Electron event selection

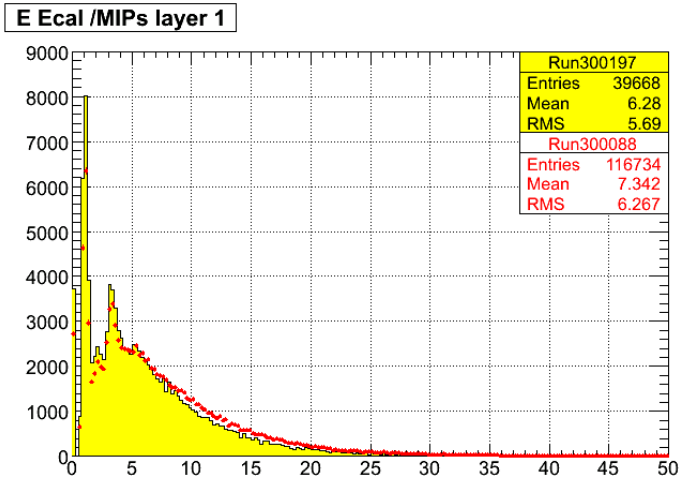
David Ward

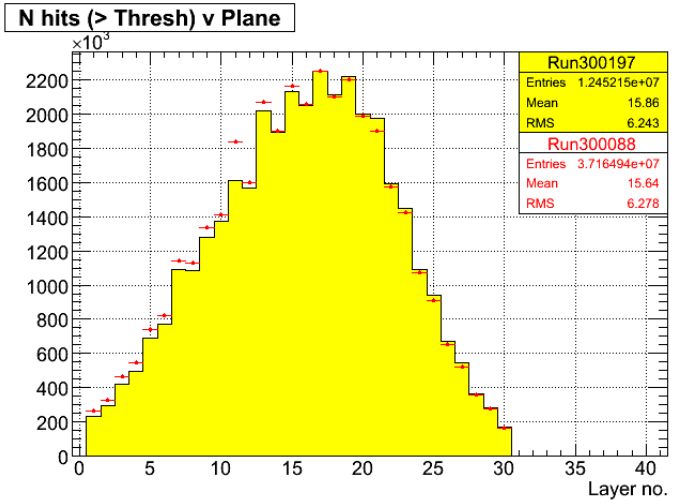
- Just a collection of thoughts to guide us in planning electron analysis
- In order to end up with a coherent analysis ought to agree on event selection / sample as soon as possible.
- Mainly summarising what I have done so far, in order to encourage discussion.
- So far focussed entirely on 0^o electron runs in 2006.

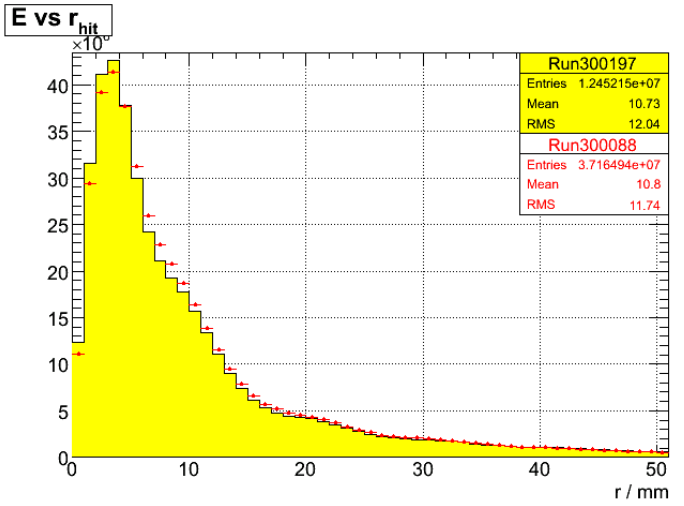
CERN runs:

- Data taken in several periods:
  - 9 Aug ’06; 30083-300104; 10-50 GeV
    - Data OK, but more pre-showering than other runs?
  - 25-26 Aug ’06; 300195-300213; 10-45 GeV
    - Mostly OK; some runs blighted by noise.
  - 29 Aug ’06; 300377-300383; 10-45 GeV
    - Mostly OK; some runs blighted by noise.
  - 7 Sep ’06; 310046-310065; 10-30 GeV
    - Mostly OK
    - ECAL only so can’t use HCAL to remove pions.
  - 23 Oct ’06; 300670-300676; 6-20 GeV
    - Mostly OK; HCAL useful to remove pion b/g

