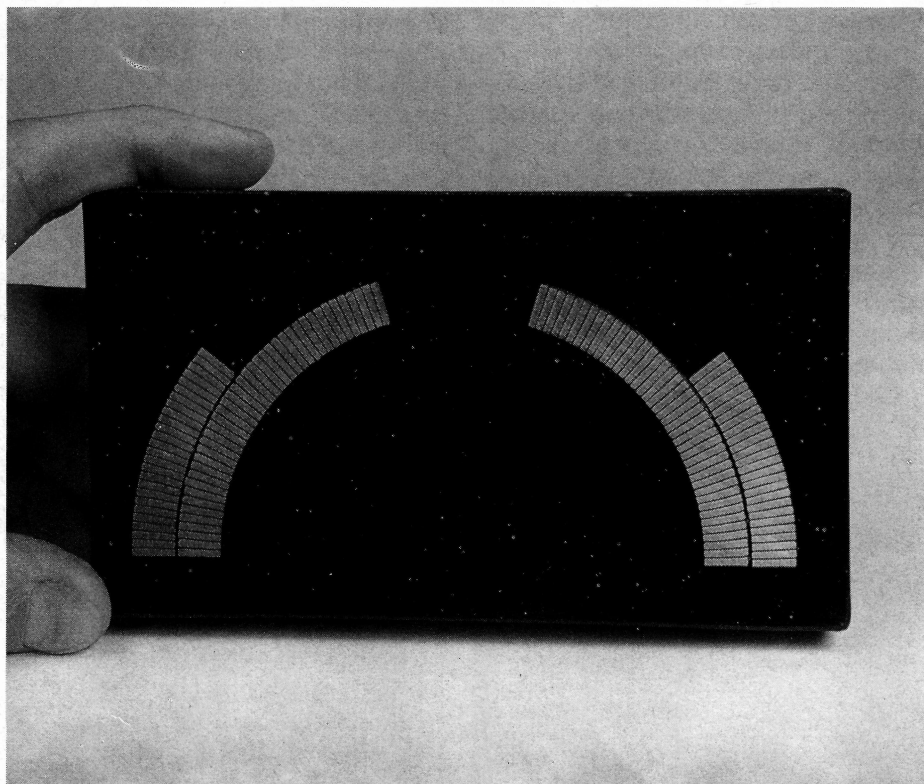


Making history

A model of the cross-section of the new niobium-tin superconducting dipole magnets being developed at Saclay for the proposed Soviet UNK machine, showing the two-layer structure of the coil.



SACLAY Prototype niobium-tin superconducting dipole

The Département de Physique des Particules Élémentaires at Saclay has for some time been working with the Institute of High Energy Physics at Serpukhov to develop superconducting magnets for use in the Soviet UNK project for a 3000 GeV proton accelerator. Now a prototype niobium-tin dipole has been successfully tested.

This magnet has the same configuration as previous UNK dipoles built at Saclay, with a 90 mm aperture and length 70 cm. In this way, the existing tooling and other equipment can be used. However on imposing such a geometry, in particular the thick-

ness of the coil, the attainable central field is limited to 6 T. This is relatively low, but the main objective was rather to develop appropriate technologies for handling the delicate niobium-tin rather than aiming right away for higher fields. Under the same conditions, niobium-titanium prototypes had reached 4.5 T.

The filamentary niobium-tin composites have to be heat treated for a day at about 700 C, which makes them very brittle. Thus for the prototype dipole, this heat treatment was carried out after winding the coil. First tests gave a central field of 5.3 T and a current of 5550 A. During these tests, the protection systems unfortunately did not allow this value to be exceeded, even though the dipole looks capable of reaching 6 T. More tests are scheduled, but already the experience gained shows that dipoles could be built capable of attaining 8-10 T.

From 21-23 July in Paris, just before this year's International Conference on High Energy Physics, an unusual meeting—the International Colloquium on the History of Particle Physics—is to be held. Its aim is to survey what happened in the field from the 1930s to the 1950s, with first hand accounts from physicists who made significant contributions during this time.

