

IRIS

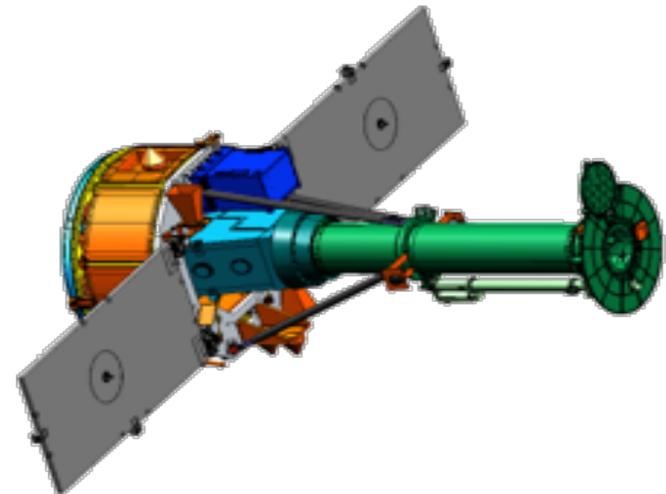
Interface Region Imaging Spectrograph

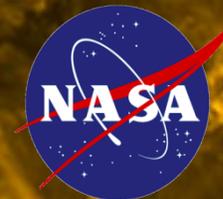
Launched in 2013 for a 2+ year mission to investigate energy transport mechanisms on the sun

IRIS Mission

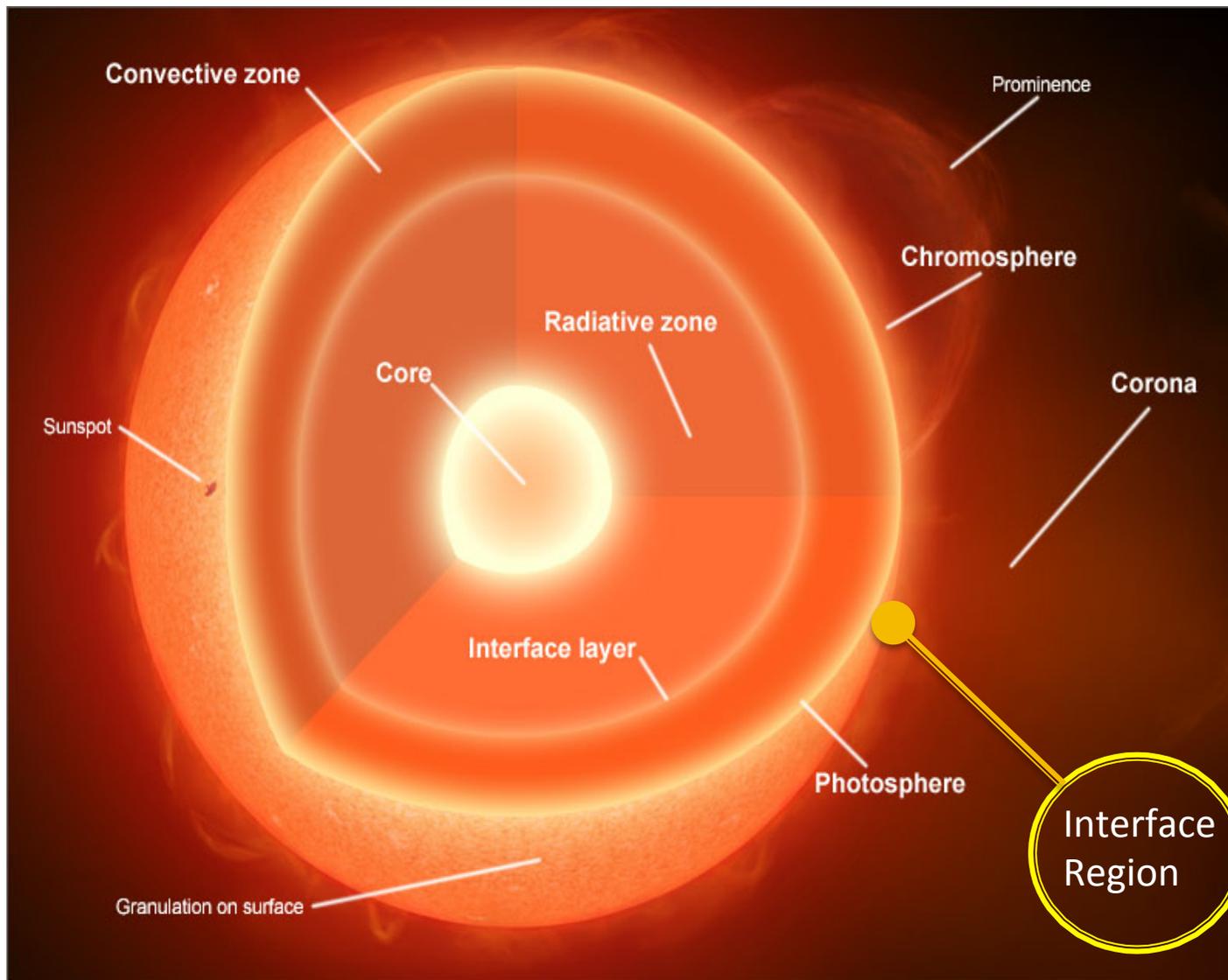
- IRIS is a NASA Small EXplorer Mission developed to study the region of the sun between the photosphere (5000 K) and the corona (1.5M K)

- The Mission Includes
 - Instrument (telescope and imaging spectrograph)
 - Spacecraft (power, pointing, C&DH, comm)
 - Ground Data Systems
 - Mission Operations Center
 - Science and data analysis





IRIS Mission Objectives



[Core ~ 16 million K]

Photosphere + 500km
@ 4,100 Deg K

Chromosphere @ up
to 20,000 Deg K

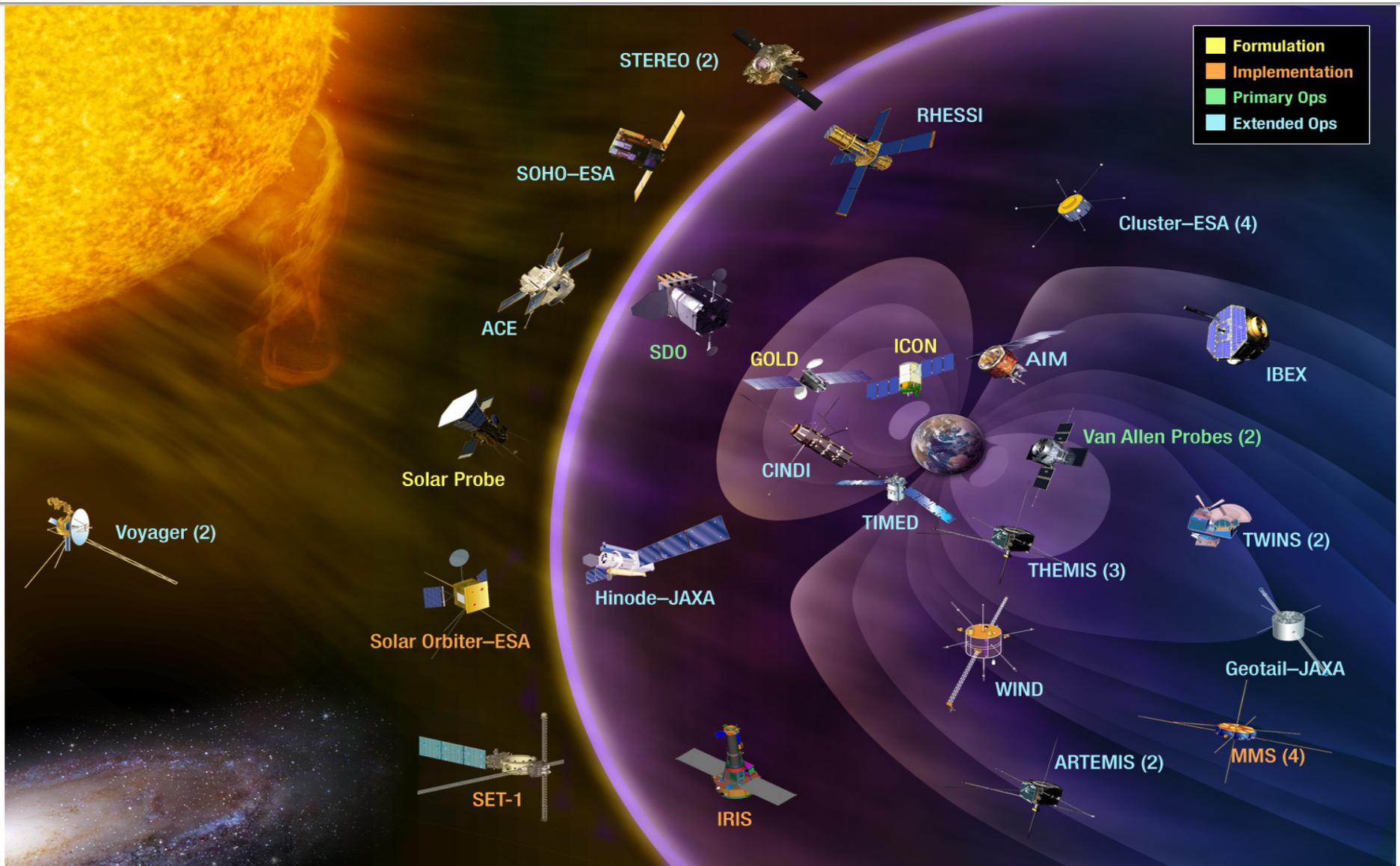
Corona @
1-2,000,000 Deg K
(& up to 20 million)

Why this increase?

