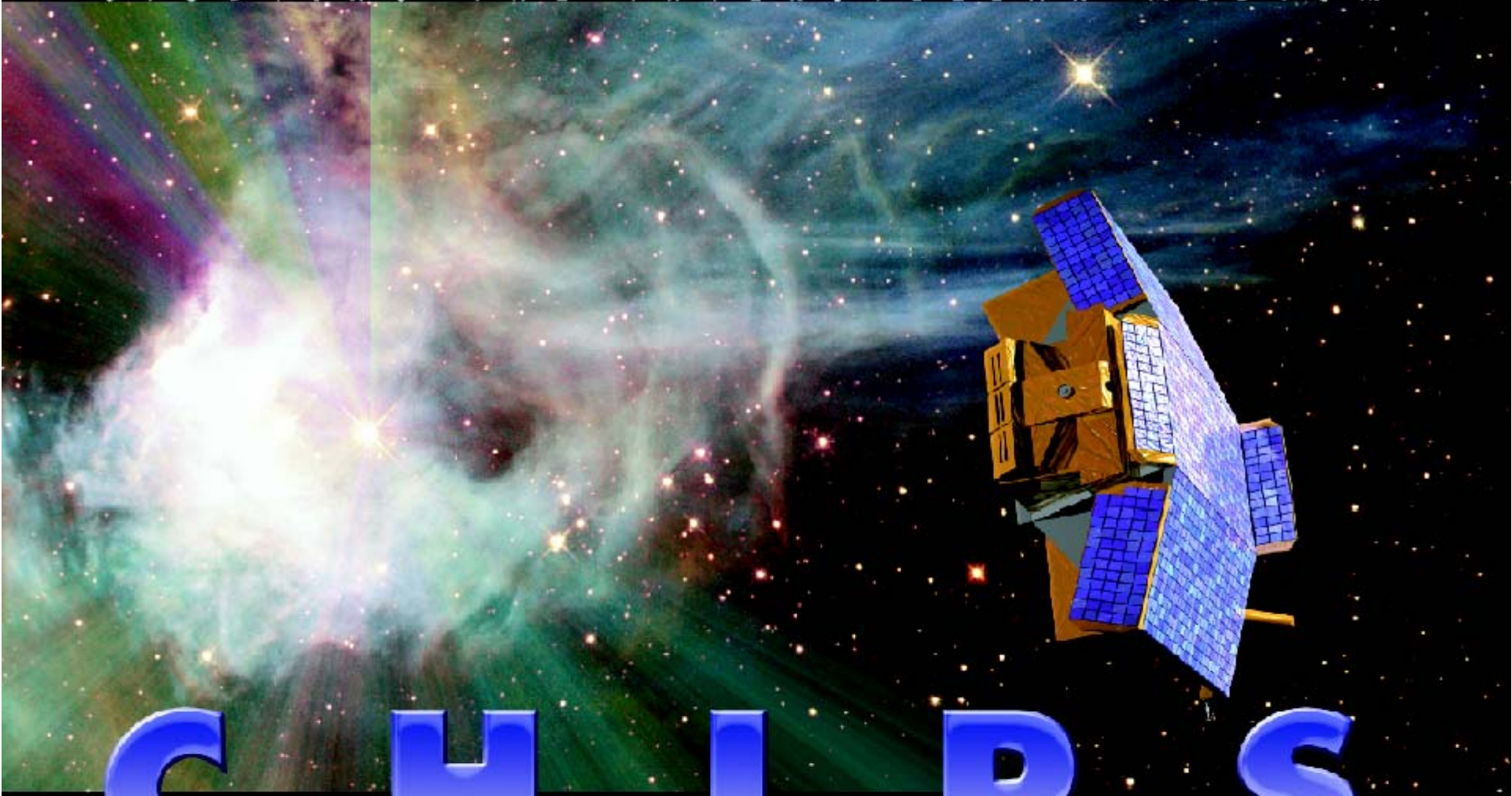
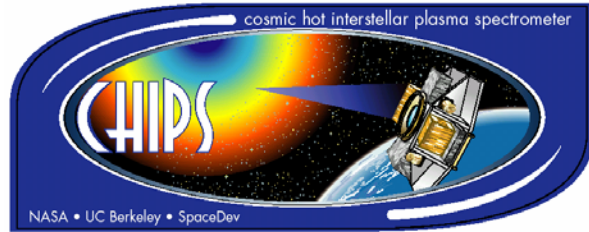


STUDYING THE INTERSTELLAR MEDIUM



CHIP S

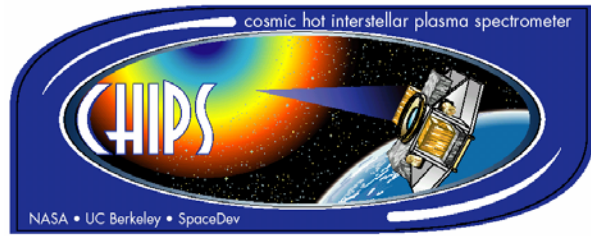
cosmic hot interstellar plasma spectrometer



