Comparison of Scone / CellNN SEMReco / EMReco algorithms for energy scale determination @ Υ(1s) peak

Pierre-Antoine Delsart
Morgan Lethuillier

IPN Lyon

Status of Upsilon production

❒ Production is running.... Around 12 K $\Upsilon(1S) \rightarrow e^+e^-$ already produced, but not yet in SAM...

☞ Standard MCC3 configuration

Pythia	→	d0gstar	→	d0sim	→	d0reco	→	reco_analyze
6.129		pmc03.00.01		psim01.01.01		preco04.00.04		preco04.00.04

☞ Wrong IDC codes (to force Upsilon decay modes) in Pythia cards corrected

❒ For the comparison, these events were reprocessed through d0reco t01.22.00

❶ Scone0401 → EMReco

❷ CellNN → EMReco

❸ (Scone0401 + SEMReco) → EMReco

❹ (CellNN + SEMReco) → EMReco

☞ not all events reprocessed, due to a problem with the GlobalTrackFinder...

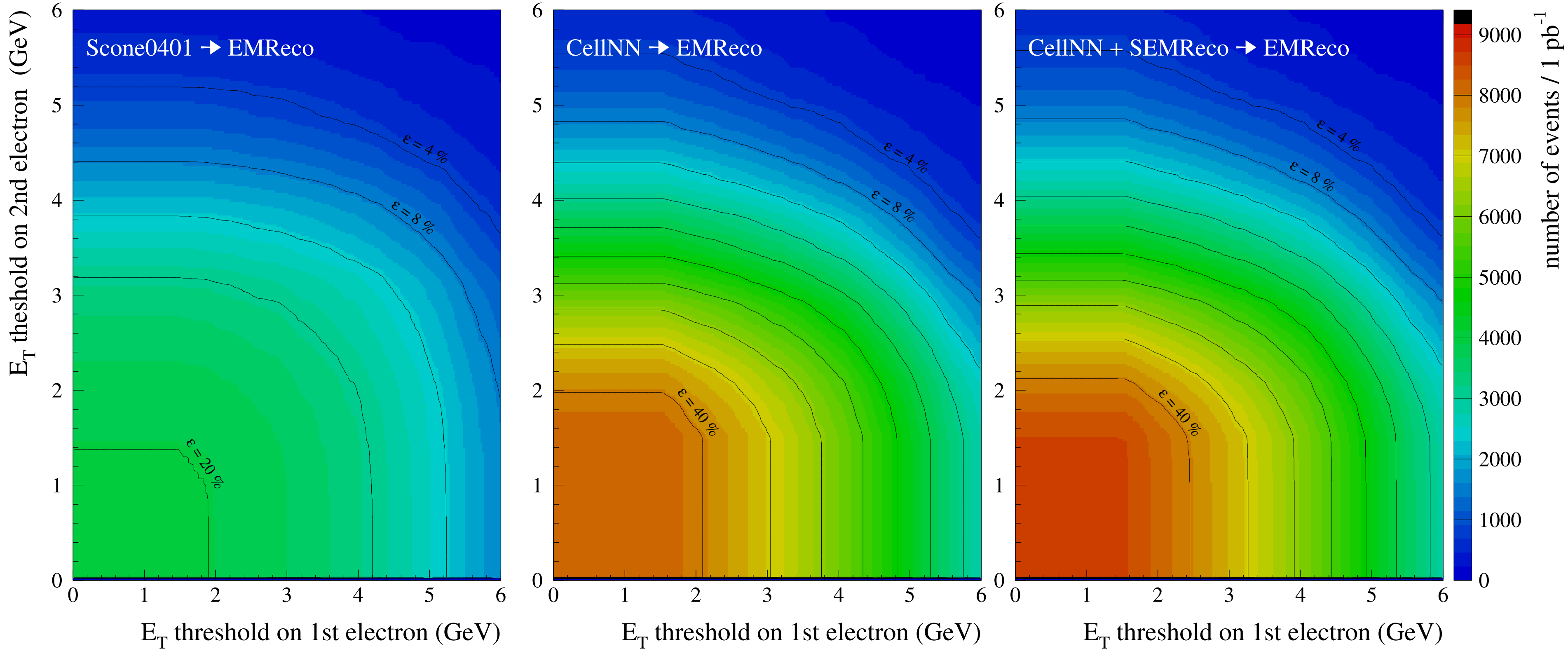
☞ ~11K events available in hbook and root files

