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SDC
SOLENOIDAL DETECTOR NOTES

ATTENUATION STUDIES OF 3.5M STRAW TUBES

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May 31, 1990

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IUHEE-7

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1) Introduction

The current cylindrical geometry for the central tracking chamber of the SDC calls for the outer most straws to be of 3.5m to 4m in length. The large length of the straws makes it critical to understand their signal transmission properties. As a first step in this process the attenuation length of two straws in a 3.65m (12 ft) chamber was measured.

2) Description of detector

The drift chamber constructed for this series of tests was a six tube array with a length of 3.65m. The large length of the straws was achieved by splicing two 1.8m straws together. The straws were glued to a plastic spacer[1], which was slid half way inside each straw, with a conductive epoxy giving a continuously conductive cathode. The straws were fabricated by Precision Paper Tube Company., Rockville, Ill. Each straw consists of a layer of 0.5 mil polycarbonate film aluminized on the inside surface, covered by an 0.5 mil mylar film. The two films are wound with overlapping pitch and bonded by an application of epoxy resin between them. The resulting tube is gas tight, and robust enough to handle easily. The inside diameter is 0.157 in or 4.0 mm.

The anode is a gold plated tungsten wire 25 μm in diameter. It is tensioned and held centered by two Delrin pins inserted in each end of the straw. The Delrin pins are inserted into an aluminum gas manifold, which positions the wires and provides a robust mechanical support. The triangular gas manifolds sit in a precision V groove that is machined in a long aluminum bar. The V groove aligns both ends and hold the straws in position. Mechanical tolerances for the construction were about ± 50 μm. In addition to these supports the wire was held with 7 Mercedes type spacers[1] every 58 cm that were melted to the wire.

3) Electronics

The tubes were run at a ground with the anode wires at positive high voltage. The wire was capacitively coupled to the scope through 0.01 μF and across 300 Ω in parallel to the scope input impedance of 50 Ω.(see Fig. 1) The 300 Ω resistor was chosen to give the lowest overshoot and ringing (see Fig. 2).