CHIPS: A NASA University Explorer Astronomy Mission

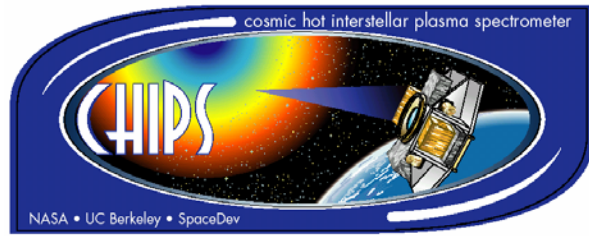
Ellen Taylor
DesignNet Engineering

Will Marchant
UC Berkeley Space Sciences Lab



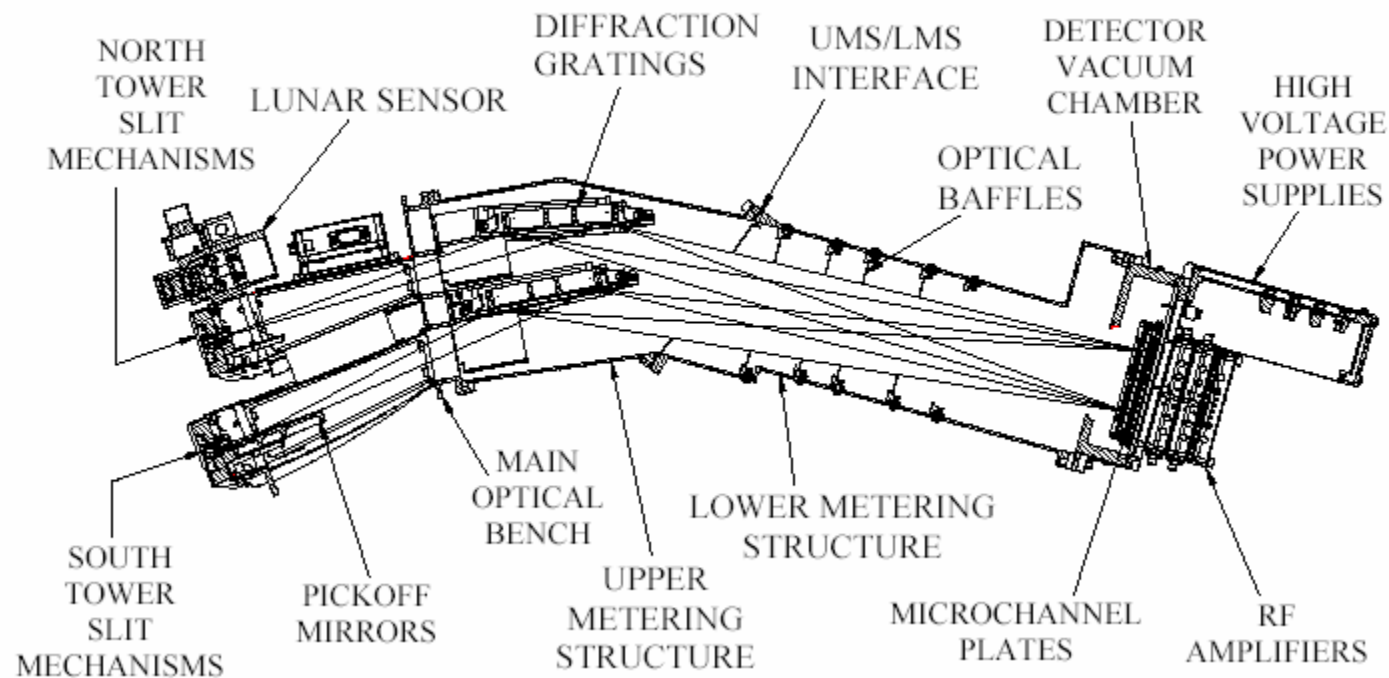
CHIPS Program Overview

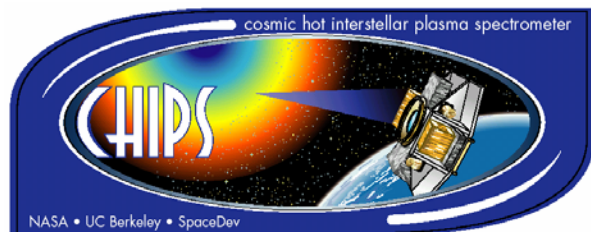
- PI-Mode Mission awarded in '99 to UCB Space Science Lab
 - Principle Investigator: Dr. Mark Hurwitz
 - Management, Systems Eng., Instrumentation, Mission Ops at SSL
 - Spacecraft Bus provided by SpaceDev, Inc.
- Small 64kg SC carrying a single extreme ultraviolet (EUV) Spectrometer
- First University Explorer (UNEX) to make it to orbit
 - Launched from VAFB on January 12th, 2003
 - Secondary Payload on a Delta II Launch Vehicle
- Mission Objectives
 - Measure extreme ultraviolet emissions from the interstellar medium (90 to 260 Å)
 - Test competing theories on the formation of hot interstellar gas plasma surrounding our solar system.
 - Initial science results presented at AAS High Energy Astrophysics Division, March 2003.



Science Instrument Layout

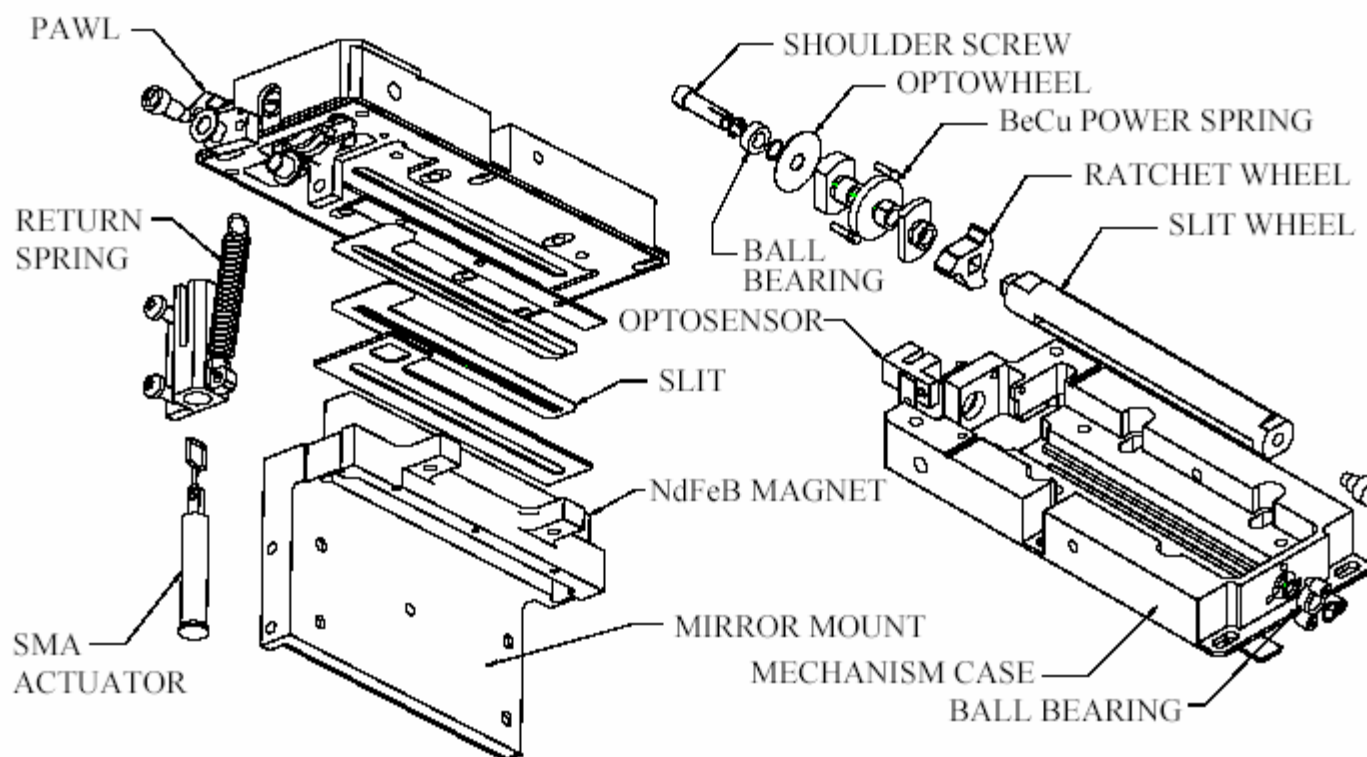
- Six-channel spectrograph
- Single photon-counting microchannel plate (MCP) detector