Detailled satus ☞ http://m.home.cern.ch/m/mlethuil/www/d0/prod/status.html

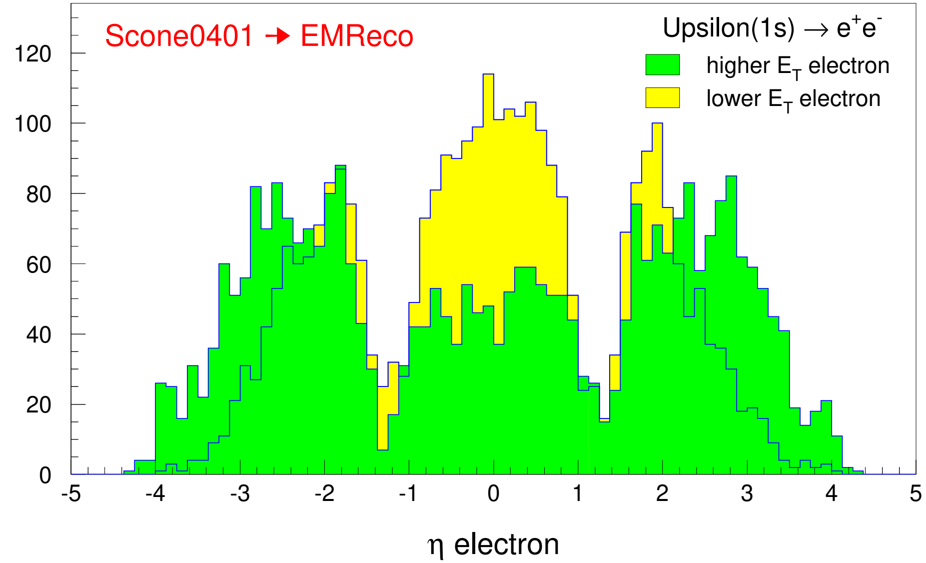
~ Trigger efficiency

❒ Upsilon trigger, UPS_CC L2: L2EM(2,3,e,fpi) & L2IM(e,3,e,3,9,1000)

☞ approximated by: 2 e^-, E_T>3 GeV, |η|<3 and M_{ee} > (Peak -1 GeV)

