UNIVERSITY OF MASSACHUSETTS LOWELL

UMLCAR

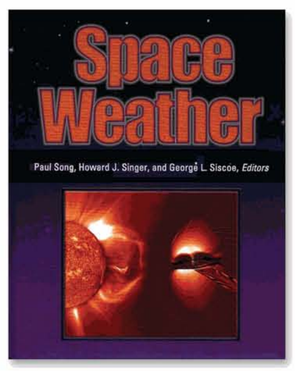
CENTER FOR ATMOSPHERIC RESEARCH

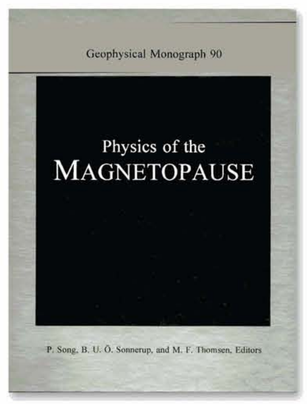
IN PARTNERSHIP WITH

UMASS

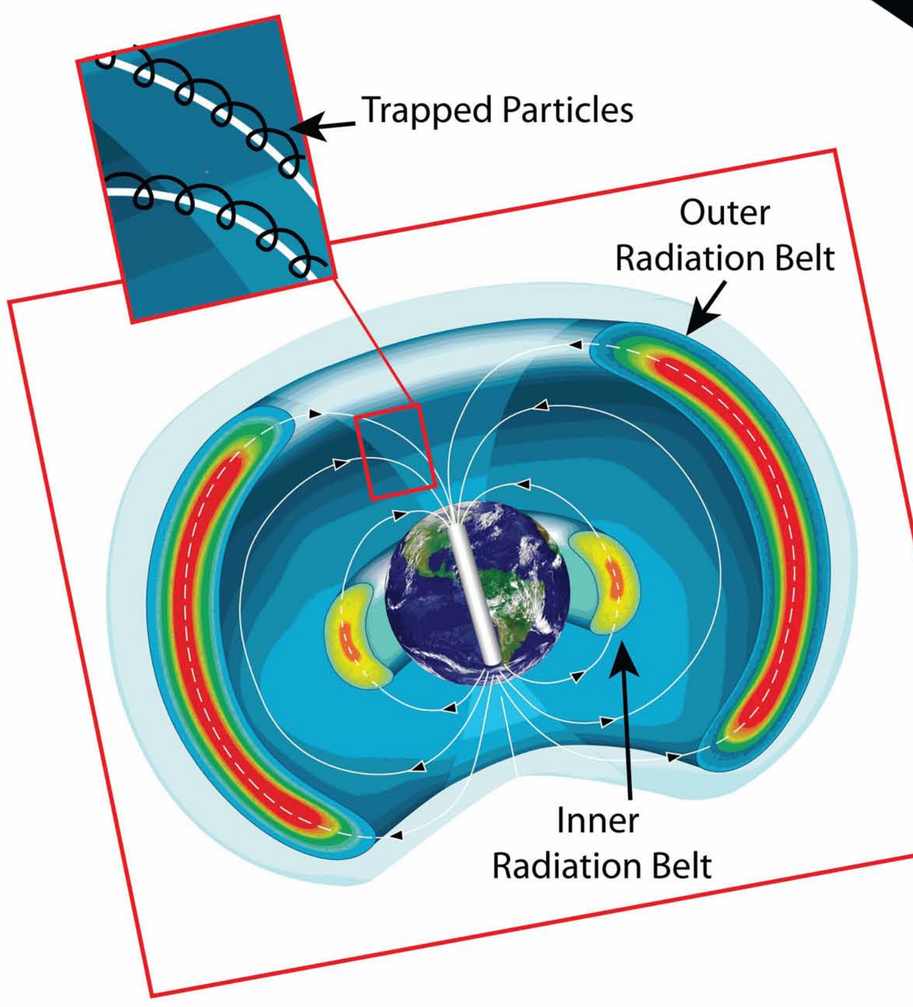
The Center for Atmospheric Research was founded in 1975 with the goal of conducting experimental and analytical research in the atmospheric and space sciences, to provide research opportunities for graduate and undergraduate students, and to demonstrate how research and development tie to solving real world problems. Carrying out these objectives requires tapping the science and engineering expertise residing in the university.

