

Isometric view of the TPC at TRIUMF currently collecting data in a search for (lepton-number violating) muon-electron conversion.

densities are achieved in accelerator beams of heavy nuclei. T. D. Lee likened the spirit of the meeting to that of the 1st Rochester Physics Conference, a watershed of new ideas and challenging problems forming a common ground for previously divergent disciplines of science.

Proceedings of the meeting, which will be published by North Holland as a special volume of the journal 'Nuclear Physics', are expected to be available by March 1984.

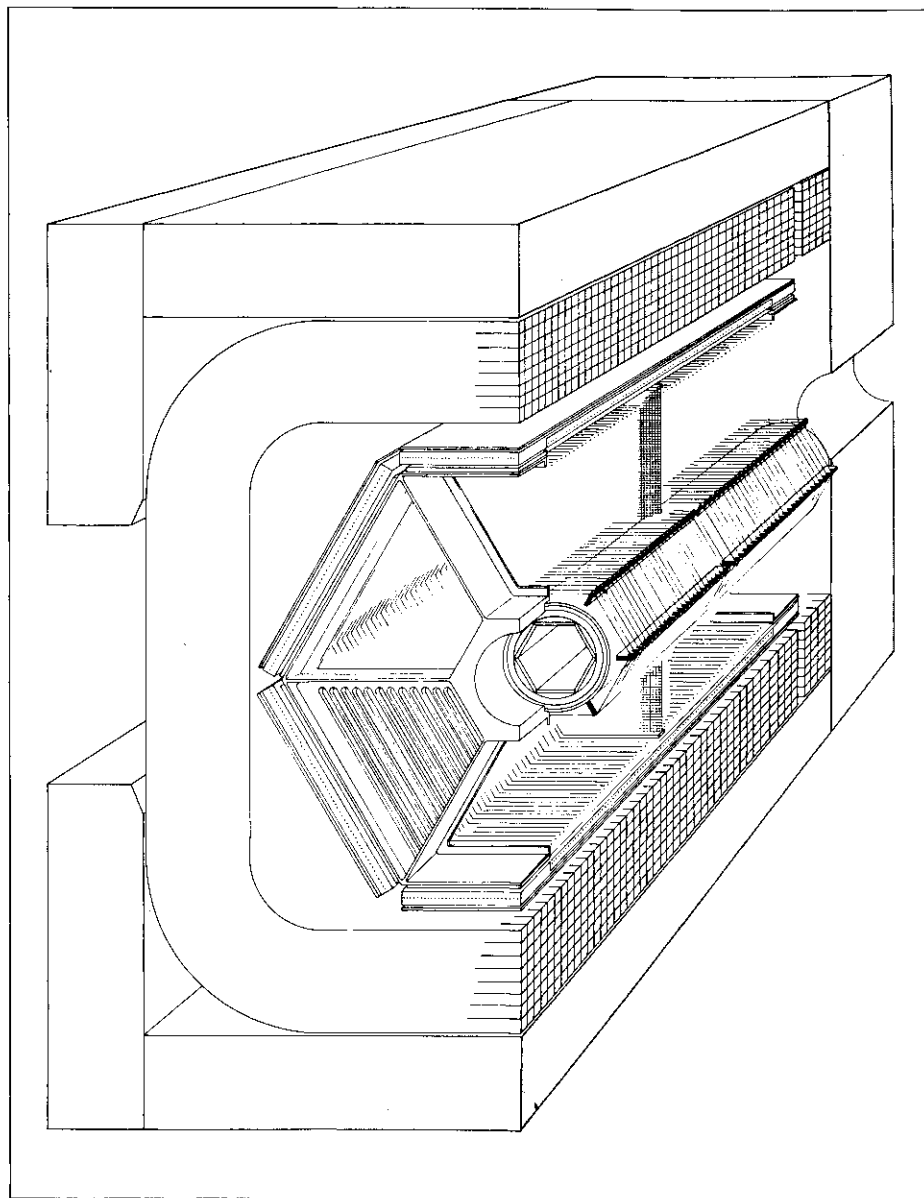
(Report by T. Ludlam)

TPC Workshop

The first workshop to focus on time projection chambers was held at TRIUMF (Canada) this summer. Some 75 participants came from groups in Europe and North America using TPCs in a variety of applications in experimental physics. Reports included several general descriptions of existing detectors as well as some proposals for new instruments.

A time projection chamber (TPC) is the name given to a class of large volume drift chambers which operate generally with parallel electric and magnetic fields. Applications span energies from a few MeV in double beta decay searches, through intermediate energies in muon decay studies to large high energy arrays planned for LEP at CERN.