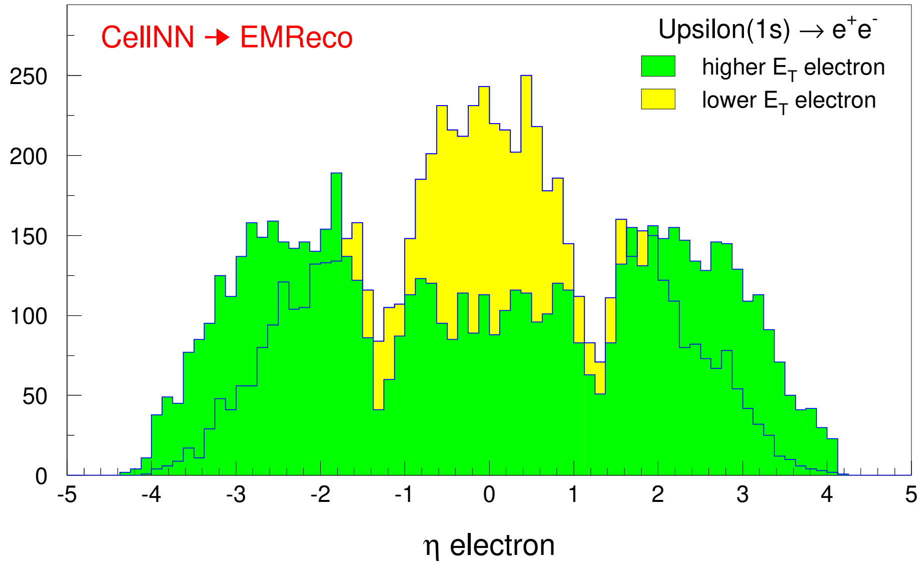


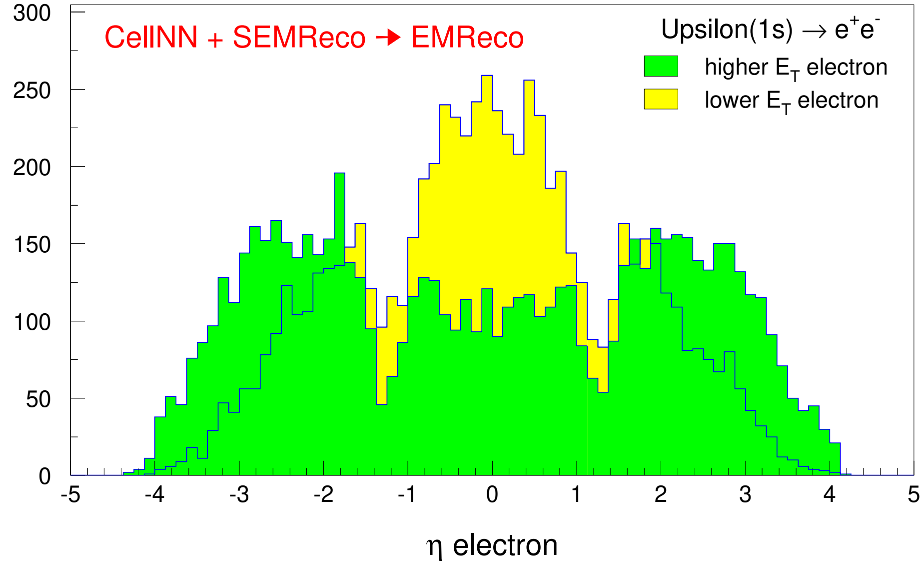
Electron rapidity



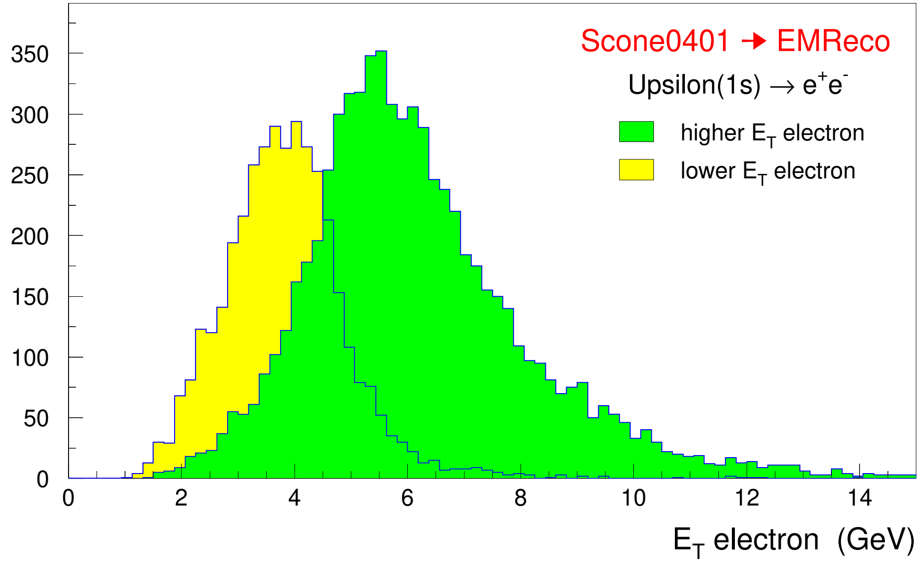
% of evts with both e^- in CC, or both e^- in EC or one e^- in CC and the other one in EC

	Scone0401	CellNN	CellNN + SEMReco
CC + CC	25.0 %	25.8 %	26.0 %
CC + EC	26.6 %	31.5 %	32.3 %
EC + EC	48.4 %	42.7 %	41.7 %