CENTER PUBLICATIONS



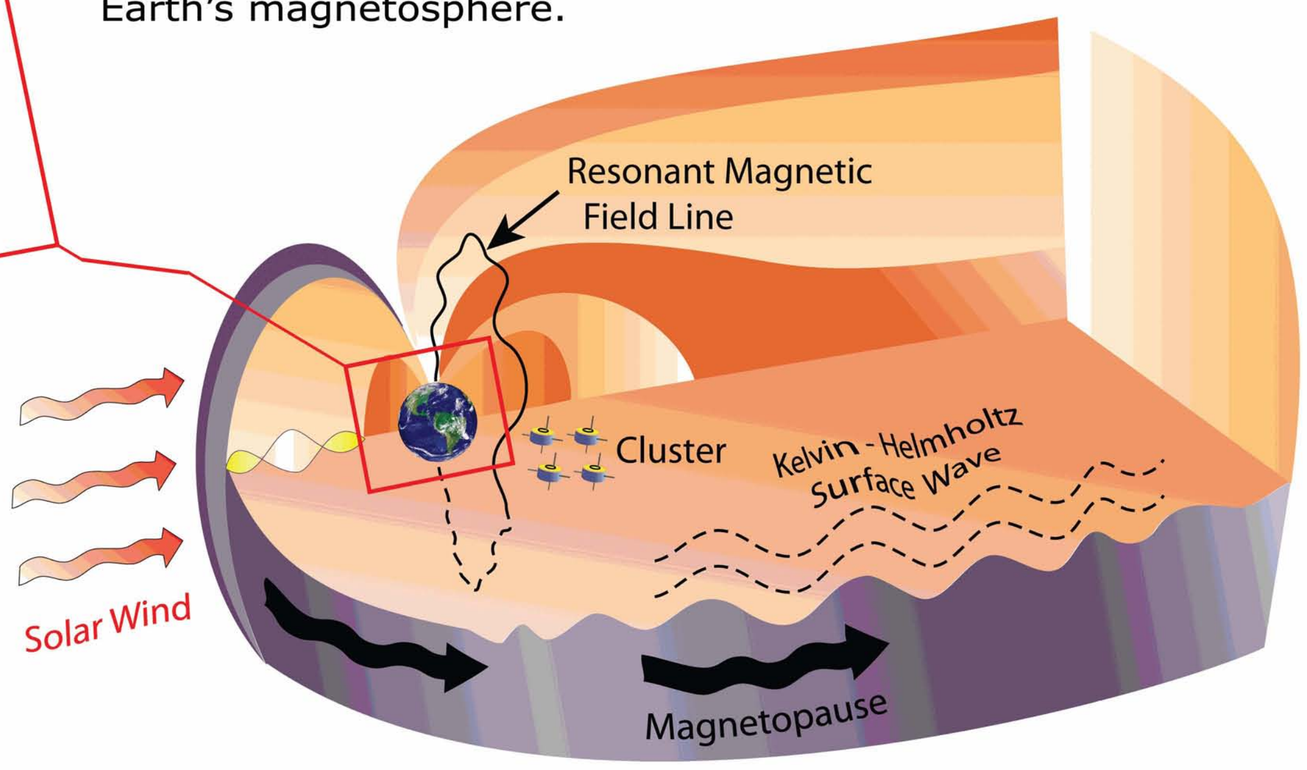


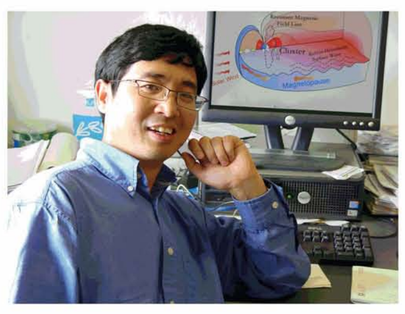
Each year the center publishes over **20 papers** in international journals resulting in over **$3 Million in research grants** & contracts from NASA, USAF, NSF & other international instituions.



FEATURED IN DISCOVER MAGAZINE

Killer electrons are extremely high energy electrons, deadly to astronauts, satellites, and space instrumentations. How they are produced in the first place is a highly contested space physics subject. Prof. Qingang Zong and coworkers used measurements from European Space Agency's Cluster satellites to reveal that killer electrons can be produced by low-frequency waves as a result of the impact of the interplanetary shocks upon the Earth's magnetosphere.





