Progress on dijet mass spectrum analysis

QCD Meeting, January 22, 2003

Alexander Kupčo

Institute of Physics, Academy of Sciences of the Czech Republic

Center for Particle Physics, Prague

Data sample

- stripped p13.04 and p13.05 thumbnails (single jet triggers)
- stripping done by QcdSkim code (`qcd_tools` package)
  - no l1l2 chunk in p13.05 thumbnails
- trigger versions **8.30**, **8.40**, **8.41**, **9.30**, **9.31**, and **9.50**
  - still no thumbnails for **8.10**, **8.20**, and **10.00**
- size is about 48GB (about 4.5M events)
- integrated luminosity is $\mathcal{L} = 38.6\,\text{pb}^{-1}$
  - $11.6\,\text{pb}^{-1}$ in p13.04, $27.0\,\text{pb}^{-1}$ in p13.05
- present status (January 20) of files available on SAM is
  - $13.6\,\text{pb}^{-1}$ in p13.04, $28.8\,\text{pb}^{-1}$ in p13.05

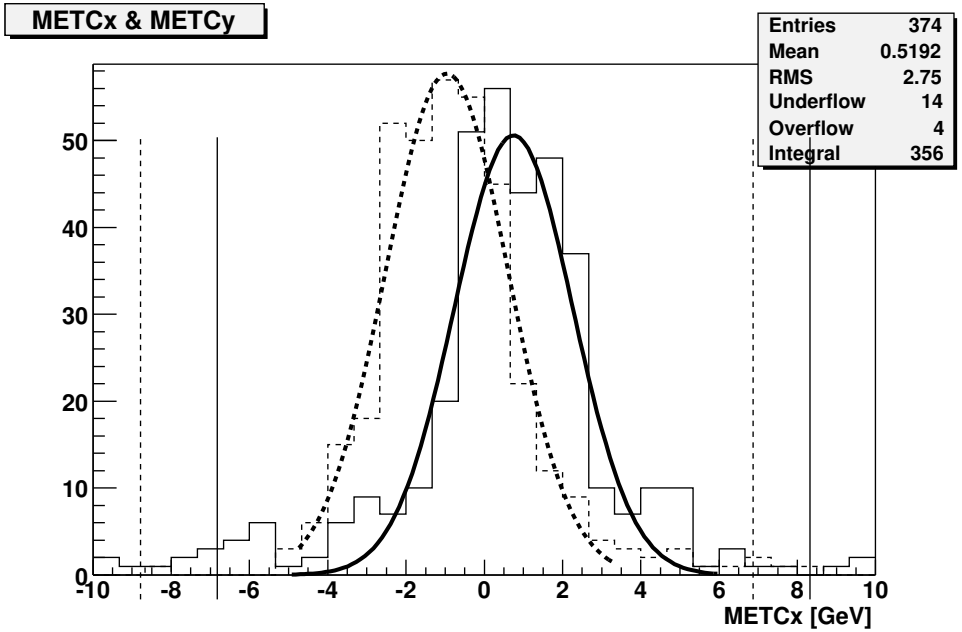
Run selections

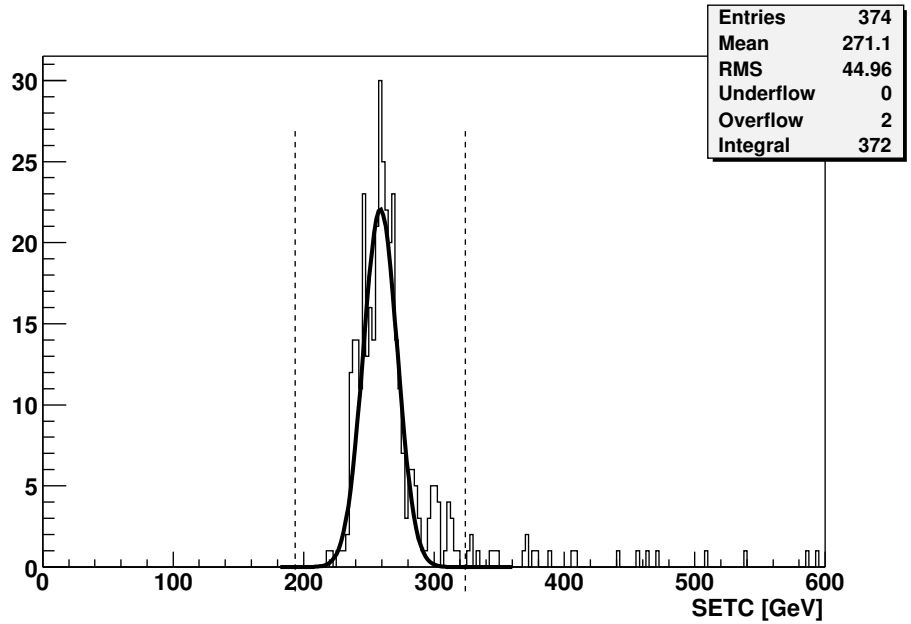
- run selection based on MET, METx, METy, SET

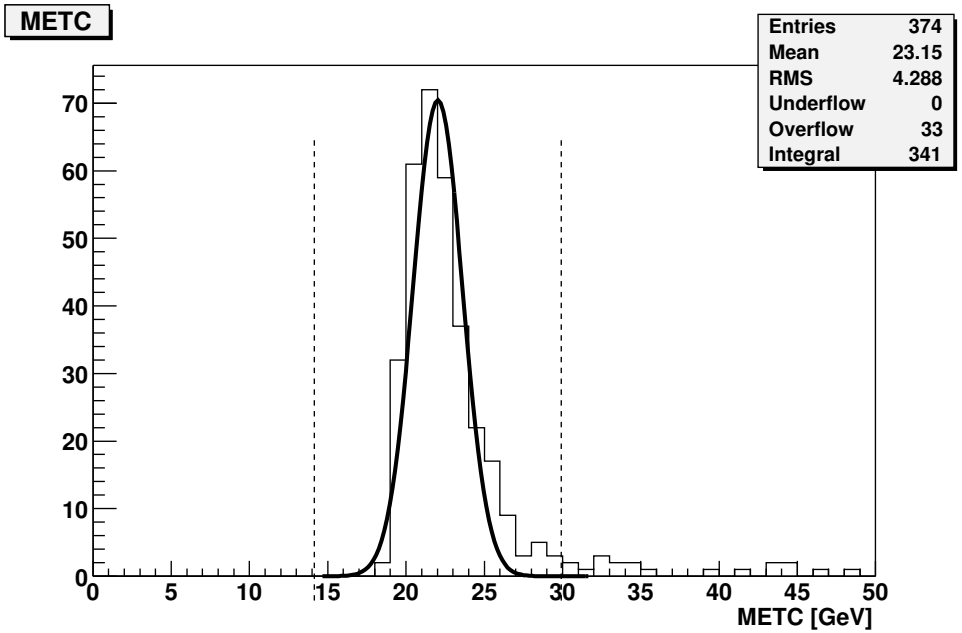
  $+$ runs with spikes in jet φ distribution were removed
- slightly loose the selection criteria - 5σ condition
- at least 200 events in trigger JT_65TT
- Number of good runs : 284 (946522 events, $\mathcal{L} = 24.2\,\text{pb}^{-1}$)
- Number of bad runs : 113 (366839 events, $\mathcal{L} = 6.6\,\text{pb}^{-1}$)
- going from 3σ range to 5σ does not recovered to much luminosity

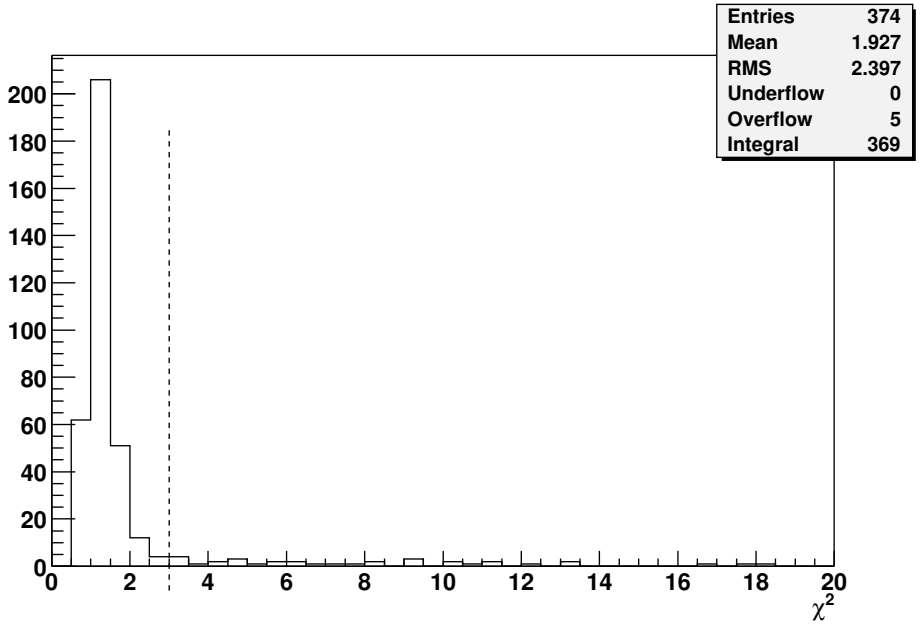
  - 3σ cut gives $\mathcal{L} = 23.1\,\text{pb}^{-1}$ in good runs