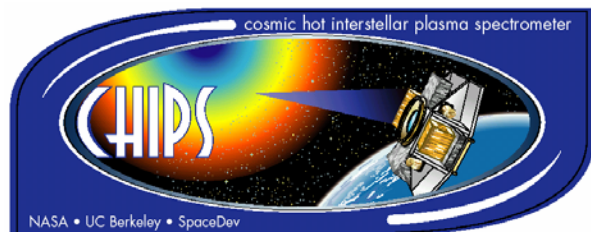




Slit Mechanisms

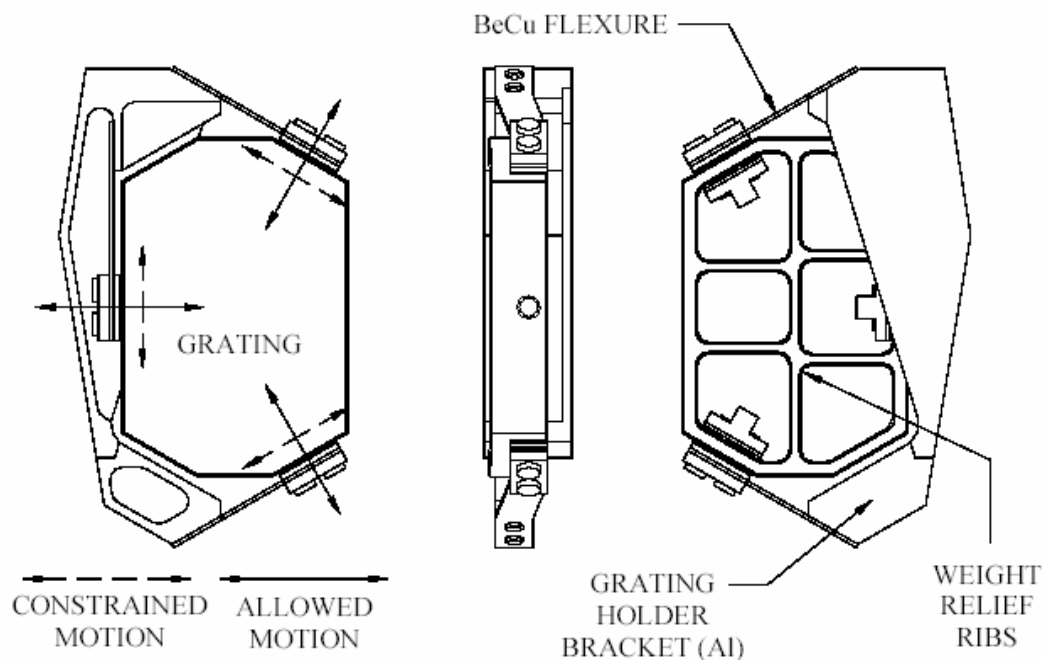
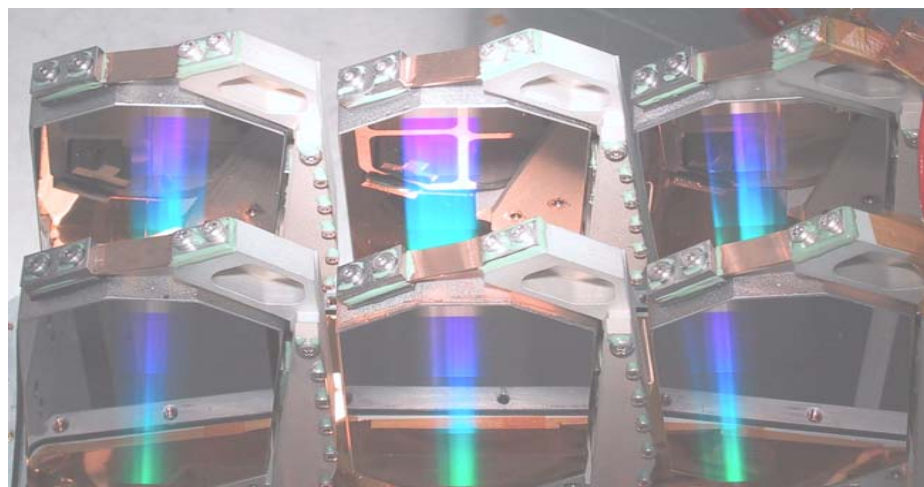
- Wide/Narrow/Closed slit wheel powered by BeCu springs
- Initiated by a 2-stage nitinol actuated ratchet/pawl assembly
- All channels actuated to Wide then moved Narrow on-orbit

