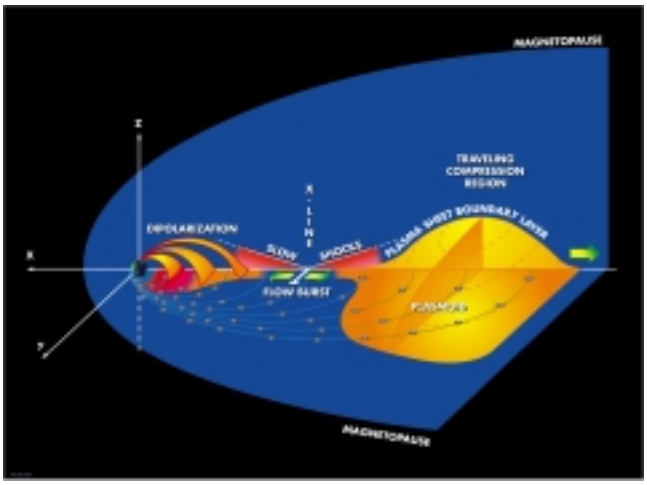


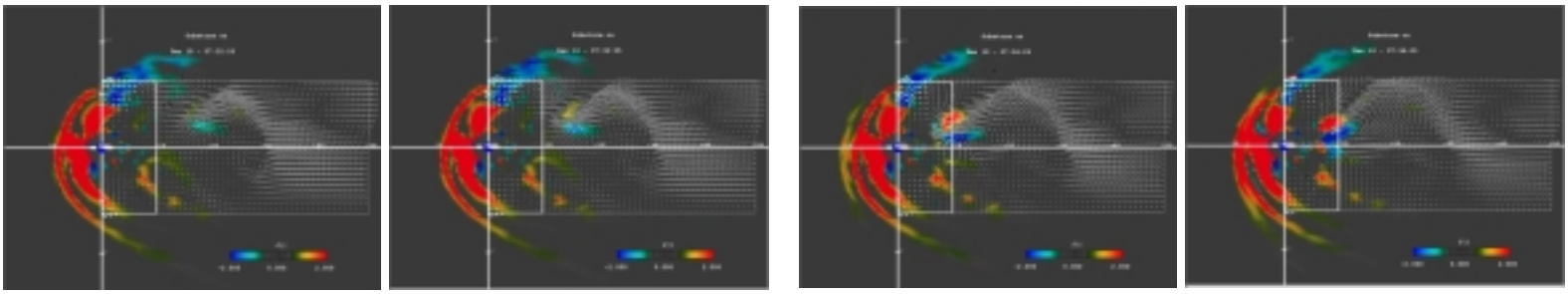
Cartoon of global consequences of tail reconnection near Earth during substorm. Fast flows propagate Sunward accompanied by rapid dipolarization. New plasmoid travels downstream, creating traveling compression region in magnetic lobes. DRACO *nanosatellites shown schematically throughout plasma sheet. (Courtesy J. Slavin, NASA/GSFC.)*

VISUALIZING AND UNDERSTANDING these processes will require observations made by a network of satellites distributed within this domain. MC–DRACO will reveal simultaneously for the first time both the global spatial structures and the time variations of the magnetotail. It will determine which phenomena are responses to solar wind inputs and which occur as a result of internal instabilities. In particular, it will reveal the locations and extents of the instabilities that trigger the explosive release of solar wind energy, mass, and momentum stored within the magnetotail, how these entities are transported, and the means by which magnetotail phenomena are propagated between regions and to the auroral ionosphere.

NASA Goddard Space Flight Center **http://stp.gsfc.nasa.gov**

MC–DRACO, the logical outgrowth of a sequence of STP missions, will explore plasma transport and energy conversion processes over a broad range of spatial sizes. Designed to be a "meso-/macroscope" for the magnetotail, it will resolve persistent controversies and yield a new understanding on which to build a predictive science of next-generation magnetospheric meteorology.

