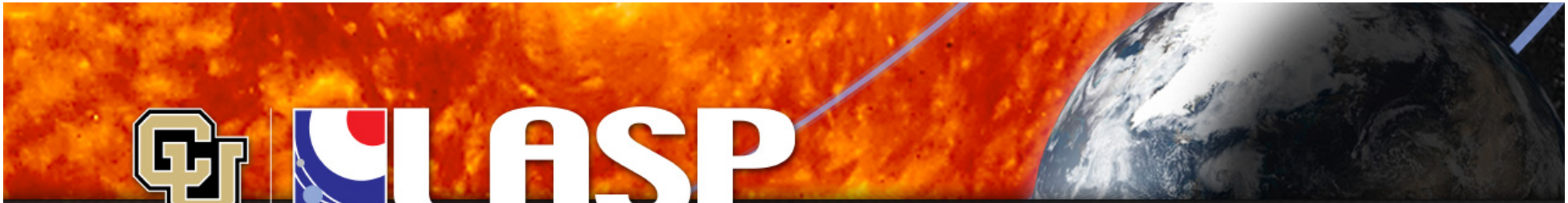


LASP

Laboratory for Atmospheric and Space Physics
University of Colorado **Boulder**

Welcome to The Laboratory for Atmospheric and Space Physics

The 29th annual National Space Symposium
April 8-12

Science and Missions

Presentation by Tom Sparn

Planetary Science • Space Physics • Solar Influences • Atmospheric Science • Engineering • Mission Operations & Data Systems

http://lasp.colorado.edu

** SCIENCE & MISSION **

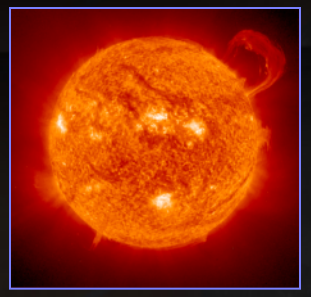
LASP is Science Driven

LASP activities stem from utilizing multiple approaches to answering scientific questions:

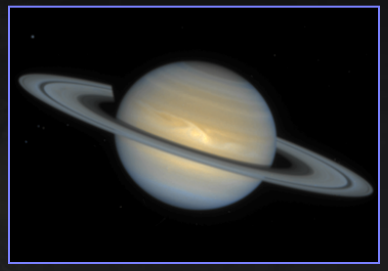
- Measurements and observations from spacecraft
- Data analysis, laboratory, theoretical investigations
- Mission operations and data management

LASP Science Disciplines

- Solar Influences
  - Understand the photon output from the Sun and the impact on the Earth

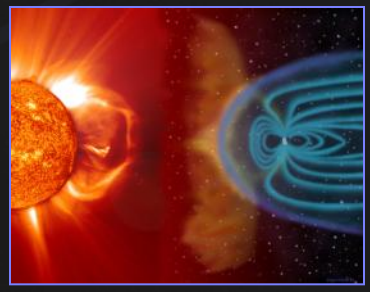


- Planetary Science
  - Explore the nature, origin, and evolution of our solar system and other planetary systems



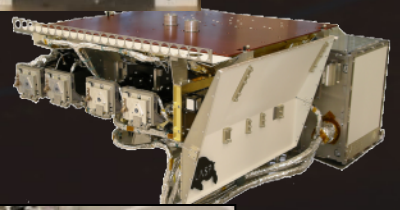
- Atmospheric Science
  - Study the Earth's atmospheric properties and processes

- Space Physics
  - Determine the nature of interactions of the solar wind with planets and planetary magnetospheres

