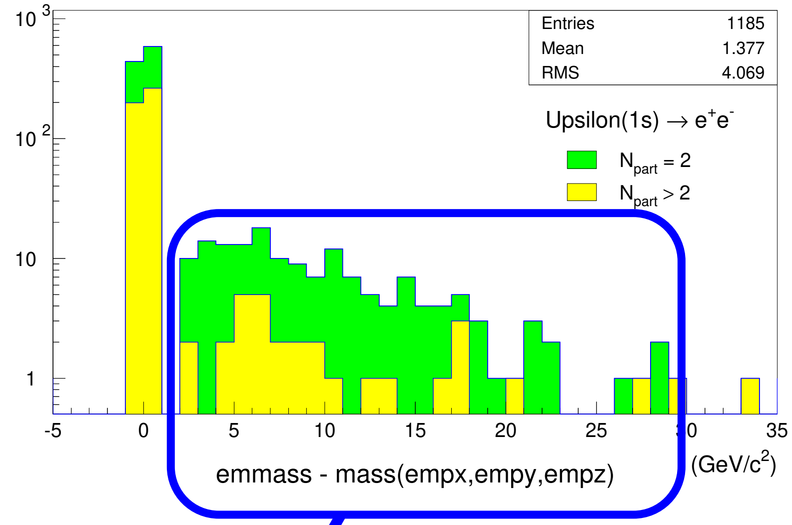
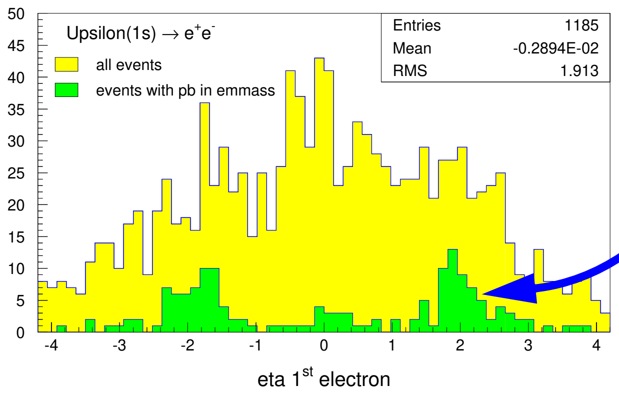
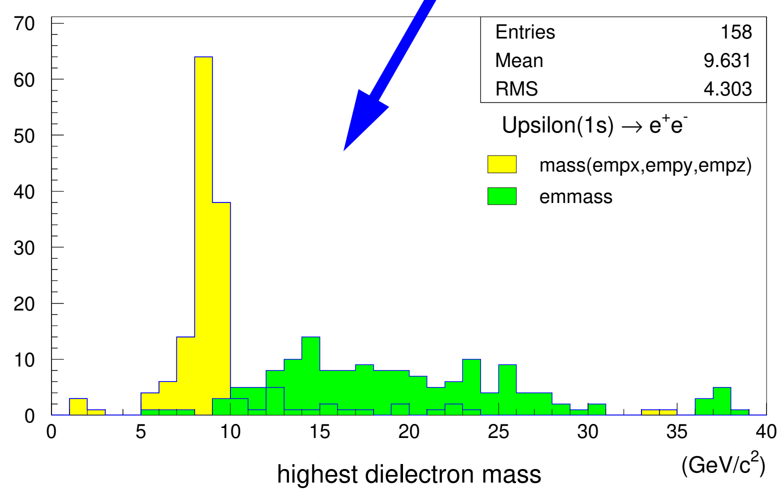
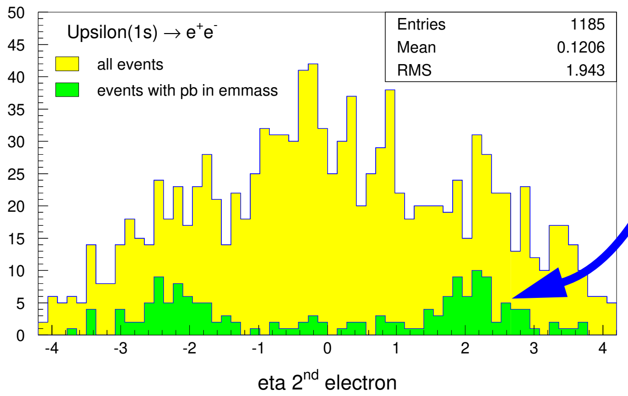
Problem with emmass...

- ❒ wrong emmass ?!
  - ☞ affects 13% of the selected Υ events
  - ☞ problem also present in J/Ψ
  - ☞ not a “pairing” problem
  - ☞ problem concentrated in fwd regions









Conclusion / Outlook

❒ Simple method to determine em energy scale and offset

But it was just a presentation of the method...

No conclusion on the efficiency, precision, resolution...