DISCOVER

Prof. Qiugang Zong & Coworkers Study

"HOW KILLER ELECTRONS FORM IN SPACE"

UNIVERSITY OF MASSACHUSETTS LOWELL

UMLCAR CENTER FOR ATMOSPHERIC RESEARCH

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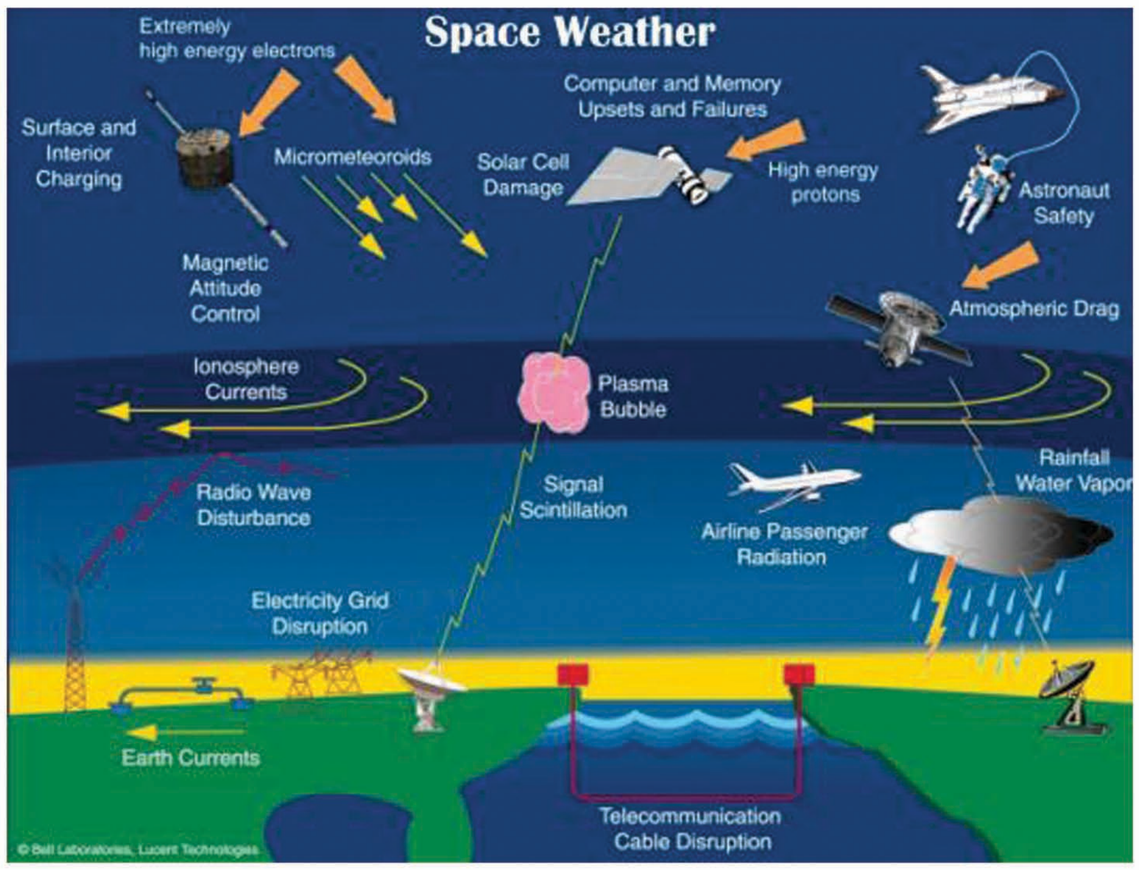
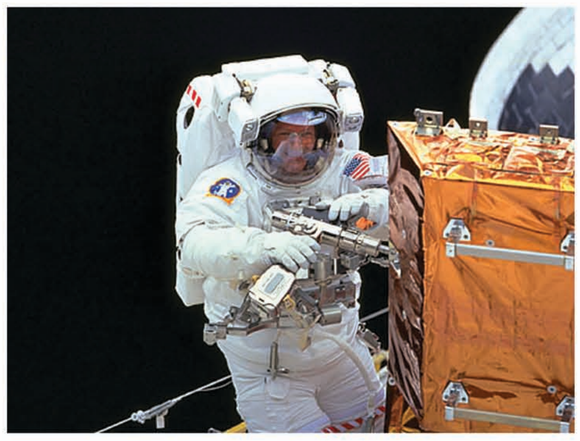
SPACE WEATHER

