TB2016 Reconstruction with LumiCalClustererClass

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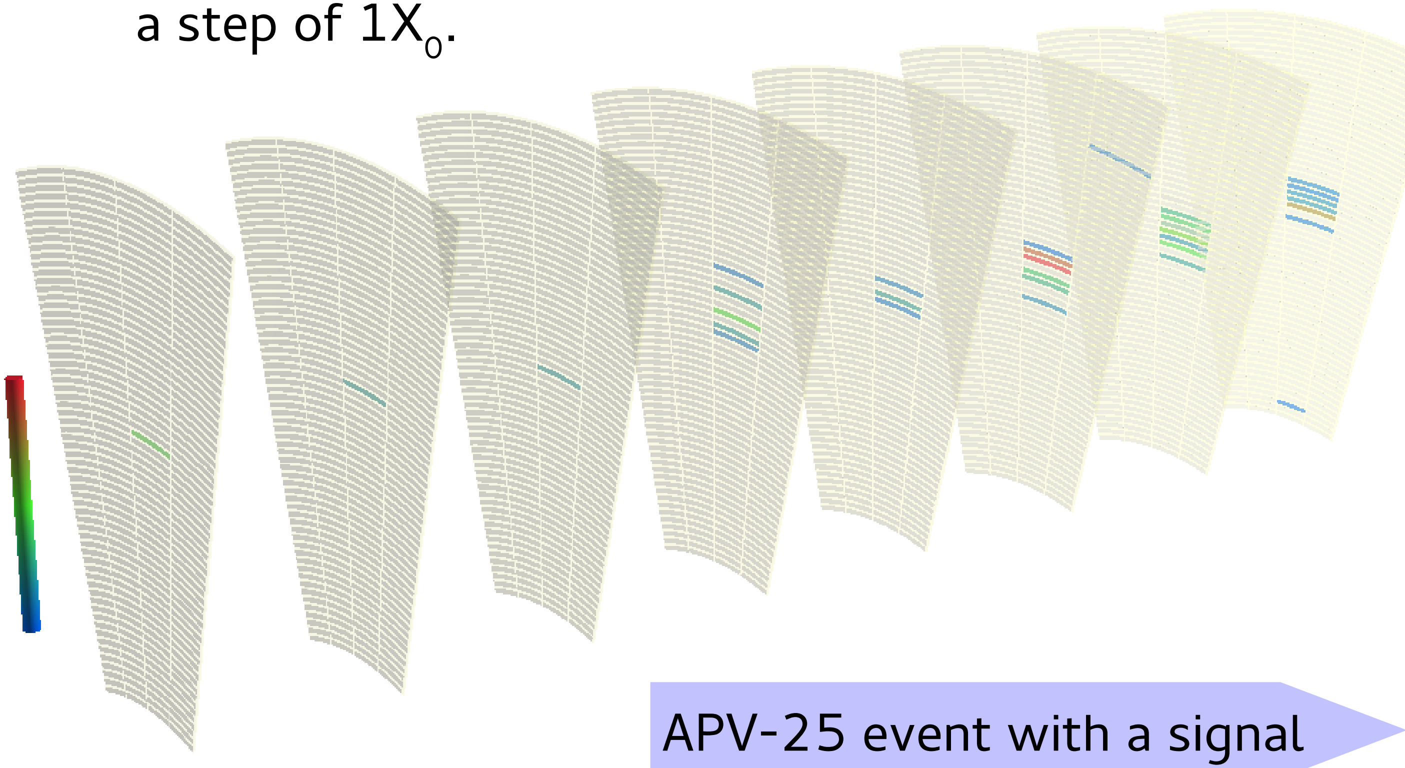
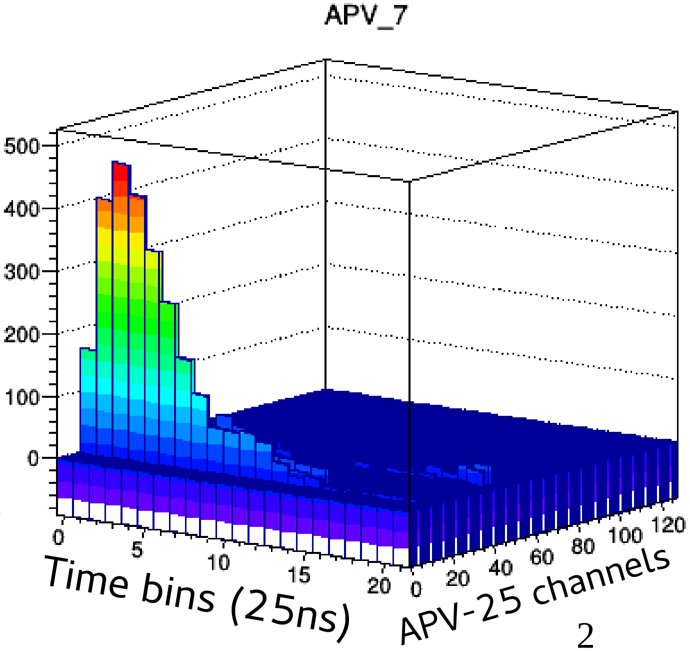
Event Example

