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COSMIC RAY DETECTOR ON PIONEER 8 WILL HELP DRAW SOLAR WEATHER MAPS

CAPE KENNEDY --

"The Interplanetary Weather Bureau has issued a solar storm alert."

You haven't heard this forecast yet on home radio and television. But the small radio-data voices of two unmanned space vehicles -- soon to be joined by another -- have already given that kind of warning to space experimenters.

Pioneer 8 will join Pioneers 6 and 7 in a launch planned for Dec. 13. From the family, space scientists brought together by the Ames Research Center, National Aeronautics and Space Administration, can get data for solar weather maps.

Each Pioneer carries several instruments. In Dallas, Texas, scientists and engineers at the Southwest Center for Advanced Studies have built a second-generation cosmic ray detector for the Pioneer 8 flight. The new design, improved from the SCAS instruments on Pioneers 6 and 7, may have a key role in mapping the energy paths of solar space.

Pioneer 6, launched two years ago, has already "advised" Lunar Orbiter experimenters to close all film ports for protection against a flare of energetic particles (or cosmic rays) from Sun, in one of its many data transmissions.

The present Pioneers are giving 15 to 17 hours' warning of cosmic ray flare arrivals at Earth's magnetic envelope.

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Weather Maps, Forecasts Are Reports on Environment; There Are Many Environments

Weather maps and forecasts are reports, summaries and warnings drawn from continuing

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studies of environments, explained Dr. Robert P. Bukata, Pioneer Project Scientist at The Southwest Center, in a pre-launch discussion.

The farmer and the commuter want to know "will it rain tomorrow -- here?" Crops and lawns may need water. Or, harvests and expressway travel may be slowed by rain. A severe storm warning may call for protection of lives and property. But for most of us, the environment means "on the Earth's surface, and close to home."

"A downpour in Cleveland doesn't worry San Francisco people very much," said Doctor Bukata.

The jet pilot's environment is both wider and deeper. A midwestern cold front may dictate a southern transcontinental route, especially if it offers favoring winds at high altitudes.

The Earth-Moon commuter or interplanetary traveler will have to look at the whole environment of the inner solar system -- say, from Mars' orbit to the Sun, as a start. The rain on his weather map will be cosmic rays, or particles of energy, from the Sun and from other galaxies, said Doctor Bukata. His severe weather may be a proton event, or burst of hydrogen nuclei carried on the million-mile-an-hour solar wind.

Pioneers 6 and 7 have shown that particle radiation is carried and fairly well confined in giant magnetic tubes that twist away from the Sun's fusion furnace in a tangle, but become clearly defined as they form a system of spirals that move with the Sun's rotation.

The space traveler's weather hazard is radiation effects on his body, modified by the total length of time he is exposed to radiation, said Doctor Bukata. And, as in any environment, there are ways to reduce exposure if you can tell how intense the storm is, how big it is, and where it's going.

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SCAS Detector C Puts More Eyes in Space Than Earlier Models, Adds Viewing Angles

The Southwest Center's detector for Pioneer 8 will record particle fluxes from

well-defined bands of direction as the upright spacecraft cylinder spins once a minute while following an orbit roughly the same diameter as the Earth's.

Pioneer 8's orbital direction will be "backwards" to Earth's. If you picture the Earth as moving counter-clockwise around the Sun (Sun east to Sun west), Pioneer 8 will move clockwise, at an orbital distance between 1.1 and 0.99 astronomical units from the Sun. An astronomical unit is equal to the approximate 93 million miles from Sun to Earth.

SCAS Detector C, looking out through the side of spinning Pioneer 8, will have more "eyes" than the A-B detectors provided for Pioneers 6 and 7, said Wayne Glasscock, Pioneer Project Manager at the Dallas center.

In addition to a main scintillation counter telescope looking at cosmic ray arrivals from the plane of the spacecraft's orbit, the new experiment adds a triple telescope with solid state detectors to survey 50-degree angles above and below the ecliptic plane.

Detector C weighs 5.62 pounds. It requires 1.72 watts of electrical power; or, one-fourth of the amount needed by a Christmas tree light.

In addition to the telescopes, which count cosmic rays by producing electrical pulses for each arrival, the SCAS experiment includes a precise electronic clock that splits each spin of the spacecraft into eight time divisions, using the Sun as a zero marker. This means that cosmic ray arrivals are sorted into eight pie-slices of direction.

Strengths of pulses are also sorted into four ranges by electronics circuits, to identify protons and alpha particles with energies from 3.3 to 6.8 million electron volts, and from 7.5 to 60 MEV. Alpha particles are a pair of protons and a pair of neutrons.

The SCAS instrument will also record proton arrivals at 1 to 8 million electron volt energies, and alpha particles in the 4 to 8 MEV range, without determining their arrival direction.

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Recording of protons at 7.5 MEV energies provides a continuous watch on cosmic ray intensity in space. The lower-energy records, linked to the angular arrival data, will better define the magnetic tubes or filaments that spiral outward from the Sun. Their diameters may 500,000 miles, as was shown in the Southwest Center's analysis of earlier Pioneer data.

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Launch Comes During Increasing Solar Activity

Pioneer 8 will be launched in a period of increasing solar activity, which varies in an 11-year cycle. The new flight should see more storms, or energetic flares, in the solar weather.

Pioneers 6 and 7 identified 29 flares from Dec. 27, 1965 to Sept. 27, 1966, or about three a month, said Doctor Bukata. This was in a presumably "quiet" Sun period.

Pioneer 7 was launched July 17, 1966. It also is in a clockwise/orbit, backward Sun-centered to Earth's, at a distance approaching the orbit of Mars.

Pioneer 6, in two years, has raced far ahead of the Earth in a counter-clockwise, or co-rotating orbit that swings inward to approach the path of Venus.

Still another launch, Pioneer 9, will add the fourth set of interplanetary weather eyes. The fourth spacecraft will move in the same general path as Pioneer 6.

SCAS Detector D will be used for the Pioneer 9 flight. It duplicates Detector C, and is already built. Both units went to Cape Kennedy for the Pioneer 8 launching, as flight equipment and backup unit.

Pioneer spacecraft, with several magnetic and cosmic ray experiments aboard, are sent into their interplanetary orbits by augmented Thor Delta rocket systems. Much less powerful than the boosters for manned flights, the Deltas and added strap-on engines are still in the "big" class. They stand more than 90 feet tall in their gantries.

The SCAS team at Cape Kennedy is Doctor Bukata, Mr. Glasscock, Project Engineer Jack Younse; Walter Adams, electronics technician, and Ed Keath, graduate student at North Texas State University who is studying at the Southwest Center.