



KEK Analysis/G4MICE Work

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CM17



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- What's done, what isn't?
- Recon Tests explained
 - Results & Issues
 - Next Steps



What's Done, What Isn't?



- To Complete a full KEK analysis...
 - All tools/code are in place, apart from the current work: Reconstruction tests (see next few slides):
 - We are waiting for a new version of RecPack, but this is just in order to be able use field maps, which is only required for matching to the TOF, D1, D2 etc.
 - To test RecPack, an upgrade to the existing control of the physics list has been added so that we can now control whether we run simulations with MCS and dE/dx (both on, both off, one on & one off). Last thing needed is to modify sensitive detectors, as we still want to see hits from the muons passing through the detectors when no dE/dx.



What's Done, What Isn't?



- The goal of the Reconstruction tests is so we know how the code in *G4MICE* is using *RecPack*, and if the values that we are passing it and the results it returns (track fit) are correct.
- Once the tests are finished. It will be possible to go step by step through every stage of the reconstruction process and confirm whether or not each stage is being performed as expected and if the output is reliable.



What's Done, What Isn't?



- Once new RecPack is released, these tests will then be able to check that the new version hasn't introduced any new issues.
- At which point, use of the field map can be used and matching to TOF etc. can be achieved.
- Current work is not just for KEK analysis, it will be useful/needed for every step of MICE and the upcoming Data Challenge, so seems to slow progress now but will speed things up massively in the long term.



Reconstruction Tests Description



- The idea is that for each physical quantity that is being tested, we will have two parallel tests.
- The first accumulates minimum, maximum, mean, RMS, etc. of each of the quantity's and performs a regression test with some reference output.
- A PAW hbook file is produced with one histogram per quantity.
- If the histograms look correct, then the regression tested output becomes the reference output.
- The histograms can be presented at a collaboration meeting as a benchmark for a given release's performance.
- By doing this we can keep track of changes made and hence the performance of the reconstruction.



Reconstruction Tests Description



- Changes may be positive (e.g. the resolution of the track fit is improved slightly) in which case the reference output is updated and all future releases are compared with this new, improved benchmark.
- Or could be bad changes (e.g. a sudden change in alignment resulting in non centered residuals) in which case the change in code or data files that produced the change will be rejected from a release until the bug is fixed.
- Current work is focused towards tests for:
 - SciFiDoubletCluster Done
 - SciFiSpacePoint Done
 - PatternRecognitionNoB (i.e. the straight line fit) Work in Progress
 - PatternRecognitionBField (i.e. the helix fit) Done
 - KalmanFitNoB (i.e. the full reconstruction) Work in Progress
 - KalmanFitBField (i.e. the full reconstruction) Done
- Eventually, we will also add tests of global matching, extrapolations, PID, etc...



