DEEP UNDERGROUND NEUTRINO EXPERIMENT

The University Of Sheffield.

Event display improvements, Fix to photon detector flash width

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Photon Flashes

- During run want to match tracks with Photon Flashes and muon counters to get T0.

- Pursuing how this is possible, and in doing so found a couple of interesting things…

- The below two things were presented yesterday at LArSoft co-ordination meeting, so will be in next release.

Adding Flashes to event display

- Can already see Flash information on 2D wire plane view of event display, but not on Ortho3D.
  - Clear benefit of being able to see location of flashes in Y, Z planes.
- Added a function to RecoBaseDrawer.cxx - OpFlashOrtho
  - Takes art::event, eve::OrthoProj_t and evdb::View2D as arguments.
  - Accesses OpFlash information (Centres and widths of flashes in Y and Z) and adds them to the Ortho3D event display if DrawOpFlash == 1.

Fix to width of OpFlash

- After adding flashes to event display I noticed that the width of flashes was very large.

- Gleb noticed that calculation of width was incorrect.

- Function is in larana/OpticalDetector/OpFlashAlg.cxx

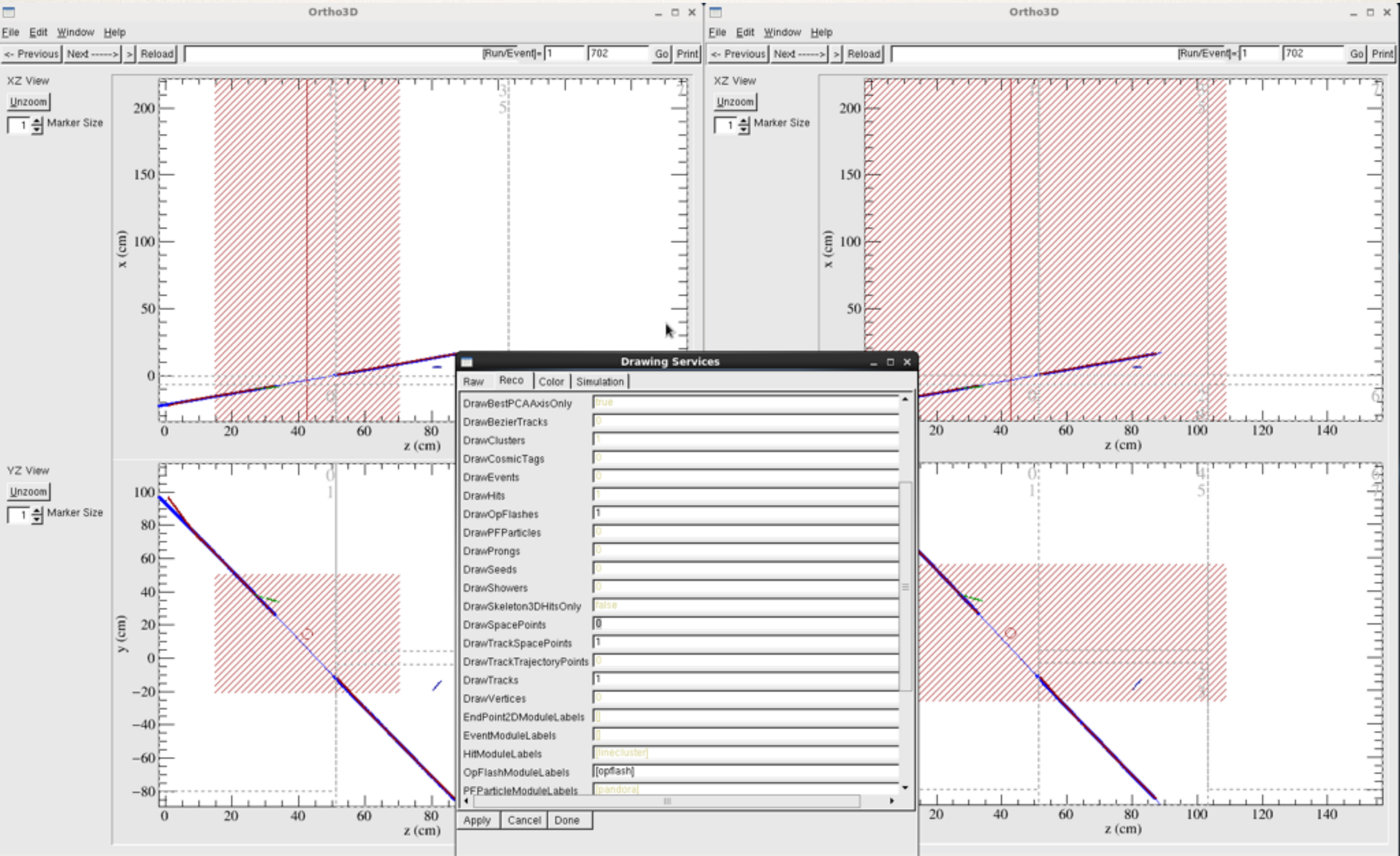
```
double CalculateWidth(double const& sum, double const& sum_squared, double const& weights_sum){
    //return std::sqrt( sum_squared*weights_sum - sum*sum )/weights_sum; // GVS bugfix
    return std::sqrt( sum_squared*weights_sum + sum*sum )/weights_sum;
  }
```