Runs 300083-300104

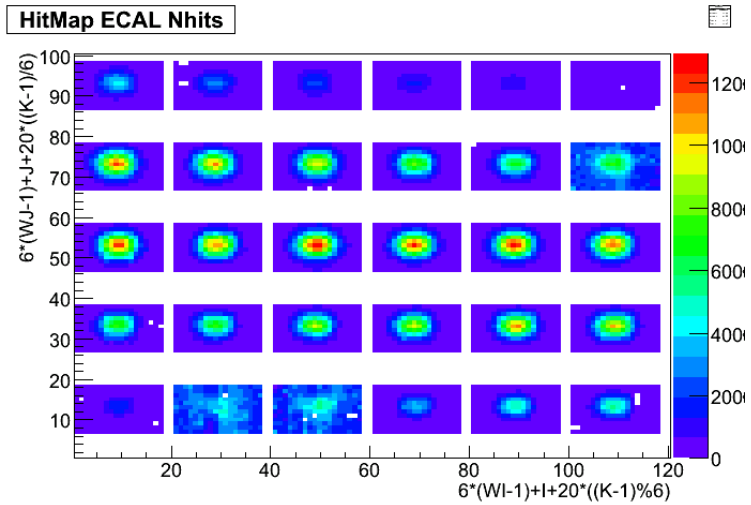


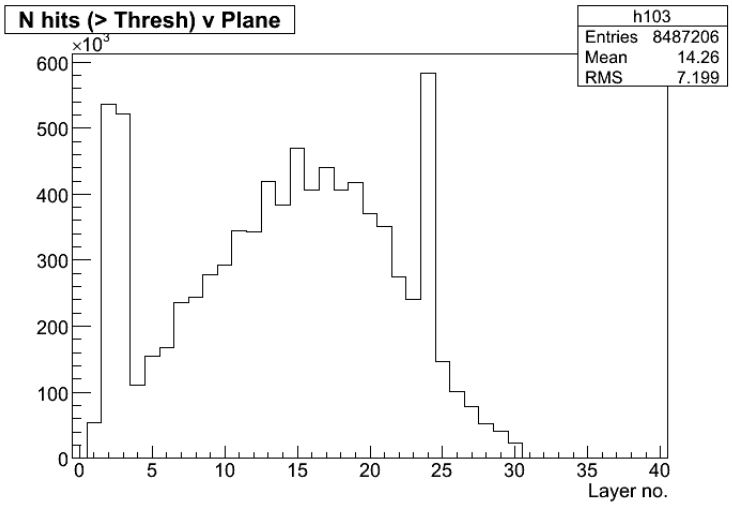




- These runs, compared with later ones, all show:
  - More energy in the first layer
  - Earlier shower development
  - Wider showers
- Our first attempt to use the beam. Suggests imperfect tuning, increased showering upstream of ECAL.
- I suggest we don't use these runs.

Noise (see Manqi Ruan's list)

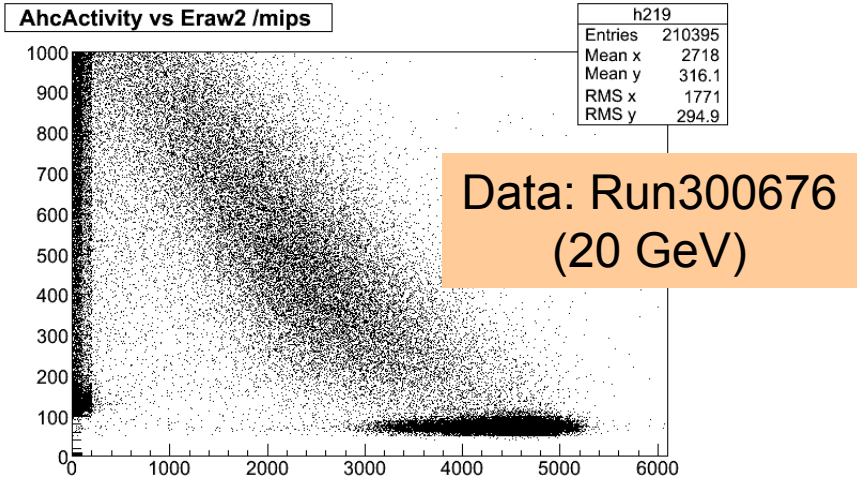


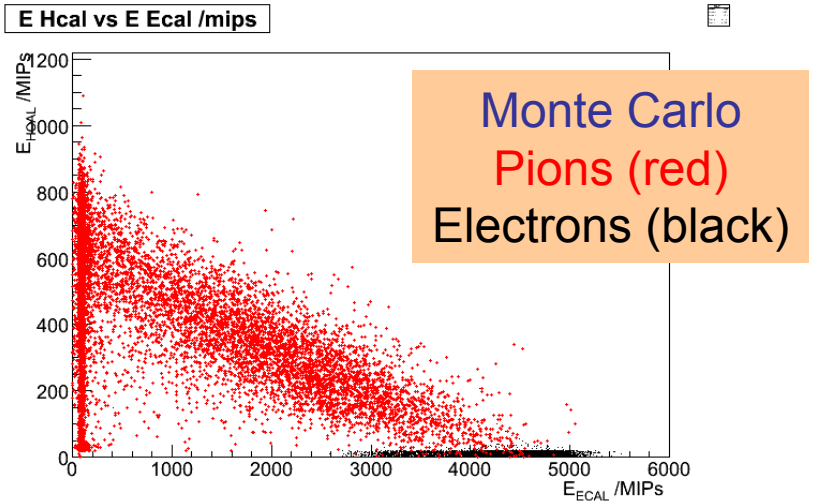


- Typical noisy run (300199) shown above.
- 3 noisy planes seen.
- In most cases, the total energy isn't too much affected.
- In some cases only a range of events is affected.
- Simplest solution is just to remove these runs, though we could try to do something cleverer.

Pion background

- The November (v04-02) data processing included an estimate of AhcActivity
- Only seems to be set usefully for runs 300670-300676.
- Used online calibrations only; only qualitative agreement with Monte Carlo seen.
- But suggests the basis of a useful cut, to complement Cerenkov information.
- Should study further when proper HCAL calibrated data are available in current round of processing.