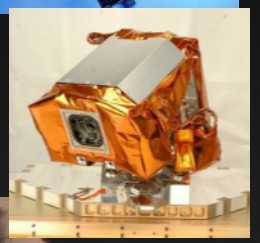


Current Missions and Science Operations



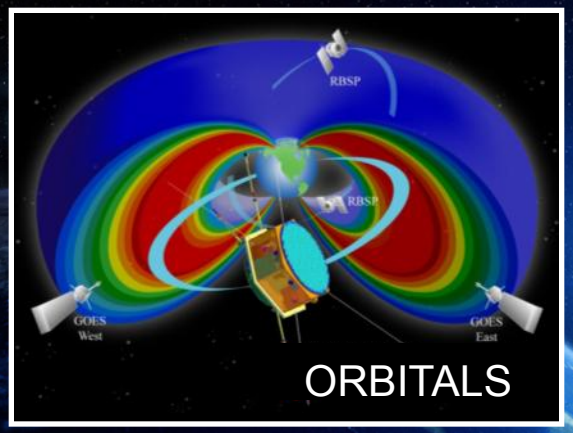



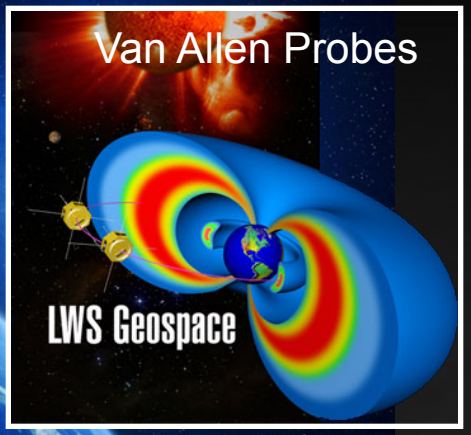

- LASP currently operates <u>4 satellites plus 12 instruments</u> on 8 different NASA satellites including:
  - AIM, Kepler, QuikSCAT, SORCE
  - Cassini UVIS (Saturn), New Horizons SDC (Pluto), Messenger MASCS (Mercury) , SDO/EVE (Sun)
- LASP is currently developing <u>15 instruments for 8 different satellite</u> missions that are expected to launch between 2013 and 2018:
  - LDEX, MMS, MAVEN, SPP, NOAA GOES-R, NOAA TSIS, NSF CubeSat

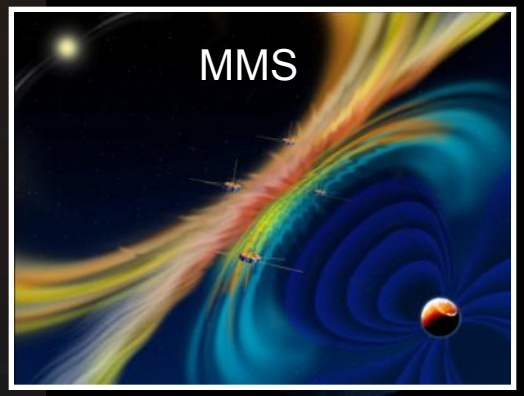



Data as of April 2013

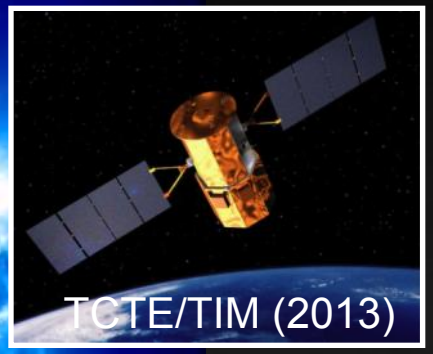
The Earth—Our Most Important Planet

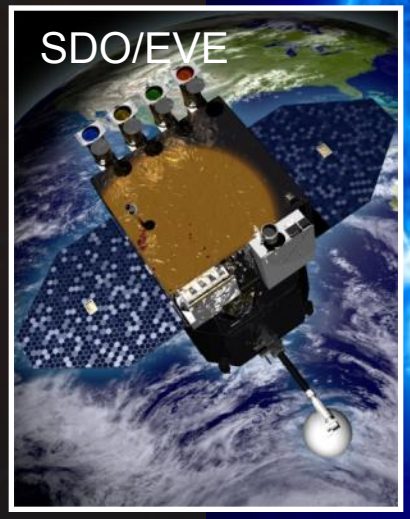






The Sun – Our Most Important Star





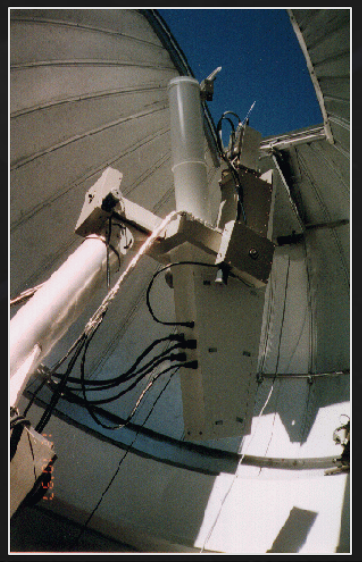
Credit: NASA and NOAA

LASP's Solar Group Programs

- Current flight hardware development
  - JPSS/TSIS (TIM, SIM) plus TCTE/TIM
  - GOES-R/EXIS (XRS, EUVS)

- Mission Operations
  - SORCE – LASP built and operated, over $100M
  - SDO/EVE instrument science operations
  - TIMED/SEE instrument science operations