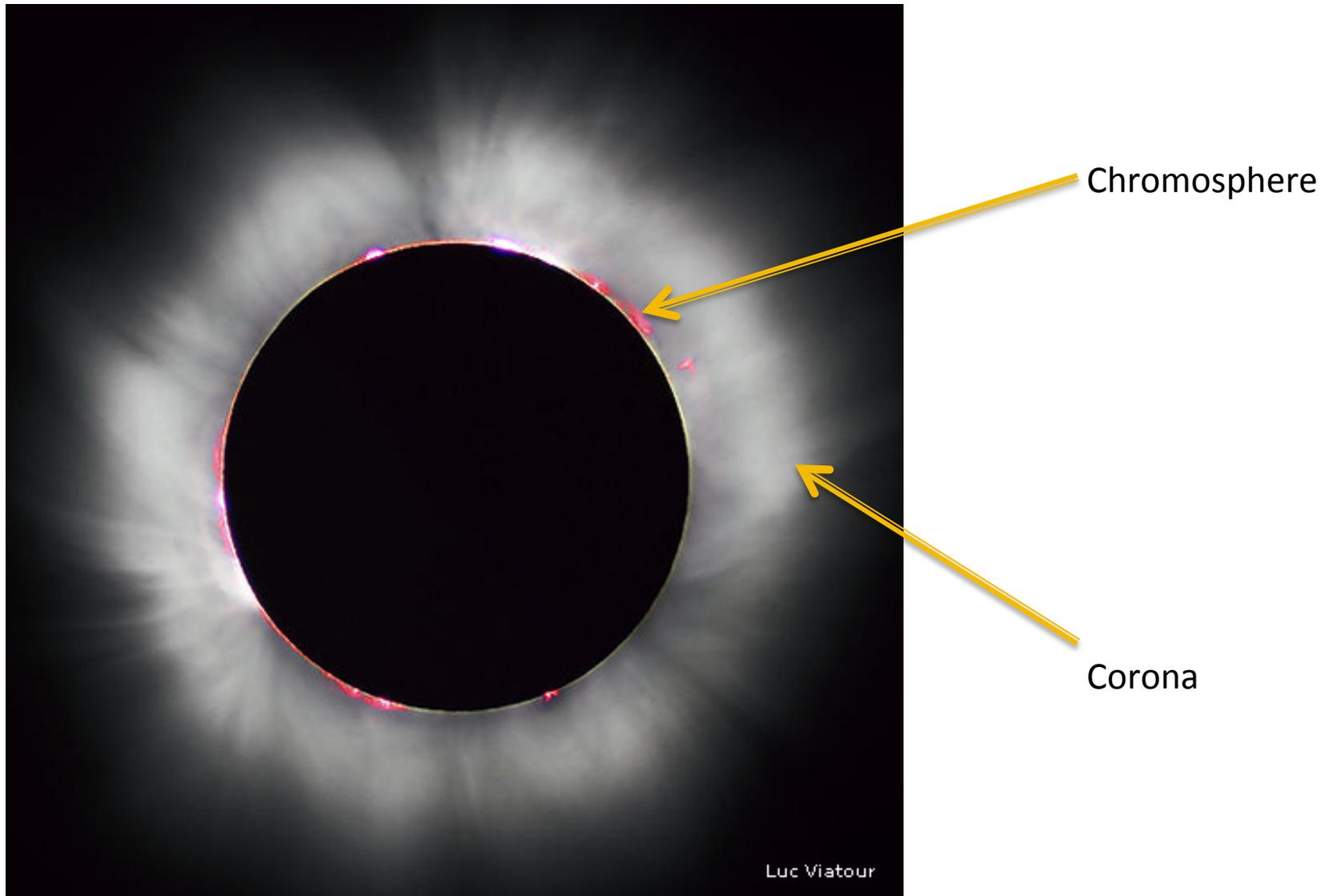
And what is the
energizing
mechanism?

Interface
Region

NASA's Heliophysics Fleet

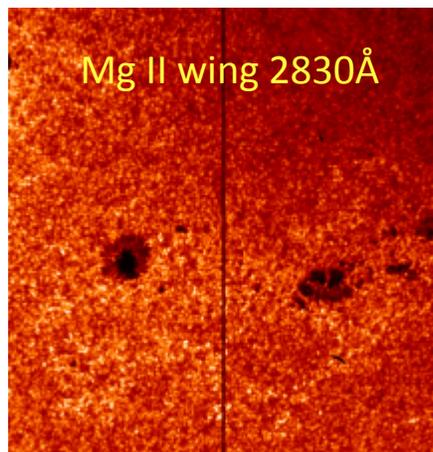


Solar Eclipse

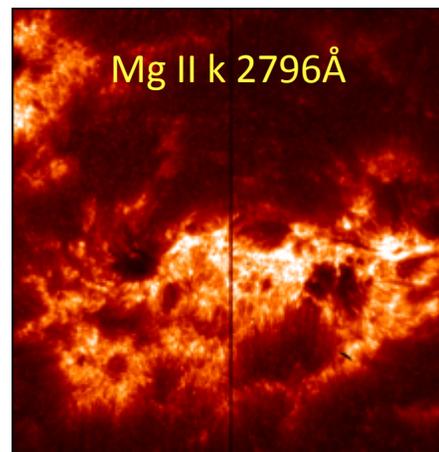


What does IRIS really do?

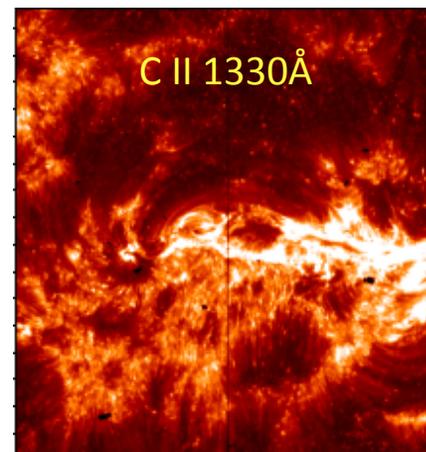
- IRIS records images AND spectra of the sun throughout the Interface Region – all ultraviolet spectrum.
- How does IRIS image different layers of the sun?



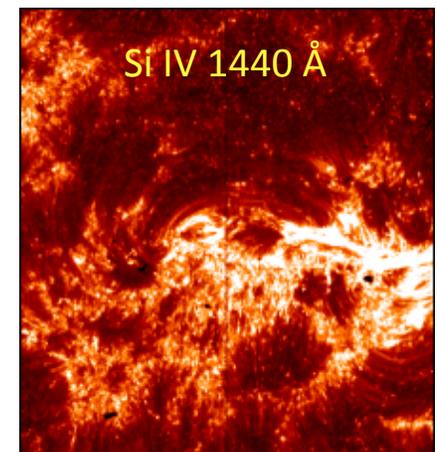
6000K



15,000K

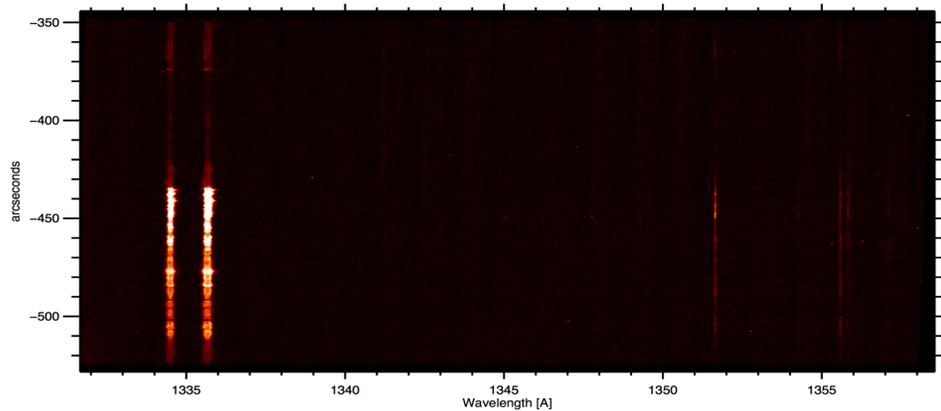
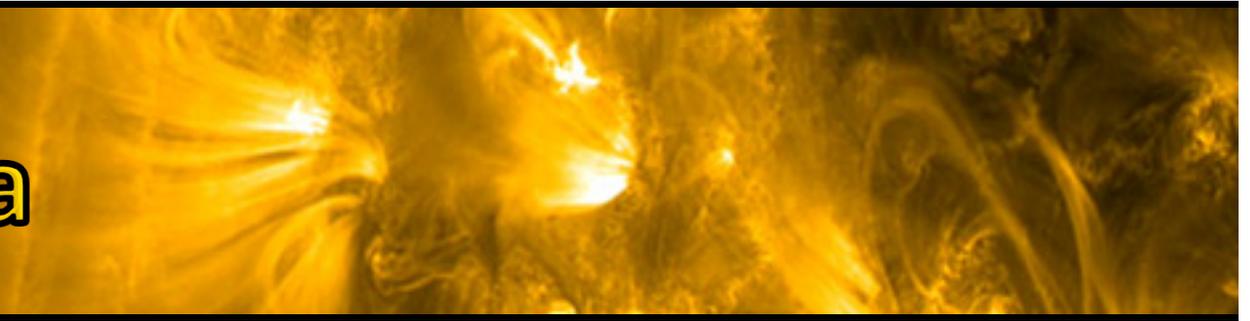


30,000K



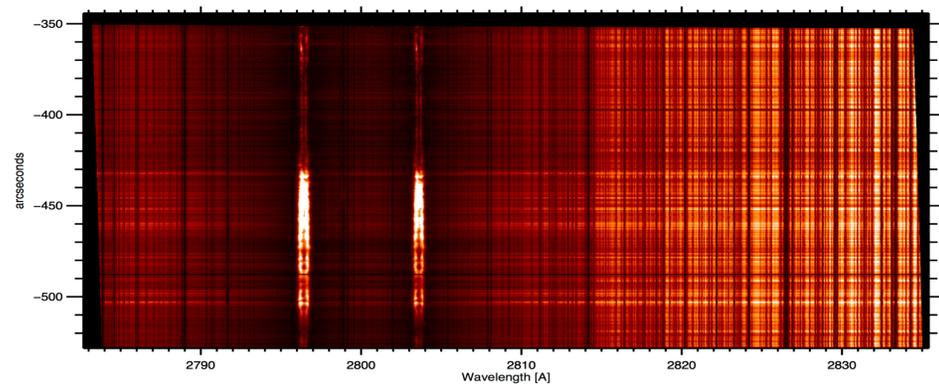
65,000K

IRIS Spectra

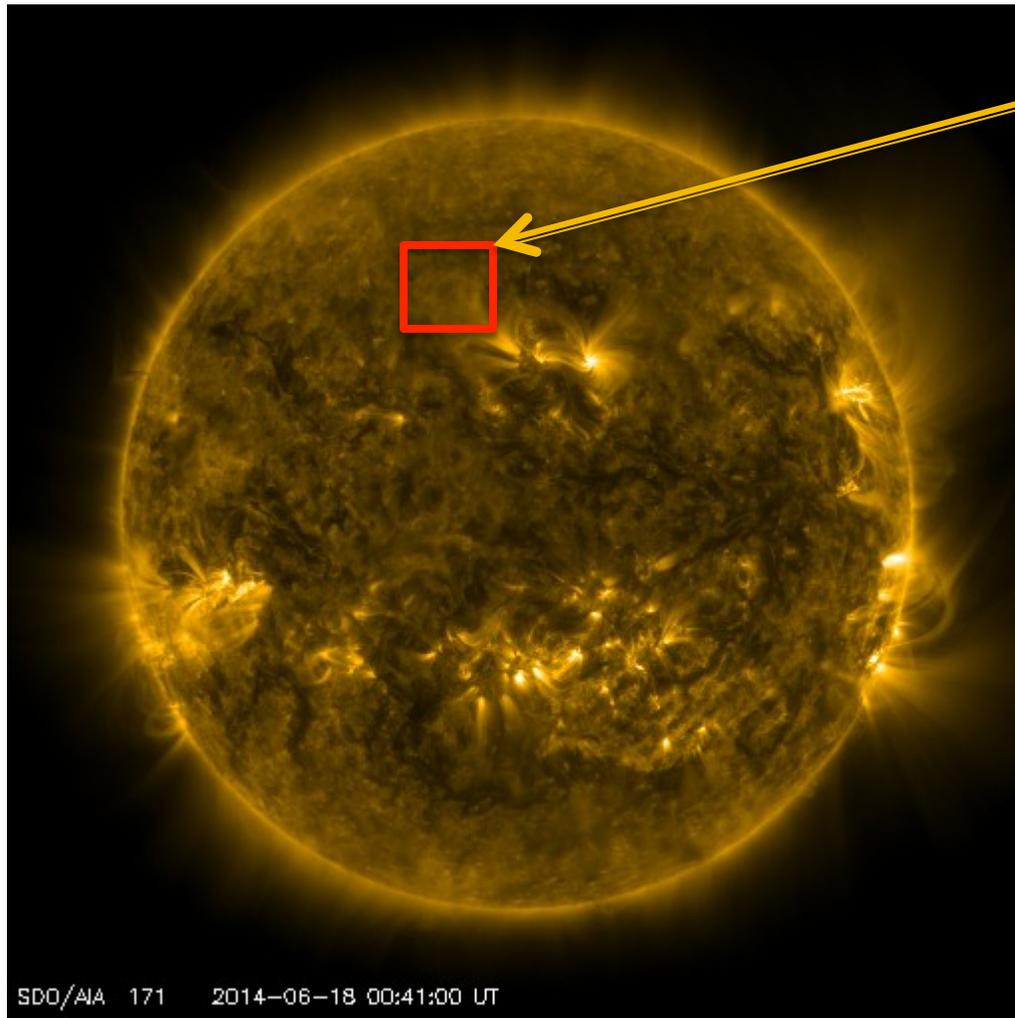


How do the scientists use spectra?

