Physical Sciences

Through a peephole tantalizingly

The flood of data that comes out of the type of physics experiment in which two subatomic particles collide at high energy is often so copious that physicists need some time to notice and interpret some of the strange new things that appear. This is especially true if the strange new things are of a sort that nobody was looking for.

Thus, some anomalous events that occurred at the PETRA colliding beam apparatus of the German Electron Synchrotron Laboratory (DESY) in Hamburg back in 1984 are now being interpreted as what Harald Fritzsch of DESY calls "a peephole" into a possible new domain of physics (quoted in the September CERN COURIER). If it is such an opening, the recently completed and more energetic TRISTAN collider at Tsukuba, Japan, and the Stanford Linear Collider (SLC) of the Stanford Linear Accelerator Center in Menlo Park, Calif., could enlarge the window.

In 1984 PETRA provided the most energetic collisions of electrons and positrons in the world with a total of 47 billion electron-volts (47 GeV) in each collision. In that run PETRA's Mark J detector saw seven instances of something unanticipated: the simultaneous production of a gang of hadrons (protons and related particles) with a wide spread of energies along with a single isolated muon. None of the other detectors working at PETRA at the time appeared to see such things, so the matter was dropped.

Later on, a reexamination of the data from the JADE detector that searched specifically for isolated muons found five more such events. That made the question interesting again, and by this year theorists were proposing that these events might come from the decay of varieties of quarks or leptons (particles related to muons) of a sort whose existence is not now contemplated by theory. Such a thing could represent an entirely new development for particle physics.

Interested physicists are hoping that TRISTAN (with up to 50 GeV per collision), which just began experiments, or SLC (up to 100 GeV per collision), which is complete and undergoing tests, may be able to cross a threshold that PETRA seems to have just bumped.

New class of celestial bursters

Up to now astronomers have known two classes of bursting sources of high-energy radiation in the sky, gamma-ray bursters and X-ray bursters. Gamma-ray bursters tend to burst once and not again. Nobody is sure whether they are in our galaxy or out of it. X-ray bursters repeat and seem to be clustered in the bulge of our galaxy.

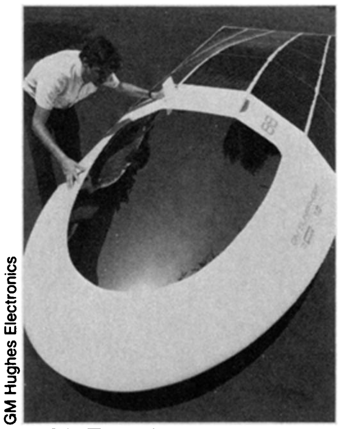
Now there is a third class, represented so far by one object, called by its discoverers Soft Gamma Repeater 1806-20.

In two papers in the Sept. 15 ASTROPHYSICAL JOURNAL, 17 scientists from France, the United States and the Soviet Union report observations of SGR 1806-20 since it was first noticed on Jan. 7, 1979. The accumulated data indicate that although the shape of the object's pulses in time resembles that of a gamma-ray burster, it repeats like an X-ray burster. It has repeated 100 times between Aug. 13, 1978 and June 27, 1986. Its spectral characteristics lie between the other two classes.

Gamma-ray bursters may lie outside our galaxy, and some theorists have suggested exotic explanations for them — for example, that they are vibrating cosmic strings (SN: 5/30/87, p.345). X-ray bursters are probably in our galaxy and may be stars that suffer periodic nuclear explosions on their surfaces. If the Soft Gamma Repeater source lies on the galactic bulge, where the X-ray bursters are believed to be, its discoverers calculate that it would have to be 1,500 times as bright as they are. However, certain of its characteristics suggest it may be much closer, perhaps as near as 6 parsecs (20 light-years).

Technology

Racing with the sun



GM Hughes Electronics

On an overcast day last month in Mesa, Ariz., an unusual vehicle, shaped like a flattened bullet, raced four times around a 5-mile circular track. On its fourth go-round, the racing car set a new world speed record for a land vehicle powered solely by direct energy from the sun. Taking 8 minutes, 28.628 seconds to complete the circuit, the GM Sunraycer traveled at an average speed of 35.227 miles per hour. This surpasses the previous record of 24.74 miles per hour set by a different vehicle in 1984. The circular course ensured that any wind or terrain effects would be canceled out.

The GM Sunraycer, designed and built by Detroit-based GM Hughes Electronics, is powered by an array of 7,200 solar cells, covering a total of 90 square feet. On a sunny day, the car can move as fast as 45 miles per hour using solar power alone. Because of cloudy conditions on the day scheduled for the record-breaking attempt, the solar cells produced considerably less than their maximum power output. On the road, the car normally uses a battery to provide extra power for acceleration or climbing hills. Under those conditions, it can reach 60 miles per hour. In the race for the record, the car's battery was disconnected.

The car itself is 19.7 feet long, 6.6 feet wide and 3.3 feet high. Its aerodynamically shaped body is constructed from a lightweight, honeycombed composite material over a welded, aluminum-tube frame. The car, including its electric motor, battery, electronic components and solar panel, weighs merely 360 pounds.

The GM Sunraycer was built to compete in a 1,950-mile race for solar-powered vehicles across central Australia from Darwin through Alice Springs to Adelaide. The race begins on Nov. 1 and will probably last at least six days. It features 25 solar vehicles from seven different nations. All vehicles must meet size constraints and have adequate braking, highway lighting and seat belts. They must also be stable in winds up to 40 miles per hour.

Speed alone won't be enough to win the race, says Bruce McCristal of GM Hughes Electronics. "It's a test of durability and reliability," he says. "You need a good vehicle and some good luck." Parts of the road are narrow, and much of it is roughly paved. The terrain varies from lush tropical forest and barren plateau in northern and central Australia to desert and mountains in south Australia. The GM team has only one car, but the team plans to bring along spare parts for just about any problem that could come up.

Because temperatures can go as high as 120°F in the Australian sun, the GM Sunraycer's canopy is plated with a thin film of gold to protect the driver. The film blocks 90 percent of visible light and 98 percent of the infrared radiation. Because the car is driven only in daylight, enough light gets through to enable the driver to see the road.

"We look at this thing as a really interesting scientific effort," says McCristal. "Our motivation is to push some technologies along that we think are important to the future, and we're very interested in stimulating high-school and college students to get into technical fields [associated with automotive engineering]." The car demostrates advances in low-speed aerodynamics, high-efficiency batteries, lightweight motors and solar cells and panels.