Neutron Energy Reconstructions

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Get single particles steering files from clusters
Generate single particles events with npsim
Run the EICrecon
Merge Outcomes
Reconstruct events: The next step is then to produce the NTuples for calibration, so you'll want to run FillBHCalClusterCalibrationTuple.cxx over each of the EICrecon outputs.

Now it's time to do the calibration! Before running anything, you'll want to make these changes in the TMVAClusterParameters.hxx:
Change this block of code

```
// -----------------------------------------------------------------------
//! Cuts to apply when training
// -----------------------------------------------------------------------
const TCut trainCut(
  "((eSumBHCal>=0)||"
  "(eSumBEMC>=0))&&"
  "(abs(hLeadBHCal)<1.1)&&"
  "(abs(hLeadBEMC)<1.1)"
);
```

To

```
// ---------------------------------------------------------------------------
//! Cuts to apply when training
// ---------------------------------------------------------------------------
const TCut trainCut(
  "((eSumBHCal>=0)||"
  "(eSumBEMC>=0))&&"
  "(hLeadBHCal<0.1)&&"
  "(hLeadBHCal>-1.1)&&"
  "(hLeadBEMC<0.1)&&"
  "(hLeadBEMC>-1.1)"
);
```

(That way we're only training on the side without the hole).
And then similarly, change the block :

```
// ---------------------------------------------------------------------------
//! Cuts to apply while reading input tuple
// ---------------------------------------------------------------------------
const TCut readCut(
  "(eLeadBEMC>0.5)&&"
  "(eLeadBEMC<100)"
);
```

To

```
// ---------------------------------------------------------------------
//! Cuts to apply while reading input tuple
// ---------------------------------------------------------------------
const TCut readCut(
  "(eLeadBEMC<100)&&"
  "(hLeadBHCal<0.1)&&"
  "(hLeadBHCal>-1.1)&&"
  "(hLeadBEMC<0.1)&&"
  "(hLeadBEMC>-1.1)"
 );
```

(And that way when we apply the model, we're only using clusters on the side without the hole)

And then run TrainAndApplyBHCalClusterCalibration.cxx on the macro output! You'll want to set the last option (do_read_cut) to true!

