Trigger scintillator study

Find the SciHi efficiency vs the number of charged particles passing through

Trigger: π, K and p beam only

Targets: thin

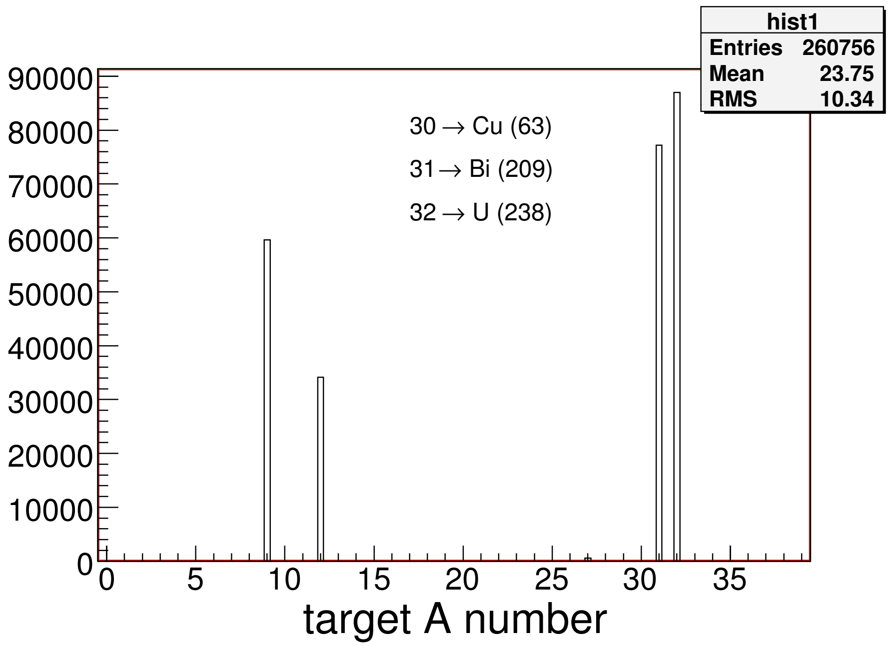
Momentum: 20, -35, $\pm$58 and 120 GeV/c

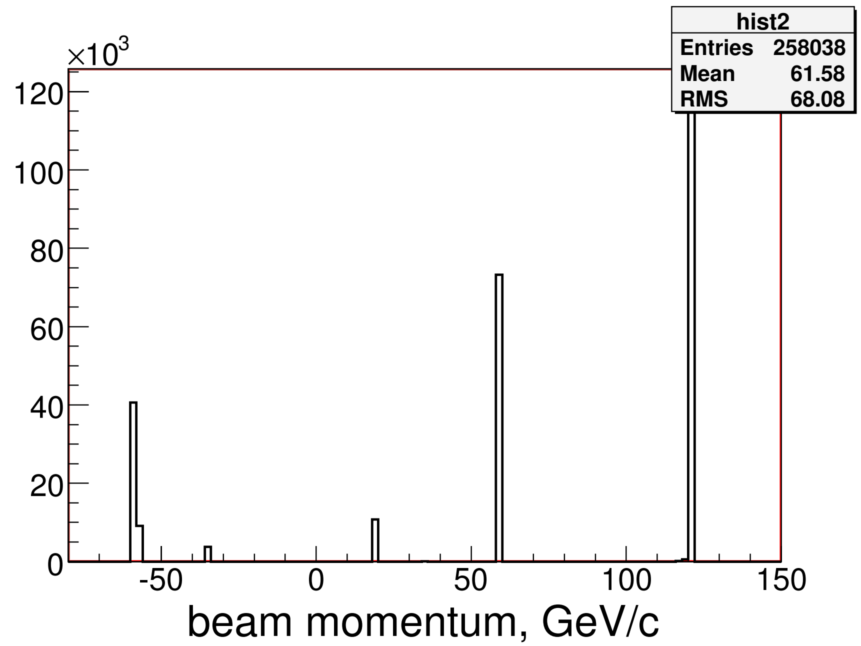
Runs: 13985-14453, 15288-16090, 17090-17502

Other requirements:

- Use the single incoming beam track events
- Try to avoid the cases when a second beam track was failed to reconstruct, $N_{cross} > 4$
- Use events when the beam track within $\pm$1 cm around the beam line