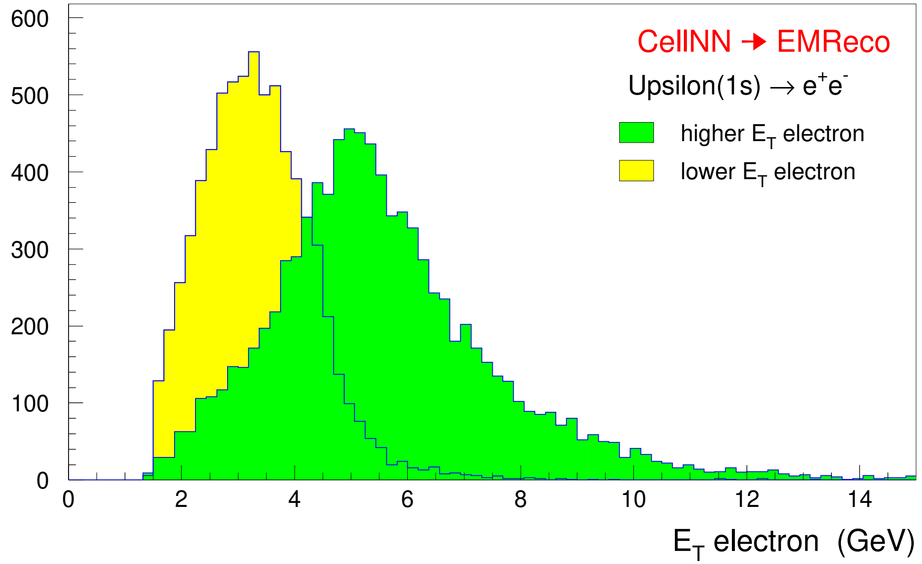


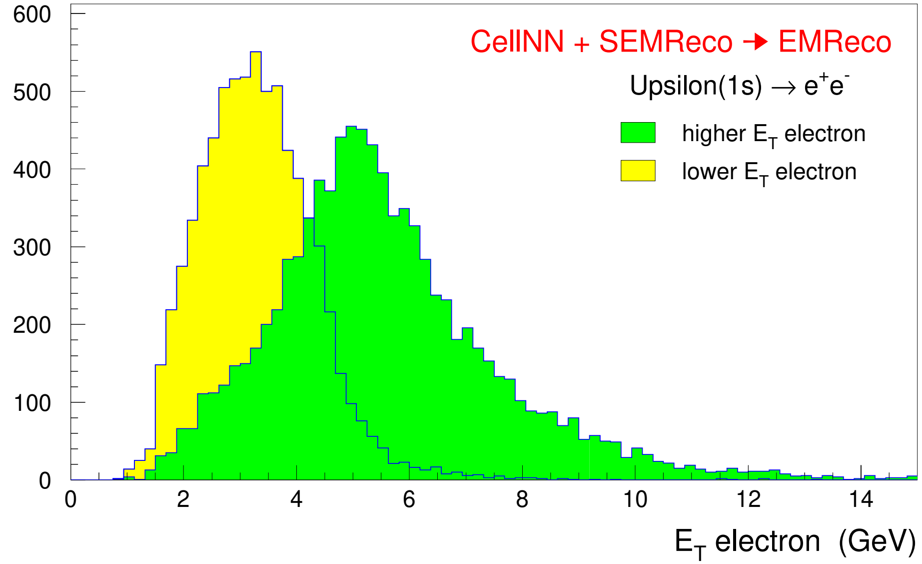


Electron energy



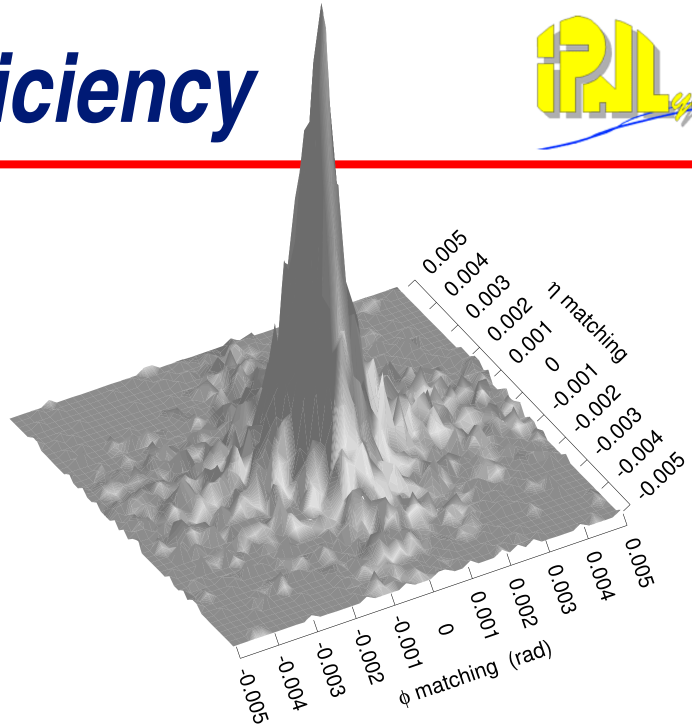
	Scone0401	CellNN	CellNN + SEMReco
$<E_T^{min}>$	3.84 GeV	3.36 GeV	3.31 GeV
$<E_T^{max}>$	6.19 GeV	5.57 GeV	5.55 GeV





“e⁻ reconstruction” efficiency

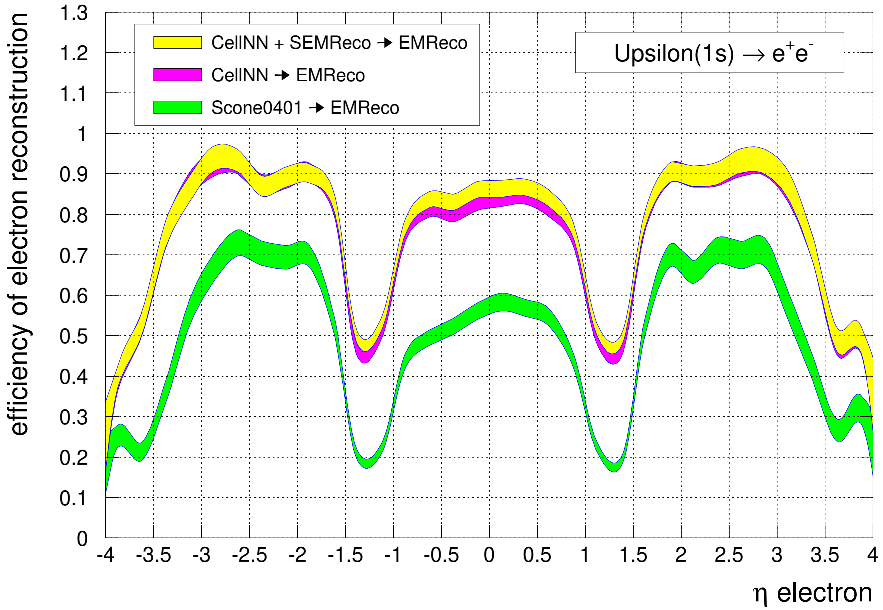
- Use both e⁻ of the Υ event to calculate the efficiencies
- For each generated e⁻, search for a matching cluster in η–φ
- Efficiencies are given for 1 e⁻, not for the event