Run selection variables



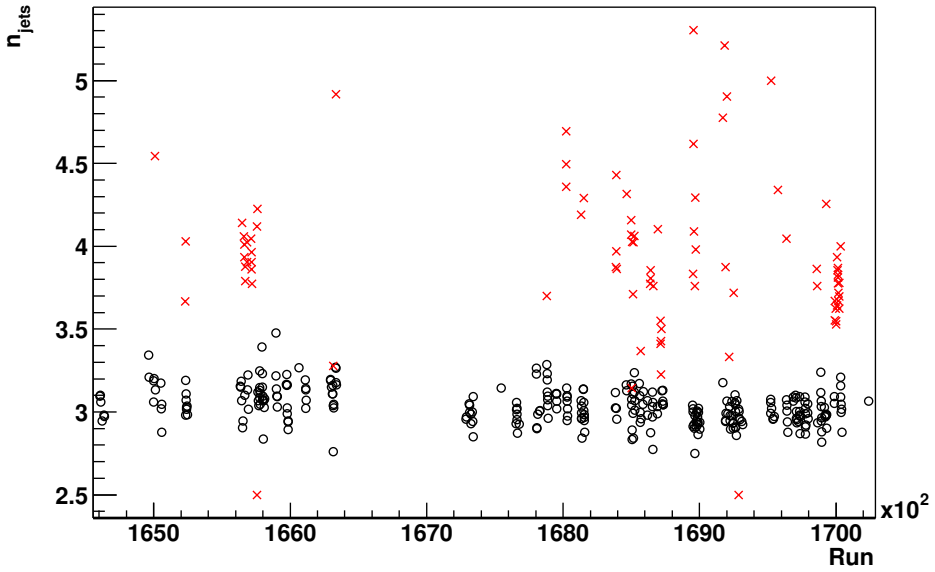




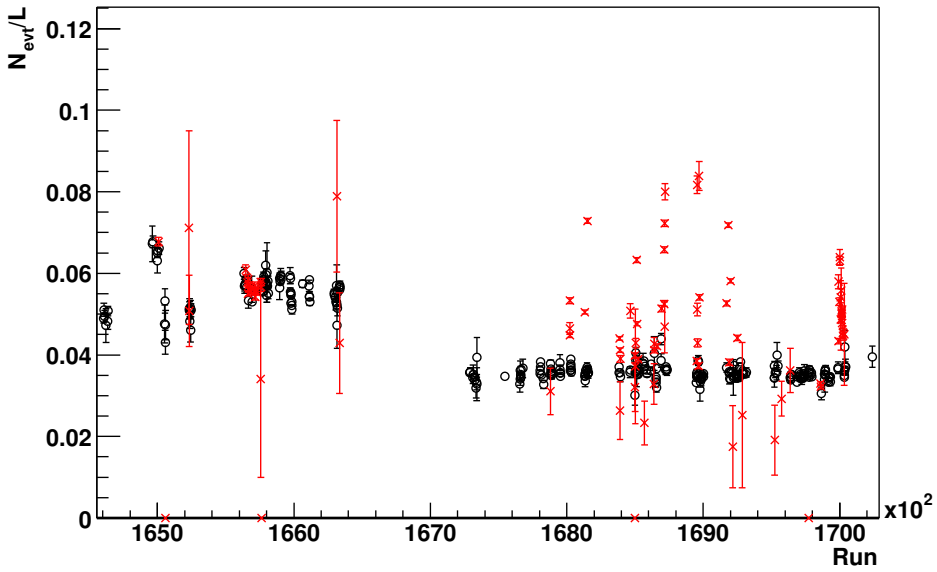


Run selection check

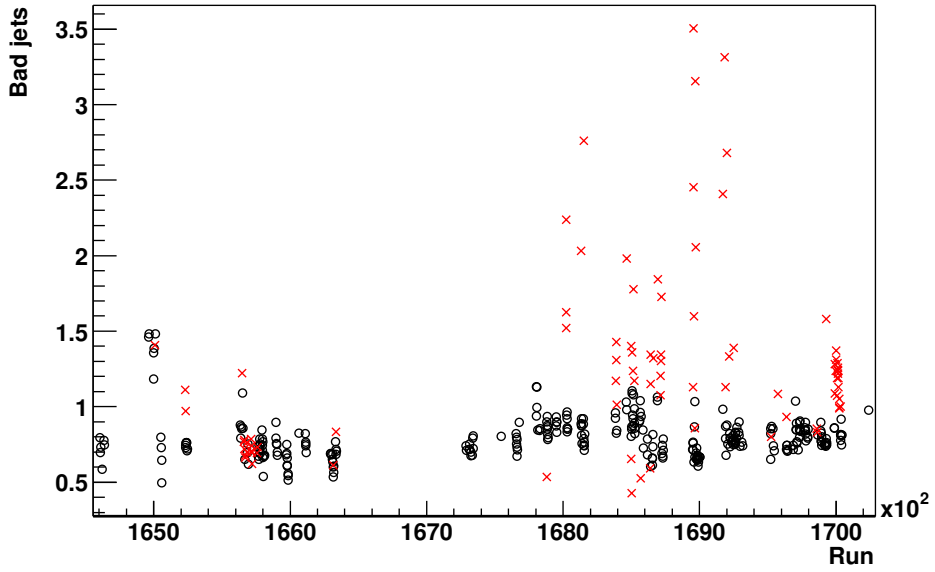
number of good jets



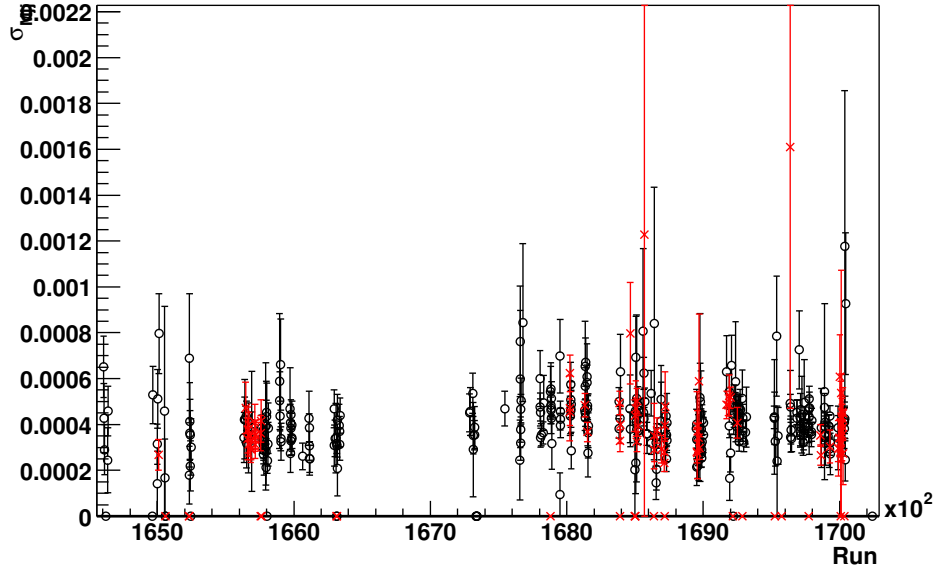
N_{evt}/L



number of bad jets



raw σ M_{jj}, M_{jj} > 250 GeV



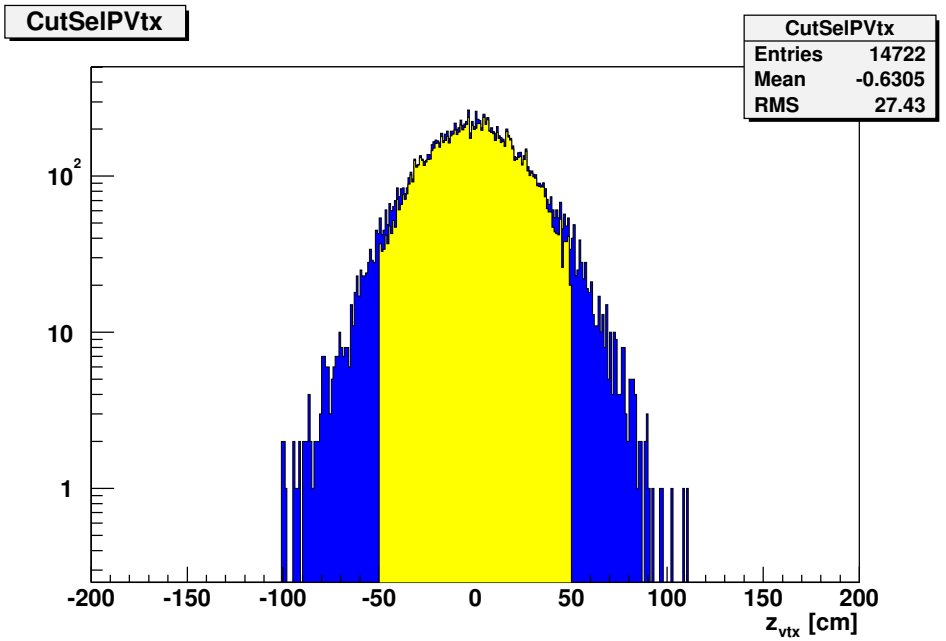
Event Selection

- p13 JES correction applied (`jetcorr v04-00-01`)
- p13 jetID criteria

Event selection criteria

- MET $< 0.7 p_T^{1st\ jet}$ (no JES and MET corrections)
- at least 5 tracks pointing to the primary vertex and $|z_{vtx}| < 50\,\text{cm}$
- the two leading jets should be good and within $|\eta| < 0.5$ region

Vertex cut efficiency



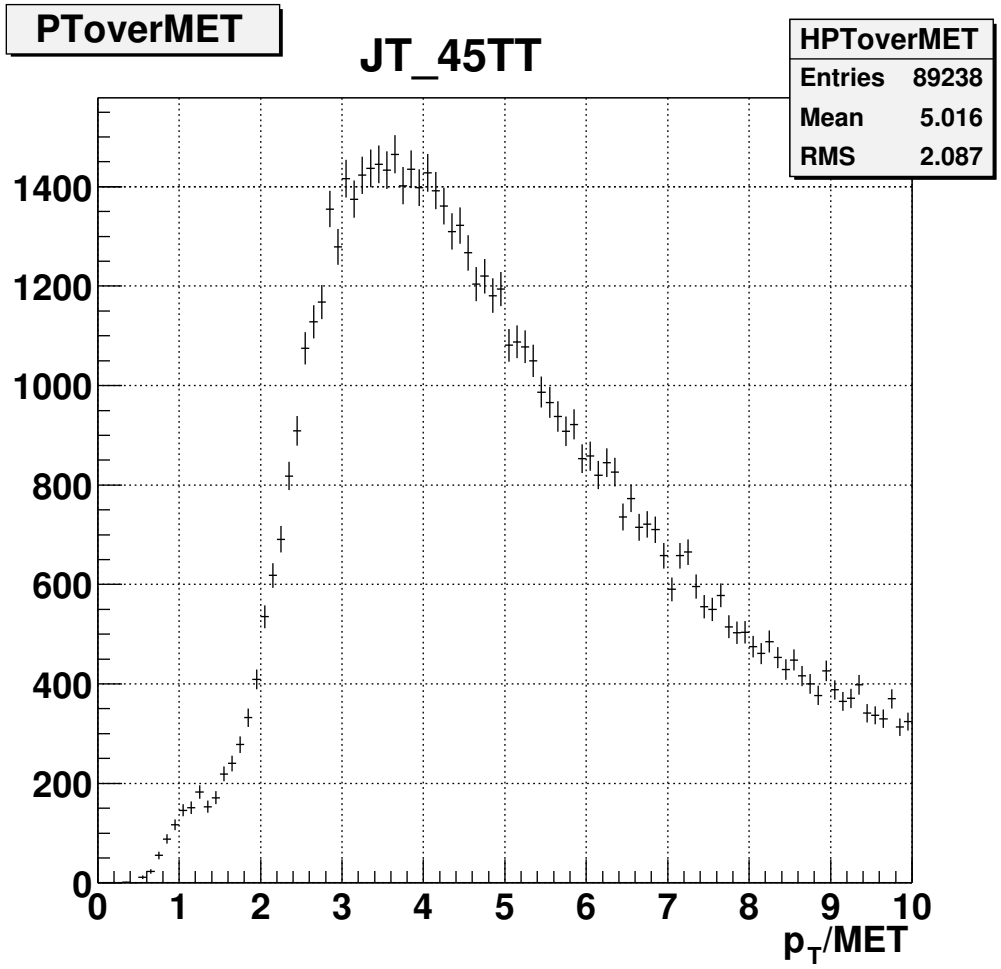
$$\varepsilon = \frac{N_{good}}{N_{all}}, \qquad \Delta\varepsilon = \sqrt{\frac{\varepsilon\,(1-\varepsilon)}{N_{all}}}$$