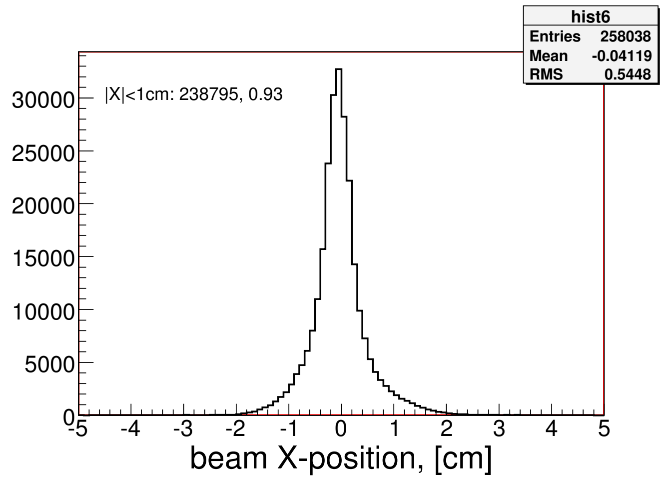
target and momentum

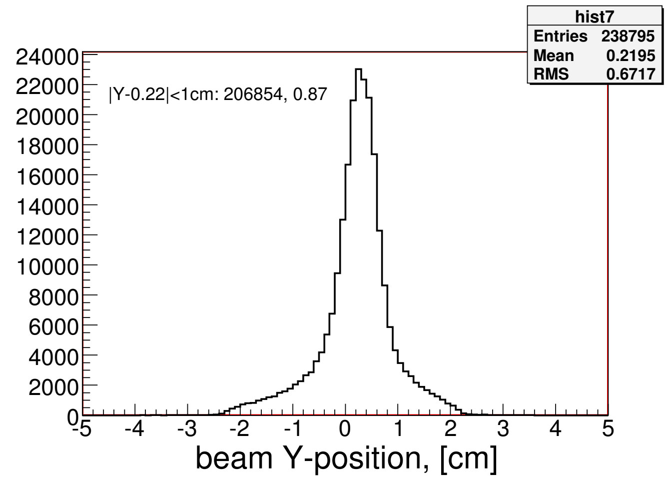


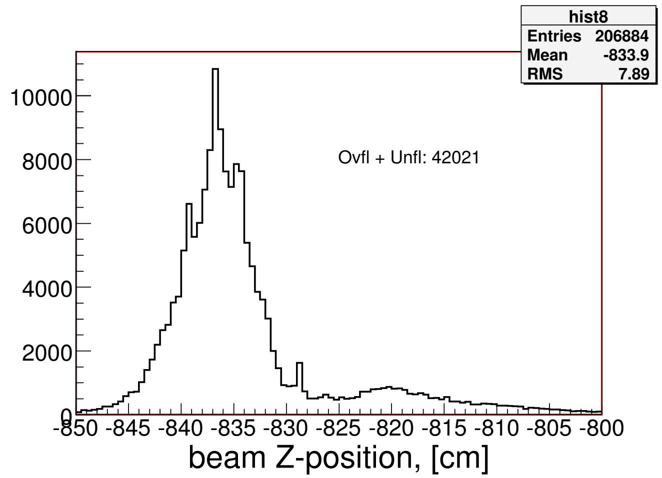


Plots shows the target atomic numbers (on left) and the beam momentums (on right) used for the current studies.

