

National Aeronautics and Space Administration



Jet Propulsion Laboratory
California Institute of Technology

Soil Moisture
Active Passive
Mission
SMAP

Project Status

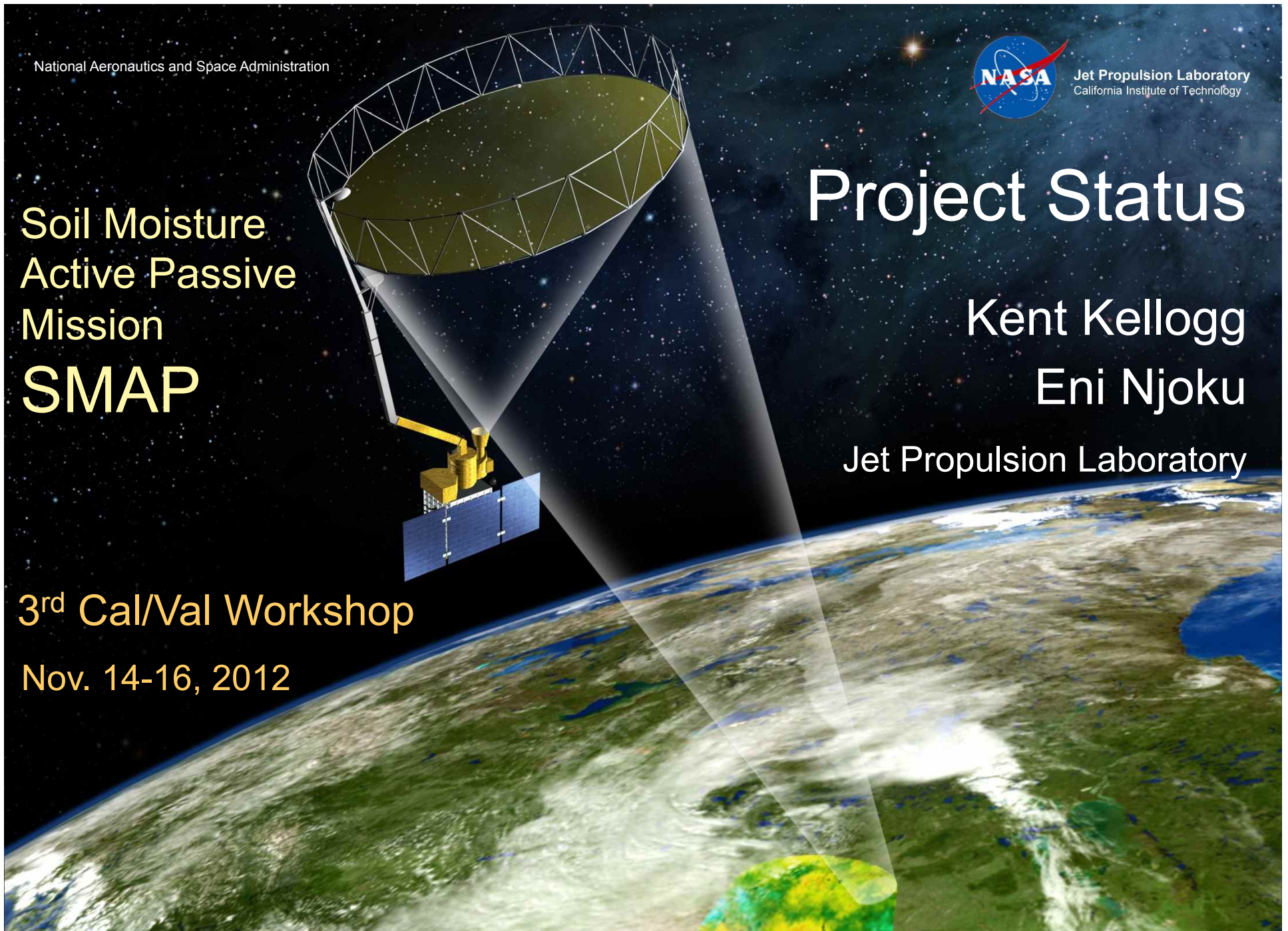
Kent Kellogg

Eni Njoku

Jet Propulsion Laboratory

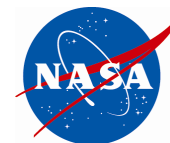
3rd Cal/Val Workshop

Nov. 14-16, 2012





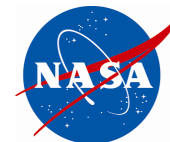
Countdown to Launch Has Started!