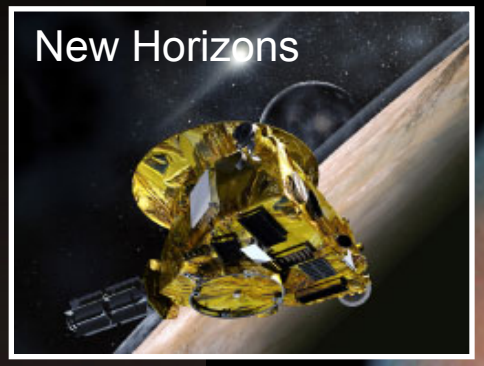
- Data Analysis and Modeling
  - LASP Irradiance Data Center (LISIRD)
  - NSF PSPT solar image analysis
  - Solar Irradiance Variability Models
  - Solar Convection Modeling



Credit: NASA

Exploring Our Solar System

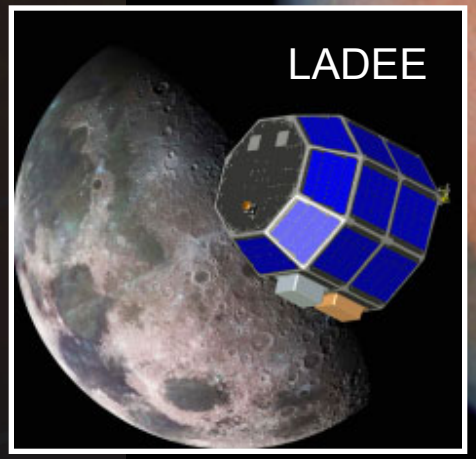
New Horizons



MAVEN

Cassini

LADEE

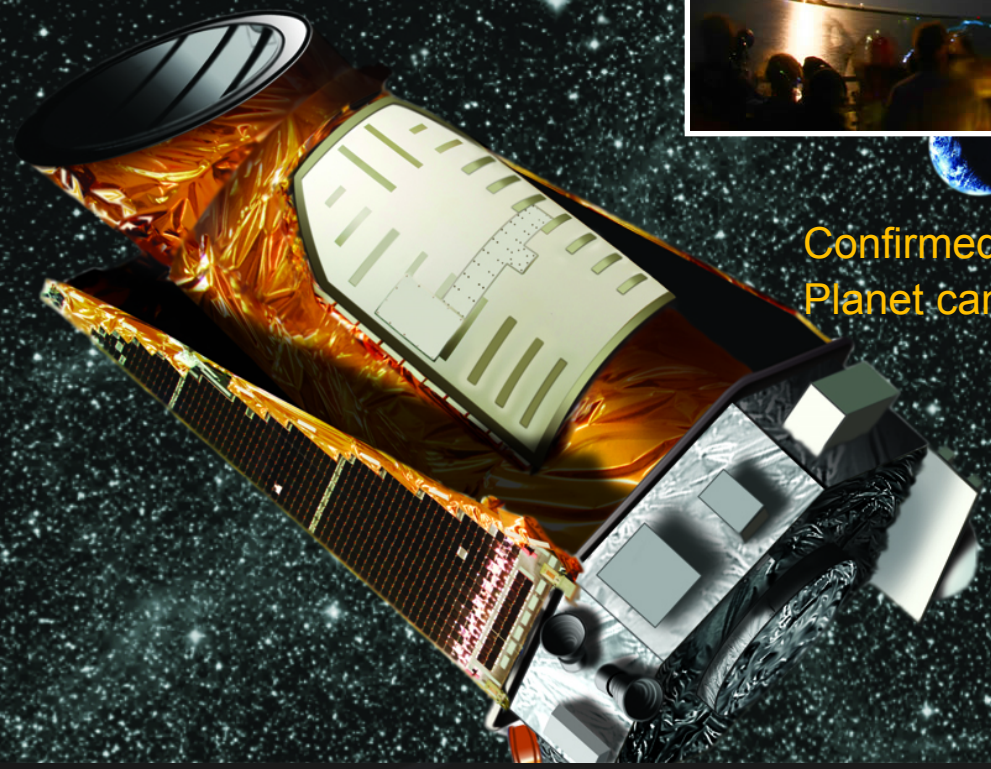


MESSENGER

JUNO

Kepler—A Search for Terrestrial Planets

LASP Managed Mission Ops
Launched: March 6, 2009
Nominal mission: 3 ½ years
Extended through 2016
LASP Lead: Bill Possel



Confirmed Planets: 114
Planet candidates: 2740
As of 3/20/2013

SORCE: Sun-Climate

SORCE's SIM instrument made the first continuous space-based observations of SSI at visible and infrared (IR) wavelengths, forming the basis for a new climatological record of the visible and IR SSI.