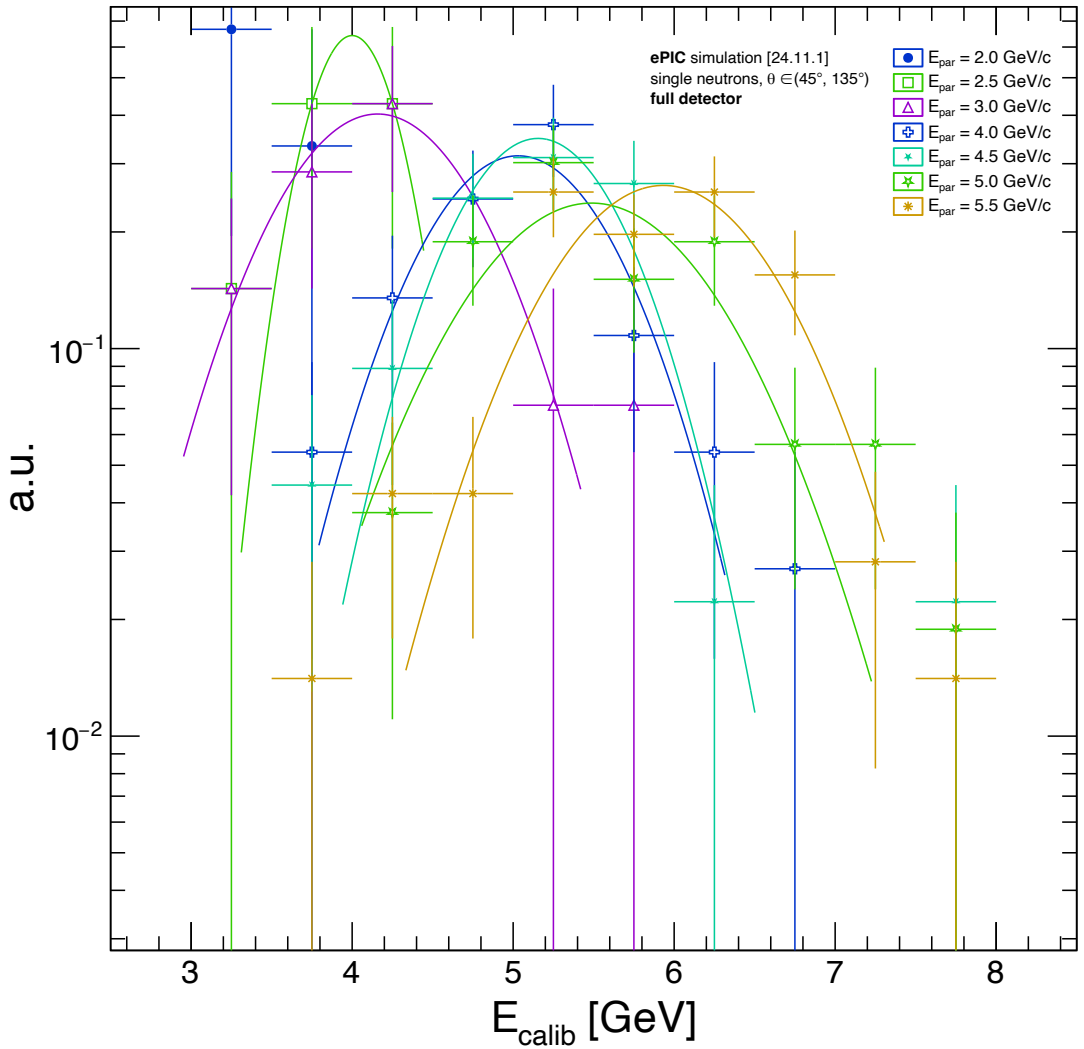
So now it's time to make histograms! You'll want to run FillBHCalClusterHistograms.cxx on your input & output to TrainAndApplyBHCalClusterCalibration.cxx.
Before you do that, you'll need to update the kinematic points to reflect the ones you ran with. So you'll want to change the block of code at line 58 from

```
const std::vector<std::tuple<std::string, float, float, float>> vecParBins = {
  std::make_tuple("Ene2",  2., 0., 4.),
  std::make_tuple("Ene5",  5., 4., 6.),
  std::make_tuple("Ene7",  7., 6., 9.),
  std::make_tuple("Ene10", 10., 9., 100.)
 };
```