beam track positions





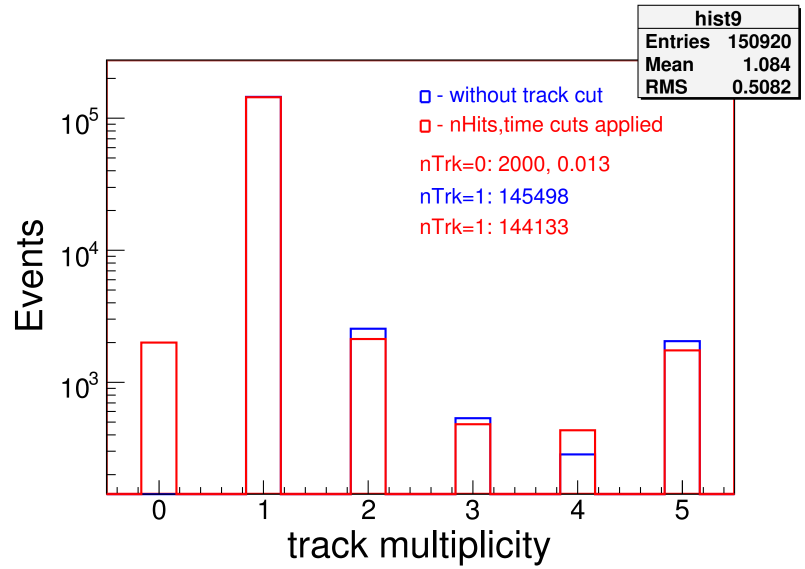


Plots shows the beam track positions: in X-view (top left), in Y-view (top right) and in Z-direction (bottom). The $|X_{beam}| <$1 cm, $|Y_{beam} - 0.22| <$1 cm and $-850 < Z_{beam} < -820$cm cuts were applied. By tightening the position cut we will get more secondary tracks through the scintillator. The Z cut will be considered in details on following pages.

