Training the Next Generation of Space Professionals

Ground Systems Architecture Workshop 2015

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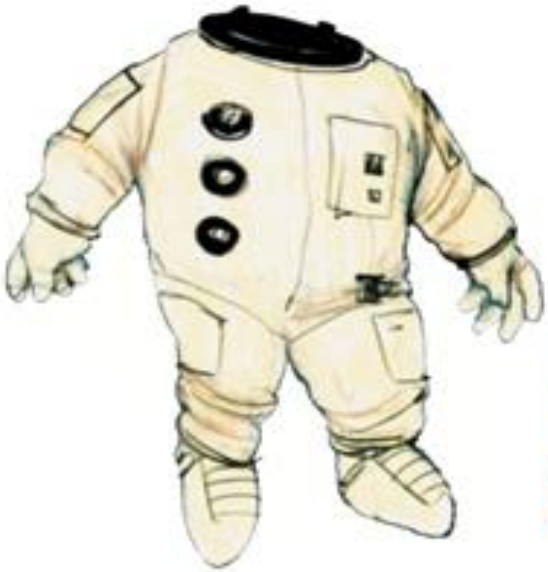
Space Exploration Uniforms



University of Colorado at Boulder
Space-Related Research and Education

LASP
Laboratory for Atmospheric and Space Physics

NIST

National Institute of Standards and Technology

University of Colorado at Boulder

Major Academic Departments

- Astrophysical And Planetary SciencES
- Atmospheric and Oceanic Sciences
- Aerospace Engineering
- Physics
- Geological Sciences

Major Research Institutes

- Joint Institute for Laboratory Astrophysics
- Laboratory for Atmospheric and Space Physics
- Cooperative Institute for Research in Environmental Science