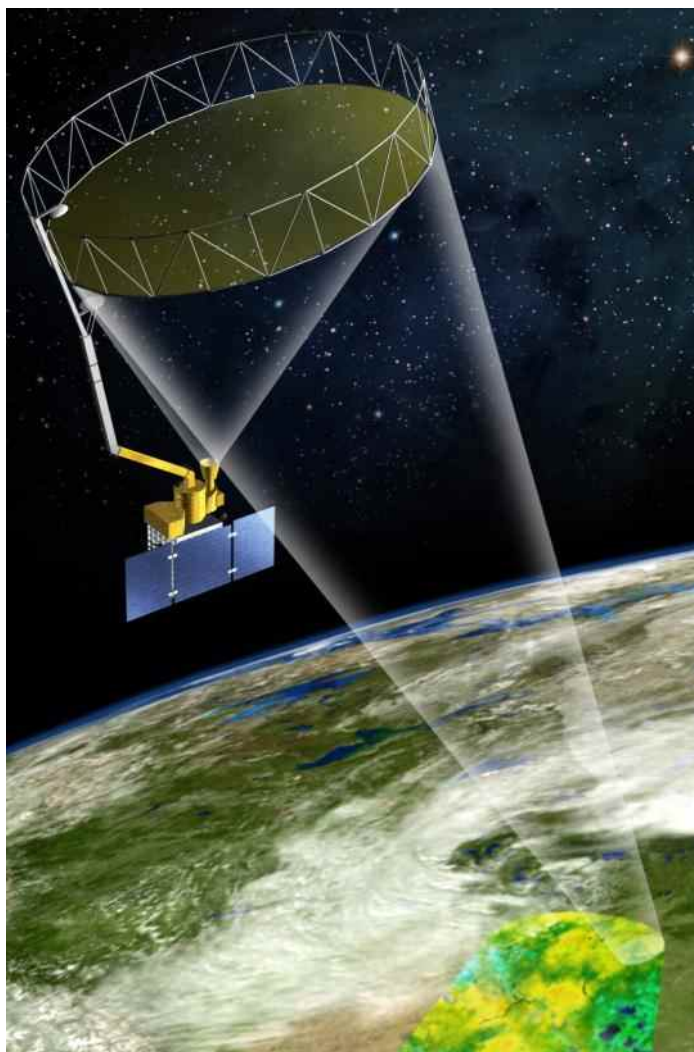
Launch Readiness Date: October 31, 2014

**1.96 Years
23.5 Months
716 Days**

**From
Today!**



SMAP Project Overview



<http://smap.jpl.nasa.gov/>

Primary Science Objectives

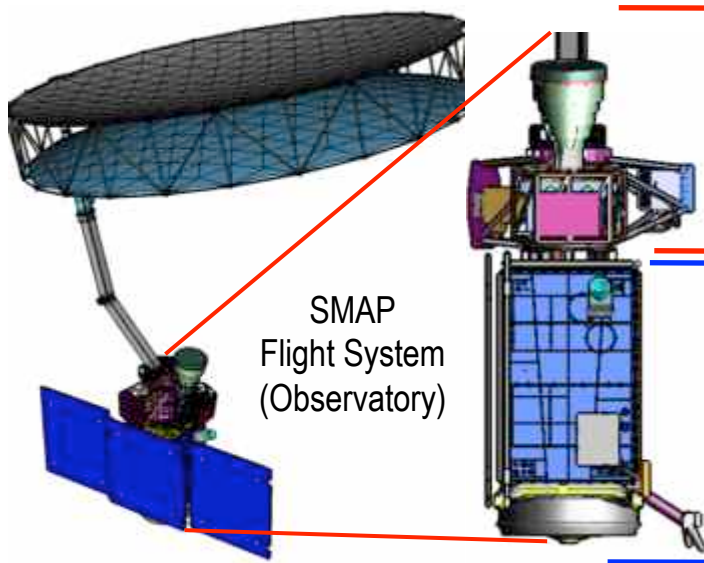
- Global, high-resolution mapping of soil moisture and its freeze/thaw state to:
 - Link terrestrial water, energy, and carbon-cycle processes
 - Estimate global water and energy fluxes at the land surface
 - Quantify net carbon flux in boreal landscapes
 - Extend weather and climate forecast skill
 - Develop improved flood and drought prediction capability

Mission Implementation

Partners	<ul style="list-style-type: none">• JPL (project & payload management, science, spacecraft, radar, mission operations, science processing)• GSFC (science, radiometer, science processing)
Risk	<ul style="list-style-type: none">• 7120-81 Category 2; 8705.4 Payload Risk Class C
Launch	<ul style="list-style-type: none">• Oct. 2014 on Delta II system
Orbit	<ul style="list-style-type: none">• Polar Sun-synchronous; 685 km altitude
Duration	<ul style="list-style-type: none">• 3 years
Payload	<ul style="list-style-type: none">• L-band SAR (JPL)• L-band radiometer (GSFC)• Shared 6-m rotating (13 to 14.6 rpm) antenna (JPL)

***NRC Earth Science Decadal Survey (2007)
recommended SMAP as a tier-one mission***

SMAP Mission Overview

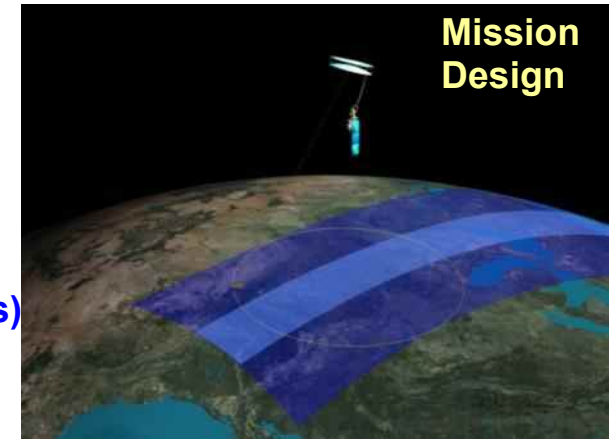


Instrument

- L-band (1.3-GHz) Radar (JPL)
- L-band (1.4-GHz) Radiometer (GSFC)
- Shared antenna (6 m diameter)
- Conical scan: 13–14.6 rpm; 40° incidence
- Contiguous 1,000-km swath width

Spacecraft (& Radar Electronics)

- JPL-Developed & Built
- JPL's MSAP/MSL Avionics, Power Assys with a small number of new mission unique card designs
- 1100 kg wet mass (Observatory-level)
- 1200 W capacity (Observatory-level)
- 80 kg propellant capacity
- Commercial space electronics elsewhere



- 685-km polar orbit (Sun-sync)
- 8-day repeat ground track
- Continuous instrument operation
- 2- to 3-day global coverage
- 3-year mission duration



- SMAP is compatible with a number of launch vehicles; Delta-II selected in July '12
- Target Launch: October 31, 2014

Near-Earth Network

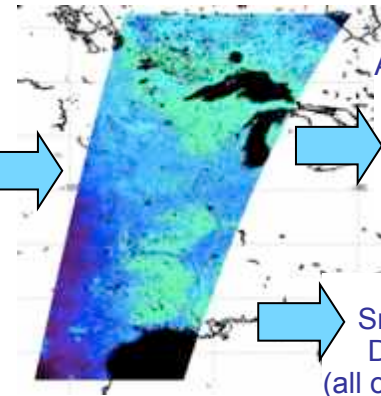


Surface Validation



SMAP Mission Operations & Data Processing (JPL, GSFC)

Science Data Products
Soil Moisture & Freeze/Thaw State Data Products

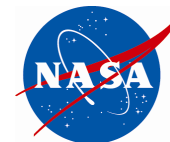


Alaska Satellite Facility
Data Center
(Radar L1 Products)

