unwanted background event. This arrangement has improved the energy resolution of proton lines, eliminated the need for an additional guard detector system, and substantially reduced the size of the sensor head.

However, the big saving in size and power in the APX instrument comes from replacing the cryogenically cooled Si or HP Ge X-ray detectors in the X-ray mode with HgI_2 ambient-temperature X-ray detectors that do not require cryogenic cooling to operate and still achieve high-energy resolution. These detectors are being provided by Xsirius, Inc. in Marina del Ray.

The spectrometer as it is implemented for Mars '94 and Mars '96 Russian missions (the Mars '94 and Mars '96 APX experiment are a collaboration of IKI of Moscow, The University of Chicago, and Max Planck Institut für Chemie in Mainz) and for NASA's Pathfinder mission (the APX experiment for Pathfinder will be a collaboration of MPI Mainz and The University of Chicago) to Mars in 1996 has a combined weight of about 600 g and operates on 250 mW of power. It still can benefit from higher-quality alpha sources available from the Russians and more hybridized electronics.

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INVESTIGATION OF MARS ROTATIONAL DYNAMICS USING EARTH-BASED RADIO TRACKING OF MARS LANDERS. C. D. Edwards Jr., W. M. Folkner, R. D. Kahn, and R. A. Preston, Jet Propulsion Laboratory, California Institute of Technology, Pasadena CA 91109, USA.

The development of space geodetic techniques over the past two decades has made it possible to measure the rotational dynamics of the Earth at the milliarcsecond level, improving our geophysical models of the Earth's interior and the interactions between the solid Earth and its atmosphere. We have found that the rotational dynamics of Mars can be determined to nearly the same level of accuracy by acquiring Earth-based two-way radio tracking observations of three or more landers globally distributed on the surface of Mars (Fig. 1). Our results indicate that the precession and long-term obliquity changes of the Mars pole direction can be determined to an angular accuracy corresponding to about 15 cm/yr at the planet's surface. In addition, periodic nutations of the pole and seasonal variations in the spin rate of the planet can be determined to 10 cm or less. Measuring the rotation of Mars at this accuracy would greatly improve the determination of the planet's moment of inertia and would resolve the size of a planetary fluid core, providing a valuable constraint on Mars interior models. Detecting seasonal variations in the spin rate of Mars would provide global constraints on atmospheric angular momentum changes due to sublimation of the Mars CO_2 polar ice caps. Finally, observation of quasisecular changes in Mars obliquity would have significant implications for understanding long-term climatic change.

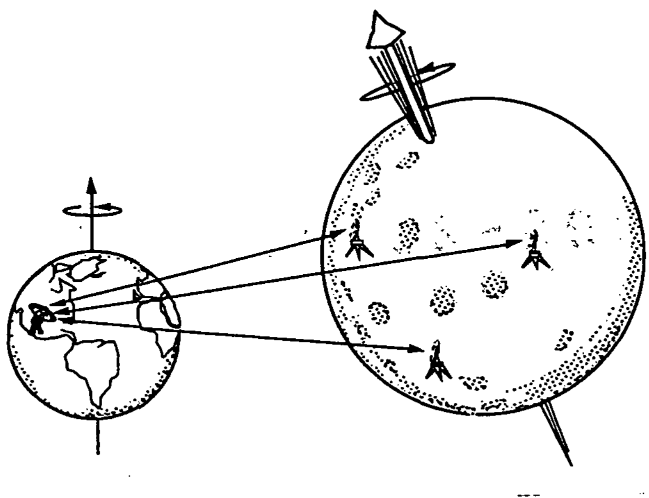

Fig. 1. Simultaneous two-way tracking of multiple Mars landers from Earth.

The key to achieving these accuracies is a globally distributed network of Mars landers with stable, phase-coherent radio transponders. By simultaneously acquiring coherent two-way carrier phase observations between a single Earth tracking station and multiple Mars landers, Earth media errors are essentially eliminated, providing an extremely sensitive measure of changes in the differential path lengths between the Earth tracking station and the Mars landers due to Mars rotation. Time variability of the instrumental phase delay through the radio transponder may represent the limiting error source for this technique. Calibration of the transponder stability to about 0.1 ns or less, over a single tracking arc of up to 12 hr, is sufficient to provide the decimeter-level determination of Mars orientation parameters quoted above.

We will provide a detailed description of the multilander tracking technique and the requirements it imposes on both the lander radio system and the Earth-based ground-tracking system. This concept is currently part of the strawman science plan for the Mars Environmental Survey (MESUR) mission and complements many of the other MESUR science goals.

N93-28778 160724 p. 2

CLEMENTINE SENSOR PROCESSING SYSTEM. A. A. Feldstein, Innovative Concepts, Inc., 8200 Greensboro Drive, Suite 801, McLean VA 22102, USA.

The design of the DSPSE Satellite Controller (DSC) is baselined as a single-string satellite controller (no redundancy). The DSC performs two main functions: health and maintenance of the spacecraft, and image capture, storage, and playback. The DSC contains two processors, a radiation-hardened Mil-Std-1750, and a commercial R3000. The Mil-Std-1750 processor performs all housekeeping operations, while the R3000 is mainly used to perform the image processing functions associated with the navigation functions, as well as performing various experiments. The DSC also contains a data handling unit (DHU) used to interface to various spacecraft imaging sensors and to capture, compress, and store selected images onto the solid-state data recorder.

The development of the DSC evolved from several key requirements: The DSPSE satellite was to (1) have a radiation-hardened spacecraft control and be immune to single-event upsets (SEUs); (2) use an R3000-based processor to run the star tracker software that was developed by SDIO (due to schedule and cost constraints, there was no time to port the software to a radiation-hardened processor); and (3) fly a commercial processor to verify its suitability for use in a space environment.

In order to enhance the DSC reliability, the system was designed