Reconstruction Tests Description

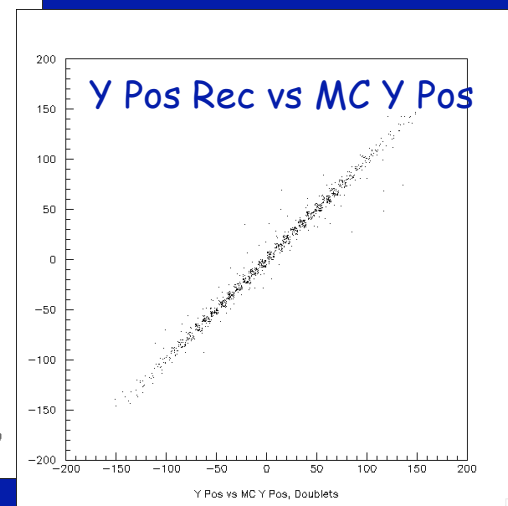
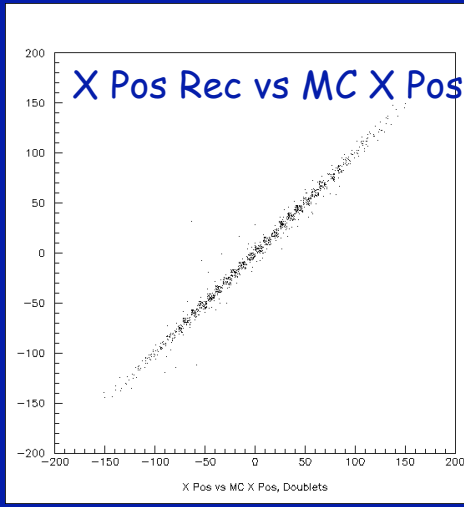
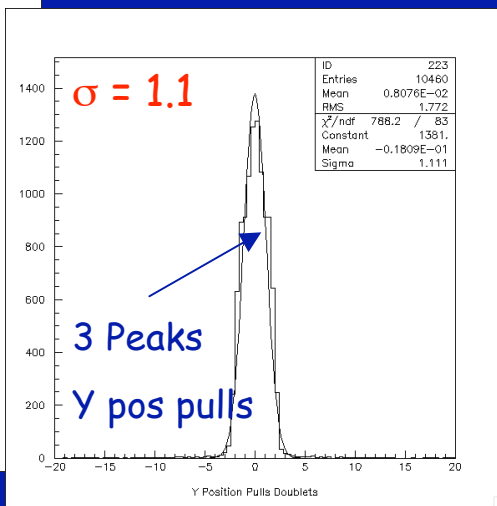
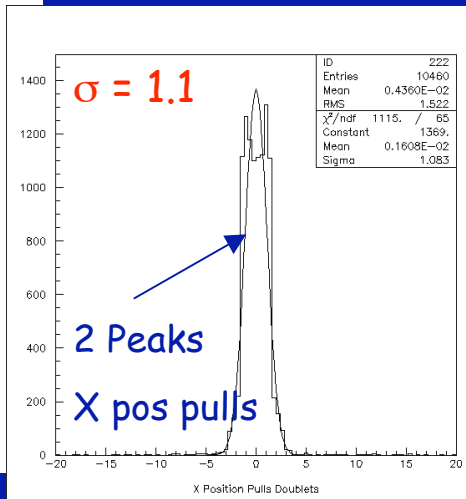
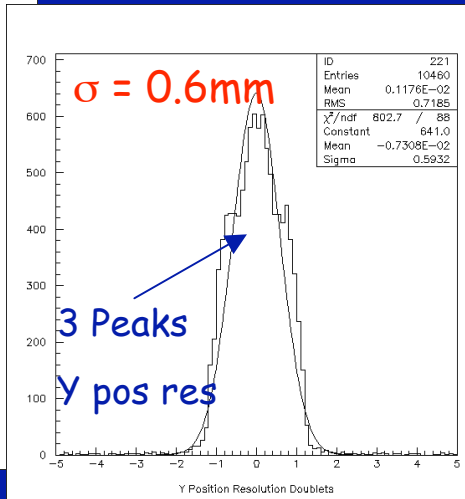
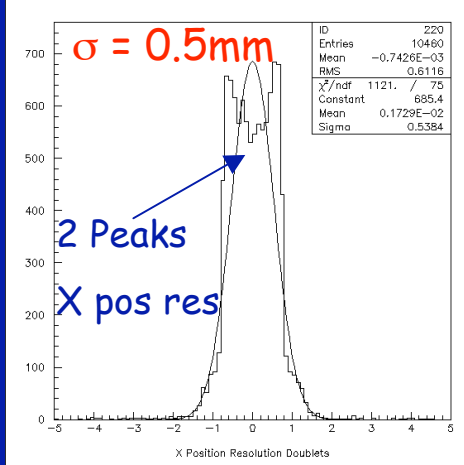


- In each case, an example of the physical variables that are tested should include (but are not limited to):
 - Reconstructed position (x, y, z) and momentum (p_x, p_y, p_z, p_t)
 - MC Truth position (x, y, z) and momentum (p_x, p_y, p_z, p_t)
 - Reconstructed position (x, y, z) and momentum (p_x, p_y, p_z, p_t)
 - Reconstructed position vs MC Truth position for each (x, y, z)
 - Reconstructed momentum vs MC Truth momentum for each (x, y, z, t)
 - Position Resolution (x, y, z)
 - Momentum Resolution (x, y, z, t)
 - Position Pulls (x, y, z)
 - Momentum Pulls (x, y, z, t)
- The next few slides will show results of the SciFiSpacePointTest, plots of doublets and triplets for both KEK and MICE stage 6.