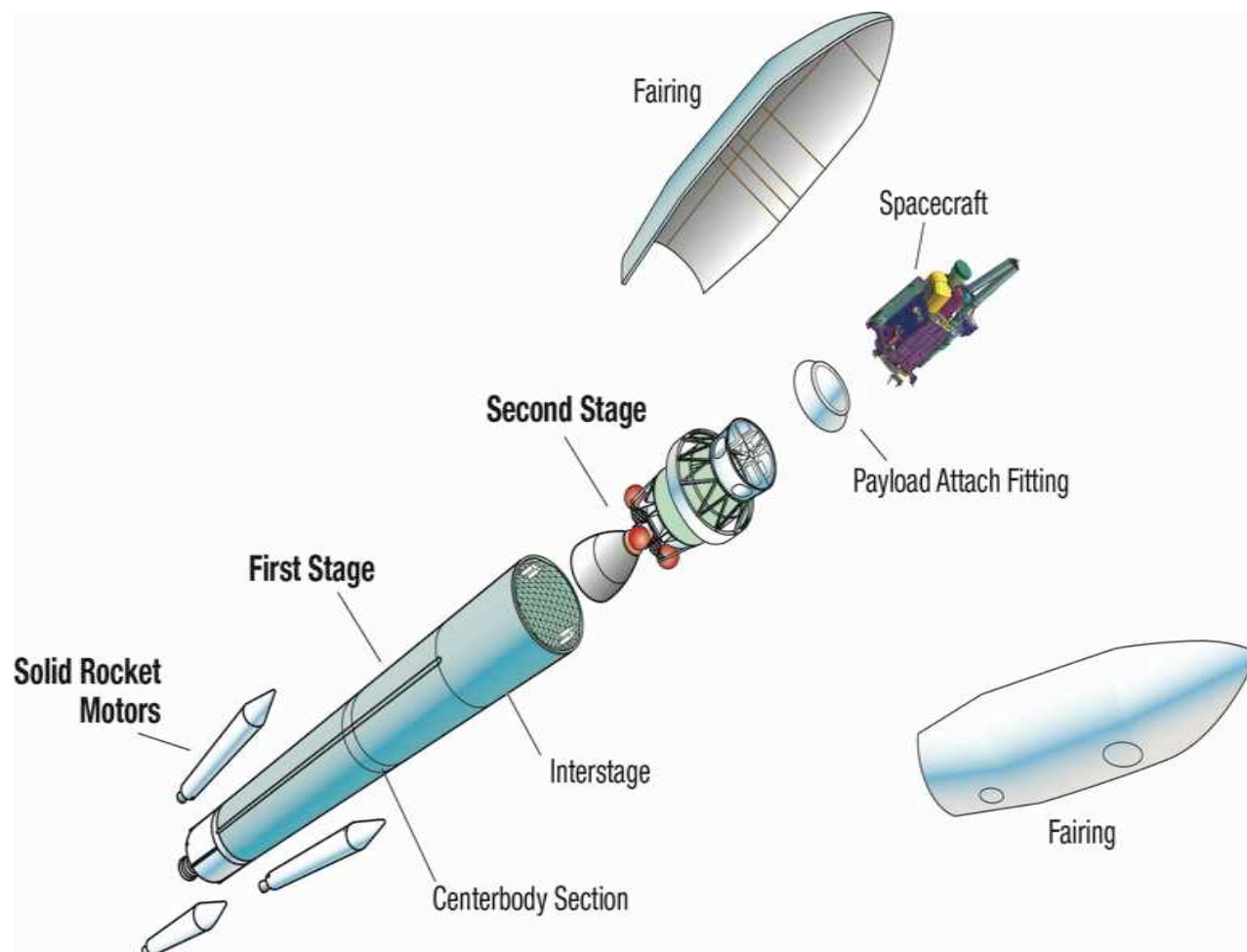
National
Snow and Ice
Data Center
(all other Products)



SMAP Has A Shiny New Delta II!



Delta II 7320-10C

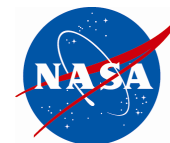




SMAP Project/Science Key Review Status



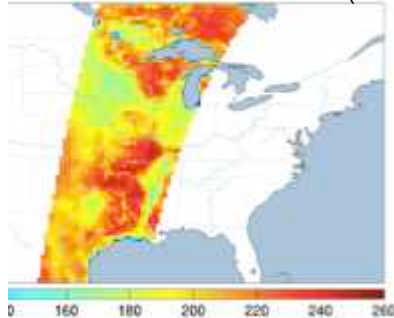
- Project was successfully confirmed (KDP-C, May 23, 2012) and is now in phase C/D
 - Project held successful combined Project/Flight System/Instrument CDR on July 16-19, 2012
 - Mission System and Science held successful Cal/Val Peer Review on October 2, 2012
 - Mission System held successful Science Data System (SDS) CDR on October 10-11, 2012
 - Project held successful Mission System CDR on November 8, 2012
 - **Next big NASA gate: System Integration Review (April 9-12, 2013)**
-



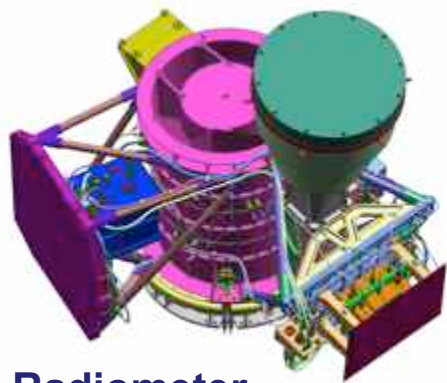
Instrument Overview



RADIOMETER BRIGHTNESS
TEMPERATURE PRODUCT (40KM)



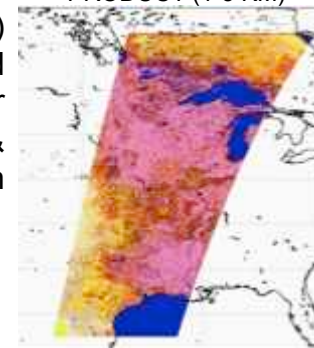
L-band (1.41 GHz)
Radiometer for high
soil moisture accuracy
at moderate spatial
resolution



Radiometer

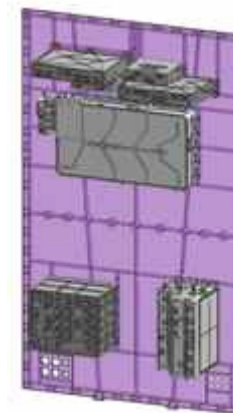
- Provided by GSFC
- Leverages Aquarius design
- Includes RFI mitigation
- V, H, 3rd & 4th stokes
- 1.3-K accuracy
- 40-km resolution

HI-RES RADAR BACKSCATTER
PRODUCT (1-3 KM)



L-band (1.26 GHz)
Radar: Unfocused
Synthetic Aperture for
high spatial resolution &
freeze/thaw detection

Mass: 357 kg
Power: 448W



Radar

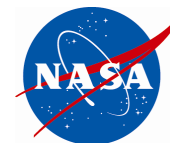
- Provided by JPL
- Leverages JPL designs
- Includes RFI mitigation
- Polarizations: VV, HH, HV
- 500-W SSPA (9% duty cycle)
- 3-km spatial resolution