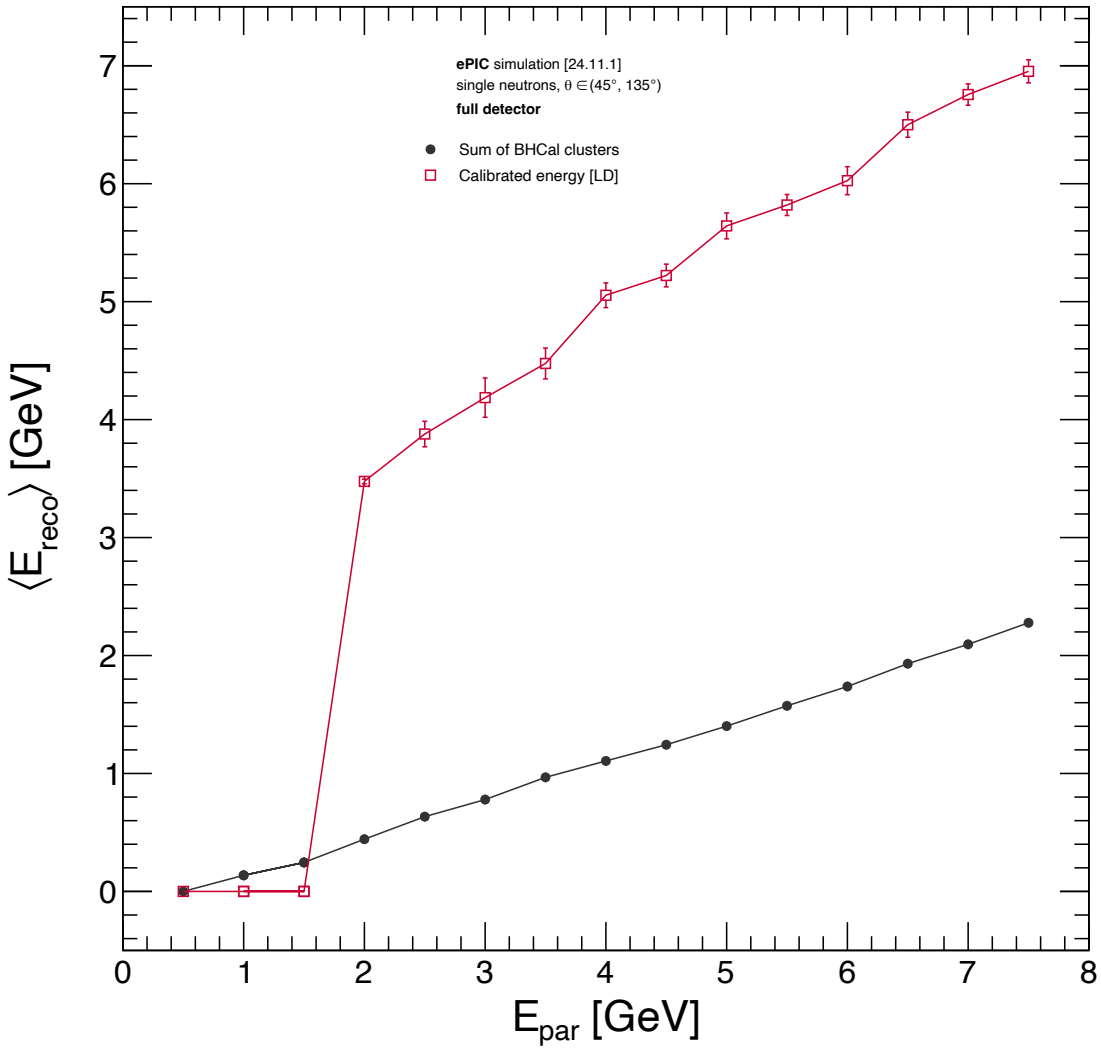
```
const std::vector<std::tuple<std::string, float, float, float>> vecParBins = {
  std::make_tuple("Ene0_5",  0.5, 0.25, 0.75),
  std::make_tuple("Ene1_0",  1.0, 0.75, 1.25),
  std::make_tuple("Ene1_5",  1.5, 1.25, 1.75),
  std::make_tuple("Ene1_0",  1.0, 0.75, 1.25),
  std::make_tuple("Ene1_5",  1.5, 1.25, 1.75),
  std::make_tuple("Ene2_0",  2.0, 1.75, 2.25),
  std::make_tuple("Ene2_5",  2.5, 2.25, 2.75),
  std::make_tuple("Ene3_0",  3.0, 2.75, 3.25),
  std::make_tuple("Ene3_5",  3.5, 3.25, 3.75),
  std::make_tuple("Ene4_0",  4.0, 3.75, 4.25),
  std::make_tuple("Ene4_5",  4.5, 4.25, 4.75),
  std::make_tuple("Ene5_0",  5.0, 4.75, 5.25),
  std::make_tuple("Ene5_5",  5.5, 5.25, 5.75),
  std::make_tuple("Ene6_0",  6.0, 5.75, 6.25),
  std::make_tuple("Ene6_5",  6.5, 6.25, 6.75),
  std::make_tuple("Ene7_0",  7.0, 6.75, 7.25),
  std::make_tuple("Ene7_5",  7.5, 7.25, 7.75)
};
```

Then the last step is just to make the plot using the plotter!
It'll be interesting to see the energy spectra with the resolution/linearity, so you'll definitely need to update EnergySpectra.hxx to reflect your new kinematic points.
17 distributions is a lot though, so for that plot, you might want to stick just a handful. I'd suggest 0.5, 1, 2, 5, and 7!

