Revised 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	231
5_hit tracks	1595
6_hit tracks	31,520 (94 % of all triggers)
All tracks	33,346 (99 % of all triggers)

Examining details of sensor data I concluded that I should not exclude merged hits which are more than one strip address away from the track position. It seems that knock-on electrons can travel to the next strip and deposit enough energy to pull the mean away from the track position. I relaxed that cut to 1.6 strip addresses and as a result many 4- and 5-hit tracks were promoted to 6-hit tracks. I think that 5-hit tracks are already well established and that the sixth hit which I pick up with the relaxed cut really belongs on the track.

Residuals in individual sensors:
Residuals in individual sensors after fitting are shown in column-2. The distributions are well fitted with Gaussians and there are some events in underflow due to the relaxed cut. The variances for the residuals range from 7.1 to 7.4 um in four of the sensors, while S2 and S5 have variances of 12 and 14 um, respectively. Sensors S2 and S5 have a very small stereo angle and thus cannot have the residual reduced by adjusting the horizontal variable, which may explain the larger variance.

The numbers of entries in each histogram yield the individual efficiencies. I find for:
S0 = 97 %
S1 = 99 %
S2 = 98 %
S3 = 99.5 %
S4 = 99.5 %
S5 = 99 %
Multiplying out these efficiencies I find an overall efficiency of 92 %, close enough to the 94 % quoted above..

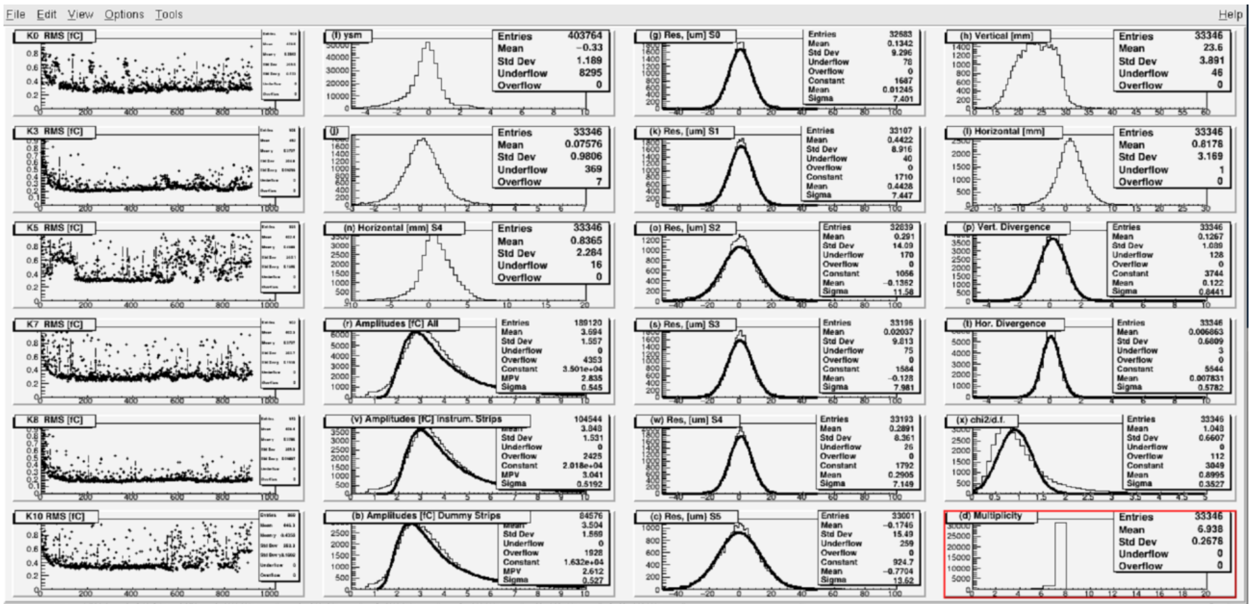
Since the sensors were closely spaced, and since the horizontal resolution due to the shallow stereo angle is ~30 times worse than the vertical resolution, there is not enough information to determine the horizontal angle from the sensors alone. Least-squares fits using only three parameters were presented previously (vertical position and angle and horizontal position).

Determining the horizontal angle from the sensor data results in a very wide angular distribution which is not compatible with tracks originating in the upstream bending magnet. Tracks originate from a target ~10 m upstream of Lycoris. To incorporate this information into the fitting, two constraints on the horizontal and vertical positions of the beam at the origin with a sigma of 5 mm were included.

An important check on the validity of the reconstructed tracks is to show that they pass through the collimator ~2 m upstream of Lycoris. Plot h in the last column shows the vertical distribution which approximates a box with most events between 18 and 28 mm, consistent with the 10 mm opening.

Plot l shows the horizontal distribution, which is narrower than the allowed +-10 mm. I think that is because due to the shallow stereo angle there is less precise information in the horizontal than in the vertical and the constraint at the production target narrows the distribution.

Fit errors (from the diagonal elements of the error matrix) were presented earlier and are 6um for the vertical position, 110 um for the horizontal position and of 0.11 [mrad] for the vertical angle.



Amplitude Spectra:
In column-1, plot r are displayed the amplitude spectra for all tracks and all sensor planes, 189,000 entries in total. The Landau fit yields an MPV of 2.8 fC and the mean is 3.7 fC. The expected mean for a 300 um depletion is 4 fC.

In order to separate the amplitude spectra from instrumented and dummy strips I use the information from fitted tracks. The resolution in each sensor is ~6 um while the strip width is 25 um. So the track position should determine quite reliably if the hit was generated in one or the other strip type.

Plot v shows the amplitude spectrum for hits in instrumented strips (as defined above). The MPV is 3.0 fC and the mean 3.8 fC. There are 55 % of the total in that plot, slightly more than the expected ½.

Plot b shows the spectrum for the presumed hits in dummy strips. The MPV is 2.6 fC and the mean 3.5 fC.

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.

The noise increases quite strongly near the zero position on the sensor, which is attributed to the sensor frame.