Trigger Simulation at Columbia University

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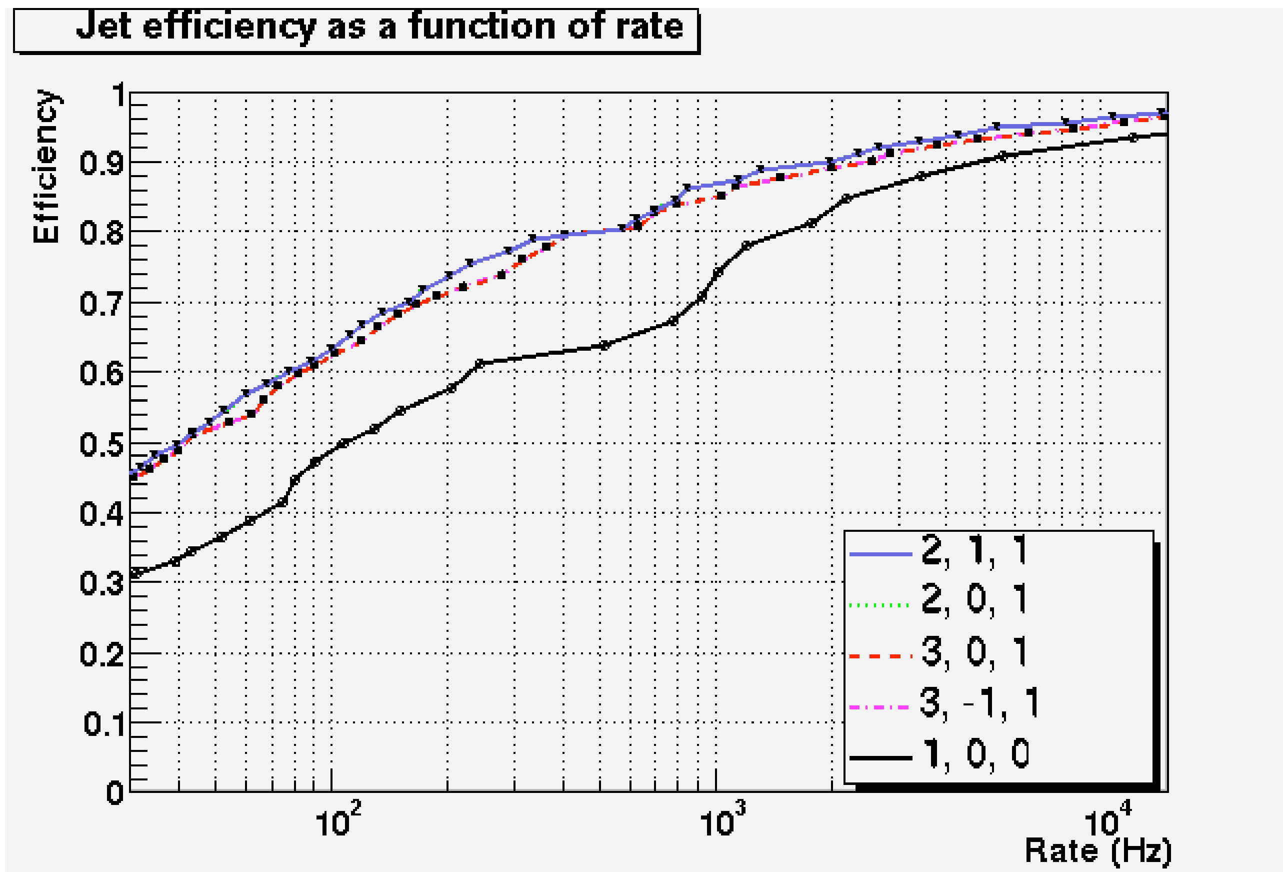
Introduction

- Since the review, the major focus of the trigger simulation studies at Columbia University has been the electron algorithms.
- But did confirm that the jet trigger results with the new simulator are comparable to the old results, as the next slide will show.
- Tau trigger studies showed promise and we are planning on incorporating a $E_{T2\times2}/E_{T4\times4}$ cut.
- In order to study ICR issues, missing energy triggers, and be confident of absolute, as opposed to relative values, we need newer Monte Carlo files.

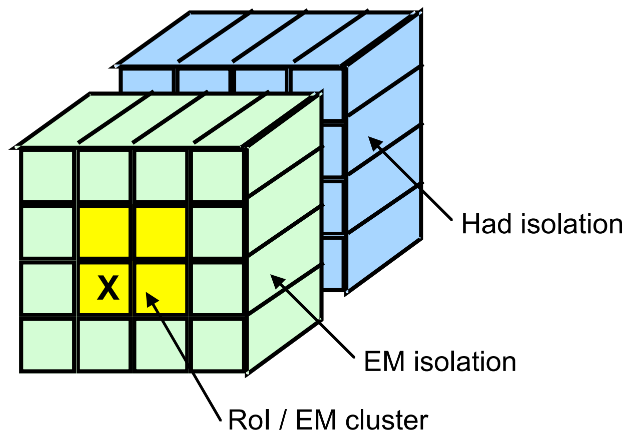
Jet Trigger Performance

- Efficiency to trigger with a single-jet trigger on the ZH □ □□bb events from Michael Hildreth's run 2b project with mb=7.5. (Luminosity = 4 □ 10^{32} cm^{-2} s^{-1})



L1 Cal Electron Trigger

- Attempt to incorporate in the L1 trigger features currently done in the L2 trigger.
  - Better measure the energy of electrons that land on trigger tower edges
  - Apply hadronic (EM fraction) cut
  - Apply isolation cut



Algorithms Investigated

- We have looked at the following algorithms
  - RoI: 2□2, decluster: 3□3 (2,0,1)
  - RoI: 2□2, decluster: 5□5 (2,1,1)
  - Atlas algorithm on RoI: 2□2, decluster: 3□3 (201Atlas)
  - Atlas algorithm on RoI: 2□2, decluster: 5□5 (211Atlas)
  - RoI: 1□1, no decluster, but standard isolation and hadronic cuts (1,0,1)
  - Run 2a L1 electron algorithm with no cuts (1,0,0)
- Standard hadronic cut: E_{Thad} □ $8 < E_{TEM}$
- Standard isolation cut: $E_{Tring} < 5$ GeV
- Want to also investigate Atlas scheme with modified isolation and hadronic cuts based on the Run2a L2 electron algorithm