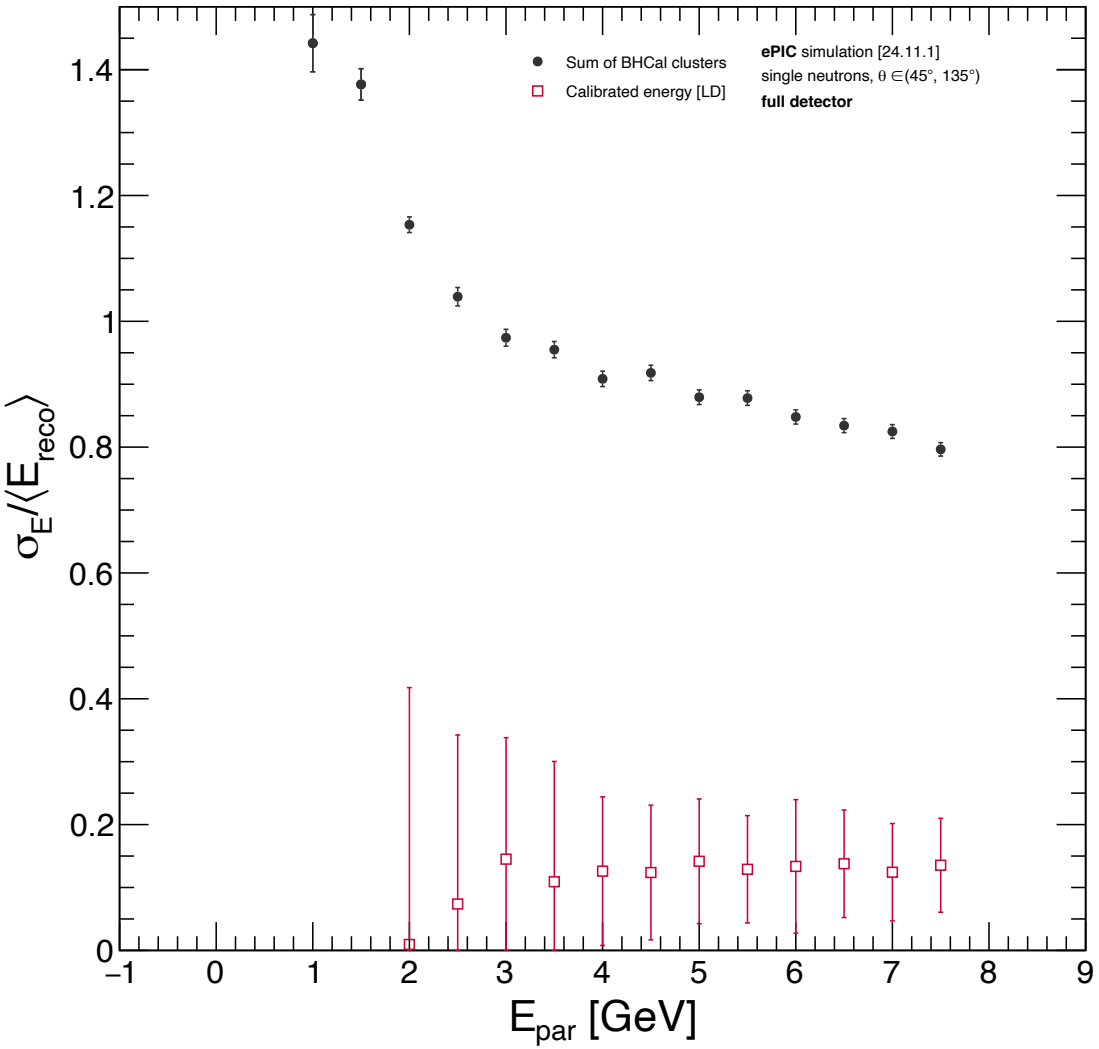
Energy plots



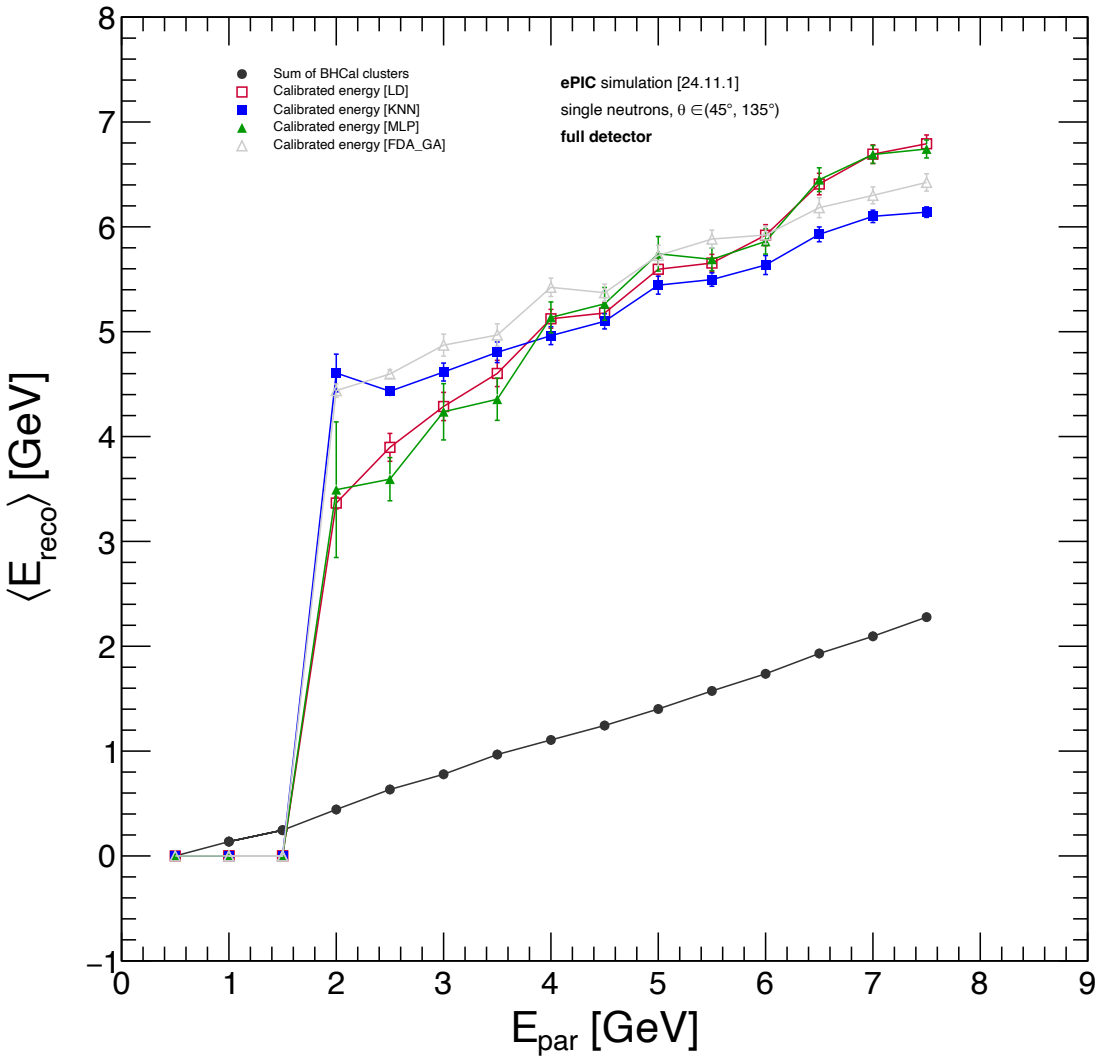