❒ Work is going on... and to get reliable numbers, we need to

- ☞ simulate more signal events
- ☞ take into account bkg events. Realistic analysis...
- ☞ use the trigger simulation
- ☞ estimate systematics (main contribution to the energy scale uncertainty during Run I)

❒ Apply same method to J/Ψ and Z resonances

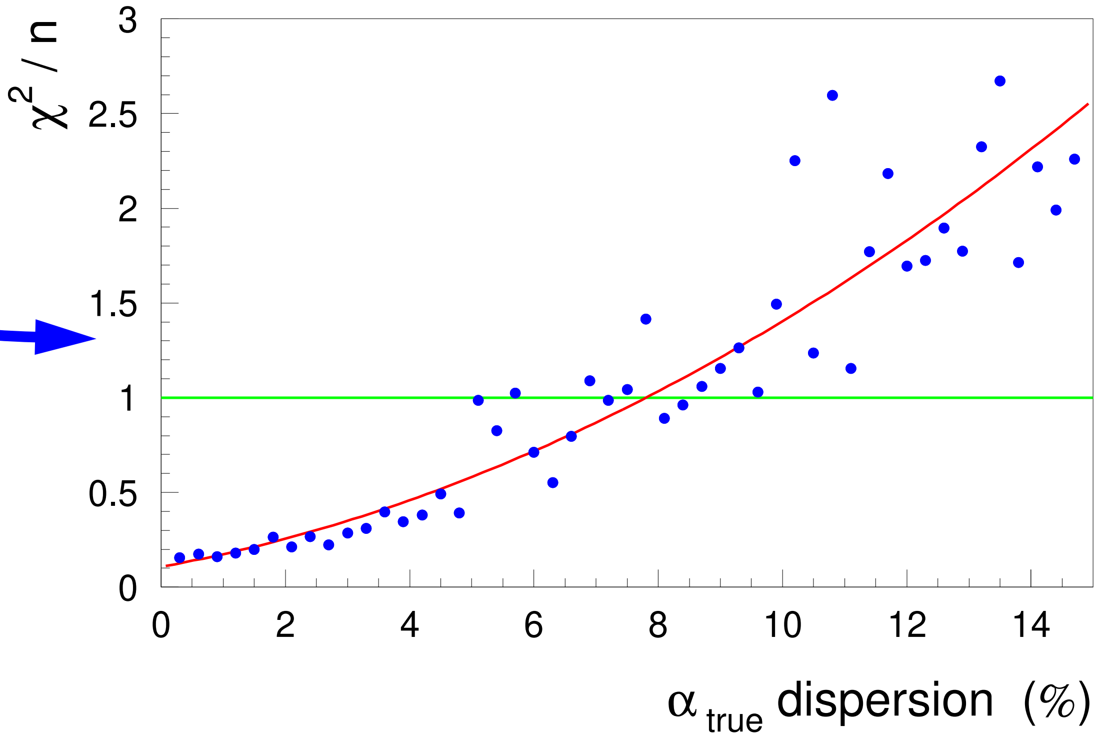
- ☞ check the sensibility of the method to non-linearity

❒ Write a package......

Precision required on the relative calibration

❒ What is the precision required for the intercalibration to reach a given precision on the energy scale ?

- ☞ Test 50 dispersion values between 0 and 15%
- ☞ For each dispersion hypothesis, test n=100 values of α_{true}
- ☞ For each value, measure α_{meas}
- ☞ Define $\chi^2 = \Sigma^n (\alpha_{meas} - \alpha_{true})^2 / \sigma^2$
- ☞ Fit (χ^2 / n) vs dispersion



- ☞ e.g. for a quality cut χ^2 / n = 1 the required precision is ~ 8 %

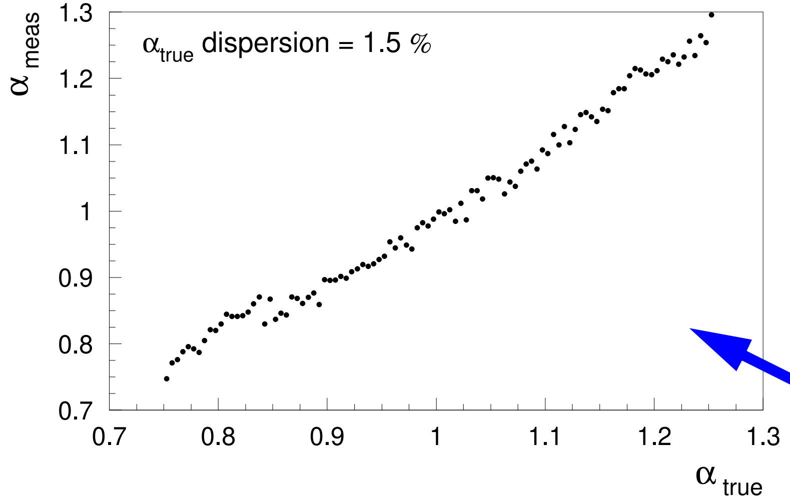
Don't care the numbers... just qualitative... no systematics yet

