Title
ION BEAM PROFILE MONITOR

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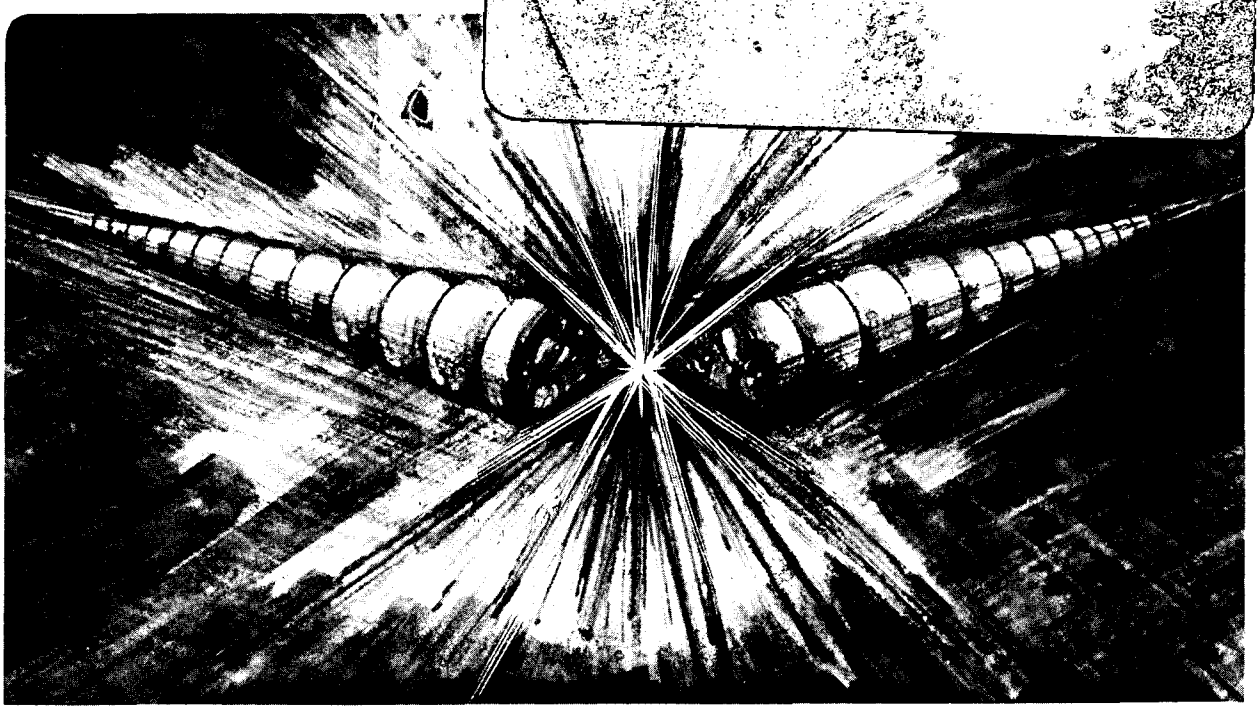

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DISCLAIMER

Ion Beam Profile Monitor

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In the course of the development of ion sources for the SuperHILAC at LBL, the need arose for a simple and inexpensive means of measuring the ion beam radial distribition. We describe here our solution - an array of charge collectors positioned across a diameter and switched electronically so as to present an oscilloscope display of ion beam charge collected during the beam pulse as a function of radius.

The detector array is simple in the extreme. We used 16 square copper plates, each 1.6 cm x 1.6 cm, mounted individually by ceramic stand-offs to a rigid metal strap positioned across a diameter perpendicular to the beam propagation direction, with spacing about 1 mm between detectors. The profile to be measured thus spanned a diameter of 27 cm. This detector array was positioned 1 m away from the pulsed ion gun whose beam we wished to diagnose. Leads were brought out of the vacuum chamber for each detector, and the cable bundle fed into the chassis containing the switching electronics.

The charge collected by each detector is stored in a 1 uF capacitor (the 16 capacitors were selected and trimmed for a 1% match), via a varistor-diode-neon-resistor protection network. The voltage on each capacitor is then sampled by an analog multiplexer IC driven at a convenient rate by a free-running counter, in our case 16 kHz. The output of the multiplexer is then fed directly to the storage oscilloscope, with

the time base triggered by the counter and sweep speed set so that one complete scan of the 16 inputs is one sweep. A schematic of switching circuitry is shown in Fig. 1. It is convenient to use a digital storage scope such as the Tektronix 468 in 'envelope' mode, in which case it acts as a peak-reading device, and the capacitor voltage, which decays over several seconds, is measured at its peak. Thus the oscilloscope presents a stored display of the radial profile of the time-integrated ion beam current. Such an oscillogram is shown in Fig. 2. The plates can be biased, or a secondary electron suppressing grid can be added if this is deemed desirable. The detector array size and details can of course be changed to suit the beam.

We assembled the detector array in one day, and the electronics was constructed from laboratory stock items in two days. The device works reliably and simply.

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Figure Captions

Fig. 1. Circuit diagram of the multiplexing electronics.

Fig. 2. Oscillogram of typical beam radial profile.