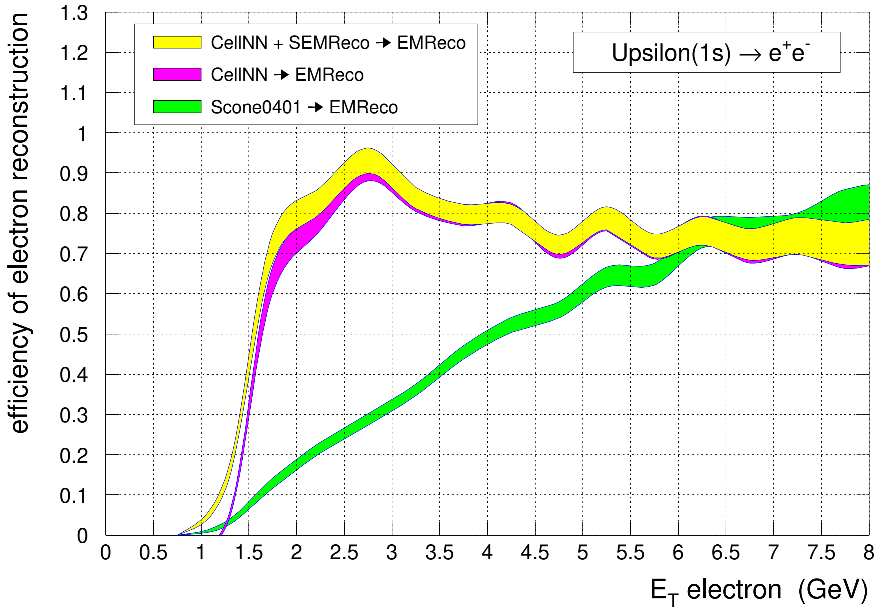


☞ CellNN is fully efficient at lower E_T (around 2-3 GeV) than Scone

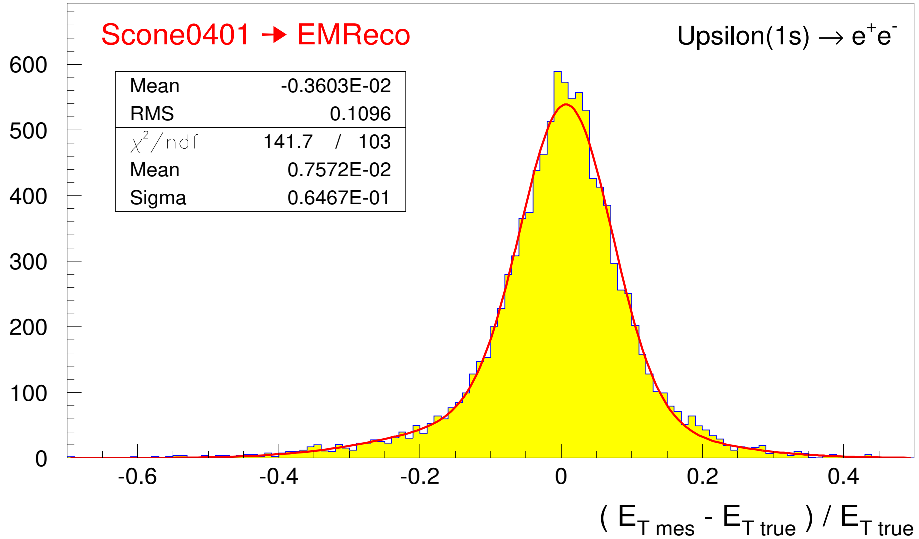
☞ The efficiency in CC is lower than in EC, because e⁻ in CC have lower E_T than in EC (cf. η distribution of the e⁻)

☞ Depending on η, the gain of efficiency (absolute) due to CellNN varies from 20 to 30%. Adding SMReco allows to gain from 1 to 5%





Energy resolution

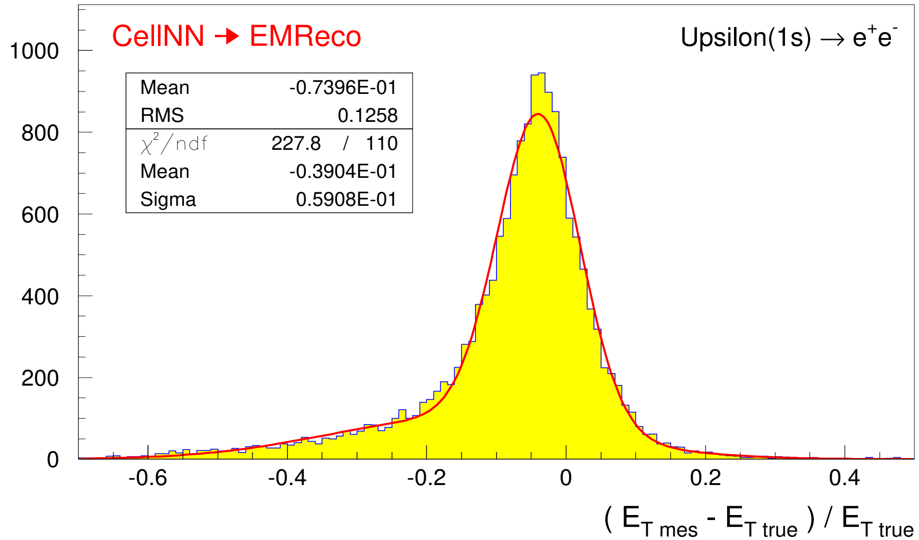


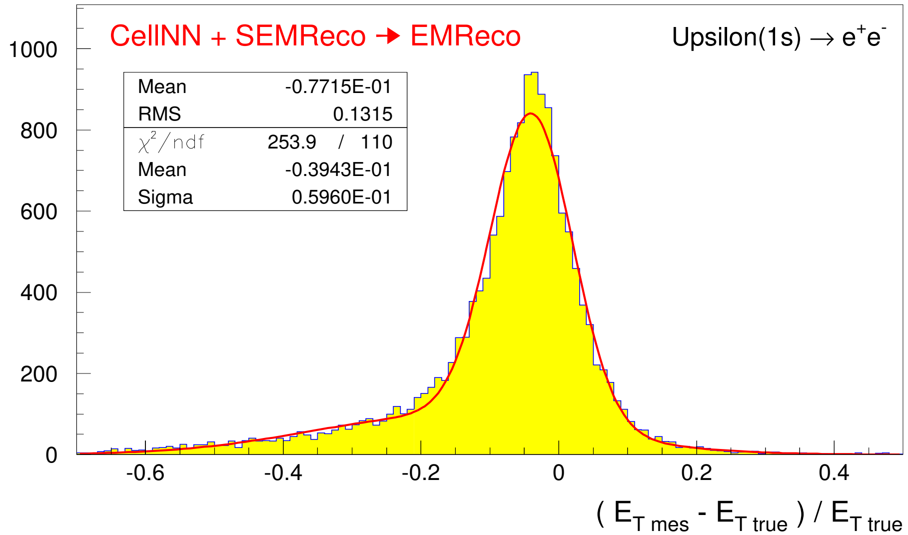
	Scone0401	CellNN	CellNN + SEMReco
gaussian mean	+ 0.8 %	-3.9 %	-3.9 %
σ_g	6.5 %	5.9 %	6.0 %
% of evts $\pm$ 1 σ_g	57.6 %	54.7 %	54.4 %
σ_{eff}	8.5 %	8.6 %	8.8 %