Space refers to the region above the atmosphere filled with plasma, which consists of an equal number of electrons and ions. Space Weather, a concept started in 1994, refers to conditions in space that can influence the performance and reliability of space-borne and ground-based technological systems, and can endanger human life or health. There are three major Space Weather threats: radiation particles, ionospheric plasma density fluctuations, and magnetic field fluctuations.

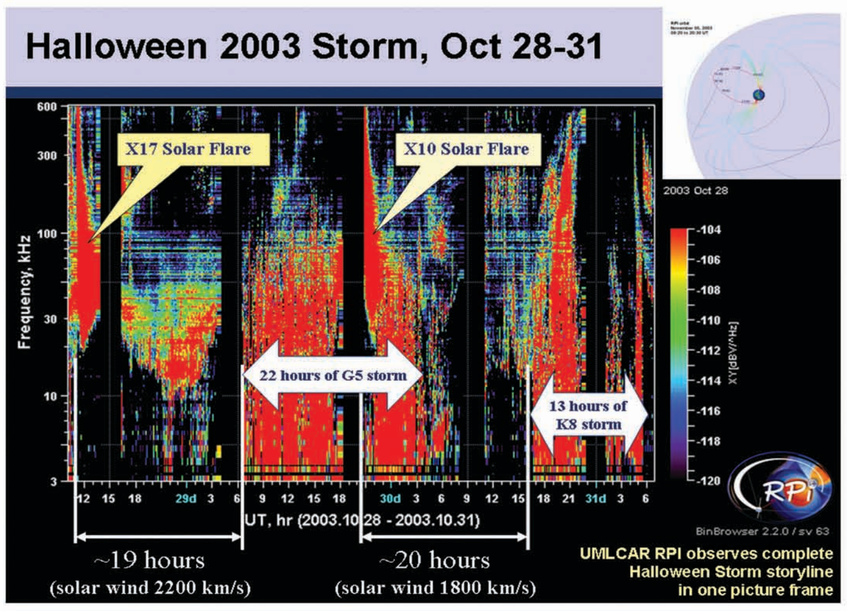


SPACE RADIATION



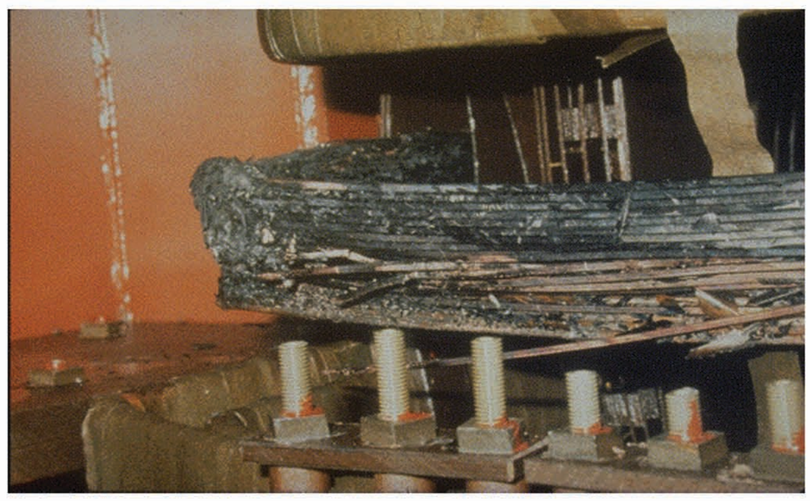
Similar to hail in weather, radiation particles can penetrate into satellite shield and space suits, damaging electronics and threatening astronauts' safety. Most of their particles are concentrated in regions called radiation belts. The life times of the particles can be as long as a few years, while their dosage varies.

IONOSPHERIC PLASMA EFFECTS



Similar to fog in weather, variations in the ionospheric plasma density can interrupt short wave communications, producing large errors in GPS and other space-borne navigation systems.

