PEPR—a random access film scanning system

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IoP Conf. Ser. **13**, 1972

The PEPR (Precision Encoding and Pattern Recognition) project at Oxford was based on the first PEPR device developed in the group of Irwin Pless at MIT. Work started in 1965 and PEPR1 came into production late in 1969 in a minimum guidance mode, using operator intervention to resolve pattern recognition difficulties. By 1979 about 4 million pictures from the 2m CERN hydrogen filled bubble-chamber had been measured. About ten times faster than manual machines on average, PEPR track measurements were also four times more precise and had the important addition of measurement of ionisation. A more advanced PEPR2 came into operation in 1975 designed to cope with the larger film size and more complex, distorted optics of the 3.7 m diameter Big European Bubble Chamber, BEBC . PEPR2 had real-time random-access to film from four stereo cameras enabling track following in 3D.

The Oxford group also developed software methods for digitising other forms of image-based data. In one application some 2 million rain-fall charts -- 30 years of records from 200 weather stations around the UK -- were digitised for the Met. Office to form an important data base for testing weather forecasting and flood control.

PEPR operation came to an end by the mid '80s but members of the team have played, and continue to play, major roles in many of the other technological developments carried out in the Oxford group since the early '70s and – for example -- are now (2002) to be found working on ATLAS, ZEUS, the GRID project and FMOS, a Fibre Multi-Object Spectrometer for simultaneous observations of many Galaxies.

PEPR2 9" CRT assembly with focus and steering magnets

THE EXPERIMENTAL IDENTIFICATION OF INDIVIDUAL PARTICLES BY THE OBSERVATION OF TRANSITION RADIATION IN THE X-RAY REGION

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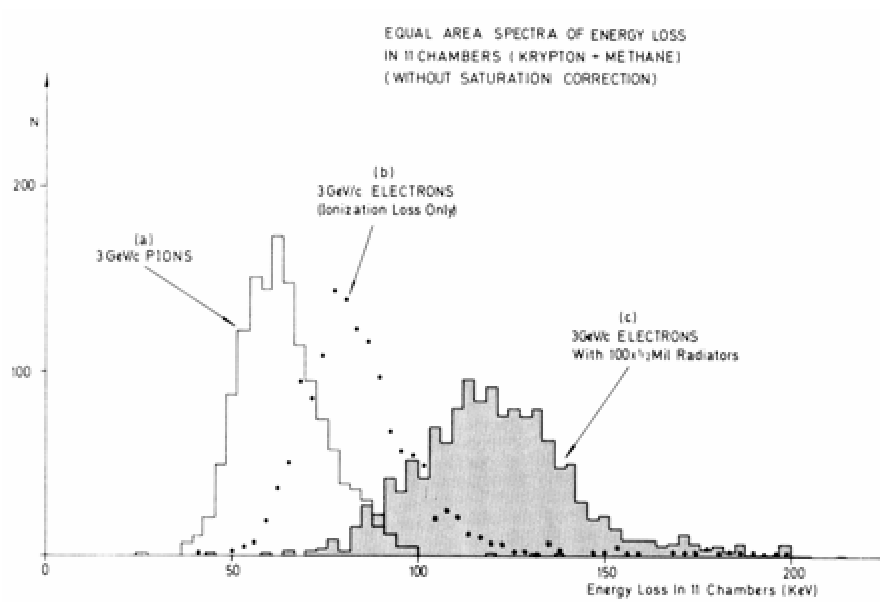
Received 13 November 1972

NIM **107**, 413 1973

A charged particle radiates when crossing a boundary separating media of different refractive index. For extreme relativistic particles, $\gamma > 10^3$, the radiation is in the X-ray region, peaked narrowly forward, and increases with γ.

This experiment was the first demonstration of a practical detector design using transistion radiation (TR) as a means of particle identification at high energies. A beam of 3GeV/c pions and electrons traversed eleven stacks each of 100 mylar sheets, separated by air, with wire proportional chambers following each stack. Summed over the eleven chambers the electron, $\gamma \sim 6{,}000$, signal was much enhanced by absorption of the accompanying TR X-rays, and clearly separated from the pion signal.

Transition radiation detectors (TRD) are now a standard technique. The experience gained in this project led directly to the conception and development of the ISIS detector at Oxford.



RELATIVISTIC CHARGED PARTICLE IDENTIFICATION WITH ISIS2

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Received 2 December 1983

NIM **224**, 396 1984

Relativistic charged particles can be identified by accurate measurement of energy loss by ionisation in the region of the relativistic rise.

In 1974 Oxford began development of a large 'pictorial drift chamber', ISIS, having a multi-particle capability to record particle tracks and many samples of their ionisation energy loss. Ionisation electrons drifted in a uniform, vertical electric field for distances up to 2m before being collected on a horizontal plane of anode wires strung transverse to the general direction of the particle motion.

ISIS2, completed at Oxford in 1980, allowed up to 320 ionisation samples to be taken per particle traversing the $40m^3$ fiducial volume, achieving an accuracy $\sim$ 3.5% rms for dE/dx. ISIS2 was taken to CERN to form a key component of the European Hybrid Spectrometer (EHS - which also incorporated a TRD). The physics of Charm particle production and decay was the main objective of the EHS programme.

The ISIS design, published in 1974, and the success of prototype tests, had a major, 'proof of principle' influence on the design of the large central detectors needed for collider experiments -- for example UA1 at CERN and the Time Projection Chamber (TPC) at SLAC-PEP, forerunners of many others including DELPHI.

Development of the underlying technology for ISIS was also crucial to the Oxford group's later success over its three US collaborating groups in the competitive selection in 1983 of the detector system for the SOUDAN II experiment searching for evidence of proton decay.

First 'walk-in' Drift Chamber

Tracks on ISIS2 control monitor