University of Michigan

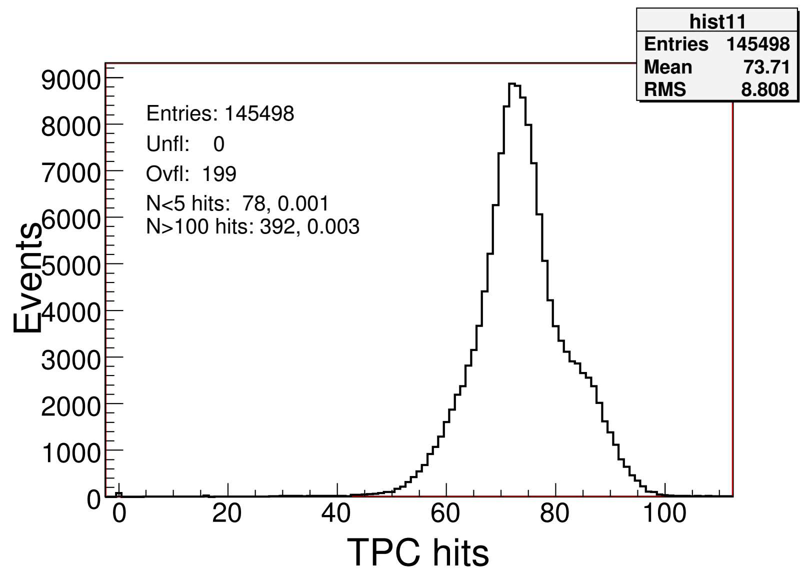
MIPP

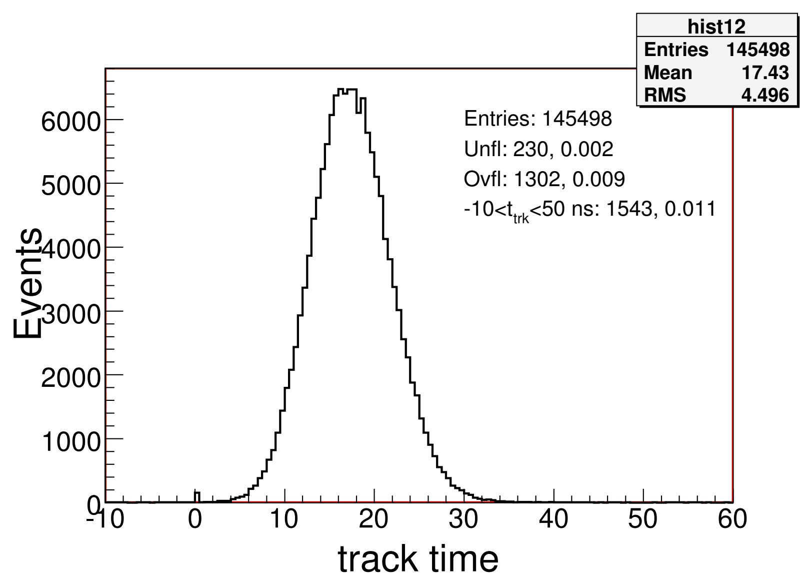
nTrks and track cuts



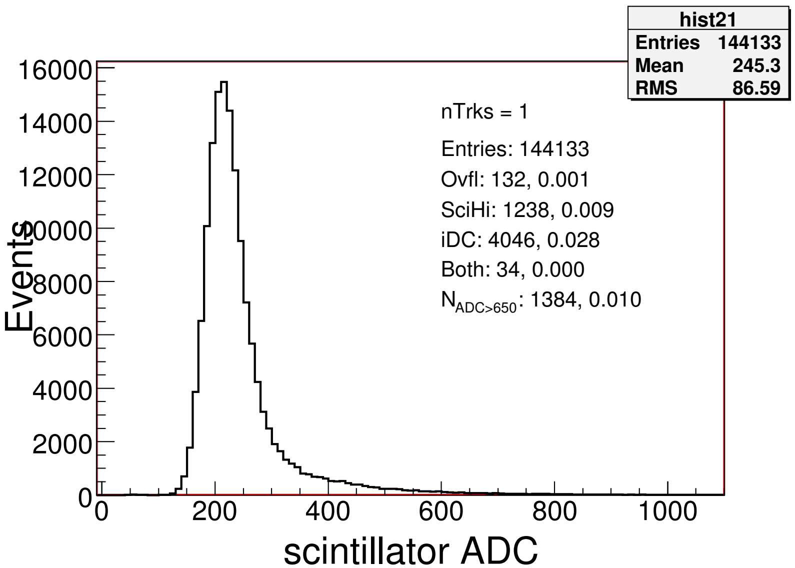
The track multiplicity distribution. nTrks=5 represents nTrks$\geq$5. Initial requirement: there is one “in” to the target and at least one “out” track (the blue plot). The red plot is case when the track time and nHits cuts were applied. It cause 1.3$\%$ losses.

The right plots illustrates that the major fraction of these losses are due to the off-time tracks, $t_{trk} >$50 ns.





scintillator pulse heights for nTrks=1

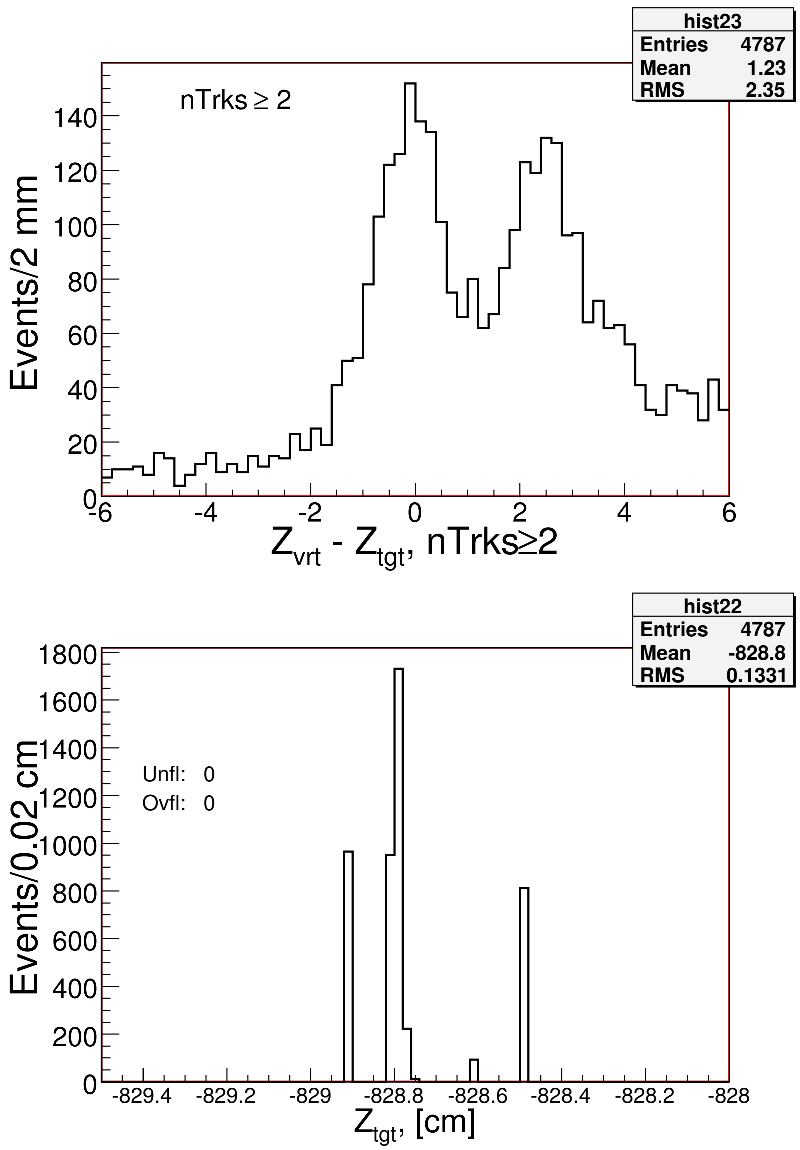


The scintillator pulse height distribution for the single track passing through. Cuts: the track time and the number of TPC hits. There is no Z cut.