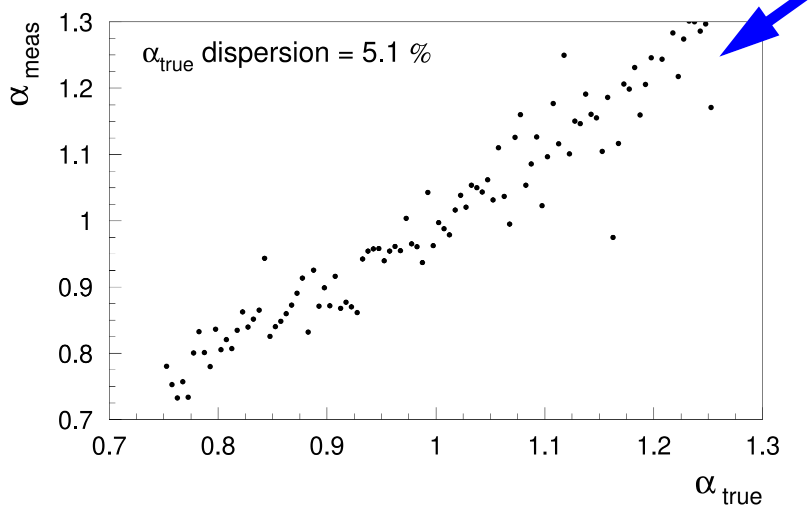
Check of the method with artificial $\alpha_{true} \neq 1$

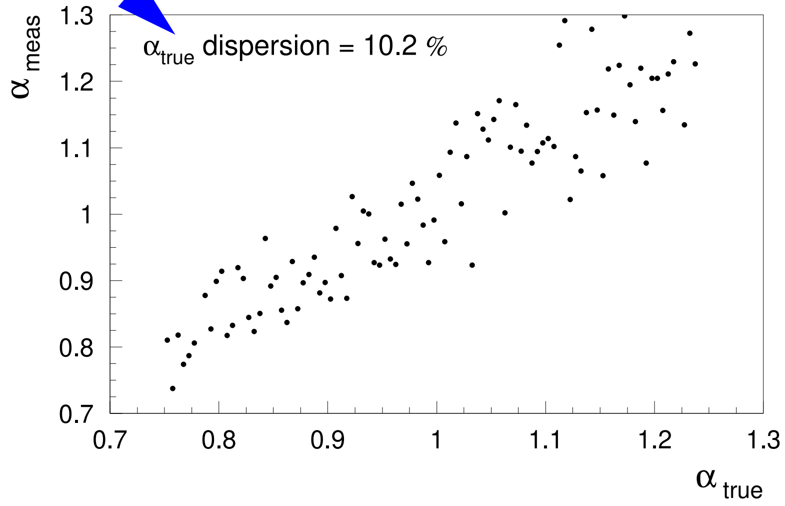
❶ Rescale energy in MC by a factor $1/\alpha_{true}$ and check that the fitted value α_{meas} match α_{true}

❷ The energy scale might present non-uniformity over the whole calorimeter (e.g. imperfect intercalibration) or might vary in time (e.g. irradiation or imperfect monitoring of the Ar purity)

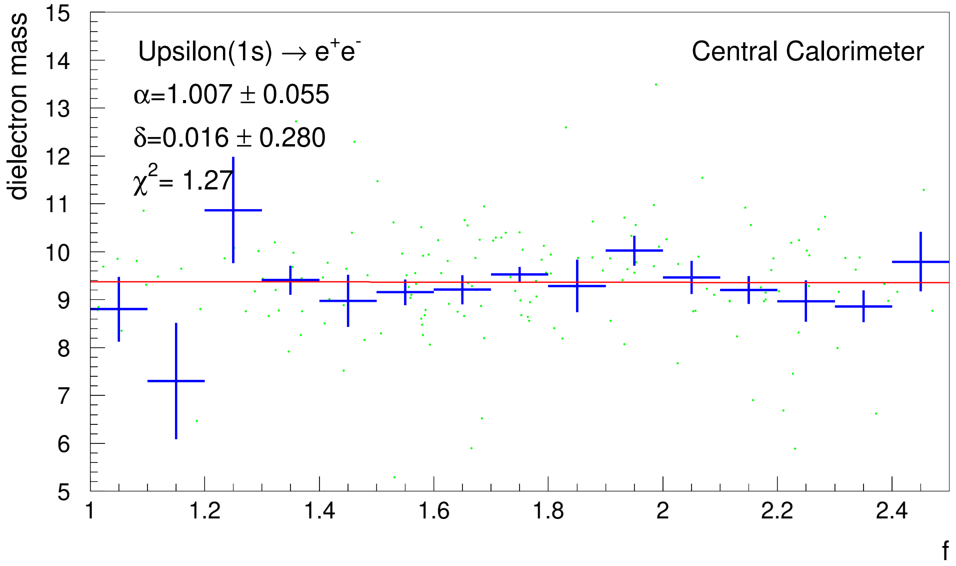
- ☞ Simulate dispersion of α_{true} in MC (assume normal distribution...)
- ☞ check α_{meas} vs α_{true} correlations for different values of the dispersion