Preliminary Results Look Promising

- **Preliminary** results based on WH □ e□bb events from Michael Hildreth's run 2b project with mb=7.5.
- Fraction of MC electrons/positrons with $p_T > 6$ GeV/c that fall in |□| < 0.8 or 1.6 < |□| < 3.5 that are children of Ws, that have an EMPART_S particle (no cuts applied), and that have a L1 electron trigger:

Algorithm	2,0,1	201Atlas	1,0,0	2,1,1	211Atlas	1,0,1
Fraction found	0.88	0.86	0.97	0.88	0.86	0.65

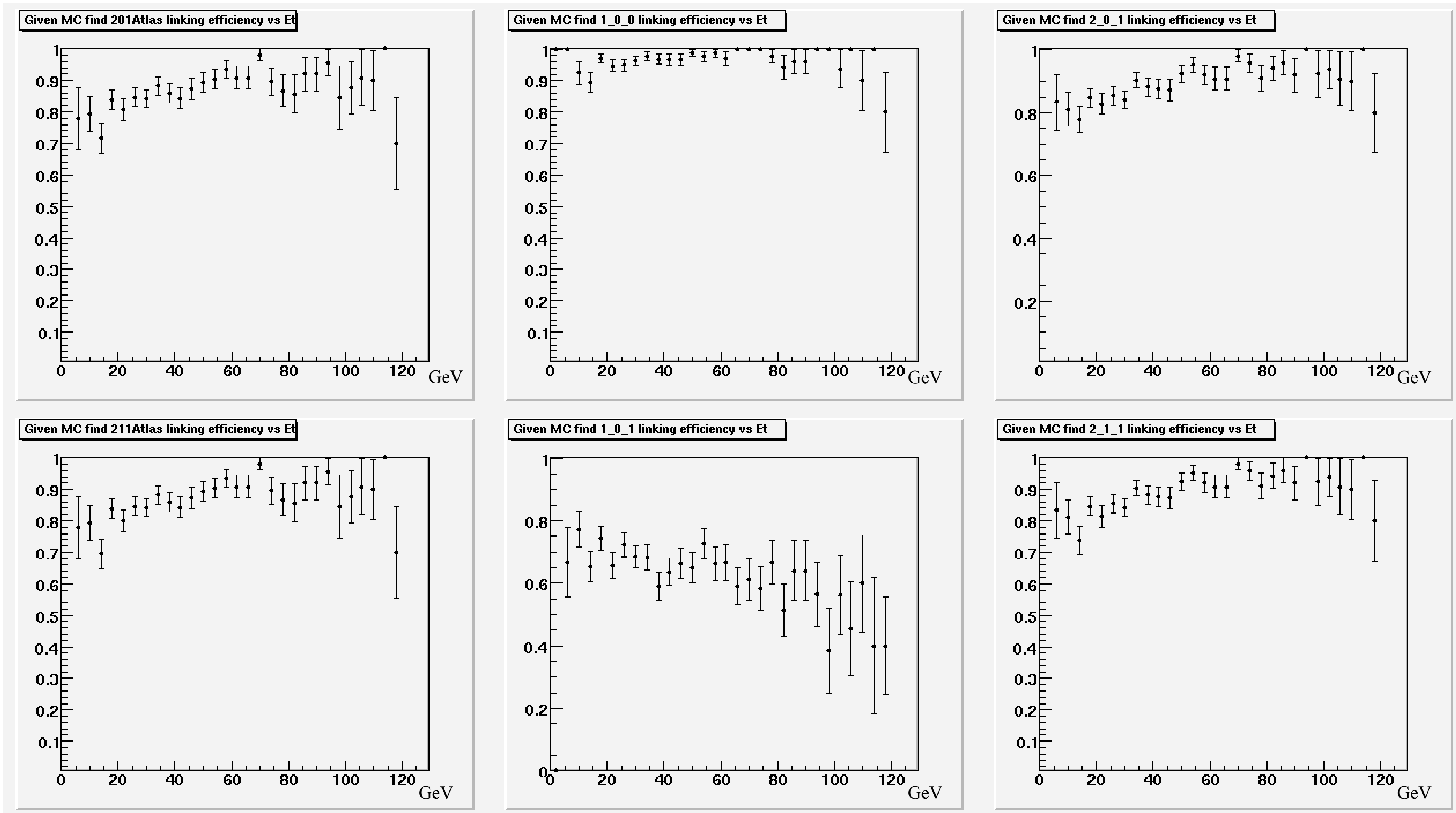
Can try to optimize triggers' hadronic and isolation cuts in the future.

