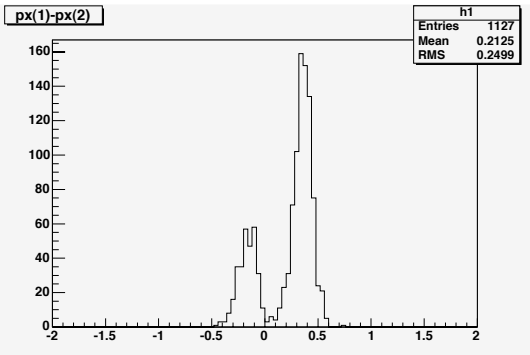
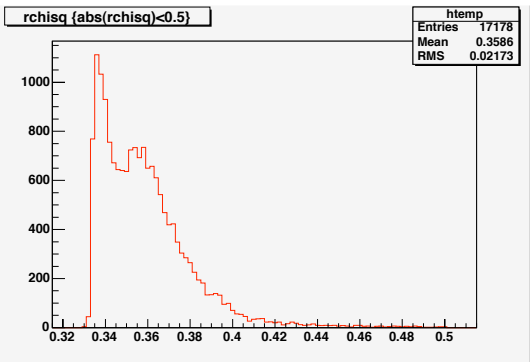
Torch test results (Miki & Ryu)
Jan 12,2004
by Ryu Hayano

- based on Miki's analysis of run 61.
- dt/dx and track reconstruction analyses were independently performed
- track fitting was improved (not perfect yet)
- Miki's results are practically OK - Torch resolution is 1.2mm (sigma) for 3He

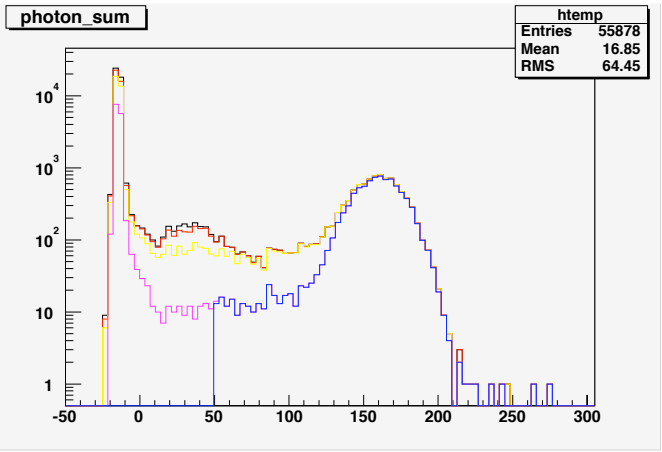
Known problems with Miki's track fitting





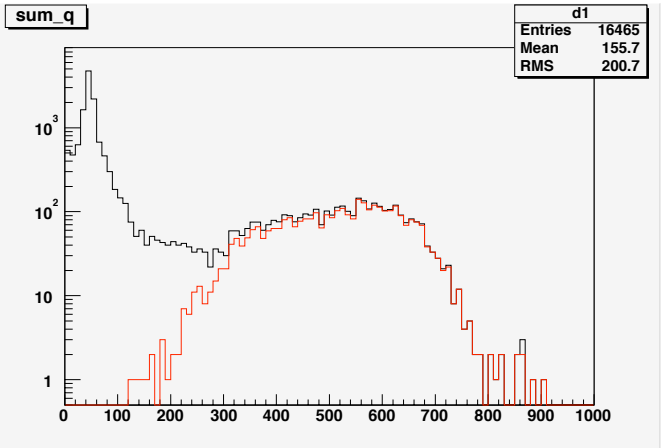
- top: Miki found that px(1)-px(2) (position difference on X and X′ planes) has double peaks
- bottom: the reduce chi2 distribution looks quite strange
- Either the track fitting procedure or dt/dx curves (or both) must be wrong
- thus, I did an independent analysis, by making a new set of dt/dx curves and preformed track fitting

PID 1: Let's first look at particle identification



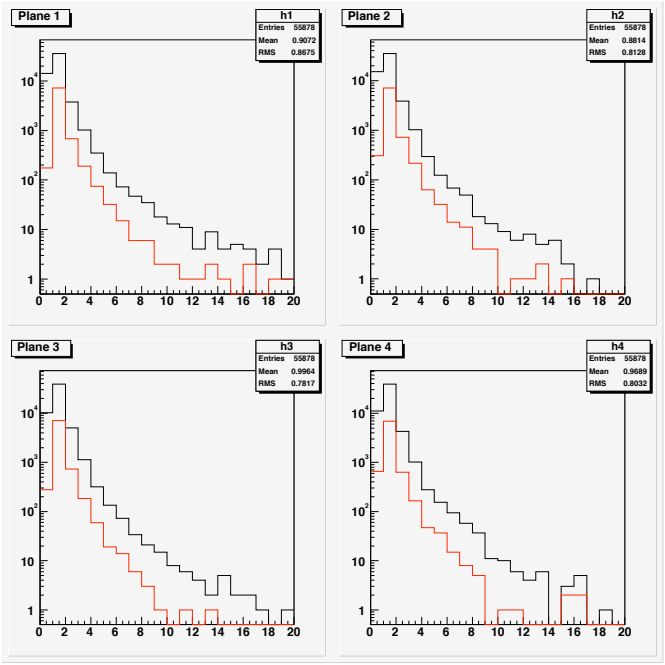
- since the size of torch radiator is smaller than the beam size, we must include torch in the 3He identification logic.
- black: photon_sum (number of photoelectrons detected by torch, integrated for 16 PMTs)
- red: pid using sc1 pulse height
- yellow: pid using sc1&sc2 pulse height
- magenta: pid using sc1&sc2&sc3 pulse height
- blue: he3=sc1&sc2&sc3&photon_sum>50