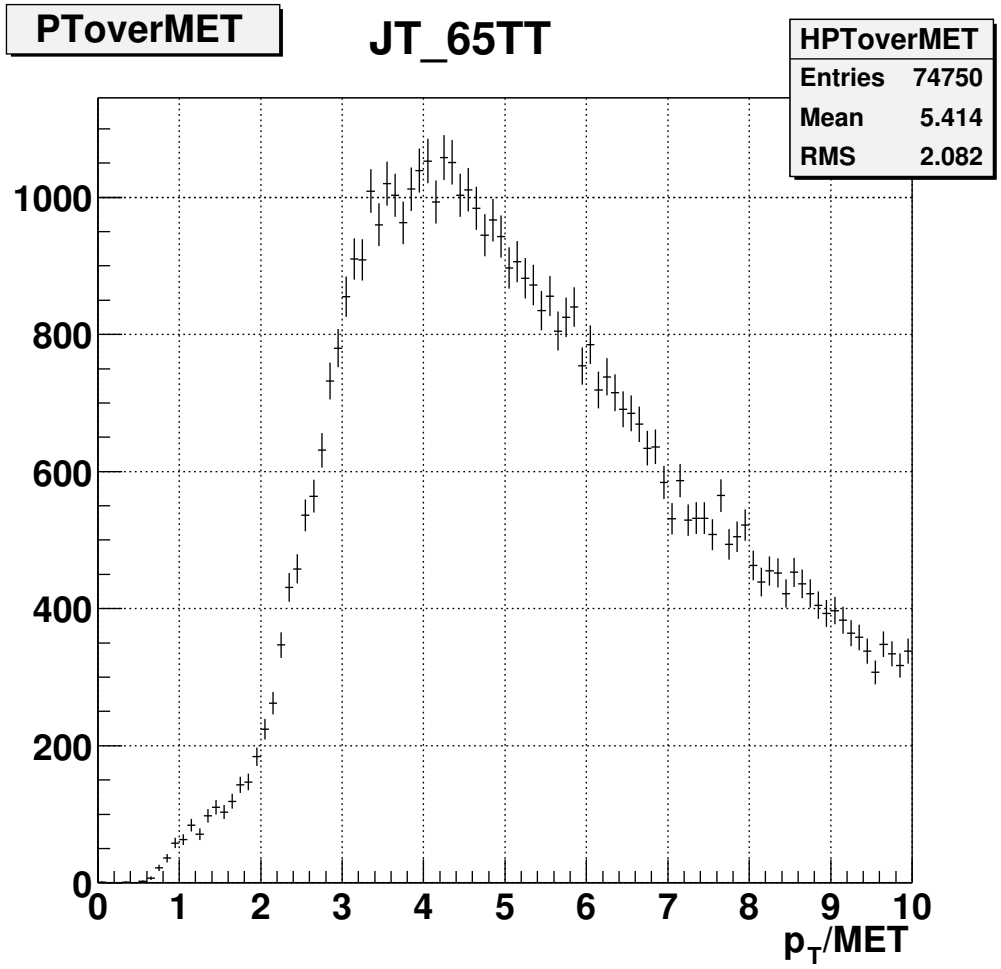
- N_{all} all dijet events (with dijet mass above some threshold) that satisfy all selection criteria except the vertex one

trigger	M_{jj}^{cut}	ε	$\Delta\varepsilon$
JT_25TT_NG	150 GeV	0.772	0.011
JT_45TT	180 GeV	0.783	0.003
JT_65TT	300 GeV	0.782	0.006
JT_95TT	390 GeV	0.767	0.011

- very weak dependence on trigger and dijet mass

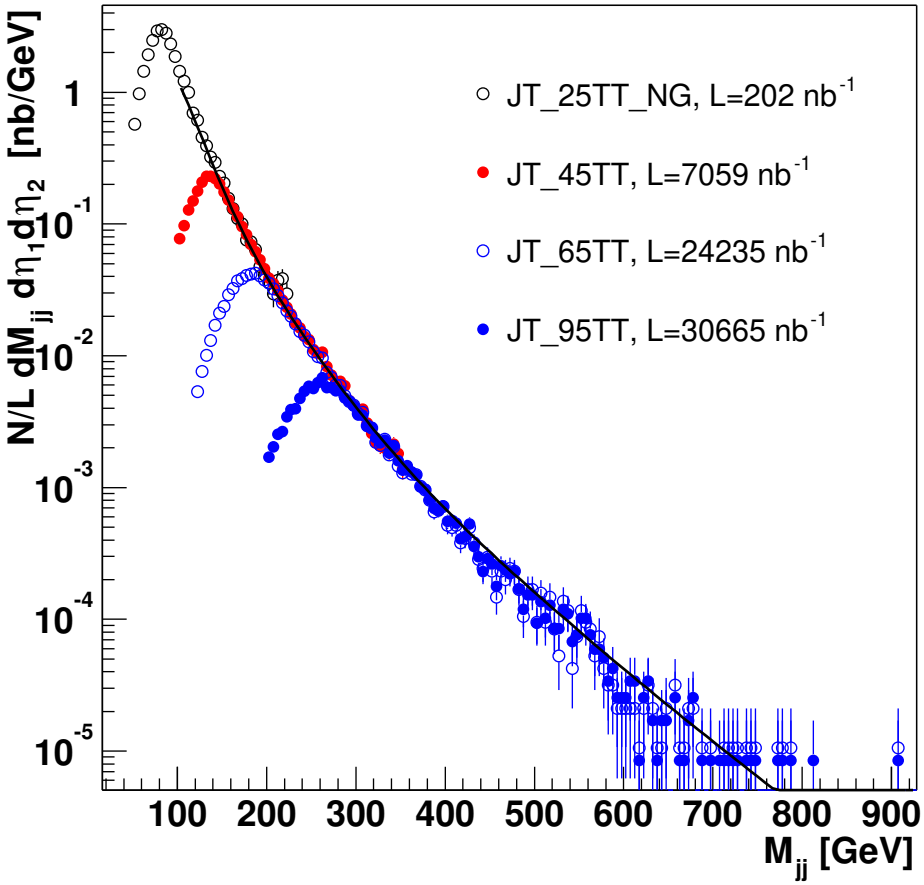
Cut on MET

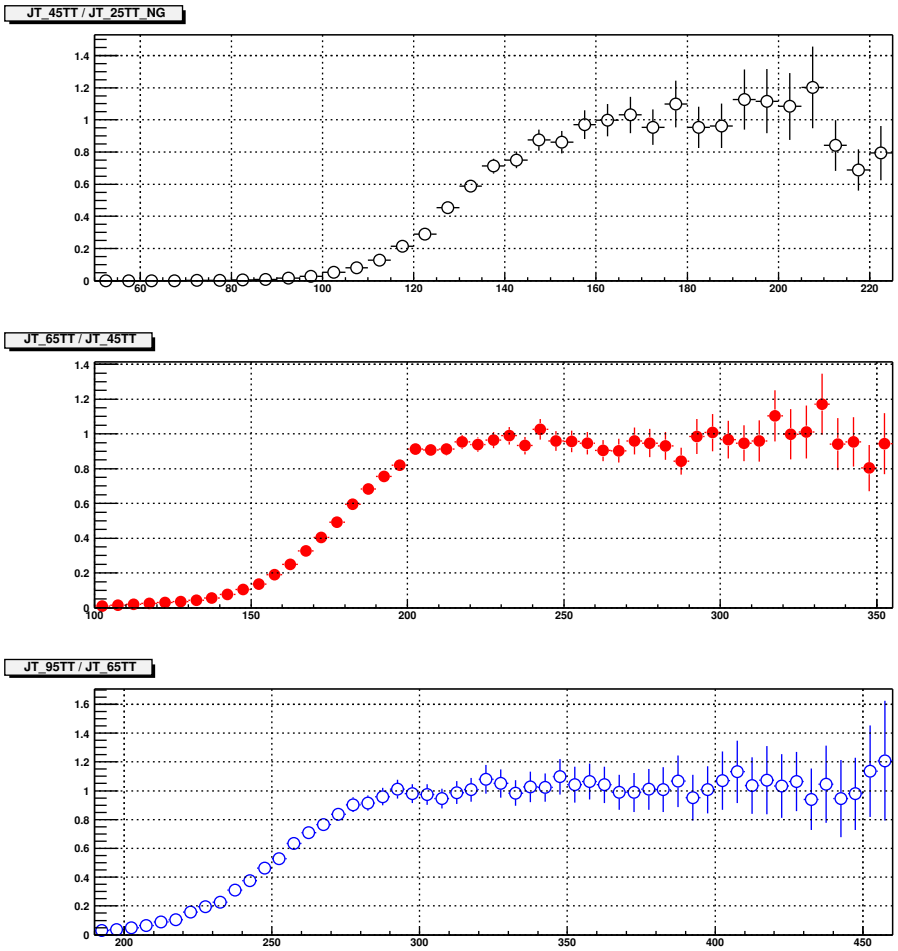




- good dijet events (all selection criteria except cut on MET)