- Good indications of:
- Velocity
 - Density
 - Temperature
 - Magnetic Fields



IRIS the Microscope?



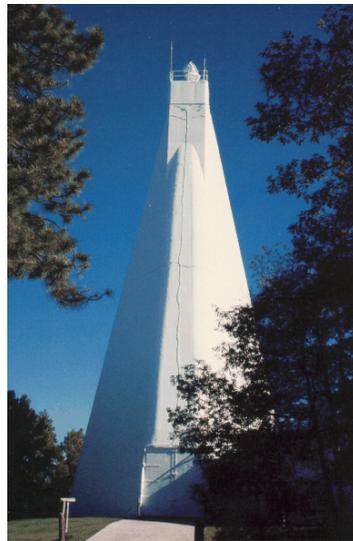
IRIS has a FOV of 175x175 arc secs
Less than 5% of total solar disk

Collaboration

IRIS science team regularly collaborates with various spacecraft and ground observatory teams



Swedish Solar Telescope (SST)



Dunn Solar Telescope (DST)



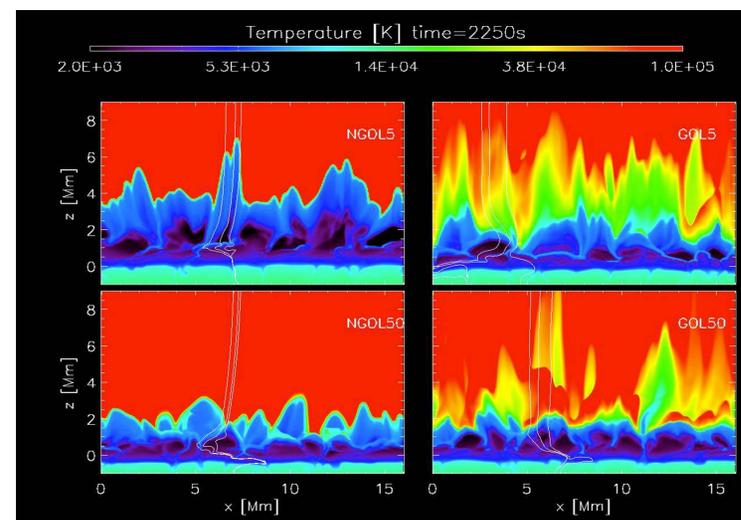
Hinode



Solar Dynamics Observatory (SDO)

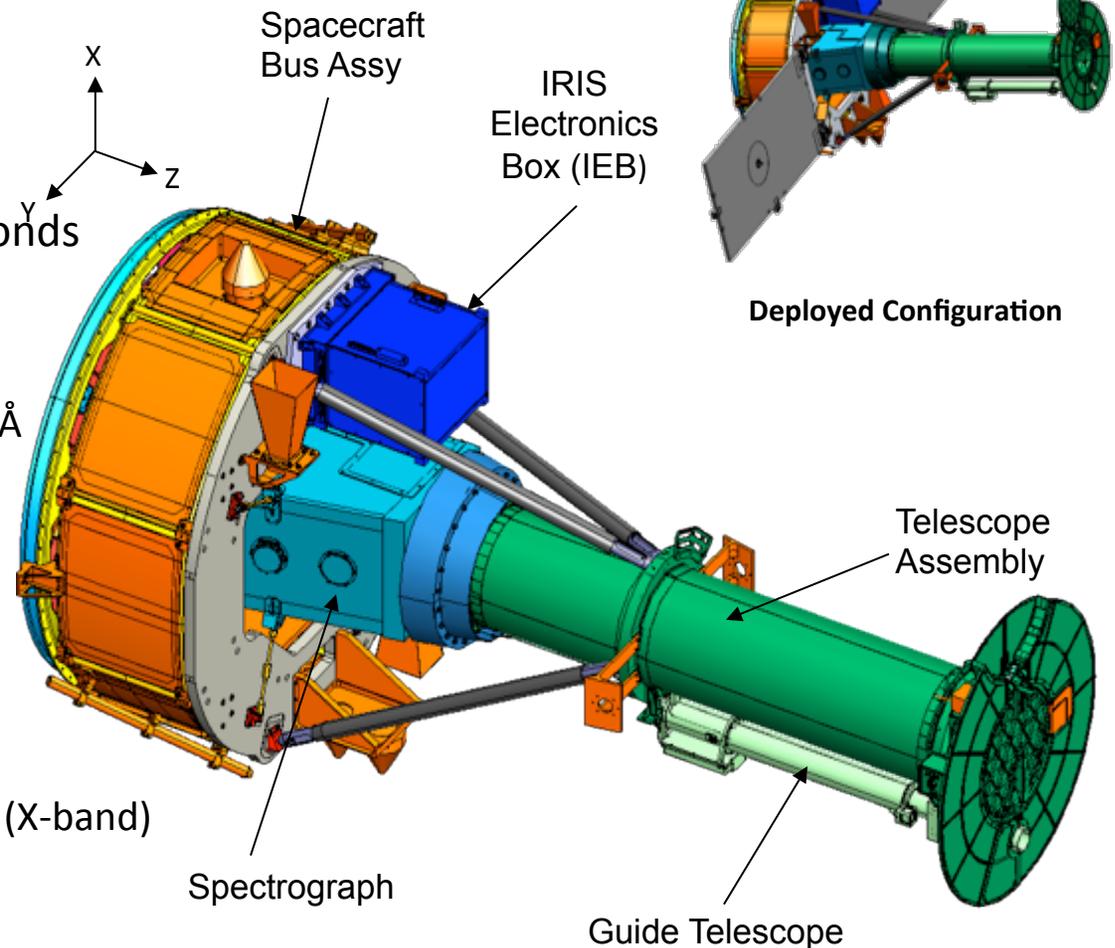
Computation

- Simulation of Interface Region dynamics
- Over 30 MILLION CPU hours on Pleiades Supercomputer at NASA Ames.
- Other computing facilities used as well
- MHD equation simulations
- University of Oslo team
- Aids in interpretation of IRIS data and is crucial for the mission!



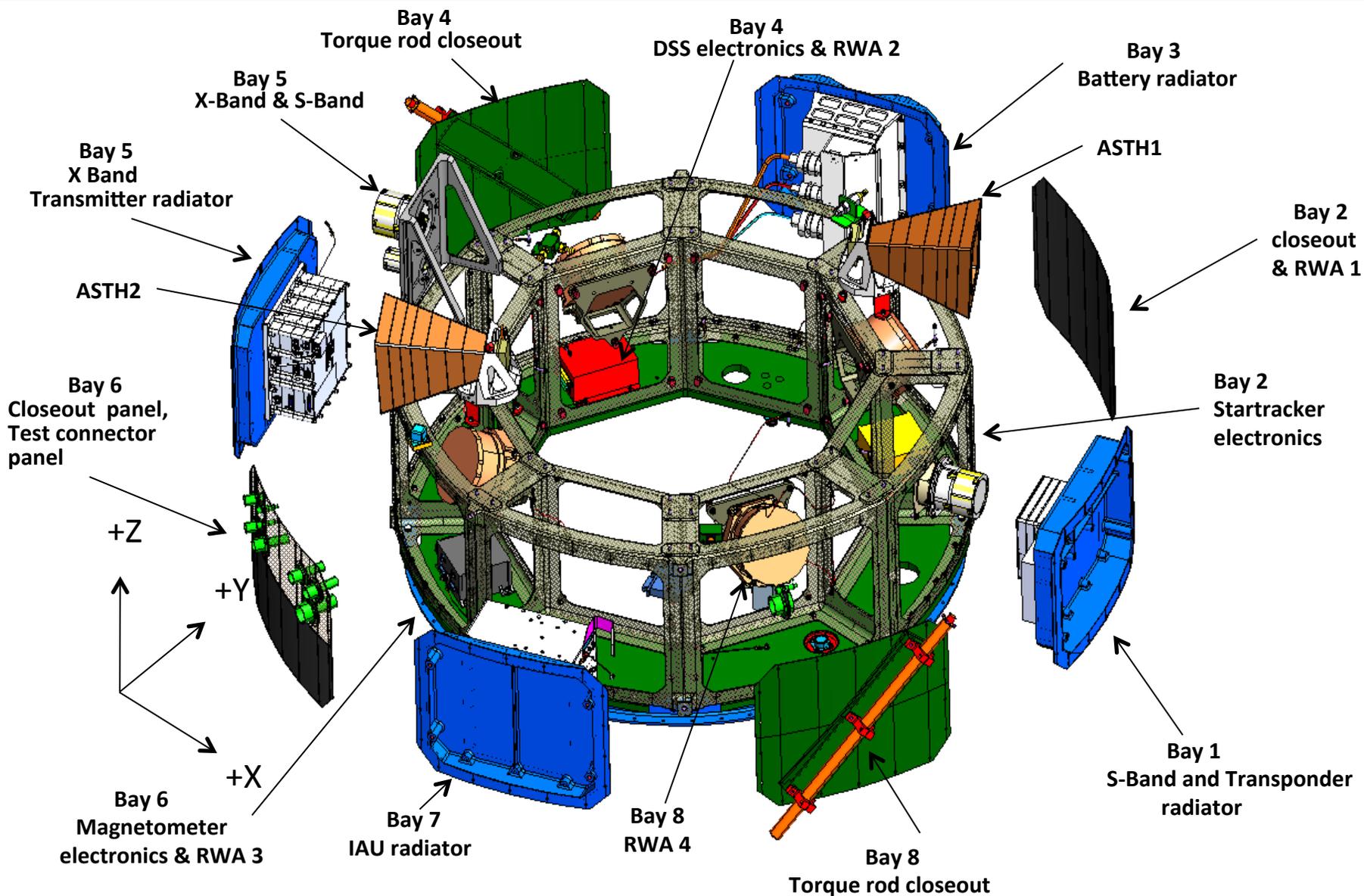
IRIS Spacecraft

- Launch Date: June 27, 2013
- Launch Vehicle: Pegasus XL
- Solar Pointing
- Telescope resolution: 0.33 arcseconds
- Observing wavelengths:
 - 1332-1406 Å & 2796 - 2803Å
 - Human eye detects ~ 3800 – 7500 Å
- Orbit: Polar & Sun synchronous
 - 620 x 670 km (385 – 416 miles)
- Orbit period: 97 min
- Mass: 183 kg
- Power: 342 W
- Telemetry rate: 15 Mbps, 60Gb/day (X-band)
- Recording capacity: 48 Gbits
- Mission Life: >2 Years