MAGNETIC STORMS



On March 13, 1989, at 2:44 am, a transformer failure in the HydroQuebec power system precipitated a catastrophic collapse of the entire power grid. The transformer failure was a direct consequence of ground induced currents from a space weather disturbance high in the atmosphere.

Magnetic Storms and substorms, periods of large geomagnetic disturbances, are space analogues of hurricanes and tornadoes. They often result in enhanced radiation dosages and strong ionospheric plasma density fluctuations. Strong geomagnetic disturbances can produce large currents underground, on conductors on the ground, such as power transmission lines and oil pipelines, and in space where satellites are flying. They have caused large power grid outages, satellite failures, and cell phone blackouts.

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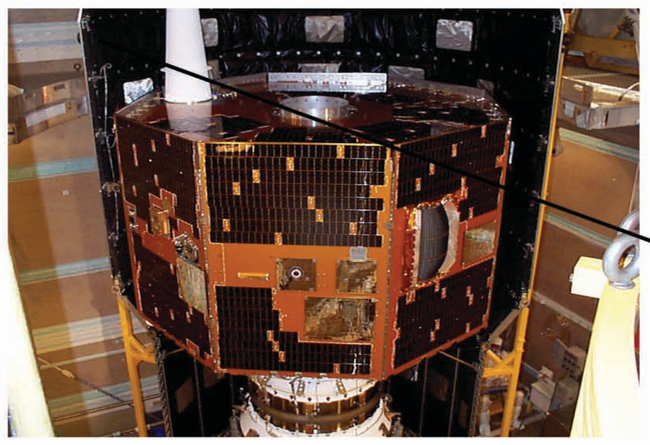
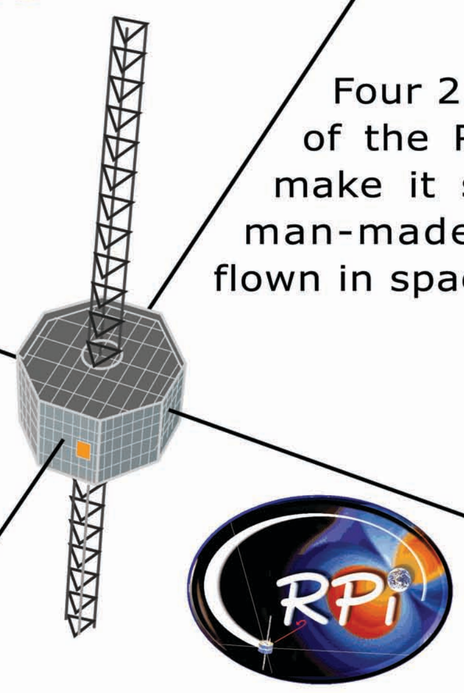
SPACE INSTRUMENTATION

DESIGNED BY UMLCAR

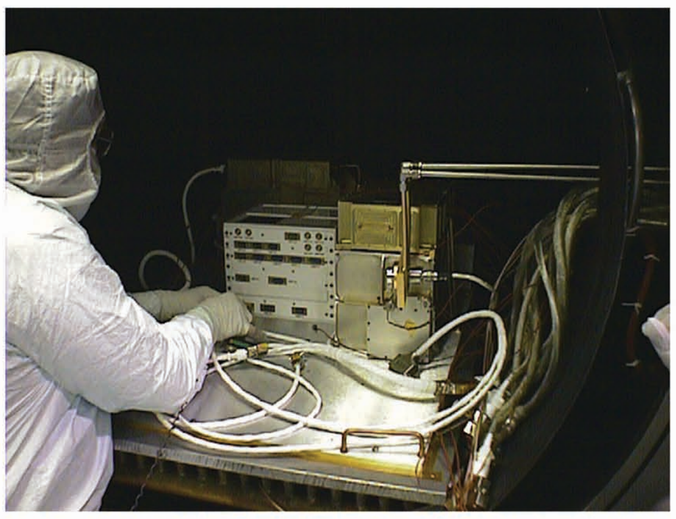
RADIO PLASMA IMAGER



NASA IMAGE satellite mounted inside Delta II rocket. IMAGE mission studied magnetospheric plasma using RPI instrument designed by UMLCAR

