Fwd Jets 99/00

- ✓ Fwd jets 99/00 – reminder
- ✓ Problems with cross-sections
- ✓ Control distributions
- ✓ Cross – sections comparison(97 vs 00)
- ✓ Azimuthal correlations
- ✓ Conclusions

Cuts

Kinematical cuts:

$0.0001 < x_{Bj} < 0.004$

$0.1 < y < 0.7$

$5.0 < Q^2 < 85.0$

$156^\circ < \theta_{el} < 170^\circ$

$E_{el} > 10$ GeV

Fwd jet cuts:

$7^\circ < \theta_{\text{fwd jet}} < 20^\circ$

$p_{t,\text{jet}} > 3.5$ GeV

$x_{\text{jet}} > 0.035$

$0.5 < p_t^2/Q^2 < 5.0$

Jets are found in BREIT frame

all cuts performed in LAB

MC used :
RAPGAP dir : lx sample 788 pb^{-1}
mx sample 2088 pb^{-1}
ARIADNE : 533 pb^{-1}

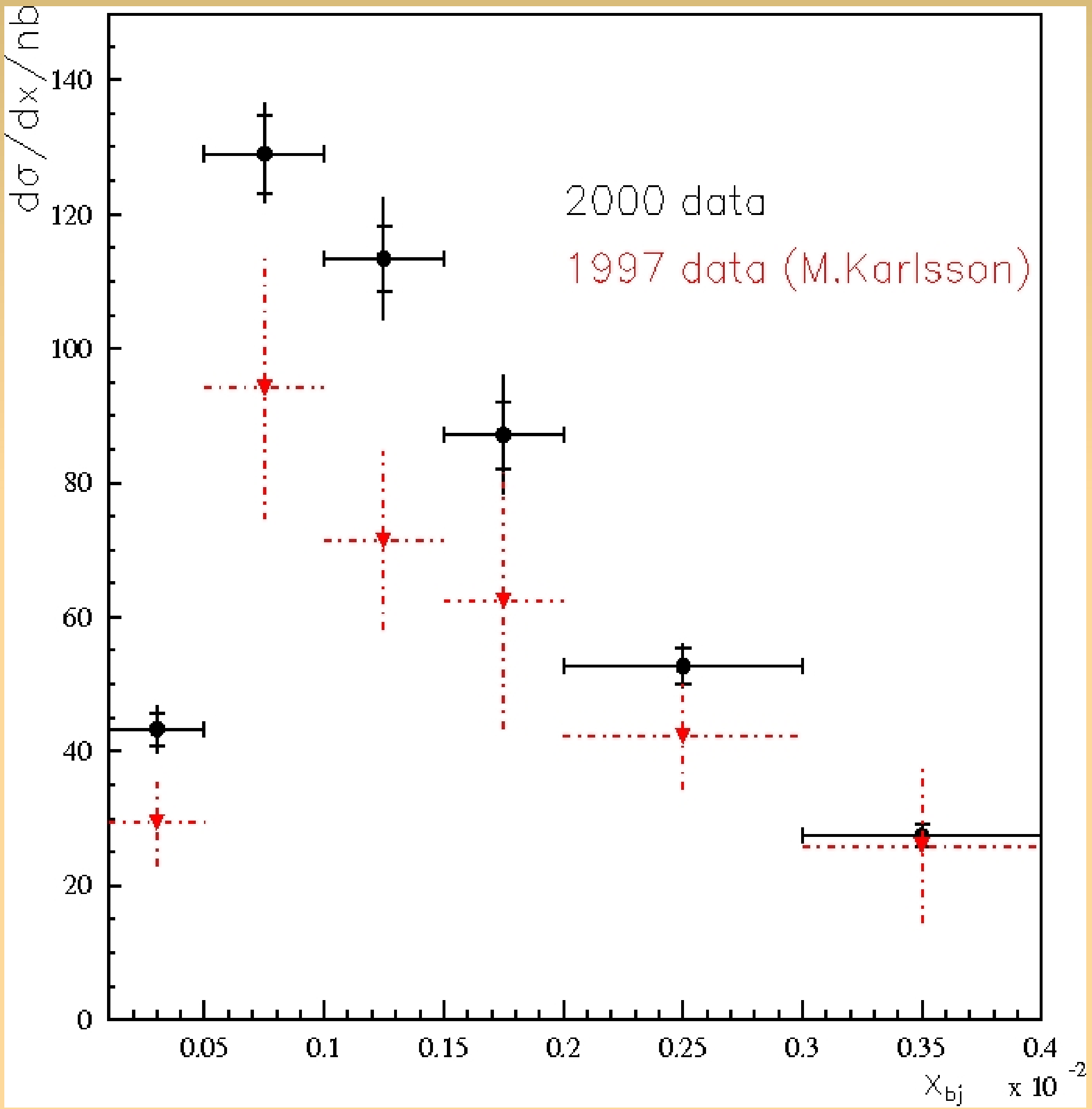
Data:
2000 data : 51.5 pb^{-1} ~ 58000 fwd jets
1999 data : 15.4 pb^{-1} ~ 18000 fwd jets