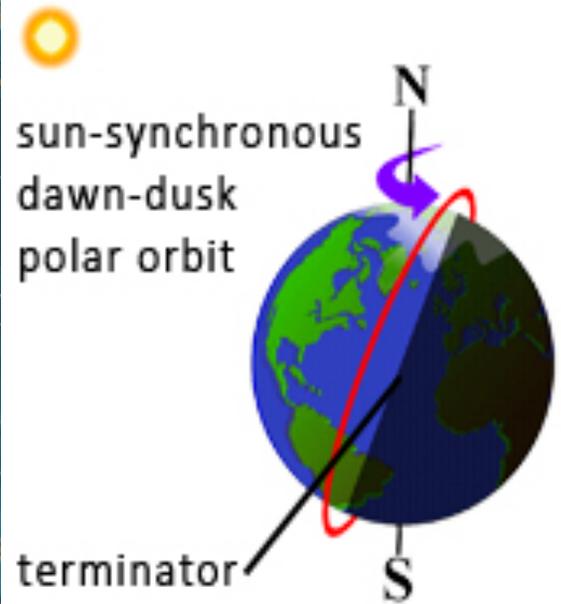
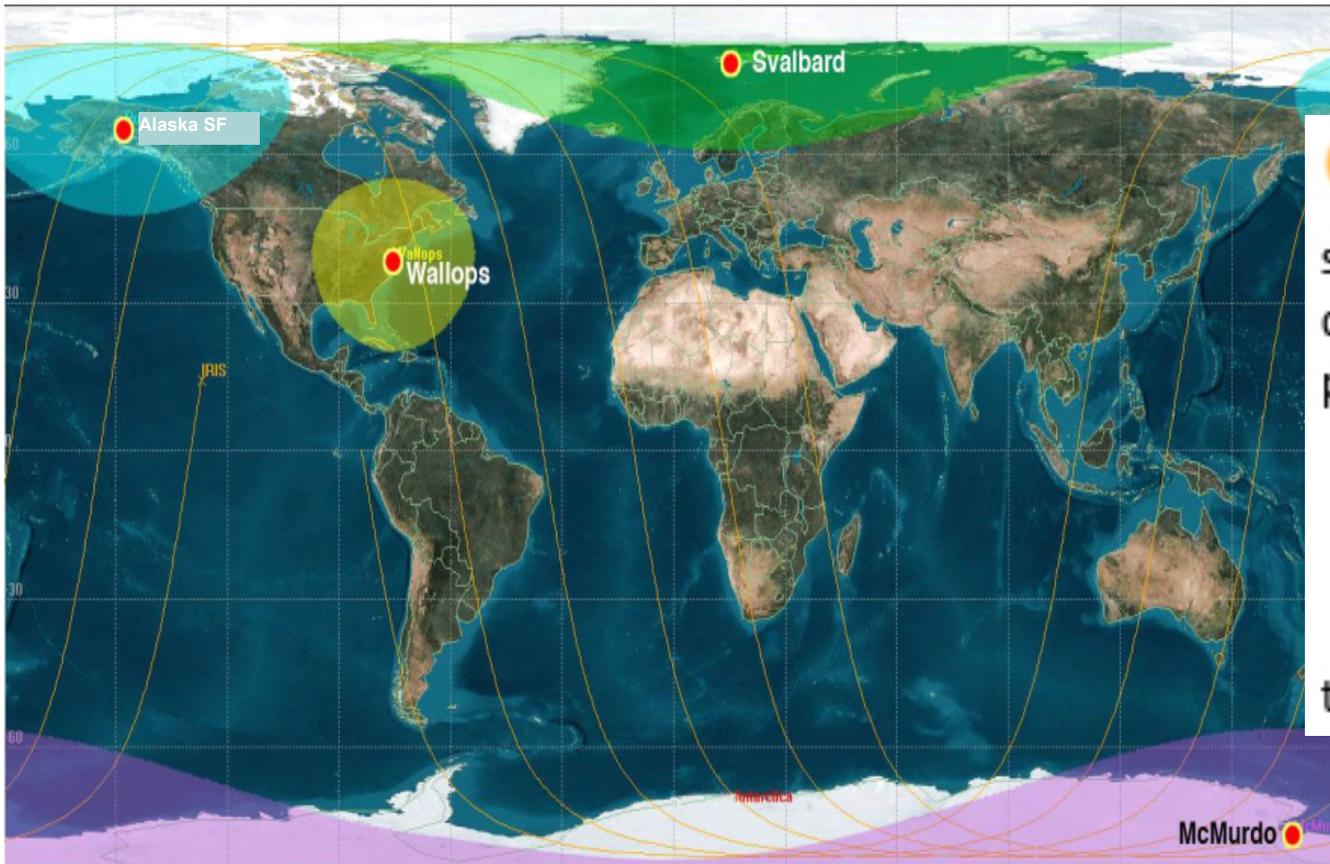


IRIS is a sun-pointed spacecraft that images the Sun's chromosphere in ultraviolet light

