Magnetospheric MultiScale Mission (MMS) Overview

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MMS Launch

- The MMS mission was launched on March 13, 2015 aboard an Atlas V rocket from Space Launch Complex 40, Cape Canaveral, Florida
- Each of the four observatories were successfully released at five minute intervals spinning at 3 rpm approximately 1.5 hours after launch
Science Goals

• Study magnetic reconnection in the Earth's magnetosphere
• Magnetic reconnection converts magnetic energy into kinetic energy
  – Oppositely directed parallel field lines are pinched
  – They join and snap apart like a breaking rubber band

• Benefit: understanding of how the Earth lives with the Sun (e.g. Class X Flash 0156 GMT Tuesday, Feb. 15, 2011)
  – Power grid problems
  – Communications disruption
  – Aurora formation

Credit: European Space Agency
Use the formation as a ‘science instrument’ to study the magnetosphere.

Need to prevent close approaches.

Formation scale matches science scale.

Night-side science (neutral sheet) bound by power (limits shadow duration).

Maneuvers used to maintain formation against relative drift (ΔV) and to maintain attitude pointing (ΔH).

10-160 km

30-400 km

Sun

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Multiple opportunities for joint observations with THEMIS and Van Allen Probes

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MMS - 5
MMS Instrument Suite Components
(view looking from the bottom of the IS Deck)

ADP - Axial Double Probe
AFG - Analog Flux Gate Magnetometer (mounted on boom)
ASPOC - Active Spacecraft Potential Control
CEB - Central Electronics Box (Fields)
CIDP - Central Instrument Data Processor
DES - Dual Electron Spectrometer
DFG - Digital Flux Gate Magnetometer (mounted on boom)
DIS - Dual Ion Spectrometer
EDI/GDU - Electron Drift Instrument/Gun Detector Unit
EIS - Energetic Ion Spectrometer
FEEPS - Fly’s Eye Energetic Particle Sensors
HPCA - Hot Plasma Composition Analyzer
IDPU - Instrument Data Processing Unit (FPI)
SCM - Search-Coil Magnetometer (mounted on boom)
SDP - Spin-Plane Double Probe
TP/HPDB – Test Panel Heater Power Distribution Box
Spin axis – within 2.5 deg of ecliptic north
Spin rate – 3 +/- 0.2 rpm

Boom Lengths
- Mag boom: 5 m
- Axial boom: ≈ 12.5 m
- Wire boom 60 m

Spacecraft Dimensions
- Diameter: ≈ 3.4 m
- Height: ≈ 1.2 m

Onboard controller tasked with performing all spin-attitude and delta-V maneuvers

Not to scale
Spacecraft GN&C Block Diagram

**Sensors**
- DSS
  - Sun Pulse
  - Sun elevation angle
  - Sun Acq
  - 20 MHz frequency signal
- Star Sensors
  - Quaternion Body rate
  - Delta-H
- AMS
  - 10 s averaged acceleration
  - Thruster firing status

**Actuator**
- EVD
  - All needed Thrusters

**ACS Flight SW Resides in C&DH**
- DSS Data process
- Star Sensors Data process
- AMS data process
  - Delta-V
  - 10 s averaged acceleration
- Delta-V (w or w/o attitude/rate control)

**Navigator (GEONS)**
- 10 s averaged acceleration
- Thrust Tim
- USO

**FD Ground Support System (FDGSS):**
- GEONS monitoring
- Orbit maneuver planning, monitoring and calibration
- Orbit product generation

**Attitude Ground System (AGS):**
- AMS parameter estimation
- Attitude maneuver planning

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