That’s not the whole story

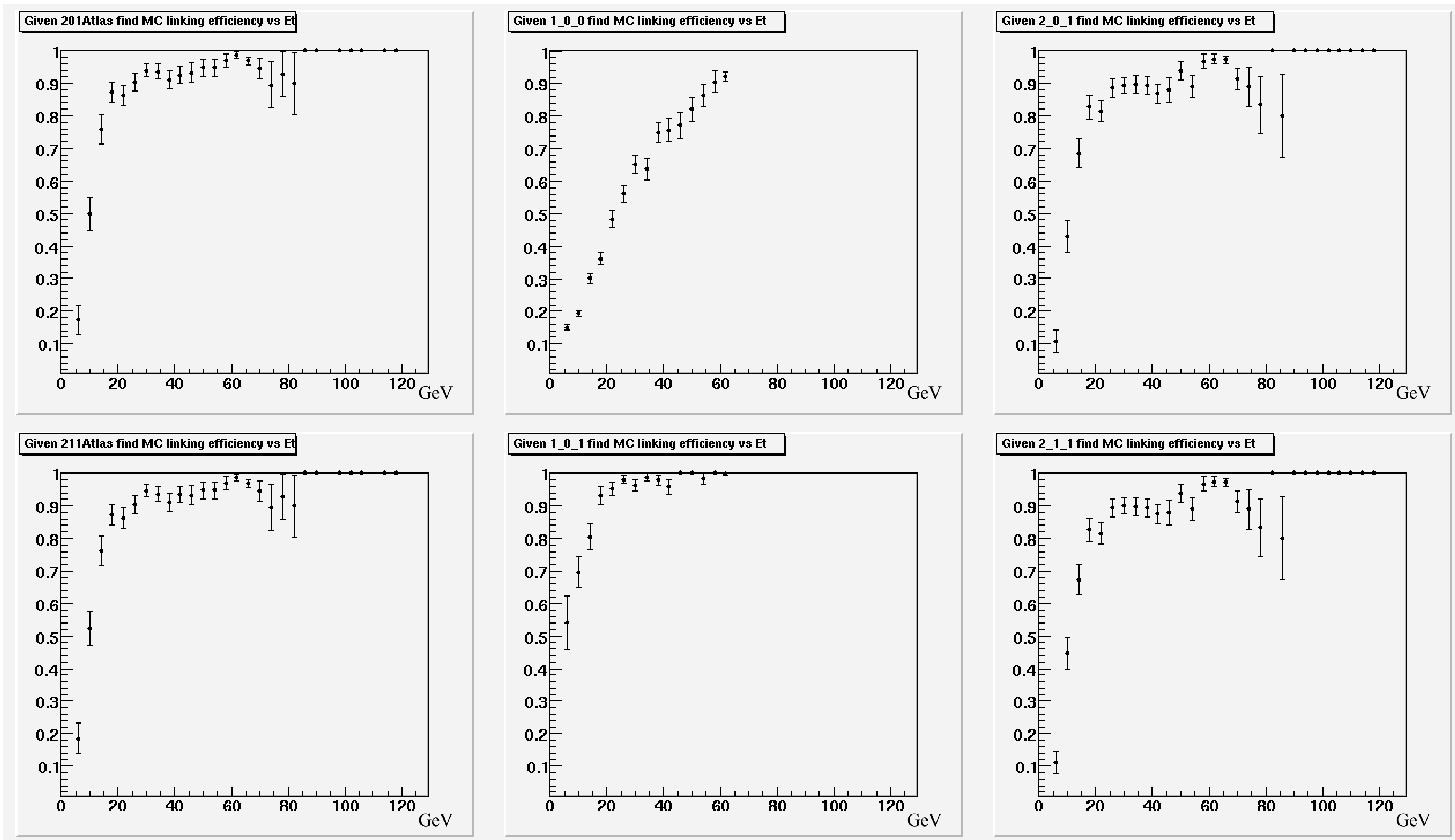
- The previous page implies that the run2a electron algorithm is the best. But those results don’t penalize fake triggers.
- Fraction of Trigger electrons/positrons with $p_T > 6$ GeV/c that fall in $|\eta| < 0.8$ or $1.6 < |\eta| < 3.5$, that have an EMPART_S particle (no cuts applied), and that link to a MC electron/positron:

Algorithm	2,0,1	201Atlas	1,0,0	2,1,1	211Atlas	1,0,1
Fraction found	0.83	0.87	0.39	0.83	0.88	0.94

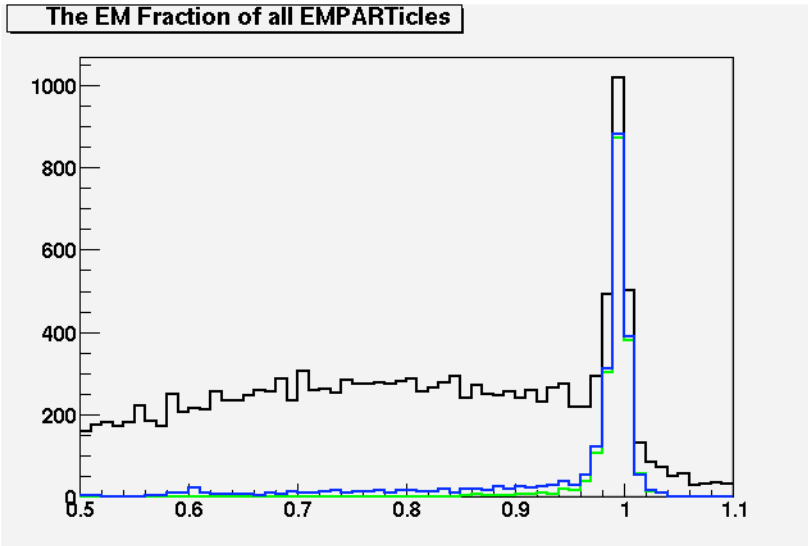
MC□ trigger link eff. vs. E_T

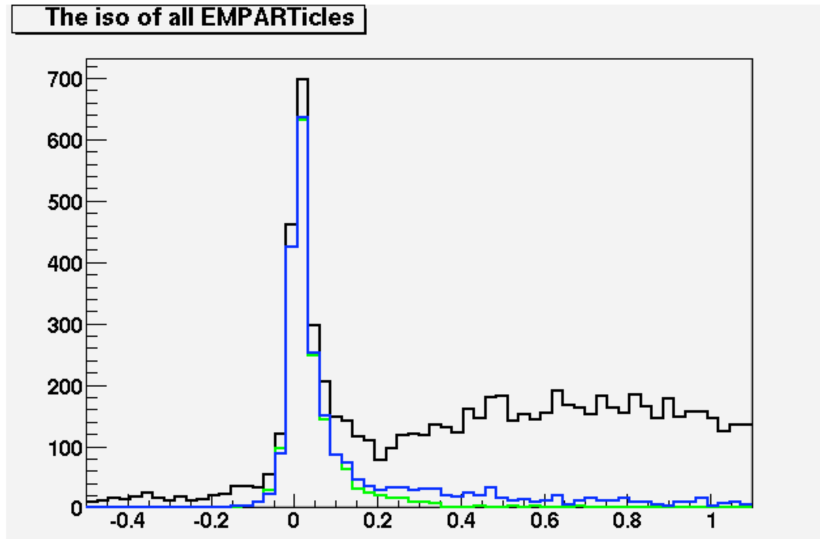


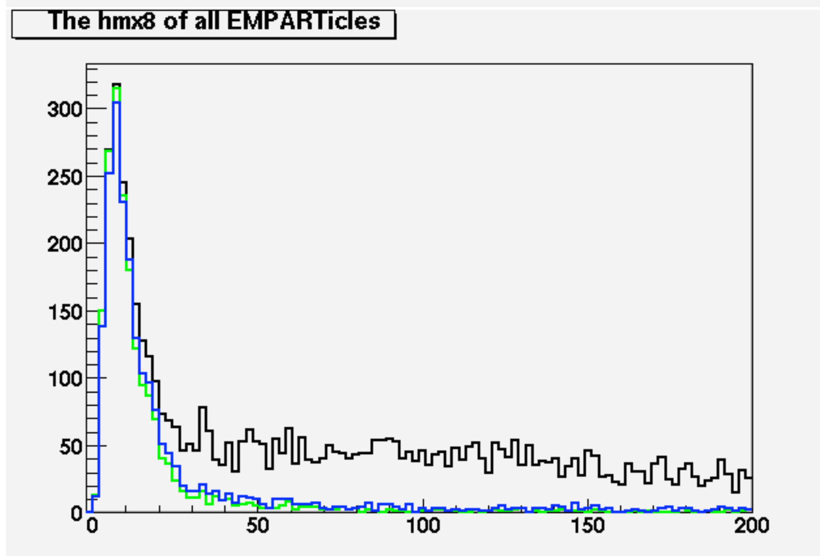
DØ Trigger MC link eff. vs. E_T



Not making cert. EMPART_S cuts makes only a small difference







- Black are for all EMPARTicles
- Green are given MC electron that is a child of a W, find EMPARTicle
- Blue are given EMPARTicle, if can link with an MC electron, only then plot.