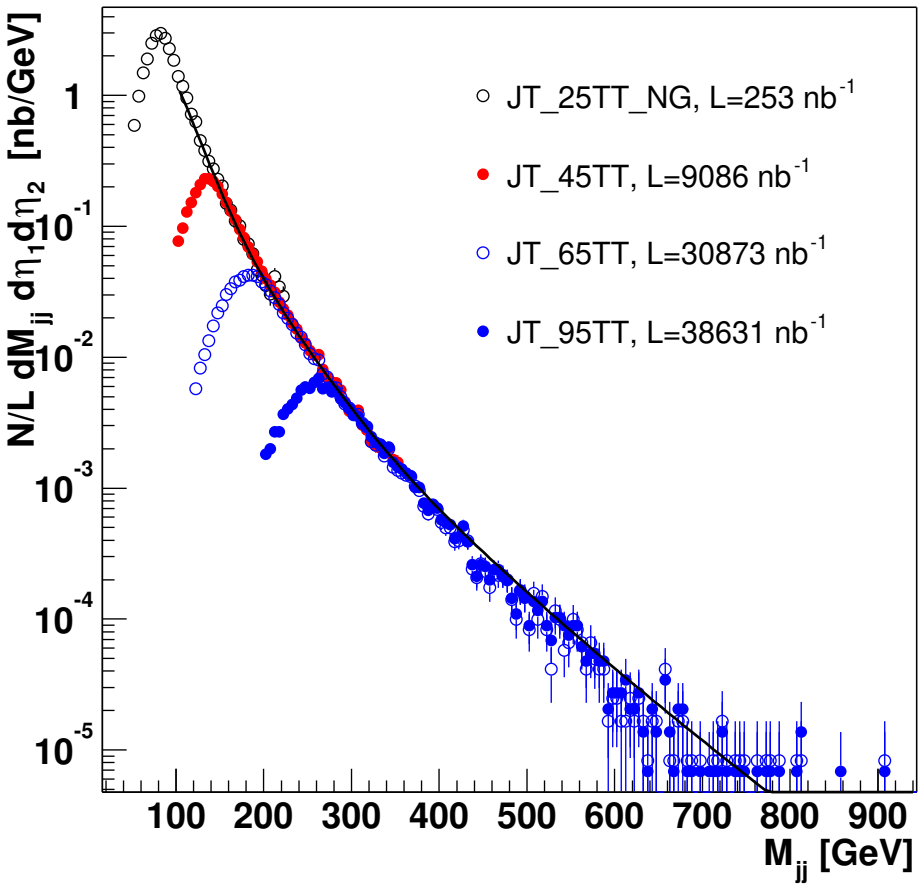
Raw dijet mass spectrum





- JES correction v04-00-01
- vertex cut efficiency correction

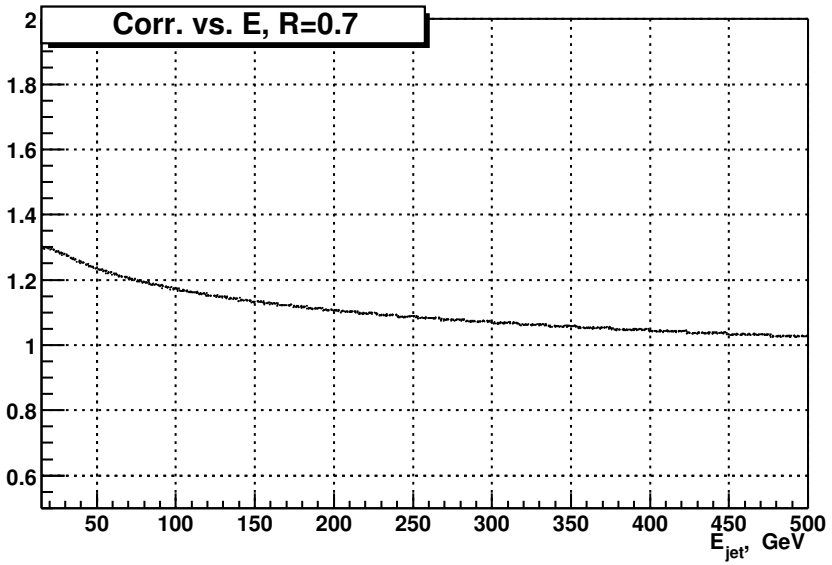
Raw dijet mass spectrum - no run selection

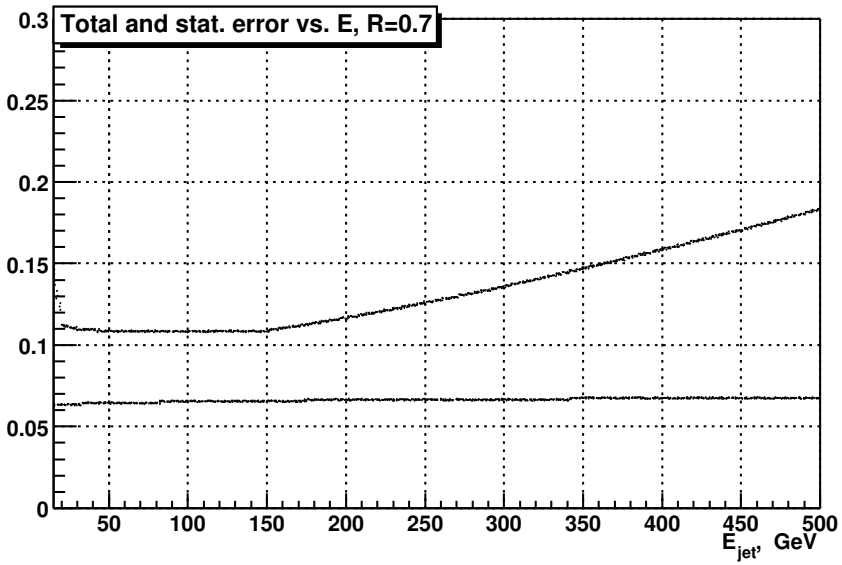


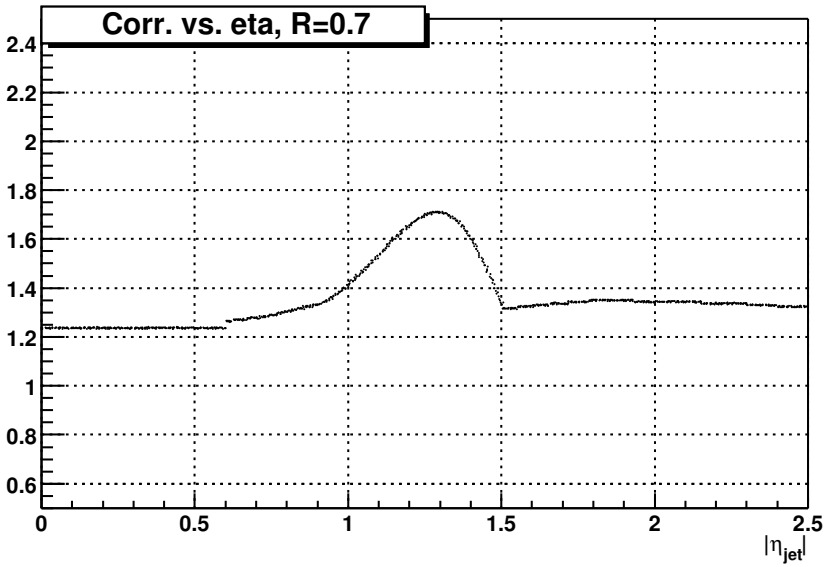
- it is hard to see any difference from the plot made with run selection

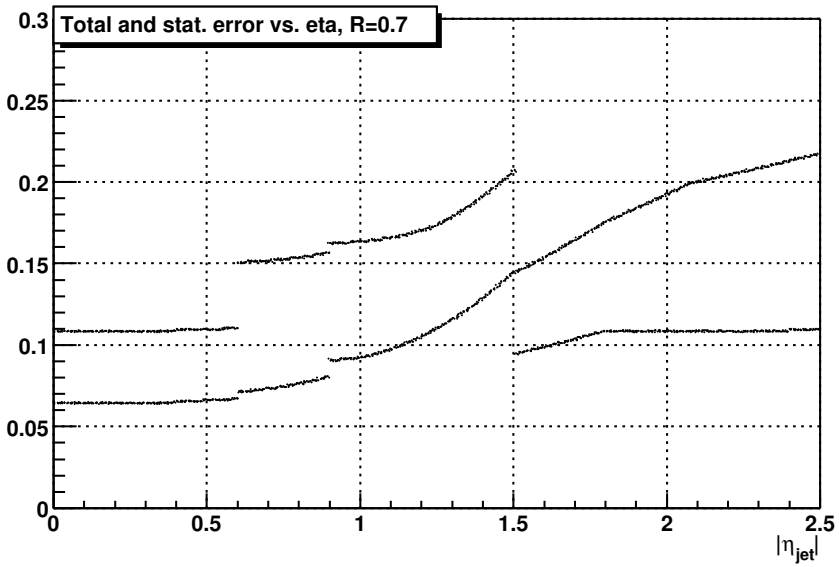
- plot shows the robustness of the dijet mass cross section analysis

