Status Report and Run Requests

E456: Measurement of the Kaon Form Factor

September 22, 1976

The kaon form factor experiment uses an improved version of the E216 narrow angle spectrometer in the MIW beam line. The principal improvement and modifications are (1) installation of high resolution drift chambers before and after the liquid hydrogen target, (2) replacement of the spark chambers downstream of the spectrometer magnets by proportional wire chambers, (3) modification of the trigger hodoscope, (4) improvement of the electron identifier shower counter system, (5) installation of the 100 foot differential counter for kaon identification.

The equipment was installed and tested during a test run scheduled from August 6 through August 25. Beam of widely varying quality was available for less than 159 hours. Its use is shown in Figure 1. Most goals of the test run were met: each component was tested, acceptable trigger rates were developed, and a brief test data run was carried out with the liquid hydrogen target. A discussion of each test run activity follows.

I. Scintillation counter and fast logic test.

These followed standard procedures without difficulty.

II. Electron beam tune.

Useful electron beams at 25, 35, 50, 70, and 100 GeV were produced with the aid of the 100 foot threshhold counter. Leaks persisted despite several repairs and frequent purging and refilling with helium was necessary. These electron beams were required for the shower counter tests and were used simultaneously for counter and PWC tests.

III. Shower counter tests.

The new shower counter system fulfilled expectations with respect to electron energy resolution and linearity and performed satisfactorily in the fast trigger. A fifth section will be added to the shower counter array in order to increase acceptance at low q^2.

IV. Proportional wire chamber tests.

Eight new PWC's (1.0 x .6 meters) were constructed and installed downstream of the spectrometer magnets in two separate blocks. In addition, station six from E-216 was moved downstream in order to provide a third block of chambers in the downstream arm.

All of the PWC's were tested and performed satisfactorily. In addition, the two particle fast triggers from the 5th and 6th PWC blocks were tested and were used to advantage in reducing the trigger rate. As anticipated, a large number of electronic component failures occurred initially in the new PWC's but the rate of failure has since fallen to an acceptable level. The PWC's must all be returned to their proper positions, checked out, and resurveyed before data taking can occur.

V. Drift chamber studies.

A total of 24 of the required 32 chamber planes were installed and made to operate. The drift chamber electronics included amplifiers for 120 channels, distributors for two signals per wire on 80 channels, discriminators, 200 TDC channels and their readout. The gas system, drift chamber stands, controlled environment houses for thermal control and electrical shielding, and DC power for the amplifiers were prepared for the run. All cables, patch panels, and test signal fan outs were installed and checked.

Approximate timing for all signals was done in the beam and all drift chamber planes were plateaued. All planes showed satisfactory results except for two planes with broken resistors in the high voltage chains. Preliminary evidence for two track resolution of 1.5 mm was obtained. An analysis of the test data is now in progress.

Prior to the data run several tasks will be completed. These include improvement in chamber design by making like outputs, improvement of amplifier sensitivity to perhaps $2\mu A$ from the present $4\mu A$, final adjustment of signal differentiation for optimum two track resolution, timing of amplifier threshholds and development of a "good beam" fast logic unit for the drift chambers.

VI. 250 GeV beam tune.

Hardware failures in the ramping system made this a time consuming task. Ramping of the field lens to its full desired value was not possible. There was insufficient beam time available to study the beam parallelism in the differential Cerenkov section. In view of the unsatisfactory results for this counter, ~~time~~ tune procedures must be developed for the next run.

VII. Differential Cerenkov tests.

The results of these tests (Figure 2) show that satisfactory $K-\pi$ separation was achieved only at the expense of poor efficiency (30%!). With the same counter, E104 achieved an 85% efficiency at 240 GeV. Our low efficiency could be caused by deterioration of tube quantum efficiency, deterioration of mirror reflectivity (about one-third of the surface was seen to be clouded over after removal), defective beam tune, or a combination of such effects. Clearly this problem must be cured before data taking.

As indicated on Figure 2 a 2.1% K to π beam flux ratio was measured at the differential Cerenkov counter. Note that this result is independent of counter efficiency. The ratio becomes 2.0% at the liquid hydrogen target, a value significantly lower than the 3.2% ratio extrapolated from the E104 data at lower proton beam energies and used in the E456 proposal.

VIII. Trigger studies.

A satisfactory trigger rate of 6×10^{-4} was developed for both kaons and pions. This was achieved with a single counter requirement at the trigger hodoscope plane. This loose trigger insures 100% efficiency up to the highest momentum transfer. A single trigger counter viewed by four photomultipliers is being constructed for the data run.

IX. K and π test data.

The full spectrometer system was exercised with straight-through and beam runs for calibration and with both kaon and pion data runs with the liquid hydrogen target full. Unfortunately, all chambers had to be removed immediately thereafter to make way for the E324 vacuum pipe which traverses the spectrometer system. The data tapes are being examined offline and are being used in a playback mode to improve the online monitoring system.