This data shows that the probability of single charged track to fire the SciHi interaction trigger is too low, in level of 1%. It tells also that the number of SciHi fires are consistent with the fraction of events ADC$>$650.

The fraction of the iDC fires is three times higher than SciHi. It might illustrates the noise level in the iDC interaction trigger or effect of the secondary interactions.

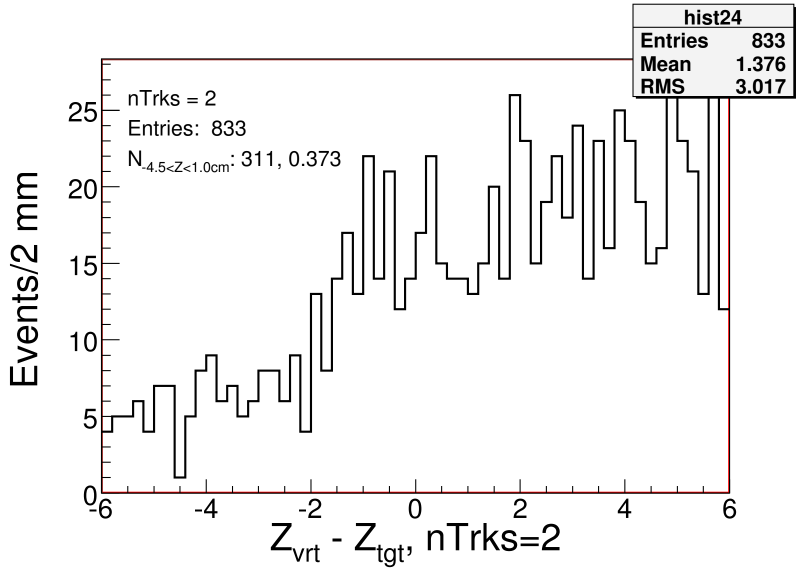
Z interaction point for nTrks$\geq$2

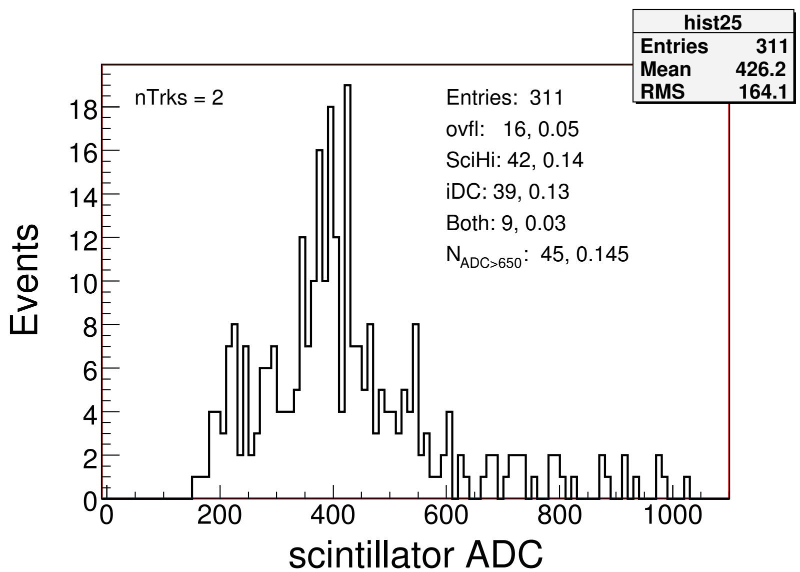


Top plot - Z interaction point distribution for nTrks$\geq$2 cases. The upstream peak represents the interactions with the thin target, next peak - interactions with the scintillator. Selecting the interactions in front of scintillator we might get the right number of the charged particles passing through. The Z cut was made for each number of tracks separately.