Radiometer is
spun-side-mounted
to reduce losses

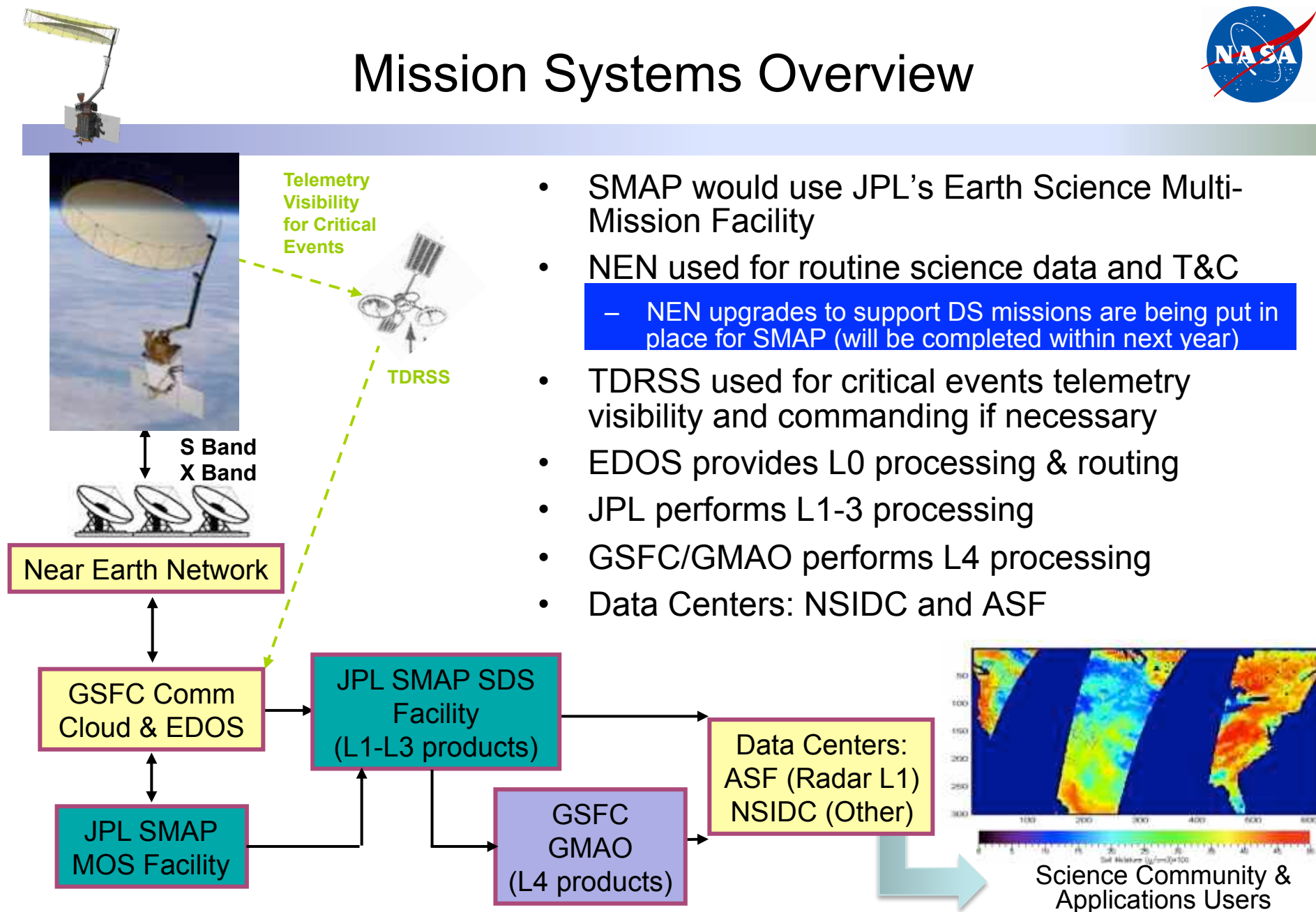
Radar is fixed-mounted
to reduce spun inertia

Common 6-m Spinning Reflector

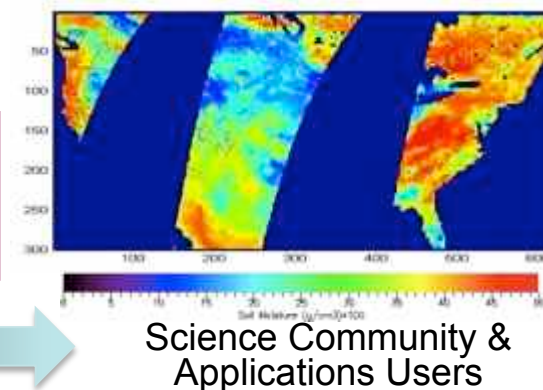
- Spin Assembly and Reflector/Boom Assembly
derived from heritage designs
- Conically scanning at 13–14.6 rpm
- Constant incidence angle of 40-deg