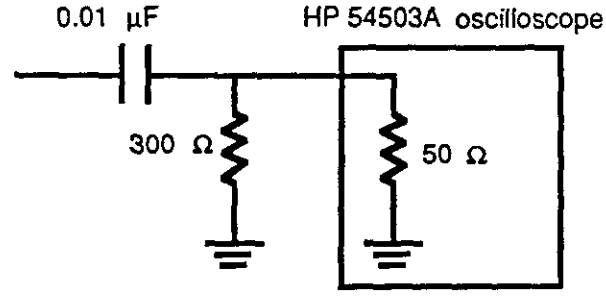

Fig 1

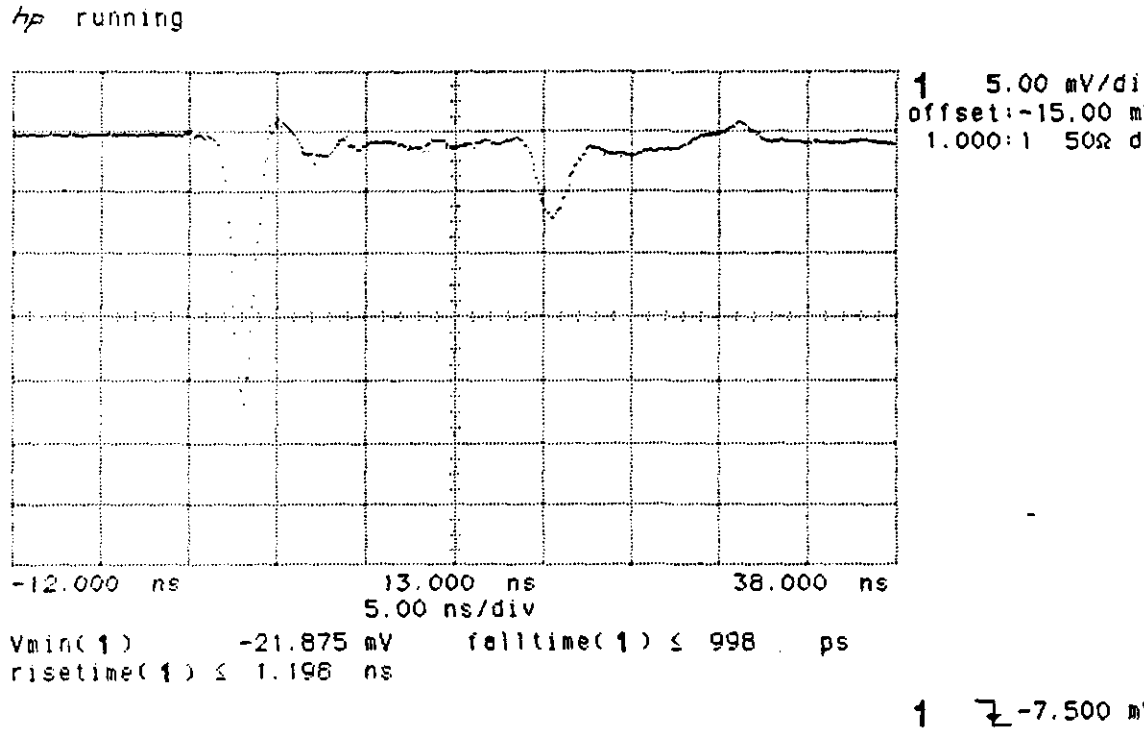

Fig 2
Typical pulse(unterminated)

Although we expect no difference the attenuation length was measured both terminated and unterminated. The termination was 34pF capacitor and a 0-300 Ω pot to ground. The pot was adjusted to give the least reflection. This value was measured to be 223 Ω.(see Fig. 3, 4, and 5)

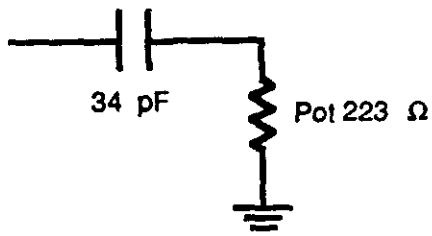

Fig 3
Termination

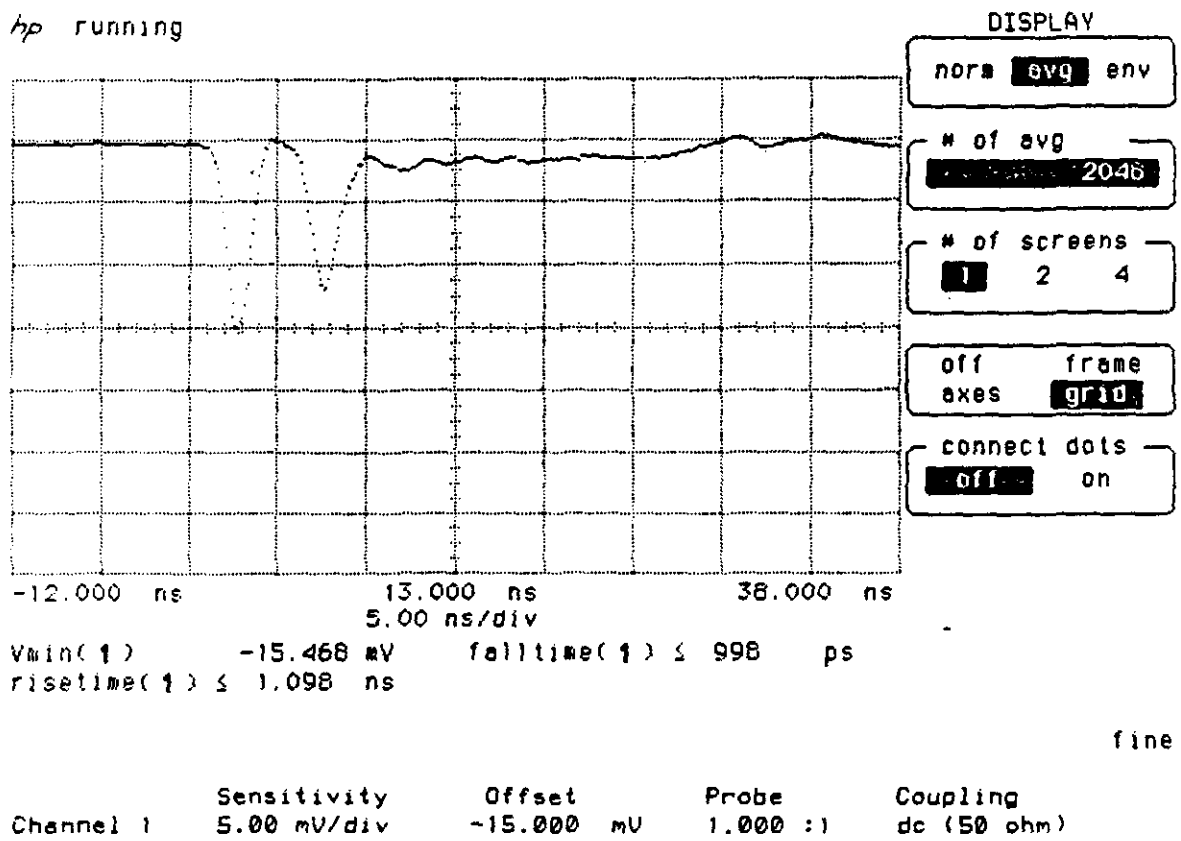

Fig 4
Pulse unterminated (source at L = 305 cm)