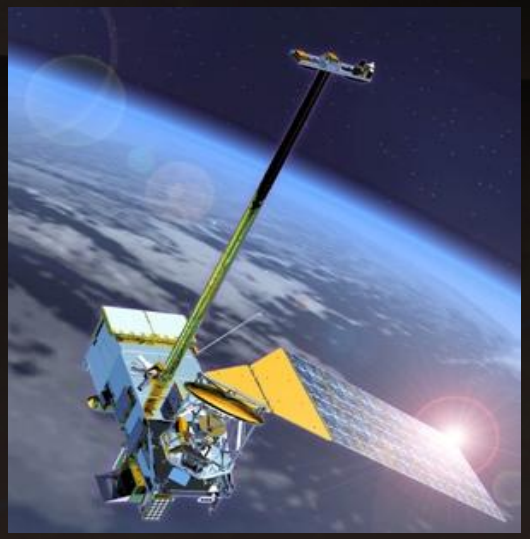
- This NASA mission is measuring the total and spectral solar "irradiance" with unprecedented precision.
- This mission will help advance the understanding of the Sun's role on global climate change.

Launched: Jan 25, 2003
Orbit type: 645 km 40deg
Nominal mission: 5 years
5 years and going extended mission

LASP Leads :
PI: Tom Woods
PM: Tom Sparn

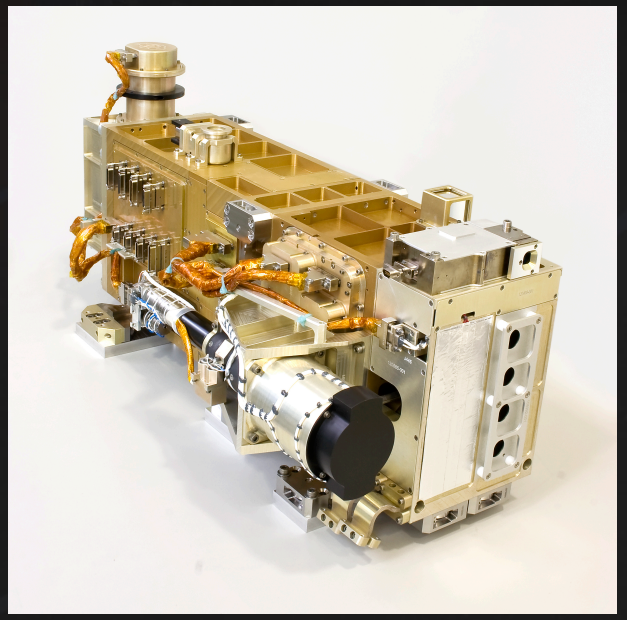
Credit: NASA/SORCE

TSIS: Sun-Climate Next Generation



Next generation of LASP's SIM and TIM instruments will be on JPSS free-flyer (small satellite)

This low earth environmental satellite will monitor global environmental conditions for NOAA.



LASP Provides:

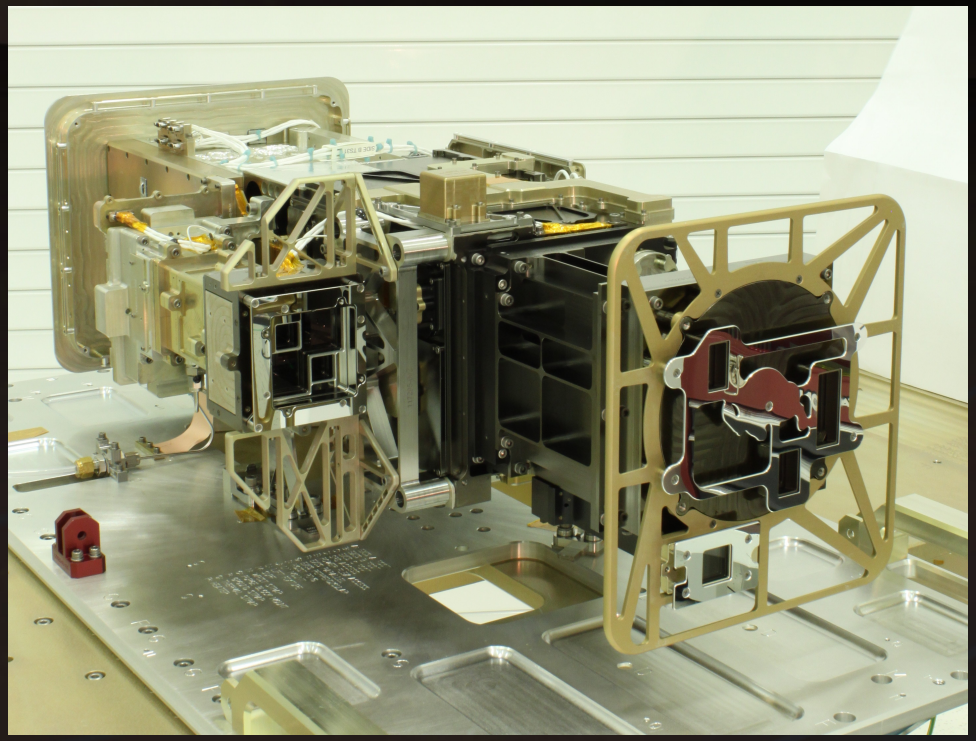
- The Total Irradiance Monitor (TIM) instrument The Spectral Irradiance Monitor (SIM) instrument
- Mission operations for TSIS