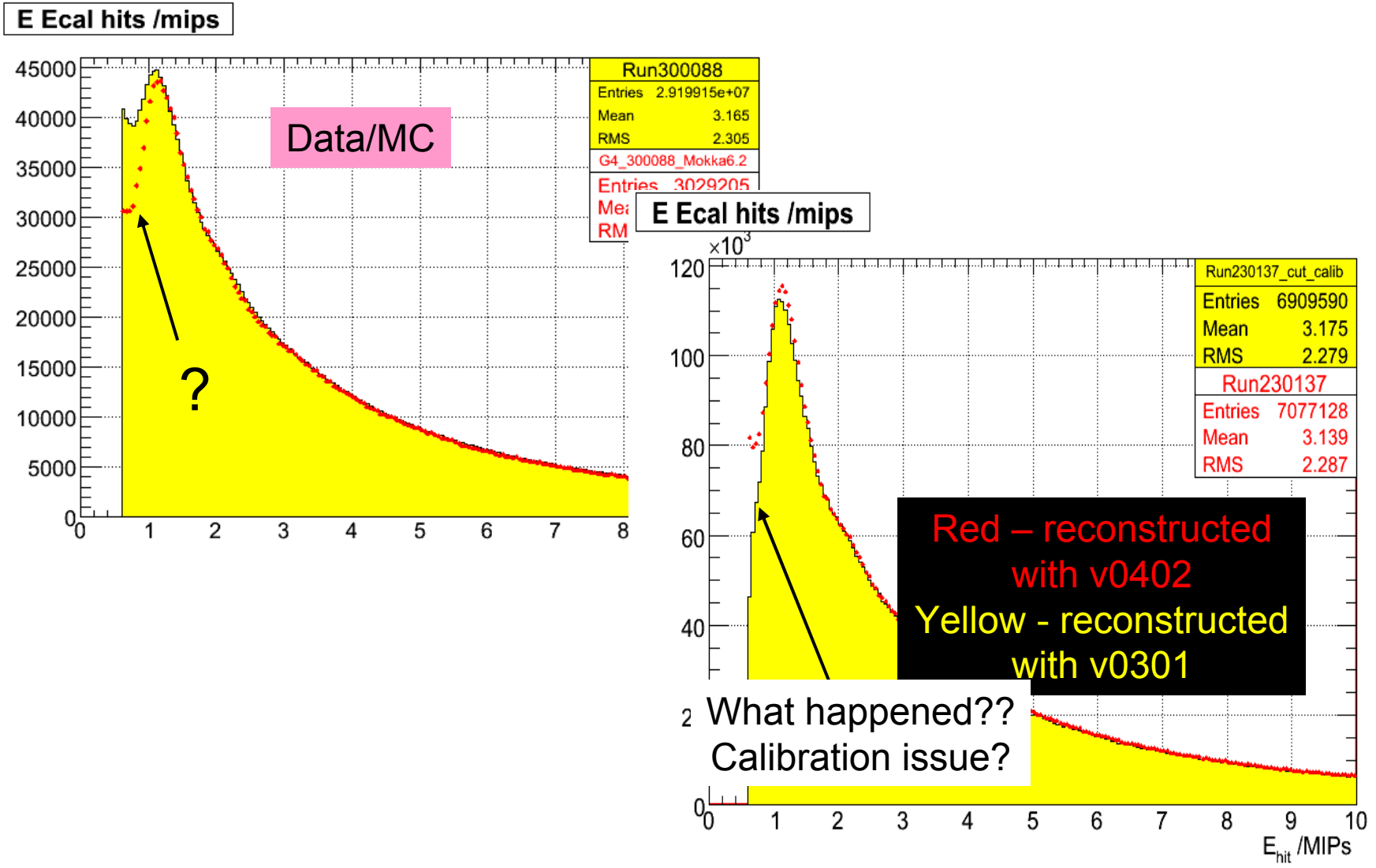




My selection cuts for CERN:

- Trigger type BeamData
- Hit energy > 0.6 MIP (should possibly be 0.65-0.7?)
- Compute $E_{tot}=E_{1\text{-}10}+2E_{11\text{-}20}+3E_{21\text{-}30}$ (in MIPs)
- Cut $E_{tot}>100*E_{beam}$ (add upper cut?)
- If HCAL data, cut AhcActivity<100 (MIPs) to reduce pion b/g. (replace by calibrated HCAL energy when available. Add Čerenkov information?)
- Possibly a cut on shower position for some analysis to avoid edge/gap effects?