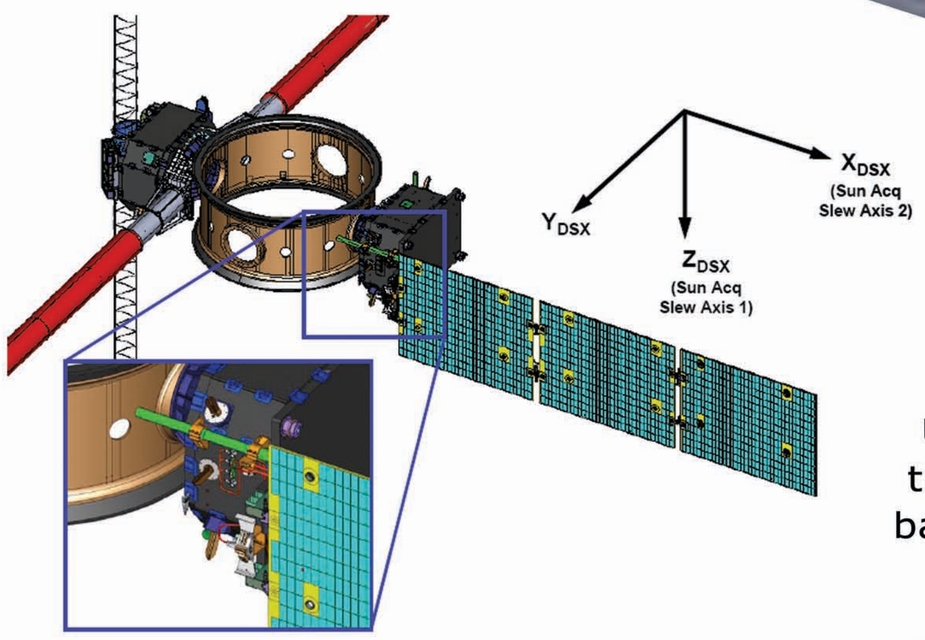


Four 250 m antennas of the RPI instrument make it second largest man-made construction flown in space



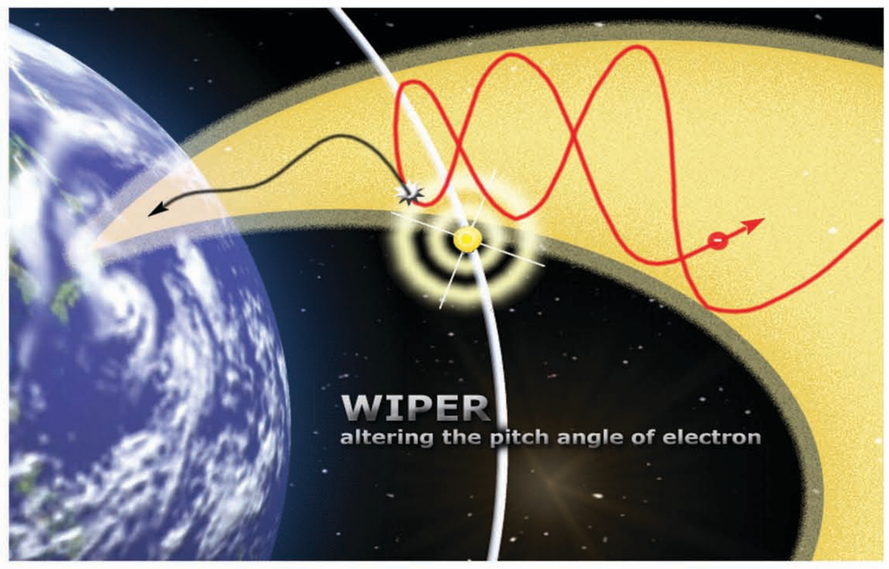
RPI instrument under acceptance testing at South West Research institute in San Antonio, TX