SciFiSpacePointTest - Doublets

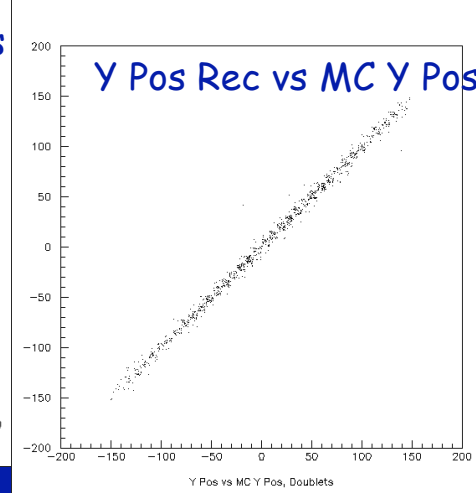
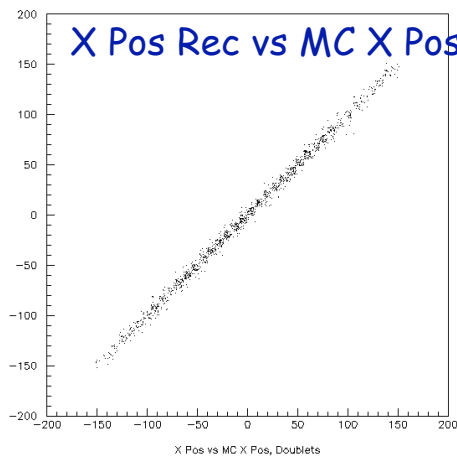
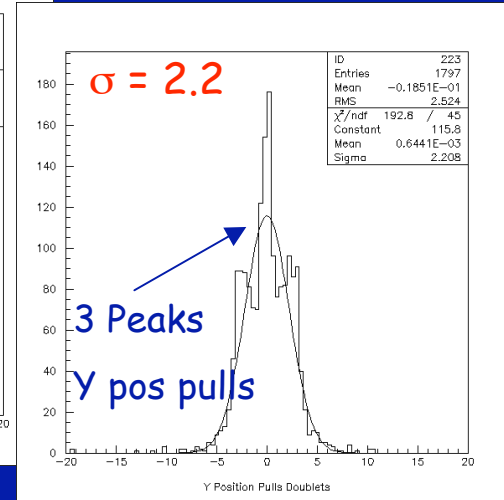
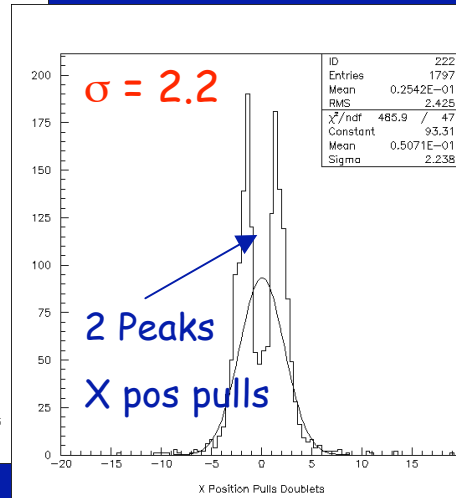
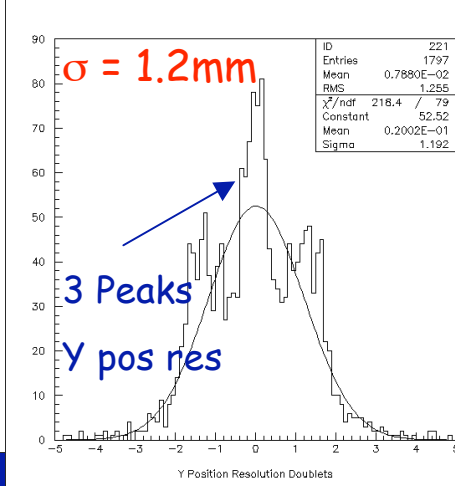
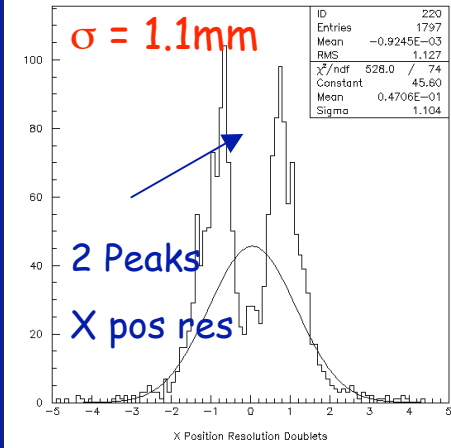
KEK Results



