SCIENCE NEWS of the week

Strange Happenings at CERN

Physics experiments that are set up to prove a well-known hypothesis sometimes go too far. The UA1 and UA2 experiments at the CERN laboratory in Geneva, Switzerland, were set up to find the still undiscovered particles predicted by the standard model, a theoretical construct that is self-consistent and explains a large collection of known phenomena. They have done that brilliantly, finding the W and Z particles and most recently the top quark, but they have also gone beyond the standard model.

Last year both experiments found anomalous events. In most experiments protons and antiprotons collide head-on and annihilate each other. Out of the annihilation reaction can come a variety of things. UA1 and UA2 consist of large arrays of detectors to record what comes out. Sometimes W or Z particles come out. However, in 1983, in five instances in UA1 and four in UA2, strange events occurred: Large amounts of energy were carried off in a direction transverse to the line along which proton and antiproton meet by something both invisible and inexplicable by anything in the standard model. This year there are more such events, and theorists are at a loss to explain them.

New runs for both experiments began in October. Carlo Rubbia of CERN and Harvard University reported last week in Santa Fe, N.M., at the meeting of the Division of Particles and Fields of the American Physical Society, that the UA1's 1984 run has found two new anomalous events. Rubbia is convinced that these events are real, not artifacts produced by something in the apparatus. Furthermore, he says, "There is no sensible way to explain the missing energy by known particles."

While UA2 has not so far seen new anomalies, Morris Swartz of CERN reported at the meeting, it holds by its old ones. These four events were tantalizing, says Swartz, yet no two of them are alike. "Our fingers are crossed," he says, but something unexpected is happening. There is a general difference between the UA1 and UA2 missing-energy events: UA2's events feature an electron or muon as one of the products of annihilation; UA1's do not. Neither experiment has yet found an example of the other's variety.

Meanwhile, other physicists discussing other aspects of UA1's work report further hints of something beyond the standard model. Gerry Bauer of the University of Wisconsin in Madison, discussing events in which a pair of muons is prominent in the annihilation products, mentioned one event in which a pair of muons appears plus two narrow jets of other particles. He points out that the CELLO detector at the Deutsches Elektronen-Synchrotron laboratory in Hamburg has seen the same distribution of products from the annihilation of electrons and positrons and similar head-on collisions. "They don't understand theirs, and I don't understand ours," Bauer says. In addition there are other events with unusual properties: one with an isolated muon and a single jet, and one with a pair of isolated muons with the same sign of electrical charge. To this Rubbia adds from the 1984 run an event with a pair of isolated positrons. All of this is hard to explain.

Stephen Geer of Harvard discussed events that feature the production of Z and W particles along with narrow jets of other particles. These jets, unlike others seen in these experiments, tend to point in the direction of the original proton and antiproton beams. Somehow they "know" that direction, which is an unusual property. The experimenters need more statistics, Geer says, to determine whether this apparent property is simply a statistical fluctuation or an indication of new physics.

To explain at least some of these anomalies, many physicists, as Rubbia points out, would like to invoke the new supersymmetry theories. The standard model covers only part of particle physics. Supersymmetry theories are one way to go beyond this. The most striking aspect of supersymmetry theories is that they predict the existence of twice the number of subatomic particles as is now known. Known particles can be divided into two classes, bosons and fermions, according to the statistical law they obey. Supersymmetry theories predict that for every known boson there exists a fermion supersymmetric partner, and for every known fermion a boson partner. Thus, for the photon or light particle there is the photino, for the W the wino (pronounced "weeno"), for the Z the zuino, for the quark the squark, for the electron the selectron, and so on. The supposition is that one or more of these particles may be carrying away the missing energy.

Those theorists who spoke at the Santa Fe meeting at least seem to agree that it is premature to make any such claim. Vernon Barger of the University of Wisconsin is generally pessimistic about the prospect of explaining the missing energy by supersymmetry. Howard Haber of the University of California at Santa Cruz is more optimistic, pointing out that some of the UA1 missing-energy events are consistent with the production of supersymmetric particles called gluinos (partners of the gluons whose function is to bind quarks to each other). However, he believes that the UA2 events are not of supersymmetric origin, and that the other weird events seen at CERN have no supersymmetric connection. Lawrence Hall of Harvard points out that the mass of the top quark, as determined recently by UA1, has to be taken into account. This complicates the supersymmetric calculations. Hall is slightly negative, voicing "a slight preference" for the notion that the experiments are not seeing supersymmetric particles. Meanwhile, an experiment at the PEP collider (which collides electrons and positrons) at the Stanford Linear Accelerator Center (SLAC) in Menlo Park, Calif., specifically looked for the production of selectrons, the supersymmetric partners of electrons. It came up negative, Bruce LeClaire of SLAC told the Santa Fe meeting.

—D. E. Thomsen

Brain tumors linked to EM radiation

Exposure to high electromagnetic (EM) fields may promote brain tumor development, according to researchers with the Maryland Department of Health and Mental Hygiene in Baltimore. Their epidemiological study finds an apparent doubling of the usual risk of developing deadly brain tumors among men whose jobs exposed them to electric and magnetic fields.

Looking at data from death certificates of 951 white males in Maryland who died of brain tumors between 1969 and 1982, Ruey Lin and co-workers noticed a seemingly high number whose job titles suggested they worked with electricity or near EM fields. Among them were electronic and electrical engineers, telephone and electric company servicemen, and communications engineers and technicians.

The tumor group again showed a possible excess of EM-exposed workers when compared with data for an equal number of men — matched to the first group for age, race and date of death — who had died from causes other than cancer. The Maryland team then focused on only those tumor victims who had died from growths clearly identifiable as originating in the brain (rather than migrating there from another part of the body). This group had 27 men in jobs suggesting "definite" EM field exposures, compared with the control group, which had 14.

In a report of their work presented last month at the annual meeting of the Society for Risk Analysis, Lin and colleagues conceded that other causative agents such as workplace chemicals cannot yet be ruled out. However, they did list eight other published studies showing data that they find consistent with their assertion that exposures to EM fields might promote brain tumors. *—J. Raloff*