DSX

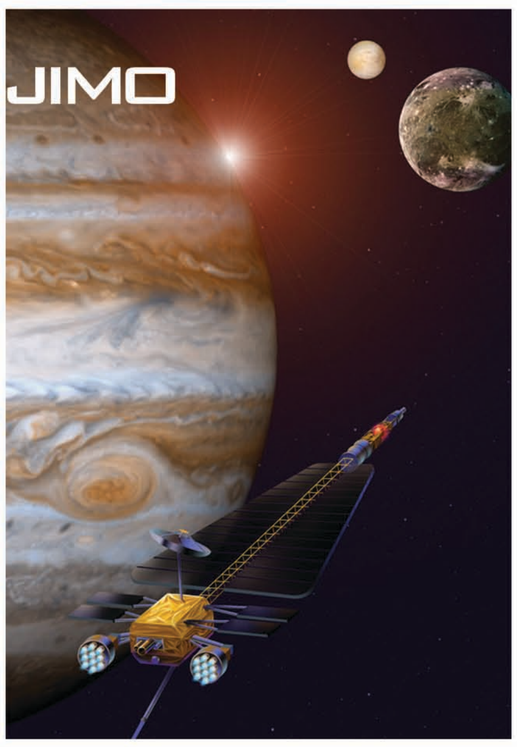


DOD SPACE MISSION PRIORITY #1

WIPER instrument on DSX spacecraft will conduct basic research designed to significantly advance DOD capability to operate in the harsh radiation environment. UMLCAR designs power transmitter and narrow band receiver for WIPER.

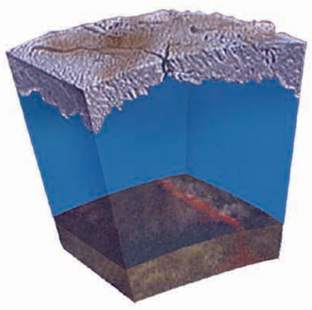


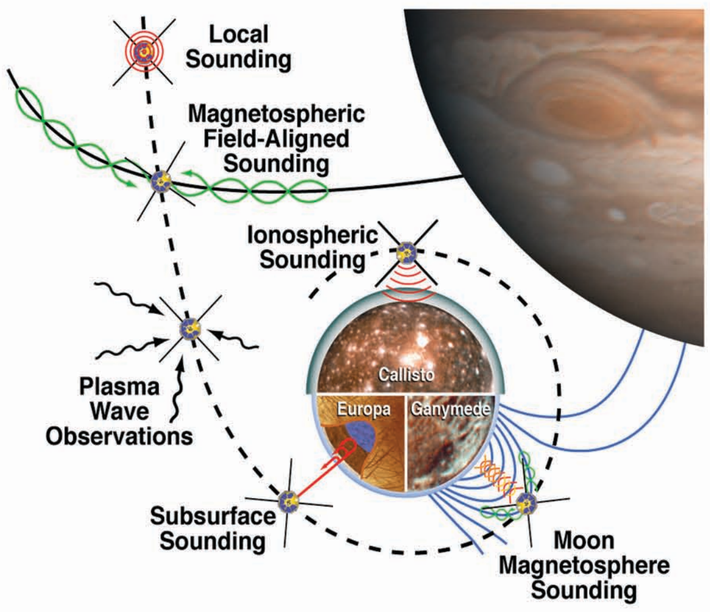
The WIPER will transmit and receive VLF waves in the 10 to 50 kHz range, and quantify their effect on the trapped electron populations in the magnetosphere



The Center recently received a NASA grant to develop a high-capability Planetary Advanced Radio Sounder (PARS). This high-power, high-data rate remote-sensing instrument will provide critical and diverse measurements necessary for detection of subsurface oceans and for characterization of ionospheres of moons, magnetosphere-moon interactions, and permanent or induced magnetic fields for missions to icy moons and other bodies in the solar system.

This information is critical to determining if life is possible on moons of this type.





Planetary Advanced Radio Sounder will combine five instruments in one enclosure.

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WORLDWIDE REMOTE SENSING OF IONOSPHERIC PLASMA

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DIGISONDE 4D

UMLCAR has built and installed over 100 Digisonde systems worldwide

EVOLUTION OF DIGISONDE

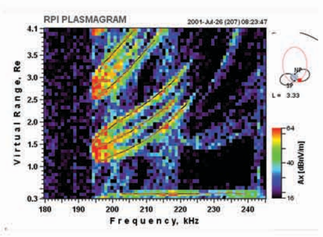
Digisonde 128 (1970)

Digisonde 256 (1978)

Digisonde DPS (1993)