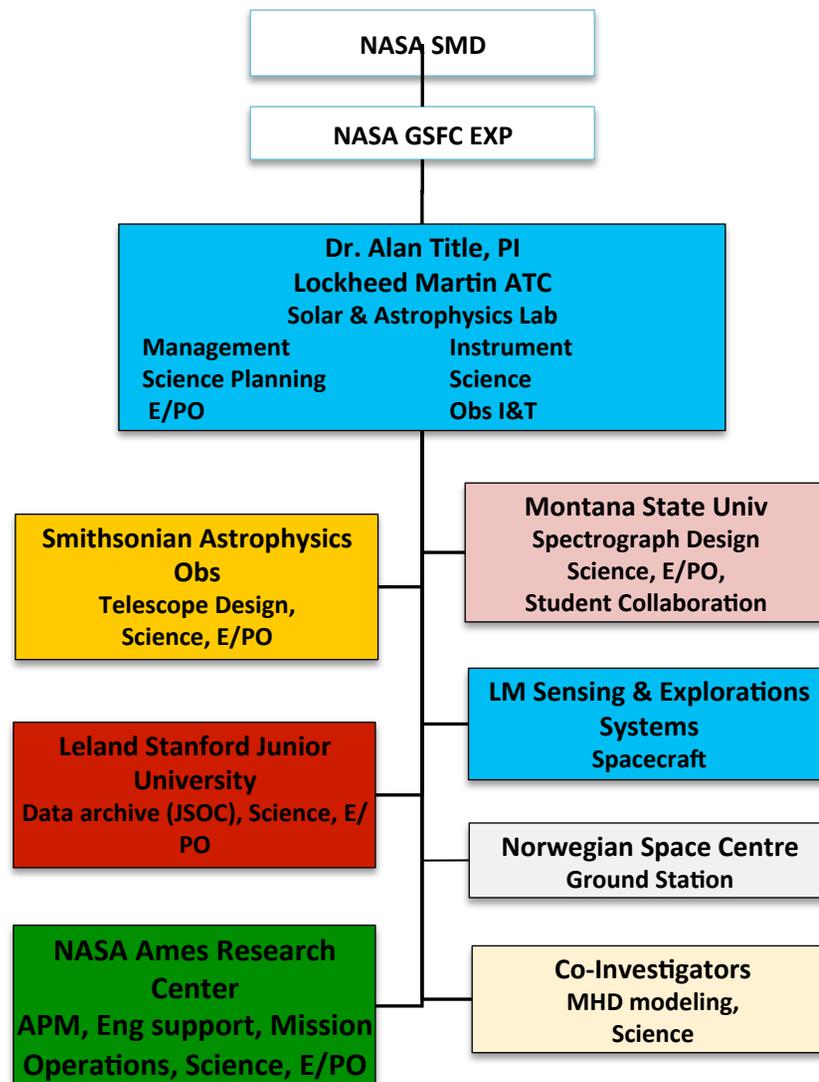
Spacecraft Bus



Orbit and Ground Stations

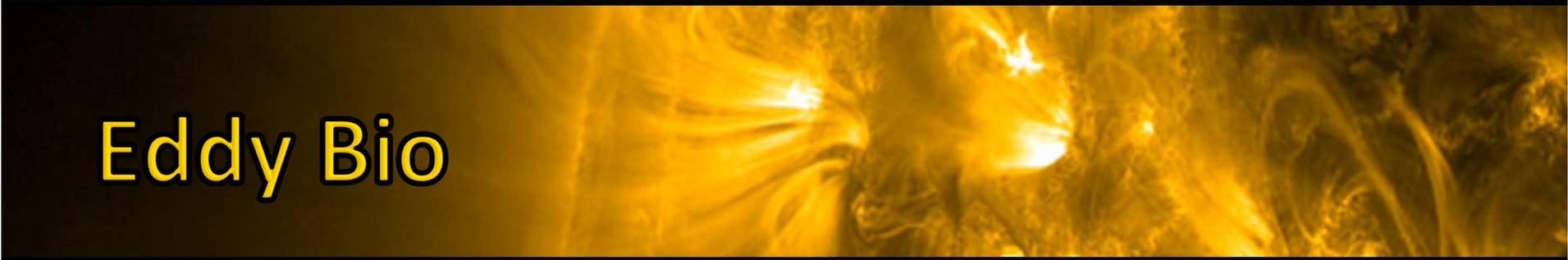


Ames on the IRIS Team



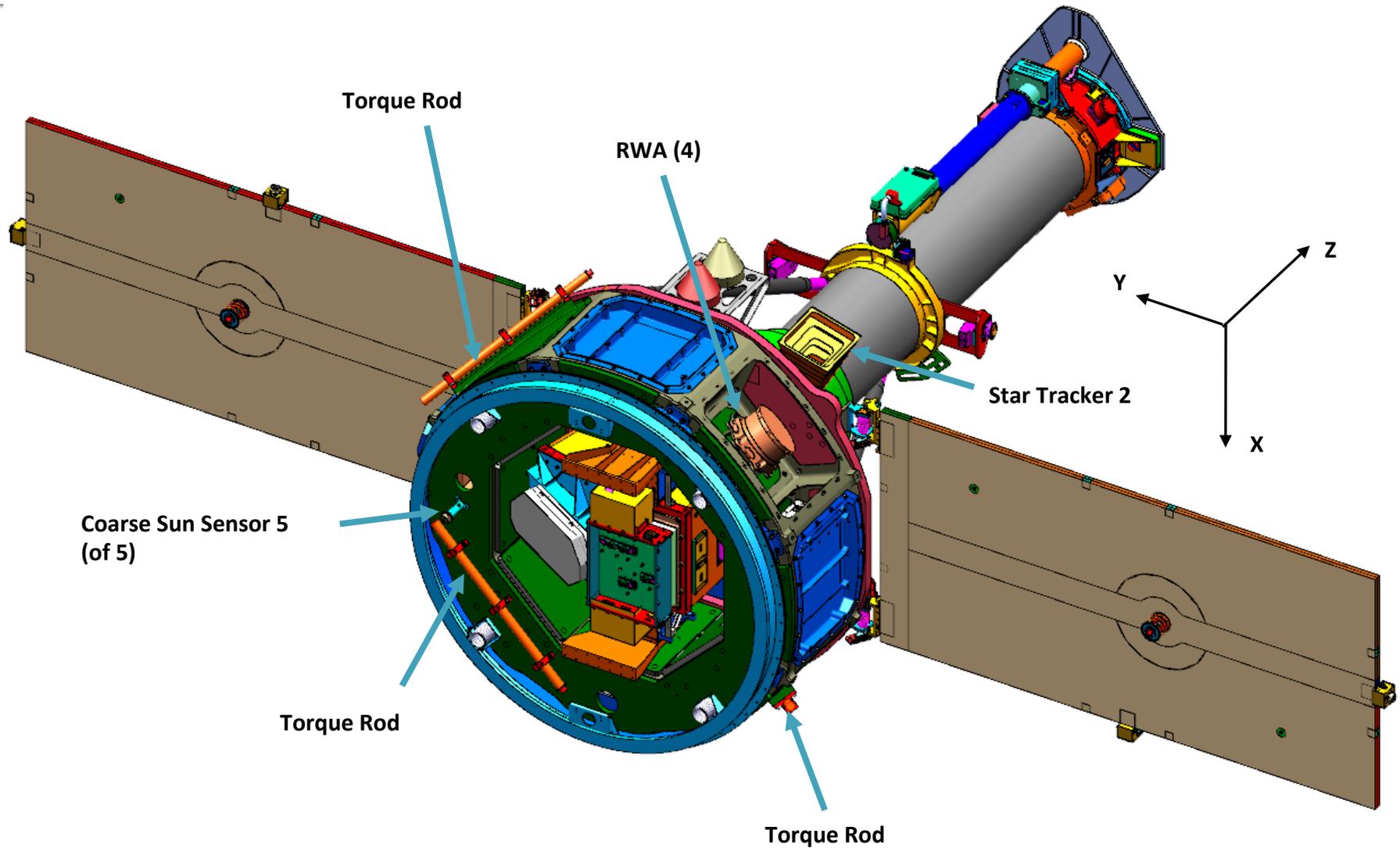
- Ames has been a critical partner on IRIS from the beginning
 - Assistant Project Manager - J. Marmie
 - Mission Operations
 - Ground Systems
 - E/PO
 - Science participation - P. Worden
 - Flight Software support
 - ACS support
 - Simulator support
 - Instrument FSW support
 - Thermal Engineering Support

Eddy Bio

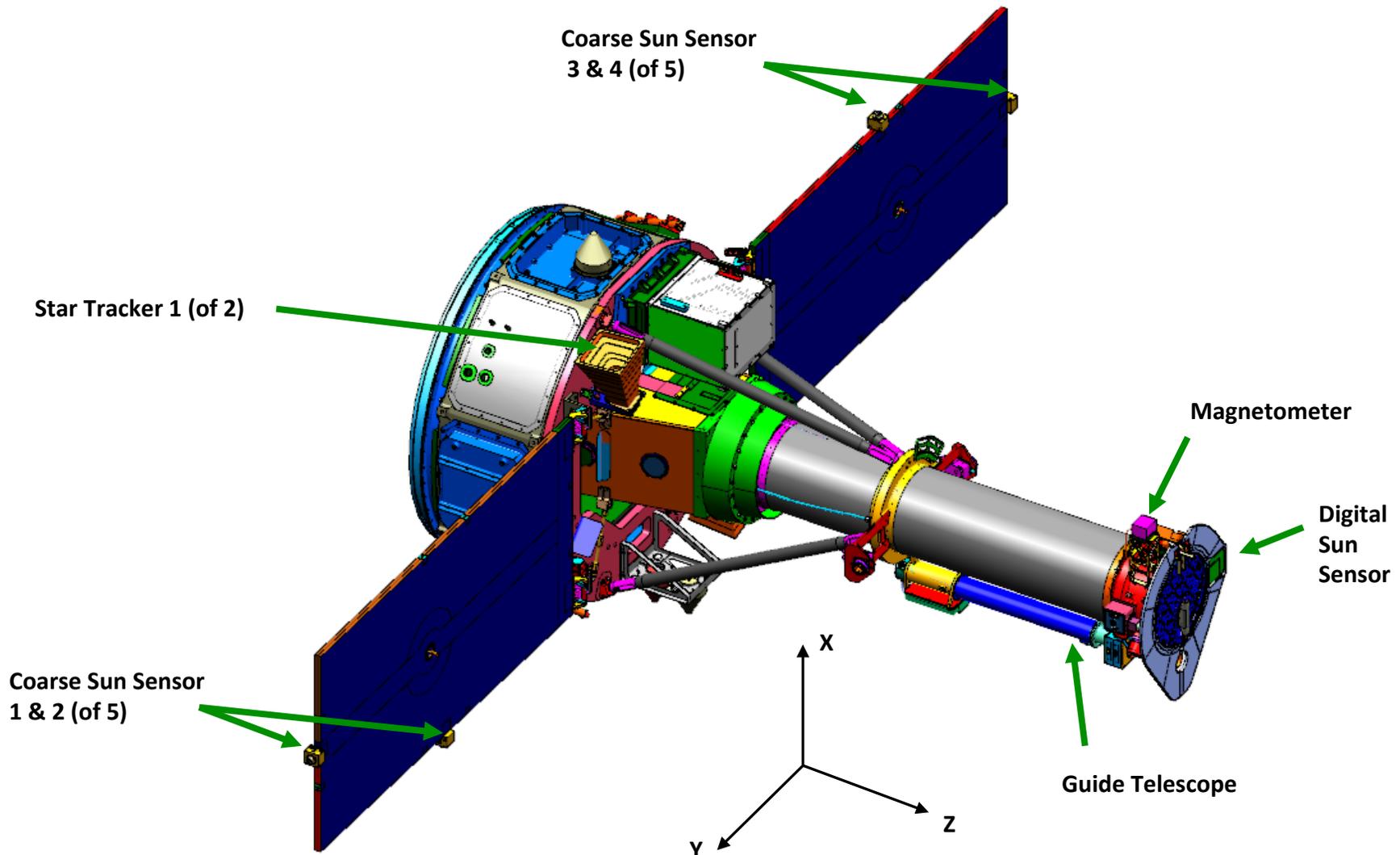


- Started working at NASA in 2006 as an intern
- BS/MS at San Francisco State and Santa Clara
- Various Projects at NASA
 - Testing/Qualification of payload to ISS
 - Hardware/Software projects
 - Proposals
 - And IRIS – worked extensively at Lockheed Martin
 - Also supporting UAS effort at Ames
- Look forward to supporting future exciting projects!

Attitude Control System (ACS)



Attitude Control System (ACS)

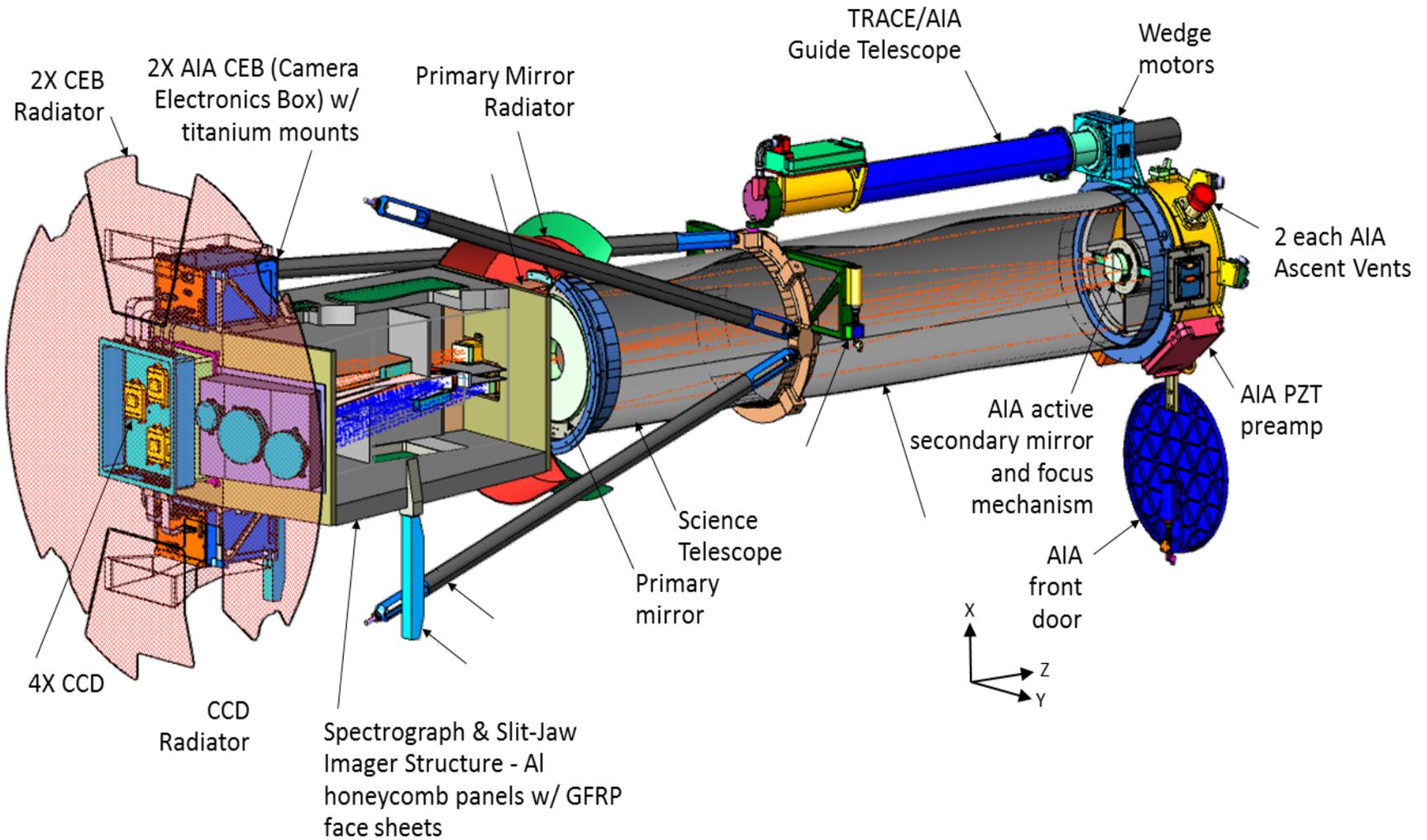


ACS

The ACS logo is displayed in a bold, yellow, sans-serif font on a black background. The background of the slide features a golden, abstract, swirling pattern that resembles a nebula or a complex network of fibers.