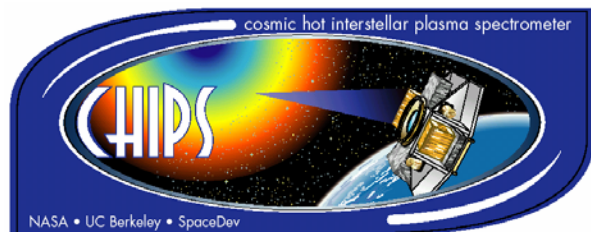




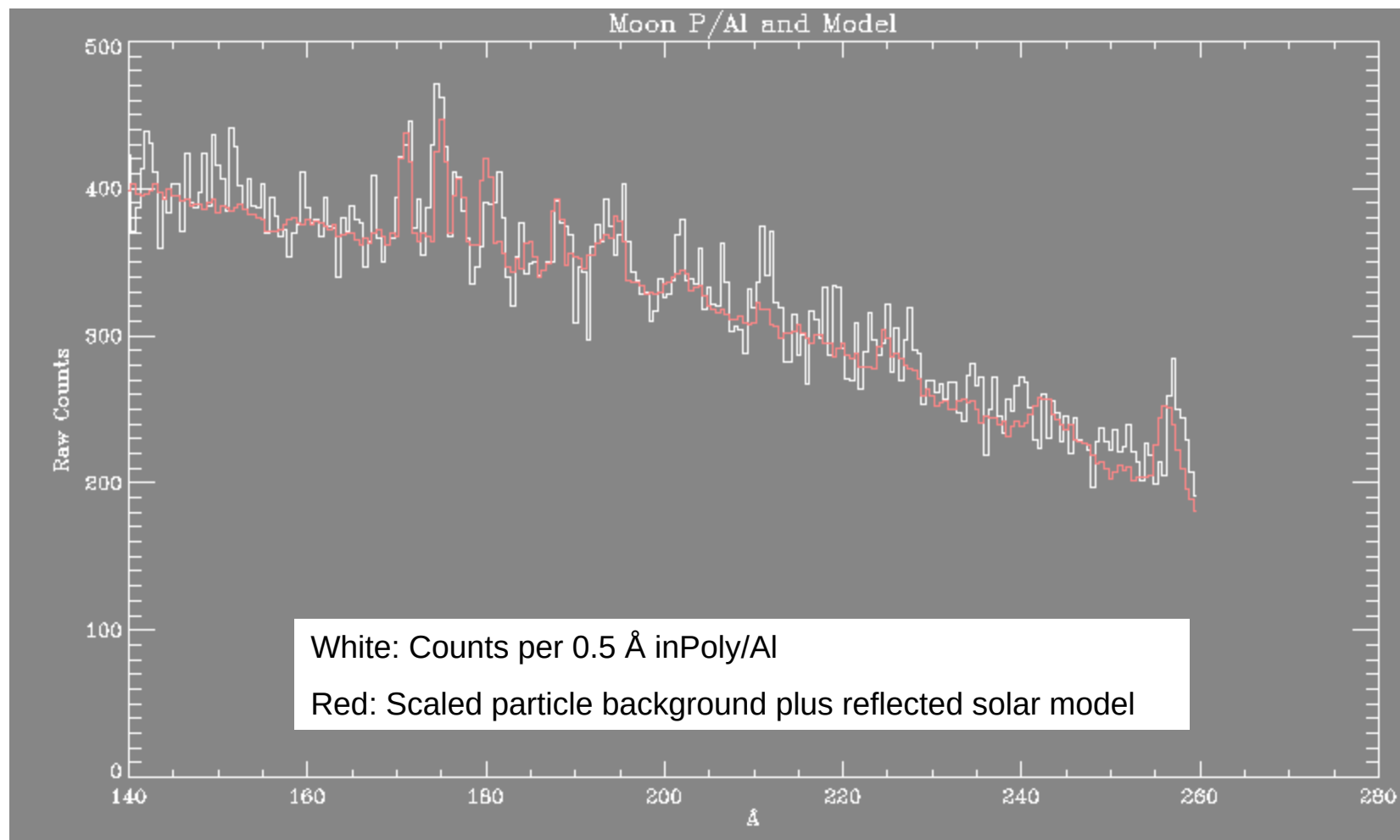
Diffraction Grating Array

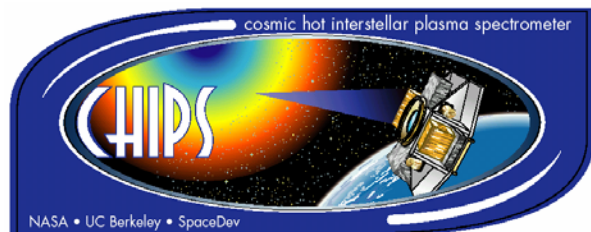
- Gratings cylindrical figure w/ varied line spacing
- Semi-kinematic mount w/ three BeCu flextures
- Aligned w/in 5-6 arcseconds, co-aligned within $0.1 \text{ \AA}$
- Alignment verified on-orbit through lunar calibrations





