1988 Nobel prizes announced for physics and for chemistry

Washington

THIS year's award of the Nobel prize for physics recognizes fundamental experiments which belong almost to the prehistory of the fast-moving field of high-energy physics. The recipients of the prize are Leon Lederman, Melvin Schwartz and Jack Steinberger, all Americans, and the work cited is their invention, in the early 1960s, of a way to generate a neutrino beam in the laboratory and their subsequent discovery of the muon neutrino.

Any surprise at the award derives from its belatedness rather than the stature of the winners. Lederman, Schwartz and Steinberger, according to the gossip that passes around high-energy physics departments, had appeared on the short-list numerous times, but with prizes having already been awarded for more recent discoveries, there was a general feeling that the three had run out of chances. Their win this year has been applauded by others in experimental high-energy physics as deserved recognition of basic work.

In the late 1950s, theoretical understanding of the weak interaction (responsible for radioactive beta-decay) was limited by the inability to do experiments in which its effects could be separated from those of the strong and electromagnetic interactions. At Columbia University, the three physicists jointly devised a way to produce and detect a beam of neutrinos, particles influenced by the weak interaction and no other.

By smashing an energetic proton beam into a beryllium target, they first created a stream of nuclear fragments containing a large proportion of pions. Each pion then decays in flight into a neutrino and another charged particle. The second, equally important step was to separate the neutrinos from the nuclear debris. This they achieved by erecting a massive steel wall, made of scrap steel from battleships, behind which they built a 10-ton spark chamber to detect secondary charged particles produced by collisions between neutrinos and atoms in the chamber.

The unexpected bonus of this experiment, whose unprecedented size made it the precursor of the vast experimental set-ups now routinely built at accelerators, was the discovery of two different neutrino types. At the time only one neutrino, produced in accompaniment with an electron in beta-decays, was recognized, but in the new experiment it was found that the charged particle that accompanied the spark-chamber detection was more often a muon than an electron, and a series of experiments soon established that the muon neutrino was a species distinct from the previously known electron neutrino. This was a first indication of the now-standard recognition that elementary particles, including quarks, neutrinos and their accompanying charged partners, fall into three parallel but separate families.

Schwartz now runs his own computer communications company in Mountain View, California, but Lederman, director of the Fermi National Accelerator Laboratory in Illinois, and Steinberger, a physicist at CERN, Geneva, are still active in high-energy physics. Lederman is an active supporter of the Superconducting Super Collider, the proposed 50-mile-circumference proton–proton collider. Under his tenure, Fermilab has run a successful programme that brings high-school students into the laboratory for summer courses. **David Lindley**

London

ELUCIDATION of the structure of a protein complex with its "body immersed in a lipid bilayer and its head and legs in water" has won Hartmut Michel, Johann Deisenhofer and Robert Huber this year's Nobel prize for chemistry. The structure is the membrane-bound photosynthetic reaction centre of purple bacteria, which converts the energy of a photon into the potential to synthesize organic molecules.

Not only is the solution of the structure an impressive technical feat, but reaction centres are one of the most important protein structures in biology. The complex of different proteins within the centre is the heart of the photosynthetic reaction.

Crystallization of membrane proteins was a goal that had been sought by many, but Hartmut Michel, working in the division of Dieter Oesterhelt at the Max Planck Institute for Biochemistry at Martinsried, Munich, made a crucial breakthrough in 1981 by devising a method to produce large, well-ordered crystals of the reaction centre of the purple bacterium *Rhodopseudomonas viridis*.

The year before, two other membrane proteins had been crystallized for the first time, but technical problems prevented the arrangement of the atoms within the crystals from being determined. It had previously been difficult to isolate membrane proteins because the detergent necessary to dissolve the protein away from the lipid cell membrane tended to denature the protein itself. But a new detergent, octylglucoside, allowed three-dimensional crystals of two protein complexes to be made: porin, a protein that forms pores in cell membranes; and bacteriorhodopsin.

The race was on to make three-dimensional crystals of a membrane protein large enough to resolve its structure in atomic detail using X-ray crystallography. Michel was the first to make such crystals, not of any of these proteins, but of the bacterial reaction centre.

Once Michel had obtained large three-dimensional crystals of the reaction centre, he began his fruitful collaboration with Robert Huber, head of the laboratory, and Johann Deisenhofer, a staff scientist.

Their first results, published in 1984

IMAGE UNAVAILABLE FOR COPYRIGHT REASONS

Top, Lederman (left), Schwartz and Steinberger, discoverers of the muon neutrino. Bottom, Deisenhofer (left), Huber and Michel, first to solve the structure of a membrane protein.