Problems with cross-section

Fwd jets cross-section for 2000 data was higher than published results for 97 data

The same tendancy was seen for triple differential cross-sections

Presented cross-section didn't include radiation correction and corrections accounting for difference in beam energies



Jet algorithm & recombination schemes

There were problems with jet reconstruction. In both analyses Inclusive k_t Algorithm is used (and the same recombination scheme – p_t ??).

Jet reconstruction:

AK:

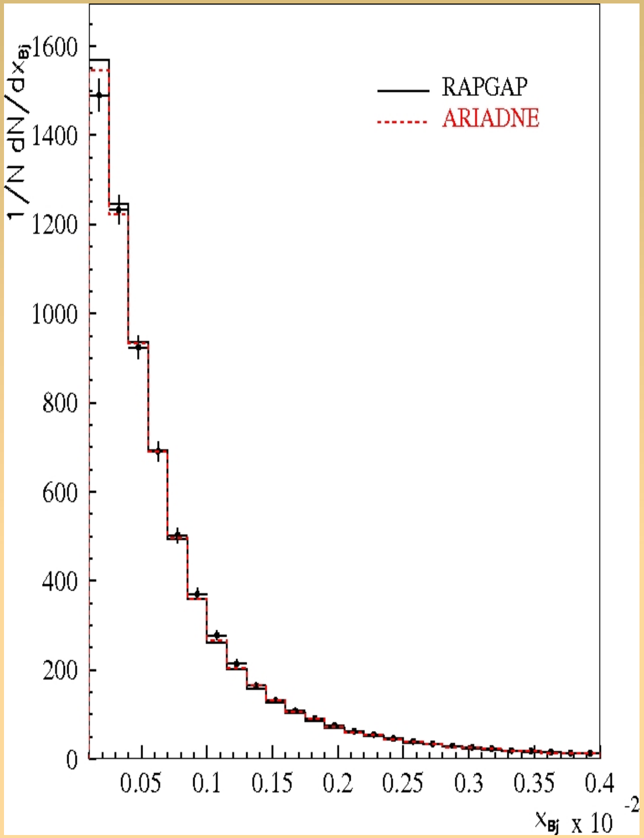
- four vectors of particles belonging to jets are summed(in Breit and Lab frames) NO BOOST
- Jets in Breit (mass ǂ 0) → Jets in Lab (mass ǂ 0)

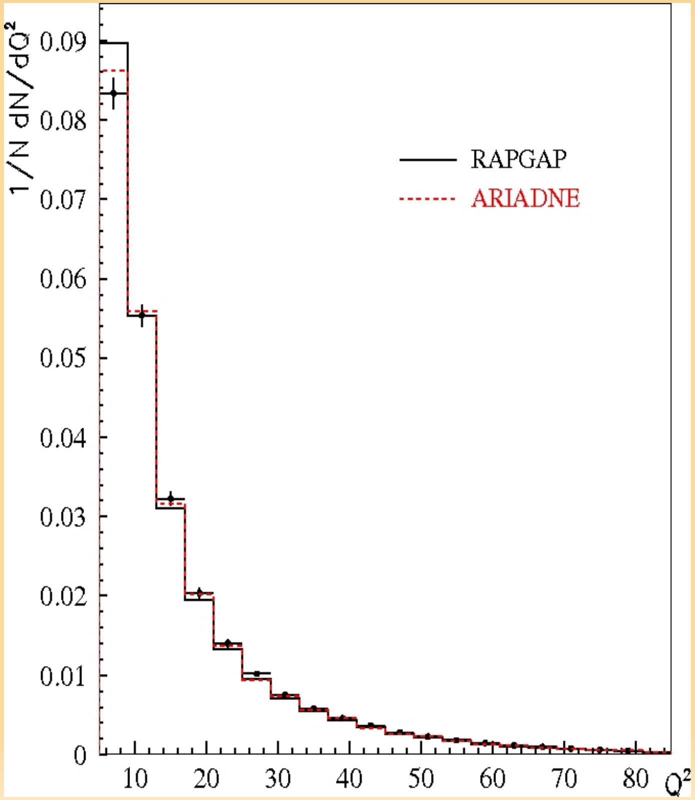
IM:

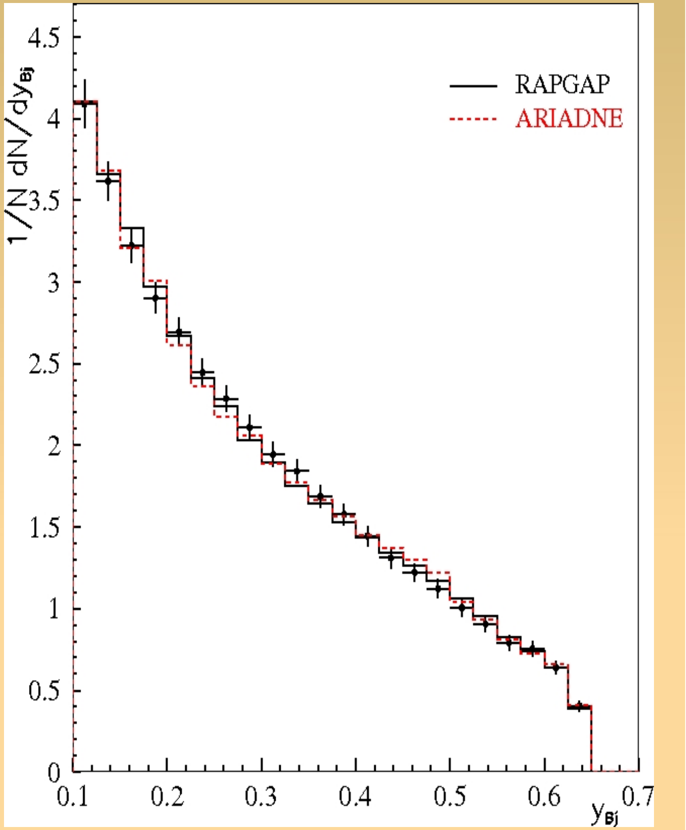
- transverse momenta are summed in Breit
- φ and η are p_t- weighted; one gets massless jets

We proceed futher using AK method.

