Track Fitting for Run_20200316_162107.dat:

This run in the test beam contains 33,647 triggers in 35,847 cycles.

Currently I find (plot c col-3 row5):

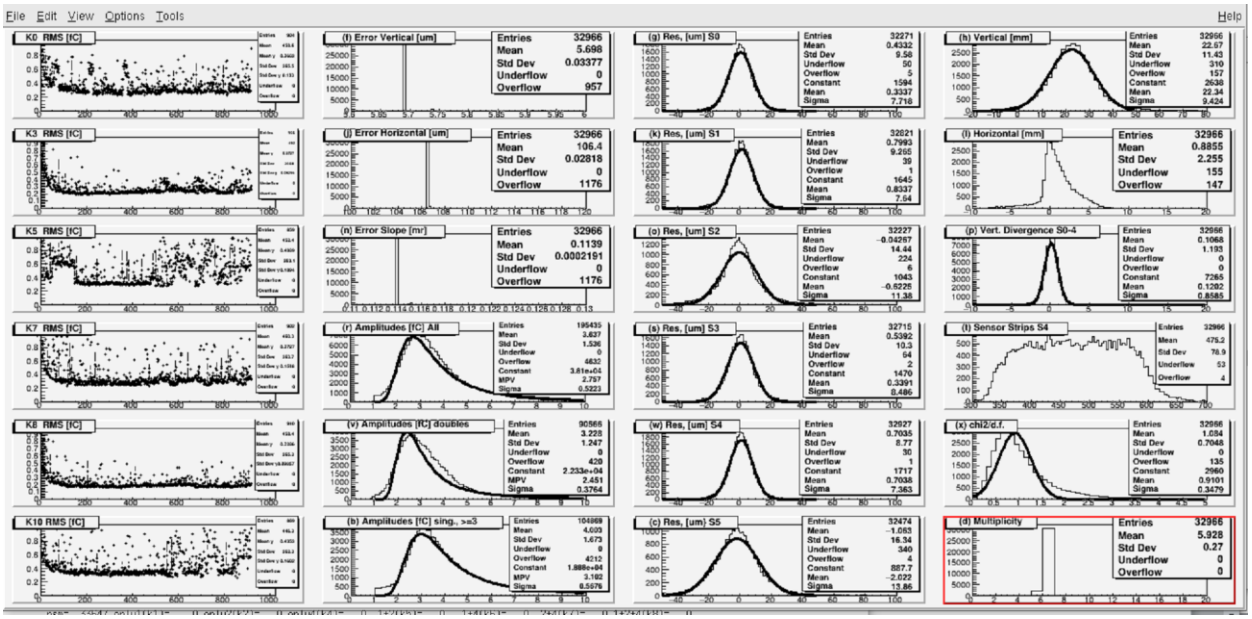
4_hit tracks	106	
5_hit tracks	2149	
6_hit tracks	30,711	(91 % of all triggers)
All tracks	32,966	(98 % of all triggers)

From the ratio of (6-hit tracks)/(triggers) one can deduce an average efficiency per plane of 98.5 %
Assuming a binomial distribution and equal probabilities in all sensors, a single-sensor efficiency of ~99% can be derived in two different ways:

(1) From the ratio of (5-hit tracks)/(6-hit tracks)
(2) From the ratio of (4-hit tracks)/(6-hit tracks)

Least-squares fits using three parameters, vertical position and angle and horizontal position, were performed. Since the sensors were closely spaced, and since the horizontal resolution due to the shallow stereo angle is ~30 times worse than the vertical resolution, there is not enough information to determine the horizontal angle. The fits were performed using a weight of (inverse 7 um-squared) and chi2/d.f. is plotted in x (col-3 row-4). The peak is at 0.7 with a tail out to 3. A Gaussian does not fit well since the distribution is asymmetric.

Fit errors (from the diagonal elements of the error matrix) are 6um for the vertical position, 110 um for the horizontal position and of 0.11 [mrad] for the vertical angle (plots f, j and n in column-1). The error distributions are very sharp, but there are ~3% of events (coincident in all three plots) in the overflow. These may be problematic fits.



Tracks uniformly populate strip addresses 300 to 600 in Sensor-4 (plot x col-3) and have a divergence of 1 mrad {plot t) and a horizontal spread of ~5 mm (plot l). The extrapolation 10 m upstream, the approximate position of the secondary beam target, has a width of 11 mm (plot h). This upstream origin of the tracks, with the appropiate weight, is a constraint in the fit.

Residuals in individual sensors:
Residuals in individual sensors after fitting are shown in column-2. The sigma values for four of the sensors are 8 um. Two more have sigma of 11 and 14 um and I am not sure why they are larger. They are the sensors with approximately zero stereo angles. It could be that the fit cannot reduce the deviation for those sensors by adjusting the horizontal coordinate. The numbers of entries into each plot vary, indicating differences in efficiency, but they are close to the average of 99 %.

Amplitude Spectra:
In column-1, plot r are displayed the amplitude spectra for all tracks and all sensor planes, 195,000 entries in total. The Landau fit yields an MPV of 2.8 fC and the mean is 3.6 fC. The expected mean for a 300 um depletion is 4 fC, so we seem to have a 10 % loss.

In first approximation one would try to associate single hits with tracks through an instrumented strip and doubles with a dummy strip. But the two classes are not easily separated. The Landau fit for single hits (not shown here) does not match the data. There is no tail to large energy deposits and both peak and mean sit at ~3 fC. Because of the narrow (25 um) and high (300 um) aspect of the active volume of the strips, it is assumed that an event with large energy deposit produces a knock-on electron which enters the adjacent dummy strip and produces a double hit, possibly even a triple hit for two knock-on electrons. Similarly, a track through a dummy strip may spill over and cause a triple or even higher multiple.

Plot v shows the amplitude spectrum for double hits with an MPV of 2.5 fC and a mean of 3.2 fC. Both values may be low estimates for dummy strip spectra because some triples, which tend to have higher amplitude, are missing.

Plot b shows the combined amplitude spectra of singles, triples and a few higher multiplicities. The MPV is 3.1 fC and the mean 4.0 fC. This plot contains all events for instrumented strips plus some of the high energy deposits for dummy strips. Total entries are 105,000 while for doubles there are 91,000, so maybe 7,000 of b belong into v to make the numbers equal.

Column-0 shows noise as a function of strip address for all six sensors. Sensors S1 and S4 are near perfect with 0.2 fC noise throughout (S/N=18). S0 and S3 are pretty good too and S2 and S5 are the worst, but even for those sensors the noise rarely exceeds 0.8 fC and the performance seems to be good enough for track reconstruction.