RAL DESIGN & DISCOVERY
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RUTHERFORD APPLETON LABORATORY
SCIENCE AND ENGINEERING RESEARCH COUNCIL

THE MULTIWIRE PROPORTIONAL COUNTER - APPLICATIONS IN MEDICAL AND MATERIALS RESEARCH

The Multiwire Proportional Counter (MWPC) is a device capable of imaging X-rays and other nuclear radiations electronically and sending the image direct to a digital computer, thus replacing, in many applications, the traditional silver halide emulsion. Suitably adapted it can also image high energy gamma radiation of the type used in nuclear medicine thus replacing scintillator/photo-multiplier detector systems.

The MWPC is the latest in a long line of gas-filled radiation detectors which stretches back 60 years to the original "Geiger Counter" with which Geiger and Marsden first observed nuclear fission. The ever growing technological demands of Nuclear and High Energy Physics led to the development of a gas counter in which a large number of fine wires (less than the diameter of a human hair) are stretched in parallel arrays on frames in an enclosure containing a suitable gas. When a high electric potential of several thousand volts is applied to the wire planes the system is capable not only of recording the impact of a particle of nuclear radiation but also of measuring the position of the impact with sub-millimeter accuracy.

When High Energy Physicists first installed MWPCs on their experiments in the early 1970s they obtained a dramatic increase in the speed and accuracy of their imaging of fundamental particle scattering events. Particles of sub-nuclear radiation could now be tracked to sub-millimeter accuracy over areas of tens of square meters with sub-microsecond timing accuracy. In addition to these advantages the technology was found to be very flexible and relatively cheap to implement. The consequence of these facts is that the MWPC in its various guises forms the main imaging element in virtually all current High Energy and Nuclear Physics experiments.

The potential for the development of the MWPC as an "electronic X-ray film" was early perceived by many workers. However, the high cost of the essential readout electronics and the associated computing power made the case very difficult to make at that time. The micro-electronic revolution of the 1970s dramatically changed this situation until today the computing power is the cheapest element in the total cost of a system.

Over the last 15 years Rutherford Appleton Laboratory has developed a range of equipments based on this technology for applications in medicine, biochemistry, engineering and materials science:-

Positron Emission Tomography in Cancer Research

This powerful imaging technique is exploited by the RAL Positron Camera which has been in use at the Royal Marsden Hospital for some four years.

Positron Emission Tomography in Engineering

A second model of the RAL Positron Camera is located at the University of Birmingham where it is used to study fluid flow problems in complex machinery such as jet engines.

X-ray Absorptiometry

A MWPC X-ray imaging system developed at RAL has been used for many years at Leeds General Infirmary for the measurement of bone loss in patients suffering from such conditions as osteoporosis and osteomalacia.

Autoradiography for Immunological Studies

A high sensitivity system was developed to replace film in studies of the human immune and hormonal systems at the University of Birmingham.

Autoradiography for DNA Sequencing In a collaboration with UMIST in Manchester a high speed imaging system was developed to speed up the process of DNA sequencing, an essential operation in the new field of biotechnology.

X-ray Diffraction Studies of Liquid Crystals

Three digital imaging systems have been produced (two for Bristol University) for the study of liquid crystals and other materials via X-ray diffraction techniques.

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