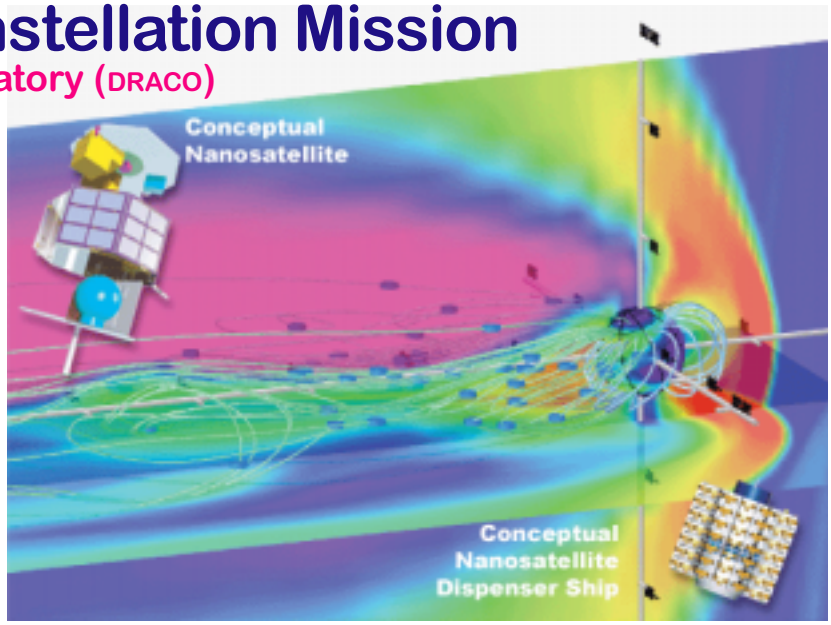
Most important phenomena involve simultaneous variations in space and time. In some cases cases measurements at two locations will provide unambiguous results. . . [I]t may be necessary to make simultaneous measurements at several hundred locations.—**C.E. McIlwain**



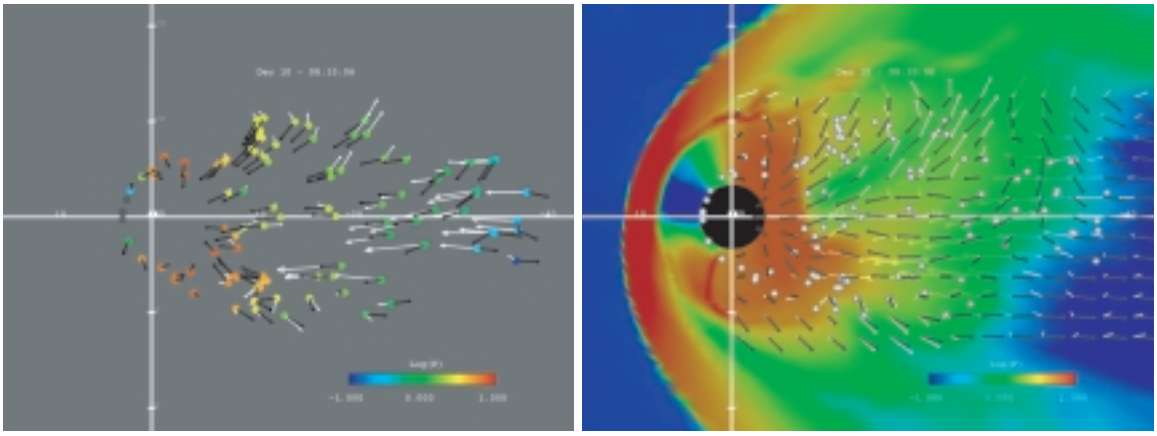
The Magnetospheric Constellation Mission

Dynamic Response and Coupling Observatory (DRACO)

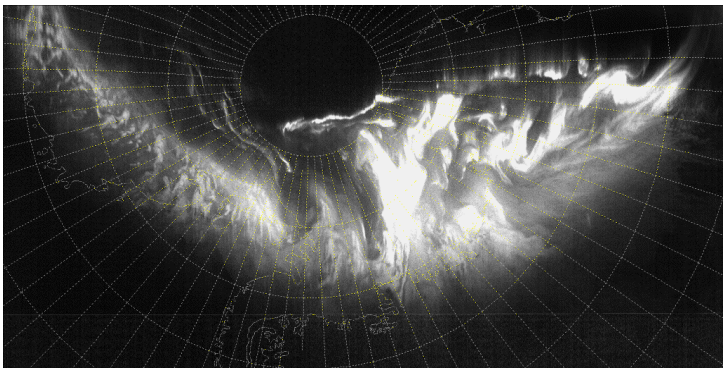
- ***How does the magnetotail control energy flow?***
- ***What processes control magnetotail structure and dynamics?***
- ***How do the physical processes and regions couple over the hierarchy of scales?***