Launch: 2016 (planned)
Orbit type: Low Earth polar orbit
Nominal mission: 5 years

LASP Leads :
PI: Peter Pilewskie
PM: Tom Sparn

Credit: LASP, NOAA/JPSS

GOES: Geostationary Operational Environmental Satellite



First Launch: Oct 2015 (planned)
Orbit type: Geostationary constellation at 75W and 137W
Nominal mission: 10 years (+ 5 yr on-orbit storage)

LASP will provide EXIS for the new R-Series for 4 Flight GOES units:

- XRS to monitor solar flares that can disrupt communications and degrade navigational accuracy
- EUVS to monitor solar variations that directly affect satellite drag / tracking and ionospheric changes, which impact communication and navigation operations

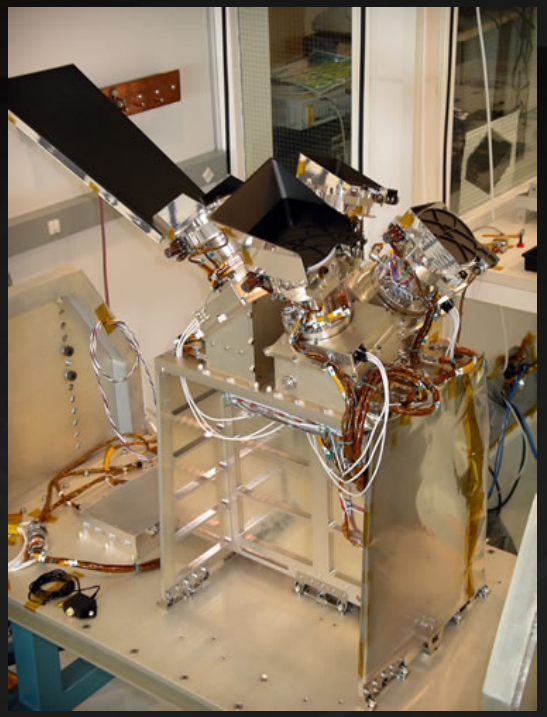
EXTREME ULTRAVIOLET AND X-RAY IRRADIANCE SENSORS
GOES-R
EXIS
NOAA ★ LASP ★ NASA

LASP Leads :
PI: F.G. Eparvier
PM: Mike Anfinson

AIM: Clouds at the Edge of Space

Aeronomy of Ice in the Mesosphere (AIM) is an Earth orbiting satellite that is carrying out the first detailed exploration of polar mesospheric clouds (PMCs), the highest clouds in the Earth's atmosphere, clouds at the edge of space.

How do the these clouds form?
Why do they change?
How will they change in the future?



Launched: April 25, 2007
Orbit type: Sun synchronous, 97.8 deg
Nominal mission: 2 years
Extended through 2012 and still going

LASP Provides:

- The Cloud Imaging and Particle Size Experiment (CIPS)

Principal Investigator: Cora Randall

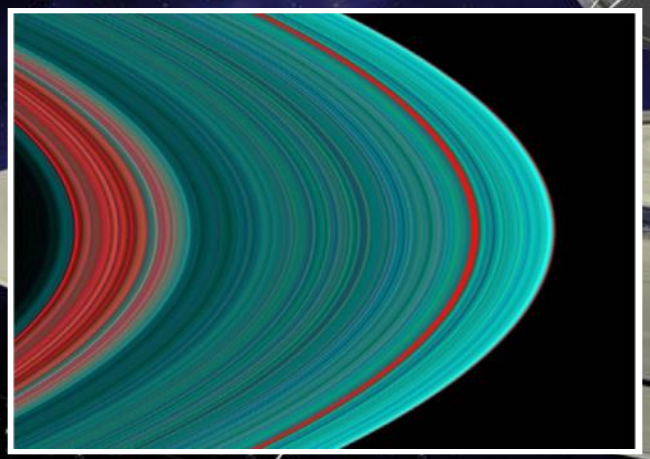
- The Cosmic Dust Experiment (CDE)

Principal Investigator: Mihaly Horanyi

Credit: Hampton University, NASA

Cassini: Saturn, its Moons, Rings and More

The Cassini mission has 12 instruments on board to comprehensively study Saturn system in more detail than ever before.