Bottom plot - Z positions of the target.

scintillator pulse heights for nTrks=2



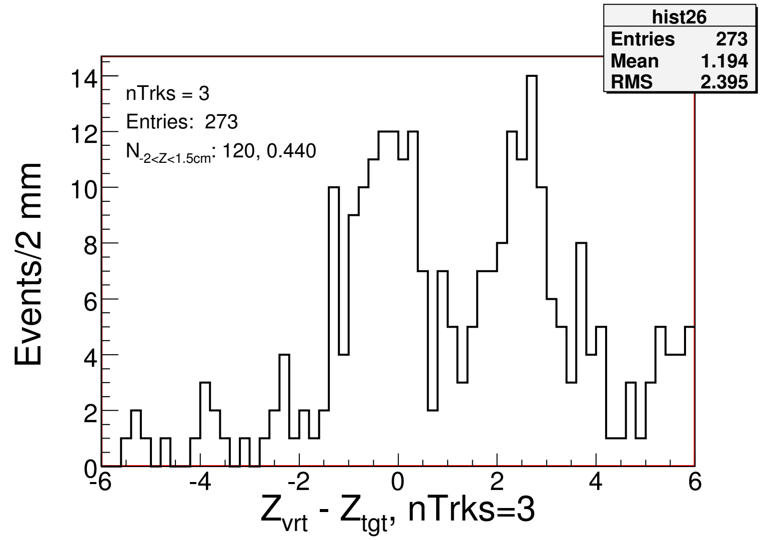


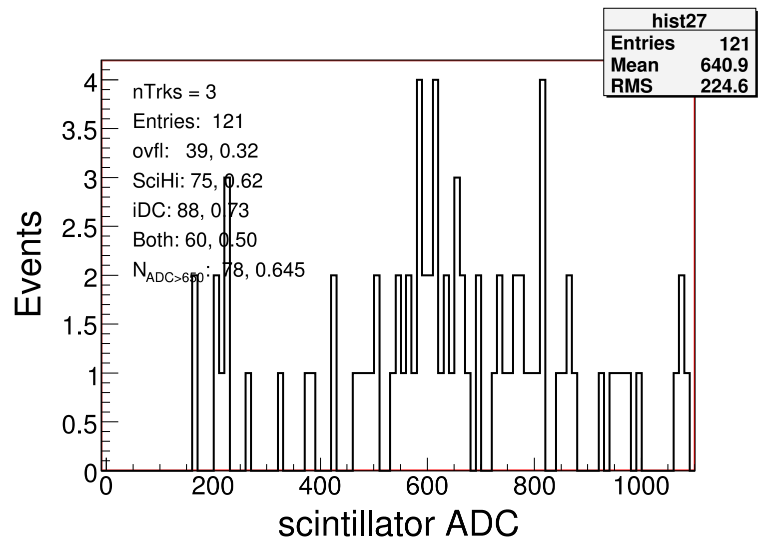
Top plot illustrates the Z interaction point distribution for nTrks=2 cases. It tells that the resolution in Z direction not allow to separate where the interactions from the target and where from the scintillator. I selected Z cut as $-4.5<Z<1.0$ cm

Bottom plot illustrates the scintillator pulse height distribution for the two tracks passing through. Each track checked to be going through the scintillator body ($\pm$2.5cm in X and $\pm$3.5cm in Y). The expected peak position: (220-60)*2+60 = 380 counts, where 60 is the pedestal position, 220 - MIP peak.

The probability of two charged tracks to fire the SciHi interaction trigger is 14$\%$. The number of SciHi fires are consistent with the fraction of events ADC$>$650. For this case the number of iDC fires is consistent with SciHi.