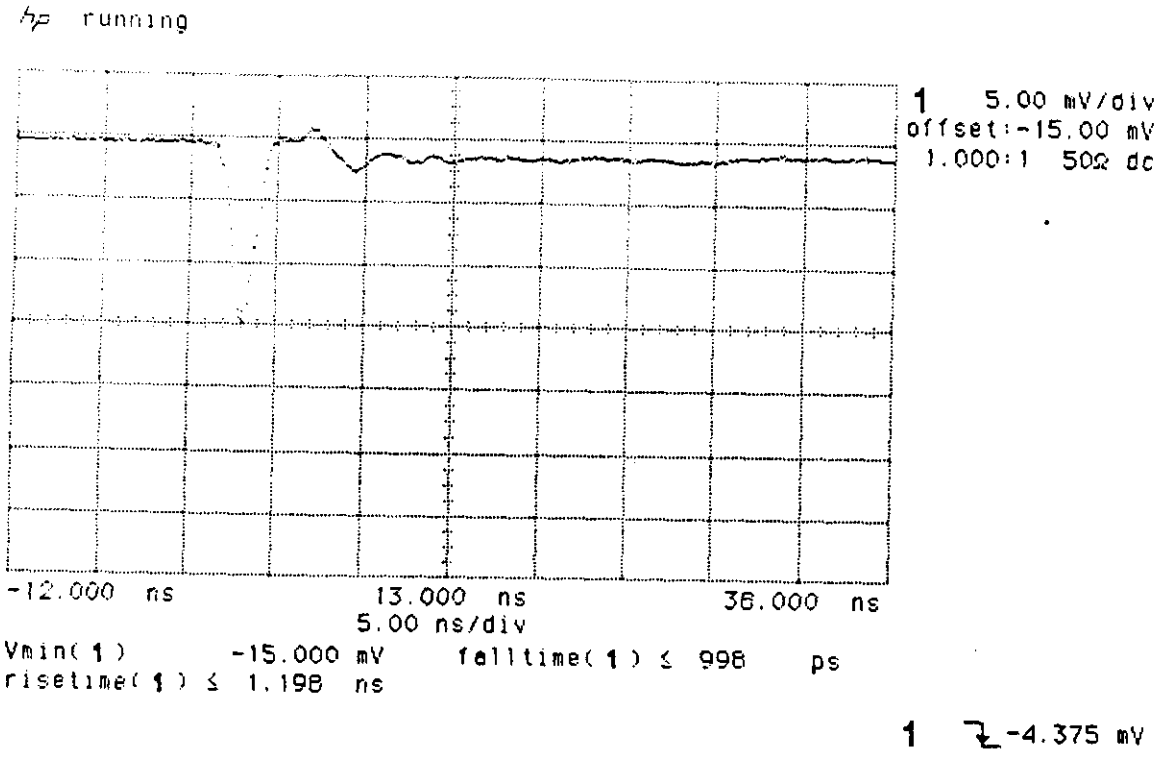

Fig. 5
Pulse terminated (source at L=305 cm)

The signals from an Fe^{55} source were recorded on an HP 54503A digital oscilloscope. The position of the source from the read out end of the tube was also measured. All distances in this paper are measured from the origin at the electronics readout end of the tubes. To reduce the effect of noise we averaged 2048 pulses to give the display from which the pulse height was measured. The pulse height as function of distance along the tube was fit to a decaying exponential of the form:

$$y=A\exp\left(\frac{-x}{L_0}\right)$$

were A in the initial pulse height and L_0 the attenuation length.
The data and the fits can be seen in Fig. 6, 7, 8, and, 9. The data are also summarized below

Table 1. attenuation length

	tube #2	tube#3
terminated	407.3	402.7
unterminated	415.0	447.0

We will continue to investigate the effects of tube splicing and termination on the attenuation length.