σ_g = gaussian width σ_{eff} = width containing 68% of evts
(defined to take into account the tails)

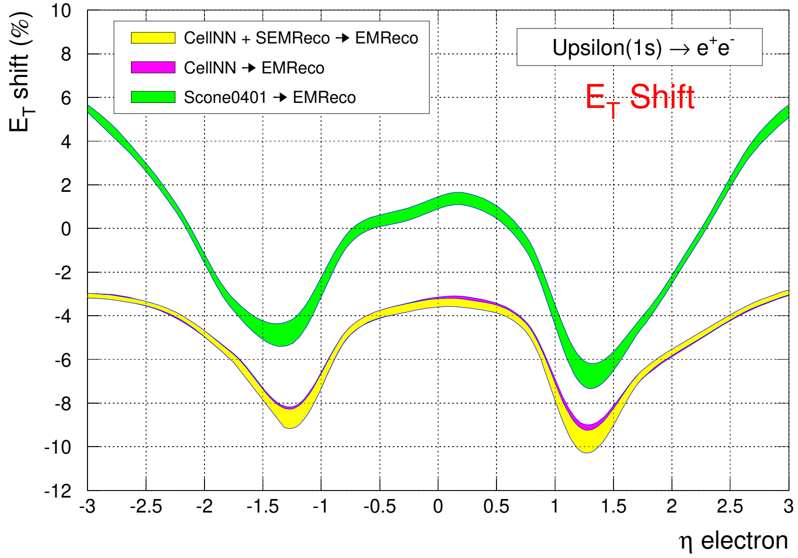
Increase of the e^- reco efficiency (relative) within $\pm$ 1σ_g

Scone401 $\xrightarrow{+43\%}$ CellNN $\xrightarrow{+1\%}$ (CellNN + SEMReco)