Jet energy scale

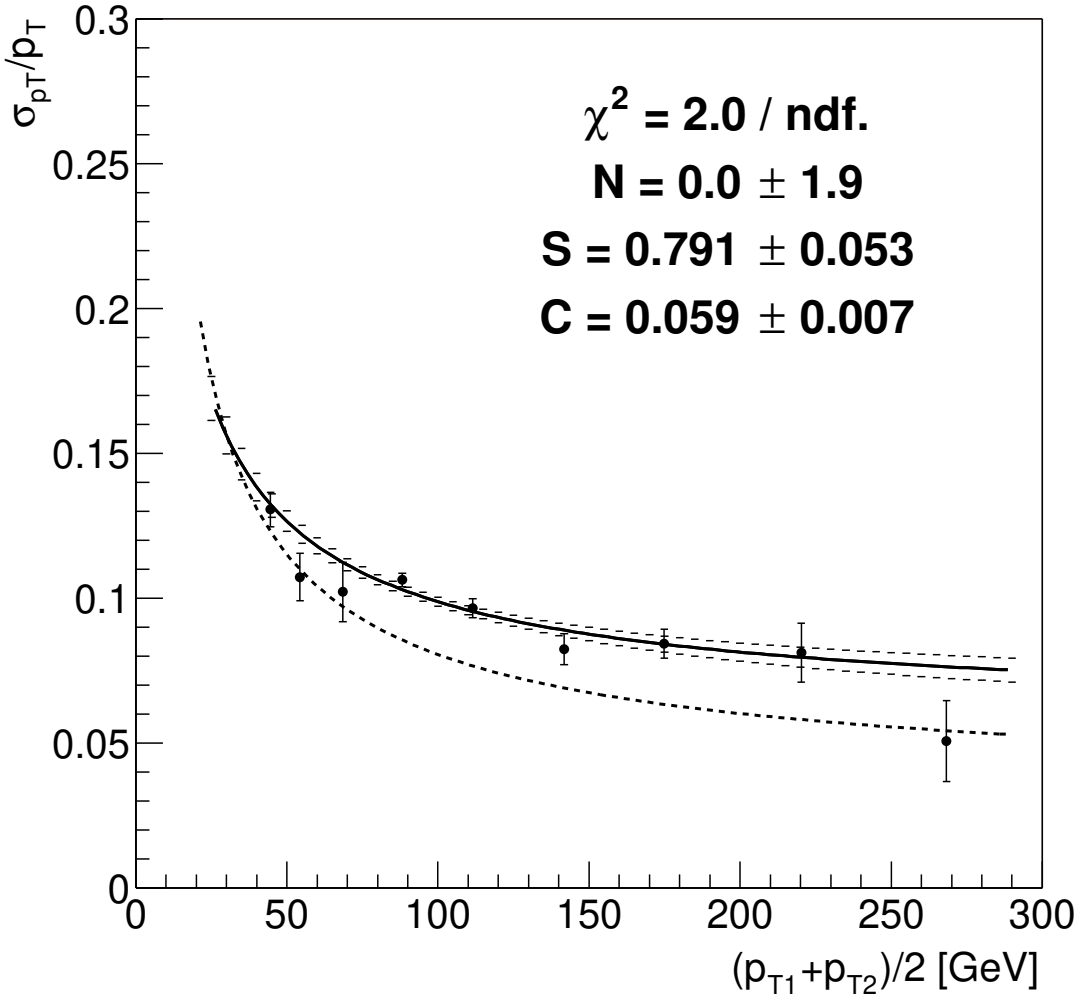








Jet p_T resolution - final result



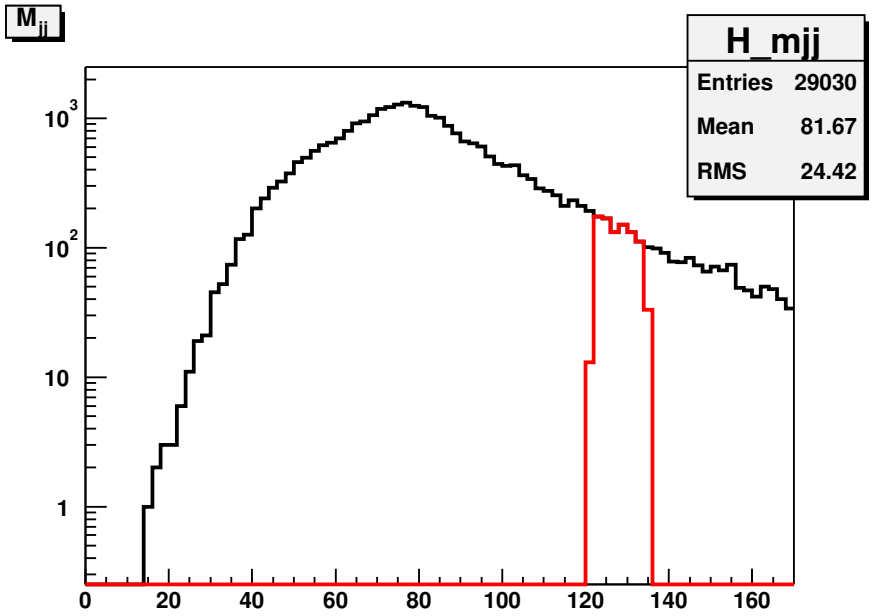
Correlation matrix

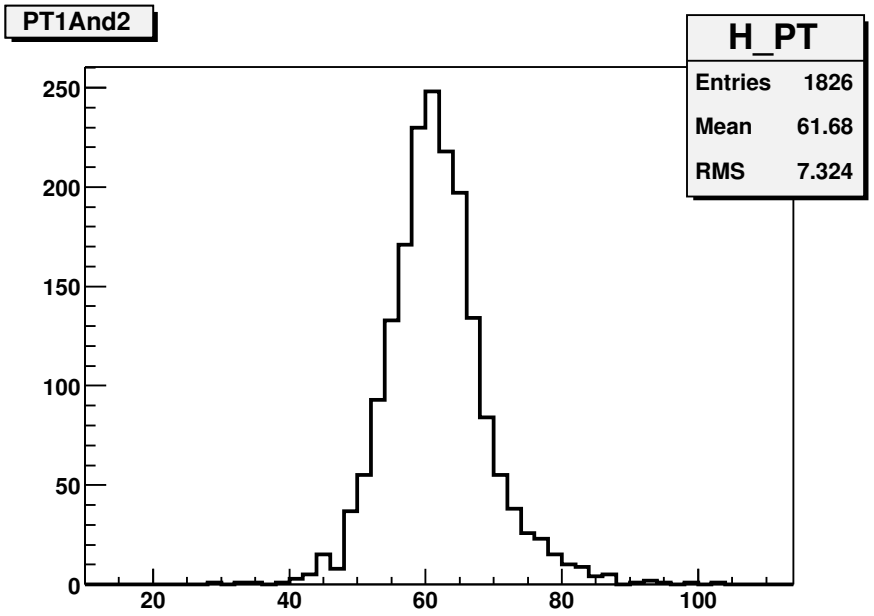
	N	S	C
N	1.000	-0.029	0.013
S	-0.029	1.000	-0.922
C	0.002	-0.922	1.000

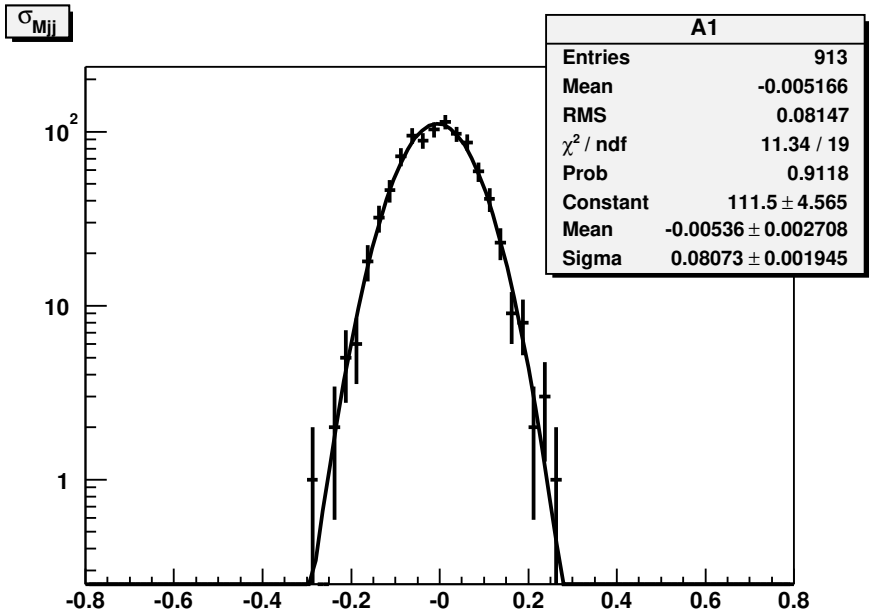
- JES correction
- soft radiation correction
- particle jet imbalance correction

- central region of calorimeter, $|\eta| < 0.5$
- event selection cuts constistent with those used in dijet mass analysis
- for more detailed information see my talk on next JES group meeting

Dijet mass resolution - method





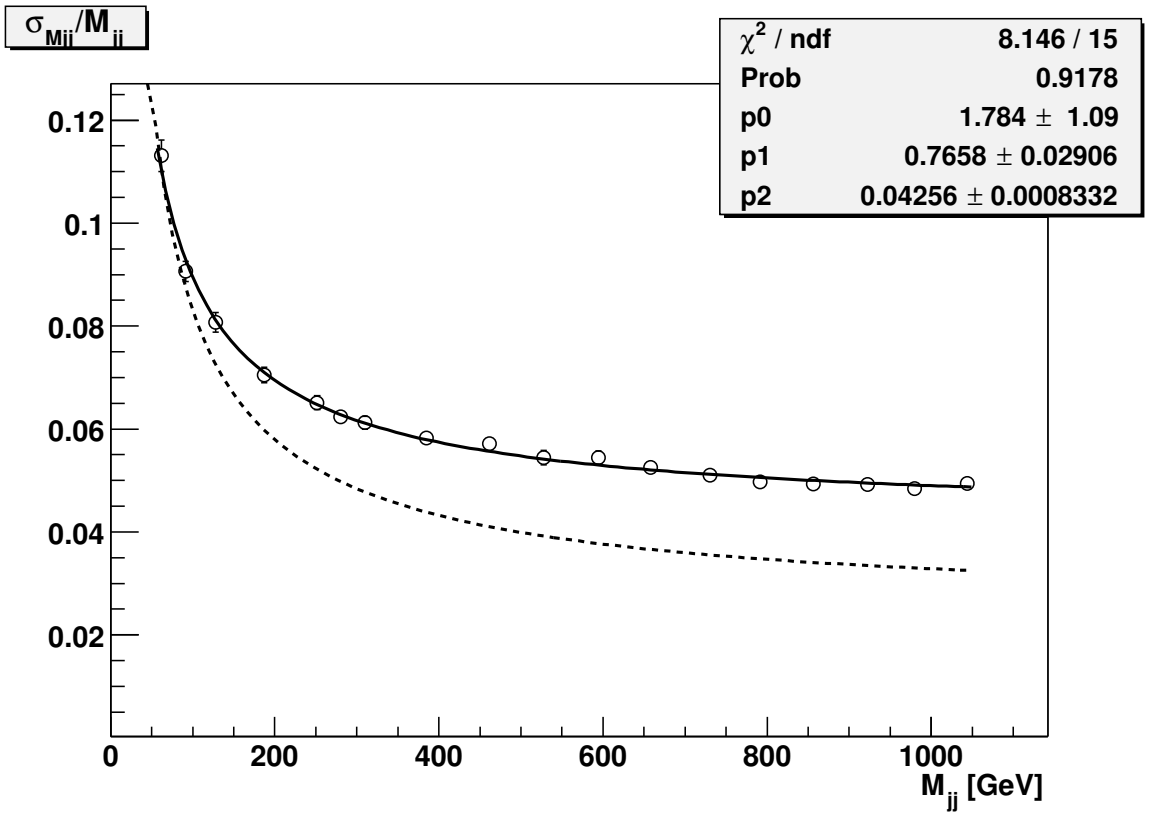


smqcd040.root

official QCD cardfiles

`np/pythia_qcd_incl.cards`

Dijet mass resolution - final result



Fitted function

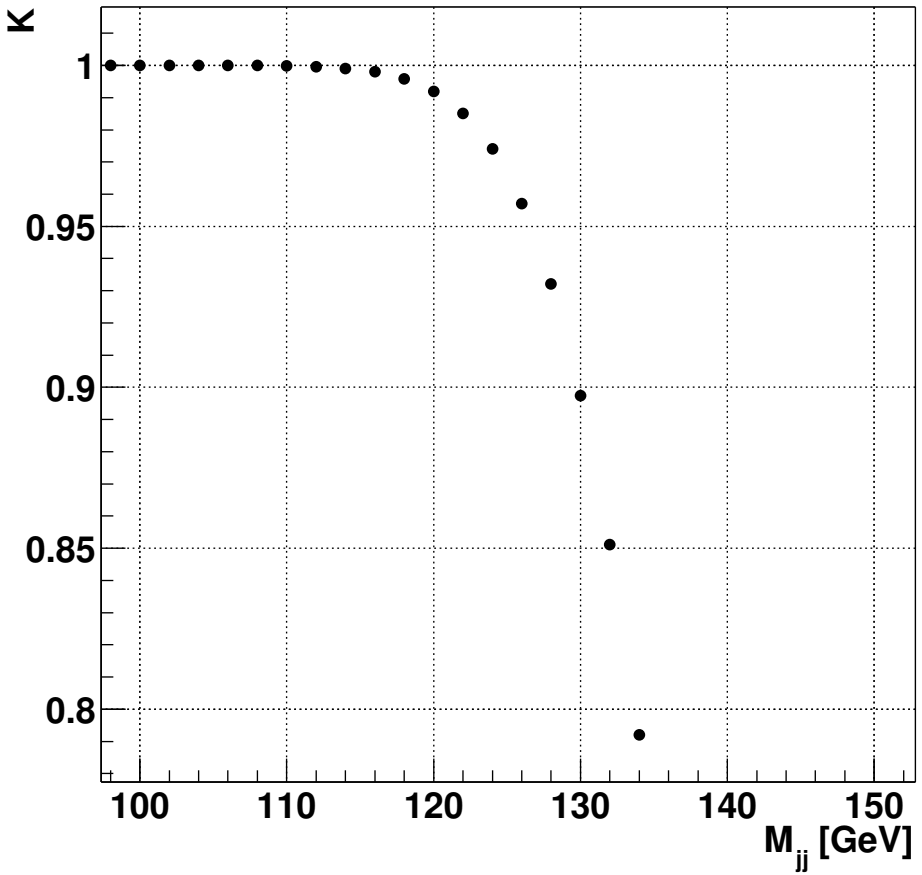
$$\frac{\sigma_{p_T}}{p_T} = \sqrt{\frac{N^2}{p_T^2} + \frac{S^2}{p_T} + C^2}$$