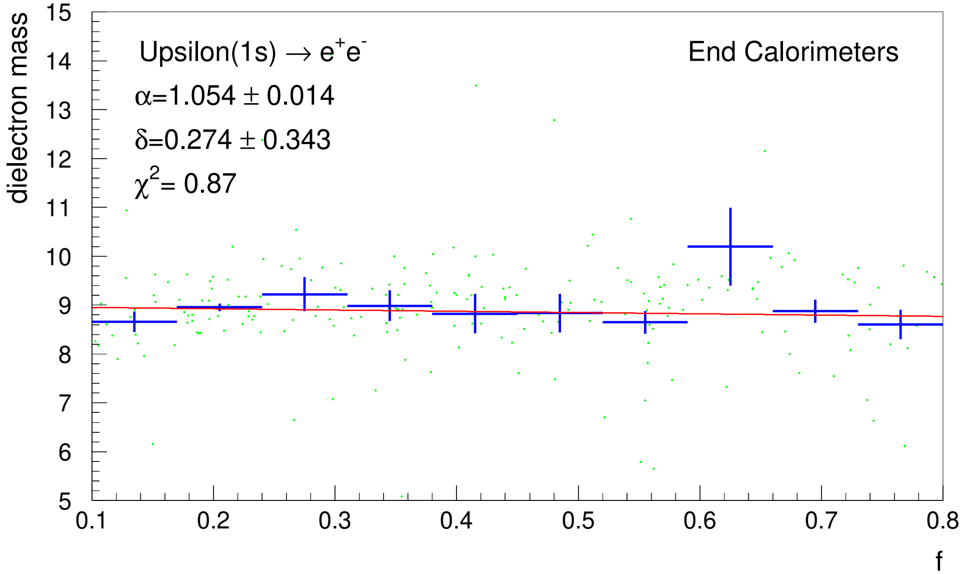






Electromagnetic energy scale





❹ Linear fit (likelihood) of M_{meas} vs. f

☞ $M_{meas} = (-\delta/\alpha)\, f + (1/\alpha)\, M_{true}$

❺ Results:

☞ energy scale α ~ compatible with 1

☞ offset δ ~ compatible with 0

☞ but fit very sensible to seeds (very low MC statistics...)

☞ no systematics yet

Electromagnetic energy scale

❶ Assume linear response of the calorimeter (test beam)

☞ $E_{true} = \alpha\, E_{meas} + \delta$

❷ Measure invariant mass of the resonance

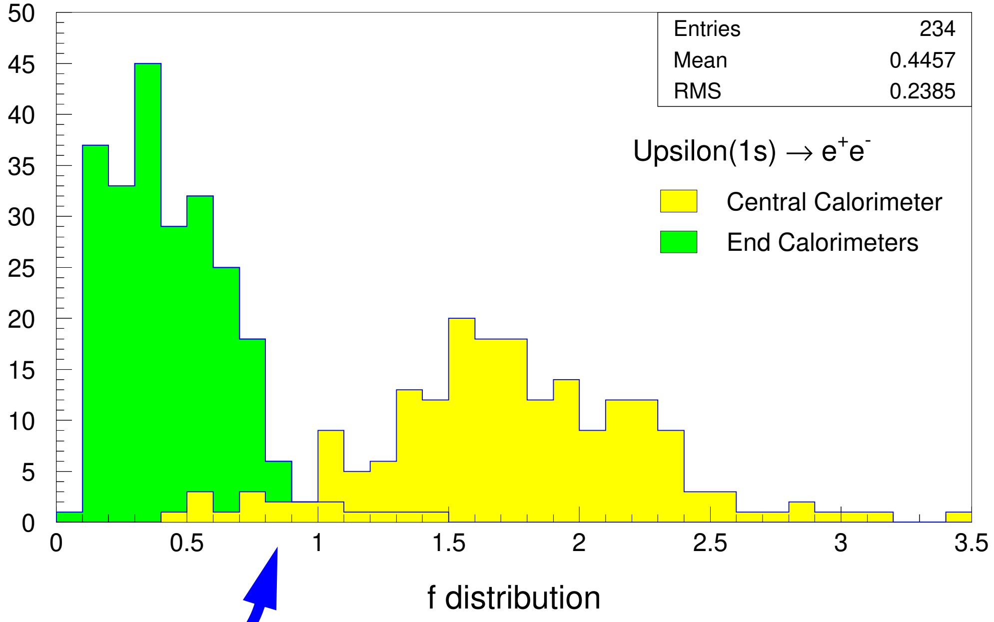
☞ $M_{meas} = [\, 2\, E_1^{meas}\, E_2^{meas}\, (1\text{-}\cos\,\theta)\,]^{1/2}$