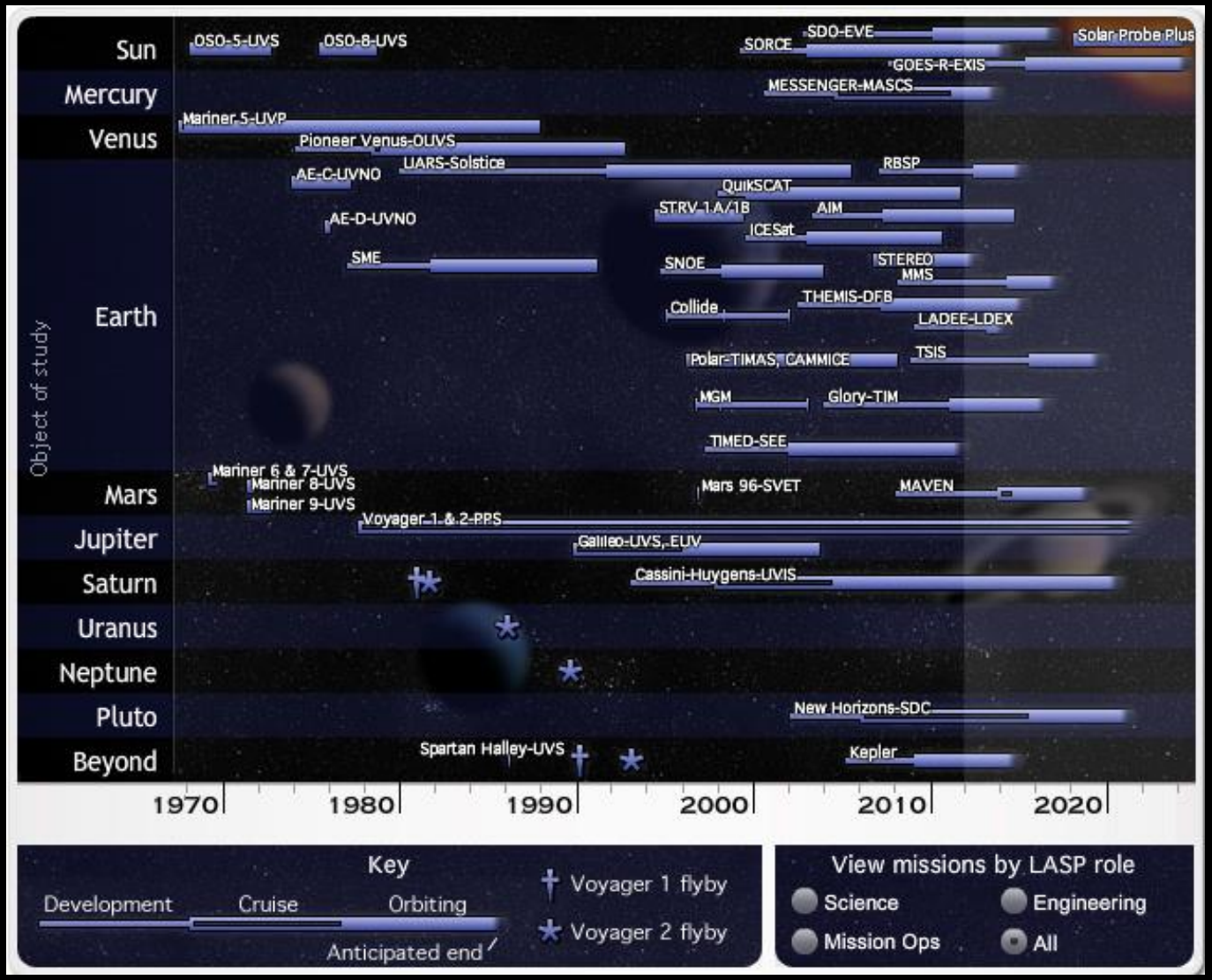
NOAA

National Oceanic and Atmospheric Administration

NCAR National Center for Atmospheric Research

NASA National Aeronautics and Space Administration

LASP Space Mission Participation



LASP has now sent instruments to every planet in the solar system and beyond (Voyager)

Unique Synergism within LASP

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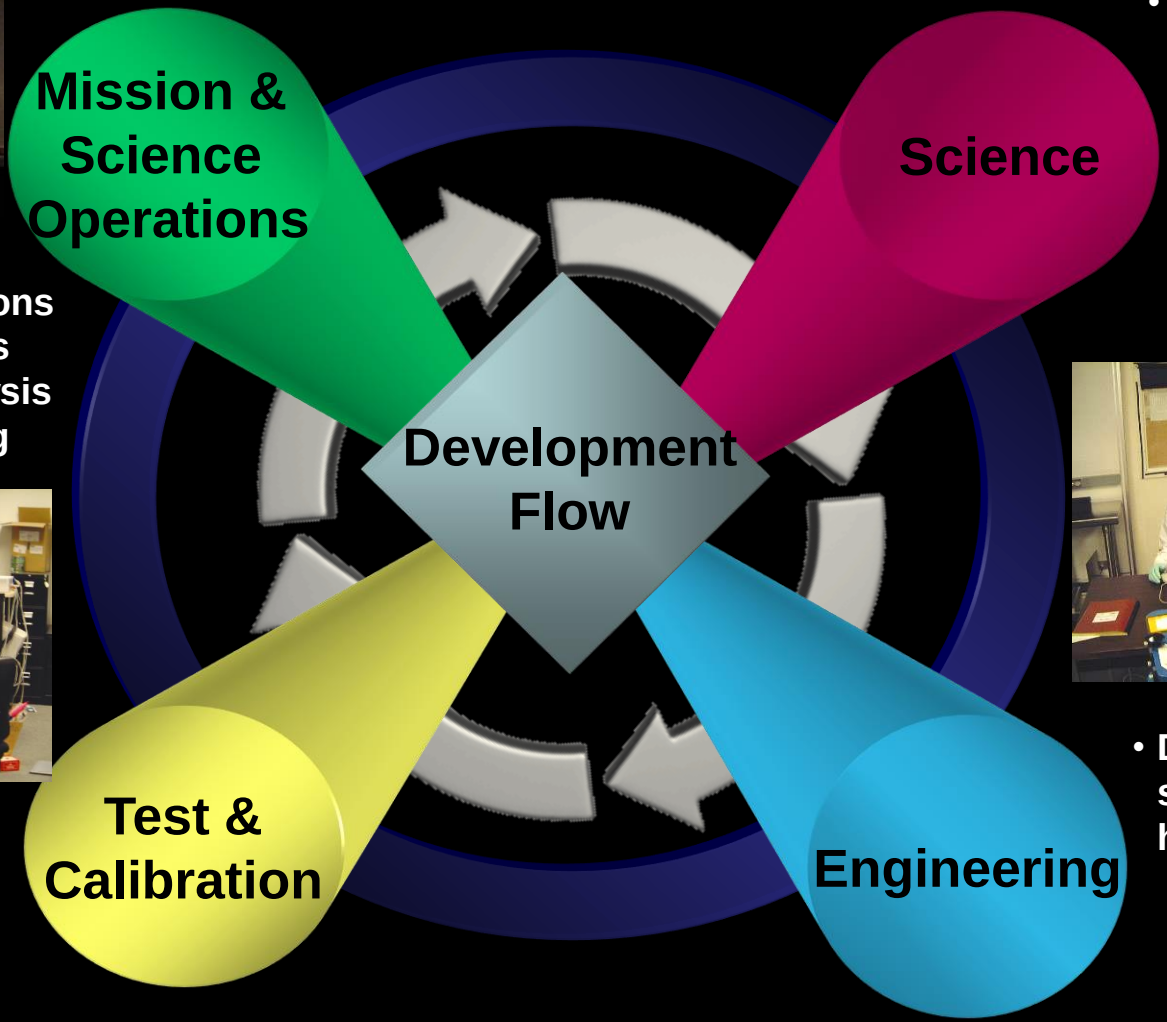
Student Involvement Throughout