The kaon trigger rate will be quite small. Perhaps six per two second spill. We propose to increase the running time by 15% in order to take simultaneous pion data in order to do a direct kaon-pion form factor comparison over the q^2 range available. This would provide additional experimental information beyond the primary goal of the experiment.

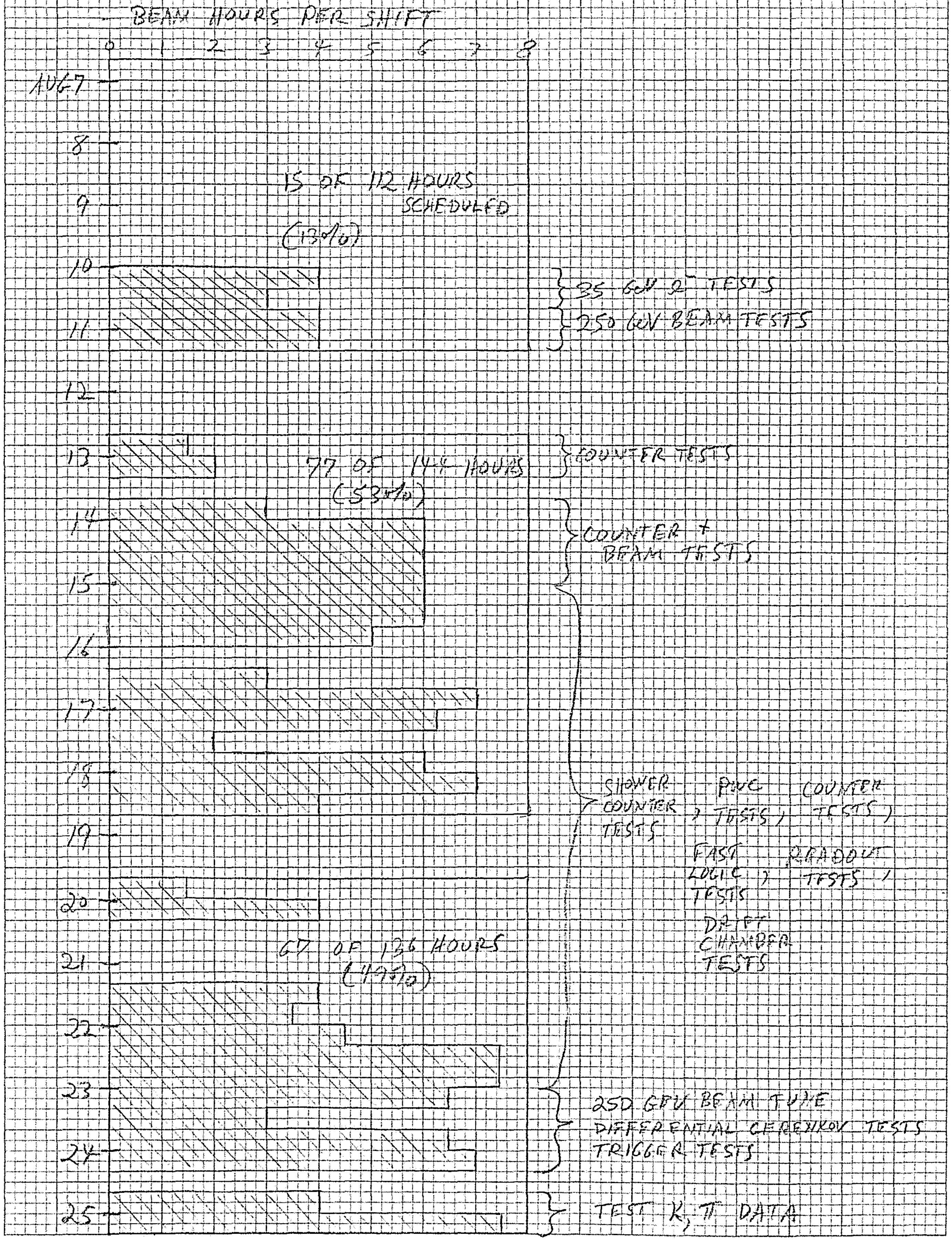
A summary of the above considerations and a comparison to the E456 proposal is listed below:

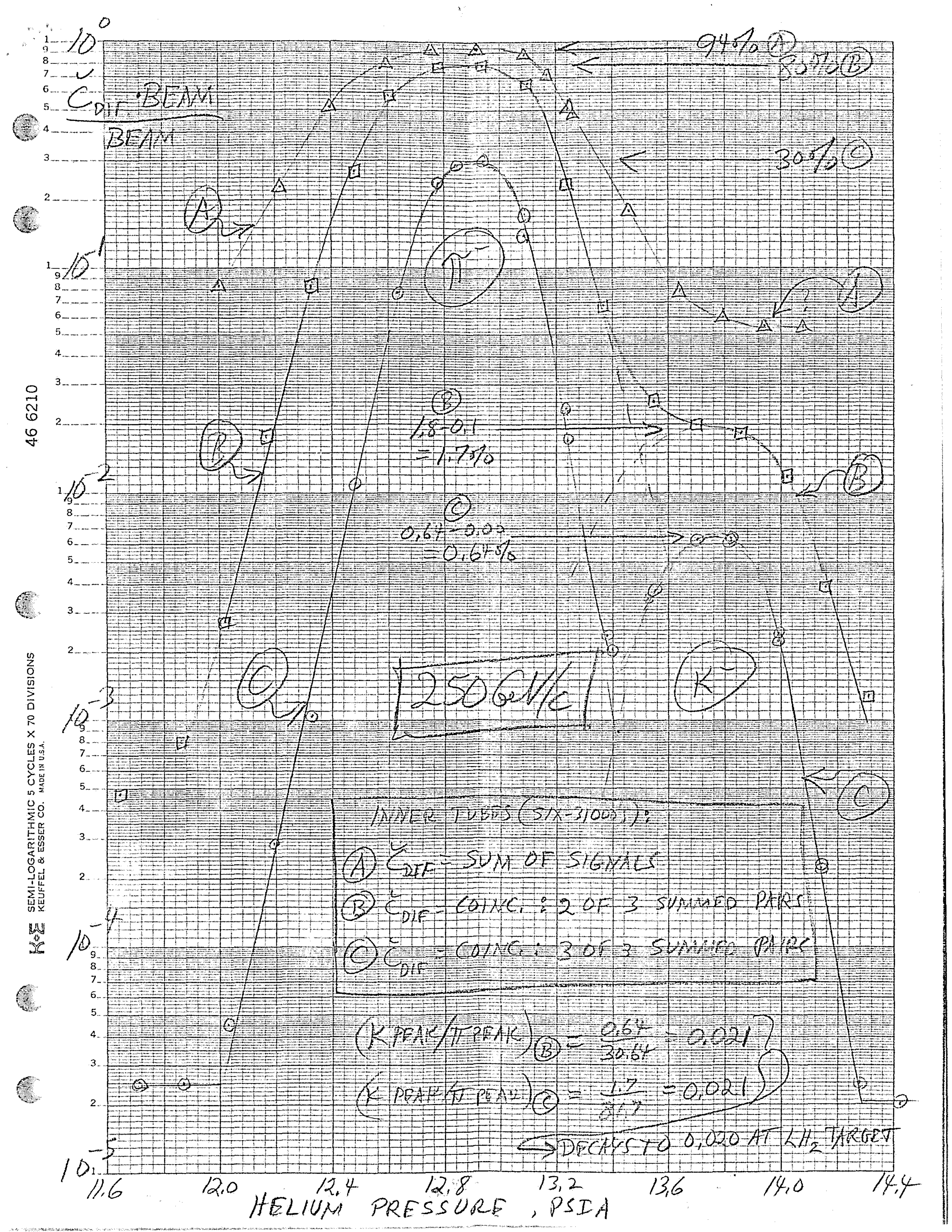
	E456 Proposal	Present report
Beam flux	180×10^6/Hour	240×10^6/Hour
K yield	3.2%	2.0%
$C_{DIFF.}$ efficiency	100%	85% (possible)
Pion running	0%	15%

the net effect is a reduction in K-e event yield to 60% compared to original expectations.

The original request was for 800 hours with 10,000 K-e events expected. We were approved for 500 hours and expected 6000 events. To obtain 6000 Ke events under the present conditions we require 667 hours of data taking. In addition, since our entire spectrometer has been dismantled and the differential Cerenkov counter taken apart to accomodate the E324 run, we require two weeks of set up time to reassemble our equipment and return it to its former state. In total, our requirements are two weeks of set up and seven weeks of running time. Implicit is the understanding that our equipment, including the differential Cerenkov counter, will remain undisturbed for the entire period, from set up through running.

E 456 TEST RUN -- AUGUST, 1976





$C_{DIF} \cdot BEAM$ / BEAM
94% (A)
83% (B)
30% (C)
(A)
π^-
(B)
1.8-0.1 = 1.7%
(C)
0.67-0.03 = 0.64%
250 GeV/c
K^-
INNER TUBES (S/X-31000):
(A) $\check{C}_{DIF}$ - SUM OF SIGNALS
(B) $\check{C}_{DIF}$ - COINC. : 2 OF 3 SUMMED PAIRS
(C) $\check{C}_{DIF}$ - COINC. : 3 OF 3 SUMMED PAIRS
$(K\ PEAK / \pi\ PEAK)_B = \frac{0.64}{30.64} = 0.021$
$(K\ PEAK / \pi\ PEAK)_C = \frac{1.7}{84.7} = 0.021$
DECAYS TO 0.020 AT LH_2 TARGET
10^0
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
11.6
12.0
12.4
12.8
13.2
13.6
14.0
14.4
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