THEORETICAL STUDIES

Theoretical studies in the Department and Laboratory are carried on principally by **Drs. William Hubbard, J.R. Jokipii,** and **Eugene Levy** along with a number of research associates and graduate students, and cover a wide range of subjects.

Jokipii and Levy are investigating the theory of plasmas, magnetic fields, and cosmic rays in the solar system and elsewhere in the cosmos. Together they are working on the entry and motion of cosmic rays in the solar system with particular emphasis on the influence of the interplanetary magnetic field's large-scale structure through magnetic gradient and curvature drifts. Both scientists are associated with the upcoming Solar Polar Orbiter mission which will measure the three-dimensional structure of the heliosphere and provide the observational information necessary to our understanding of these phenomena.

Jokipii is also carrying out studies of cosmic-ray confinement and lifetimes in the galaxy. Evidence suggests cosmic rays move in a large halo surrounding the galaxy, and radio emission from extended regions surrounding other galaxies suggests that this is commonly the case. Theoretical work at Arizona is exploring the possibility that cosmic rays move in an extensive region of gas and magnetic field flowing from the galaxy like a wind.

Levy is engaged in a program of studies aimed at the generation and behavior of astrophysical magnetic fields. These naturally generated magnetic fields are thought to have a profound influence on the behavior and evolution of many objects. There is evidence that a strong magnetic field was present during the formation of the solar system. Recent work suggests that such a field may have been a natural product of the properties of the gaseous nebula from which the solar system formed. It also appears that the field could have played an important role in the evolution of the preplanetary nebula by helping to transport angular momentum and mass across the nebula.

Hubbard's areas of interest include the equilibrium and transport properties of materials at high pressures and the application of such work to the modeling of planetary interiors. Evolutionary models of the outer planets have recently been calculated with the objective of explaining enigmatic measurements of large differences in heat flow between Uranus and Neptune. Cooperative projects continue with investigators at the Jet Propulsion Laboratory (spacecraft geodesy) and at Lawrence Livermore Laboratory (high pressure physics).

Hubbard's interests also include applications of the planetary occultation technique. LPL has a strong capability for mobile observations of occultation events, employing two portable Celestron-14 telescopes and pulse-counting occultation photometers.