- First two planes are installed without absorbers - tracking detector:
  - The goal is to study the possibility of using a tracking detector in front of LumiCal for e/γ identification, it is important for various physics analysis at LC.
- Three absorbers are installed in front of the third plane ($3X_0$).
- One absorber is installed between other planes. Sampling from $4X_0$ to $7X_0$ with a step of $1X_0$.



TAB Module



APV-25 event with a signal

Root TTree Output

MMDAQ raw data is saved in TTree together with calibration (noise, pedestal) and run parameters in root file.

The first reconstruction stage saves results also in root files using TTree.

Produces two files:

- RunXXX_....._plot.root   : histograms
- RunXXX_....._reco.root   : Tree with extraced signal

```
UInt_t     m_apv_evt;
std::vector <UInt_t>        m_apv_fec;
std::vector <UInt_t>        m_apv_id;              // APVChip;
std::vector <UInt_t>        m_apv_ch;              // APVChannel;
std::vector <Double_t>      m_apv_signal_maxbin;    // maximum value of the bins in signal range
std::vector <Double_t>      m_apv_signal_bint1;     // value of time bin m_apv_bint1
std::vector <Double_t>      m_apv_signal_bint2;     // value of time bin m_apv_bint1+1

std::vector <Int_t>         m_apv_maxbin;           // number of the time bin with maximum signal
std::vector <Int_t>         m_apv_bint1;            // number of the fixed time bin for this apv and this run

std::vector <Double_t>      m_apv_signal_maxfit;    // maximum of the fit with RC-CR response function
std::vector <Double_t>      m_apv_fit_t0;           // t0 of the fit with RC-CR response function
std::vector <Double_t>      m_apv_fit_tau;          // tau of the fit with RC-CR response function
std::vector <Double_t>      m_apv_fit_chi2;         // chi2 of the fit with RC-CR response function
std::vector <Double_t>      m_apv_nn_output;        // neural network output
```

No selections are applied in the event loop.

Output Tree

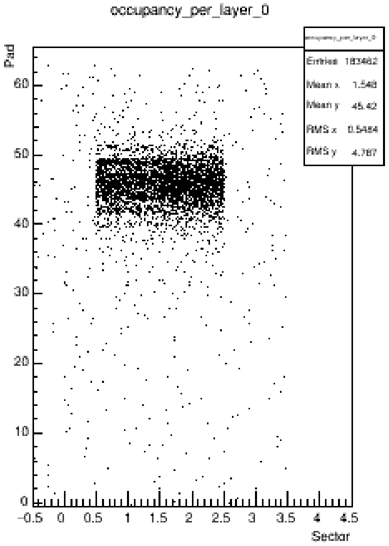
```
APV_Reco_Tree *apv_reco = new APV_Reco_Tree(fnames_vec);
  while (apv_reco->Next()) {
    const std::vector <UInt_t>    *p_apv_id = apv_reco->GetAPVid();
    const std::vector <UInt_t>    *p_apv_ch = apv_reco->GetAPVChannel();

    const std::vector <Double_t>  *p_signal_maxfit = apv_reco->GetSignalMaxFit();
    const std::vector <Double_t>  *p_nn_output = apv_reco->GetSignalNNOutput();
    ...
    int nsig = p_apv_ch->size();
    for (int ii = 0; ii < nsig; ++ii) {
      ....
      if (   p_nn_output->at(ii) > 0.98  && ....)  {
        apv_hists->FillHist("signal_max", p_apv_id->at(ii), p_signal_maxbin->at(ii));
        ....
      }
      ....
    }  // active channels of APVs
  } // events
```