❸ Replace E_{meas} by $(\, E_{true} - \delta\,) / \alpha$

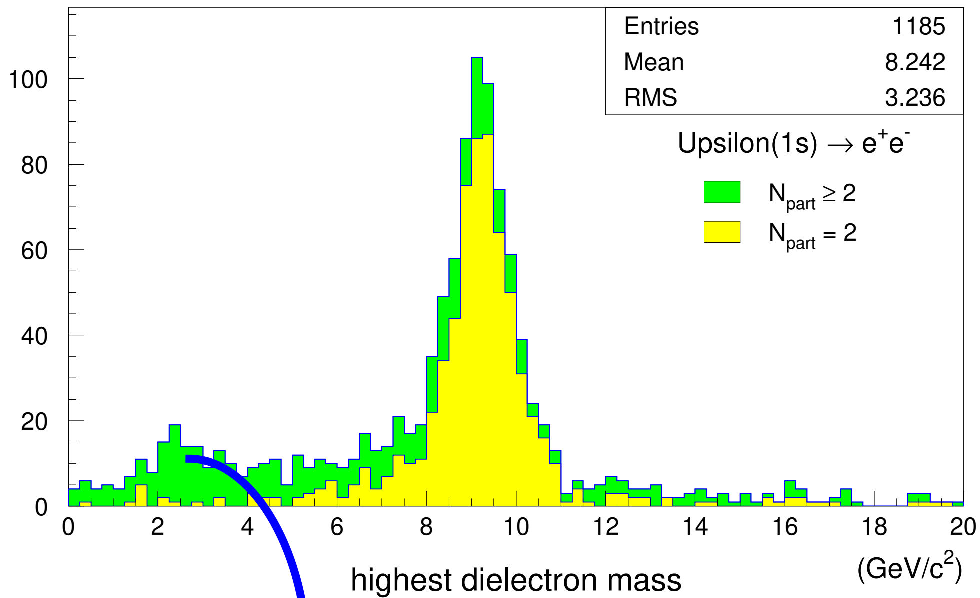
☞ $M_{true} = \alpha\, M_{meas} + f\delta$

where f is a kinematic factor, function only of the measured quantities:

$f = (E_1^{meas}+E_2^{meas})\,(1\text{-}\cos\,\theta) / M_{meas}$

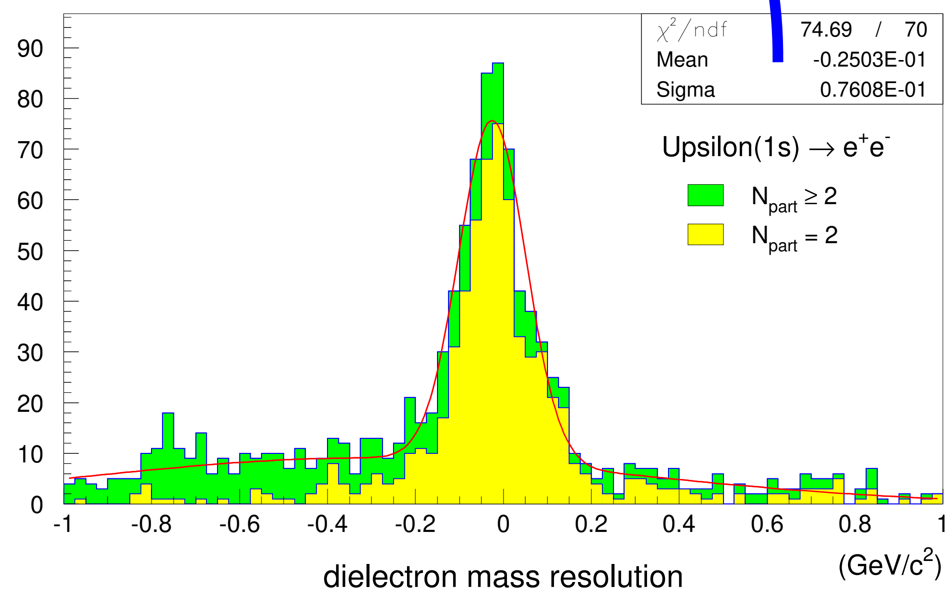


Upsilon peak



Mass resolution ~ 8 %

☞ is it possible to distinguish the Υ(1S) and Υ(2S) peaks ?



☞ e^- interacts with matter before the calorimeter

☞ possible to recover these events with cones around the electrons, but consequence on the bkg ?

Trigger efficiency

❒ Upsilon trigger, UPS_CC L2:

L2EM(2,3,e,fpi) & L2IM(e,3,e,3,9,1000)