Need to understand and fix problem of 2/3 peaks in doublet x & y position resolutions and pulls??

SciFiSpacePointTest - Doublets

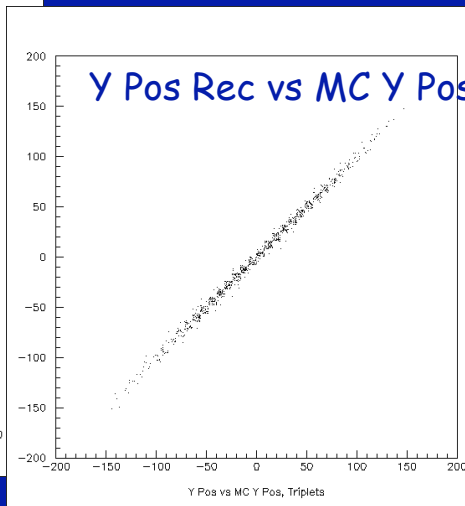
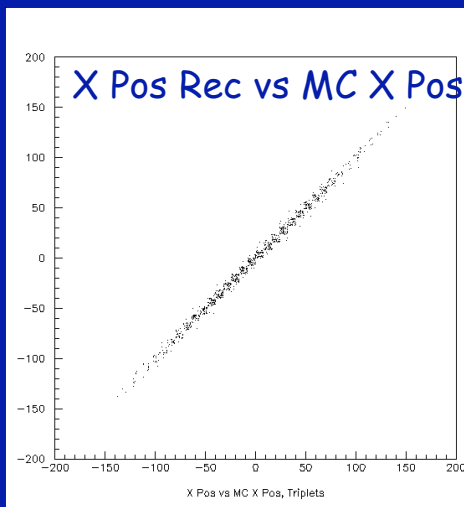
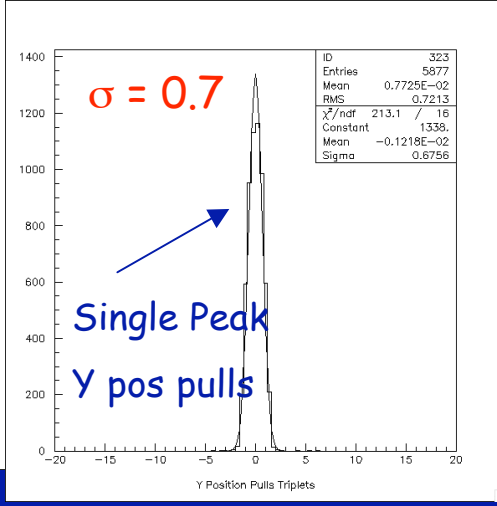
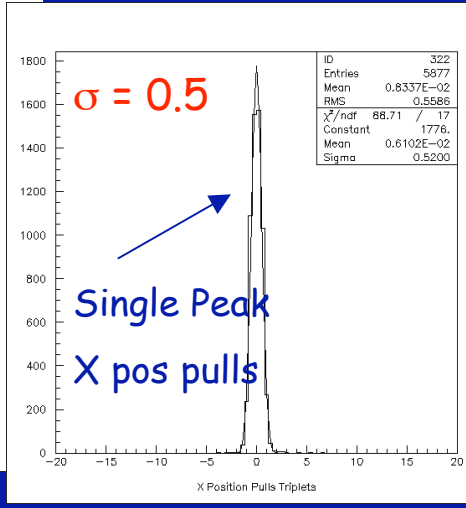
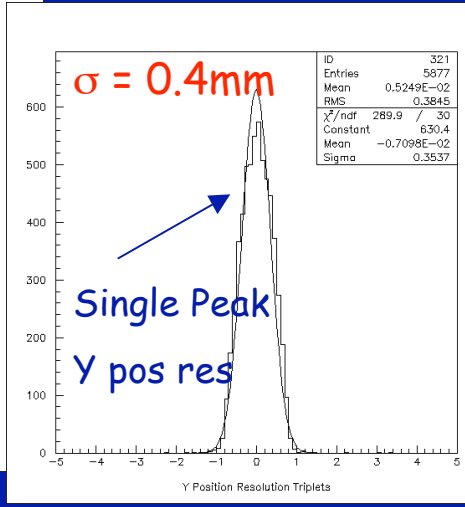
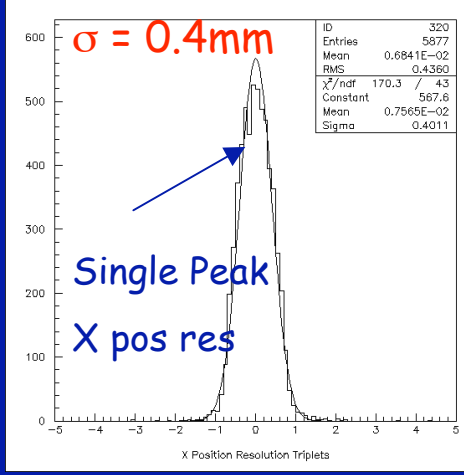
Stage6 Results