PID 2: sum_q (trigger threshold study)



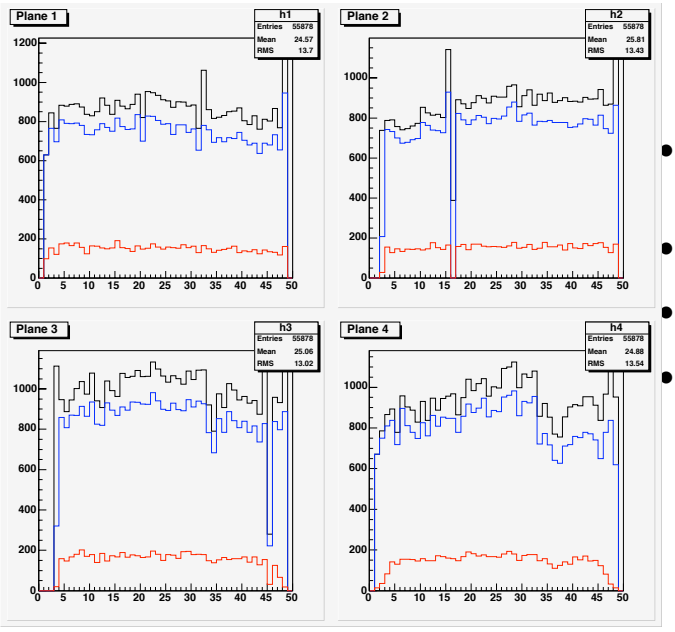
- Black: sum_q distribution
- Red: sum_q distribution for 3He (selection is s1&s2&s3&torch photon_sum)
- These curves show that the discriminator threshold should be set at 1/3 of the sum_q peak
- Of course, pmt gain adjustment is quite important ...

Tracking 1:Multiplicity for each chamber plane



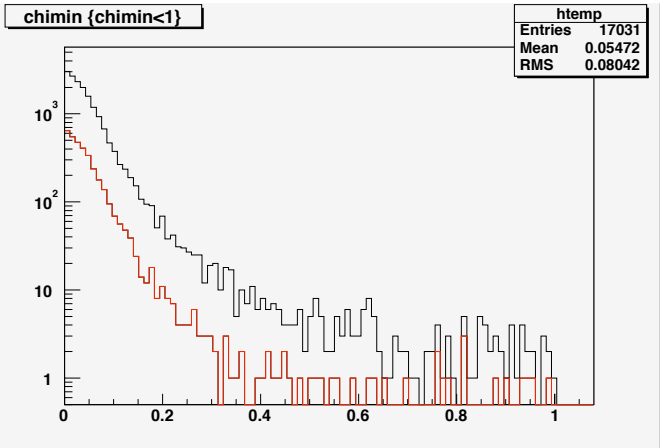
- black: multiplicity distribution for all events
- red: multiplicity distribution for 3He events
- These distributions look OK

Tracking 2: Chamber hit pattern



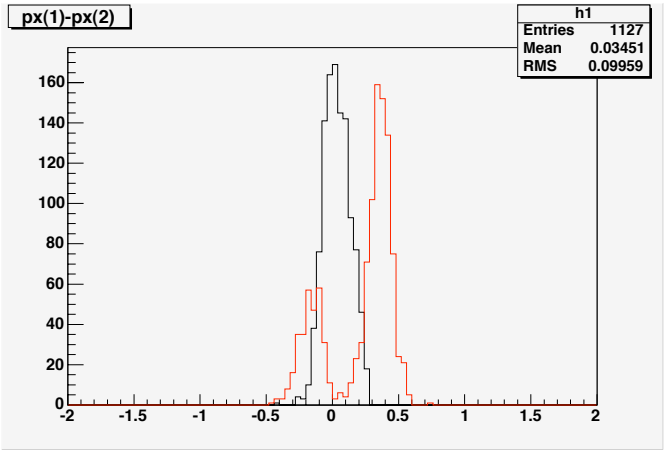
- black: chamber hit pattern (counts vs wire number for each plane)
- blue: with multiplicity=1
- red: multiplicity=1&he3
- although there are some glitches (which we shall look into later), the hit patterns are essentially flat, and look OK

Tracking 3: ch2 distribition



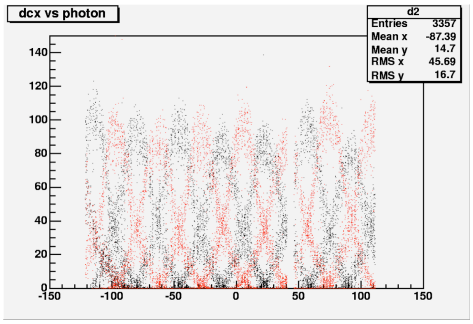
- Black: ch2 distribution for all events, Red: ch2 distribution for 3He events.
- chi2 distribution for dof=2 is $\frac{e^{-\frac{\chi^2}{2}}}{2}$
- as shown, the obtained distributions are consistent with the chi2 distribution.
- fit to the data gives exponential slope of -22.5, which indicates that the resolution is about 300μm
- this is worse than the expected resolution, indicating that the dt/dx curve still needs tuning.