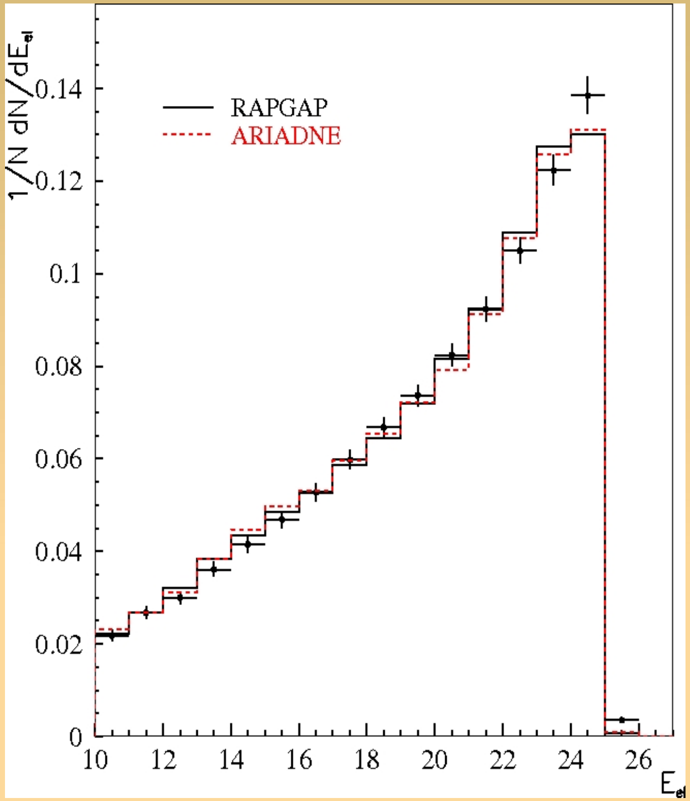
Inclusive control plots

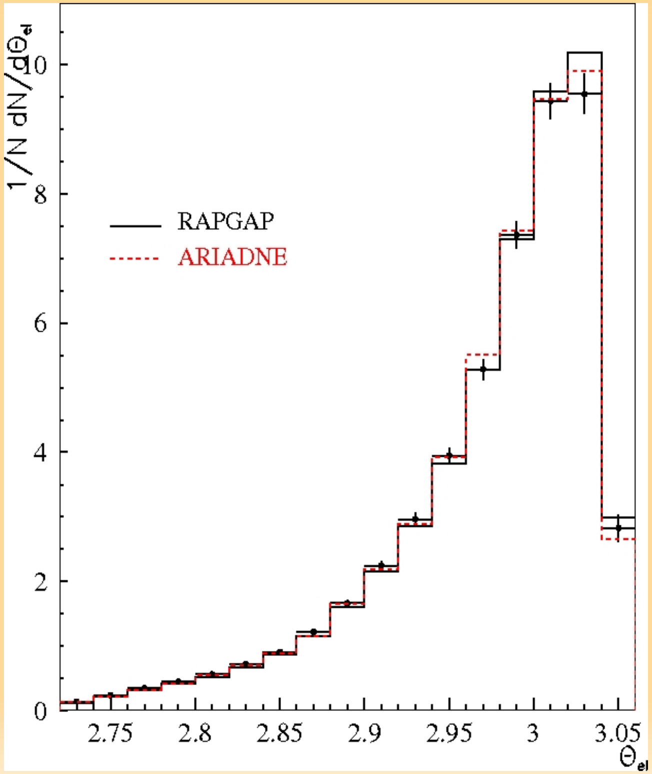


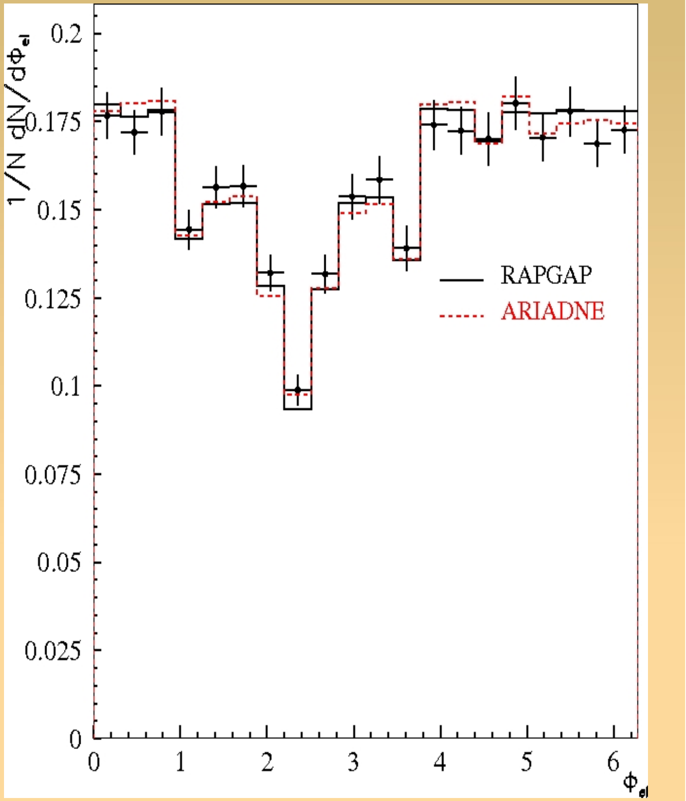




Inclusive control plots