Checking the linearity



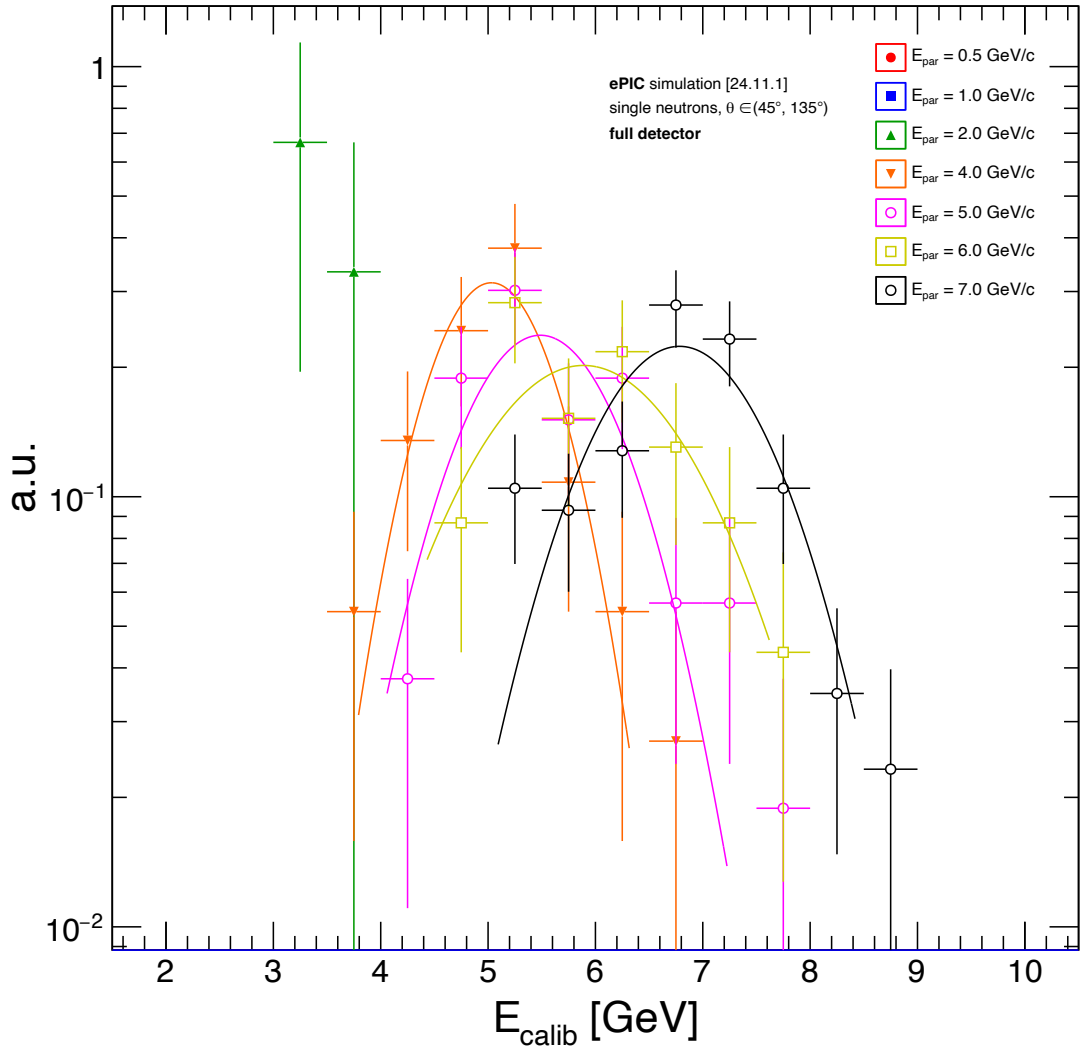
The sigma plot shows some missing points for energies less than 2, this is strange. We need to understand this.