Correlation matrix

	N	S	C
N	1.000	-0.891	0.736
S	-0.891	1.000	-0.898
C	0.736	-0.898	1.000

- from the QCD MC sample - the particle jet energies were smeared using measured jet p_T resolution
- dashed line is for corresponding RunI curve

Dijet mass resolution - the lowest reliable point



$$K = \frac{\int_M^{150} \mathrm{d}M' f(M') G(150 - M')}{\int_{80}^{150} \mathrm{d}M' f(M') G(150 - M')}$$

- contribution smaller then 1% for masses under $120\,\mathrm{GeV}$

- minimal value of p_T is about $40\,\mathrm{GeV}$ for the sample with dijet mass around $120\,\mathrm{GeV}$
- the lowest bin in the jet p_T resolution curve starts at $40\,\mathrm{GeV}$

Unsmearing - method

- ansatz function

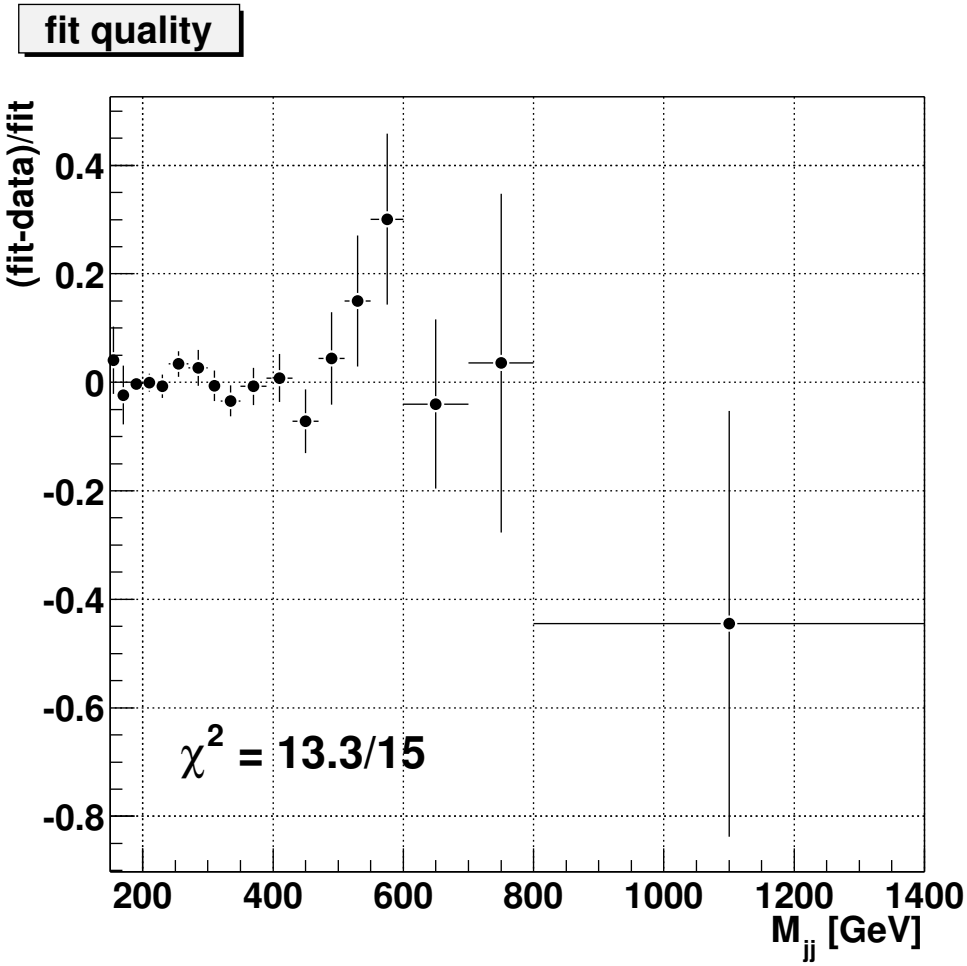
$$f = N M_{jj}^{-\alpha} \left(1 - \frac{M_{jj}}{\sqrt{s}}\right)^{-\beta}$$

- for a given set of parameters
  - convolute function f with the dijet mass resolution

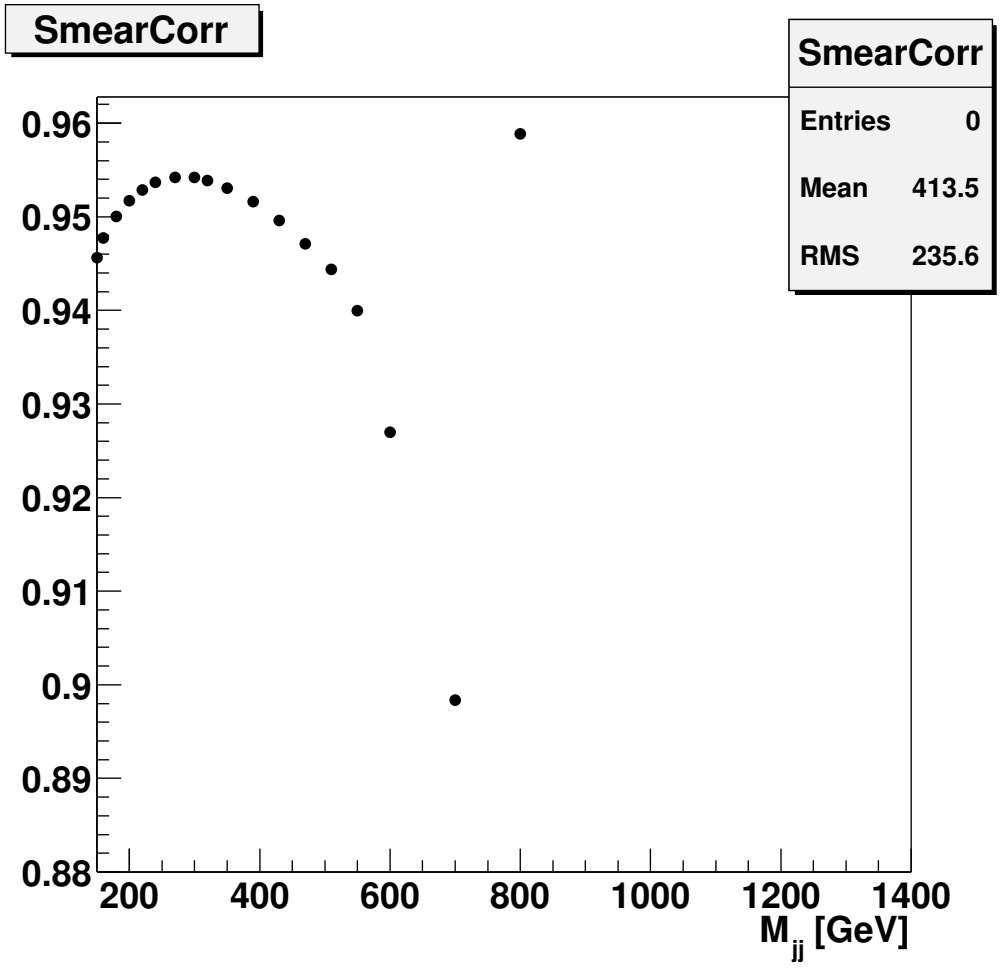
$$F(M) = \int \mathrm{d}M' f(M') G(M - M')$$

  - make prediction on dijet mass cross section for all bins
  - calculate χ^2 for the prediction
- use Minuit to find the best fit
- unsmearing correction

$$C_{bin} = \frac{\int_{bin} \mathrm{d}M \; f(M)}{\int_{bin} \mathrm{d}M \; F(M)}$$

