

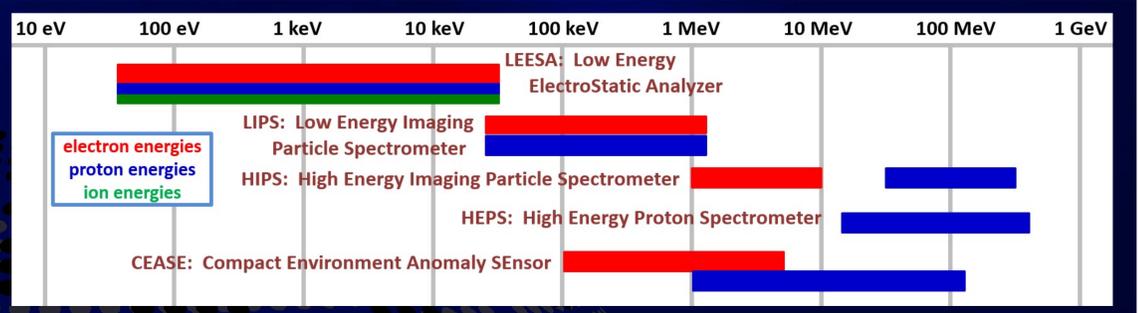
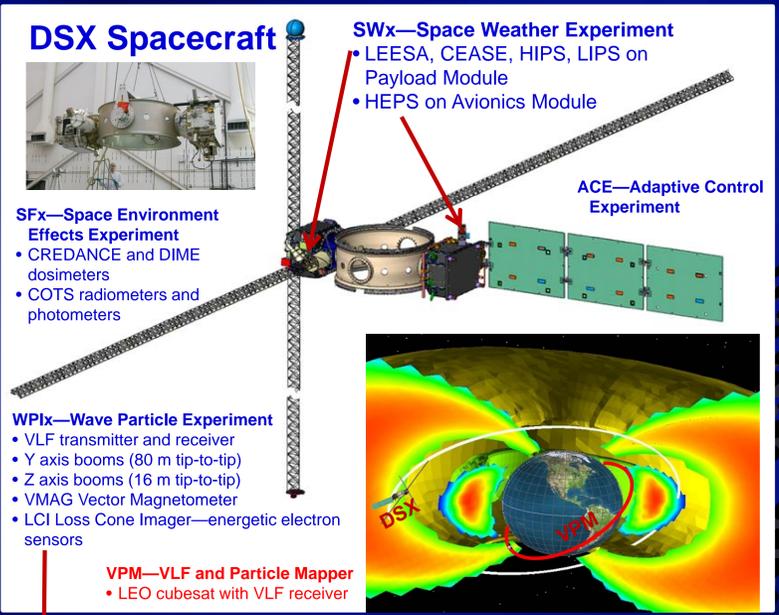


DSX Space Weather Experiments (SWx): Capabilities and Science Plans



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Introduction: The Air Force Research Laboratory's Demonstration and Science Experiments (DSX) mission will be launched in 2018 to investigate wave-particle interactions and the particle environment in medium Earth orbit (MEO). It includes the Space Weather Experiment (SWx) package of five particle instruments which will collectively observe electrons from 30 eV to 10 MeV and protons from 30 eV to 400 MeV. DSX will conduct concentrated study of dynamics of the slot region using pitch-angle resolved electron measurements together with separate wave measurements.



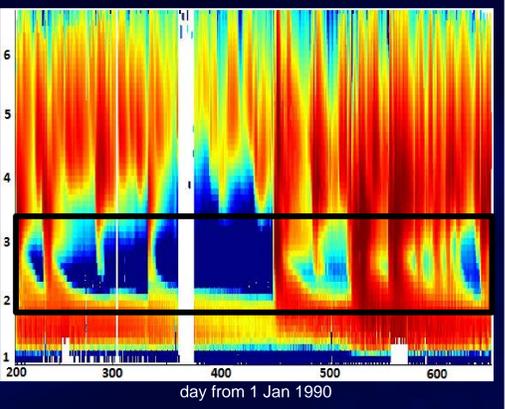
- **Compact Environmental Anomaly Sensor (CEASE):** AFRL/RVB
 - telescope: FOV 60°; dosimeters: FOV 90°; 100 keV – 6.5 MeV e-; 20 – 100 MeV p+
- **Low-energy Imaging Particle Spectrometer (LIPS):** PSI, AFRL
 - 8 angular zones, FOV 79° x 8°; 30 keV – 2 MeV e-, p+
- **High-energy Imaging Particle Spectrometer (HIPS):** PSI, AFRL
 - 8 angular zones, FOV 90° x 12.5°; 1 – 10 MeV e-, 30 – 300 MeV p+
- **High Energy Proton Spectrometer (HEPS):** ATC, Amptek, AFRL
 - 1 look direction, FOV 24° (p+), 40° (e-); 20 – 440 MeV p+