From/to cert. EMPART

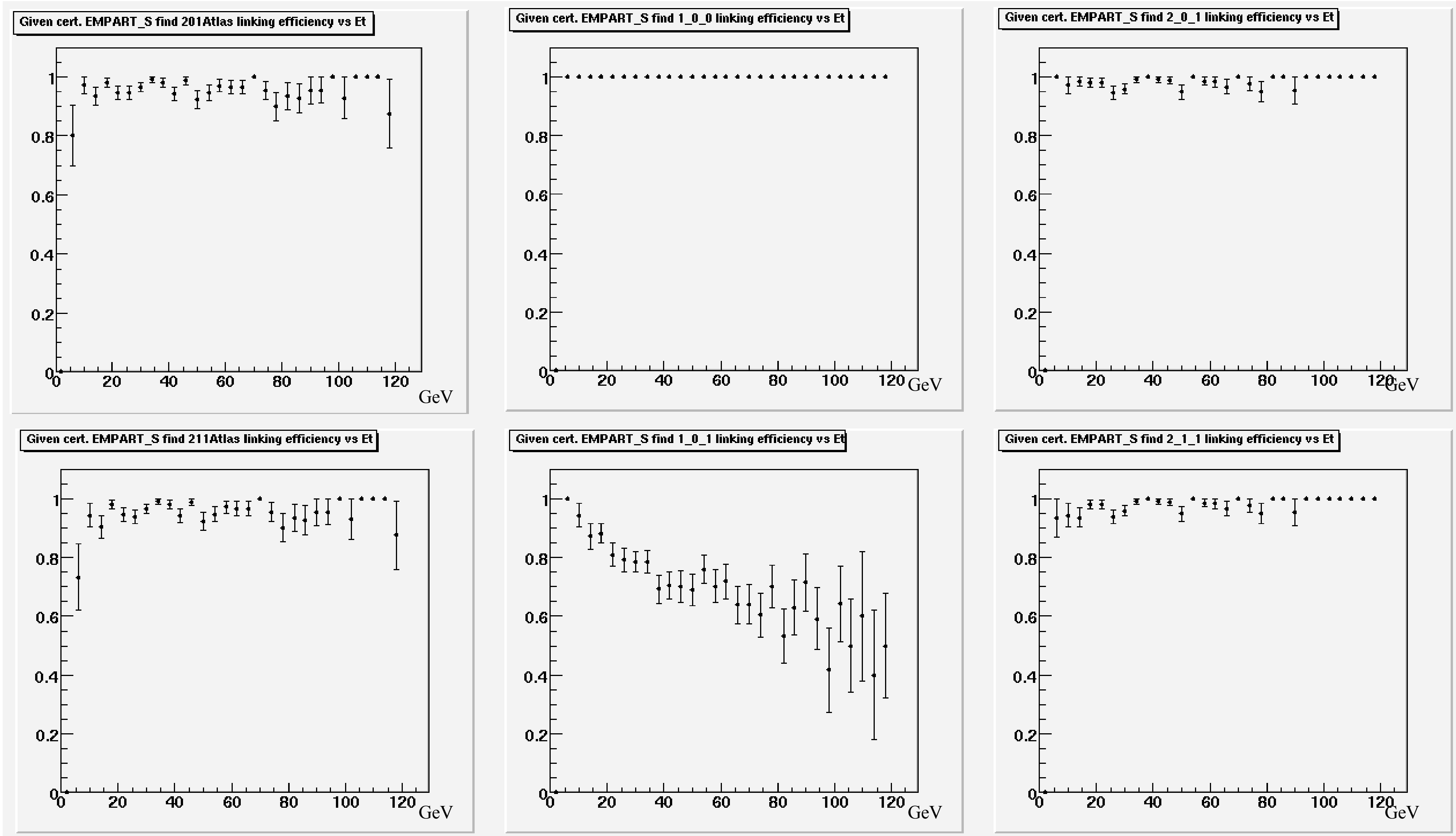
- Results of linking efficiency from certified EMPART_S to trigger clusters (same p_T and □ cuts) look similar but higher overall:

Algorithm	2,0,1	201Atlas	1,0,0	2,1,1	211Atlas	1,0,1
Fraction found	0.98	0.96	1	0.97	0.95	0.74

