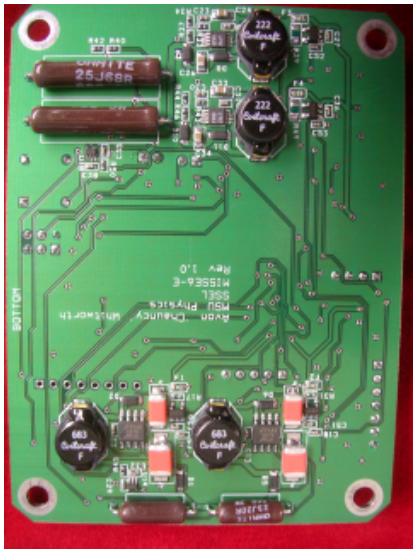
David Klumpar
Montana State University – Space Science and Engineering Lab

SSEL's Materials International Space Station Experiment (MISSE-6)

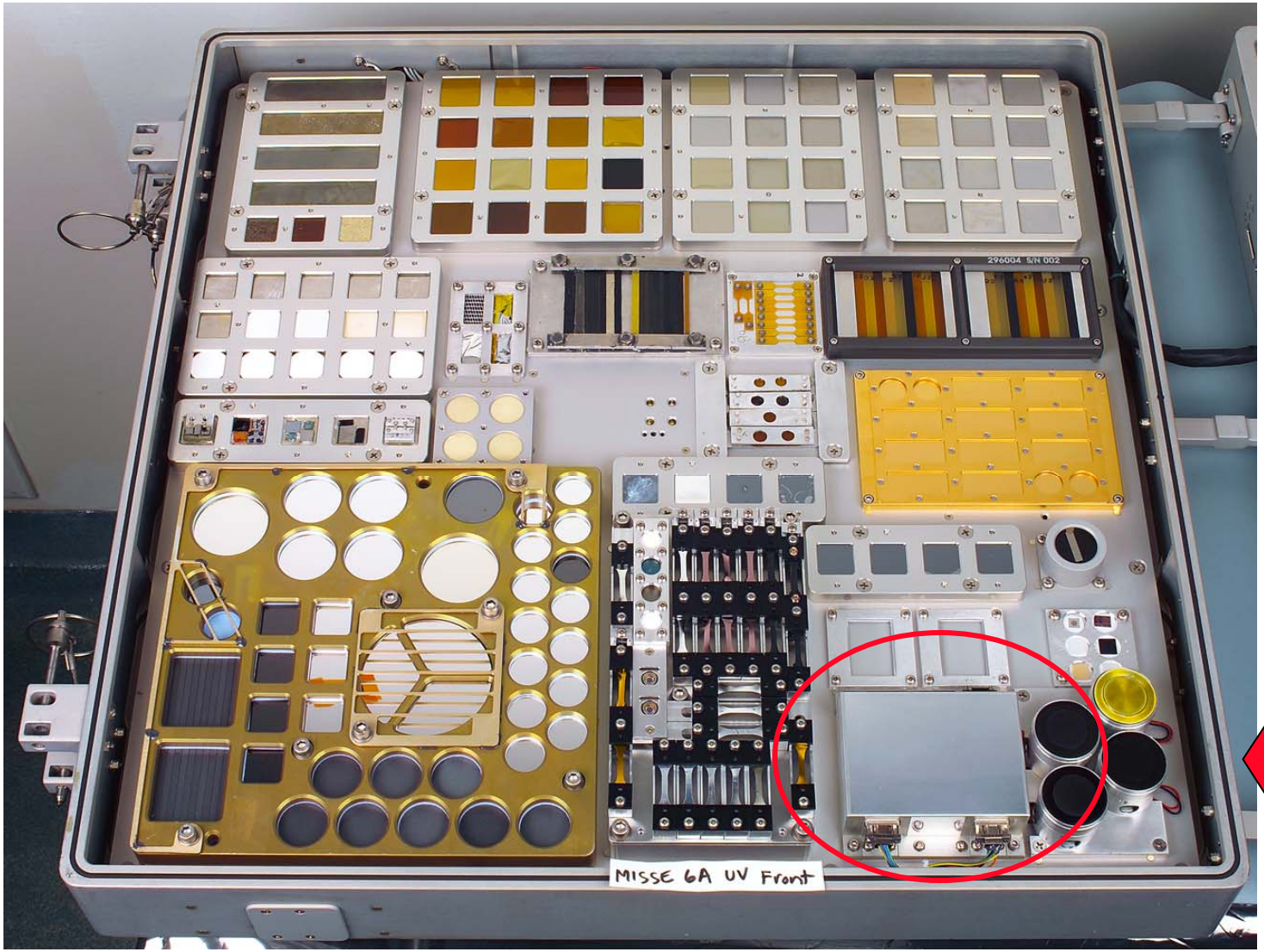
- **Two student-designed and built payloads**
  - **Materials exposure experiment to investigate behavior of materials exposed to space hazards (polymer and treated Tethers)**
  - **Penetrating Radiation susceptibility of consumer electronics**
- **Record changes during 9-month exposure to space hazards**
- **Placed on ISS and activated on March 24, 2008**