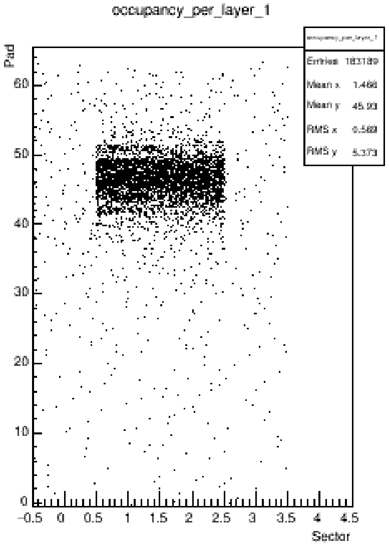
LCIO Output

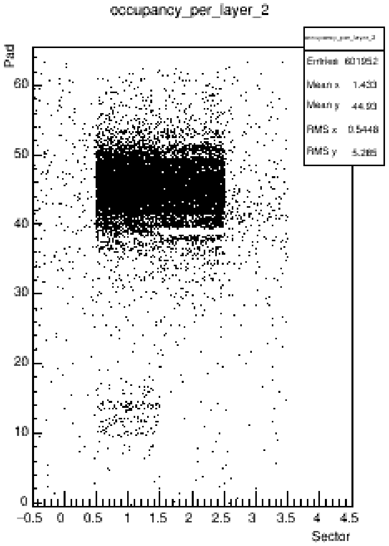
LCOI is produced from the root with selection criteria applied

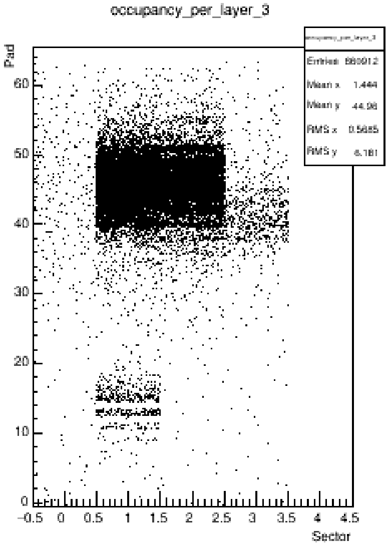
```
 CollectionName = "LumiCalSimHits"
 fcalVec = new IMPL::LCCollectionVec( EVENT::LCIO::SIMCALORIMETERHIT );
 fevt->setEventNumber(fevid);
 fevt->addCollection(fcalVec, CollectionName);   // add the collection with a name
 cellid = new UTIL::CellIDEncoder<IMPL::SimCalorimeterHitImpl>( "I:7,J:6,K:6,L:2" ,fcalVec );
                                                  // rCell 0-64, phiCell 0-48, layer 0-40, side 0-1

IMPL::SimCalorimeterHitImpl* hit = new IMPL::SimCalorimeterHitImpl ;

(*cellid)["I"] = pad_id & 0xff ;                 // cell number in sector, rCell
(*cellid)["J"] = (13 - sector_id) & 0xff ;       // sector number, phiCell
(*cellid)["K"] = (layer_id + 1) & 0xff ;         // layer number
(*cellid)["L"] = 0 & 0xff ;                      // side, arm;
```