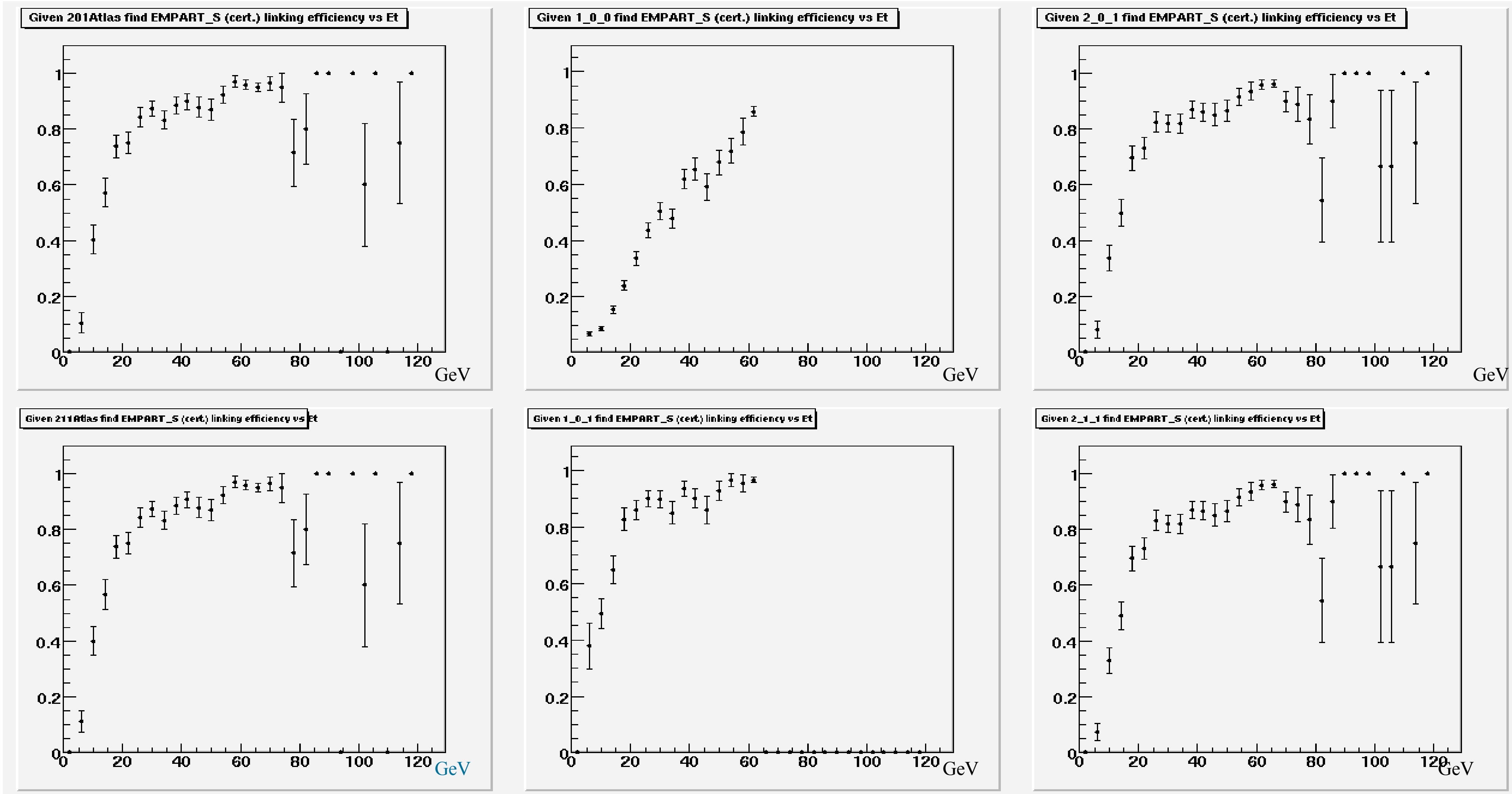
- The reverse looks similar, but lower overall:

Algorithm	2,0,1	201Atlas	1,0,0	2,1,1	211Atlas	1,0,1
Fraction found	0.77	0.81	0.28	0.78	0.81	0.85

Cert. EMPART_S □ trigger link eff. vs. E_T



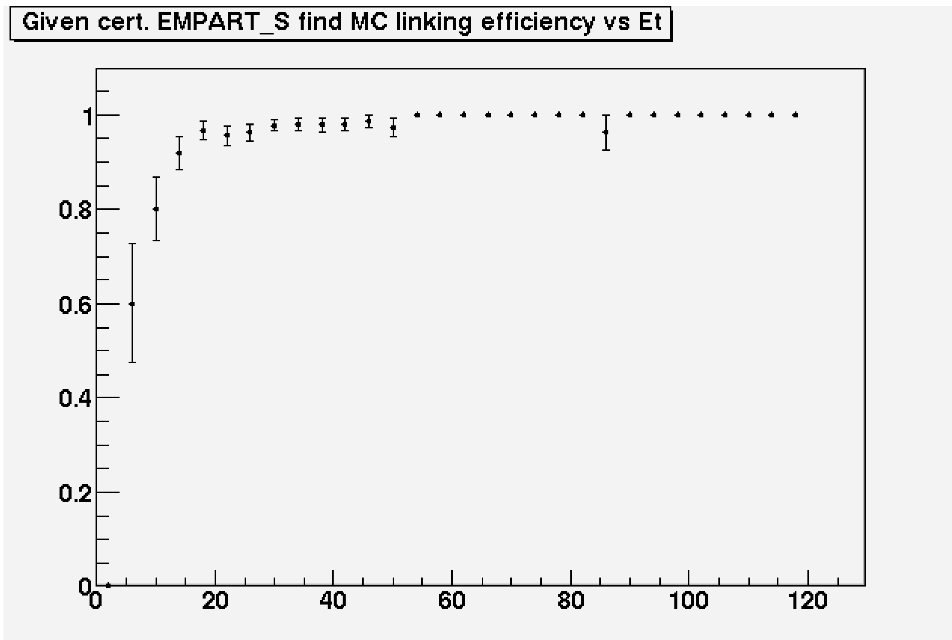
Trigger □ cert. EMPART_S link eff. vs. E_T

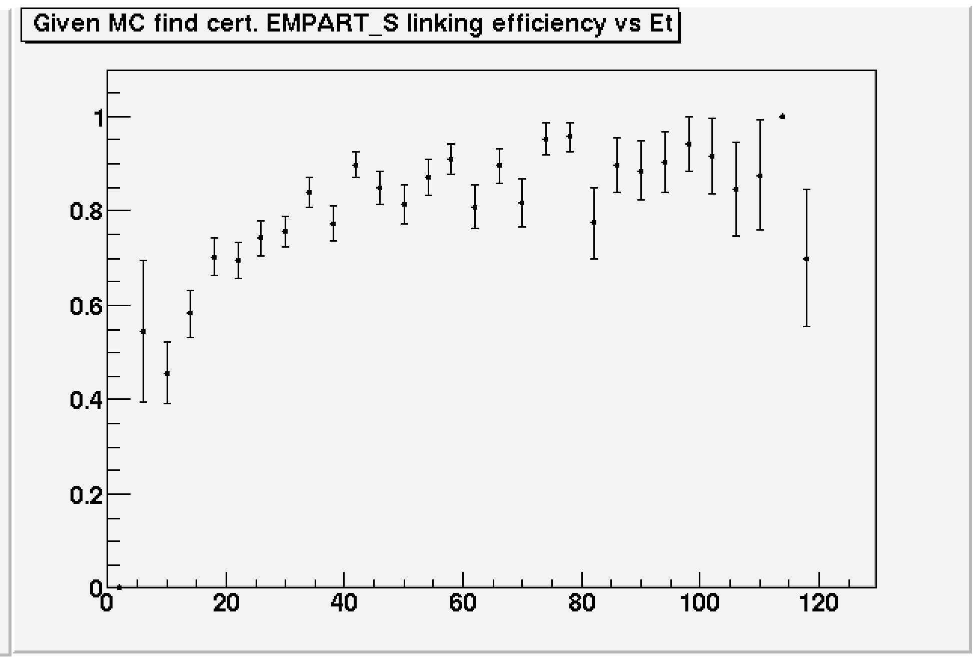


There are fewer certified low-energy EMPARTicles than triggers.

