Resolving power in the RBS mode is determined by the energy spread of the alpha source and the range of backscatter angles observed by the detectors. These parameters in turn determine the number of backscattered alpha particles per unit time. In the present design the use of proton and X-ray data permits us to trade selectivity for sensitivity.

The instrument has a long standing space heritage, going back to the days of Surveyors V, VI, and VII (1968–1969) and Phobos (1988). The present design is the result of an endeavor to reduce mass and power consumption (Surveyor: 10 kg/10 W; Phobos: 2.7 kg/2.5 W; this instrument: 0.6 kg/0.3 W); four instruments are scheduled to fly on the Russian Mars '94 mission: two on penetrators (without X-ray mode) and two on small stations (including the X-ray mode, using "room temperature" mercuric iodide detectors provided by the University of Chicago). These are currently being calibrated and prepared for integration.

The instrument for Mars Pathfinder will be a duplicate of the instruments for the Mars '94 small stations but with minor changes. It consists of a sensor head, incorporating the alpha sources, a telescope of silicon detectors (35 and 700 m thick) for the detection of alpha particles and protons and a mercuric iodide X-ray detector with preamplifier, and an electronics box (80 × 70 × 60 mm) containing a microcontroller-based multichannel spectrometer. The sensor head will be mounted on the rear of the Mars Pathfinder Microrover on a deployment mechanism that permits placement of the sensor in contact with sample surfaces inclined at any angle from horizontal to vertical, thus permitting measurement of the composition of soil and rock sample. The electronic box will be contained in the microrover's "warm" container and will communicate with the microrover control system through a standard RS 232 serial interface.

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ATMOSPHERE STRUCTURE AND METEOROLOGY INSTRUMENT FOR MARS PATHFINDER. A. Seiff, San Jose State University Foundation, Mail Stop 245-1, NASA Ames Research Center, Moffett Field CA 94035, USA.

The MESUR Science Definition Team recommended that all MESUR probes, including Pathfinder, carry an ASI/MET experiment, in order that no opportunity be lost to characterize the atmosphere of Mars in passing through it. The experiment was thus included on Pathfinder from the start (February 1992), but on an essentially noninterference basis: It was to make no unusual demands on the spacecraft. A Science Advisory Team appointed by NASA Headquarters in September 1993 first met on November 3 to initiate formal science participation, and the level of activity has since been high. The instrument passed its Preliminary Design Review on February 28.

The structure of the atmosphere is measured during entry and descent; meteorological parameters, pressure, temperature, and wind velocity are collected during the mission lifetime after landing. The structure experiment has two phases. During high-speed entry, from 160 km to near 8 km (where the parachute is deployed), accelerometers define the density structure. In the parachute descent, atmospheric pressure and temperature are measured until airbags are deployed ~150 m above touchdown. Entry phase pressures are obtained by integrating measured densities assuming hydrostatic equilibrium (the technique used on the Viking and Pioneer Venus missions and to be used on the Galileo Probe); the equation of state then yields temperatures. The sensors employed are guidance-quality accelerometers, Tavis and Vaisalla pressure sensors, and chromel-constantan thermocouples with platinum resistance thermometers at their cold junctions.

Constraints imposed do not allow the descent phase sensors to project outside the lander envelope, nor are the accelerometers in an optimum configuration about the center of gravity. The Science Advisory Team (SAT) is exploring the effects of these limitations, but they should not prevent the acquisition of valuable data.

The meteorology measurements were originally limited to pressure and temperature, but were extended to include winds because of the apparent simplicity of the hardware. The measurement resolution will be 256× better than that of Viking, which was resolution limited. Temperature measurements at three elevations above the surface, and wind measurements at two heights (if affordable within available lander resources), will define profiles not available from the Viking instrument. Rapid sampling for 5 min/hr will define both diurnal and seasonal variations and turbulence. Consideration is being given to sampling over selected 1-hr intervals for better definition of fluctuations. Pressure sensors are shared with the ASI. Temperature sensors are chromel-constantan thermocouples of 75-μm wire diameter. Wind is sensed from the convective heat loss of heated wires. Sensors have been designed and evaluated analytically. They will be evaluated experimentally and refined if necessary from tests at Mars surface conditions in the Mars Wind Tunnel at NASA Ames Research Center (operated by Arizona State University).

To move them away from thermal influence of the lander electronics, the temperature and baseline wind sensor are mounted on the whip antenna, which communicates with the rover, about 1 m away from the lander core. The wind sensor and primary temperature sensors are about 0.5 m above the surface; two other temperature sensors are 0.25 m and 0.125 m above the surface. The second wind sensor is proposed to be mounted on the low-gain antenna, about 1 m above the surface. Pressure sensors are in the Warm Electronics Box in the lander core. The temperature profiles will differentiate between stable and convective near-surface conditions, and define atmospheric heating rate. Wind profiles will likewise discriminate stable from unstable conditions, and define near-surface shear, as well as provide a valuable input to boundary layer models.

The greatest concern we have for the descent phase results from the restriction against external deployment of the temperature sensor (for reasons of air bag safety). The sensor must sample atmosphere flowing through the lander rather than around it, at velocities well below the descent velocity. This slows sensor response time, e.g., to ~4 s if the internal velocity (yet to be established) is 1 m/s. For the entry phase, the major problem is correction of measured accelerations for angular inputs at off-center of gravity locations. For landed meteorology, the major concern is the design of the wind sensor to work sensitively at extremely low power levels in the low-density atmosphere and define wind directions. Problems of thermal contamination are also inevitably present.