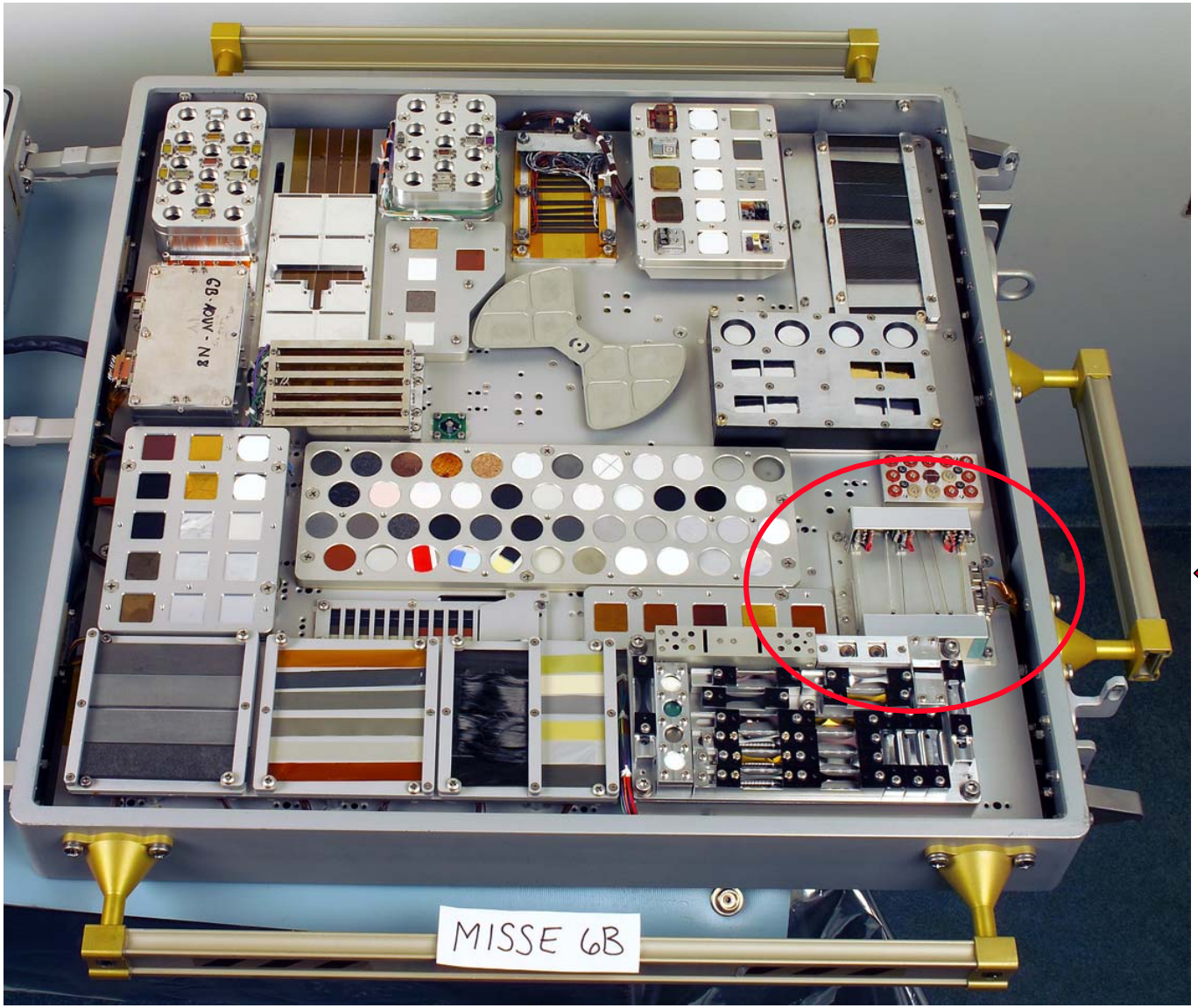


MISSE-6A UV Tray



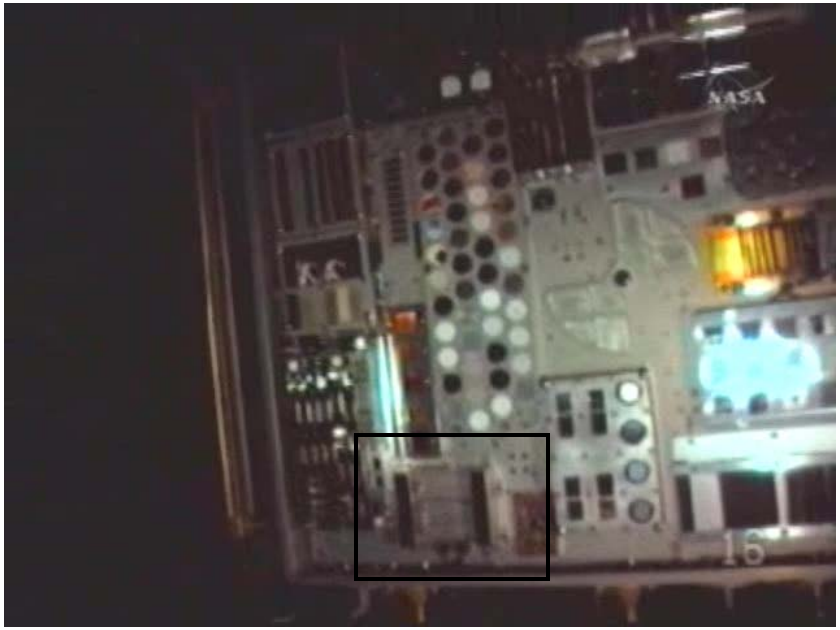
MSU SSEL Electronics Experiment

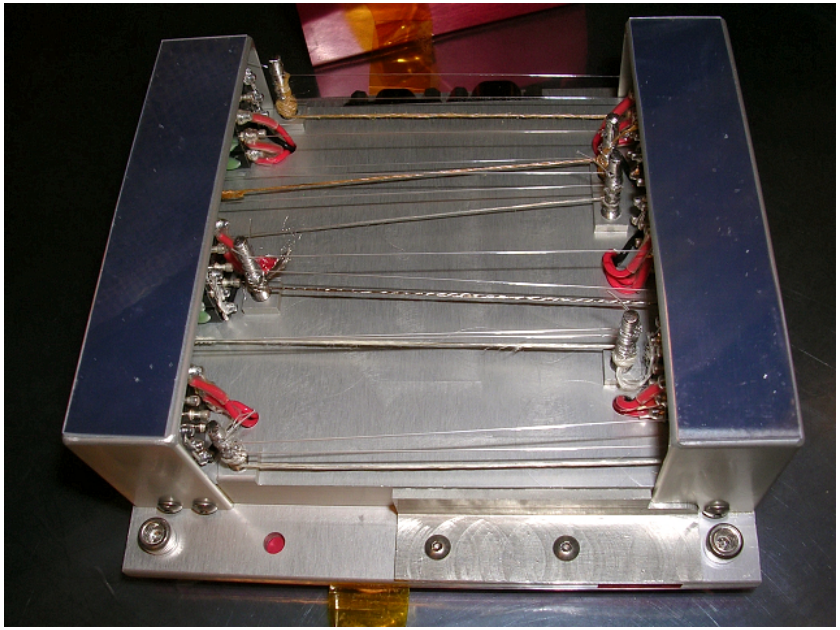
MISSE-6B AO-UV Tray



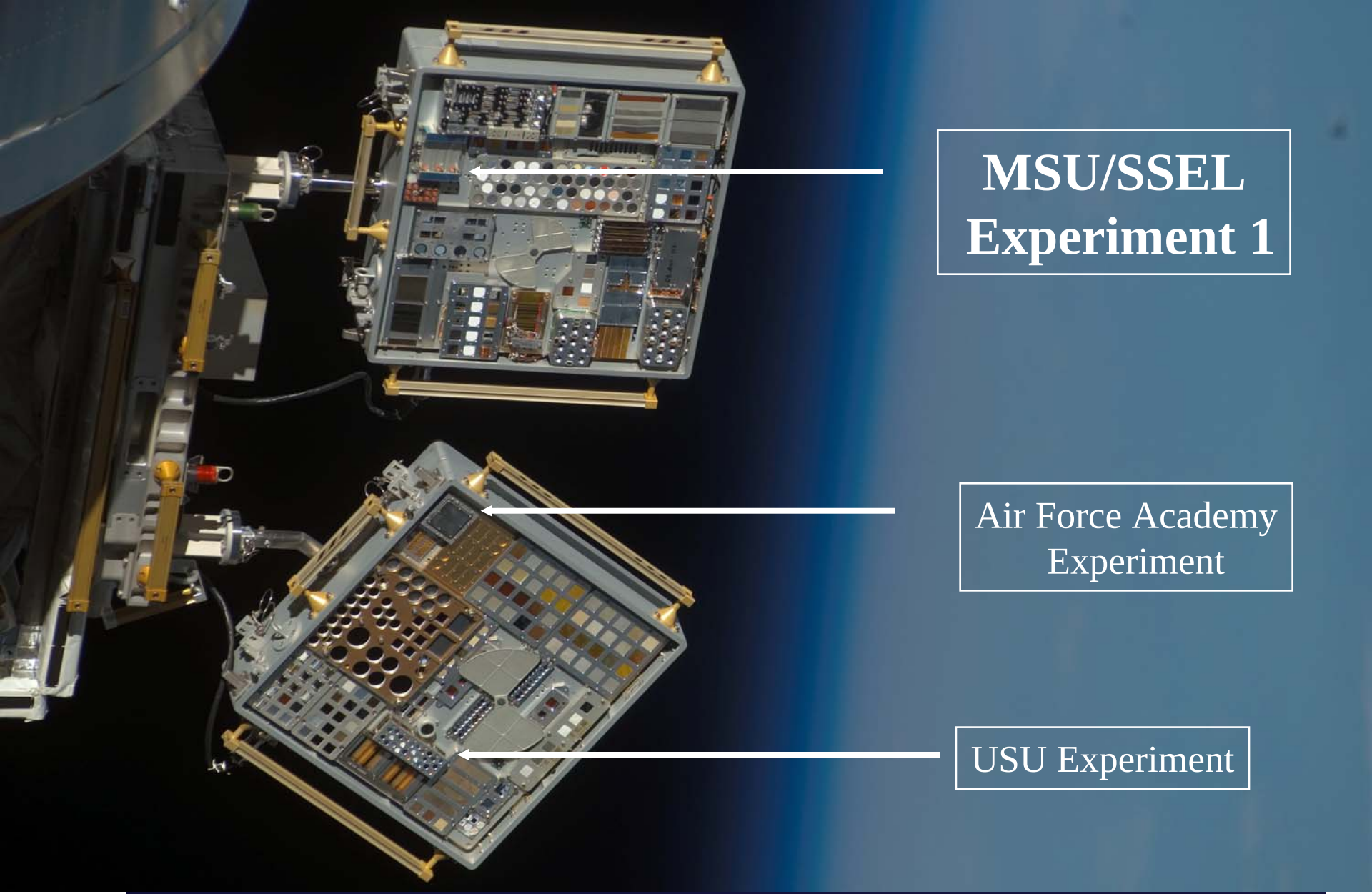
MSU SSEL Materials Experiment