Principal Investigator: Larry Esposito

The Cassini Ultraviolet Imaging Spectrograph (UVIS) is part of the remote sensing payload of the Cassini Orbiter spacecraft, built at LASP.

UVIS science objectives include investigation of the:

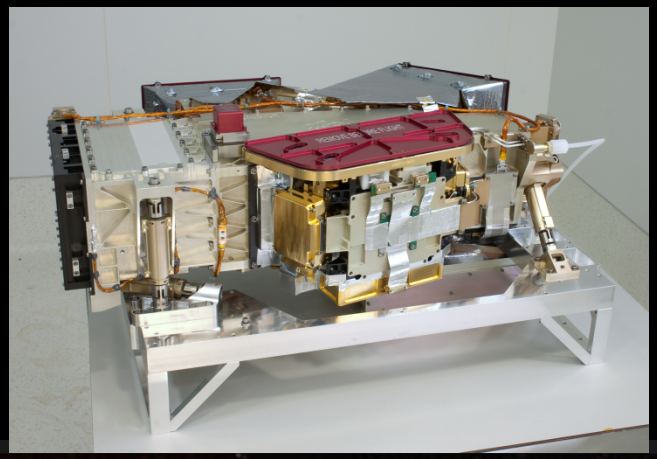
- Chemistry, clouds, and energy balance of the Titan and Saturn atmospheres
- Neutrals in the magnetosphere
- Surfaces and tenuous atmospheres of icy satellites
- Structure and evolution of Saturn's rings

Launched: Oct 1997
Nominal mission: 4 years
Extended Mission: 2X thru 2017

MAVEN
Mars Atmosphere and Volatile Evolution Mission

MAVEN will explore Mars' upper atmosphere, ionosphere and interactions with the Sun and solar wind.

LASP provides:
- Imaging Ultraviolet Spectrometer (IUVS) instrument
- Langmuir Probe and Waves, and Extreme Ultraviolet (LPW-EUV) instrument
- Science Operations Center



Questions to be answered:
Where did Mars' atmosphere go?
Why did the water and CO_2 disappear?

Launch: Nov 2013 (planned)
Orbit insertion: Sept 2014
Nominal mission: 1 Earth Year

Principal Investigator: *Bruce Jakosky*

MASCS: Mercury's Surface and Atmosphere

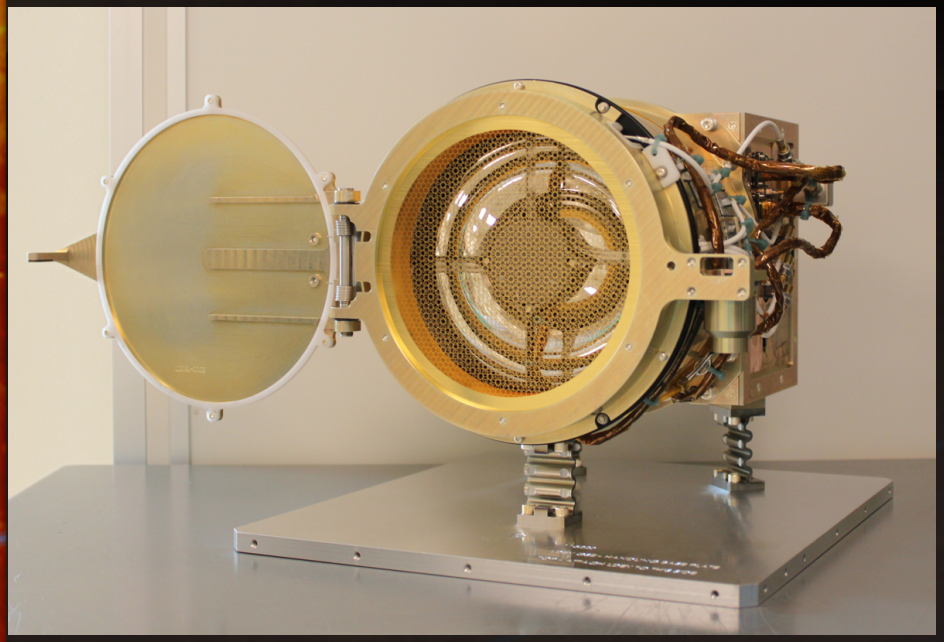
Data from MASCS will help answer the questions:

- What is Mercury's surface made out of?
- How is Mercury's atmosphere generated?
- Does Mercury have ice at its poles?