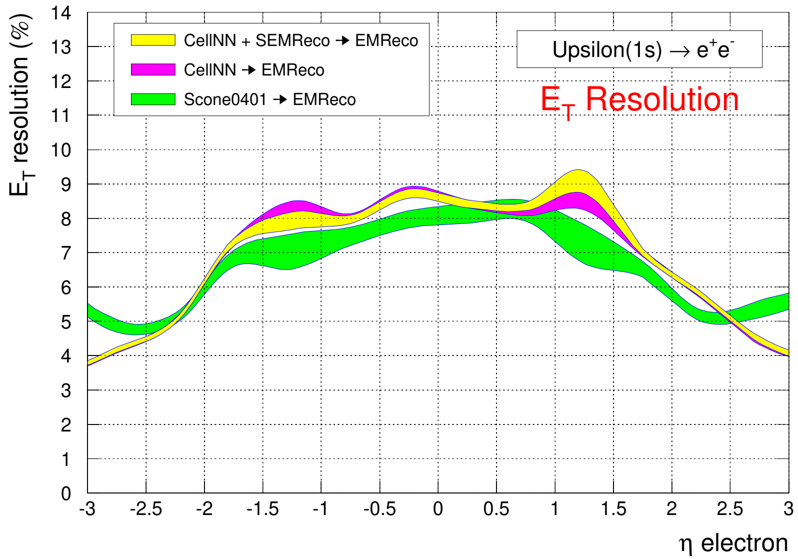


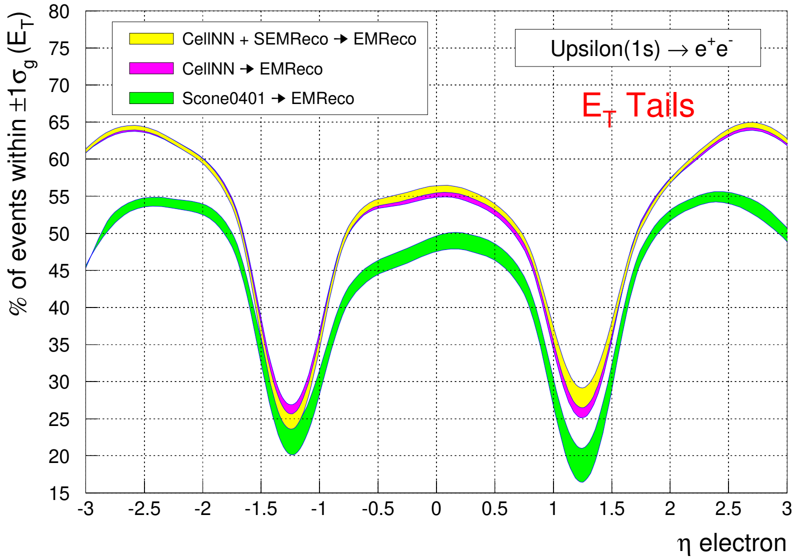


Energy resolution vs η

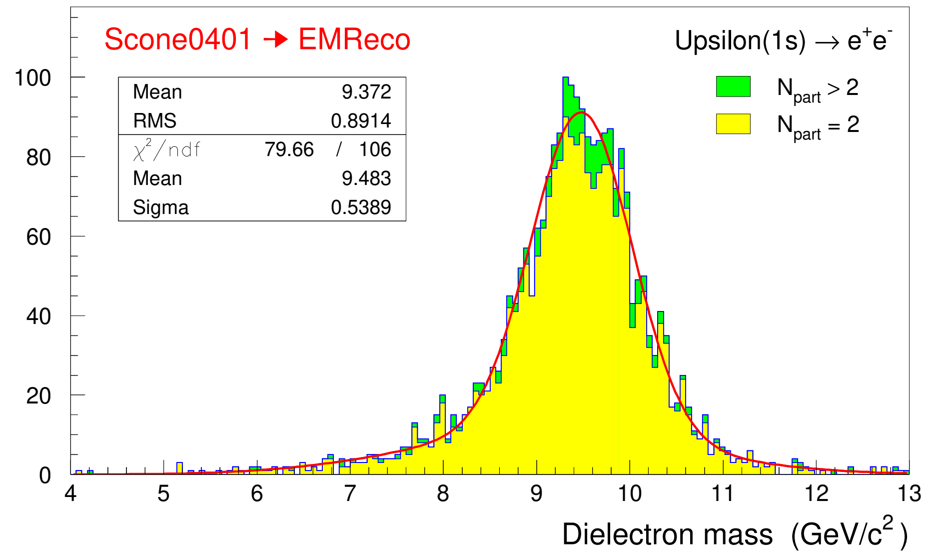


- In each η slice, gaussian fit of $(E_{T\ mes} - E_{T\ true}) / E_{T\ true}$
- Calculate mean, σ, and % of evts 1σ
- Plot them vs η