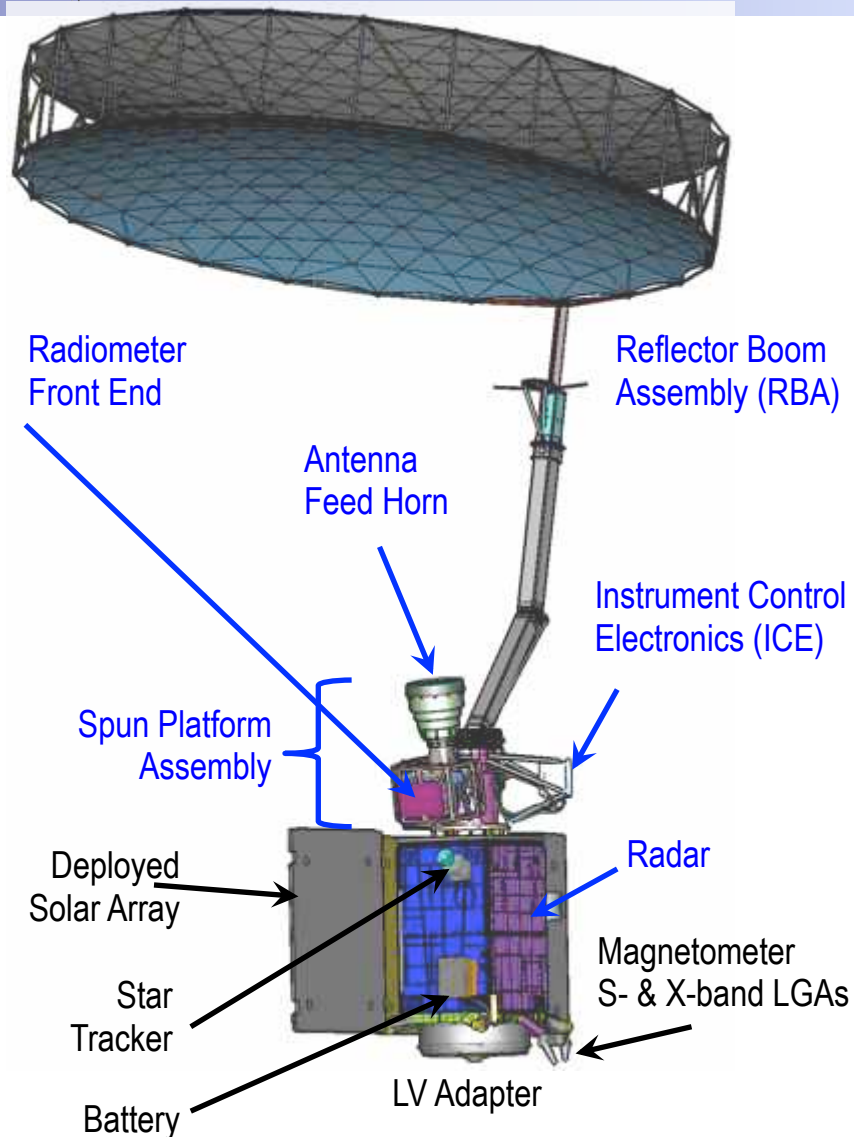
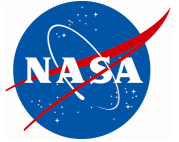
Mission Systems Overview



- SMAP would use JPL's Earth Science Multi-Mission Facility
- NEN used for routine science data and T&C
 - NEN upgrades to support DS missions are being put in place for SMAP (will be completed within next year)
- TDRSS used for critical events telemetry visibility and commanding if necessary
- EDOS provides L0 processing & routing
- JPL performs L1-3 processing
- GSFC/GMAO performs L4 processing
- Data Centers: NSIDC and ASF

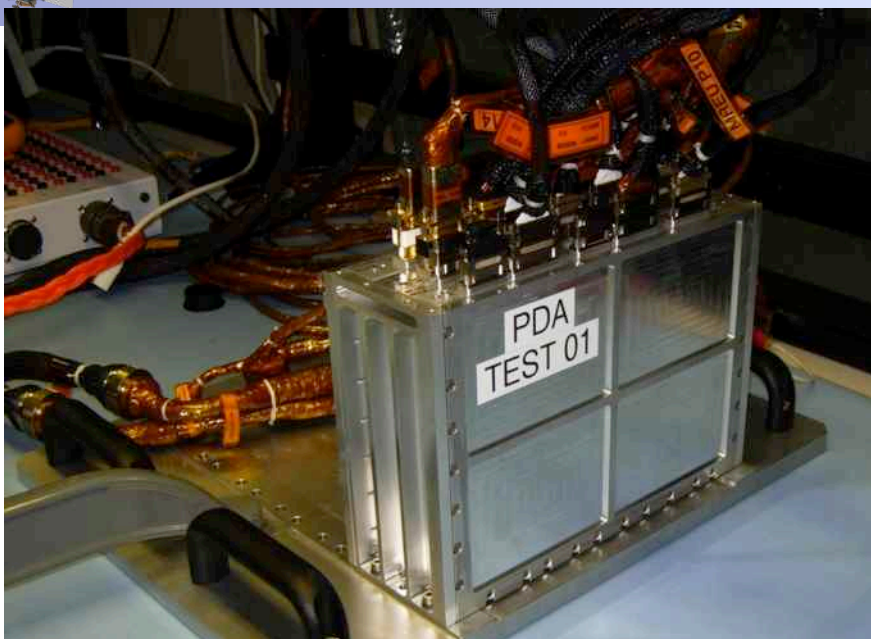
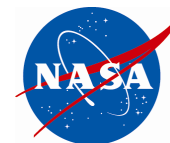


Observatory Configuration Has Been Stable



- 3-axis-stabilized spacecraft, provides momentum compensation for RBA
- Single-string avionics and power control/distribution electronics
- Redundant S-band telecom (NEN & TDRS) and 130 Mbps X-band link for science data
- Limited redundancy in ACS sensors and actuators
- 3 panel deployable, fixed solar array
- Hydrazine blowdown propulsion system
- Passive and heater-based thermal control with bus structure serving as radiators
- 1089 kg wet mass
- 1023 W (science mode load), via 3-panel deployable solar array
- 59-Ah BOL battery for launch, eclipse, and other off-Sun modes
- 80.0 kg usable propellant capacity
- Delta-V: 112.6 m/s (includes contingency)

Flight Power Subsystem Electronics are Built and are in Assembly and Test



Flight Power Subsystem “Three Slice Box” Assembly is in Test
Remote Engineering, H/K Power Conversion, Guidance I/F Driver



Flight Spacecraft Power Bus Controller Slice

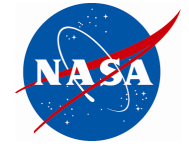


Pyro Firing Slices are Assembled and Tested

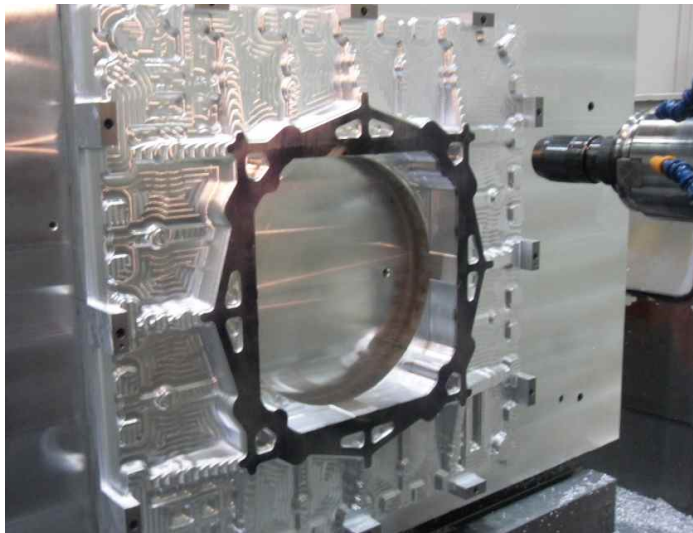


Flight Solar Array Interface & Switching Slice

Flight Spacecraft Bus Mechanical Panels & Decks are in Manufacturing



**Spacecraft Zenith Panel (Instrument Deck)
in rough machining**



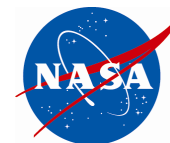
Spacecraft Propulsion Deck in rough machining