2 EM towers with E_T>3 GeV
of type electron, quality fpi

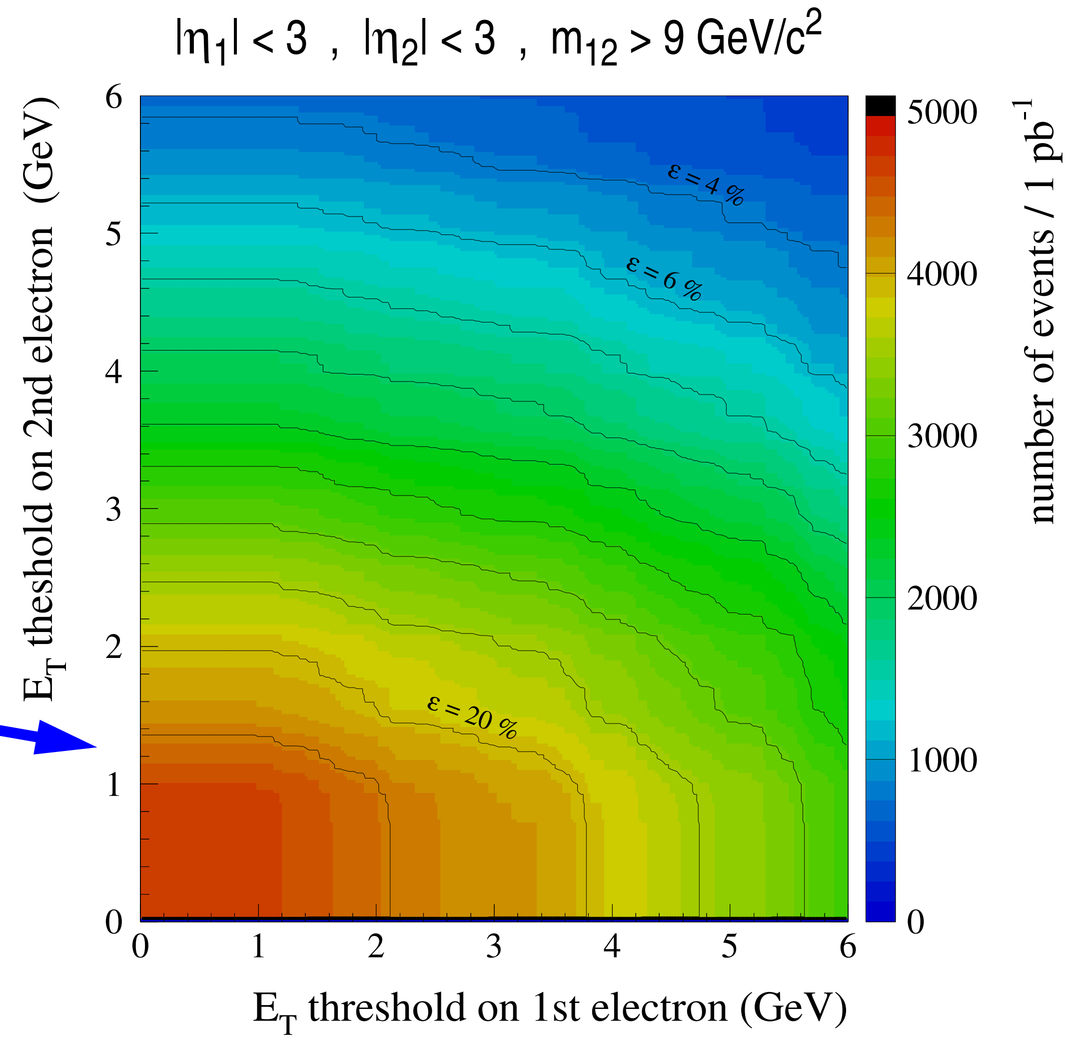
and

invariant mass of e ($|\eta|$<3)
and e ($|\eta|$<3) must be in the
window [9 -1000] GeV/c^2

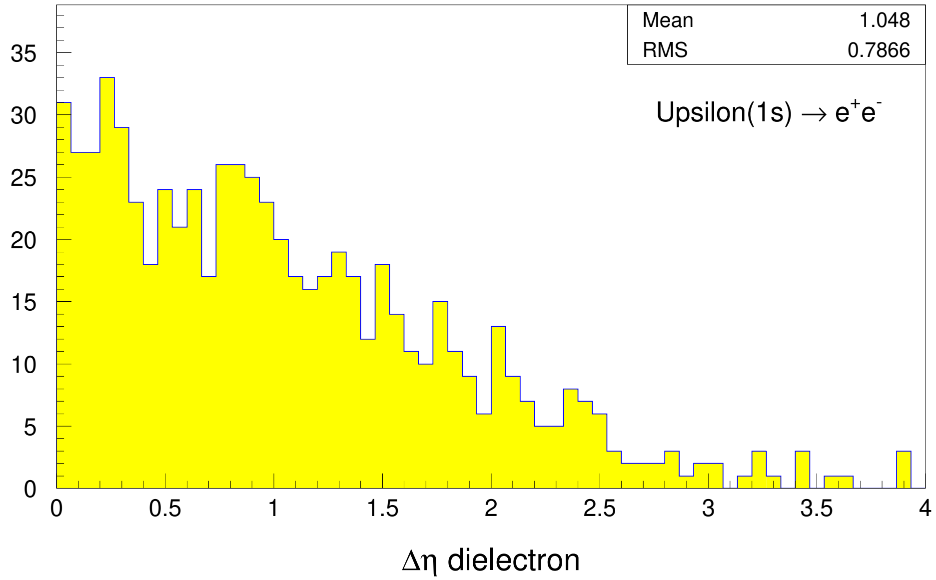
☞ Approximative efficiencies
(no quality requirements)