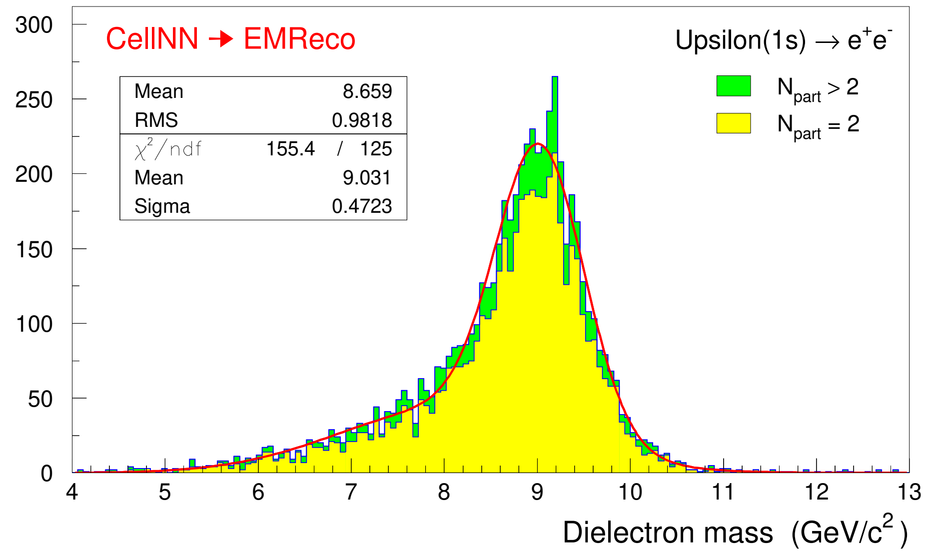


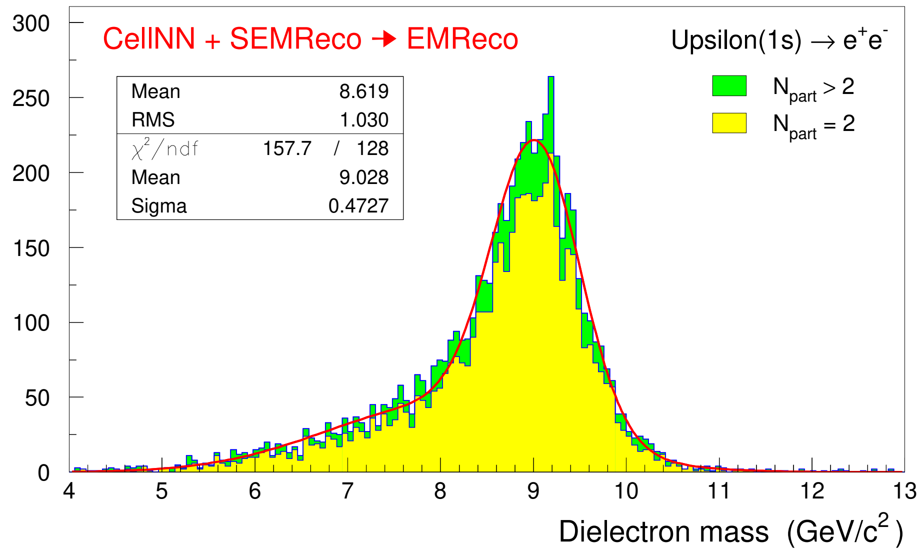
Mass shift



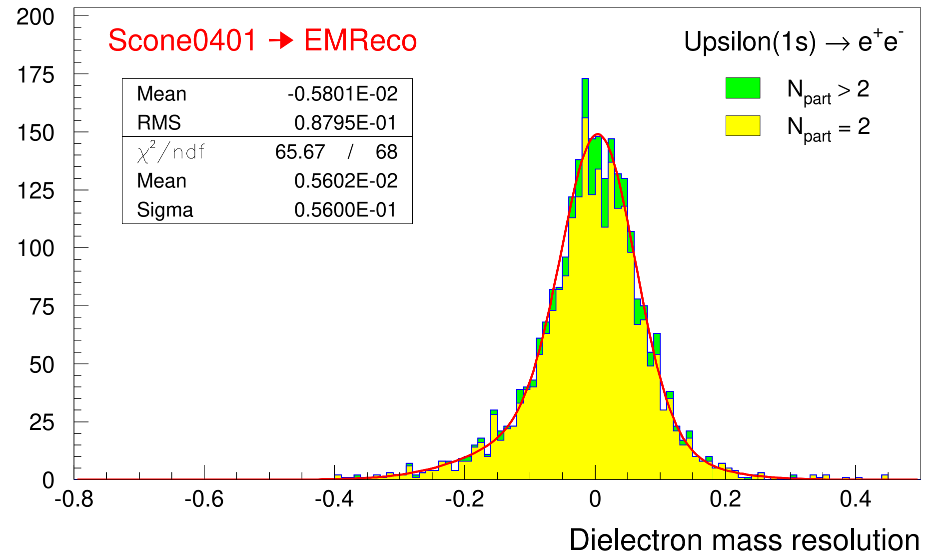
	Scone0401	CellNN	CellNN + SEMReco
Mass shift	+ 23 MeV	- 429 MeV	- 432 MeV

Does this mean that we need a specific energy scale for each algorithm ???





Mass resolution

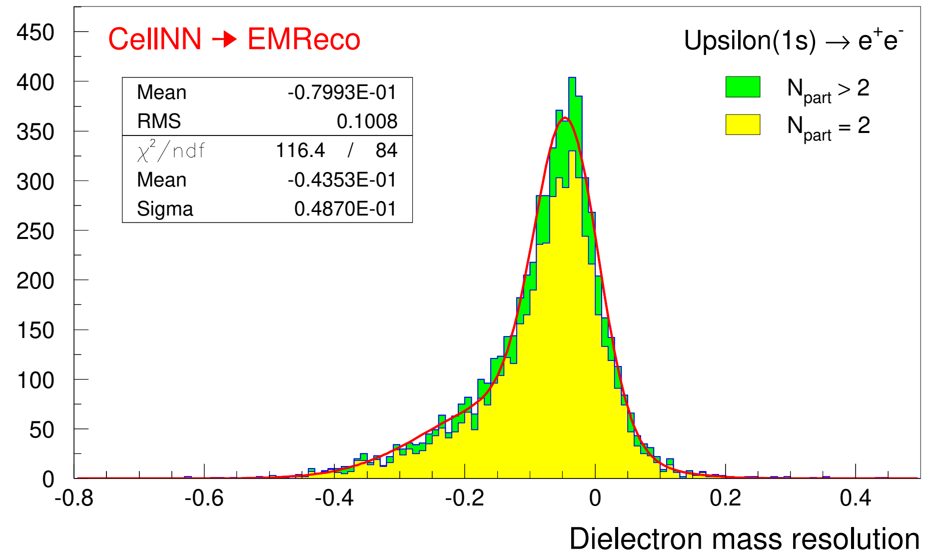


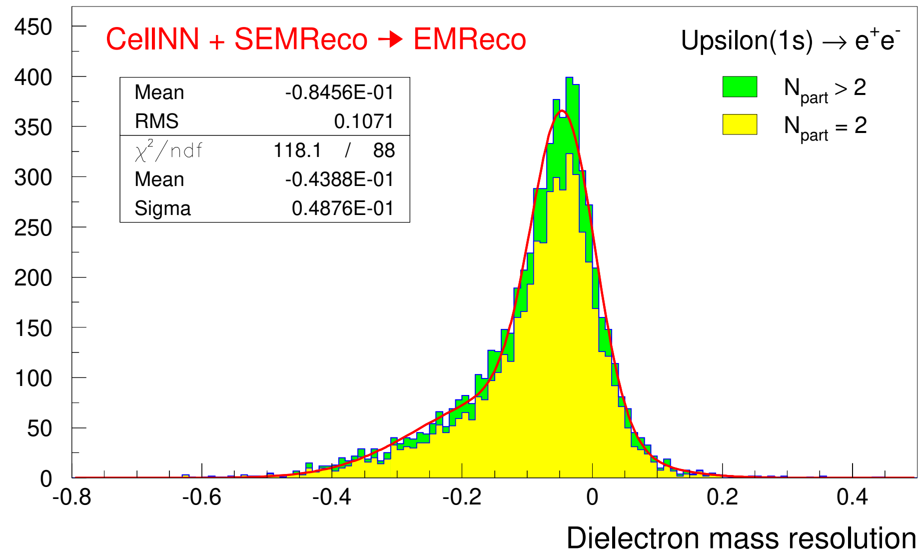
	Scone0401	CellNN	CellNN + SEMReco
gaussian mean	+ 0.6 %	-4.4 %	-4.4 %
σ_g	5.6 %	4.9 %	4.9 %
% of evts $\pm$ 1 σ_g	57.8 %	51.2 %	50.0 %
σ_{eff}	7.3 %	7.9 %	8.3 %

σ_g = gaussian width σ_{eff} = width containing 68% of evts

Increase of the number of evts selected between $\pm$ 1σ_g :

Scone401 ➔ (**+113%**) CellNN ➔ (**+1%**) (CellNN + SEMReco)





Conclusion

❒ No surprise: if you have to work with soft e^-
(em calibration at ψ or Υ peak, B physics,
or degenerated susy)

USE CellNN !

In case of the Υ, the fraction of usefull
events is more than doubled

❒ But.... how to deal with the mass shift (~400 MeV for Υ) ?