Again, same problem for stage 6 as KEK doublet x, y position resolutions and pulls??



SciFiSpacePointTest - Triplets KEK Results

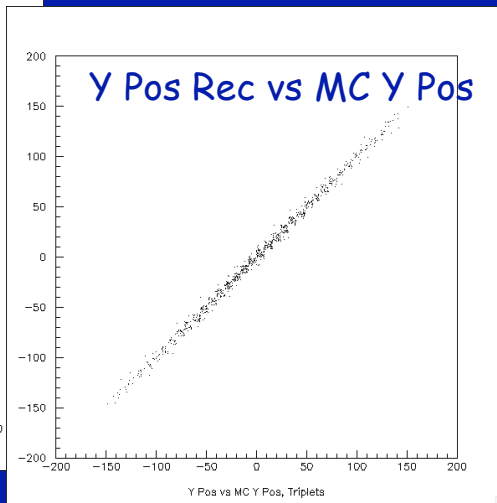
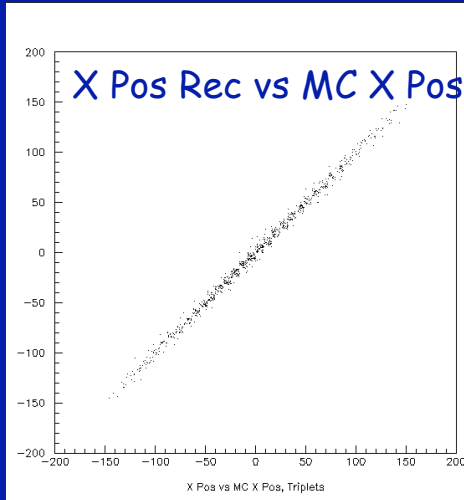
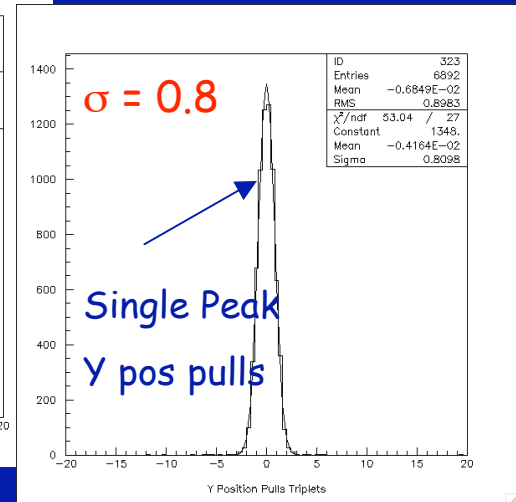
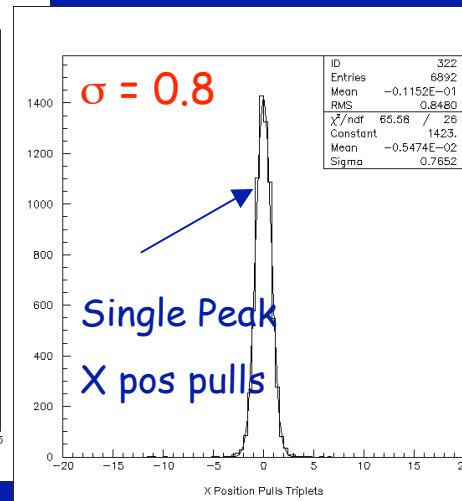
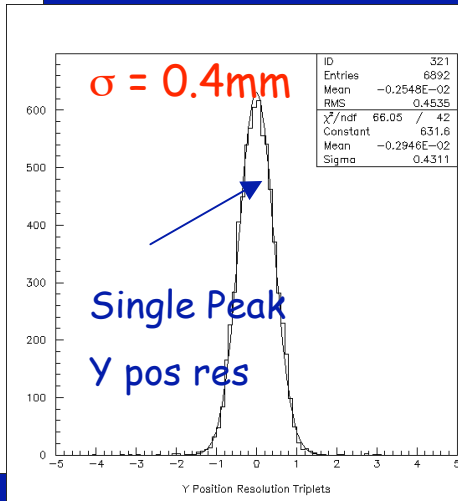
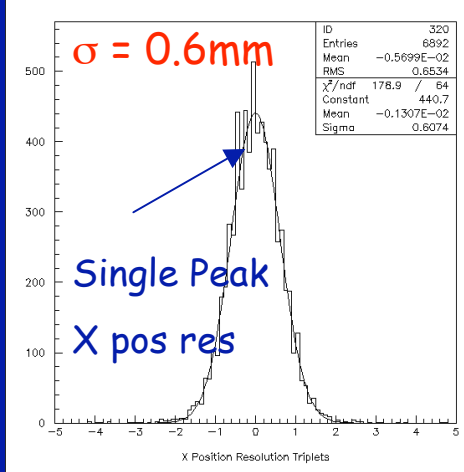


2/3 peak problem not seen
for KEK triplet x, y
position resolutions and
pulls??



SciFiSpacePointTest - Triplets

Stage6 Results



2/3 peak problem not seen for stage 6 triplet x, y position resolutions and pulls??