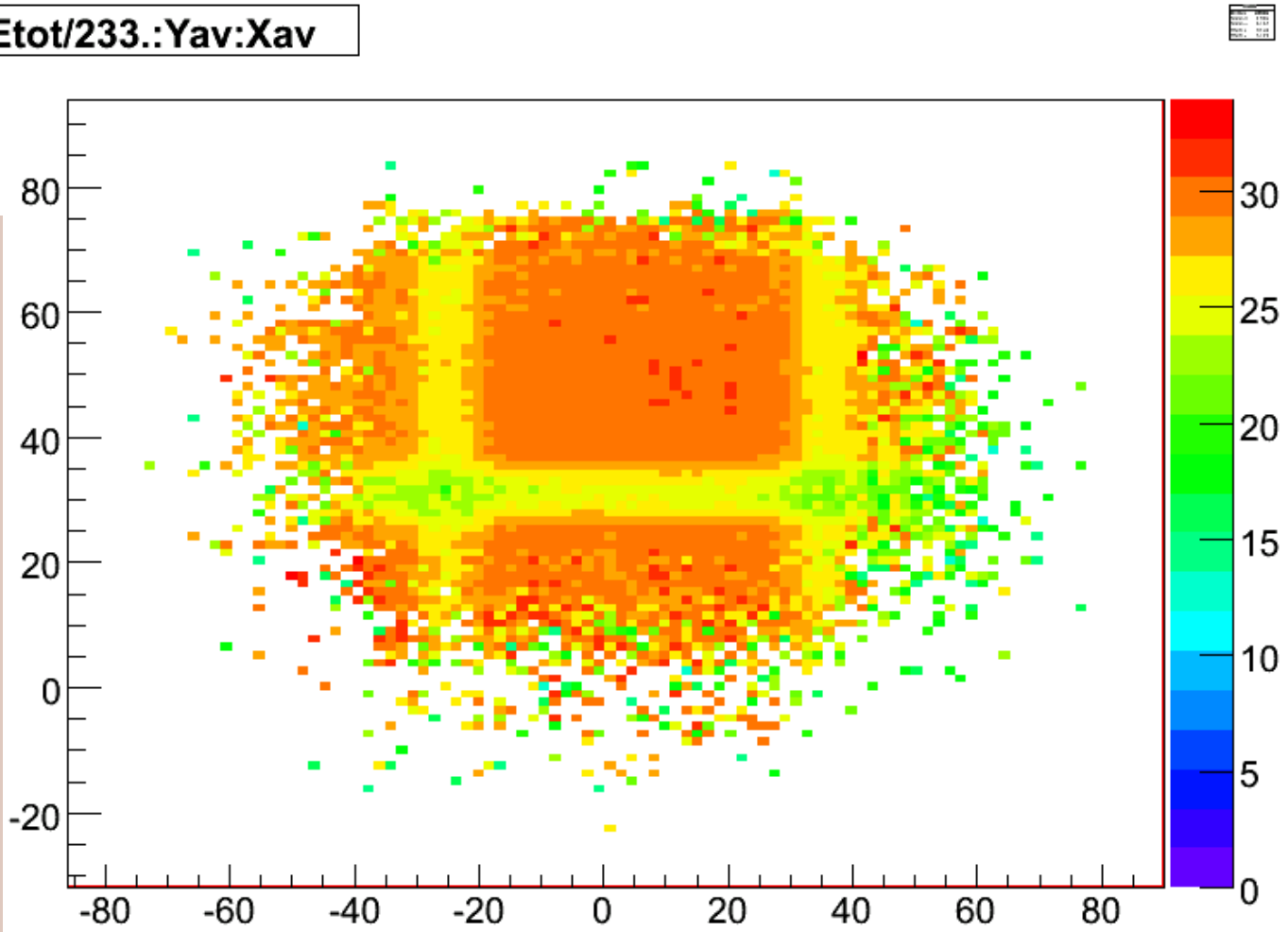
Hit energies



Dependence on shower position

Have typically used a cut of ±10mm around the centres of observed gaps (at ±30mm) in order to focus on wafer centres

But lose a lot of data; typically 70% at CERN; even more in some DESY runs.