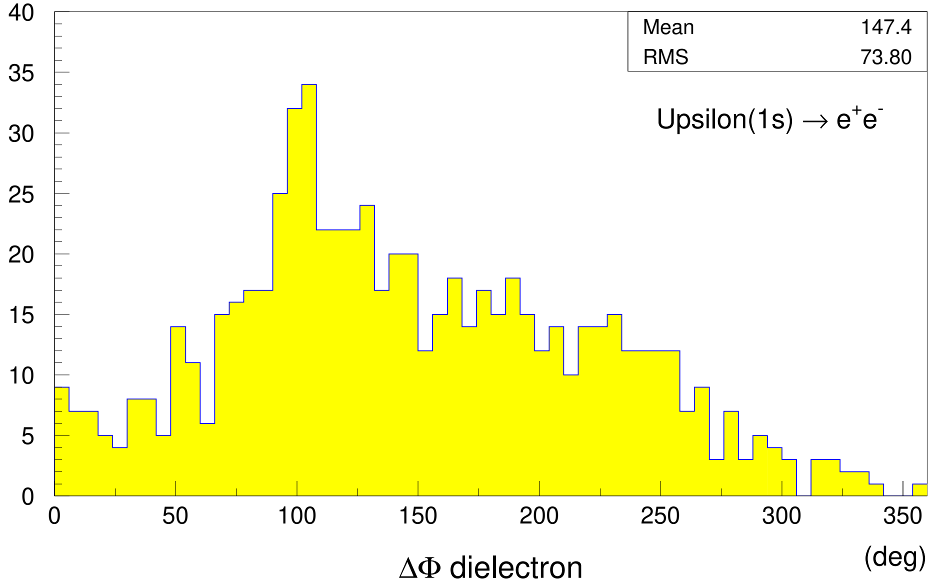
☞ For a 3 GeV threshold on both e^-:
ε = 13.7 % , N = 2675 evts / (1 pb^{-1})

☞ Is it possible to lower the mass
threshold to 8.5 GeV/c^2 ?
(will give 25% more events)