The TRIUMF TPC, described by D. Bryman, is being used to search for the lepton-number violating decay of a muon to an electron on a titanium target. It was perhaps the first to produce a physics result, having acquired data on about 2×10^{12} stopped muons, permitting a new limit on muon-electron conversion. The extensive measurements to understand the chamber and developments to improve its acceptance, re-



solution and rate capability were described. One highlight was a report on the status of the original TPC operating on PEP at SLAC. A. Barnes of Berkeley described experience with the chamber and emphasized efforts to understand and control factors affecting the resolution, especially gain stability required for the impressive energy loss resolution achieved. Meanwhile the superconducting coil of the PEP TPC has suf-

fered some damage during tests, requiring repairs at Berkeley.

The ALEPH and DELPHI detectors, planned to operate in LEP experiments at CERN in the late eighties, will both incorporate TPCs as central detectors, and were described by L. Rolandi of Trieste and H. J. Hilke of CERN. Reduced-scale prototypes have been constructed to evaluate various new design concepts in end-cap configuration, calibration and

readout techniques. Both projects are major steps in the evolution of TPCs.

The Los Alamos TPC was described by W. Kinnison who showed how it will be used to obtain high precision measurements of muon decay parameters to test the standard electroweak theory. Development is continuing to improve the acceptance and resolution. Some innovative analytical techniques are used to obtain track reconstruction.

Two exotic variants were reported. A liquid argon TPC, considered to be a powerful tool with potential application to neutrino physics and proton decay, for example, was described by P. Doe of Irvine. A high pressure hydrogen gas TPC 'TREAD' (The Recoil Energy and Angle Detector) has been used in the tagged photon beam at Fermilab and was described by K. Goulianos of Rockefeller.

A combination of a TPC with an emulsion to obtain improved accuracy on wide angle tracks in a measurement of beauty lifetime was described by L. Rossi of CERN. There are tests on a low energy pion beam to study the problems of correlating tracks. Two proposals to use gaseous xenon TPCs to search for double beta decay in xenon were described by Rossi and A. Forster of Caltech. Encouraging Monte Carlo simulations and some preliminary studies of prototype chambers were outlined. A helium-filled TPC constructed at the University of California at Irvine, described by M. Moe, will shortly be used to look at double beta decay in selenium.

There were several discussions on detailed aspects of design and performance. F. Sauli of CERN described some of the basic processes in TPC-like gas detectors and how, for example, an optimization of suit-

able gas mixtures may be achieved. Some of the other topics raised were new geometries and techniques for endcap detectors, mechanical tolerance limitations on resolution and stability, calibration schemes with sources and lasers, problems with electrostatic uniformity in the drift region, and the incorporation of new developments in electronics into the next generation of readout schemes.

To give some perspective there were three reports on alternative techniques — the JADE jet chamber at DESY (R. D. Heuer), including an adaptation for relativistic heavy ions, DIOGENE at Saclay (J. Gosset) and SINDRUM at SIN (A. van der Schaaf).

The workshop was summarized by the father of TPCs — Dave Nygren of Berkeley — who must have felt some satisfaction at the widespread and varied applications of this technique which he and his group pioneered with the PEP proposal in the mid-seventies.

The occasion of the workshop was saddened by the sudden passing two days before of E.P. (Ted) Hincks of Carleton University who was one of the prime organizers and co-chairmen of the workshop committee. The success and usefulness of the workshop served as part of a fitting tribute to him.

Nobel Prizes

The common theme in this year's Nobel Prize for Physics, shared by Subrahmanyan Chandrasekhar of the University of Chicago and William A. Fowler of Caltech, is stellar evolution.

A star is formed from the gas and dust clouds which exist in the galaxies. Under the influence of gravity, a condensation slowly contracts to

form a star. In this process, energy is released which leads to heating. Finally the temperature is high enough to set off nuclear reactions in the interior of the star. As a result, the hydrogen, forming the major part, is burnt to helium. This creates a pressure which stops the contraction and stabilizes the star so that it can exist for millions of years.

When the hydrogen has been consumed, other nuclear reactions take over, particularly in the more massive stars, and increasingly heavy elements, up to iron, are formed. When the evolution has reached this stage, the star can no longer resist gravity, and it undergoes some form of collapse, the exact nature of which depends on its mass. In some instances the collapse takes the form of an explosion whose visible result is the creation of a supernova. This brings about a brief but extremely intense flow of neutrons, which leads to the formation of the very heaviest elements.

For less heavy stars having a mass of the order of our Sun, the collapse gives rise to a so-called 'white dwarf'. The matter has here been compressed so that one cubic centimetre weighs around a kilogram. The electron shells of the atoms have been crushed and the star consists of atomic nuclei and electron gas.

For slightly heavier stars, the final stage is an even more compressed state in which electrons and nuclei unite to form neutrons. For the heaviest stars having a mass in excess of a few Solar masses, the force of gravity becomes so strong that the matter simply disappears in the form of a so-called 'black hole'.

Stellar evolution provides examples of physical processes which cannot be observed under laboratory conditions. Many scientists have studied these fundamental questions, but Chandrasekhar and Fowler