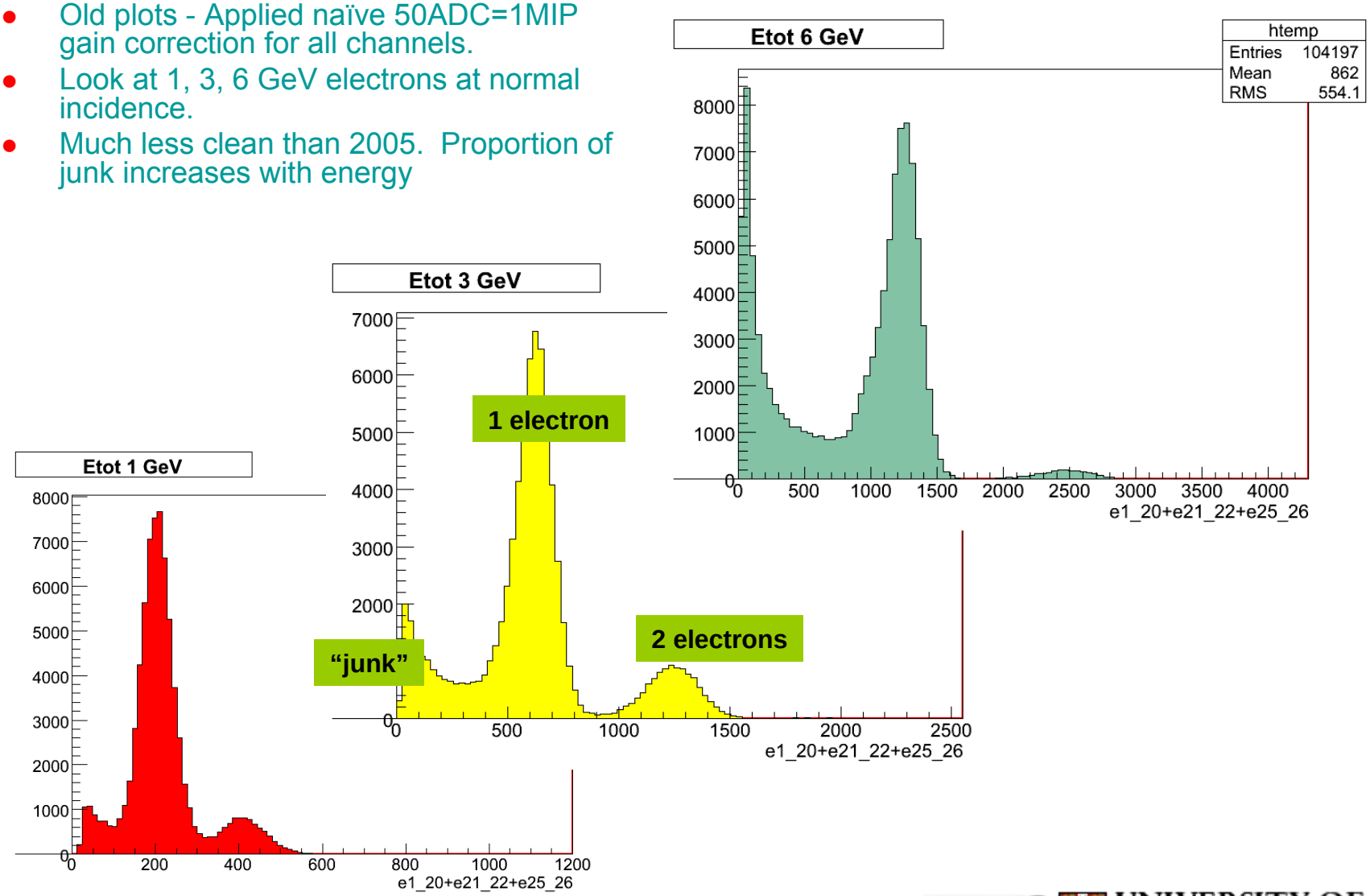
Summary of CERN 0° electron data

E_{beam} /GeV	Runs	# electrons
10	300200 300201 300383 310054 310056	285K (70K)
12	310052 310055	205K (0)
15	300202 310047 310048 310053 310063	366K (78K)
20	300189 300203 300205 300379 310046 310062 310064	398K (65K)
30	300197 300207 300378 310059 310065	528K (462K)
40	300195	68K (68K)
45	300208 300377	424K (424K)

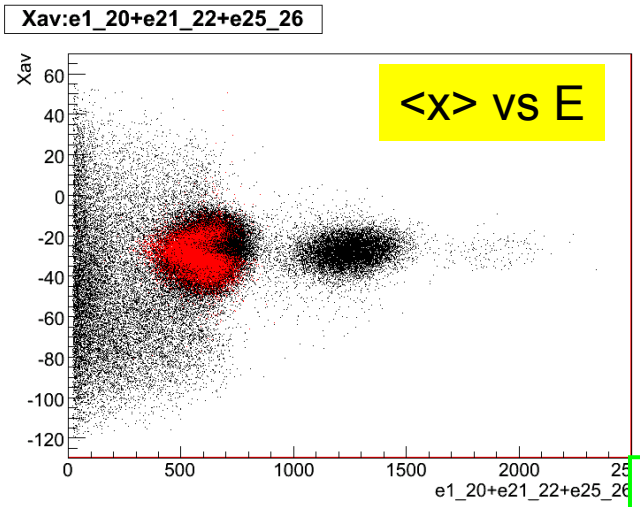
- Numbers of events in parentheses refer to runs which include HCAL info
- At some energies most of the data are with ECAL alone.
- A cut in the wafer centre would reduce these numbers by $\sim$ 70%

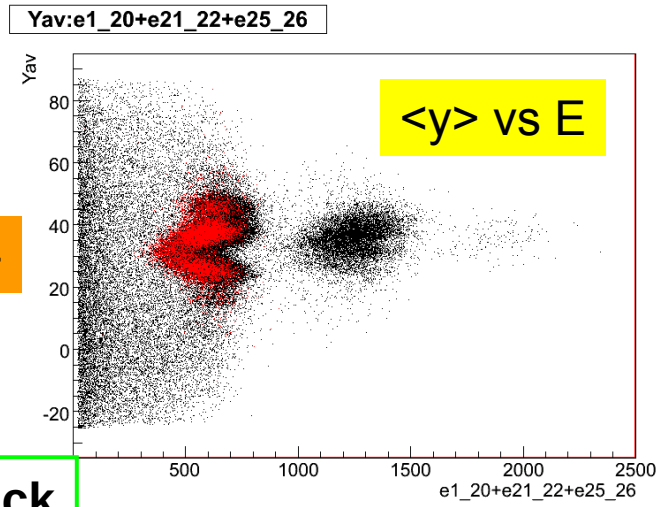
DESY May'06 - Total raw energy

- Old plots - Applied naïve 50ADC=1MIP gain correction for all channels.
- Look at 1, 3, 6 GeV electrons at normal incidence.
- Much less clean than 2005. Proportion of junk increases with energy



Separation of junk from signal?