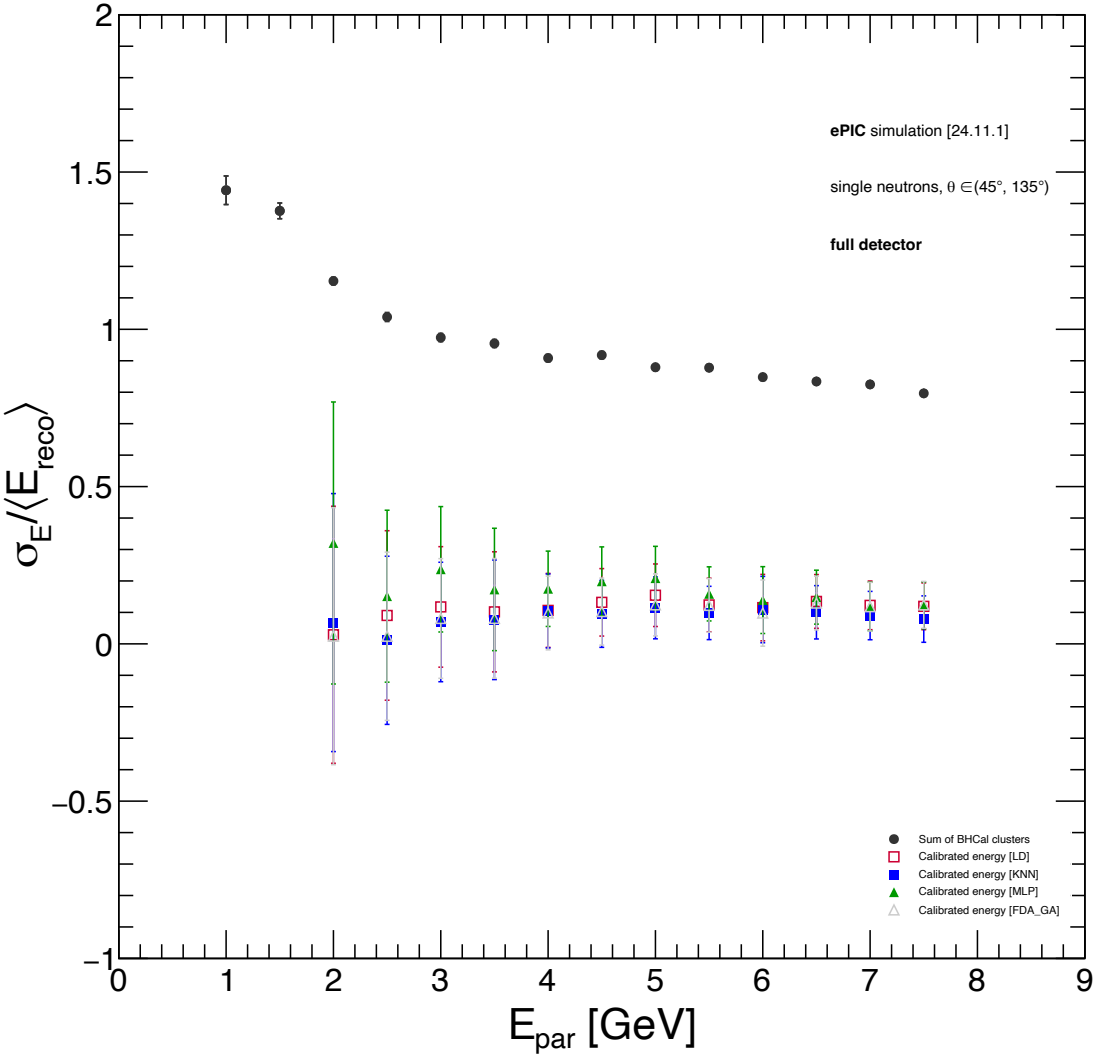
The flatness at lower energies is also observed here.