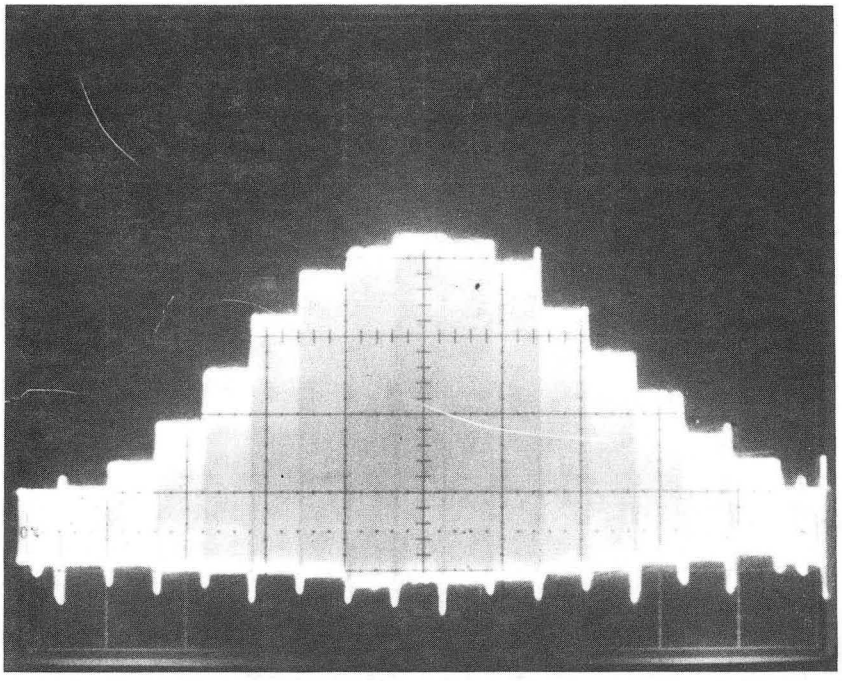

Fig. 1 Circuit diagram of the multiplexing electronics

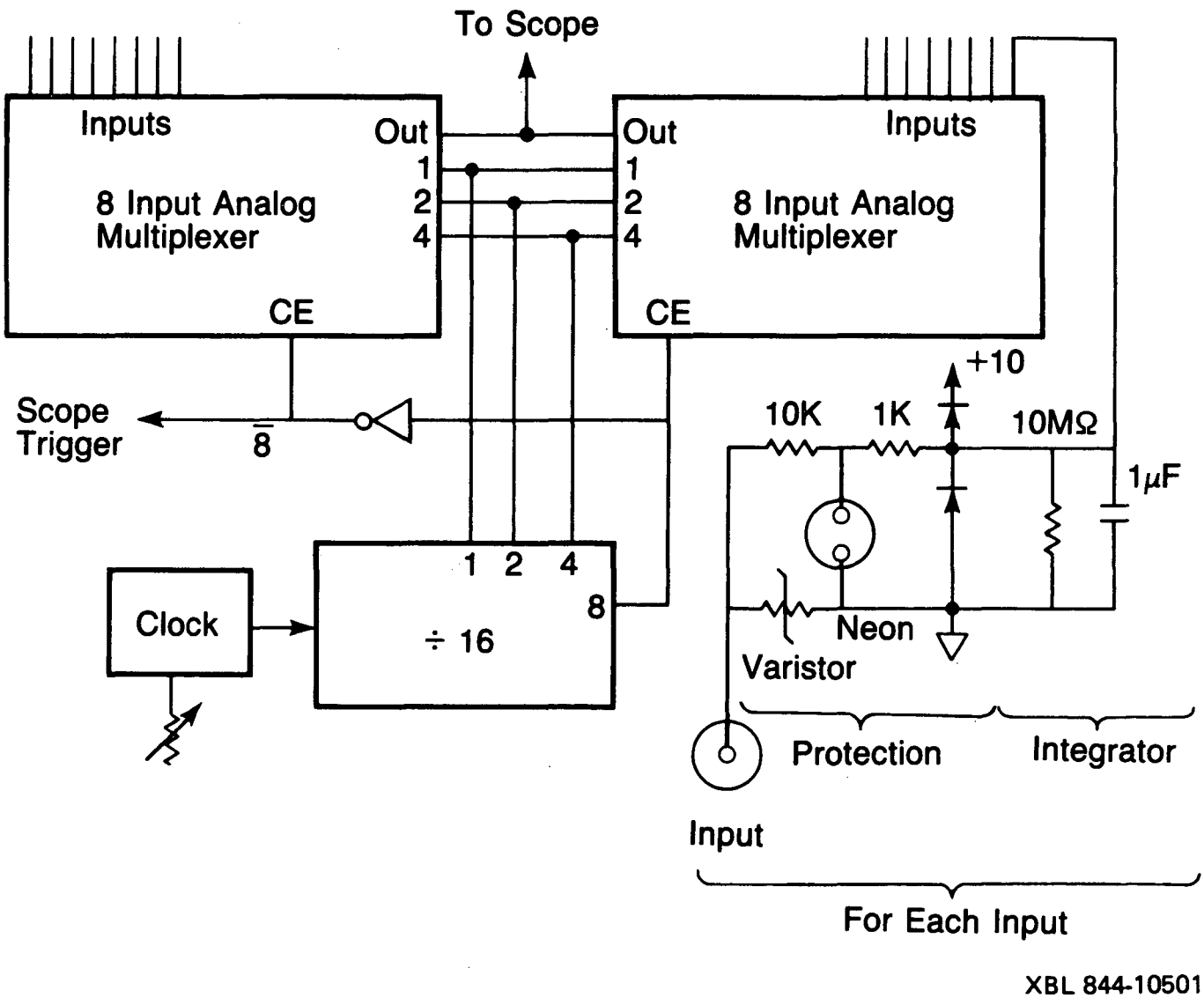

Fig. 2 Oscillogram of typical beam radial profile

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