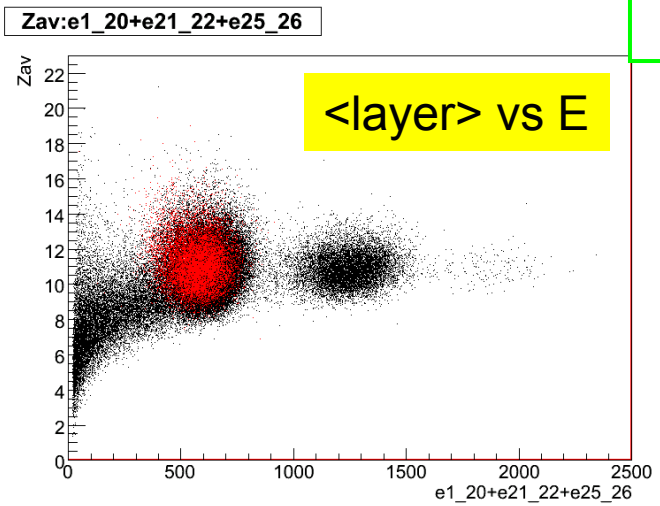


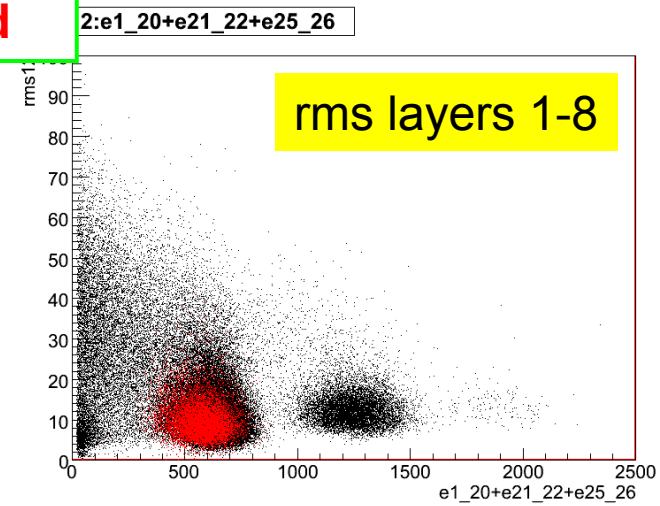


3 GeV e-

Data – black

MC - red



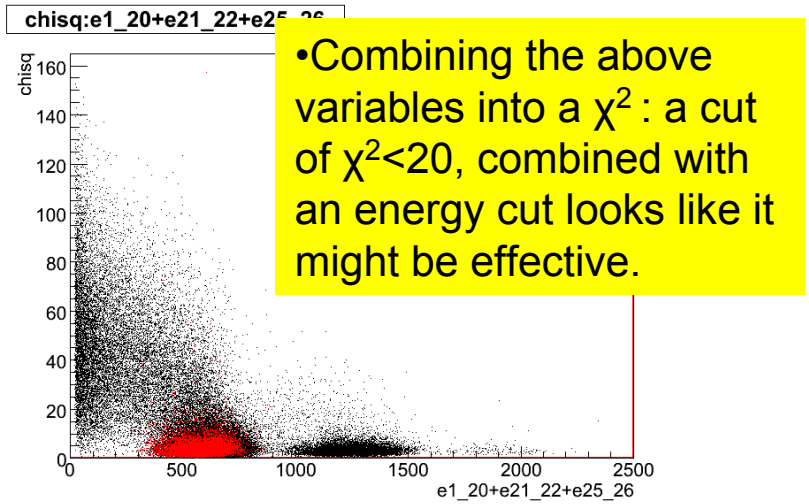


My selection cuts for DESY:

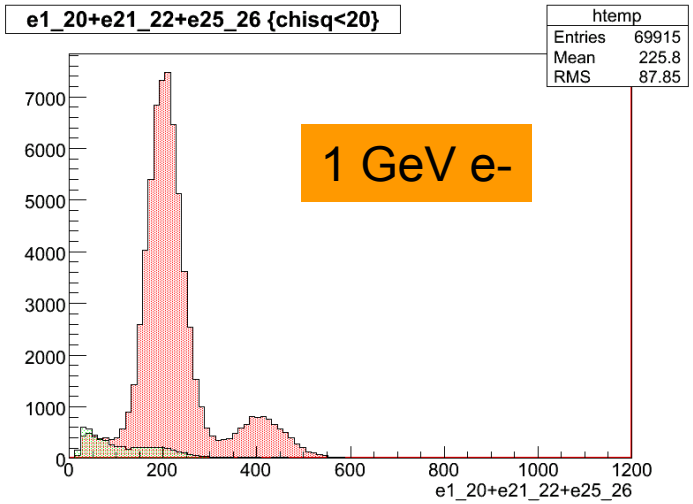
- Trigger type BeamData
- Hit energy > 0.6 MIP (could possibly be 0.65-0.7?)
- Compute energy weighted (x,y,z) of shower (all planes weighted equally). Also r.m.s. spread r about mean (x,y) in layers 1-8.
- $\chi^2=((x-\langle x\rangle)/\sigma_x)^2+((y-\langle y\rangle)/\sigma_y)^2+((K-\langle K\rangle))^2/1.7+((r-\langle r\rangle)/9)^2$
- Cut on $\chi^2<20$.
- Compute $E_{tot}=E_{1\text{-}10}+2E_{11\text{-}20}+3E_{21\text{-}30}$ (in MIPs)
- Cut $120*E_{beam}<E_{tot}<320*E_{beam}$