- Spacecraft Operations
- Payload Operations
- Science Data Analysis
- Mission Scheduling

- In-House Facilities

- Identify/Address Space Science Questions
  - Planetary
  - Atmospheric
  - Solar
  - Space Physics

- Design, build, test space system hardware

Mission Operations & Data Systems

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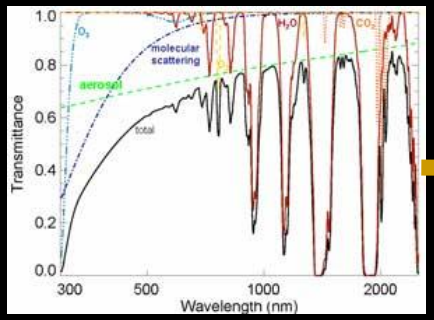
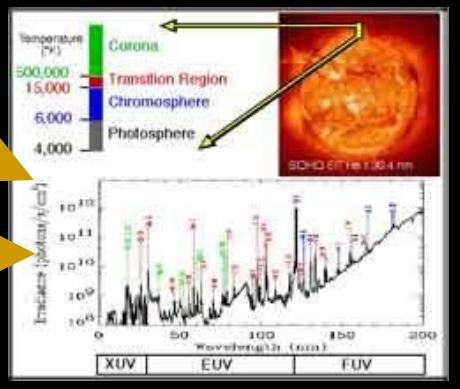
Develop & Test
New Systems

Operate Spacecraft &
Payloads

Integrated Professional &
Student Operators



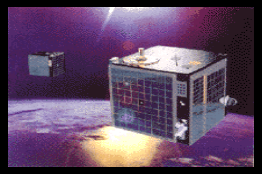
Process & Distribute Data
to LASP Scientific
Community and Beyond



33+ years of LASP Mission Ops

Past & Current Spacecraft/Instruments Operated by LASP

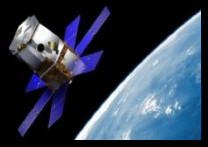
SME (1981-1989)



STRV-1A & STRV-1B (1996-1998)

SNOE (1998-2004)

QuikSCAT (1999-present)



SORCE (2003-present)

ICESat (2003-2010)

AIM (2007 - present)

Kepler (2009 - present)

	Built S/C	Built Instr	Mission Ops	Instr Ops
SME		✓	✓	✓
STRV-1A & 1B			✓	
SNOE	✓	✓	✓	✓
QuikSCAT			✓	
SORCE		✓	✓	✓
ICESat			✓	
AIM		✓	✓	✓
Kepler			✓	