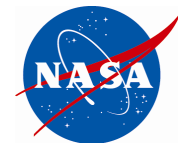
**Spacecraft -Y Panel (Radar Panel)
in rough machining**



Flight Telecom Antennas (S- & X-band) Delivered to JPL



***Telecom Antenna
Cognizant Engineer
Luis Amaro with RUAG
S- and X-band Telecom
Antennas in their
Shipping Container***



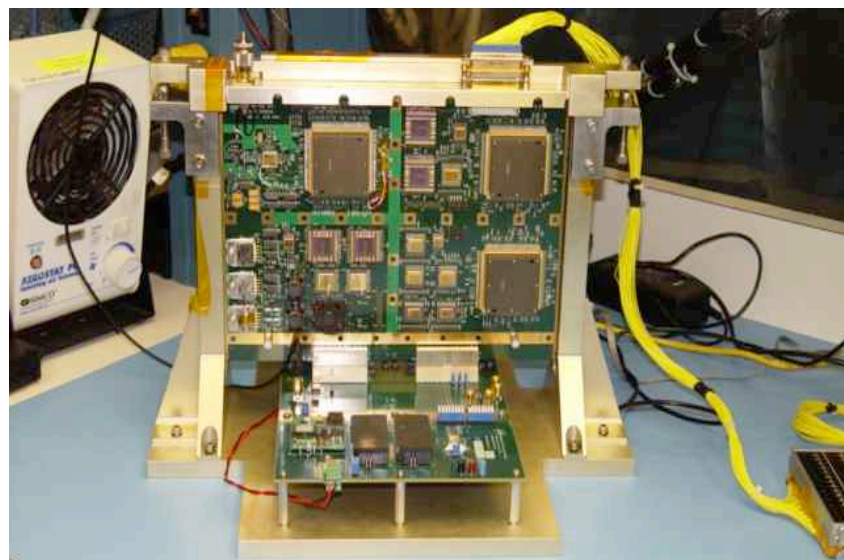
EM Radiometer Testing is Complete Flight Radiometer Hardware in Production & Test



EM Radiometer Digital Electronics Assy (RDE)



EM Radiometer RF Electronics Assembly (RRE)

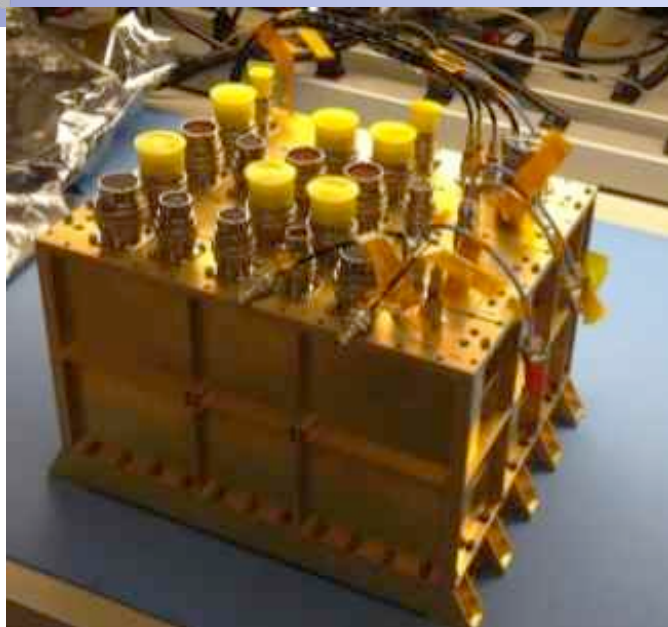
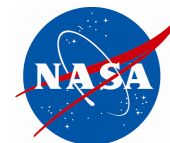


Flight Analog Processing Board #1 in Test

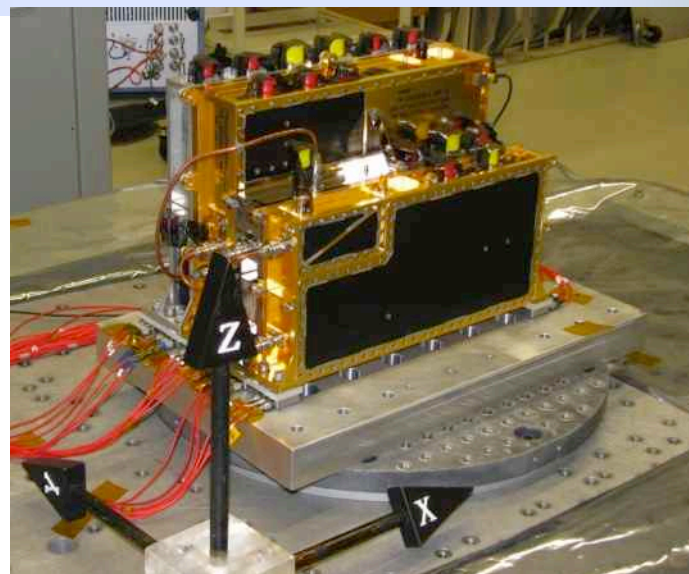


Flight Correlated Noise Source

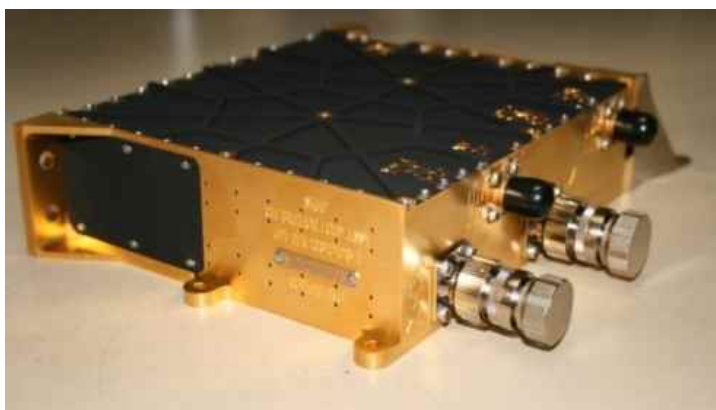
All Radar Flight Hardware Manufacturing Is Complete; Assembly & Test is Underway