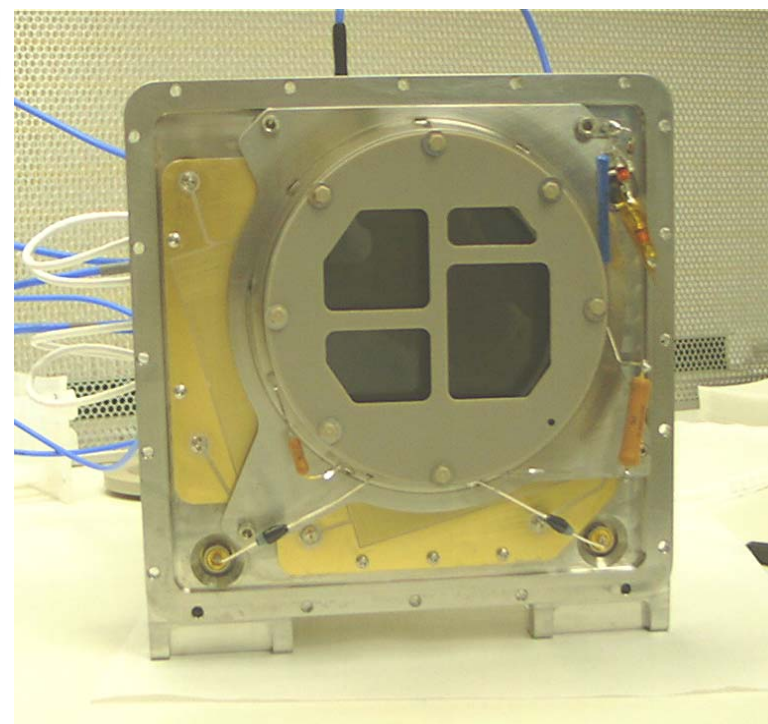
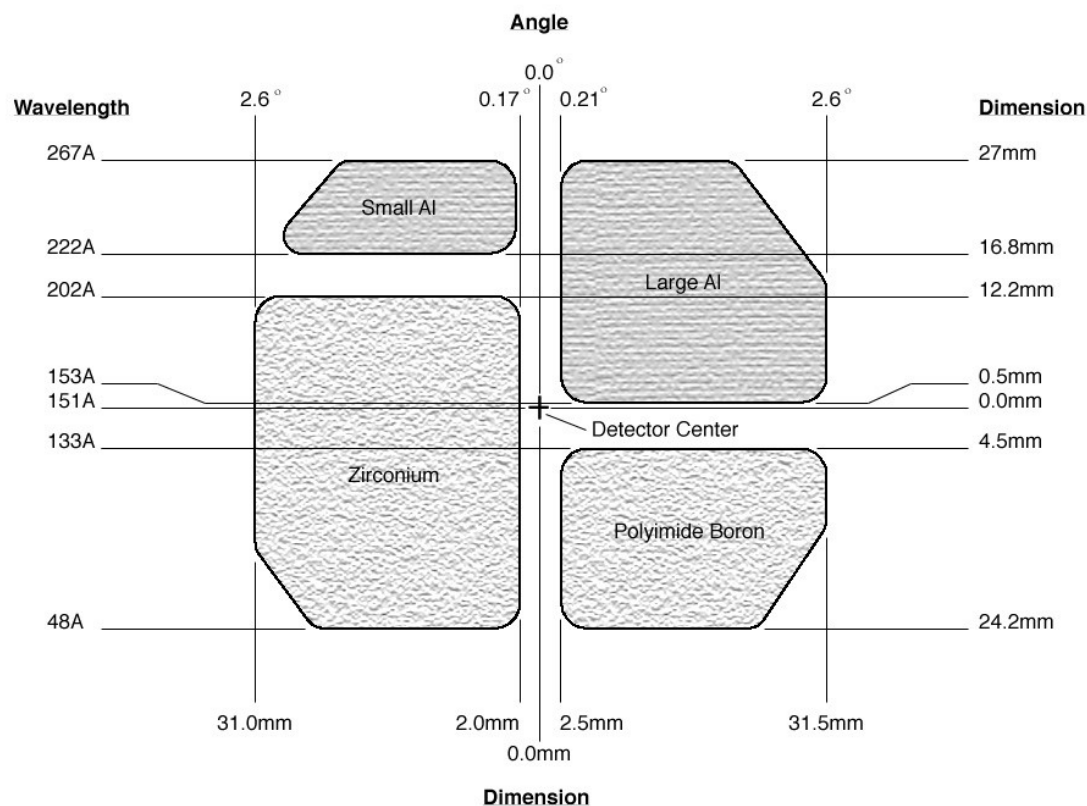
Lunar Calibration

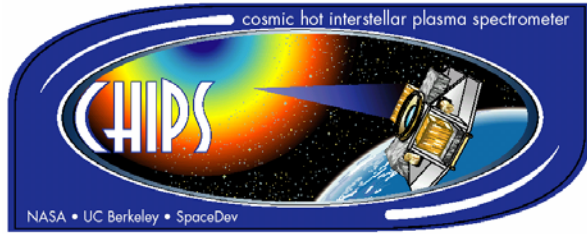




Filter Assembly

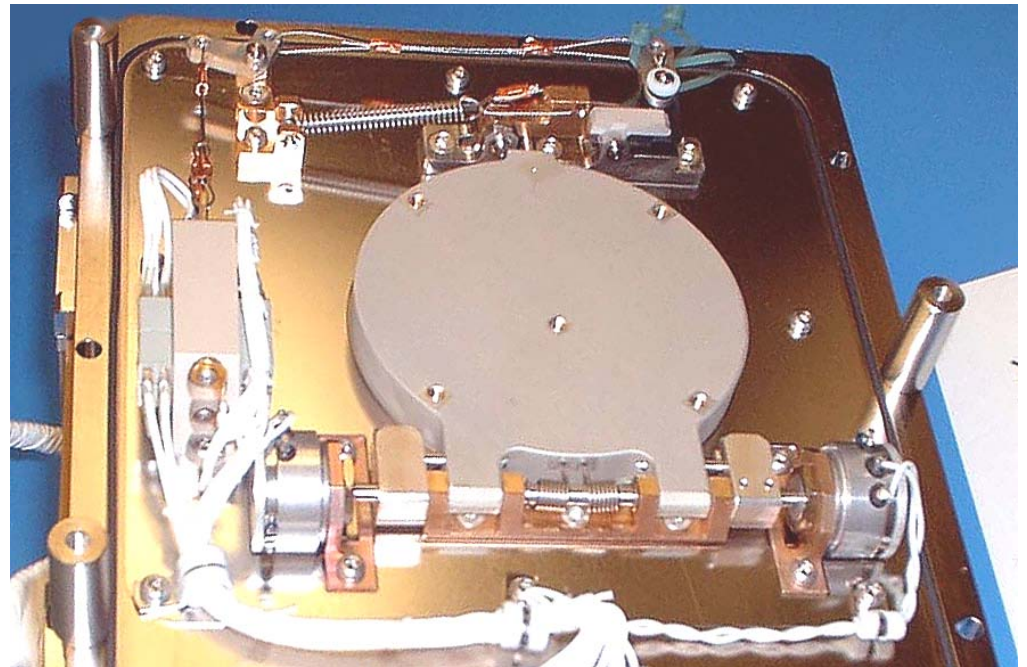
- Thin metal filters clamped ~1cm above MCP Detector
- Poly/B, Aluminum and Zirconium panels