- Several Different modes of Operation:
 - De-tumble
 - Sun Search
 - Coarse Control
 - Inertial Sun Point
 - Fine Sun Point
 - Spend ~99% of time in this mode during operations
 - Better than 0.5 arc-sec stability

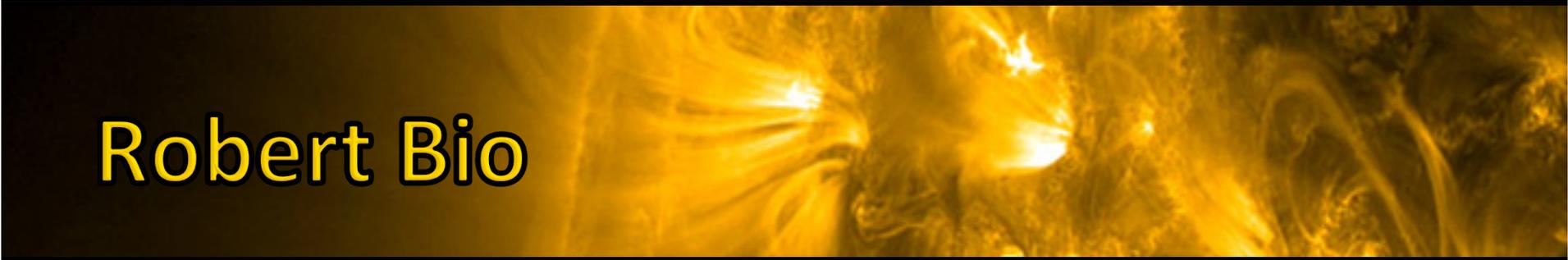
Instrument



Flight Software

- Separate CPU/Code for Spacecraft Bus and Instrument
- RAD750 and RAD6000 CPUs
- Coded in C/C++ with VxWorks OS
- Fault Management
 - Checks on various components and health
 - Responds to many potential anomalies
- Flight Software Loads
 - Sometimes things just aren't perfect!
 - Loaded FSW from the ground for Instrument, Spacecraft, AND Star Tracker!

Robert Bio



- BS Computer Engineering Santa Clara University 1995
- Graduate Program Spacecraft Systems Engineering APEX/
Stevens Institute of Technology 2009
- Started as an intern at Ames in 1993
- Highlights of NASA career include:
 - Leading and supporting Ames mission proposals
 - Operations and Information Architecture for Constellation
 - Developing astronaut training management systems
 - Supporting the Columbia Accident Investigation Board
 - Developing Operations for upcoming Resource Prospector
- Robert has long been a space enthusiast, and looks forward to the exciting new things that NASA is doing

Ground Data System

- The tools to support the operation of the mission
 - Building Command packages
 - Receiving and processing Telemetry
 - Communication Scheduling
- Systems Engineering
 - Requirements coverage
 - Architecture and Interface design
 - System design
 - Verification and Validation
- Tool Development

Testing and Training

Testing

- GDS Component
- GDS System
- Flight Software
 - Range of Simulators
- Interfaces
 - Flight Software
 - Ground Stations
 - Science Planning
 - Scheduling Systems

Training

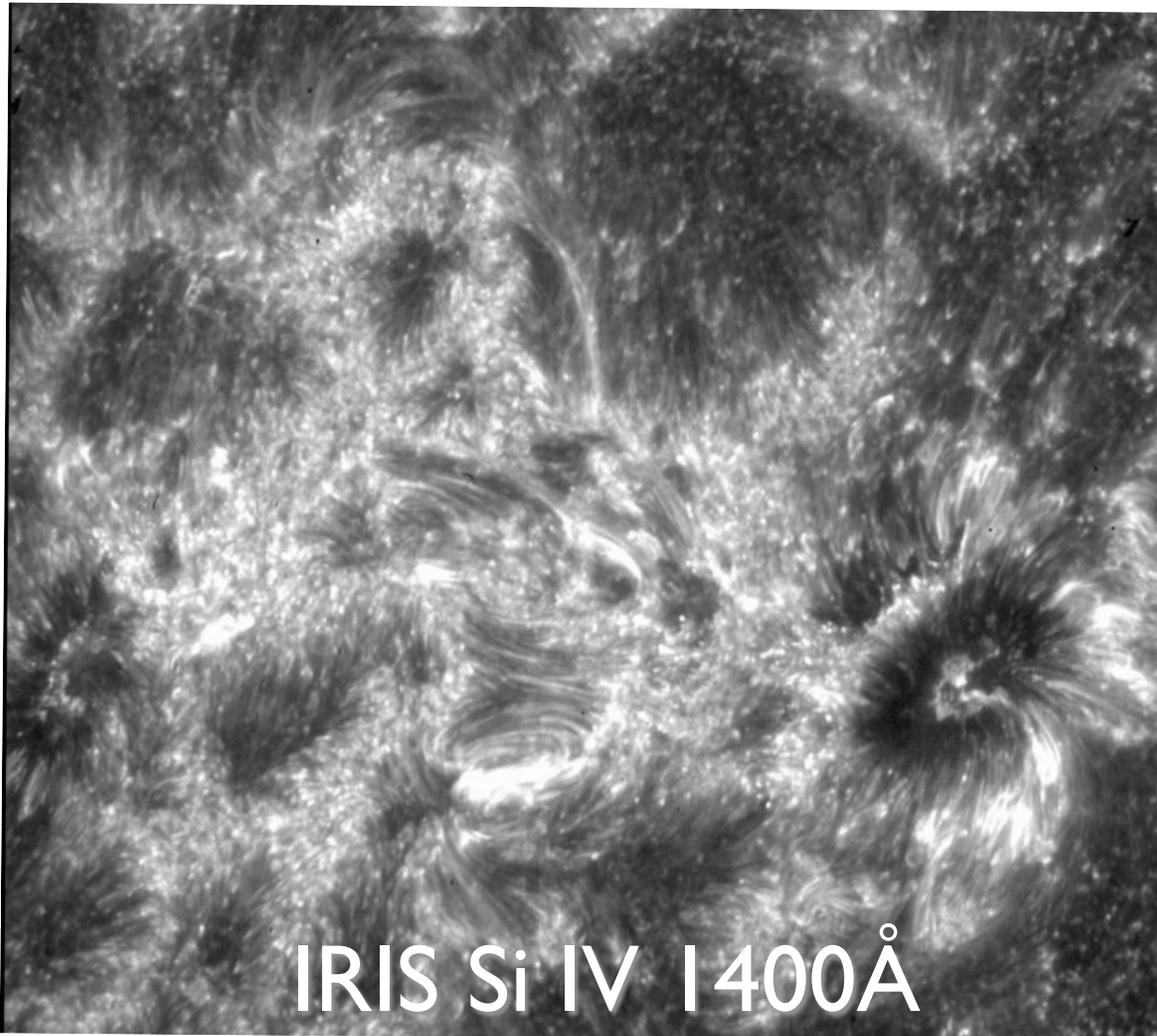
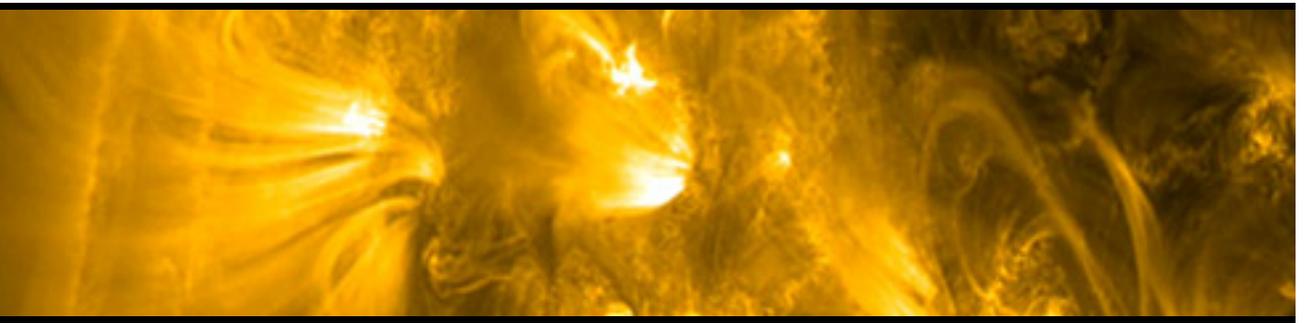
- Flight Software
- Spacecraft Systems
- Instrument Systems
- Ground Stations
- Voice Systems
- GDS Systems
- Mission Sims
 - Day in the Life
 - Launch and Early Ops
 - Comm Scheduling

IRIS is acquired by TDRSS!



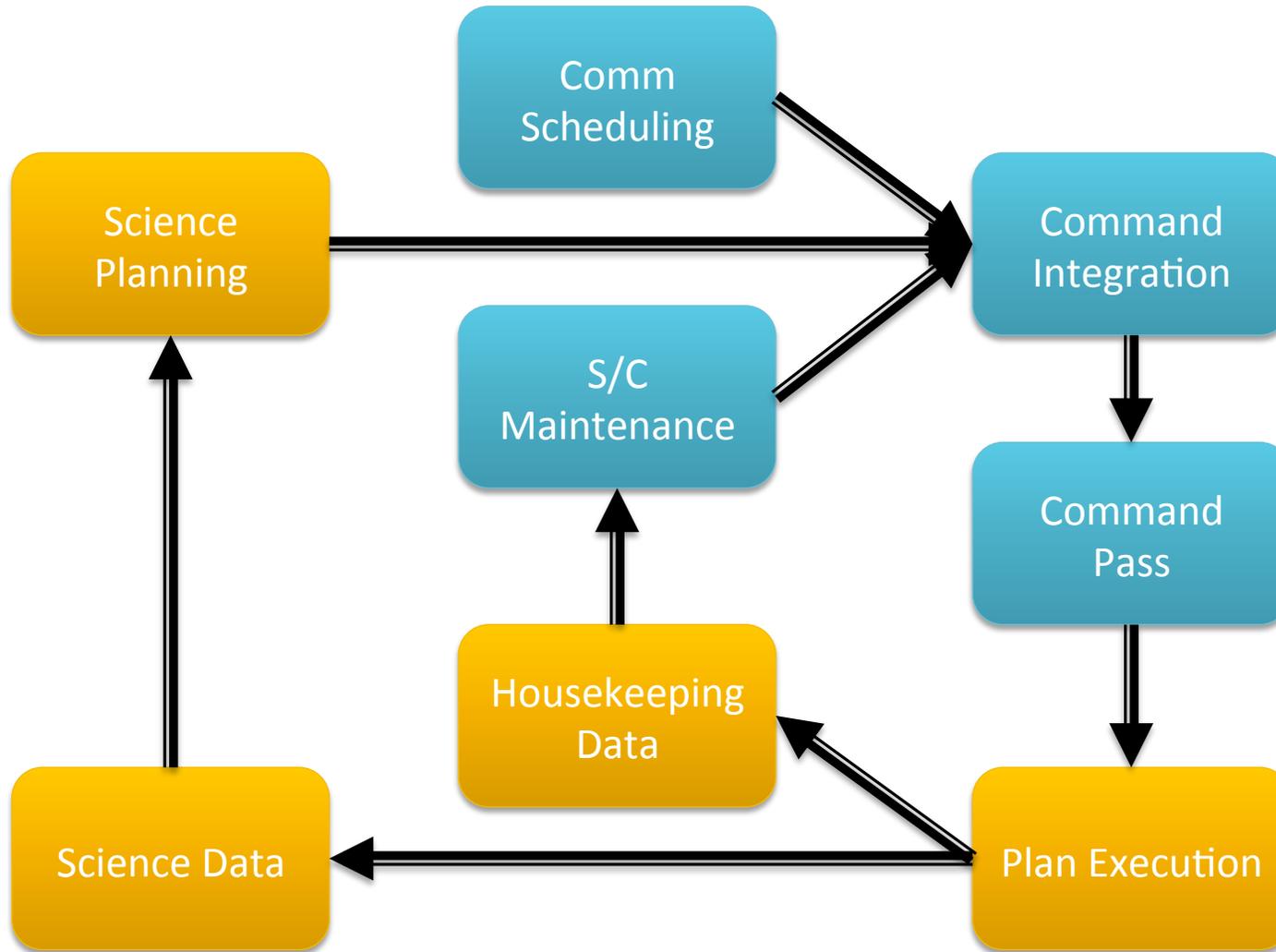
Success! But you'd hardly know it

First Light



- First light announced July 25, 2013
- Nearly 1 year of successful on orbit operations
- Threshold mission requirements met
- Data available to public at: iris.lmsal.com/iristoday