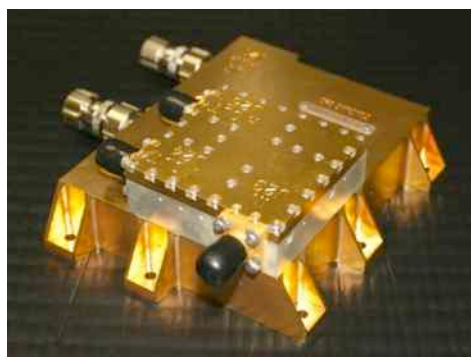
Radar Flight Digital Electronics Assembly in Test



Radar RF Assembly in Vibration Test



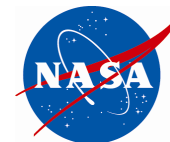
Flight Calibration Loops have been delivered



Flight High Power Switch has been delivered



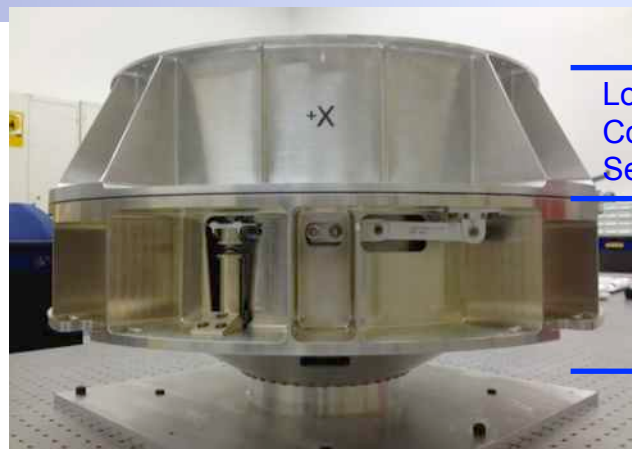
High Power Amplifier is in Assembly



Spin Subsystem Launch Lock Qualification & Development Assembly



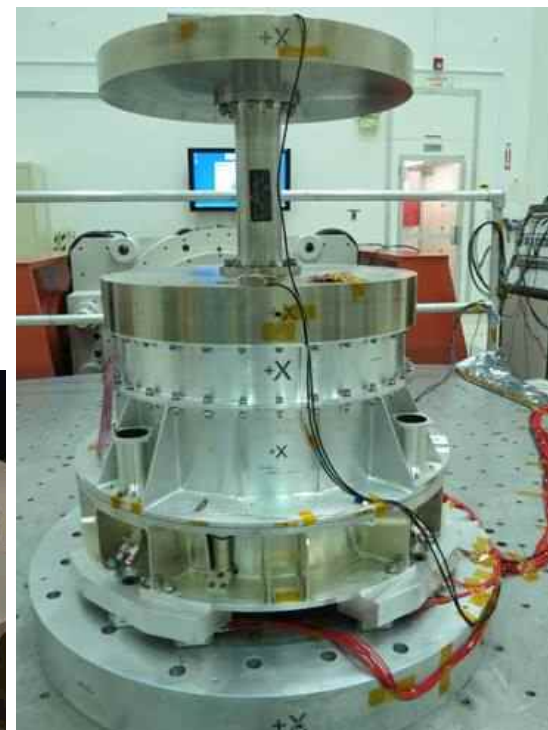
Brassboard Bearing & Power Transfer Assembly (BAPTA)



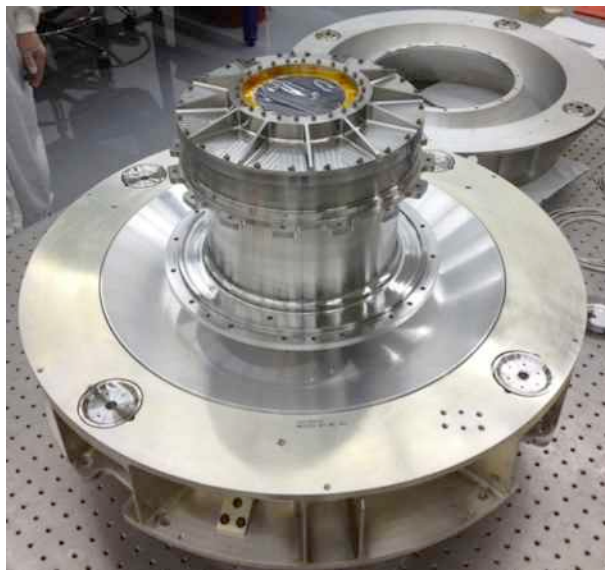
Integrated Development Cone-Clutch Assy (CCA) and Lower Core Instrument Structure Segment

Lower Instrument
Core Structure
Segment

Cone-Clutch
Assembly
(Launch Lock
for Spin S/S)



*CCA/BAPTA in random
vibration test configuration*



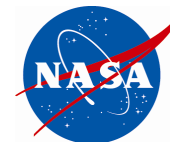
Integrated Brassboard CCA and BAPTA



CCA (bottom view showing inner cone)



Antenna Scale Model Testing Completed, Data Reduction & Analysis Underway



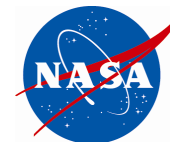
SMAP Scale Model Observatory (10.45 to 1 scale)



*SMAP Scale Model Observatory being Tested in JPL's
Cylindrical Near Field Range (Mesa 40' chamber)*



Flight Reflector Mesh is Being Assembled (NGST Astro Aerospace)