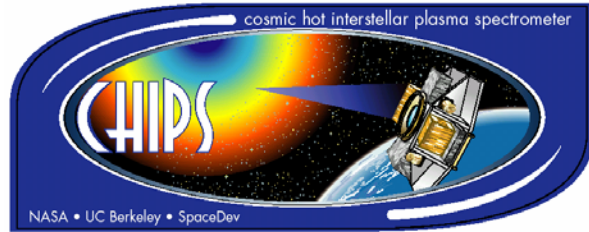




MCP Detector

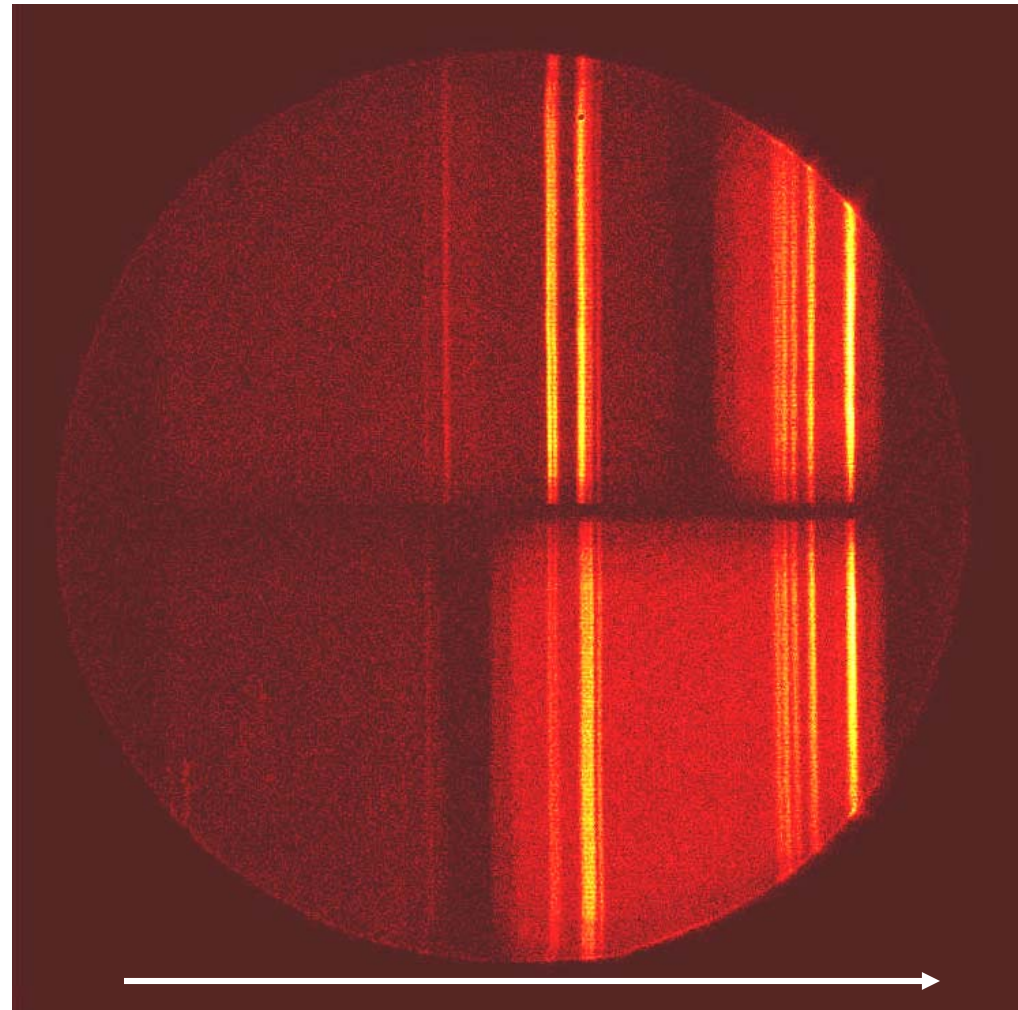
- Cross Delay Line (XDL) MCP, 60mm active area
- Operated at HV ~5000V using low-risk, redundant supplies.
- Kept at vacuum throughout integration and launch. Vacuum Box door opened on-orbit.