INTELLIGENT SYSTEMS

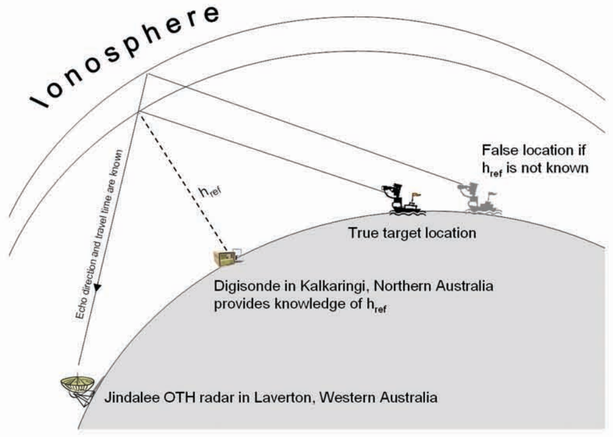
ARTIST 5 software automatically interprets Digisonde ionogram images to derive ionospheric specification data for use in space weather forecasts.



CORPRAL is an automatic image prospecting tool that locates images of interest to various scientific pursuits in 1.5 million image collection acquired by the RPI instrument on NASA's IMAGE spacecraft.

The Digisonde network provides real-time sensor information for efficient mission planning of International Space Station (ISS) spacewalks.

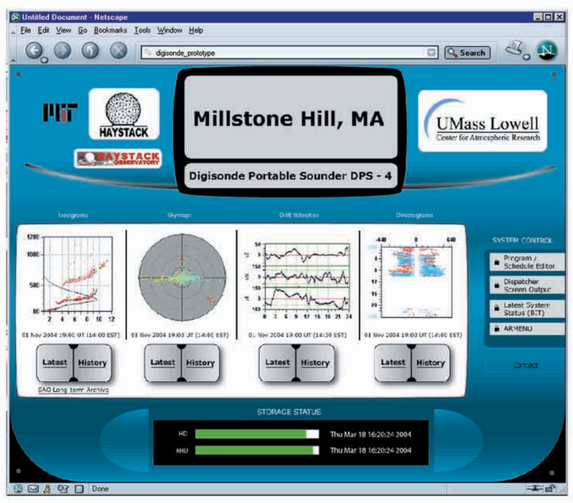
Provided information is used to predict the amount of charging of the ISS that presents a serious hazard of electric shock to the astronauts working on orbit.



The Digisonde network of 15 systems in Australia is a part of the $A1.8 billion Jindalee Operational Radar Network (JORN) that monitors Northern coastline and Indian ocean for illegal immigration, drug trafficking, and unregistered air transports.

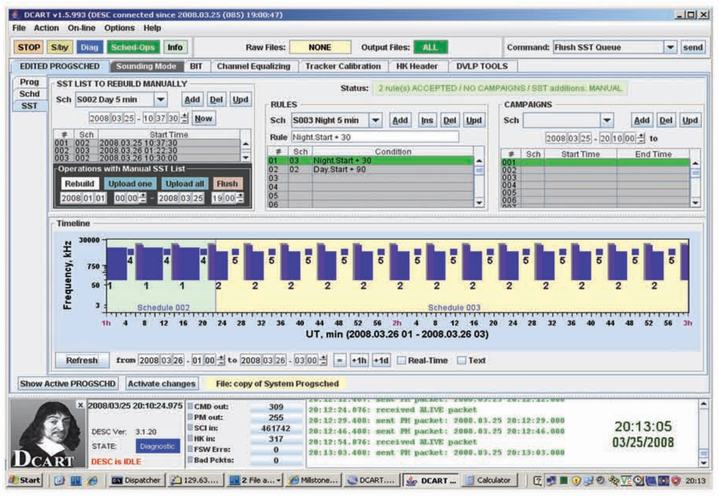
JORN resolution allows Air Force commanders to see the aircraft turning on their approach to Indonesian airports, but accuracy of target location is low without knowledge of echo reflection height in the ionosphere that Digisondes provide 24/7.

SOFTWARE DEVELOPMENT



ADRES and DIDBase are software projects at UMLCAR for efficient Digisonde data management. UMLCAR accepts real-time feeds from ~30 digisonde locations to service online data requests from a variety of organizations, including the US Air Force, Boeing Company, and North West Research Agency. Digisonde network state of health is monitored automatically.

Web interface for remote commanding of Digisonde



UMLCAR mission planning software is a candidate for USAF DSX mission