SciFiSpacePointTest Results



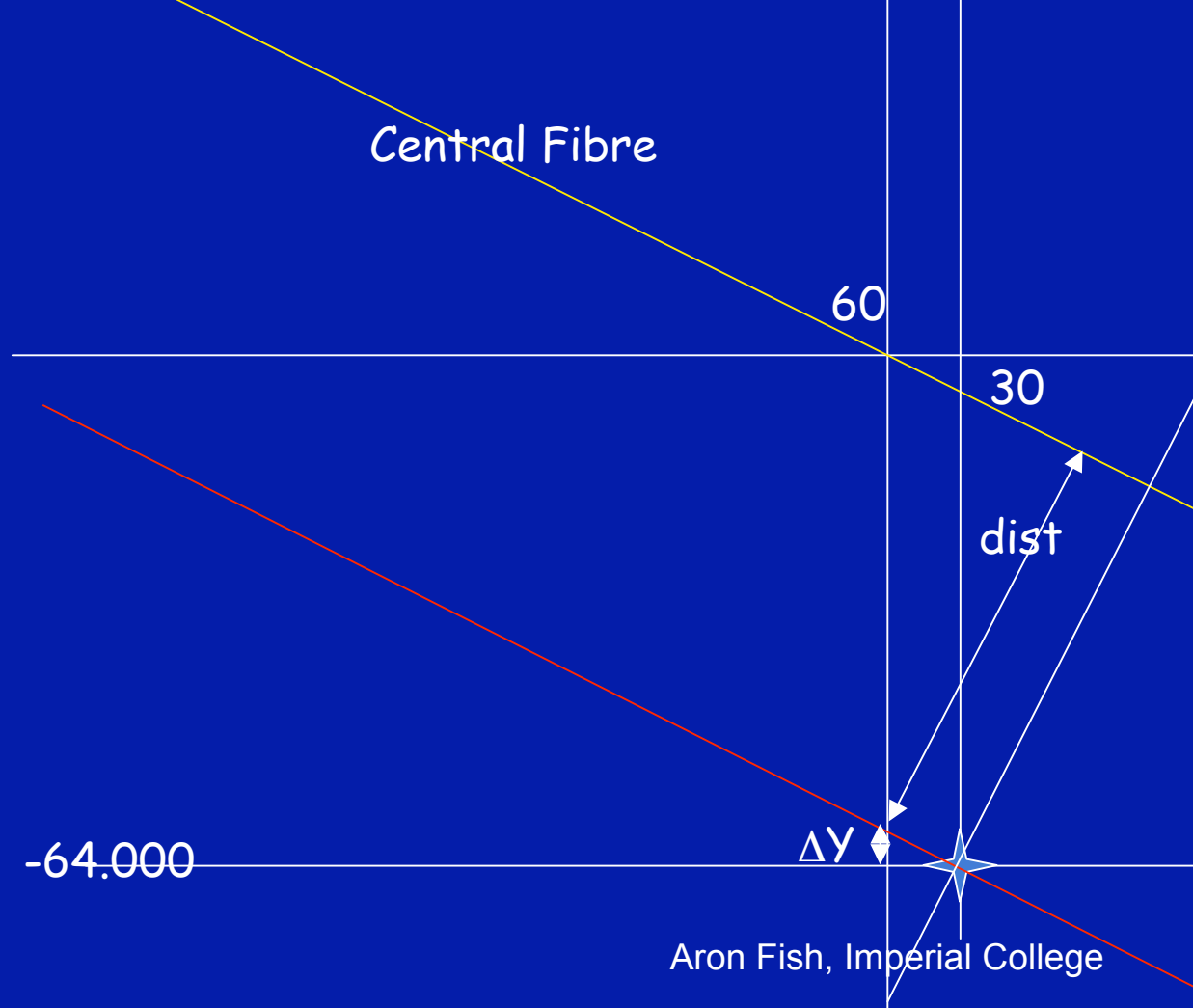
- Need to understand why we are seeing 2 peaks for x position & pulls and 3 peaks for y position & pulls? Problem only seen for doublets??
- In the last few days (since tracker workshop) we have been going through the maths by hand to try and verify that each stage is working correctly.
 - So far we have verified that the hit position is being simulated correctly, giving the correct fibre for the hit.
 - Also, the maths in G4MICE to calculate the clusters crossing position has been checked and is correct.
 - Other possible reasons? Still searching...



SciFiSpacePointTest Results - maths to find fibre hit



True position = { 5.054, -64.000 }
Simulated hit on Fibre = 70



Positions rounded to the nearest micron.

Central fibre of the W plane, goes through the origin of the coordinate system.