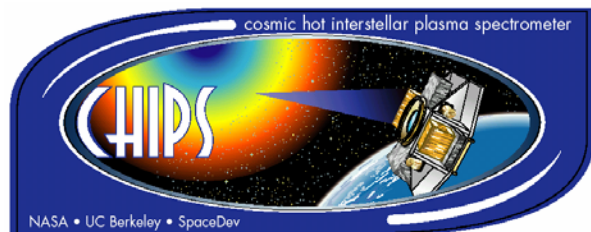


Calibration Detector Image

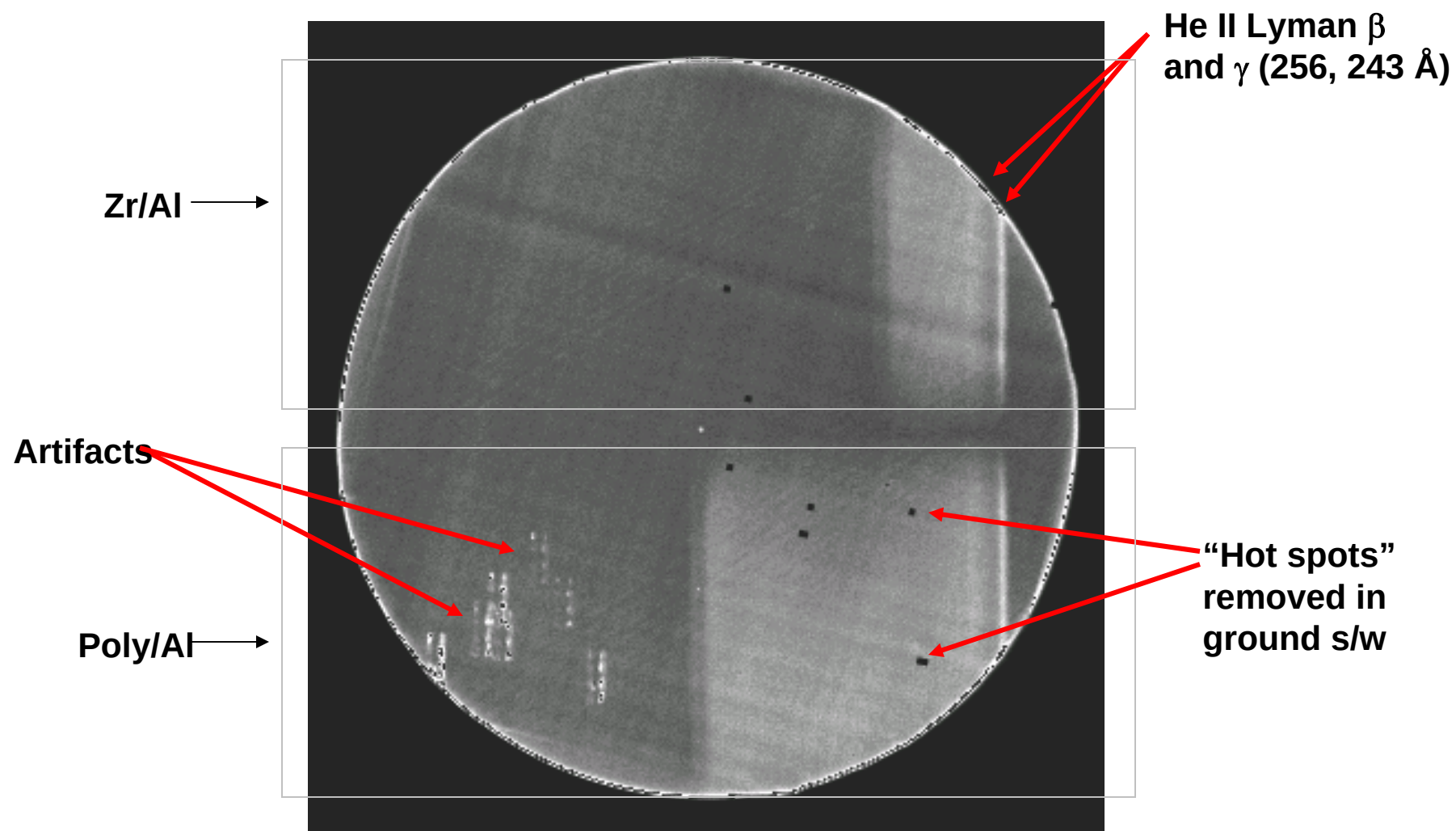
- Field of view w/ collimated beam sweeps
- Multiple source spectra co-added
- Detector performing well on orbit, with uniform, low background rate of 20-25 counts per second and few 'hot-spots'

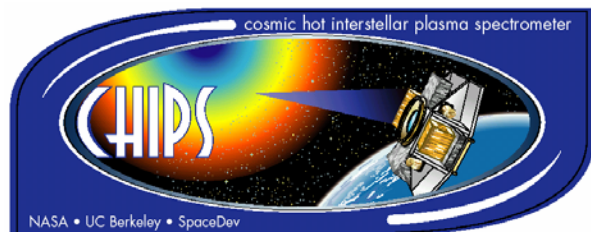


Wavelength



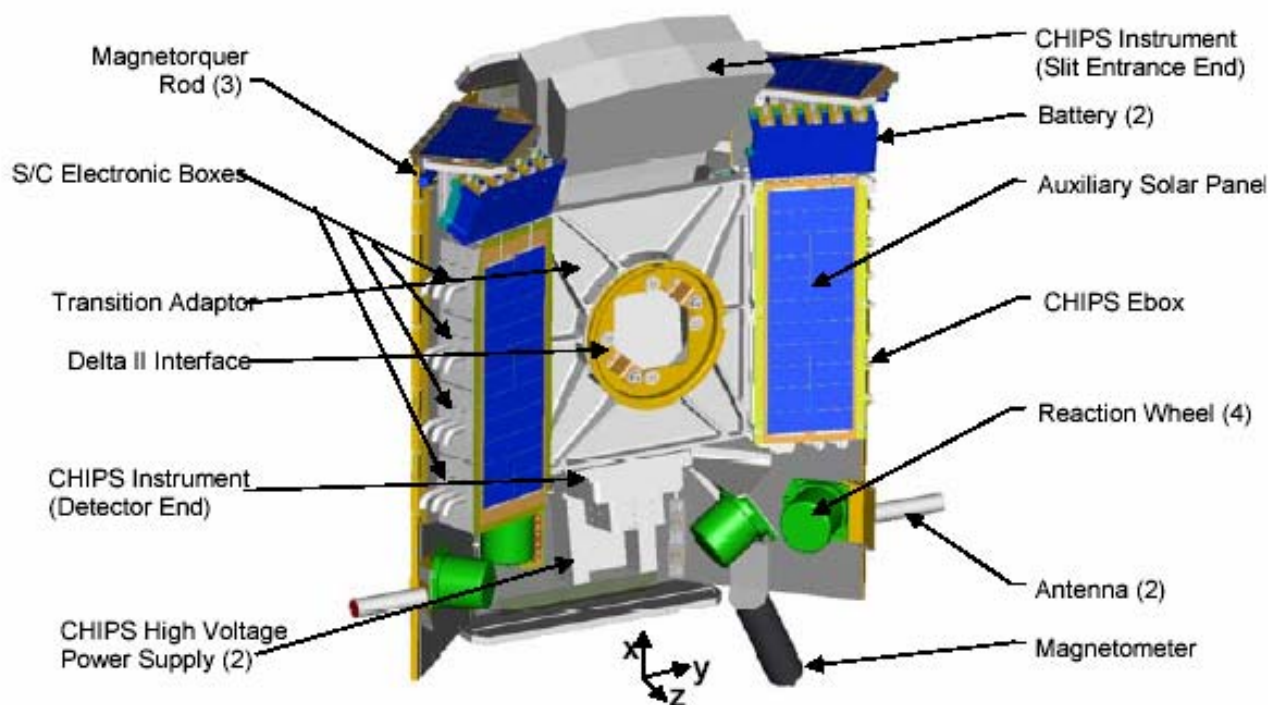
Flight Detector Image

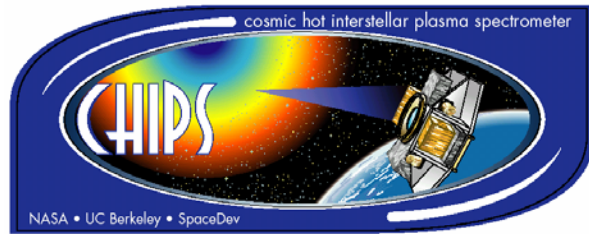




Spacecraft Bus

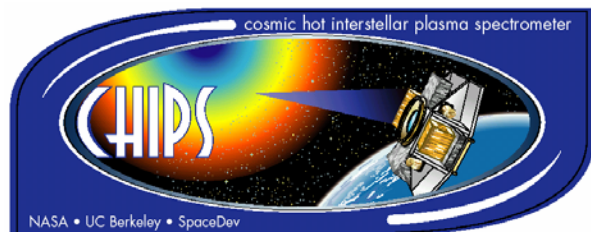
- 3-axis stabilized spacecraft
- 64 kg mass
- Body-mounted solar arrays (GaAs/InPh/Ge)
- Passive thermal design
- Single power PC 750 CPU
- S-band transceiver