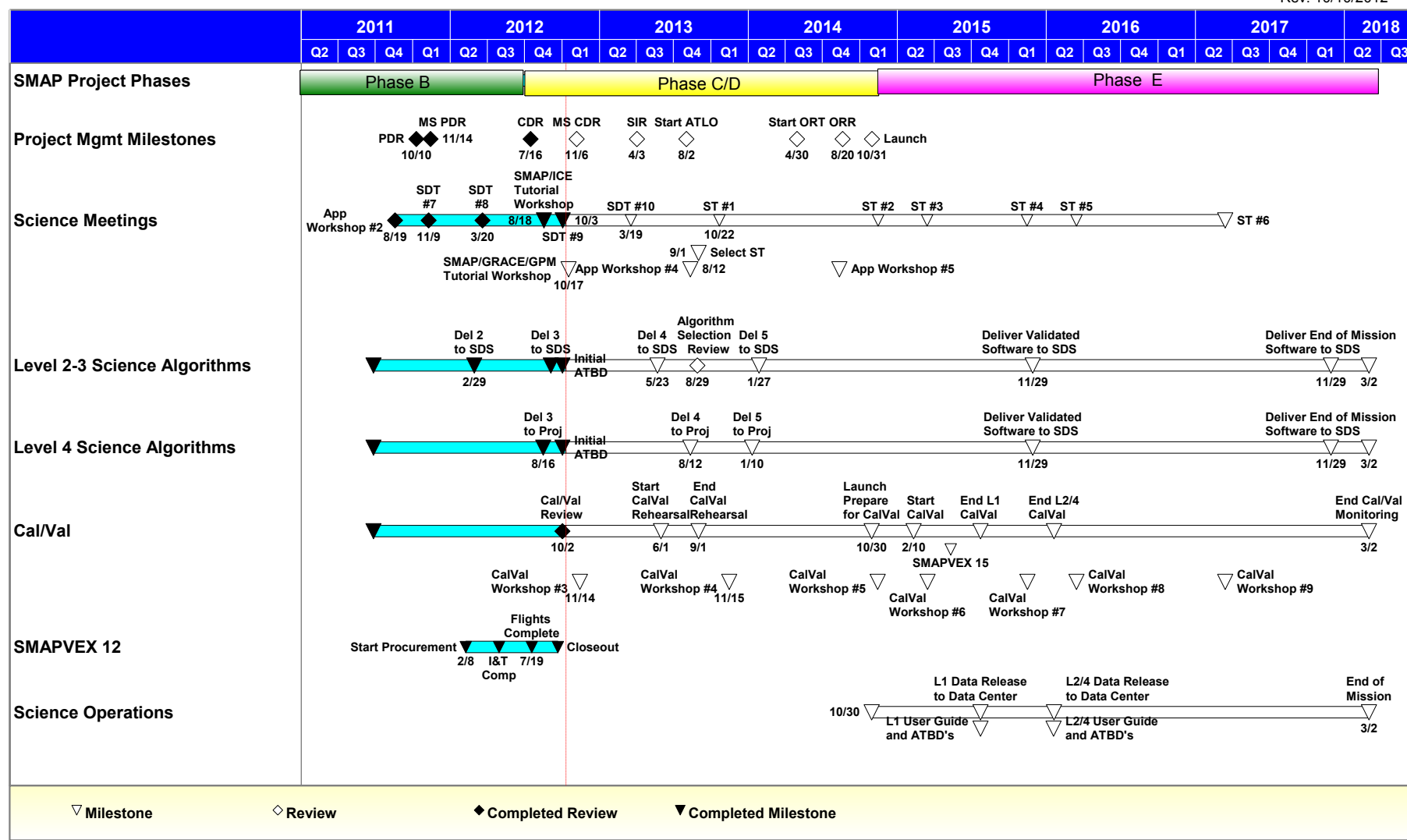


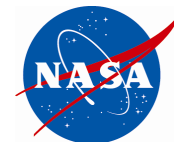
Science Schedule and Milestones



SMAP Science Top Level Schedule

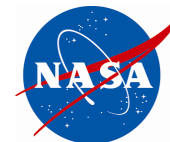
Rev. 10/10/2012





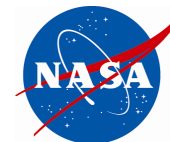
Science Key Reviews/Meetings

- SDT meetings: #9, Oct. 3-4, 2012, #10, March 5-7, 2013
 - SDT transition to augmented Science Team: Sept/Oct 2013
 - Algorithm Baseline Selection Review: September 2013
 - Cal/Val Peer Review: Oct. 2, 2012
 - Cal/Val Rehearsals:
 - *June-September 2013: Initial test of core site/sparse network data collection*
 - *Spring 2014: Expanded rehearsal based on lessons learned and updated tools*
 - SMAP Cal/Val Workshops:
 - *#3 Nov. 14-16, 2012 (plan 2013 rehearsal)*
 - *#4 November 2013 (review rehearsal 1; plan rehearsal 2)*
 - *#5 July/August 2014 (~launch-3mths; review rehearsal 2, and launch prep)*
 - *#6 Feb/Mar 2015 (~first data & Cal/Val assessments)*
-



Algorithm & Documentation Status

- Algorithm Software Delivery 3 to SDS is complete
 - ATBD status
 - Initial release (v.1): October 2012 (updates, v.1.1 ...) – posted on SMAP website
 - Final pre-launch version (v.2): September 2014
 - Data Product Specifications
 - Passive L2/3 products: November 2012 prelim
 - Active & active/passive L2/3 products: January 2013 prelim
 - Final dates: ~Oct. 2013
 - Science Cal/Val Plans
 - Science Data Cal/Val Plan: init. release July 2012 (at CDR)
 - Project L1 Cal/Val Plan: draft in progress (~Nov 2012)
 - Project L2-L4 Cal/Val Plan: draft complete (~Oct 2012)
 - Data Product Users Guide(s)
 - Prepared in collaboration with DAACs
-



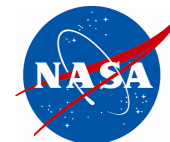
SDT Transition to Science Team

- ROSES SMAP Science Team solicitation issued by NASA/HQ on February 14, 2012

“A.24 The Soil Moisture Active Passive Mission (SMAP) Science Team”

- Science Team (ST) is expected to consist of up to 15 U.S. members (plus non-U.S. team members)
 - Expected annual program budget for new awards ~ \$1600K+(?)
 - Maximum duration of awards expected to be through mission life(?)
 - NOI due date: (see pending ROSES amendment update)
 - Proposals due date: 02/01/2013
 - Selections: 07/31/2013
 - ST contracts in place: 09/30/2013
- See SMAP web page for further details

<http://smap.jpl.nasa.gov/science/team/STInfo/>

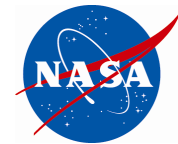


SMAP Science Team

- Science Team members will:
 - Provide guidance to the SMAP Project in implementation of the Cal/Val Plan for the mission;
 - Participate directly in carrying out Cal/Val activities specified in the Cal/Val Plan; Expect to attend several meetings and telecons during first 12 months
 - Through implementation of the Cal/Val Plan, assess the accuracies of the instrument data products (Level 1) and geophysical data products (Level 2-Level 4) generated by the mission and the performance of the algorithms used to create these products;
 - Identify necessary actions to be taken by the Project in improving the quality of the data products generated by the mission;
 - Provide guidance on improvements to the Science Data System (SDS) necessary to support the mission data processing; and
 - Provide guidance for the entrainment of SMAP mission data in application users' models, processes, and decision support systems.
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SMAP Project Status



END