Launched: 8/3/2004
Inserted into orbit: 3/18/2011
Nominal orbit mission: 1 earth year
18 month extended mission

LASP Leads : W. McClintock
D. Baker

LDEX: Lunar Dust Experiment



Lunar Dust Experiment (LDEX) measures dust anywhere in the solar system

Launch: August 2013 (planned)
Expected Orbit: Launch + 30 days
Nominal mission: 160 days

Measurement Concept:

- LDEX is an impact ionization dust detector
- It measures the mass of individual dust grains with $m \geq 1.7 \times 10^{-16}$ kg (radius $r_g \geq 0.3$ micron) for impact speeds ≈ 1.7km/s
- LDEX also measures the collective current due to grains below the threshold for individual detection, enabling the search for dust grains with $r_g \approx 0.1$ micron over the terminators

Performance Data/Key Science Results

- Characterizes the dust exosphere by mapping size and spatial distribution of dust grains
- Measures relative contribution of dust sources:
  1. Ejecta due to bombardment by interplanetary micrometeoroids
  2. Lofting of small grains from the lunar surface due to plasma-induced near-surface electric fields

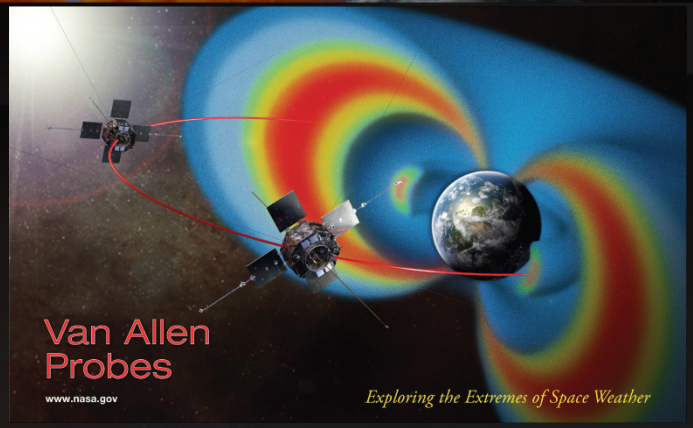
Team:

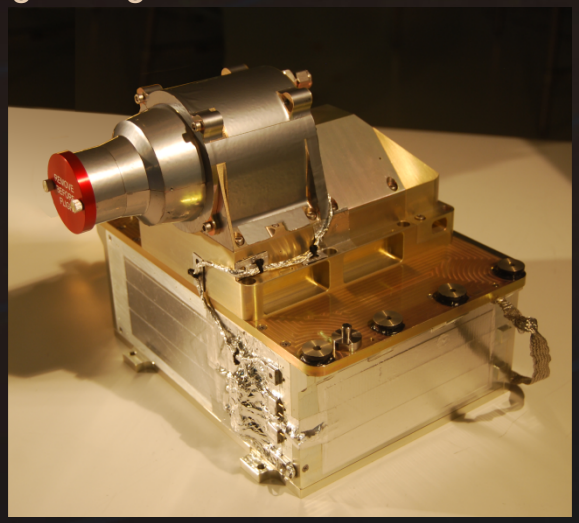
PI: *Mihaly Horanyi*
PM: *Mark Lankton*

Van Allen Probes (formerly RBSP)

Scientific Objectives

- Discover which processes - singly or in combination - accelerate and transport energetic particles (electrons and protons) in the radiation belt
- Measure and quantify radiation belt electron losses
- Determine the balance between processes that cause electron acceleration and those that cause losses
- Understand how the radiation belts change in the context of geomagnetic storms





Launched: August 2012
Orbit type: Earth radiation belt transiting
Nominal mission: 2 years

Relativistic Electron Proton Telescope (REPT)

- 10 channel, 32 cm^3 solid-state silicon detector
- 300keV to 100MeV dynamic range, ~150keV noise
- >300k particle events per second measured
- Up to 4 year survival in Van Allen radiation belts

Results

- Accelerated early commissioning 3 days after launch, captured disappearance of outer belt and rebuilding of new belt phenomena. First results published *Science Express*, 28 Feb, 2013

PI & Cols: Dan Baker, Shri Kanekal, Xinlin Li, Scot Elkington
PM: Mary Bolton

Student Dust Counter: Pluto and Beyond

Students' Goal: To Contribute New Science and Insight to the Field of Interplanetary Dust Physics by Making the First Dust Particle Observations Beyond 18 AU