Environmental Testing: AFRL



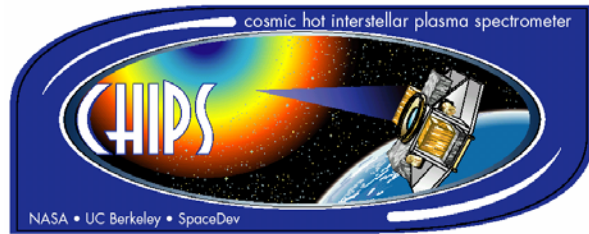


CHIPS Launch

- Delta II Secondary Payload w/ICESat Primary
- Vandenberg Air Force Base
- Launch Attempts
 - Dec 19, 2002: Shroud Pyrotechnics Anomaly
 - Jan 11, 2003: Tank Pressurization Anomaly
 - ***Jan 12, 2003: Launch at 1645 PST***

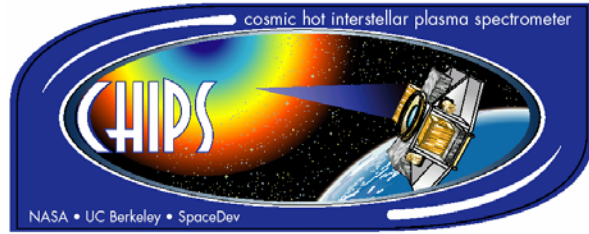






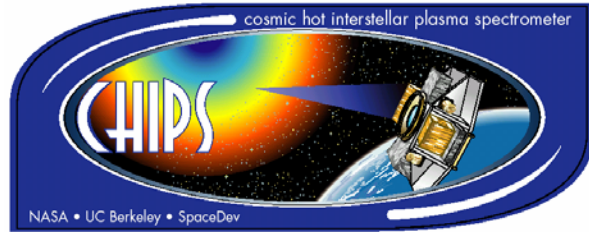
Observatory Status

- 5 resets (radiation?)
- Spurious Engineering
 - Several per week?
- Data storage: good
 - Several dropped files
- Communications: good
- Pointing: good
 - One reaction wheel showing communications retries
- Power: good
- Thermal: good
- Lunar pointing: good
 - Daylight scattering
- Narrow slits in April
- One short duration HVPS anomaly
- Pulse height filtering software added



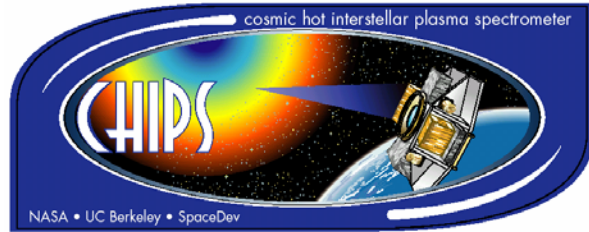
IP Protocols

- Mission going well!
- No problems with time synchronization
- Real time data via UDP: minor dropouts
- Real time commands via UDP: minor drops
- FTP transfers work well: ~16 MB/day



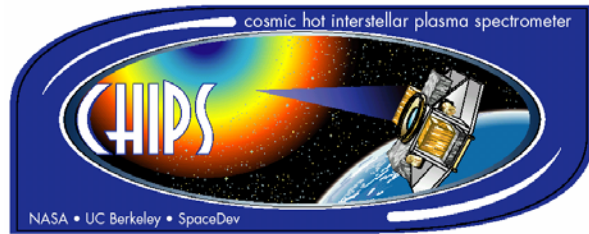
Ground Station Network

- Minor issues:
 - Adelaide, Australia
 - RF: moved low noise amplifier closer to antenna
 - Several antenna tracking problems
 - Several power outages
 - Berkeley, California
 - Several antenna tracking problems
 - Several power outages
 - Several network outages
 - NASA Wallops Flight Facility
 - Amplifier
 - Manual configuration
 - Antenna ran to limits



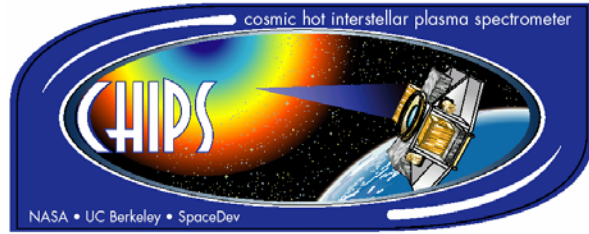
Control Center Status

- Several minor issues:
 - Mission Control Center
 - Several network outages
 - Science Operations Center
 - Several network outages
 - Public Server at SSL
 - Public server hack
 - Configuration control on software installs



Summary / Conclusions

- CHIPS is on orbit and working well
 - IP protocols and tools work well
 - Adds complexity because of factors not under project control: wiring, routers, power, etc.
 - Reduces costs of special infrastructure
 - Increases flexibility
 - Preliminary constraints well below the reported detection of iron line complex by McCammon et al. (Ap.J. **576**, 188)
 - Tight constraints on strength of iron emission line near 170-180 Å
 - Canonical sun-centered “local hot bubble” seems ruled out unless abundances and/or ionization conditions anomalous
 - Observational challenges posed
 - Properties of hot gas in the local cavity
 - What ionizes the helium and other elements in warm interstellar clouds?



References

CHIPS Science Web Page
chips.ssl.berkeley.edu

University Class Explorers Office
www.wff.nasa.gov/pages/code850.html

GSFC OMNI Project
lpinspace.gsfc.nasa.gov