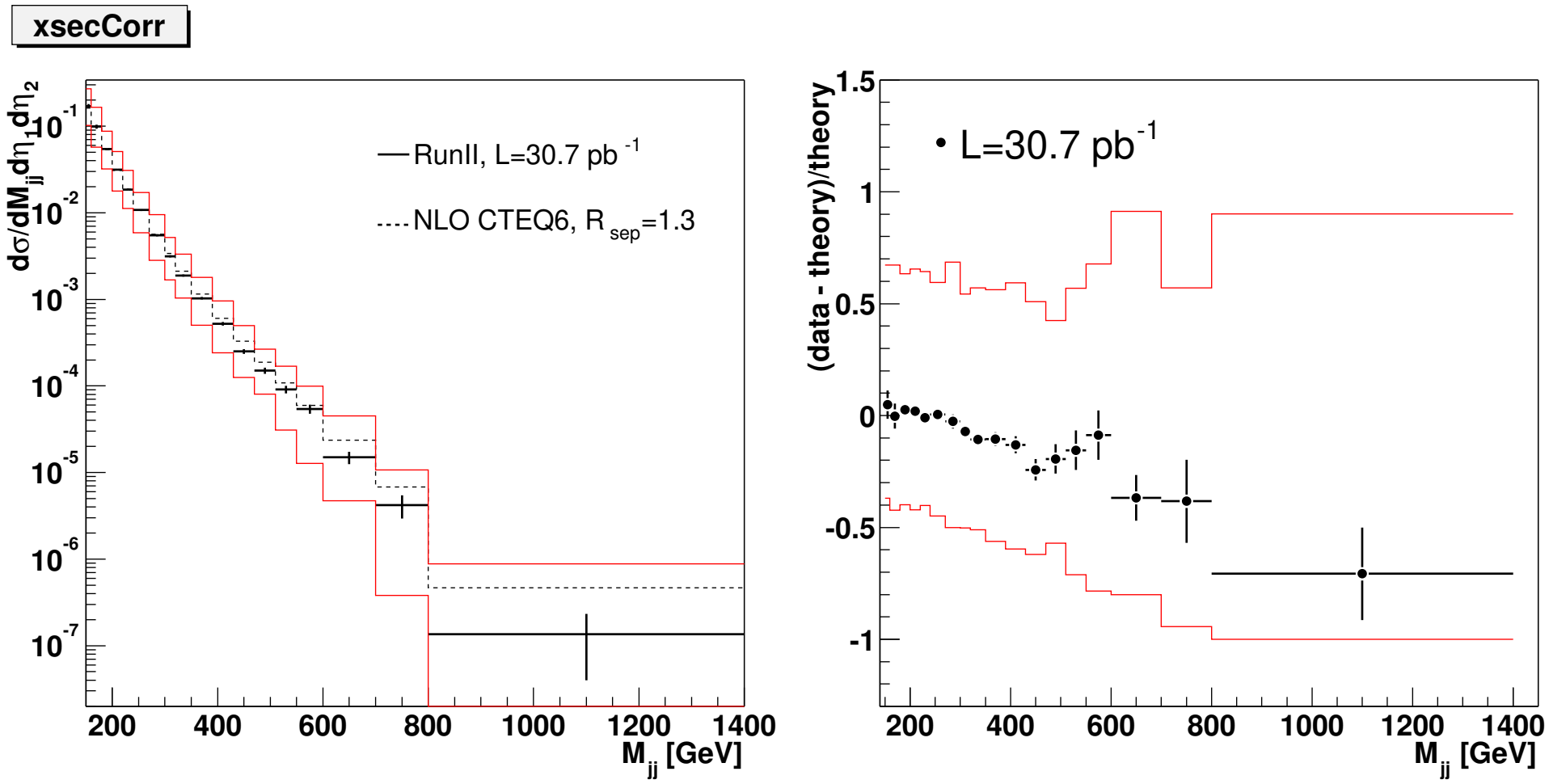


Unsmearing correction



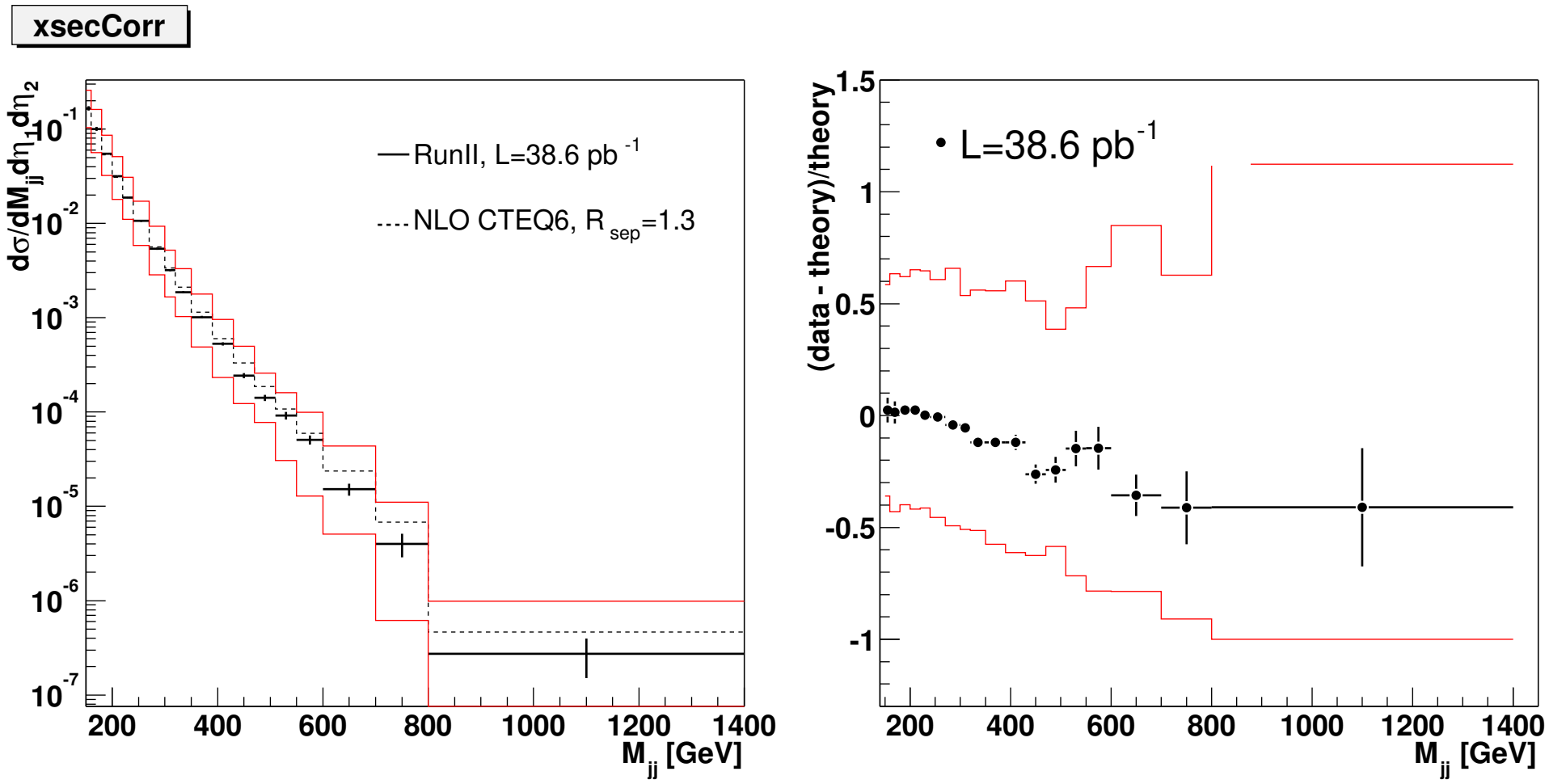
- same binning as in RunI
- slightly higher than in RunI
- the same shape
- no error estimate
  - error from dijet mass resolution
  - error conected with the selection of the ansatz function

Inclusive dijet mass cross section



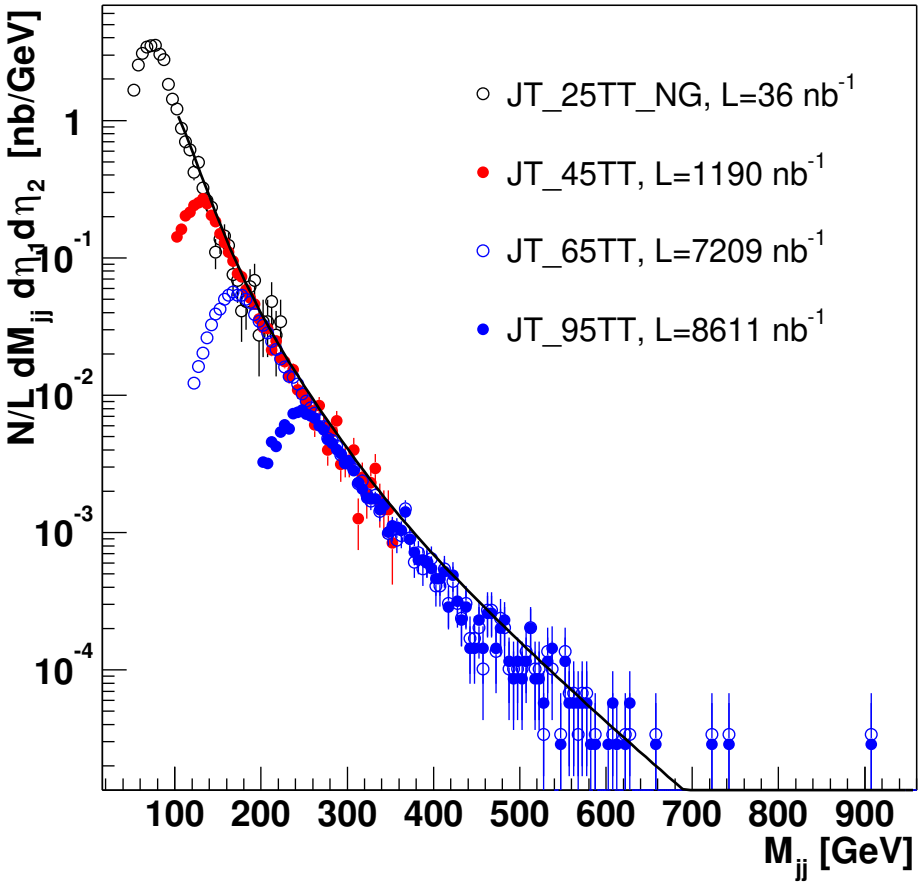
- very nice agreement with the theory curve
- red lines shows the distribution for the upper and lower value of JES
  - JES errors are still large

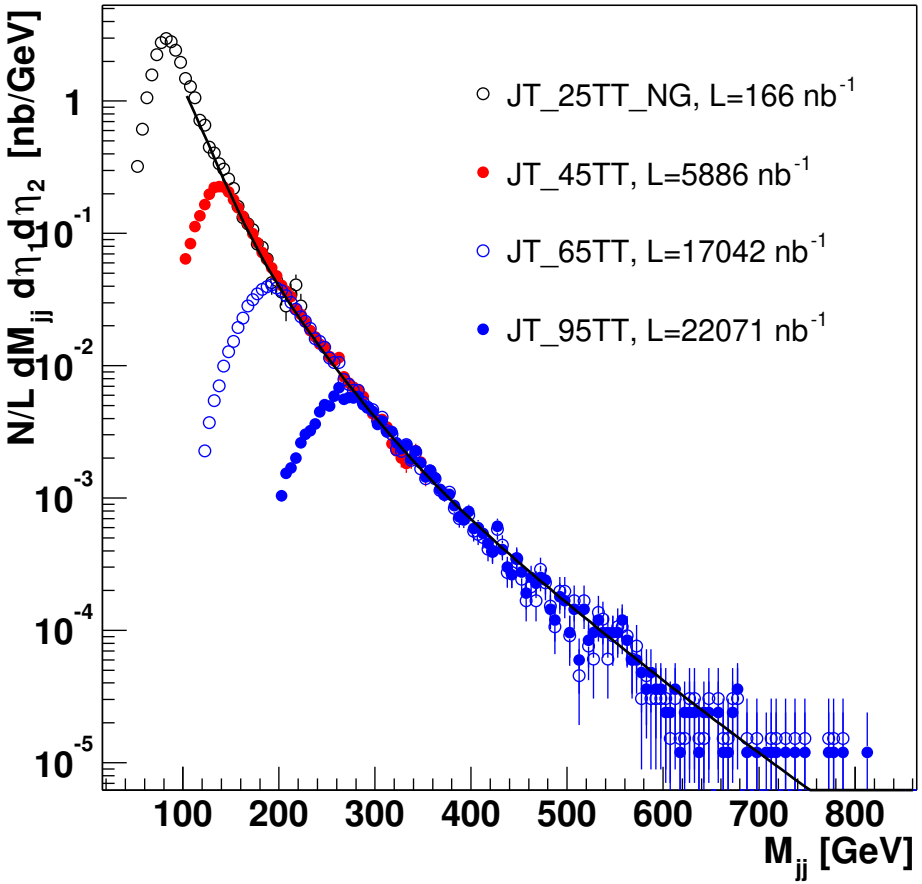
Dijet mass cross section - no run selection



- very nice agreement with the theory curve
- red lines shows the distribution for the upper and lower value of JES
  - JES errors are still large

