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PIONEER 9 EXPERIMENT WILL LOOK AT AT DETAILS OF COSMIC RAY FLUX

CAPE KENNEDY--

On your second trip through the woods, you can look at the bushes instead of the trees.

This is the way Dr. Robert P. Bukata compares the upcoming flight of Pioneer 9 and his cosmic ray experiment to three-year-old Pioneer 6, among other members of a growing interplanetary family of research spacecraft.

Pioneer 9 will join Pioneers 6, 7 and 8 in a launch planned for Nov. 6. Program management for the four Pioneers is by NASA's Ames Research Center, Mountainview, California. And, for the fourth time, the Southwest Center for Advanced Studies in Dallas, Texas, will provide a cosmic ray detector to measure low-energy, solar-origin radiation. Doctor Bukata heads the Pioneer research project at the SCAS.

The instrument, explains Doctor Bukata, will record both time and directional properties to 1 million to 100 million electron volt cosmic radiation; it is a second-generation detector, improved from those provided by the SCAS for the two earlier Pioneers.

Pioneer 9 will make the "second trip through the woods" in an orbit much like that of Pioneer 6 -- Sun-centered, with a closest approach to the sun of .75 Astronomical Units, and moving out ahead of the Earth as the spacecraft swings toward the orbit of Venus. The measurement in Astronomical Units translates into 75 per cent of the distance from Sun to Earth; or about 70 million miles from the Sun.

Where Pioneer 6 instruments sent back data that saw the big picture of energetic particle radiation spiraling out from the Sun in massive streams -- two million miles wide as they sweep past the Earth -- Pioneer 9 will look into the finer structure of interplanetary

-more-cosmic rays. "We expect to see important localized effects, and the physical extent of what we might call 'millistructure' -- finer than the first observations, but still rather gross and not quite down to 'microstructure' yet," says Doctor Bukata.

Pioneers Prove to be a Hardy Family

The Pioneer spacecraft have proved to be a hardy family. Pioneer 6 was launched Dec. 16, 1965; Pioneer 7, Aug. 17, 1966, and Pioneer 8, on Dec. 13, 1967. The design plans, in each case, anticipated that each unit (carrying several experiments) would transmit data for six months, at distances out to 130 million miles.

Actually, the three older spacecraft -- as Doctor Bukata puts it --"are still walking and talking." They have a total time of nearly 72 months in orbit, and are being heard all the way around the Sun, at distances up to 200 million-miles, through the 210-foot NASA tracking antenna at Goldstone, Calif.

The instruments are still going on all three. This means a more complete data picture, where the presence of three or four instruments offers a complementary set of measurements.

Pioneer 9 will not take that name officially until after a successful launch at Cape Kennedy. Up to liftoff and orbit, on a 90-foot-tall Thor-Delta booster, the new spacecraft is called Pioneer D as the Ames Research Center, National Aeronautics and Space Administration, brings it together and oversees final testing. More than 100 experimenters and subcontractors have been involved in the building and assembly of the spacecraft's components.

If you make a mental map, looking "down" on the Sun and Earth and linking them by a straight line, Pioneers 6 and 9 will be moving out ahead of the Earth (counter-clockwise) on an inside track after the coming launch. Pioneers 7 and 8 are going the other way, the elder sister fairly well out toward the orbit of Mars. Pioneer 8 is closer to Earth's orbit; several years from now, it may sweep past at a distance of 2 million miles, between Earth and Mars' orbits.

"Spinners" Scan Full Circle to Map Particles, Fields

All Pioneer spacecraft, 145 pounds and drum-shaped, are "spinners." They rotate once each second to scan a full circle in the plane of the Earth's orbit. Doctor Bukata's experiment has three cosmic ray telescopes, to survey 50-degree angles above and below the ecliptic plane.

Most Pioneer experiments have been designed to see particles of energy -- the cosmic radiation -- and the magnetic streams that shape particle paths amid the million-mile-an-hour solar wind. The flights also have recorded high-energy particles that can break free of the twisting field pattern and reach the Earth's protective magnetic envelope in 20 minutes.

Such sun-based storms in the interplanetary weather are a hazard to spacecraft, and especially to manned vehicles. In this sense, the Pioneers have been compared to space weather stations capable of looking part way around the Sun and spotting stormy outbursts before they enter the Earth-Sun path. The earlier Pioneers have given as much as 17 days' warning of solar storm regions.

In one instance a Pioneer warning resulted in a command to a Lunar Orbiter to close ports and avoid radiation damage during a Moon-photo expedition.

But, beyond these capabilities, the Pioneers are aimed at helping man understand the Sun -- which is the Earth's primary source of energy.

The Sun is a huge fusion furnace producing magnetized plasmas -- very hot gas made up of energetic particles. If its fusion reaction could be scaled down and kept under control, the prospect of producing very cheap commercial power would be enormous. But the first problem is to understand such a reaction.

The hardy Pioneers may help.

SCAS Team Joins With Many Others in Project

Dr. Robert P. Bukata earned his three degrees at the University of Manitoba, his doctorate in 1964. He joined the staff of the Southwest Center for Advanced Studies in 1965, after beginning specific research in cosmic ray physics in 1960 as he sought the master's degree.

Last March, he was invited to present a paper on Pioneer 6 and Pioneer 7 results (proton propagation) at the Midwest Cosmic Ray Conference. The meeting was held at the University of Iowa, under the co-chairmanship of Dr. James A. Van Allen.

The SCAS cosmic ray detector designed for both Pioneer 8 and Pioneer 9 converts energetic particle arrivals into pulses of electricity

-more-and sorts them out by direction of arrival. The experiment includes a precise electronic clock that splits each spin of the spacecraft into eight pie-slices, using the Sun's flash-by as a zero mark.

Electronics circuits sort out particle energies to identify protons (hydrogen nucleii) and alpha particles (helium nucleii) in the 3.3 million to 6.8 million electron volt range, and in the 7.5 to 60 MEV range. The experiment also records proton arrivals in the 1 million to 8 million electron volt range, and alpha particles in the 4-8 MEV range, but without determining arrival directions.

The low-energy recordings linked to arrival directions are the key to looking into the finer structure of cosmic rays, while the 7.5 MEV proton records provide a continuous monitor on the whole flux of cosmic energy in space.

These instrument capabilities have had to be built into a package that is less than 8 inches cubed, weighs 5.6 pounds, and uses about one-fourth of the electrical power needed by a Christmas tree light. Also, magnetic materials must be held to a minimum (so other experiments won't be disturbed) and the whole assembly must be rugged enough to ride the Thor-Delta rocket -- some 30 G's of thrust on liftoff.

Doctor Bukata, Project Engineer and Manager Jack Younse, Electronics Engineer Felipe Selva, and doctoral-degree candidate Ed Keath of North Texas State University are the Southwest Center's full team for Pioneer 9.

The Pioneer program is directed by NASA's Office of Space Science and Applications, with Project management by the Ames Center. The Delta launch vehicle is managed by Goddard Space Flight Center, Greenbelt, Md., and is launched by Kennedy Space Center, Fla.

Communications and tracking are by NASA's Deep Space Network operated by Jet Propulsion Laboratory, Pasadena, Calif., and the Pioneer spacecraft itself is built by TRW Systems Group, Redondo Beach, Calif. The Delta rocket is built by McDonnell Douglas Corp. of Santa Monica, Calif.