- The ‘+’ should be ‘-‘ as per RMS calculation.

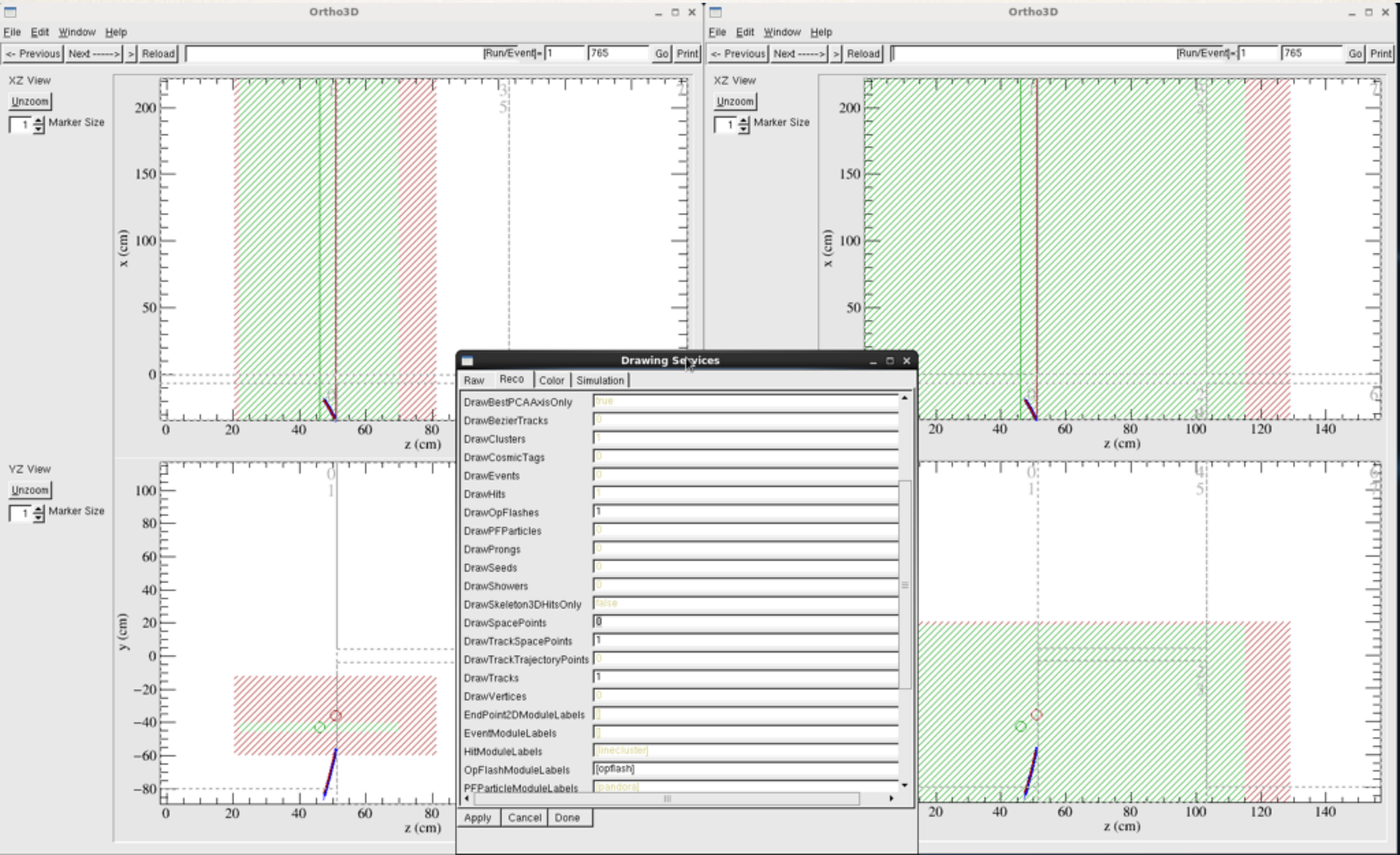
Comparing event display

- On the subsequent slides I am showing the new Flash information on the event displays. I used the evd_lbne35t.fcl event display.
- Left hand side is the corrected width calculation.
- Centre is the Reco Drawing Services option box.
- Right hand side is the uncorrected width calculation.
- Key to understanding the plot…
  - Blue line - MCTruth Particle trajectory.
  - Red line - Reconstructed track.
  - Circle - Flash centre. (Is a line in the XZ plane as no X information)
  - Shaded box - Area where flash could be, taken to be range of flash centre +/- width.