References

1 R. Foster , A Wire Support Design for Straw Chambers, IUHEE 90-3

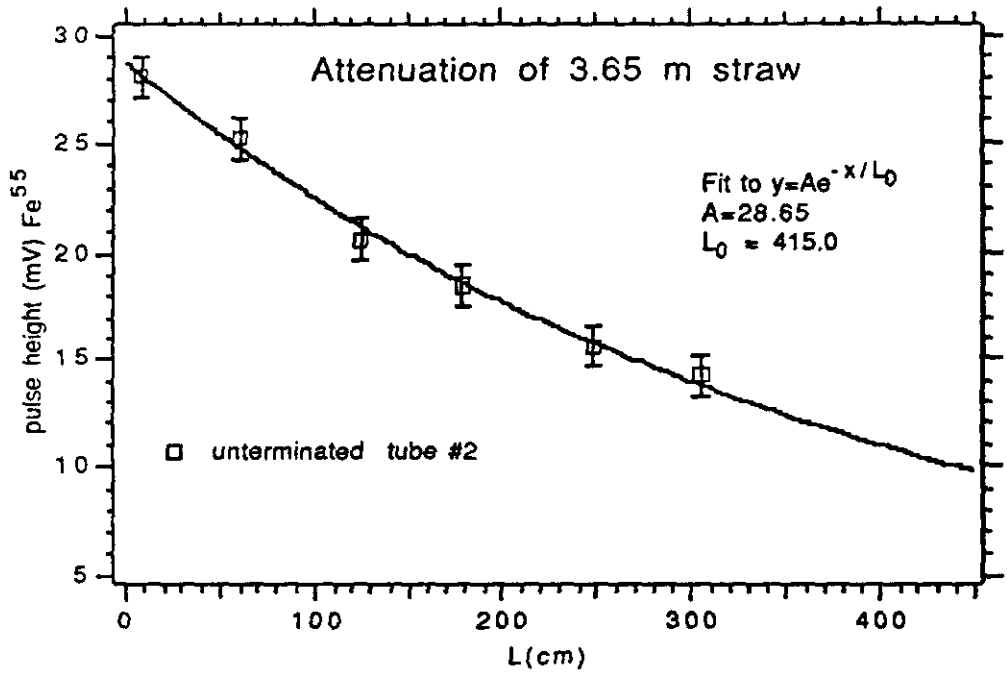

Fig 6
Tube #2 unterminated

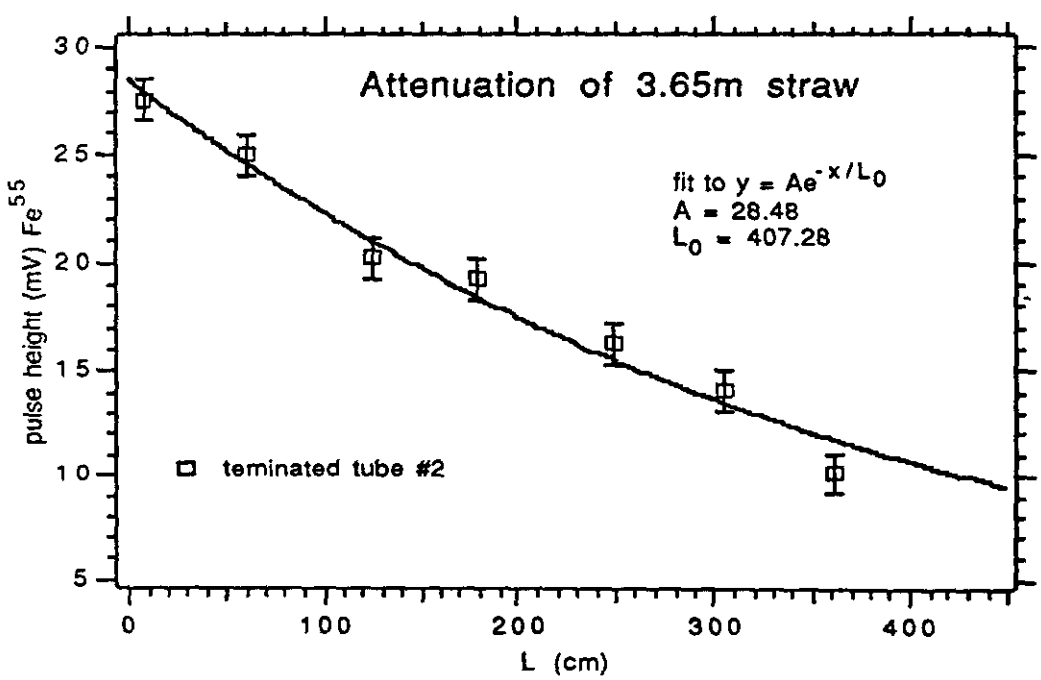