Work Philosophy of Build Team:

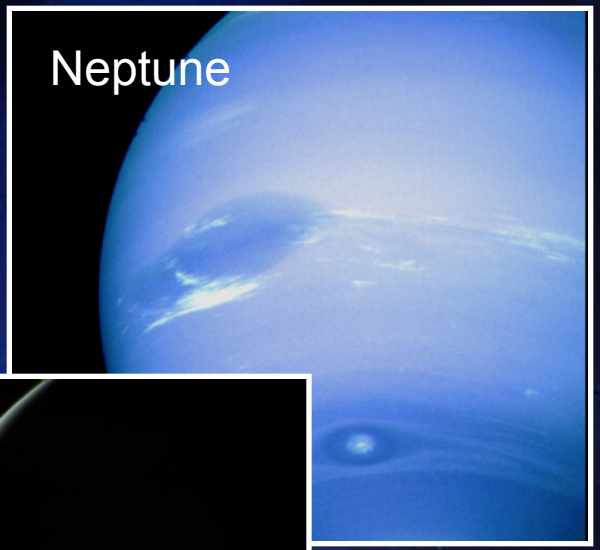
- Students have Primary Responsibility for the Design and Development of the SDC Instrument.
- LASP Professionals Provide Advice and Guidance

By the Numbers:

- Build team: 11-16
- Upwards of 10 generations of student researchers, engineers, and mission operations specialists.

Principal Investigator:
Mihaly Horanyi

Voyager: The Interstellar Mission



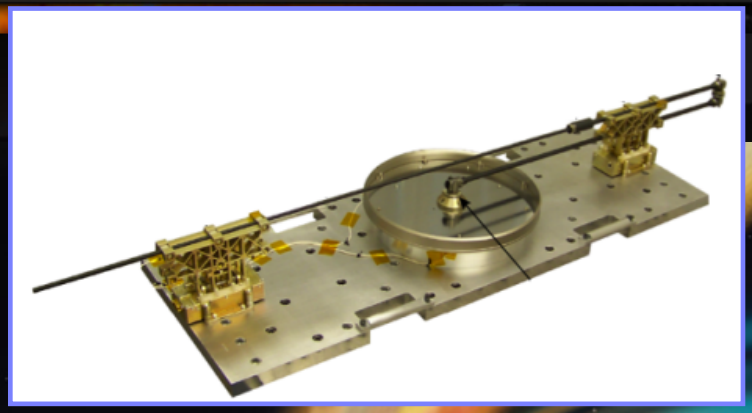
LASP provided the Photopolarimeter System (PPS) experiment.

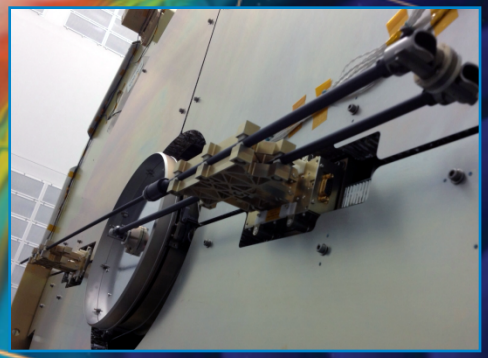
PPS Science team: C.W. Hord, C.F. Lillie, A.L. Lane, D.L. Coffeen, J.E. Hansen, J.T. Bergstralh, M. Sato, R.A. West, W.R. Pryor, & L.W. Esposito.

MMS: Magnetospheric Multiscale Mission

MMS mission, consisting of four identically instrumented spacecraft, will use Earth's magnetosphere to study magnetic reconnection.

- Overall Goal: Determining the kinetic processes occurring in the electron diffusion region that are responsible for collissionless reconnection, especially how reconnection is initiated.
- Instruments: In situ instruments measuring: electric and magnetic fields, energetic particles





MMS Axial Double Probe Instrument (ADP)

Launch: October 2014 (planned)
Orbit: Elliptical Earth orbit in two phases
Phase 1: $1.2R_e$ X $12R_e$ (day side)
Phase 2: $1.2R_e$ X $25R_e$ (night side)
Tetrahedral flying formation
Nominal Mission: 2 years

Credit: NASA/MMS

Laboratory for Atmospheric and Space Physics
University of Colorado **Boulder**

Thank you for your attention.
While at the National Space Symposium please contact Thomas Sparn (303) 591-1861 if you have further questions.

Contact LASP

- 1234 Innovation Drive, Boulder, CO 80303
- 303-492-6412
- http://lasp.colorado.edu
- info@lasp.colorado.edu