Comparison with one Flash



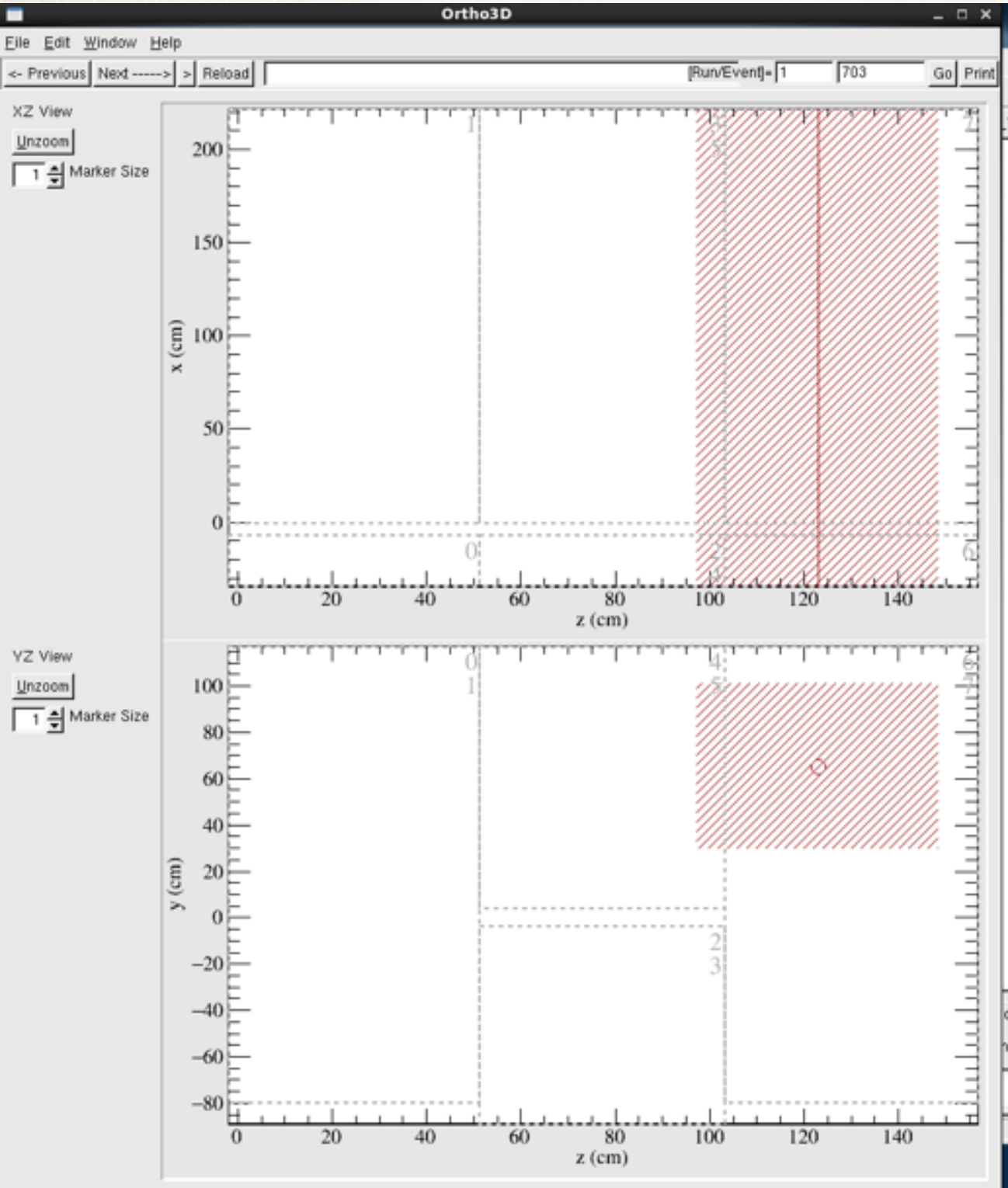
Comparison with two flashes

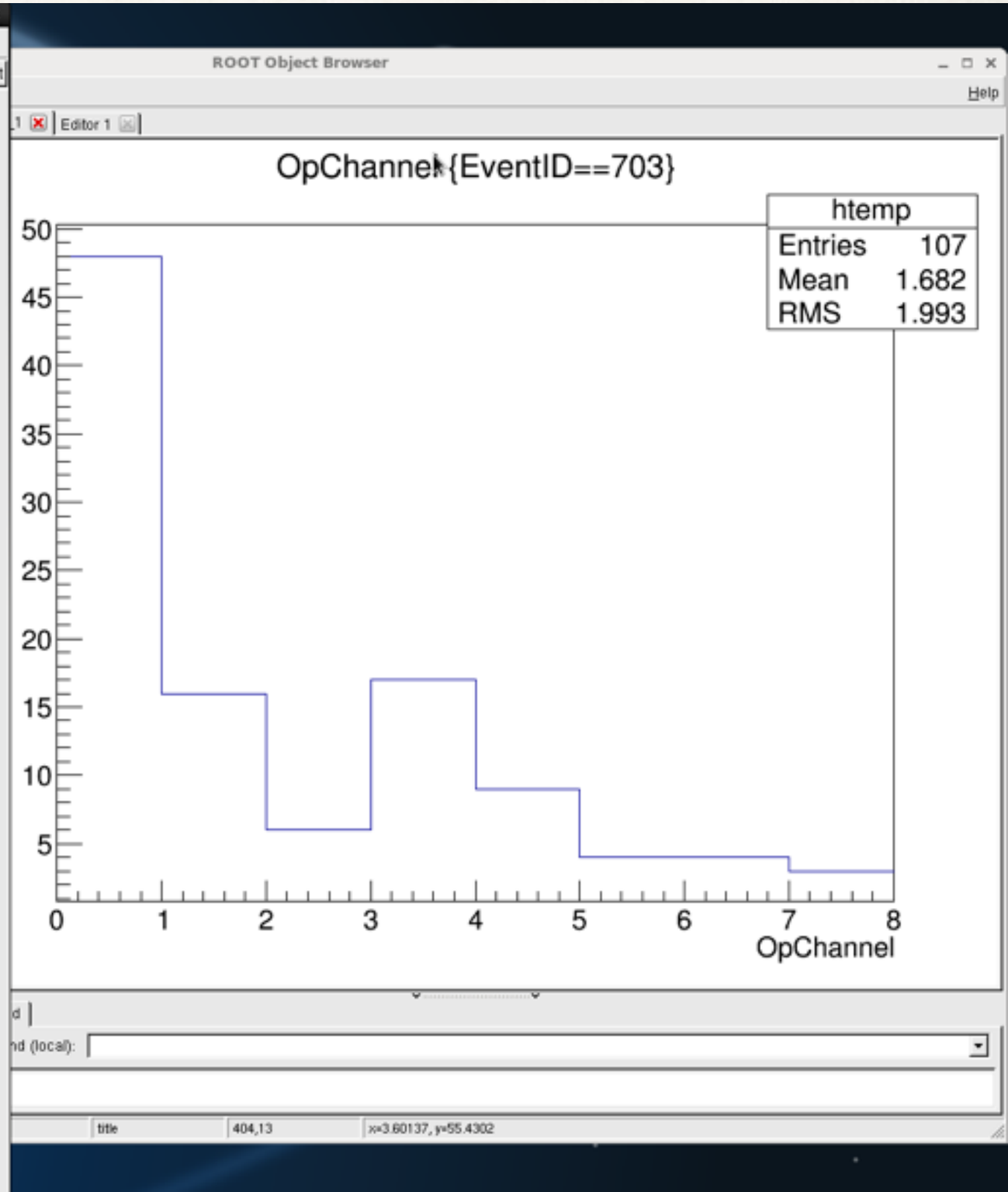


Other interesting things I've found

- Sometimes there are flashes in the TPC when there are no MCParticles in the TPC.
  - Is OpFlash working properly?
  - Yes! If particle goes through LAr but not TPC will get recombination photons which are collected, even though observe no track.
  - In the below plot, a muon has passed through the top left (in YZ plane) corner of the Cryostat, but not gone into the TPC. Therefore, though there are recombination photons, there is no track in the TPC.
  - Looking at the SSP's which record hits, can see that this is the case.

Muon through LAr but not TPC





Conclusion

- Now have optical flash information in the event display.

- Fixed a bug where the width of a flash was calculated incorrectly, meaning it was too large.

- Flashes and flash finders are behaving as expected.

- Need to look further at trying to match tracks with flashes.