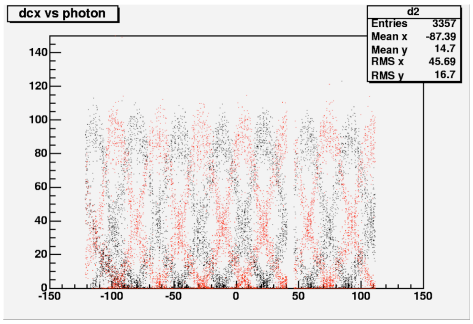
Tracking 4: double-peak problem solved?



- now, look again at px(1)-px(2)
- Red: same as before (Miki's analysis)
- Black: new
- the double-peak problem has been solved
- since the resolution is still very poor, more work is needed
- however, this does not affect the Torch resolution estimation, since the chamber position resolution is much better than that of torch

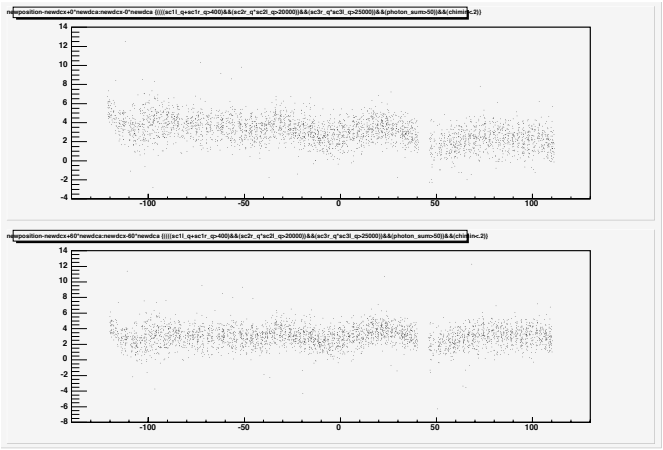
Miki's gain calibration is OK within 5%





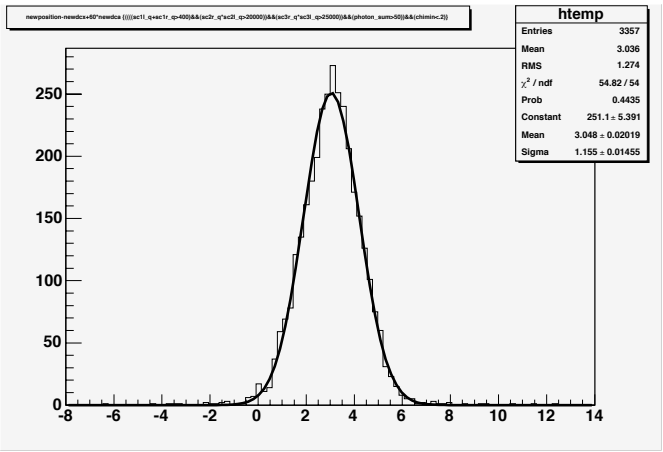
- when a 3He hits torch pmt [i], plot the number of photons detected by pmt[i] with respect to the hit position
- with Miki's calibration, we find that there is a slight (<5%) gain variation from pmt to pmt (left)
- after correction (right)

Something wrong with the geometry?



- top: (torch_position - dcx) vs dcx
- bottom: same as above, evaluated at z=-60mm
- data indicate that Torch is at z= -60mm, but since the last chamber plane is at -78mm, this can't be true. Something is wrong.

Torch resolution: 1.2 mm (sigma)



- weighted average (using the number of photoelectrons as the weight) was used for torch position determination
- (torch position - dcx) for he3, chi2<.2
- torch position is at z=-60mm (since this gives better resolution, but the geometry must be checked again)
- torch gain adjustment of some 5% is applied, but the results are essentially unaffected without this adjustment
- resolution is 1.2mm
- geometrical offset is 3mm

Conclusions

- Miki's analysis was basically OK.
- Torch resolution is 1.2 mm (sigma) with the weighted-average method. This is 7% of the Torch segmentation (17mm), and is quite good.
- The gain calibration using LEDs is accurate to within 5%. The position resolution is not sensitive to the gain variation (resolution is 1.2mm with and without the 5% gain adjustment).
- The chamber&torch geometry must be understood.
- There is no position-dependent trigger bias, if the gain is well adjusted (as in the test experiment), and if the discriminator threshold on sum_q is ~ 1/3 of the 3He peak.