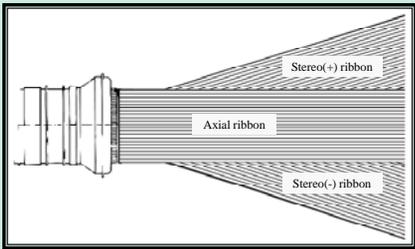
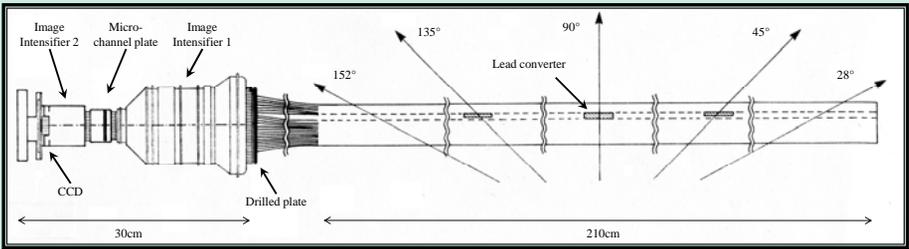


UA2

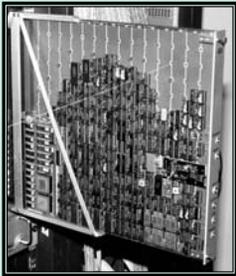
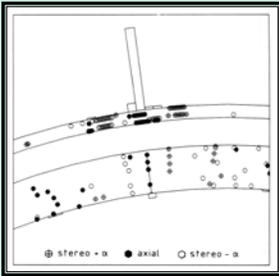
The Scintillating Fibre Detector

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The UA2 Scintillating Fibre Detector (SFD) is a combined tracking and preshower detector designed to measure the trajectory of charged particles and to provide identification of electrons by associating the track with the electromagnetic shower produced in a lead converter. The SFD takes the form of a 40 cm radius, 6 cm thick cylindrical shell consisting of about 60000 1 mm diameter plastic fibres each having 210 cm active length. The fibres are arranged in 24 layers (8 stereo triplets) of which 18 layers form the tracking detector and a further 6 layers form the preshower detector. Between the tracking and preshower part is a layer of lead which presents about 1.5 radiation lengths to particles emerging from the collision point. Scintillation light produced in the fibres by the passage of charged particles is detected at the ends of the fibres by a system of image intensifiers coupled to CCDs. The CCD signals are read out and processed by custom digitiser modules.

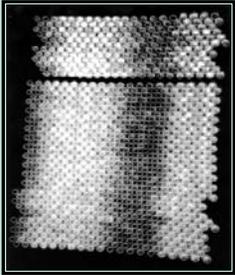
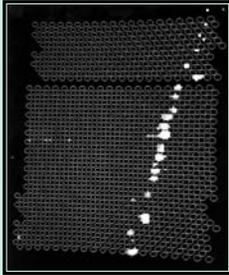


Each Cambridge FASTBUS digitiser (photo) converts the analogue signals from one CCD and performs pedestal subtraction, common-mode correction and zero suppression. The individual pixel signals are assigned to a fibre using a look-up table and summed. The fully reconstructed data are illustrated in the computer-generated image where the three stereo projections can be seen together.

The UA2/DEP image intensifier and CCD. The three stages (II 1, micro-channel plate and II 2) are encapsulated into a single module. The combined effect is to demagnify and amplify the image so that it can be captured on the CCD.

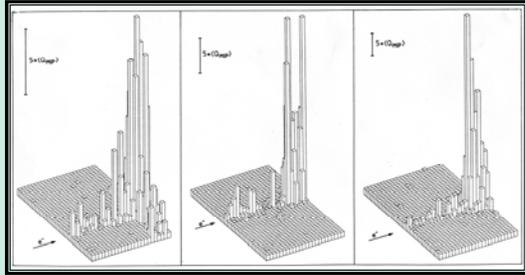
The SFD under construction at Saclay. The first few tracking layers have been placed and the fibres threaded through the precision drilled end-plates. After all the fibres are threaded, the ends are cut and polished flush with the end-plates.

CCD images illustrating the response to real tracks. Superimposed are the calculated positions of the scintillating fibre images taking into account the distortions due to the electrostatic focussing of the image intensifier chain in the Earth's magnetic field.



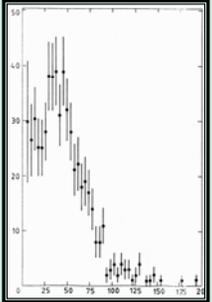
Single track

Accumulation of many tracks

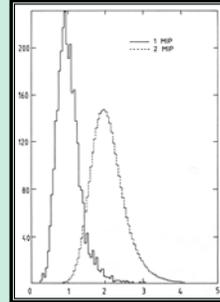


Three examples of the response of the SFD to electrons. The difference in response in the tracking and preshower layers can clearly be seen. The larger response in the preshower layers is due to electromagnetic showering in the preceding layer of lead.

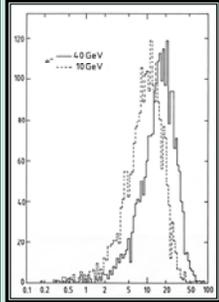
Comparisons of SFD response to different particles with different energies in the tracking and preshower parts. In all cases the response is measured in units of the average response of a minimum ionising particle (MIP). The vertical axes represent the number of events in arbitrary units.



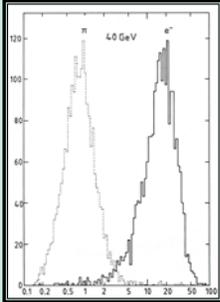
The distribution of the SFD response in arbitrary units for single photoelectrons emitted at the photocathode of II 1.



The 1 MIP response compared to a 2 MIP distribution deduced from the 1 MIP distribution.

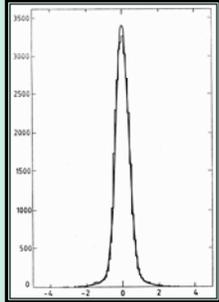


The response due to 10 GeV and 40 GeV electron showers in the preshower detector.

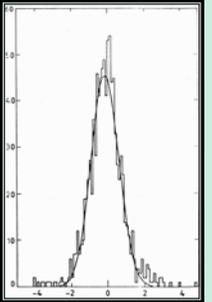


The response due to 40 GeV pion and 40 GeV electron showers in the preshower detector.

The detector performance depends on how well the positions of tracks and preshower clusters can be measured and how well they can be associated. The distributions below illustrate the excellent resolution of the fully calibrated detector.



The distribution of the distance of a single fibre from the calculated track position in mm.



The distribution of the distance of the preshower cluster centroid from the projected track.