MAGNETOSPHERIC CONSTELLATION DRACO hopes to answer these questions. It is the Solar Terrestrial Probe designed to understand the nonlinear dynamics, responses, and connections within Earth's structured magnetotail, using a constellation of as many as 100 distributed vector measurement spacecraft. MC–DRACO will reveal magnetotail processes operating within a specified domain, on spatial and time scales accessible to global circulation models.

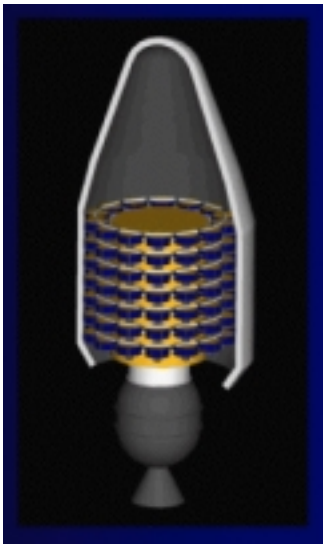


Single-spacecraft snapshot gives good information at a point in space and time. Single-spacecraft orbit gives good information, but over a 3-day orbit that evolves through space over time. Constellation gives a dense set of data with time and spatial resolution adequate to resolve main global features of simulation (right). (Courtesy C.C. Goodrich.)



Example of global auroral structure during significant magnetospheric disturbance. Image acquired by Defense Meteorological Spacecraft Program spacecraft moving along relatively low Earth orbit, and is, therefore, time-aliased. (Courtesy Air Force Research Laboratories.)

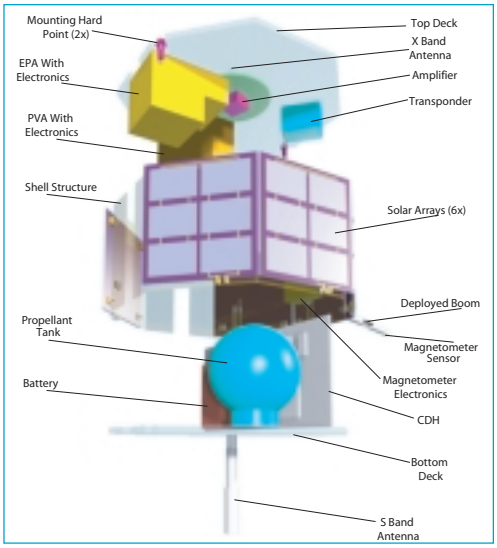
IN THE MAGNETOTAIL, global circulation of magnetic fields and plasmas responds to changing solar wind conditions. Impulsive localized flow bursts launch and dissipate, powerful electrical currents form and evolve abruptly, and magnetic energy is explosively converted to particle energy. The fundamental plasma process known as magnetic reconnection is thought to occur during substorms and is more frequent during magnetospheric storms. Because of the magnetotail's dynamic and turbulent evolution, globally coherent pictures of the system dynamics become lost in the "noise" of individual measurements. Despite over 30 years of research with ever more sophisticated instrumentation on ever-evolving spacecraft, fundamental questions concerning the dynamic response of the magnetotail remain unanswerable due to a lack of relevant measurements.



Conceptual dispenser ship.

MC–DRACO WILL USE rapidly developing technologies to deploy a "constellation" of nanospacecraft. With resources of ~10–20 kg and 10 W apiece, 50–100 nanosatellites will be deployed in highly elliptical, equatorial orbits with com-mon perigees of 3 R_E and apogees distributed from 7–40 R_E, yielding mean interspacecraft separation of ~1–2 R_E. The primary science will be accomplished annually when the constellation sweeps through the magnetotail. Ancillary magnetospheric/magnetosheath/solar wind science occur during the balance of each year.

With a design lifetime of 2 years, MC–DRACO is scheduled for launch in 2010 or earlier, depending on the progress of miniaturization and mass manufacturability of nanosatellites and their instrument payloads, while preserving functionality.



Conceptual view of ST–5 satellite for Magnetotail Constellation.