Current Mission & Science Operations

- **4 Satellites**: QuikSCAT, SORCE, AIM, Kepler
  - **SORCE**: Mission to study solar irradiance
  - **QuikSCAT**: Study ocean's surface winds
  - **AIM**: Study polar mesospheric clouds
  - **Kepler**: Search for Earth size planets

- **Instruments on many different satellites including**:
  - MAVEN (latest mission to Mars)
  - Solar Dynamics Observatory/EVE
  - Cassini UVIS: Study Saturn's atmosphere, rings, & moons
  - MESSENGER MASCS: Study Mercury's atmosphere & surface
  - New Horizons SDC: Study interplanetary dust (Pluto)
  - Magnetospheric Multiscale (MMS) (launching March 12th)

Over $1B of space systems controlled from LASP

The Mission Operations Team

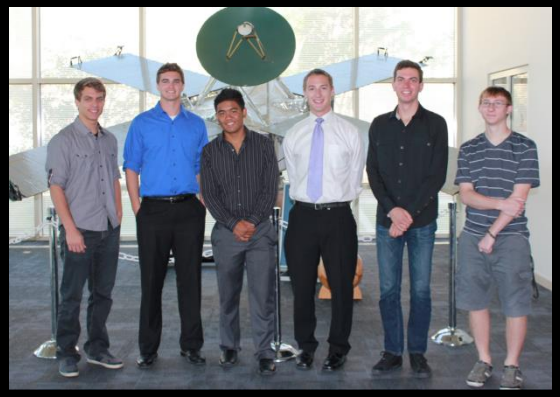
- Comprised of both Professional and Student operators
  - Two sets of eyes on all operations activities
- Professionals are in charge during realtime supports
  - Give command and planning approvals to students
- Students issue commands
  - Provide realtime and command planning support

Student Operators – "Command Controllers"

- 20 Graduate and Undergraduate students
- Students are involved in all phases of mission development and operation
- Routine responsibilities
  - Planning &Scheduling
  - Realtime commanding
  - Short and Long-term state of health trending
- Trained to operate all four LASP missions

Command Controller Training

- Hired once per year starting in January
  - This allows for a formal and consistent training as a group
- 10 week training starts in late May
  - Classroom lectures
  - Hands-on tasks
  - Shadowing of senior CCs



CC Training - Fundamentals

- Ops students are hired from all majors
  - Most are Engineering or Science but we accept any major
  - Starting sophomore or junior year
- LASP provides “Aerospace 101”
  - Thermal
  - Comm/C&DH
  - ADCS
  - Power
  - Remote Sensing

CC Training – Operations

- Realtime Commanding and Data Flows
  - How do commands get to the spacecraft?
  - How is data routed once it has been downlinked?
  - Pass protocol and on-console communications

- Command Planning
  - Routine (weekly) planning
  - Special activities
  - Generating command scripts

CC Training – LASP's Missions

- Detailed instruction on the life of the missions LASP operates
  - Flight Directors (staff) are heavily involved
  - Emphasis is placed on changes to nominal operations

- Subsystems student leads instruct new CCs
  - Health and safety monitoring
  - Seasonal activities
  - Component degradation

Certification

- 3 certification exams throughout the summer
  - Given at 3 week intervals
  - Short-answer style
  - Questions apply lectures to operations tasks
- Oral certification
  - Covers information in the checklist
  - Nominal operations scenarios
  - Reaction to anomalous situations

Advanced Training

- Given the second summer of a CC's career
- Advanced engineering and operations topics
  - CCSDS
  - Space Weather
  - DOORS
  - Earned Value
  - ITAR
- Enhances knowledge
- Provides exposure to standard engineering practices

After Graduation

- NASA
- Lockheed Martin
- Raytheon
- Northrop Grumman
- Sierra Nevada
- EchoStar
- DigitalGlobe
- SpaceX
- ULA
- JPL
- Ball Aerospace
- Boeing
- AGI
- Sandia National Lab
- Paragon Space Dev
- Aerojet
- Blue Origin

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THANK YOU!