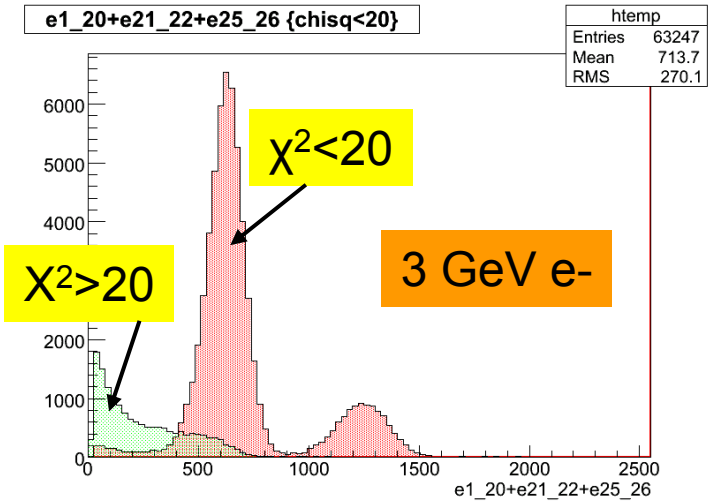
E/GeV	$\langle K\rangle$	σ_x /mm	σ_y /mm
1	9	16	16
1.5	9.6	13	12
2	10	11	10
3	10.5	9	8
4	10.8	9	8
5	11.1	9	8
6	11.4	9	8

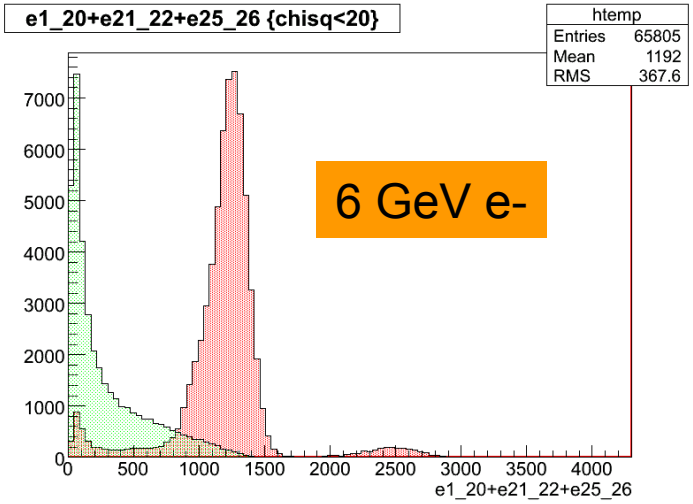
Possible separation of junk?



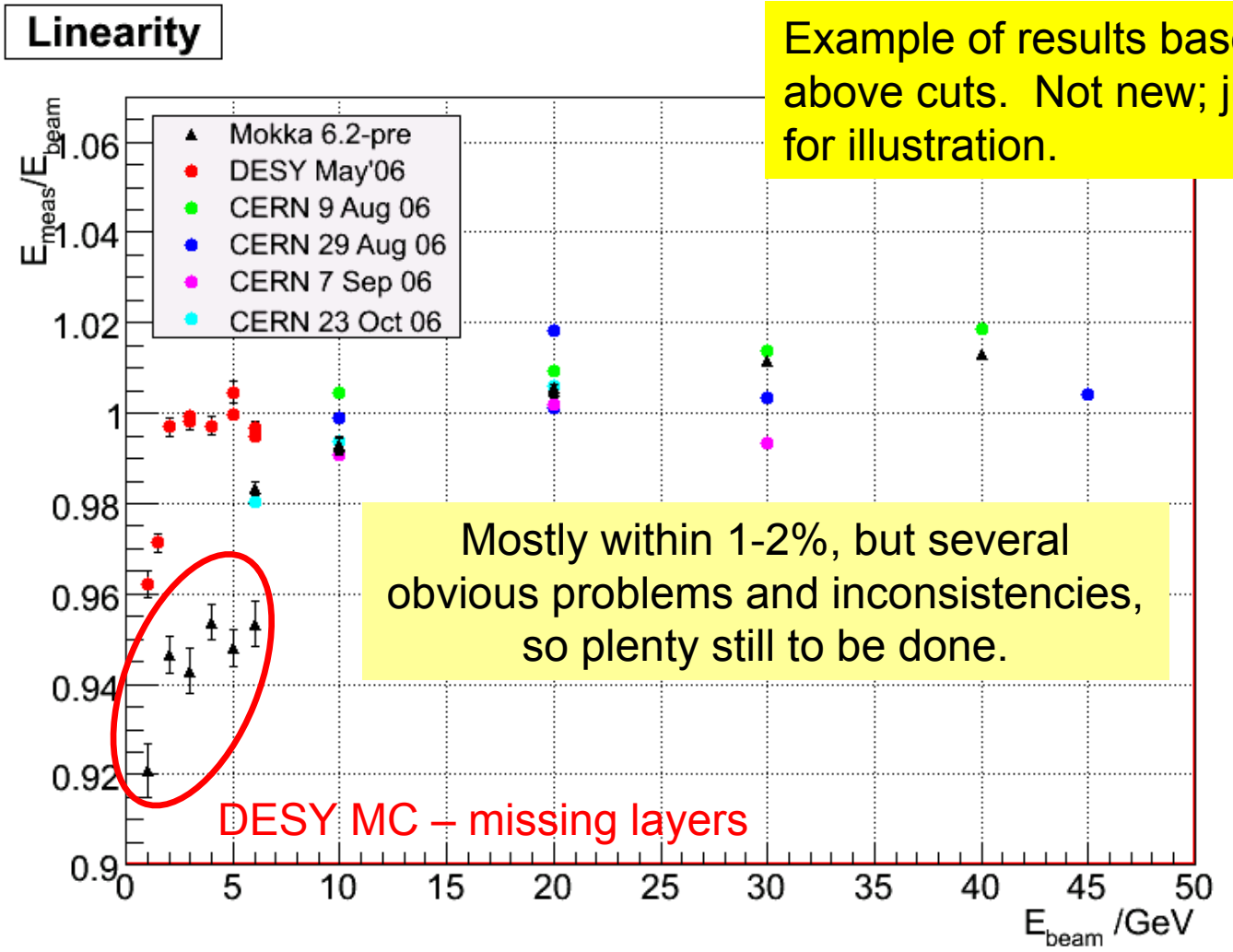
•Combining the above variables into a χ^2 : a cut of χ^2<20, combined with an energy cut looks like it might be effective.