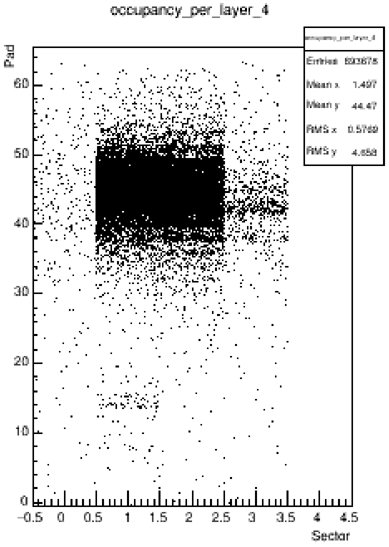
Run 741, Occupancy per Leyer

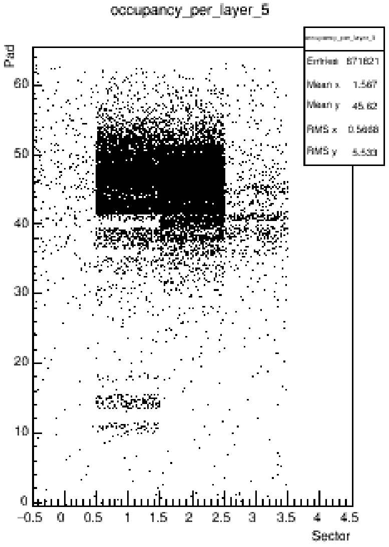


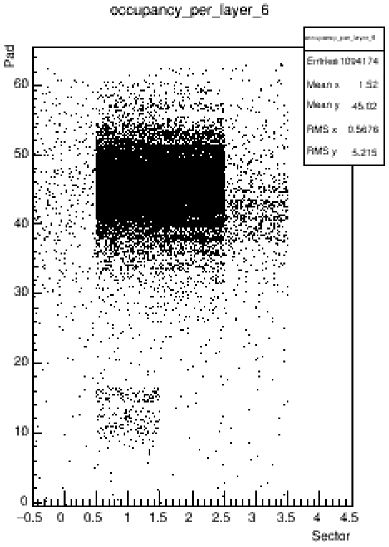


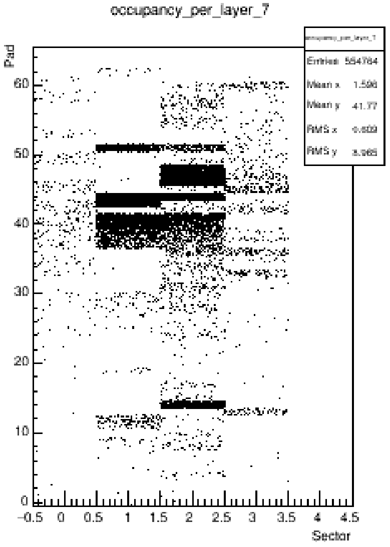










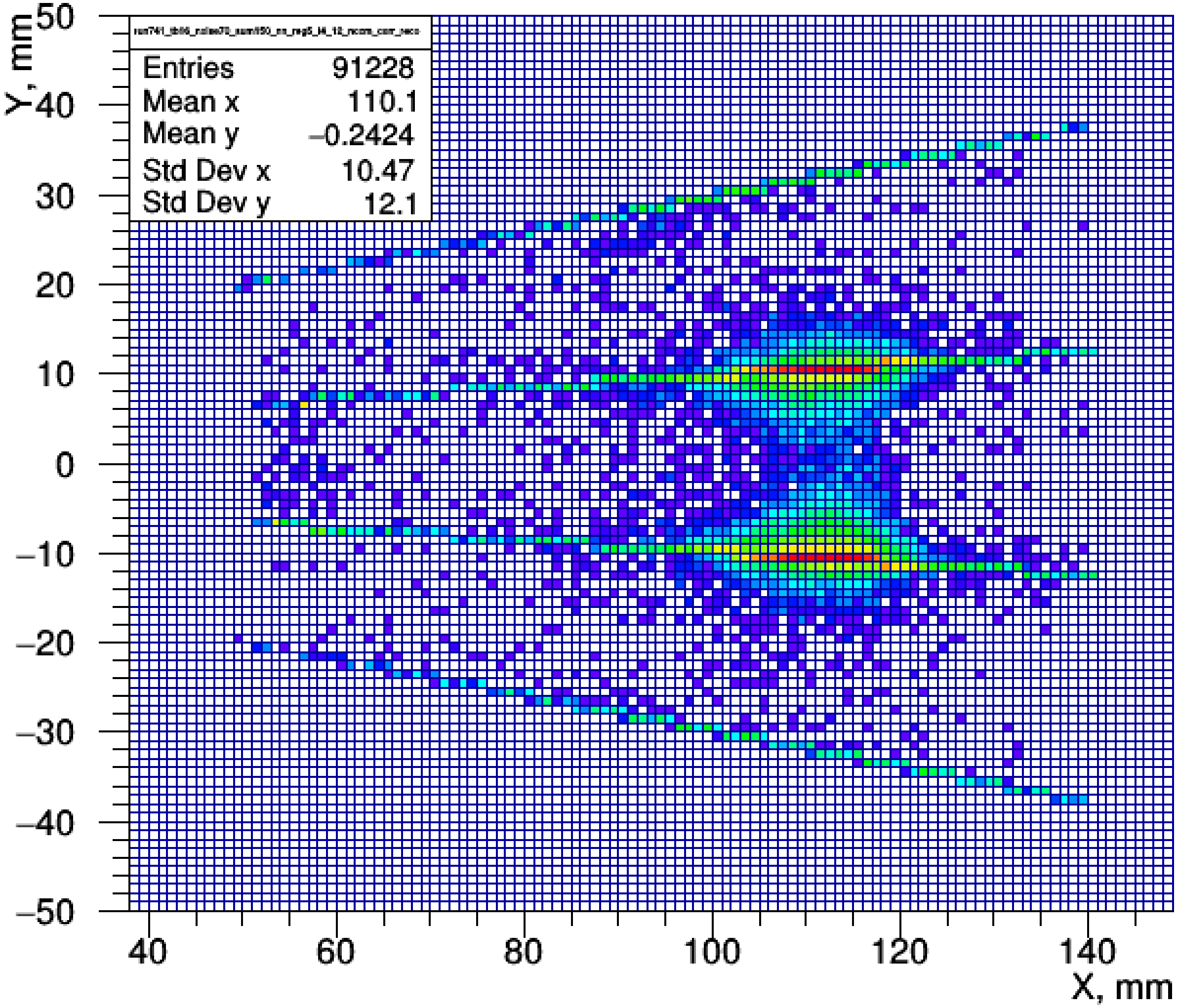