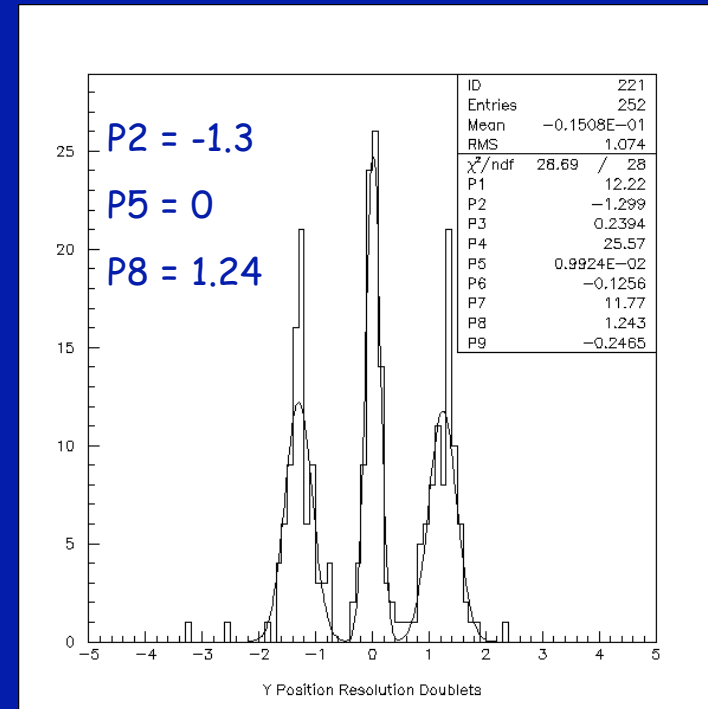
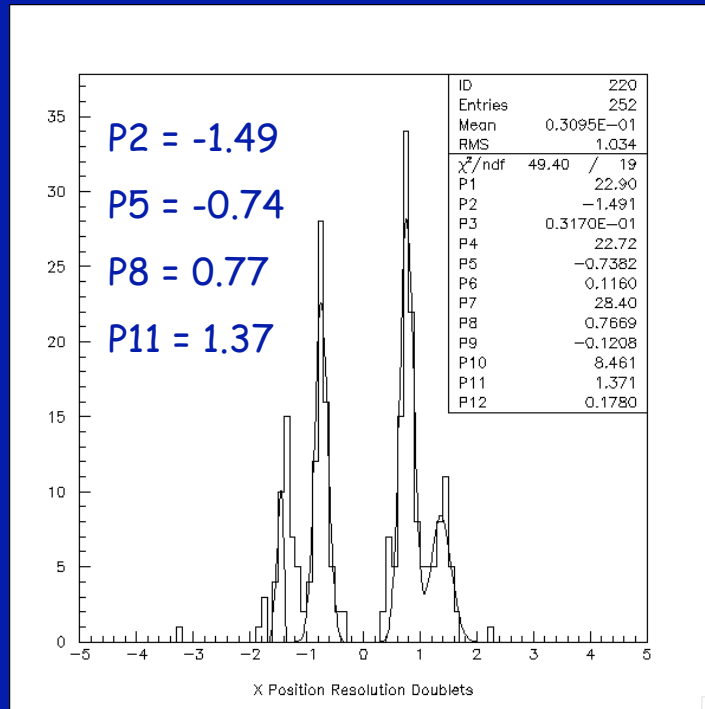
Line parallel to this that goes through the true hit position (i.e. fibre hit is on).

perpendicular distance:
 $\Delta Y = 5.054 * \tan(30) = 2.918$

New Y = -64.000 + 2.918 = -61.082

So dist = 61.082 * sin(60) = 52.899

We then divide by the channel pitch and get: 52.899 / 1.47 = 36 channels 105.5 - 36 = 69.5 which we round to channel 70.



Results with MCS switched off we see an interesting effect:
 X position Resolution: 4 peaks? Means \sim channel pitch/2 apart
 Y position Resolution: 3 peaks? Means \sim channel pitch apart



Next Steps



- 1st task is to fix the bug in SciFiSpacePoints reconstruction, this is already a work in progress
- 2nd fix PatternRecognitionBField
- 3rd fix KalmanFitBFieldTest bug
- Finish writing last 2 tests (PatternRecognitionNoB and KalmanFitNoB), should just involve small change for straight tracks
- Also, not mentioned today, but an Application is now written and working which simulates the time of every muon hit in the tracker(s) for every step of MICE. Which will be useful information for Craig MacWaters et al. in terms of defining L1A to send to the AFEIIt boards. So for the different steps of MICE minor adjusts are needed when tracker 1 is moved further & further downstream.