MC/EMPART linking

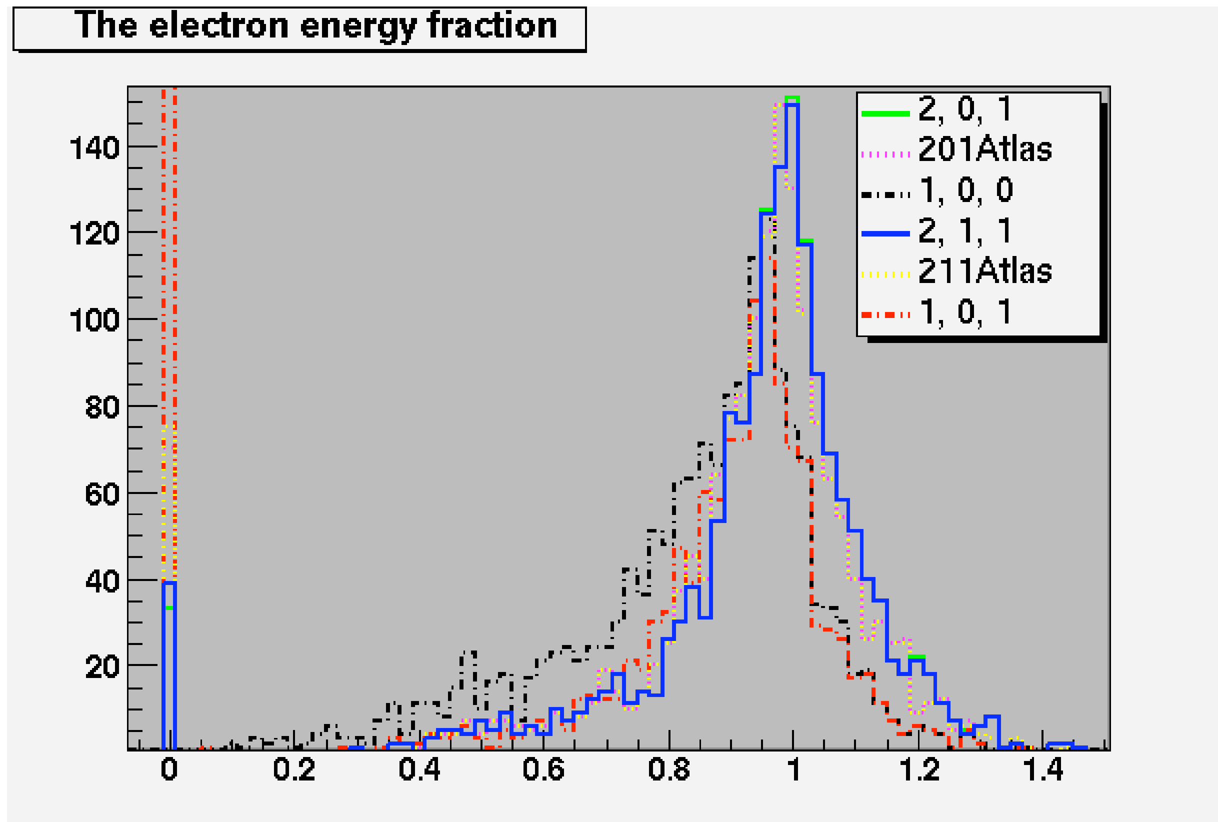
- 97% of certified EMPART_S electrons have a MC electron.
- 79% of MC electrons that have a W as a parent have a certified EMPART_S electron.





Energy Fraction

- This plot shows the trigger cluster energy divided by the EMPART_S electron energy. The linking is done by taking certified EMPART_S electrons with $p_T > 6$ GeV/c and that fall within $|\eta| < 0.8$ or $1.6 < |\eta| < 3.5$ and finding the nearest trigger cluster electron in delta-R. (Those at zero are no matches.)