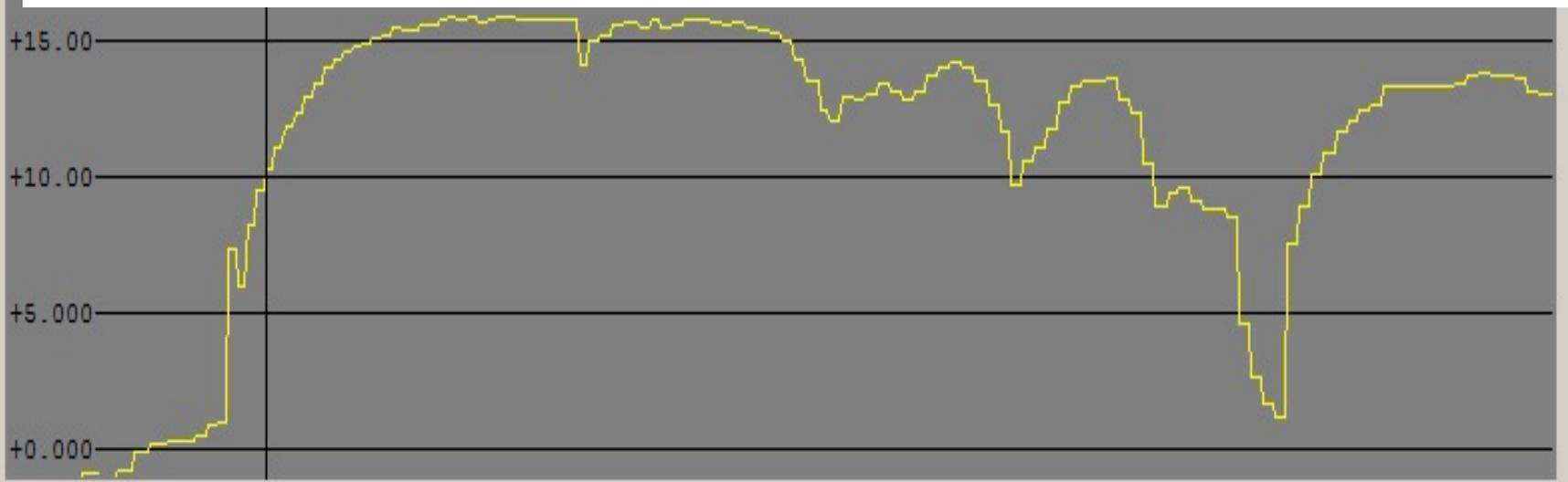
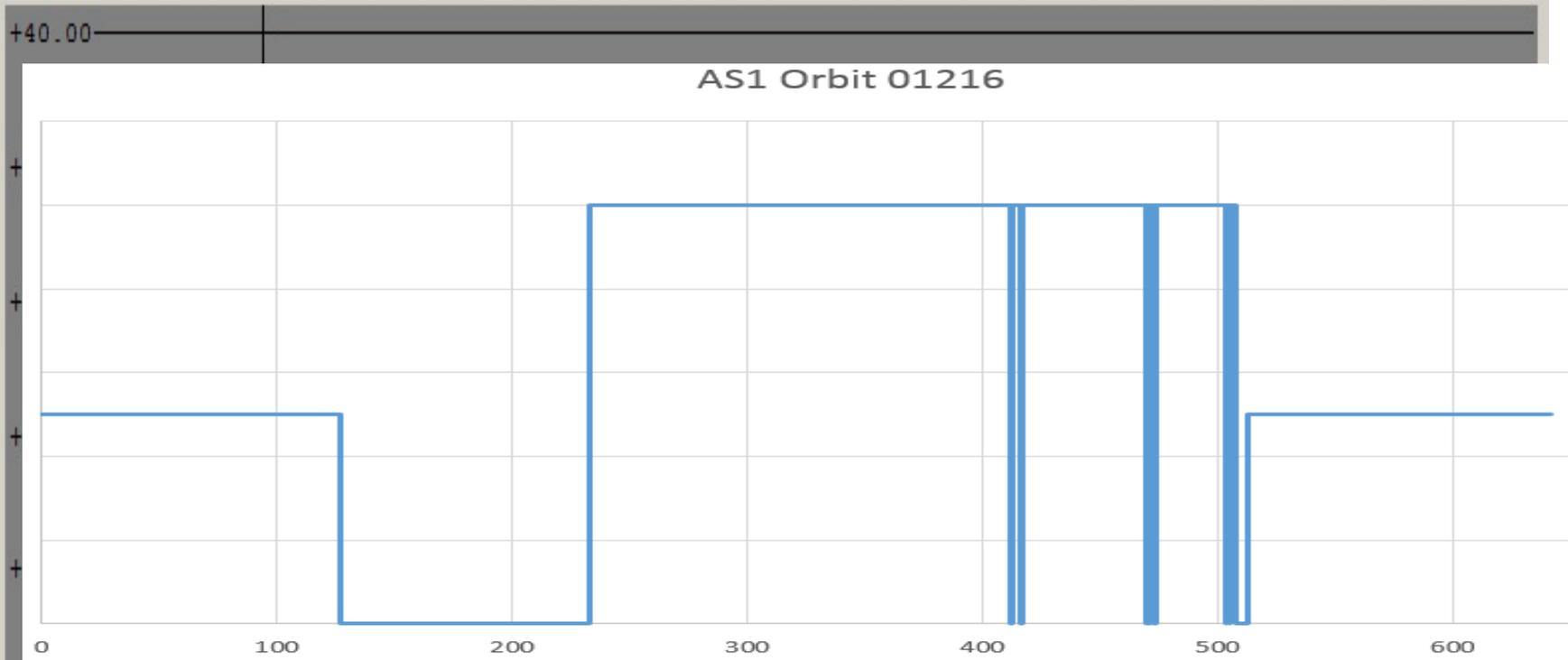
IRIS Day in the Life

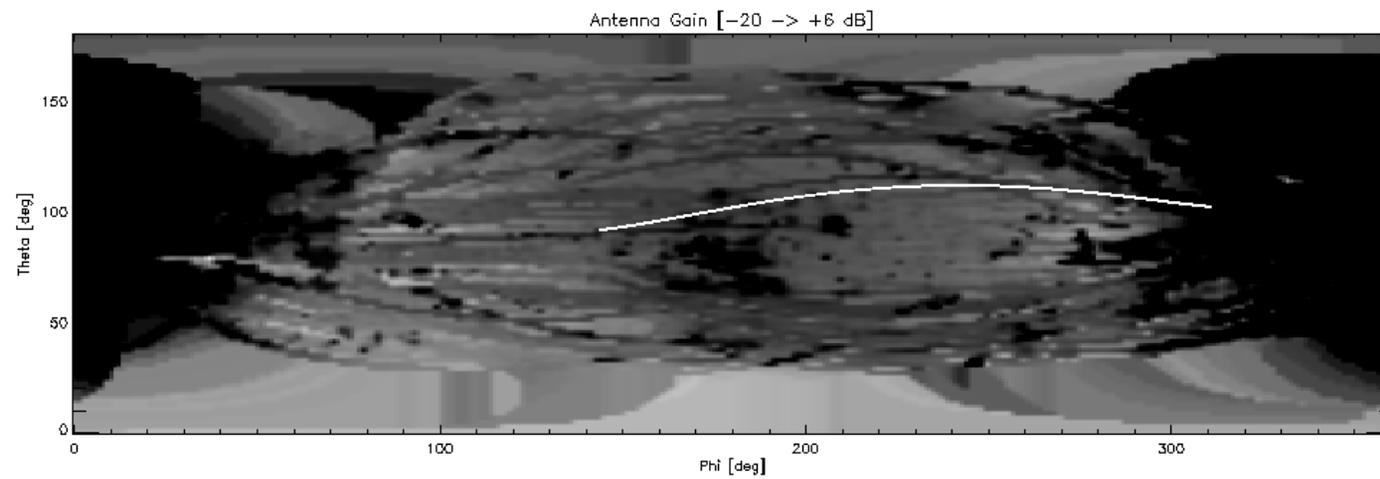
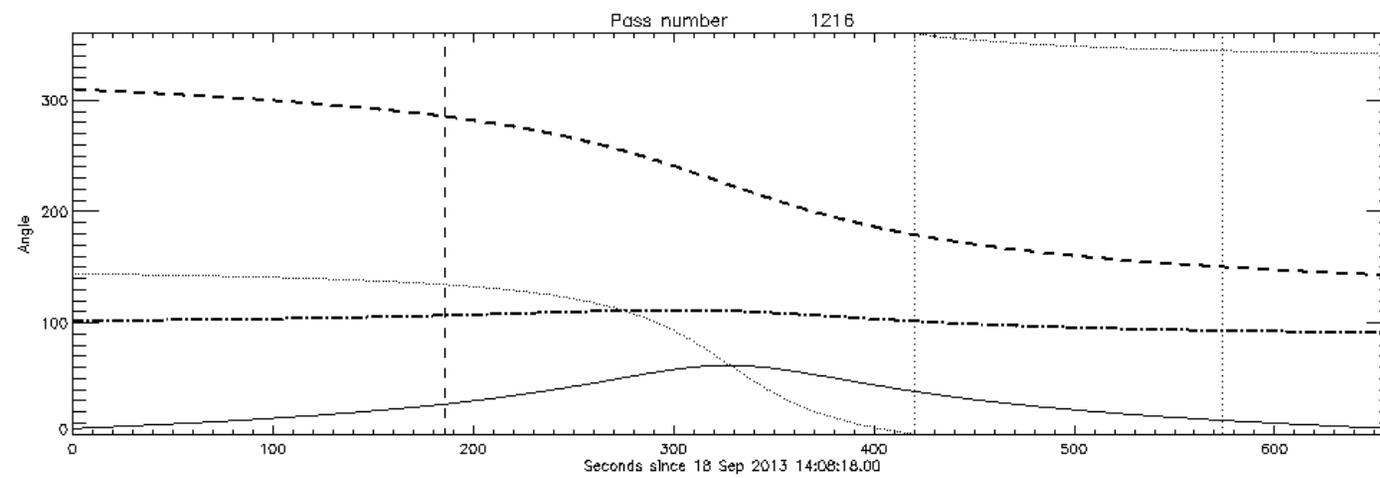
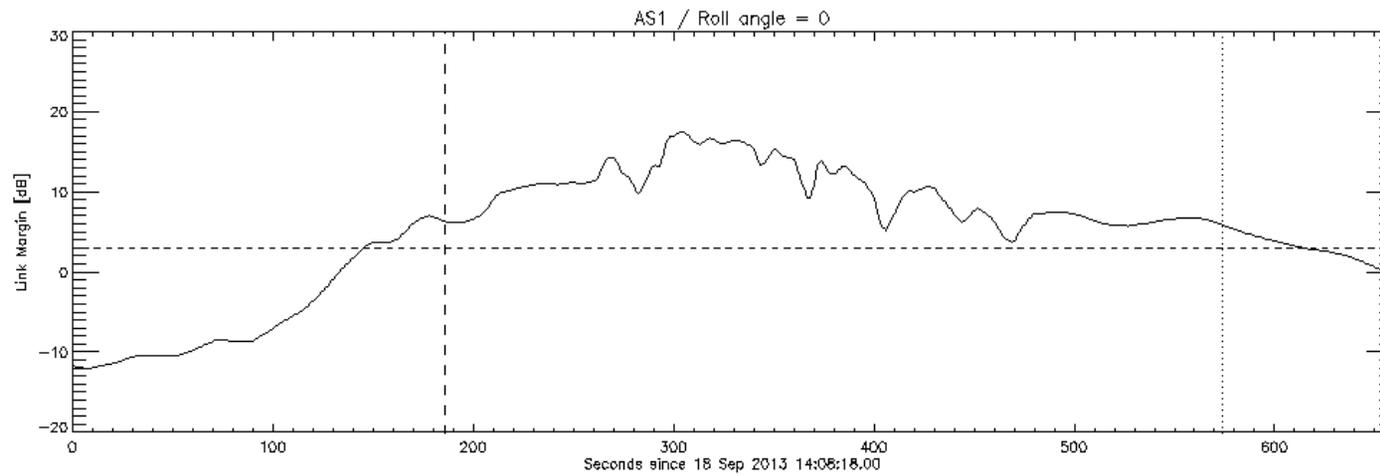


