



IGPP

**Institute of Geophysics
and Planetary Physics**

2004 Annual Report

Table of Contents

Mission of IGPP and Institutional Goals.....	iii
<u>Astrophysics</u>	1
Astrophysics Focus	3
Improvement of Background Rejection Algorithms in Milagro	3
Precessing Neutron Stars.....	7
Nucleosynthesis in Asymmetric Core-Collapse Supernovae	9
Migration of Protoplanets in Gaseous Disks.....	12
Probing Nature’s Particle Accelerators	14
Cosmological Hydrodynamics with Adaptive Mesh Refinement	16
<u>Space Plasma Physics</u>	21
Space Physics Focus.....	23
Magnetospheric Seismology: A Pilot Study	23
Interaction of Small Bodies with the Atmosphere	29
The Quantifying IMAGE EUV Plasmaspheric Images Using the In Situ LANL Geosynchronous Orbit Plasma Measurements.....	37
Full Particle Simulations of Magnetic Reconnection at the Magnetopause.....	40
Space Plasma Physics Workshops.....	42
<u>Solid Earth</u>	49
Solid Earth Geoscience Focus.....	51
Direct and Indirect Forcing of Oceanic Infragravity Waves by the Atmosphere: Origins of the Continuous Earth Oscillations	51
Silicate Reaction Kinetics in a Major Aquifer in New Mexico.....	67
Multiphase Flow, Transport and Reaction in Porous and Fractured Media	76
A Study of Continents and Supercontinent Cycles in 3-D Spherical Geometry.....	88
Behavior of Th and Sm in Planetary Surface and Magmatic Environments. Extending Remotely Sensed Chemical Data To Better Understand Planetary Evolution.....	91
Multi-Dimensional, Coupled Heat-Fluid-Solute Transport in Oceanic Lithosphere: The Impacts of Seamounts and Faults.....	94

Using Neutron Computed Tomography to Determine the Influence of Pore Structure and Mineralogy on Two-Phase Flow and Transport in Fractured and Faulted Geologic Media	100
Nonlinear Response of Granular and Other Materials*	104
Anisotropy in the Earth	107
The Middle Awash Region Structural Transition Zone: Age Constrains on Volcanotectonic and Sedimentation Process and Paleontological Resources	110
Solid Earth Geosciences.....	112
<u>Complex Dynamical Climate and Environmental Systems</u>	121
Complex Dynamical Climate and Environmental Systems Focus.....	123
Sensitivity of Global Thermohaline Ocean Circulation to Disintegration of West Antarctic Ice Shelves and Ice Sheet.....	125
Paleoclimate Records from Bogs and Trees in the Jemez Mountains.....	130
Automated Feature Detection and Hydrocode Modeling of Impact-Related Structures on Mars.....	135
A Realistic Multi-layer Snow Model for the Los Alamos Sea Ice Model	137
Improved Combustion Physics for the LANL Wildland Fire Prediction Model (FIRETEC).....	138
Complex Dynamical Climate and Environmental Systems	140
<u>IGPP's Summer Schools</u>	143
IGPP Summer Schools	145
<u>IGPP's Scholars</u>	149
IGPP Scholars	151

Mission of IGPP and Institutional Goals

The Institute of Geophysics and Planetary Physics (IGPP) at Los Alamos National Laboratory (LANL) is a branch of the IGPP systemwide multicampus research unit of the University of California (UC). As such, the science mission of IGPP is “to promote and coordinate basic research on the understanding of the origin, structure, and evolution of the earth, the solar system, and the universe, and on the prediction of future changes, as they affect human life.”

In addition to its role as part of a UC MRU, IGPP at Los Alamos is also a Laboratory institutional center. The institutional goals of IGPP are:

- a. To enhance University-Laboratory relations by fostering collaborations between UC campus faculty, staff, and students and LANL staff;
- b. To provide LANL programs with input of new ideas, people, and contact with the university community at-large;
- c. To foster top-quality research at LANL in the more “basic” or “fundamental” aspects of fields that can be mapped to LANL mission thrust areas; and
- d. To provide a stimulating venue for LANL scientists to broaden their research horizons.

IGPP Activities

In order to achieve IGPP’s goals, the institute supports small scale science involving Laboratory and University PIs, graduate students, and postdocs. In addition, IGPP supports numerous workshops, i.e., scientific workshops designed to exchange information and research workshops designed to solve emerging and urgent problems.

The IGPP minigrant program, with a co-PI from the Laboratory and a co-PI from a university, presently supports about 40 graduate students and postdocs, who spend a substantial fraction of their research time on-site at the Laboratory. Minigrants are selected via a peer review process, with input from an external advisory committee which meets at LANL in June each year. Minigrants normally cover a three year period.

IGPP also supports summer schools in areas of scientific interest to the Laboratory. Summer schools are supported in order to provide the necessary training to university graduate students so that they are well qualified to start a career on Department of Energy (DOE) critical research topics immediately upon graduation.

IGPP Management

IGPP/LANL is a dynamic organization, and portfolios are adjusted according to changes in the scientific landscape and anticipated new directions within LANL. At present, management consists of a director, managers of four scientific focus areas, an administrative officer, and a secretary:

- Director: Gary Geernaert
 - Administrative officer: Debra Saiz
 - Secretary: Deb Rivera
- Astrophysics focus area: Richard Epstein
- Space physics focus area: Reiner Friedel
- Geophysics focus area: Claudia Lewis
- Climate focus area: Manvendra Dubey
- Summer schools
 - Geophysics (SAGE): Scott Baldrige
 - Cosmology: Salman Habib
 - Carbon sequestration: Julianna Fessenden-Rahn

Steering Committees: *meet annually in June*

- External advisory board: chair, Jerry Schubert, UCLA
 - Astrophysics and cosmology: Bob Rosner (Chicago), George Fuller (UCSD)
 - Space physics: Chris Russell (UCLA), Mike Liemohn (Michigan), Janet Green (Colorado) as backup.
 - Climate/environment: John Roads (UCSD)
 - Geophysics: Jerry Schubert (UCLA), Freeman Gilbert (UCSD)
- Internal advisory board of partner divisions:
 - Terry Wallace, EES Division
 - Doug Beason, ISR Division
 - Len Margolin, X Division

The Orson Anderson Scholar and the Visitor Program

The Laboratory supports the IGPP Orson Anderson scholar for one year, with funding from the LDRD program. The Orson Anderson scholar is selected each year, based on Laboratory science challenges and opportunities for collaboration with external institutions. In addition to the Orson Anderson Scholar, IGPP hosts visiting scholars with terms lasting up to six months.

During FY04, IGPP's scholars included:

- a. Orson Anderson scholar: Fernando Grinstein, Naval Research Laboratory
- b. Visiting scholar: Phil Kronberg, University of Toronto