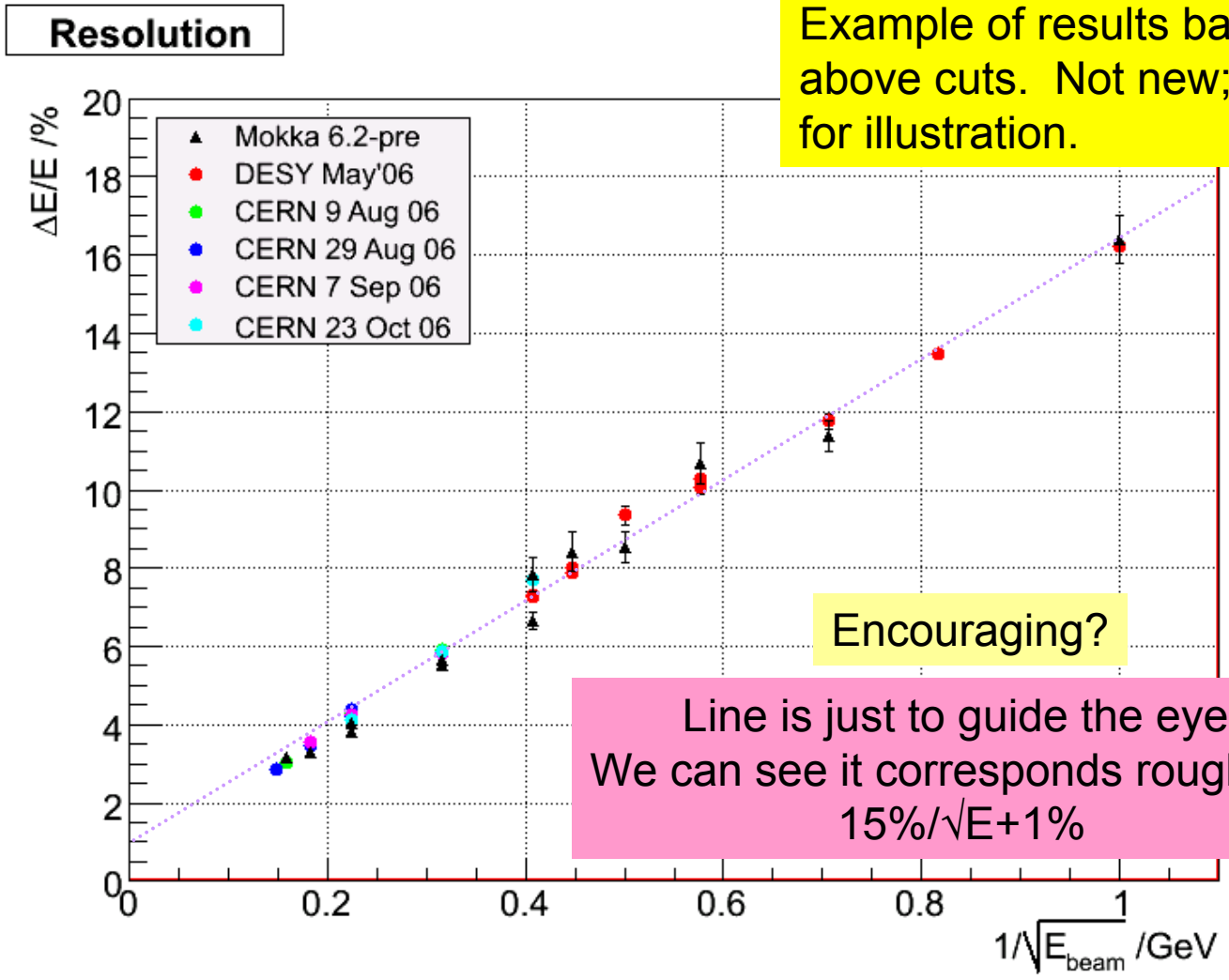
Linearity



Example of results based on the above cuts. Not new; just shown for illustration.

Mostly within 1-2%, but several obvious problems and inconsistencies, so plenty still to be done.

Resolution



Example of results based on the above cuts. Not new; just shown for illustration.

Encouraging?

Line is just to guide the eye.
We can see it corresponds roughly to 15%/√E+1%

Concluding remarks

- We should aim to show significant quantitative analysis results at LCWS07 - end May.
- In order to put a coherent set of material together we should agree a set of provisional event selections, so that we are all working on the same data samples.
- Then we can proceed in parallel on different analysis topics, and bring results together in a coheren way at start of May, in order to be discussed and approved by the Collaboration.
- I've only discussed electron normal incidence data. Probably not much needs to change for inclined angle data.
- Obviously must also do something similar for hadrons