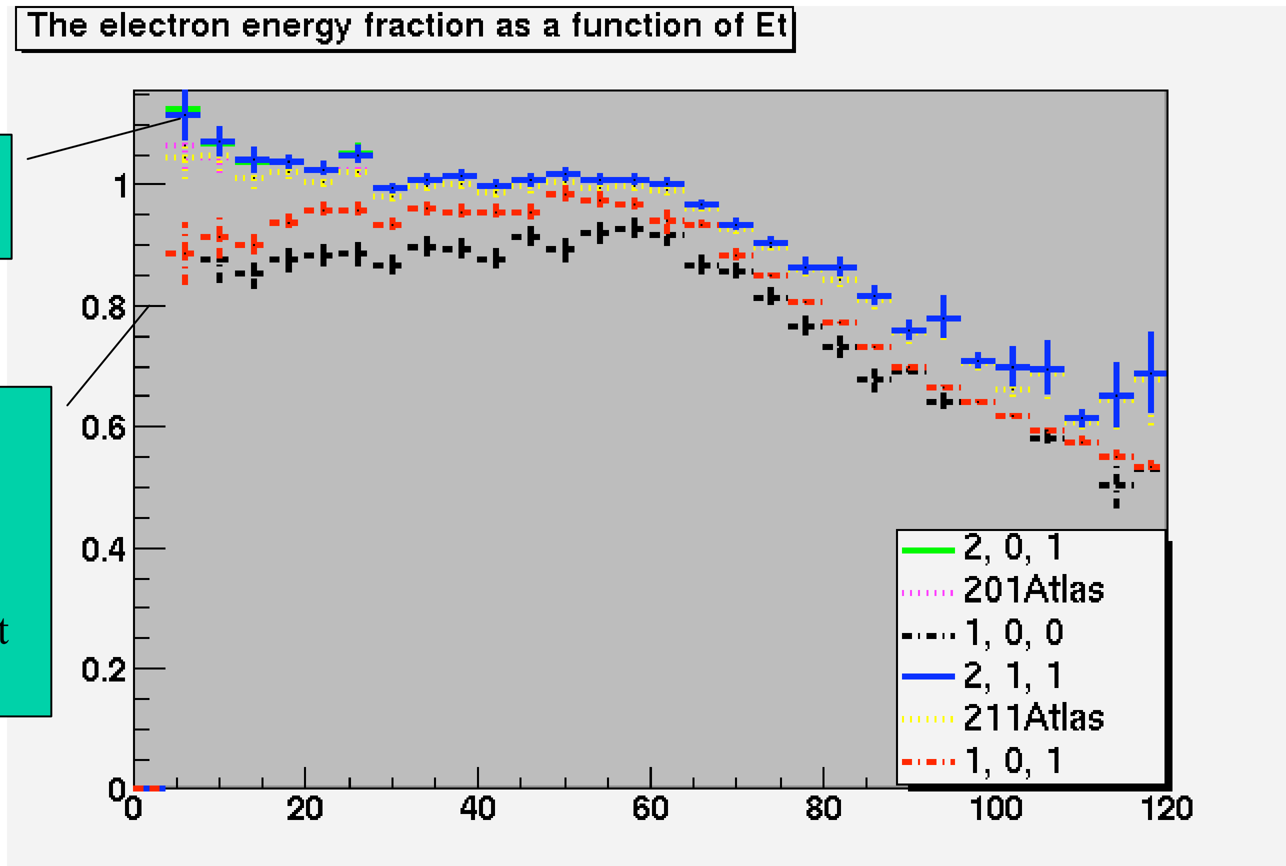


Energy fraction vs. E_T

- Using the same linking scheme as before with the same p_T and cuts, here is the energy fraction as a function of trigger cluster E_T.

Note increase at low E_T

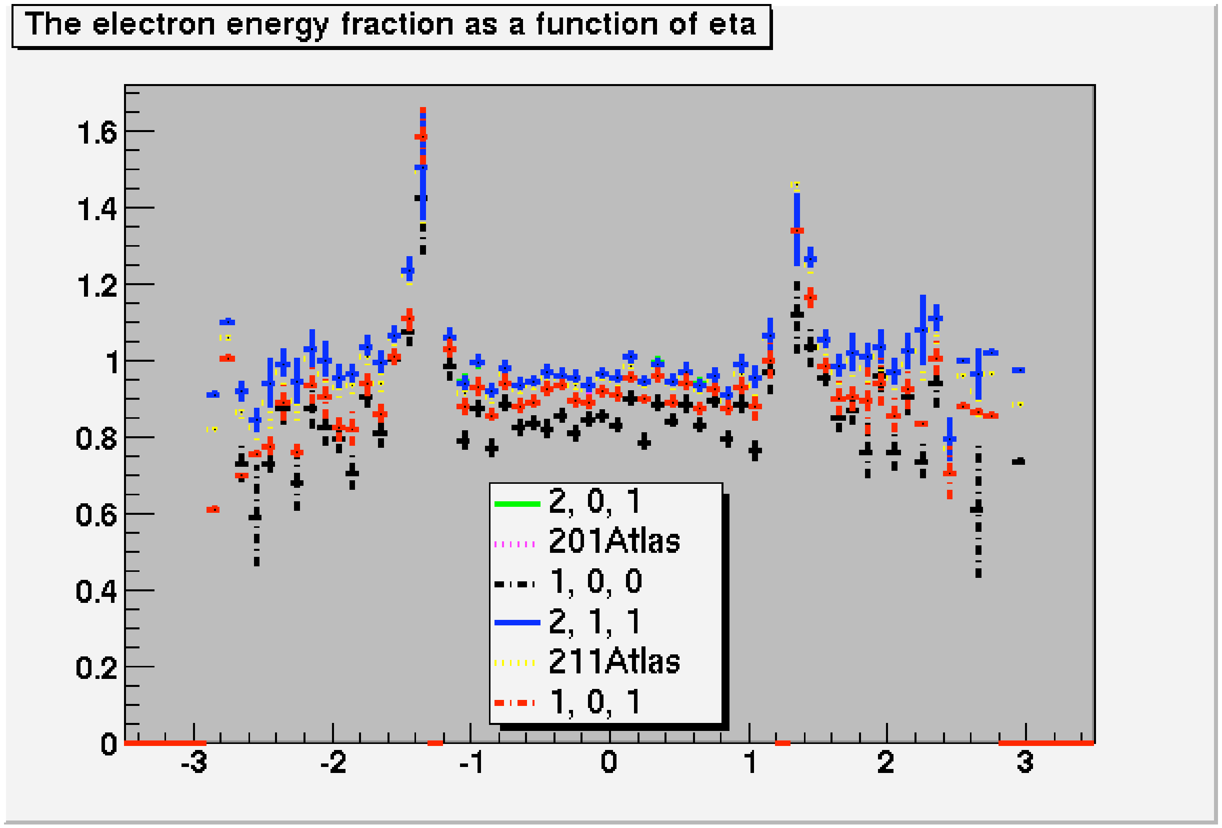
Only matched electrons included (i.e. zero column from prev. plot is excluded)