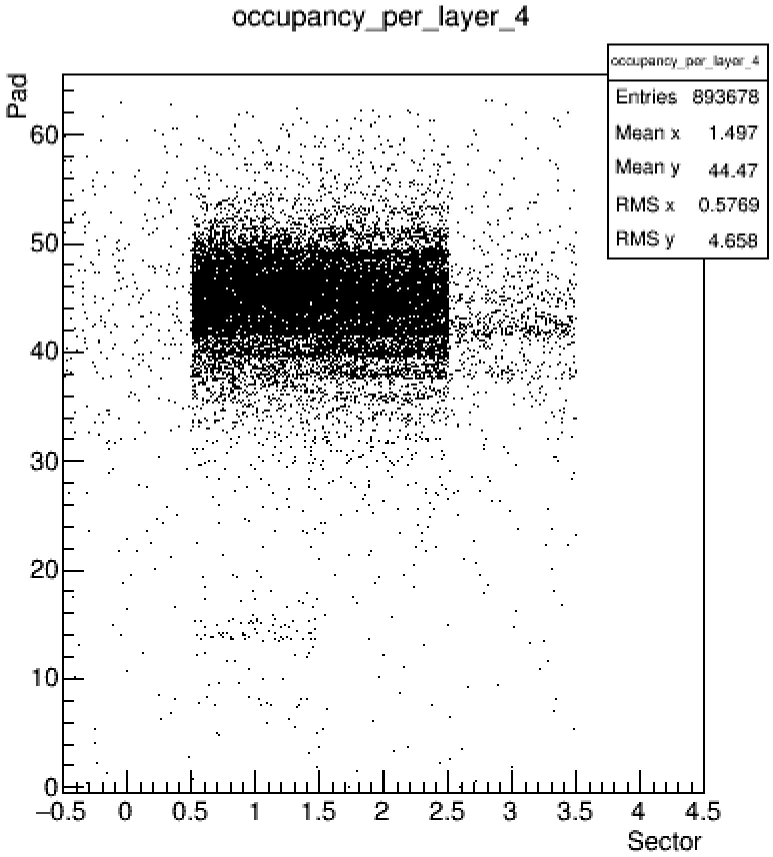
Run 741, Clusters

55371 events;

5 GeV e$^-$ beam, w/ Charge Div.

No target, (no photons).





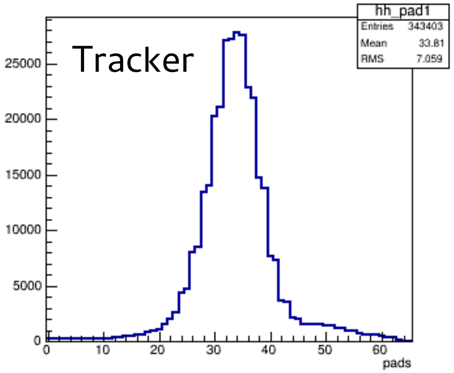
Run 771, Clusters

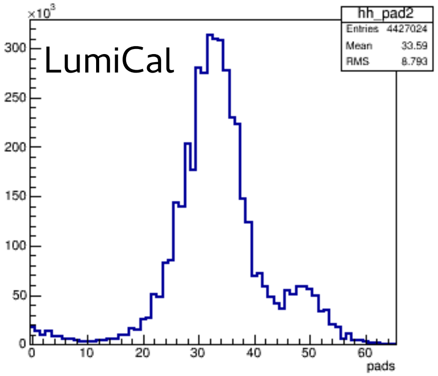
50027 events;