scintillator pulse heights for nTrks=3



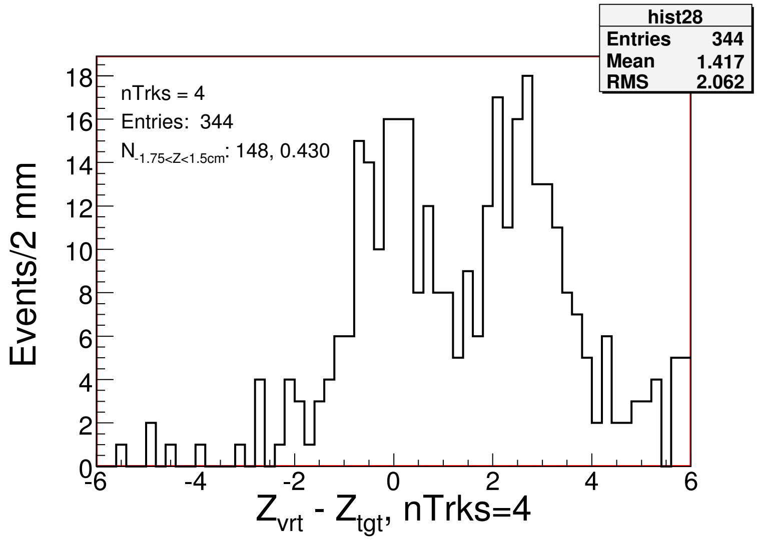


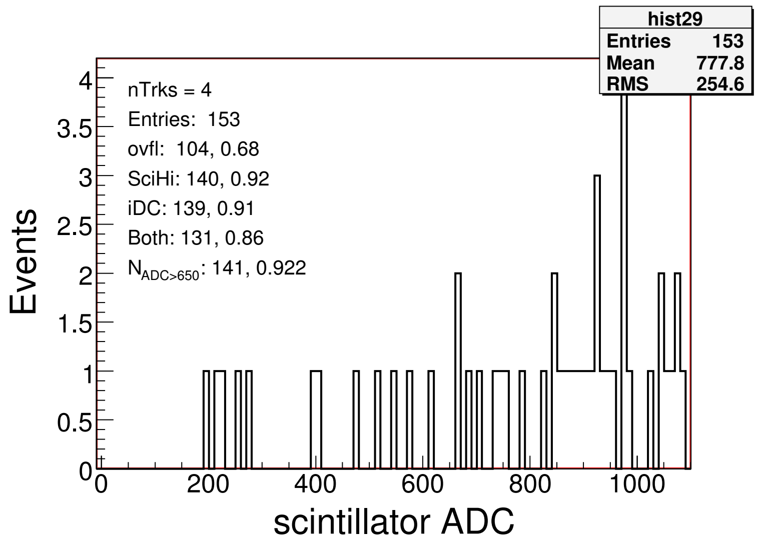
Top plot illustrates the Z interaction point distribution for nTrks=3 cases. Here we able to separate the interaction sources. I selected Z cut as -2$<$Z$<$1.0 cm

Bottom plot illustrates the scintillator pulse height distribution for the three tracks passing through. The expected peak position: (220-60)*3+60 = 540 counts.

The probability of three charged tracks to fire the SciHi interaction trigger is 62%. The number of SciHi fires are consistent with the fraction of events ADC$>$650. The number of iDC fires is higher than SciHi. It might be due to noises or/and the secondary interactions.

scintillator pulse heights for nTrks=4





Top plot illustrates the Z interaction point distribution for nTrks=4 cases. I selected Z cut as -1.75<Z<1.5 cm

Bottom plot illustrates the scintillator pulse height distribution for the 4 tracks passing through. The expected peak position: (220-60)*4+60 = 700 counts.

The probability of 4 charged tracks to fire the SciHi interaction trigger is 92%. The number of SciHi fires are consistent with the fraction of events ADC>650. The number of iDC fires is consistent with SciHi.

summary

nTrks	Entries	SciHi	iDC
1	144133	0.01 ± 0.01	0.03 ± 0.01
2	311	0.14 ± 0.02	0.13 ± 0.02
3	121	0.63 ± 0.04	0.73 ± 0.04
4	153	0.92 ± 0.02	0.91 ± 0.02

Table 1: SciHi efficiency vs the number of charged tracks passing through. iDC efficiency given for the comparison.

conclusions

- The SciHi trigger efficiency depend on the number of charged particles passing through. iDC trigger is a little less predictable because of some noises and possible secondary interactions
- The efficiency for triggering on the single charged particle process is 1$\%$. For an example, the elastic charge exchange reaction
- The efficiency for triggering on the two charged particles process is 14$\%$. For an example, the elastic pp, πp, Kp ....
- The K,π productions, or K/π ratio studies would have the different triggering efficiencies depending on the number of the charged tracks on the final states.
- The inclusive neutron and/or proton productions would also depend on number of the associated charged tracks required: one charged track - 1$\%$, two - 14$\%$, three - 63$\%$ and four - 92$\%$