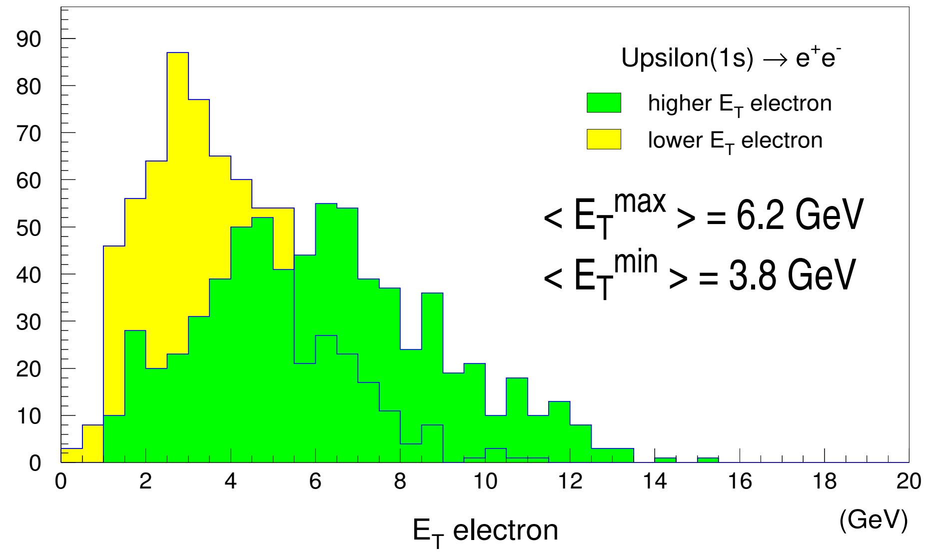


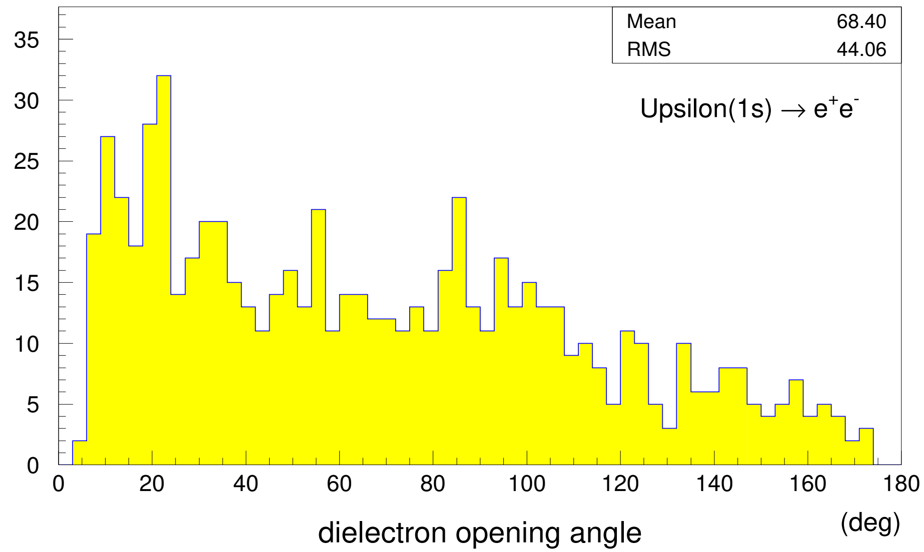
A few signal characteristics

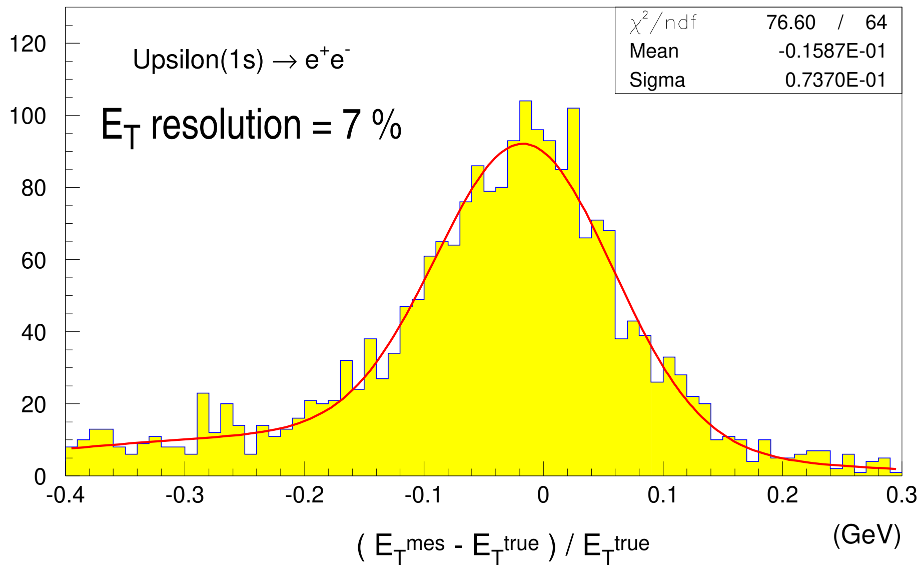


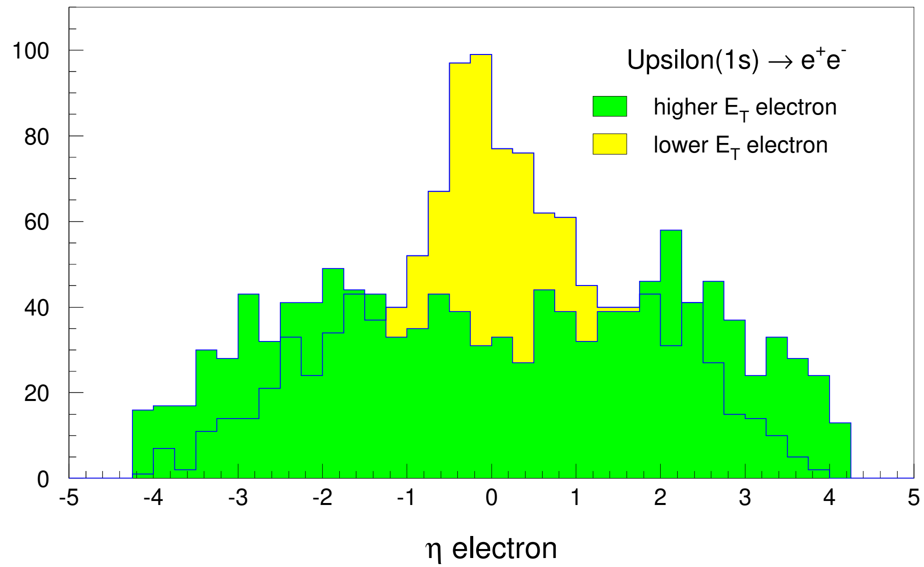


A few signal characteristics









Data sample

❐ 2000 Υ (1S) → e^+e^- events generated by PYTHIA

1.1 min. bias , preco 03.07.00

↓

Run emreco 04.00.01 on this sample

(include preshowers in the reco)

↓

Ntuple created with em_analyze

Expected number of events

- ☞ Trigger efficiencies very approximative...
- ☞ High J/ψ x-sect due to b $\rightarrow$ J/ψ ,
  but electron less isolated (b jet)

	σ (nb)	trigger efficiency	2001 0.6 fb^{-1}	2002 1.2 fb^{-1}	2003 (a) 0.8 fb^{-1}	2003 (b) 2.6 fb^{-1}
J/$\psi \rightarrow e^+e^-$	11 10^3	~ 10 %	7.10^8	13.10^8	9.10^8	29.10^8
Υ (1S) $\rightarrow e^+e^-$	19.6	~ 15 %	1.8 10^6	3.5 10^6	2.4 10^6	7.6 10^6
Υ (2S) $\rightarrow e^+e^-$	15.0	~ 15 %	1.4 10^6	2.7 10^6	1.8 10^6	5.9 10^6
Z $\rightarrow e^+e^-$	0.202	?	0.12 10^6	0.24 10^6	0.16 10^6	0.52 10^6

Introduction

❐ Motivation

☞ determine the absolute energy scale of the em calorimeter

❐ How ?

❶ assume the calorimeter response is linear

❷ measure resonances masses (J/Ψ, Υ , Z),

❸ adjust energy scale so that the meas. masses match the true masses

❹ check a posteriori linearity hypothesis ❶ with different resonances

❐ Today

☞ only Υ resonance

☞ use a Run I method ("binned Z") within the new D0 Run II framework (em_reco / em_analyze)