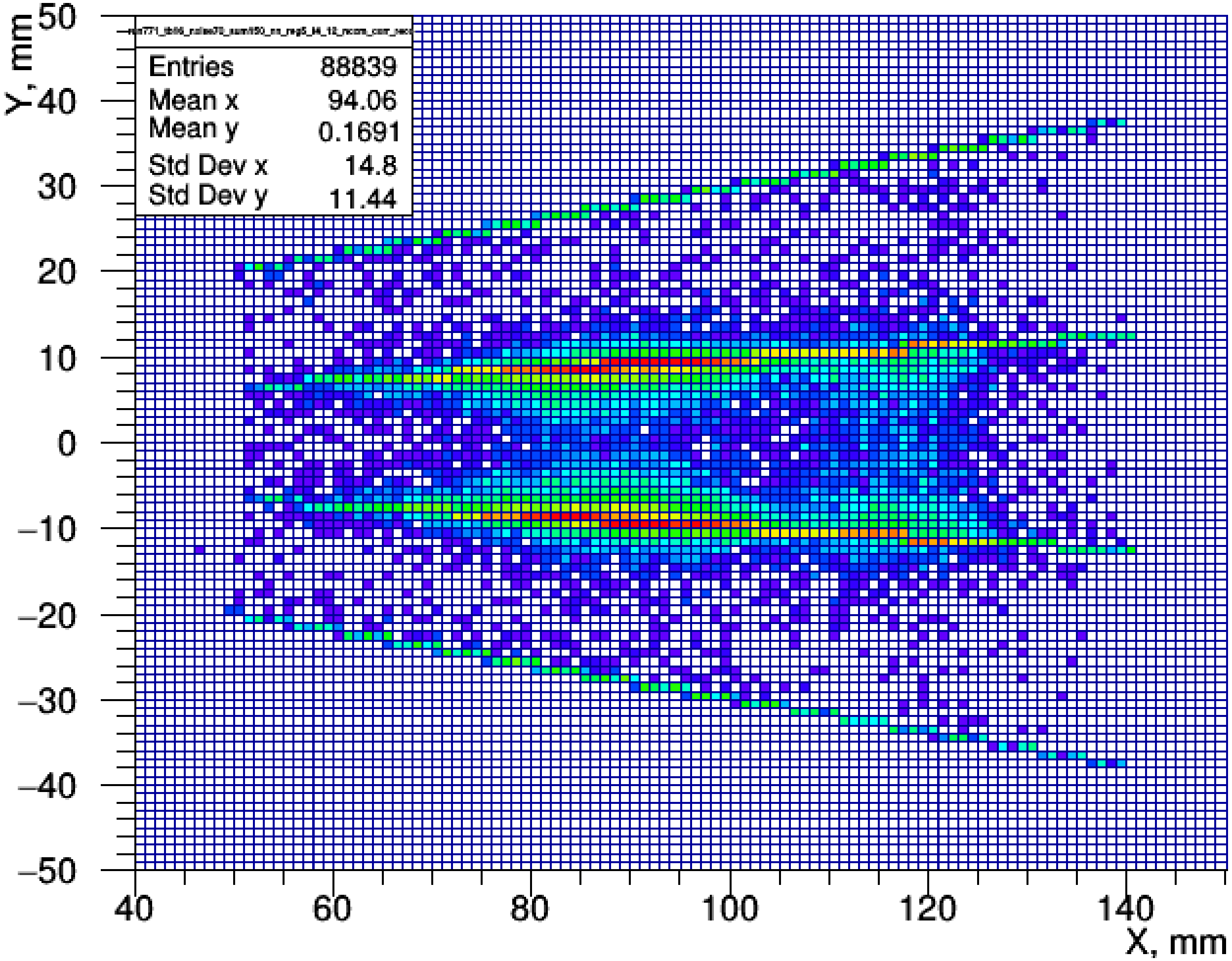
5 GeV e- beam, w/ Charge Div.