Fig 7
Tube #2 terminated

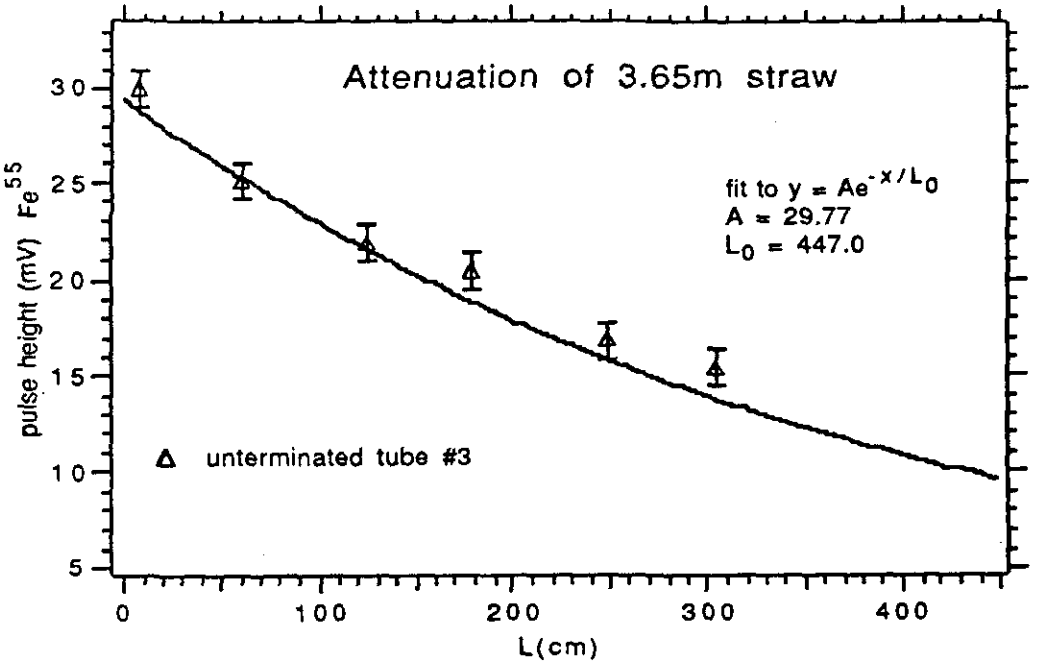

Fig 8
Tube #3 unterminated

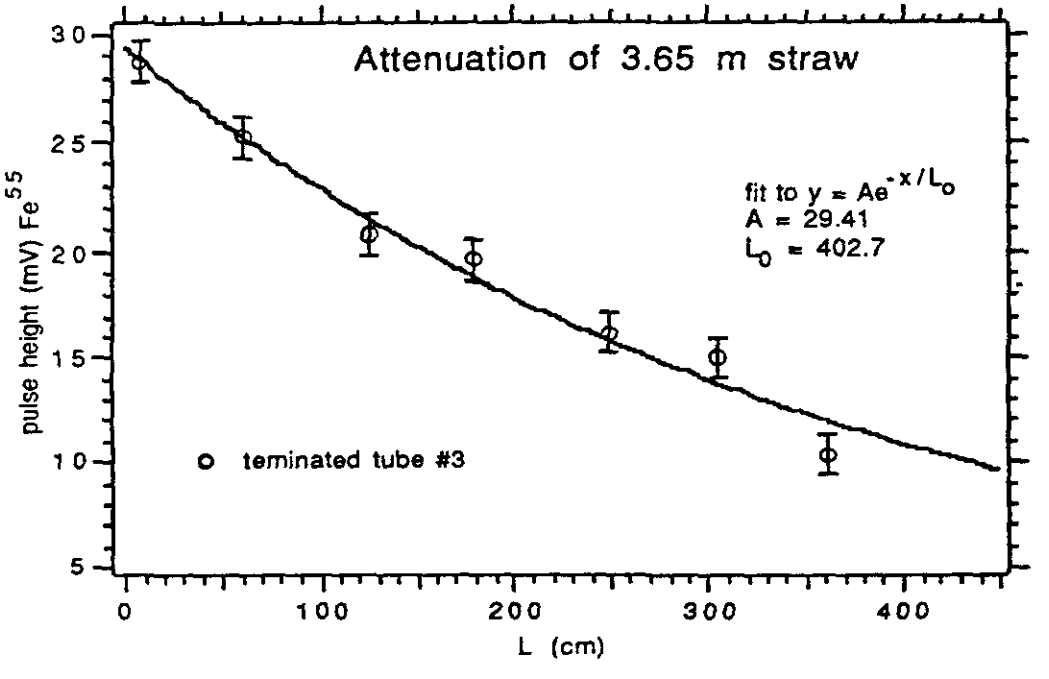

Fig. 9
Tube #3 terminated