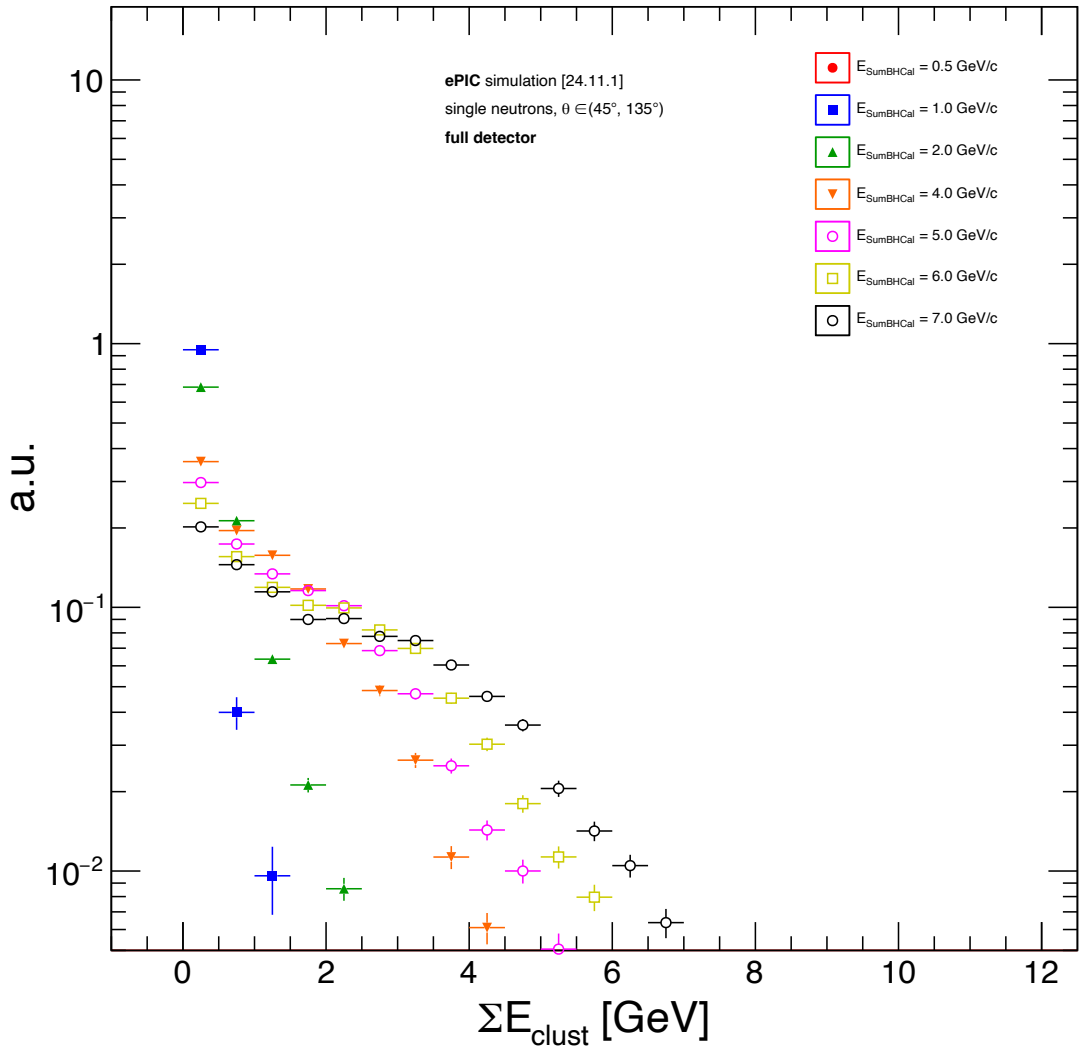
Other energy configurations



Other configurations in order to address the missing contributions



The uncalibrated energy plots are reasonable.



The uncalibrated energy plots are reasonable.