Backup

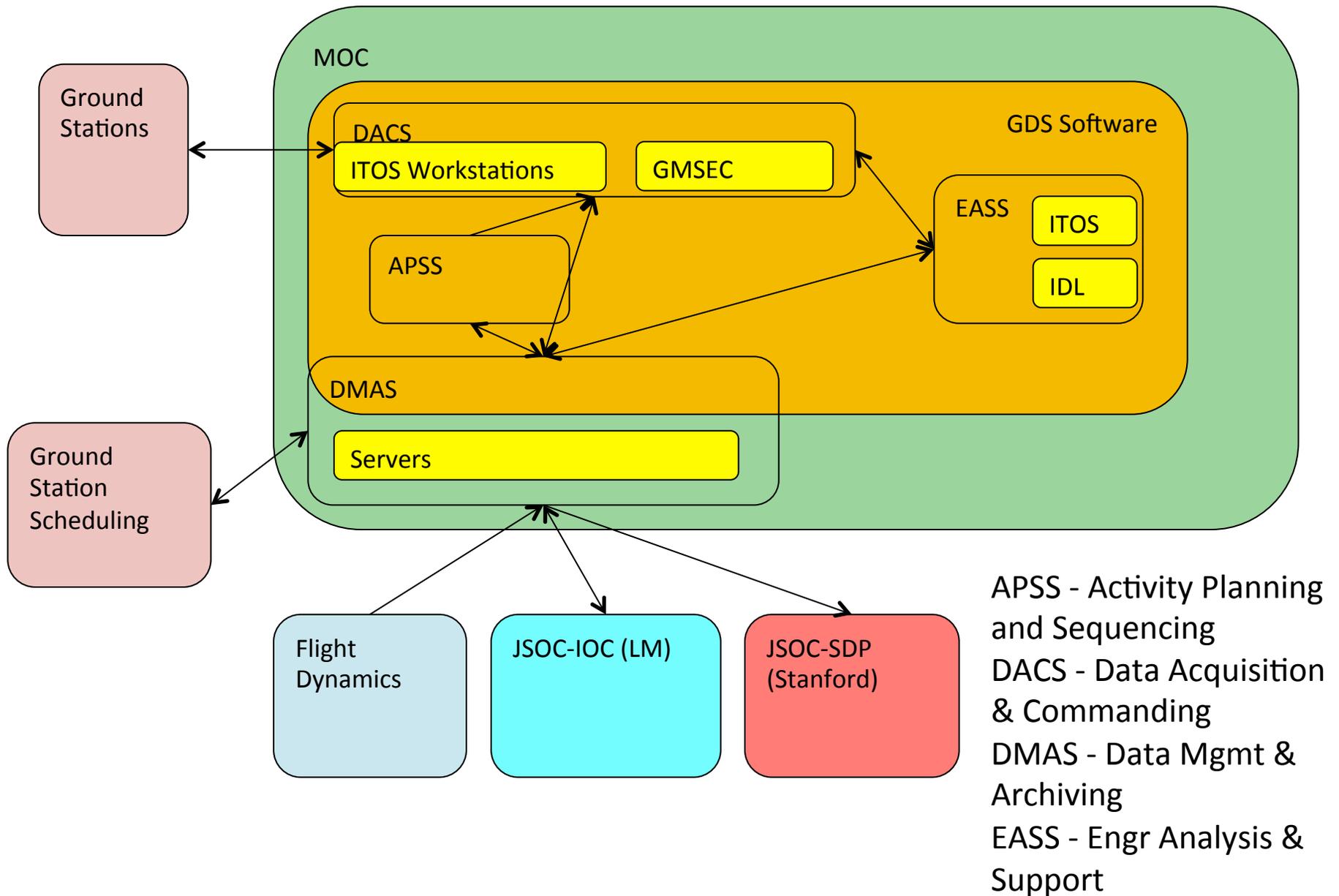


AS1 Orbit 01216

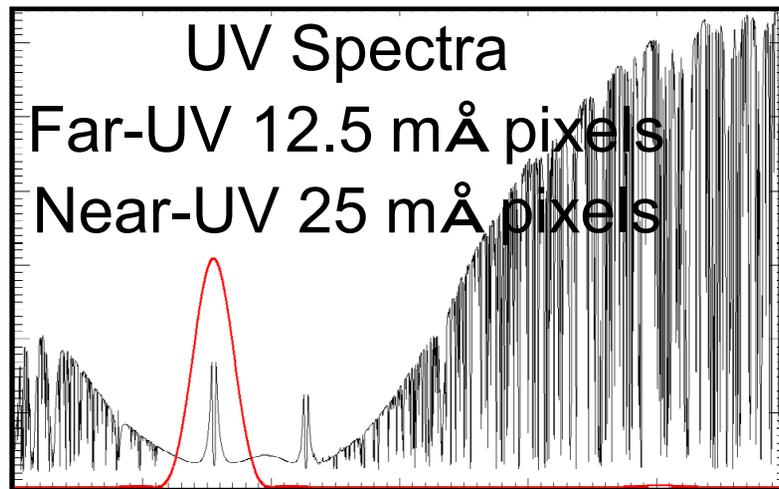
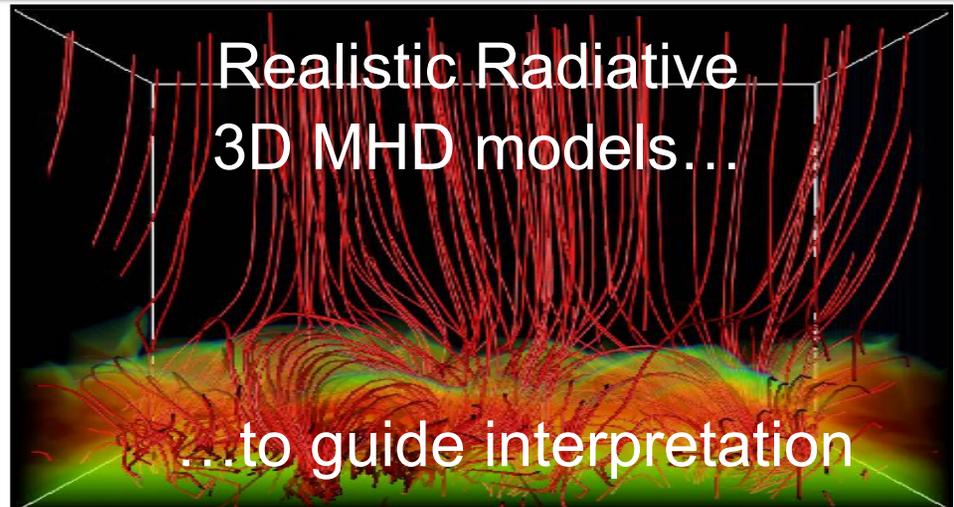
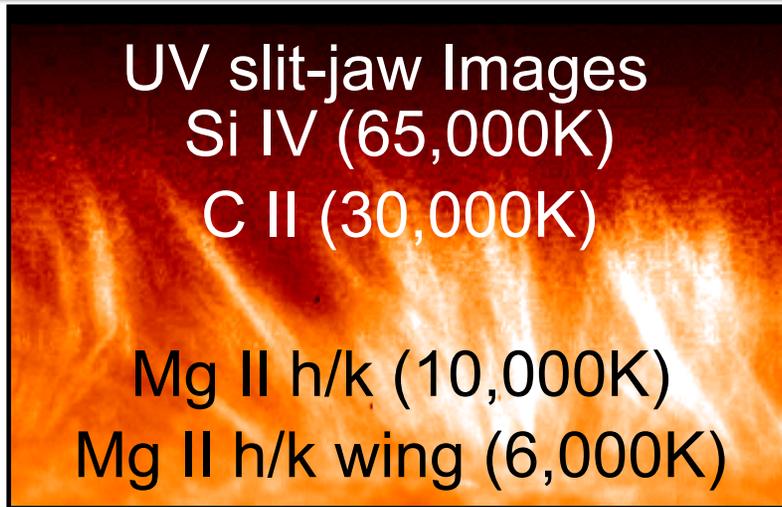




GDS Architecture Overview



Science Implementation



2790 2800 2810 2820 2830

20 cm UV telescope:

1/6 arcsec pixels

multi-channel spectrograph

far-UV: 1332-1358 Å, 1390-1406 Å,

40 mÅ resolution, effective area 2.8 cm²

near-UV: 2785-2835 Å,

80 mÅ resolution, effective area 0.3 cm²

slit-jaw imaging

1335 Å & 1400 Å with 40 Å bandpass each;

2796 Å & 2831 Å with 4 Å bandpass each.