Any history of this period has to be dominated by the shadow of the Second World War, and particle physics is no exception. The spectacular pace of developments, in experimental discovery and techniques and in the underlying theory, of the early thirties soon began to slow under the weight of economic depression and the gathering clouds of war. Large scale research did not get under way again until the late 1940s.

But when physics did resume, it was soon to benefit from the immense investments made in scientific (particularly nuclear) projects during the war years. The era of Big Science had begun.

The 1930s marked the beginning of particle physics as we know it today. Just fifty years ago this year, the positron was discovered (see May issue, page 143). This confirmed Dirac's prediction of the parallel existence of matter and antimatter and paved the way for the development in the 1940s of quantum electrodynamics, still the paragon of modern field theory. The positron story of the early 1930s was also the precursor of the subtle interplay between particle physics theory and experiment which is such an integral part of modern research.

In addition, 1932 marked the discovery of the neutron, confirming that the atomic nucleus was more complex than had once been thought. This was the first step on the long path to our present under-

standing of the strong force.

Using natural sources of radiation, Rutherford and his colleagues at the Cavendish Laboratory in Cambridge had seen induced nuclear transformations as early as 1919 and had gone on to develop early forms of particle detectors to improve the efficiency of their experiments.

In the early 1930s came the first induced nuclear transformations using synthetic particle sources, notably the Cockcroft-Walton accelerator. Meanwhile the first cyclotrons were coming into action in the US, and were soon to provide the staple source of higher energy particle beams for laboratory experiments.

The 1930s also saw the first developments in nuclear theory with Yukawa's picture of nuclear exchange forces. There was a brief euphoria when cosmic ray experiments discovered signs of a new 'meson', heavier than the electron but lighter than the proton. Yukawa's nuclear force carriers should interact readily with nuclear matter, but these new mesons appeared to be capable of passing through considerable thicknesses of material. The riddle was not solved until after the war, when further cosmic ray studies found that there were two new particles. There was the pi meson which did interact with nuclear matter and therefore looked a serious candidate for Yukawa's nuclear force carrier. In addition there was the penetrating muon, transparent to the strong nuclear force but interacting instead through the weak force. For many years the muon defied any kind of theoretical explanation.

The resurgence of interest after the war also provided the first evidence for kaons and for hyperons, particles later to be attributed with the new strangeness quantum number. While isospin, developed in the thirties, had showed that the initial

description of nuclear forces had to work in an abstract two-dimensional space, the discovery of strangeness was soon to lead to the enlargement of this space to three dimensions. (The notion of quarks, smaller constituents carrying the various nuclear quantum numbers, did not emerge until the early sixties.)

The study of nuclear beta decay under the weak force had also begun in the thirties, and the discovery of a continuous spectrum of produced particles resulted in the then seemingly bizarre prediction of a massless neutrino emitted in beta decay. Physics had to wait until 1956 before the elusive neutrino was discovered, but it was not until several years later that the special behaviour of the weak force became apparent, leading to some particularly elegant theory.

The particle physics achievements of the thirties are now ripe for study and appraisal. Rapporteurs at the forthcoming Paris meeting will include many people who took part in these developments (Bruno Rossi and Charles Peyrou for cosmic rays, Bruno Pontecorvo for neutrinos, Edoardo Amaldi for weak interactions, Nicholas Kemmer for isospin,

Paris History Conference

Further information on the International Colloquium on the History of Particle Physics to be held in Paris from 21–23 July can be obtained from the Colloquium Secretariat, IN2P3, 20 rue Berbier du Mets, 75013 Paris, France.

Edoardo Amaldi, scheduled to speak about the history of weak interactions at the Paris History Conference.

Pierre Auger, one of the honorary presidents of the forthcoming international colloquium on the History of Particle Physics, to be held in Paris in July.