MISSE-6 on International Space Station



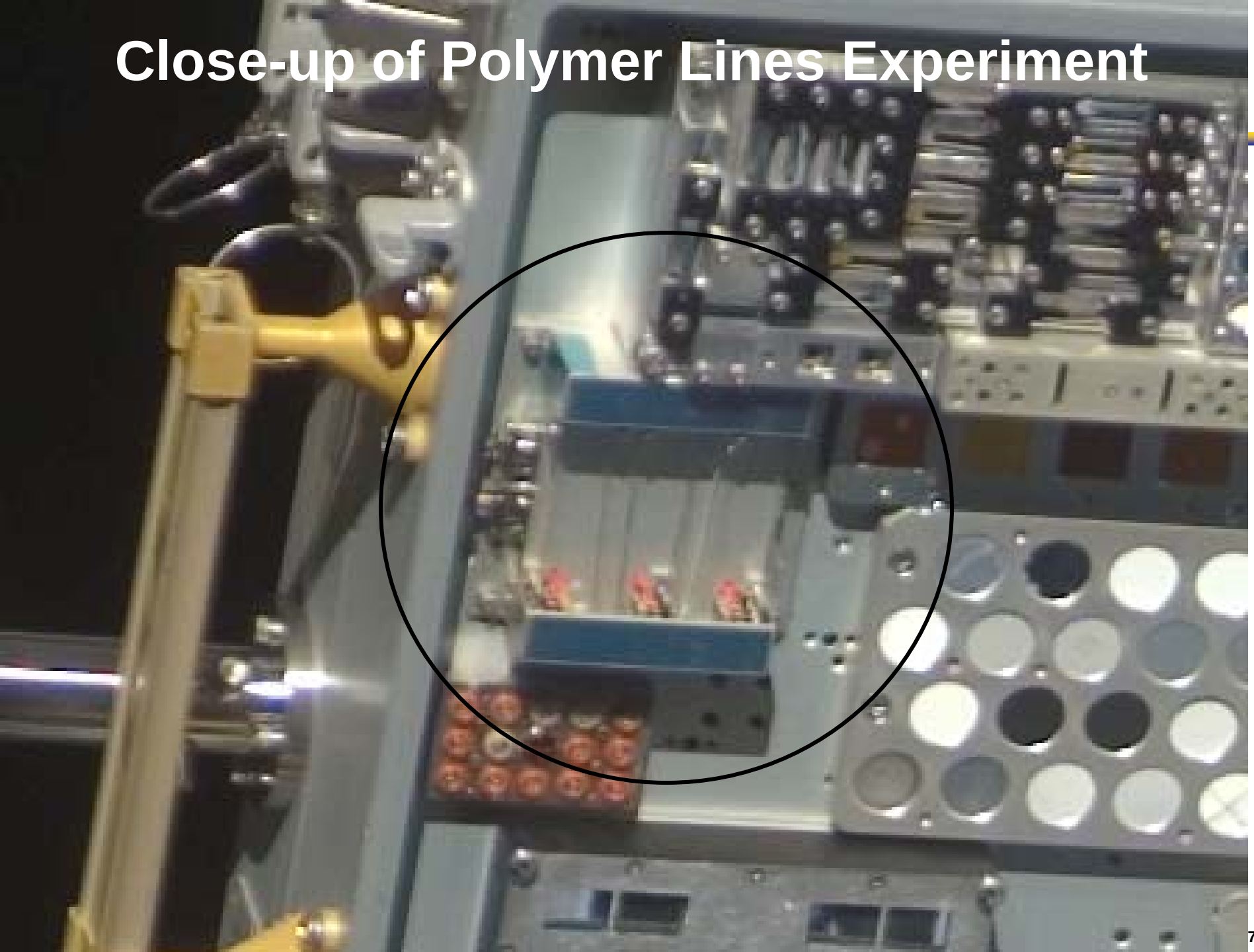


- **Left: Frame capture of MISSE-6B (AO-UV Tray) taken during EVA on March 22, 2008 by Astronaut Robert Behnken's Helmet video camera upon deployment. SSEL's materials experiment is highlighted by white rectangle.**
- **Right: SSEL's materials experiment in the lab before integration with MISSE-6**



As Endeavor Undocked March 24, 2008 (two days exposed in space)

Close-up of Polymer Lines Experiment



AFOSR

University NanoSatellite Program

10 May 2007

Dr. Kent Miller

Program Manager

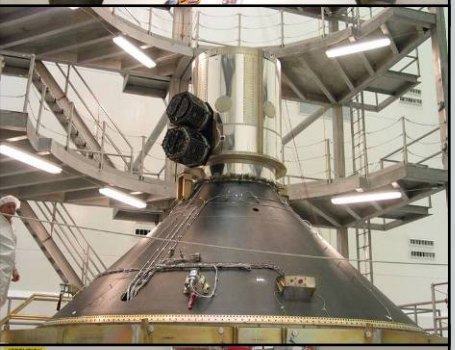
Physics & Electronics Directorate

Air Force Office of Scientific Research

Adapted* for presentation to the April 2008 CubeSat Workshop
D.M. Klumpar

*** by permission of the Author.**

University NanoSatellite Program (UNP)