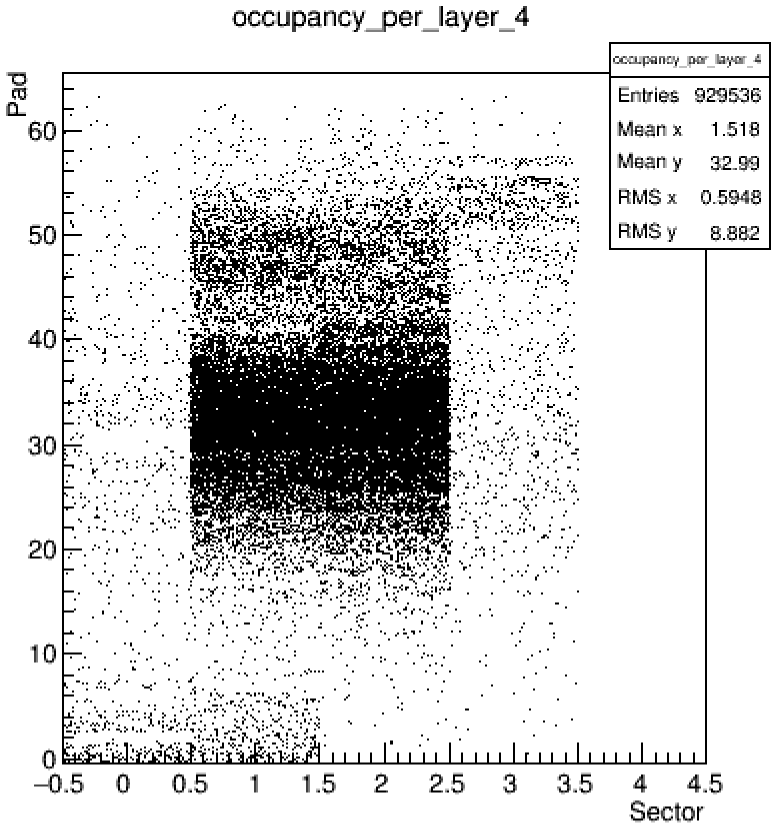
1.5 mm Cu target,

Low Eγ trigger.



