shallow and deep structure of the planet. Problems that will be specifically addressed are (1) identifying the location of the crust/mantle boundary, (2) determining the presence or absence of a mantle low-viscosity zone, (3) establishing the state of the core (is there a liquid outer core?), (4) measuring the spatial and temporal distribution of Venus quakes, and (5) determining source mechanisms for Venus quakes.

Mission Structure: The Venus Interior Structure Mission (VISM) consists of three seismometers deployed from landers on the surface in a triangular pattern (two located approximately 250 km from each other and the third at the apex of the triangle at a distance of 1000 km). The landers will be delivered by a carrier bus that will be placed into Venus orbit so it can act as relay to transmit data from the surface to the Earth (data rate of 100 Mb/day/lander). By necessity, the surface stations must be relatively long-lived, on the order of six months to one year. In order to achieve this goal, each lander will employ a General Purpose Heat Source (GPHS)-powered Stirling engine to provide cooling (refrigeration to 25°C) and electric power. Upon reaching the surface, a seismometer is deployed a small distance from each lander and is directly coupled to the surface. Seismic data are recorded at a rate of 1100 b/s (including lander engineering telemetry). The seismometer will be enshrouded by a shield so as to isolate it from wind noise. The instrument is an accelerometer patterned after that proposed for MESUR, having a sensitivity in the range of 0.05 Hz to 40 Hz. On the basis of theoretical analyses, it should be possible to observe over 600 events of magnitude 4.0 or better over the lifetime of the network, which will provide sufficient data to characterize the large-scale interior structure of Venus.

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PLASMA DIAGNOSTICS BY ANTENNA IMPEDANCE MEASUREMENTS.

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The impedance of an electrically short antenna immersed in a plasma provides an excellent *in situ* diagnostic tool for electron density and other plasma parameters. By electrically short we mean that the wavelength of the free-space electromagnetic wave that would be excited at the driving frequency is much longer than the physical size of the antenna. Probes using this impedance technique have had a long history with sounding rockets and satellites, stretching back to the early 1960s [1]. This active technique could provide information on composition and temperature of plasmas for comet or planetary missions.

There are several advantages to the impedance probe technique when compared with other methods. The measurement of electron density is, to first order, independent of electron temperature, vehicle potential, probe surface contamination, and orientation to the geomagnetic field. Surface heating and variations of the antenna surface physics do not effect the VLF and RF characteristics of the antenna and hence do not effect the accuracy of the measurements. As such, the technique is ideal for probes plunging into planetary atmospheres where surface contamination is a concern.

Currently two classes of instruments are built and flown by SDL-USU for determining electron density, the so-called capacitance and plasma frequency probes. The plasma frequency probe [7] operates in nearly collisionless plasmas and can provide absolute electron density measurements with 1% accuracy at sampling rates as high as 20 kHz, and the capacitance probe can provide electron density measurements with about 5% accuracy in strongly collisional plasmas. The instrumentation weighs less than 0.5 kg, consumes less than 1 W (continuous operation), and only requires a simple 0.1-m antenna [4]. Recently, from 1987 to 1991, the plasma frequency probe has successfully flown on 11 sounding rockets launched into the Earth's ionosphere at low, mid, and high latitudes and 5 more are being readied for missions in the immediate future.

The impedance of such short antennas has been extensively studied theoretically [2,3,5] and laboratory experiments have shown excellent agreement with theory [6]. When the current distribution on the antenna matches a natural mode of the plasma, energy is carried away by a plasma wave resulting in a large contribution to the antenna impedance. A measurement of the antenna impedance provides information on the normal modes of a plasma from which electron density, temperature, or ion composition could be deduced. The versatility and simplicity of an impedance probe would be ideal for the limited resources of planetary missions.

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LUNAR SCIENCE: USING THE MOON AS A TESTBED.

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The Moon is an excellent testbed for innovative instruments and spacecraft. Excellent science can be done, the Moon has a convenient location, and previous measurements have calibrated many parts of it. I summarize these attributes and give some suggestions for the types of future measurements.

Lunar Science: The Lunar Scout missions planned by NASA's Office of Exploration will not make all the measurements needed. Thus, test missions to the Moon can also return significant scientific results, making them more than technology demonstrations.

Location: The Moon is close to Earth, so cruise time is insignificant, tracking is precise, and some operations can be controlled from Earth, but it is in the deep space environment, allowing full tests of instruments and spacecraft components.

Calibrations: The existing database on the Moon allows tests of new instruments against known information. The most precise data come from lunar samples, where detailed analyses of samples from a few places on the Moon provide data on chemical and mineralogical composition and physical properties. Apollo field excursions provided *in situ* measurement of surface geotechnical