MANDATE

Develop a "Space cadre" of highly-trained US university students

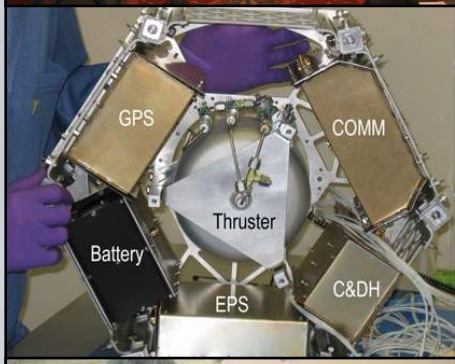
Teach "hands-on" systems engineering through design, AI&T, launch and on-orbit operation of student-built nanosatellites

SECONDARY GOALS

Develop militarily-relevant small satellite technologies

Develop US university space research capabilities

Background: Nanosat-2 launch on Delta 4 Heavy (2004)



University NanoSatellite Program Cycle Process Flow

AFOSR BAA
Proposals Due
Late CY Even Years

AFRL/AFOSR/AIAA
Rank Proposals
via BAA reqs

Universities selected and notified
January Odd Years

Kick off meeting
Competition begins
Early spring Odd Years

Grants awarded
(After Kick Off Meeting)
~$110K / school over 2 years

Open to U.S. Universities only

Former Student PM's now Professor PI's

~2 years

AFRL/VS

Program Management

Systems Eng

S/C Eng

Flight I&T

AIAA Flight Competition Review (FCR)
Late March/Early April Odd Years

Winner!

Launch Opportunity Via AFRL/SMC (SERB)

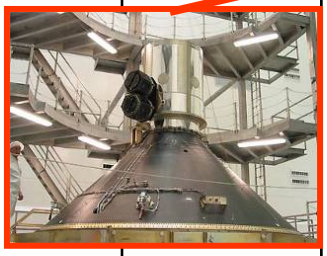
Cycle Repeats every 2 Years – 2 Cycles running at any point in time

University NanoSatellite History

1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007

NANOSAT-1/-2
Arizona State
New Mexico State
U Colorado-Boulder
Stanford
Boston
Carnegie-Mellon
Utah State
Virginia Tech
Washington

UNP 2 Delivery
3-Corner Sat
January 2002



UNP 2 Launch
Delta IV Heavy
December 2004

UNP 2
LV Integration
May 2004

UNP 3 Downselect
UT-Austin (FASTRAC)
January 2005

NANOSAT-3
UT Austin
Washington U - St. Louis
Michigan Tech
Arizona State
Montana State - Bozeman
Penn State
Taylor U
U Colorado, Boulder
U Hawaii at Manoa
U Michigan
Worcester Polytechnic
New Mexico State
Utah State

NANOSAT-4
U Cincinnati
U Minnesota
U Central Florida
Santa Clara U
Cornell
U Missouri - Rolla
Texas A&M
New Mexico State
Washington U - St. Louis
Utah State
UT Austin

UNP 3
Delivery
Summer
2006?

UNP 4
Downselect
March 2007

NANOSAT-5
U Minnesota, Santa Clara U,
Texas A&M, Michigan Tech,
Washington U - St. Louis,
Utah State U, Colorado U,
Montana State, UT Austin,
Penn State, Boston U

University & Student Involvement

25 universities and >2500 students since 1999

NanoSat-5

- Competition in progress
- Eleven schools participating
- Missions varied from ionospheric observations, to autonomous separation and GPS navigation, to remote sensing using GPS signals.
- Preliminary Design Review (PDR) will occur in August 2007 at the USU SmallSat Conference.

Session 3: Nano-Satellites

Chair: Dave Klumpar
Montana State University

9:20-9:40 Title: TBD, pSAT I **Can Kurtulus**, Istanbul Tech University

9:40-10:00 Title: Project OPTOS. Team Introduction proposal,
Cesar Martinez, INTA

10:00-10:20 Title: Small Sat Scientists Looks at NanoSat Capabilities,
Dr. John P. Doty, Noqsi Aerospace, Ltd.

10:20 –10:50 Morning Break

10:50-11:10 Title: Space Buoy, **J.D. Glenn et.al**, Montana State University/SSEL

11:10-11:30 Title: Small Satellites working together to accomplish Big Missions
Hobson Lane, Northrop Grumman

11:30-11:50 Title: Networking for NanoSats, **Luke Stras**, Stras Space

11:50 pm–1:00 pm Lunch Sponsored by Northrop Grumman
Lobby/ Bonderson Building