Rutherford Laboratory

Technical leaflet

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THE CATHODE RAY TUBE FILM MEASURING SYSTEM

In a typical spark chamber experiment some 200,000 pictures may be taken. These pictures are examined carefully by hand and around 100,000 may be selected as suitable for measurement. The Cathode Ray Tube film measuring system has been developed to make measurements on the film at speed and with consistent high precision to speed up the data reduction process (See Technical Leaflet No. B4).

The scanning device is a cathode ray tube (CRT) flying spot scanner where a precision Ferranti cathode ray tube is used to produce a spot 30 μin diameter (25 μ ≡ 0.001"). The spot is deflected magnetically over the tube face to produce a fast scan line. This scan line is demagnified (X2) and projected simultaneously by a lens system on to the film and a reference grating. Track signals from the film and reference pulses are detected with photomultipliers. The reference grating has a pitch of 48 μ and interpolating between the reference pulses by 16 results in a train of fiducial pulses representing 3 μ intervals on the film plane. Comparison of the track signals and fiducial pulses allows measurement of points on the film to an accuracy of ± 3μ. The whole film frame is scanned by a T.V. type raster where in this case the slow scan is generated by moving the film slowly on a carriage which is driven by an hydraulic ram. The motion of the carriage is digitised by a Heidenhain grating system to an accuracy of ± 2.5μ. At present the slow scan length is limited to 70mm but could be increased to a maximum length of 120mm. The film is moved by a stepping motor and vacuum capstan to the correct frame. The start of each frame is identified by a Brenner Mark on the film which is detected electronically. Vacuum boxes isolate the capstan from the main reels and large stepping motors control the pay out of film from these reels which can carry 300 ft. at any one time.

The information on the film is transferred scan line by scan line through a four word buffer into the memory of a DDP 224 computer. The device is completely under the control of this computer which decides when to start the scan, when to move film, when to transfer information etc. Output Control Pulses (OCP's) from the DDP 224 initiate the commands and sense lines detect when the operation has been completed.

The computer reads the event number which is to be scanned, from paper tape, and starts the scanning procedure. As the information comes into the memory it is examined scan line by scan line and any redundant information is rejected. Also at this stage the DDP 224 forms a binary number from the digitisings in a particular region and compares the number found with that one on the paper tape.

If they do not compare corrective action is taken to find the correct event. The remaining information is then written onto magnetic tape and stored there. Scanning continues automatically until all the interesting events have been scanned.

The DDP tape is then read on the Atlas computer and the digitisings are formed into sparks. The information can be stored at this intermediate state or one can contine and link the sparks to form tracks or showers. A geometrical reconstruction is then carried out to combine the two stereo views into one 3-dimensional representation. A kinematical analysis finally completes the process.