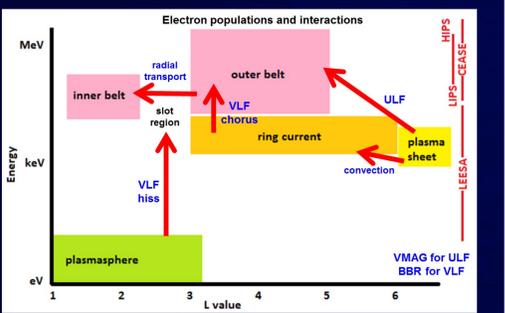
See abstract SM11G-04 (Active Experiments with the DSX Mission) for more info on DSX & WPIx—or contact AFRL.RVBXR.AE9.AP9.Org.Mbx@us.af.mil

SWx Science Objectives

- Objective: map electron and proton particle populations in MEO
- Slot region (L=2-3) has lower particles fluxes on average, but is very dynamic
 - CRRES observed filling of slot region with MeV electrons
 - TacSat-4 observed transient MeV proton enhancements at outer edge of proton belt
 - SWx suite will survey full range of proton+electron energies

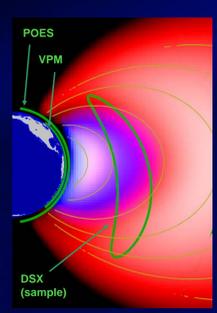


- Objective: study dynamics of the particle population in the slot region
- DSX will observe interactions of multiple particle populations and EM waves (figure)
 - DSX orbit targets the slot region which results from VLF hiss-induced electron losses



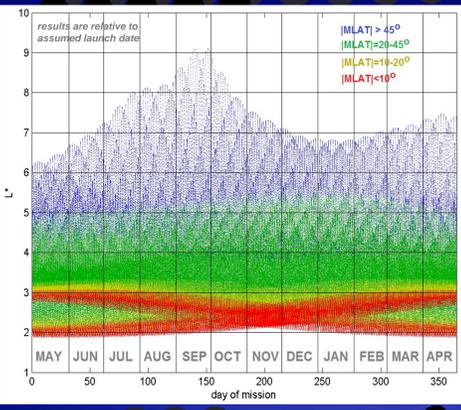
SWx Survey and Conjunction Plans

- SWx instruments other than LEESA will always be in survey mode
- LEESA will primarily be in survey mode, with exceptions:
 - During DSX high power transmissions, LEESA will survey selected energies to check for plasma heating
 - LEESA will conduct focused surveys with high time/energy resolution



Right: Figure shows L*, magnetic latitude vs. time coverage during mission

- High power transmissions occur at |MLAT| < 20° or L < 3.5

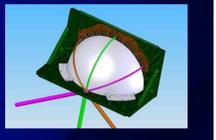
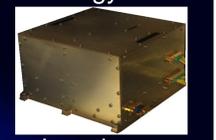


- Collaborative studies with other missions are planned
- Table gives nominal number of conjunctions during one year mission
- Numbers in parentheses give ranges dependent on orientation of initial DSX orbit; conjunctions will tend to cluster in 2-3 seasons during year

Type of conj.	Spatial <2000 km	Mag footprint <200 km	Mag footprint <200 km and DSX L < 3.5
Van Allen Probes A+B	15 (11-20)	309 (208-387)	81 (62-105)
Arase	7 (2-21)	116 (60-190)	33 (25-44)

Low Energy Electrostatic Analyzer (LEESA)

- Comprises 2 pairs of concentric quarter spherical electrostatic analyzers, particle energies selected by cycling voltage differences
- Measures electron/ion fluxes for ~20 eV to 50 keV energies
- 80 energies sampled per sweep from 256 choices of energy
- Low energy limit in practice will be constrained mostly by spacecraft potential
- Full FOV 120° x 12° in 5 angular zones for each species (electron/ion)
 - FOV spans 105° on one side of B-field line, 15° on the other
- Two modes for cadence: 1 sec/sweep or 10 sec/sweep
- Survey mode is highly programmable
 - Survey energies/sampling are programmable on orbit
 - Typically will survey a subset of energies per sweep with periodic low energy sweeps for spacecraft potential check
 - But can do high resolution energy sampling in limited range
 - Or high resolution time sampling of a subset of energies
- Supports study of fine structure and dynamics in the MEO warm plasma environment.



Right: sample particle paths in LEESA

Summary

- DSX will be a unique mission, studying active VLF transmission interactions with the MEO plasma and particle environments.
- It will also study the ambient particle and wave environments, including opportunistic conjunction experiments with ground transmitters and with other satellites.
- DSX supports diverse opportunities for collaborative studies.