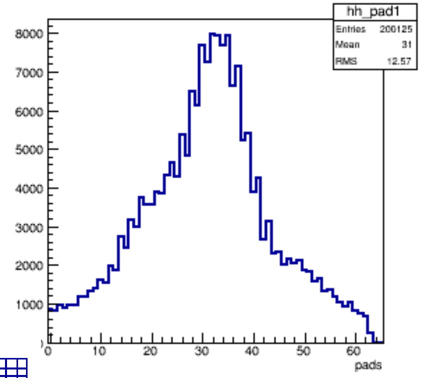


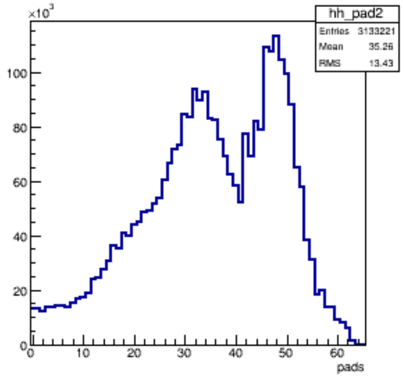


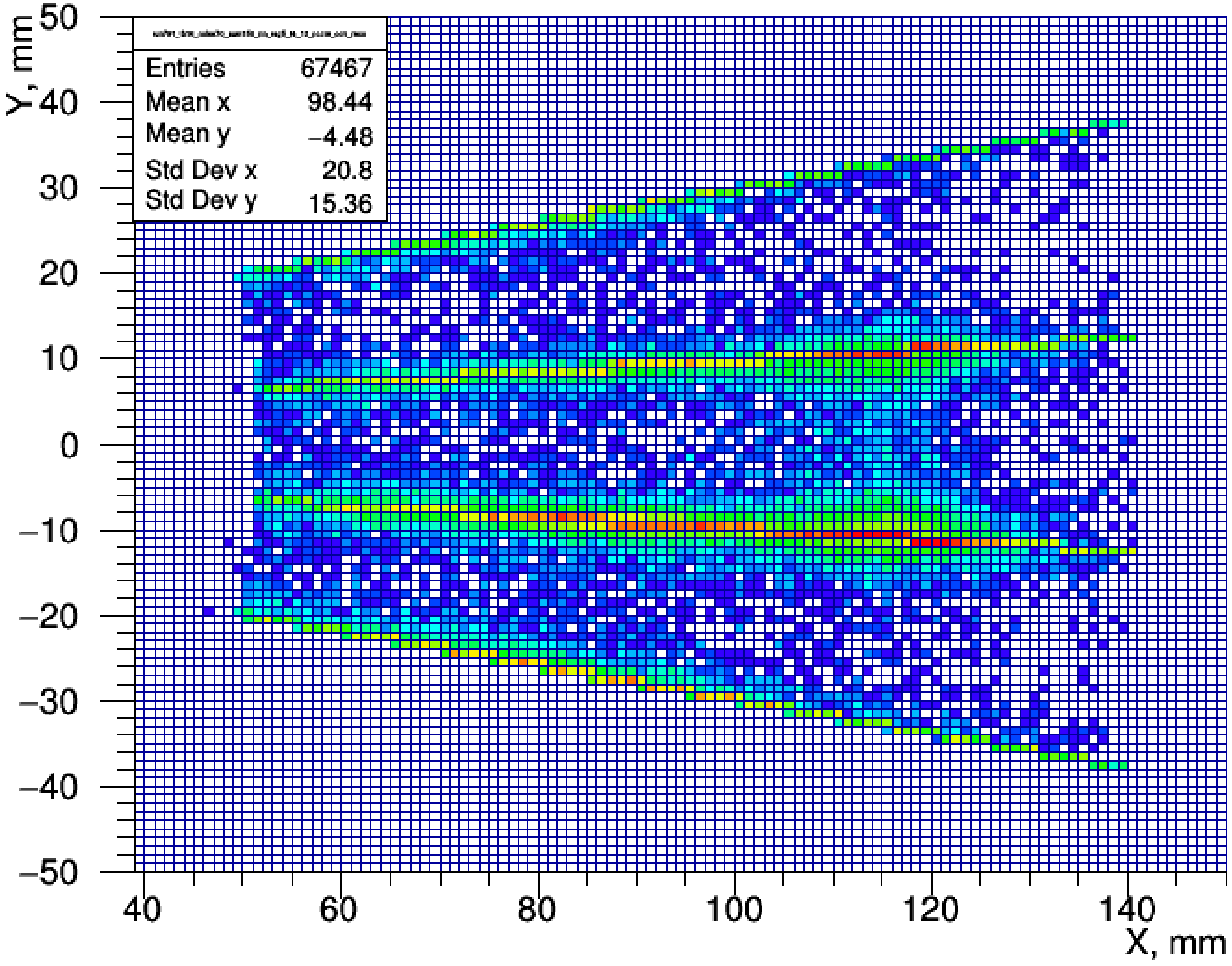


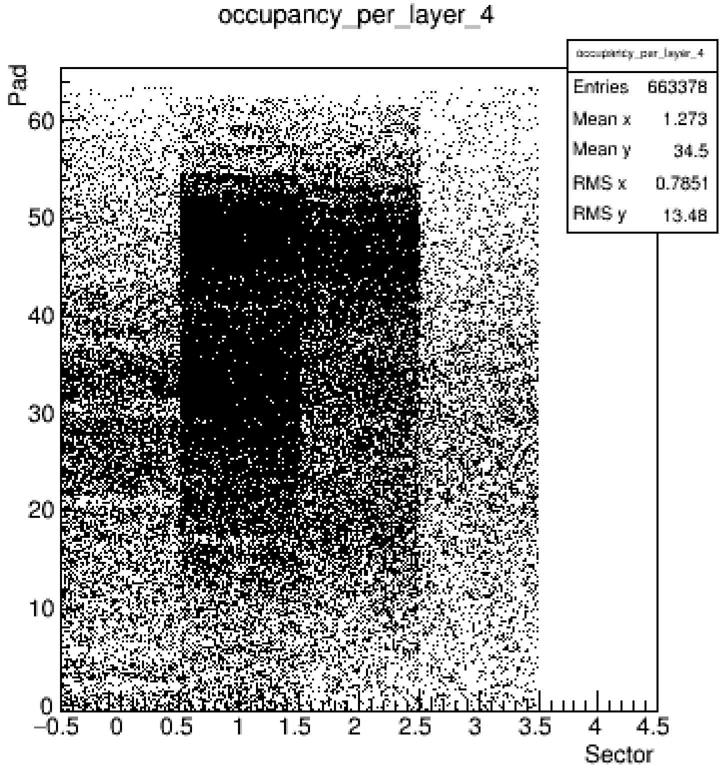
Run 791, Clusters

38611 events;
5 GeV e- beam, w/ Charge Div.
2.5 mm Cu target,
High Eγ trigger.









Summary

- First attempt to use LumiCalClustererClass demonstrates that it can work with TB2016 data even without changes.
- The parameters of the clustering should be optimized for the energy of the test beam electrons.