GeV

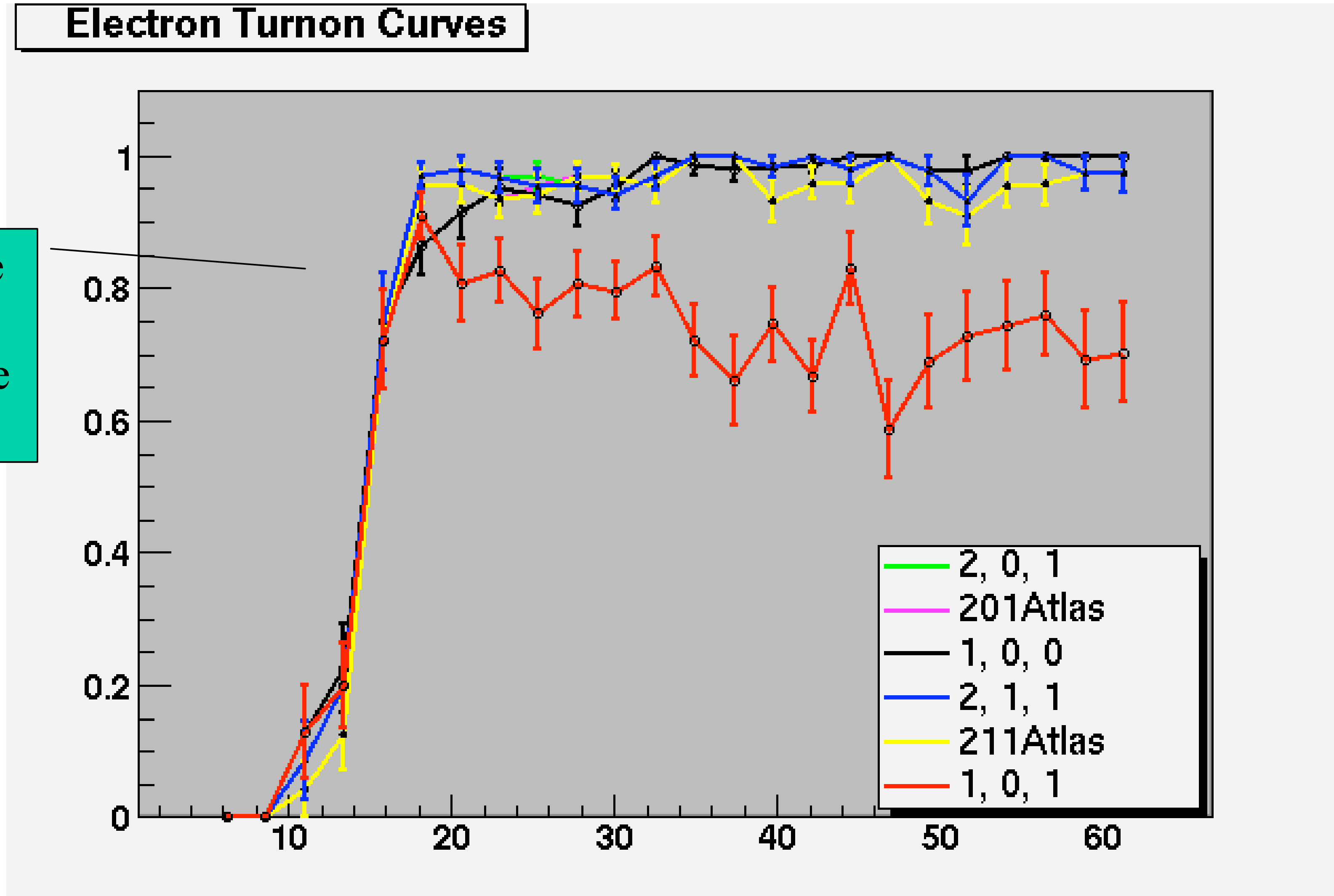
Energy fraction vs.

- Loosening the cut to just || < 3.5 for this plot only, here is the energy fraction as a function of . The ICR detectors are not included.
- I do not understand the behavior.



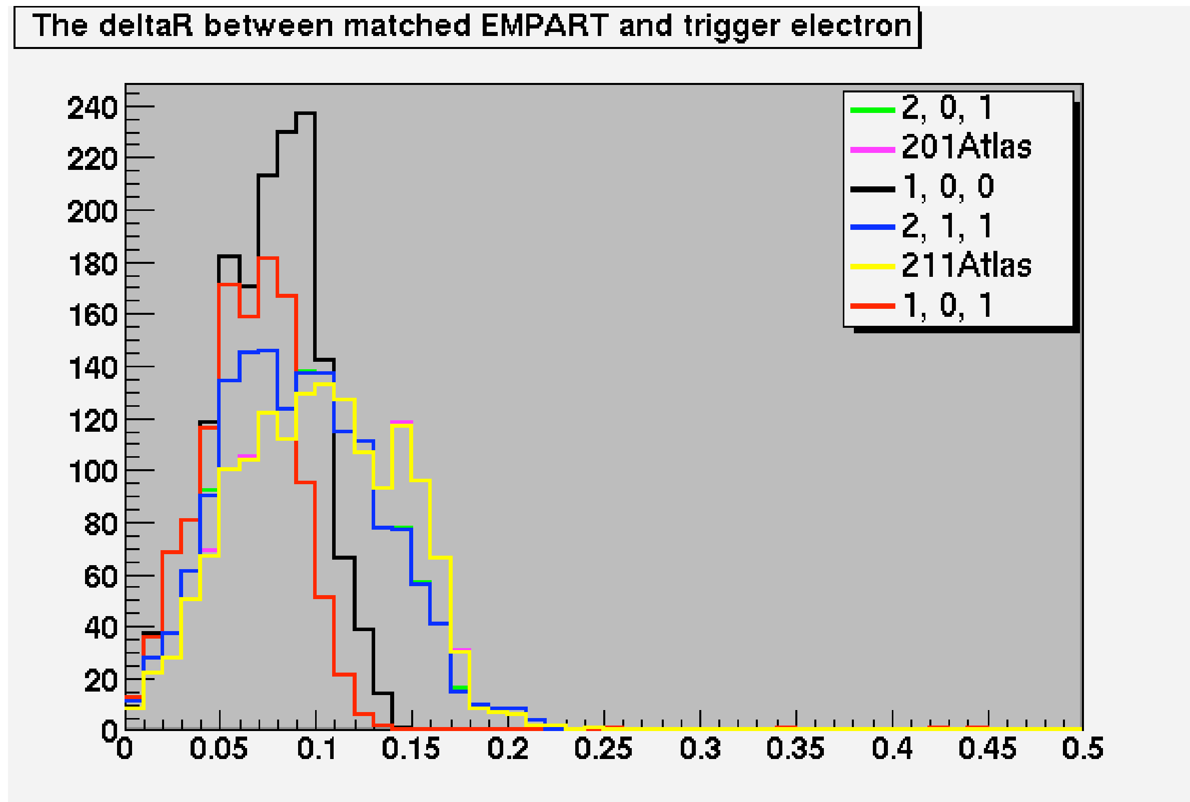
Turn-on Curves

Using the more restrictive range



Position

- For the track matching, determining the position of the electron is important. Here is the delta-R between EMPART_S electrons and triggers where the linking is done by taking certified EMPART_S electrons with $p_T > 6$ GeV/c and that fall within $|\eta| < 0.8$ or $1.6 < |\eta| < 3.5$ and finding the nearest trigger cluster electron in delta-R.



Conclusion

- This is still very much a work in progress.
- Still have not come to a conclusion as to what algorithm should be implemented.
  - Should we try to do different hadronic and isolation cuts?
  - Is the 2×2 RoI with ring around it for isolation too large of a structure?
- Any ideas would be appreciated.