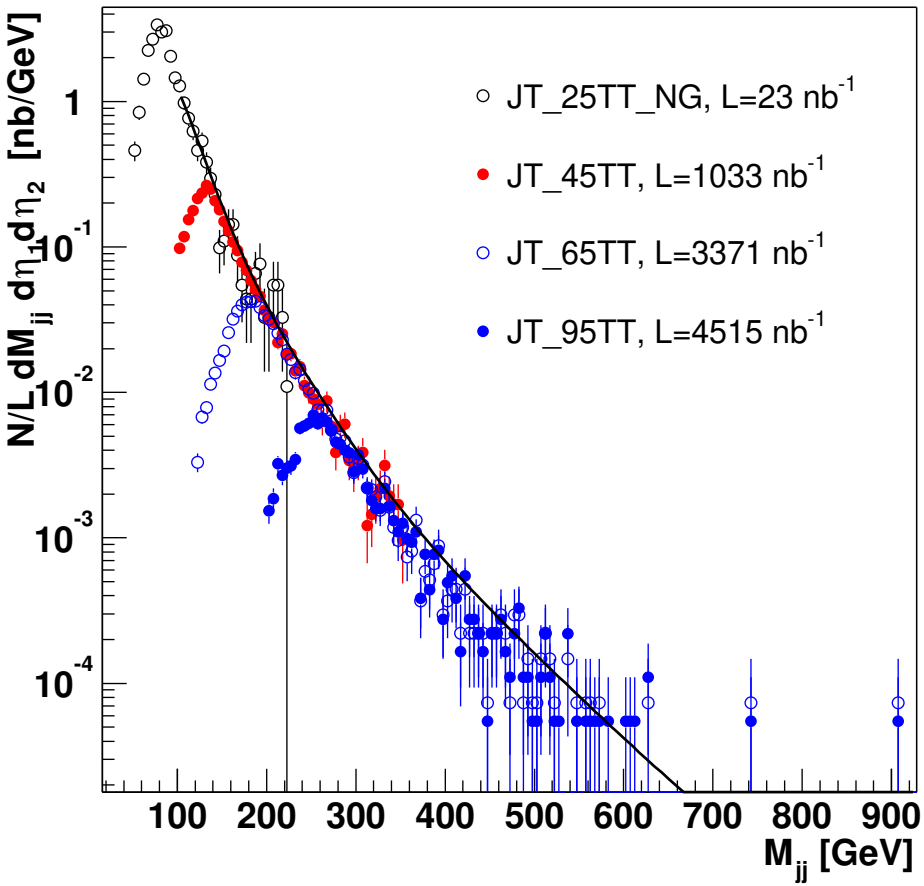
p13.04.00 versus p13.05.00

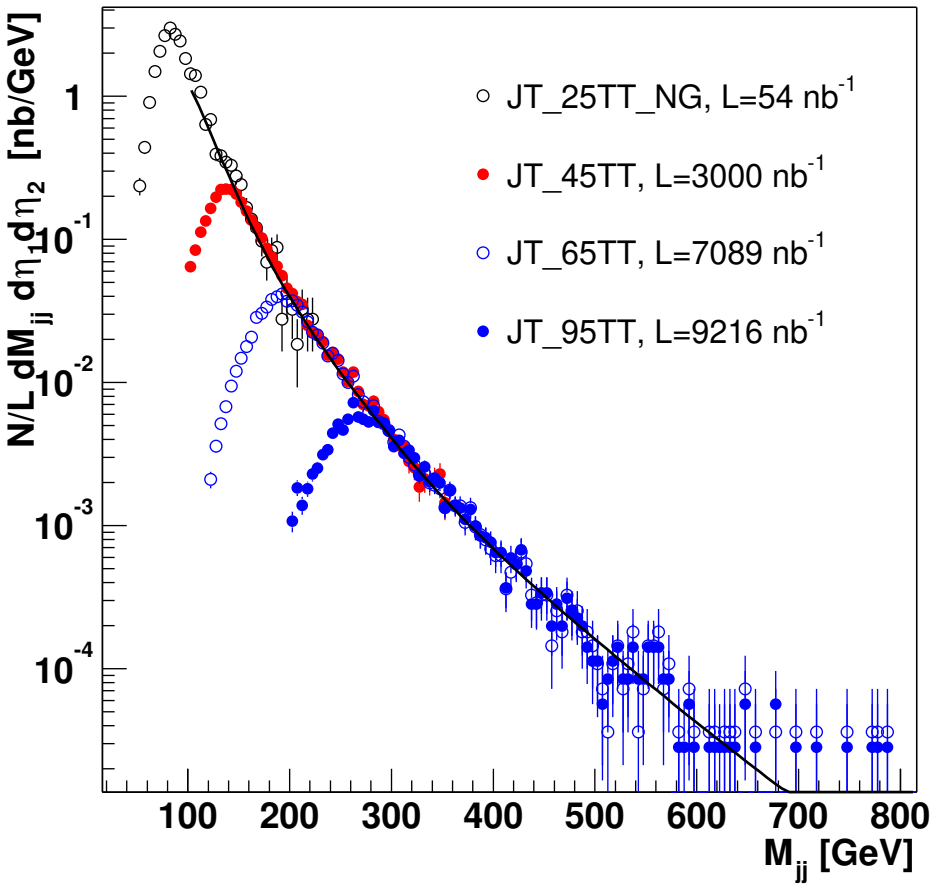




- clean difference in dijet mass cross section
  - p13.04 data are clearly bellow theory while p13.05 is above
- p13.04 in average represents older data

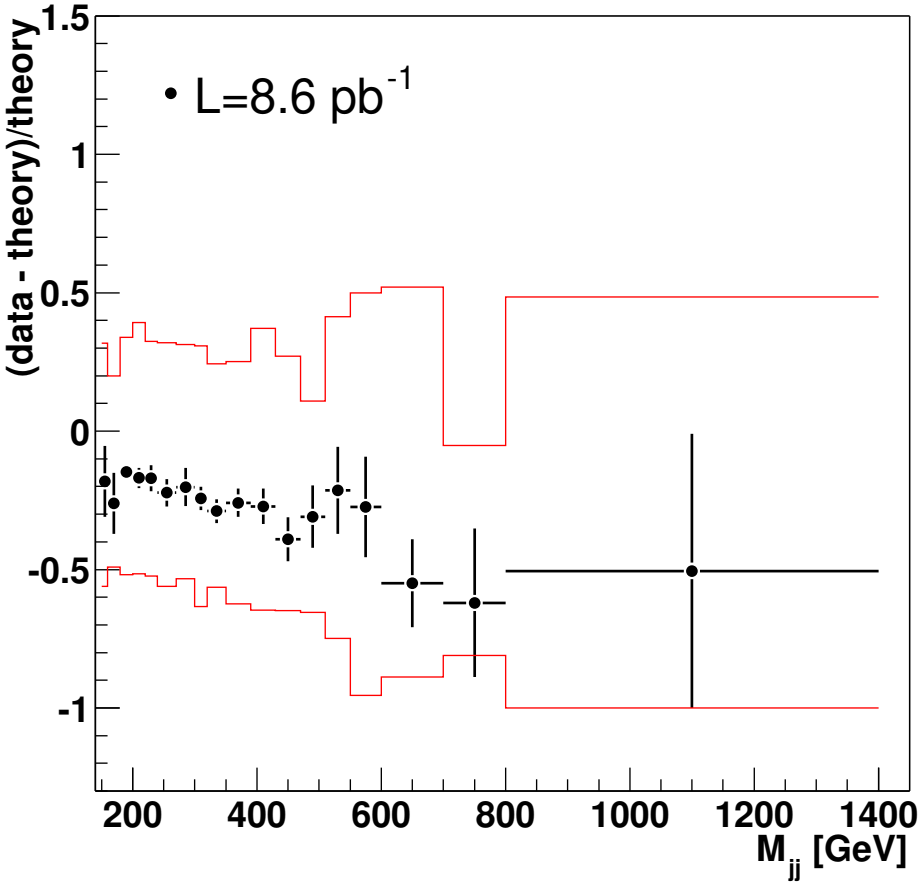
p13.04 vs. p13.05 in CMT-9.30 and CMT-9.31

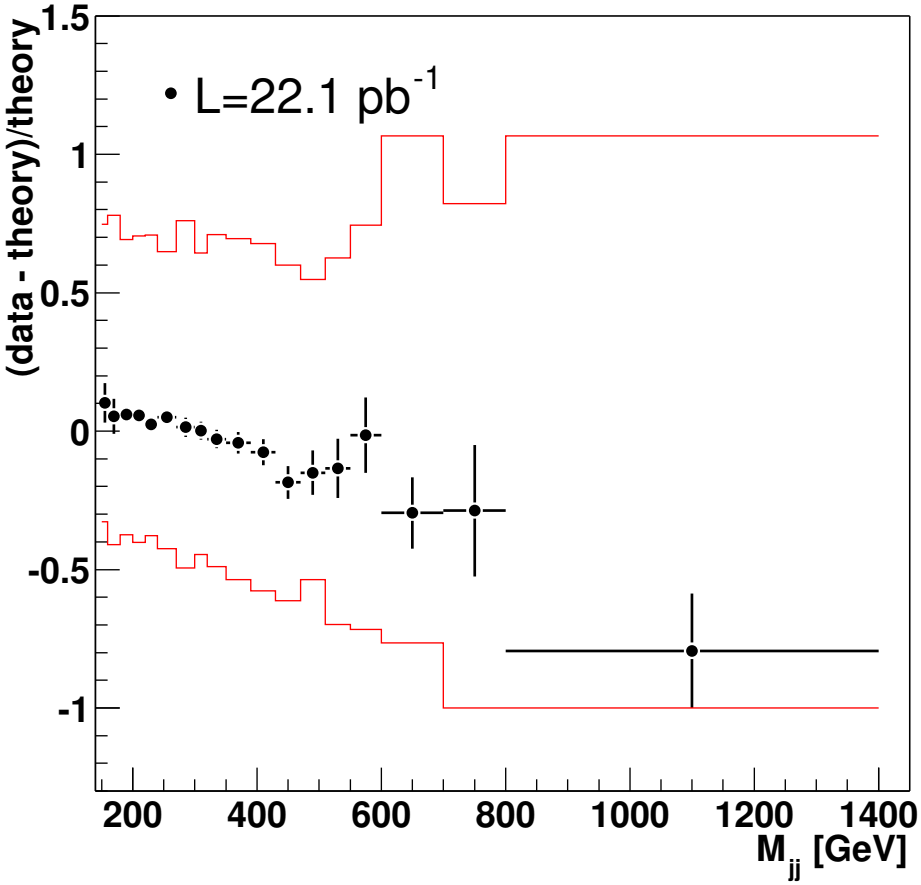




- the difference is the same within the same version of triggers
- p13.04 does non-linearity correction in slightly different way
  - it may make JES (and resolutions) different in p13.04 than in p13.05

p13.04.00 versus p13.05.00





- the difference in cross section is 24% arround $230\,\mathrm{GeV}$
- corresponds to $3-4\%$ difference in JES