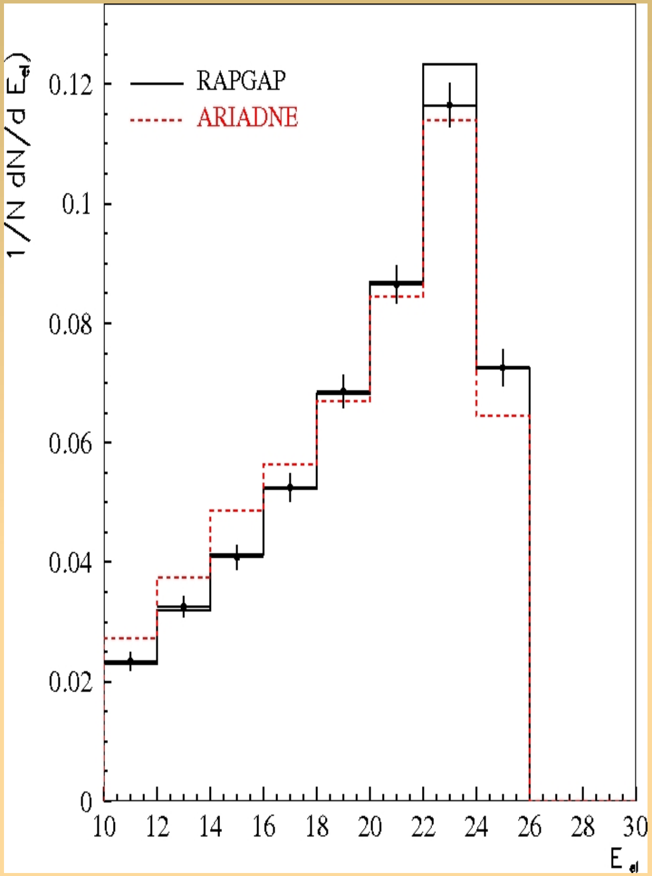


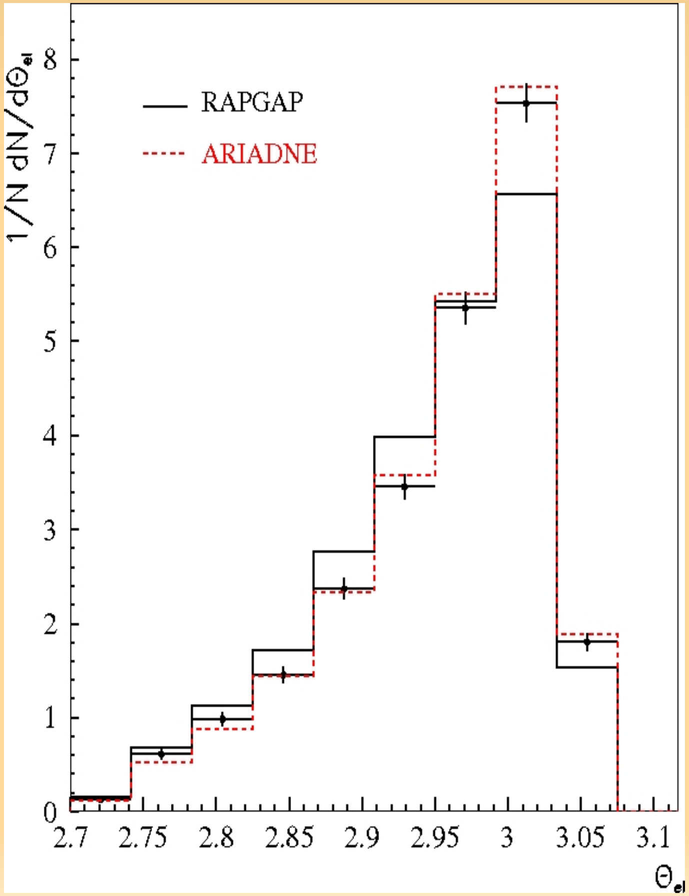


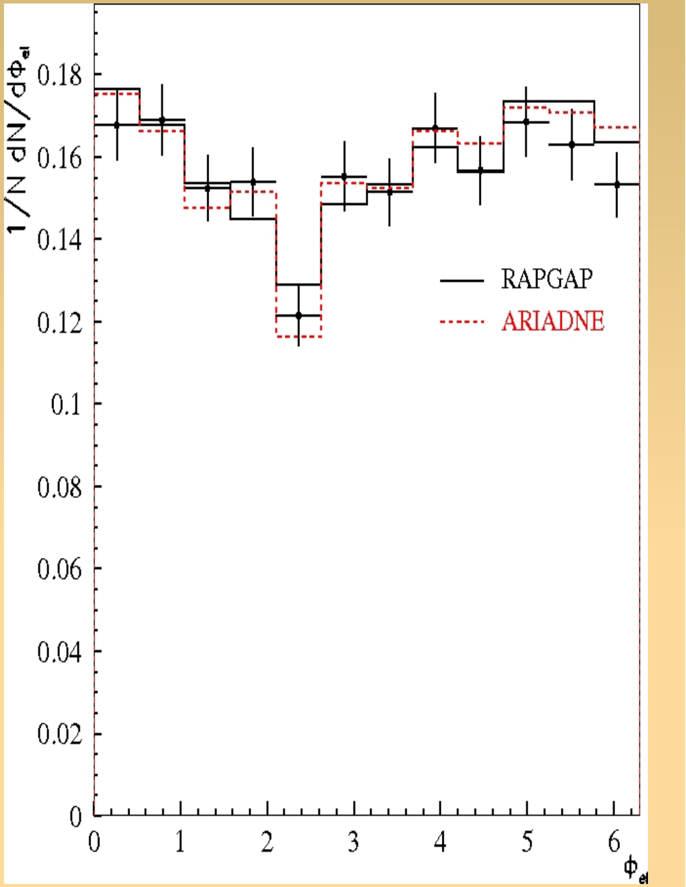


φ very well described by both MC's

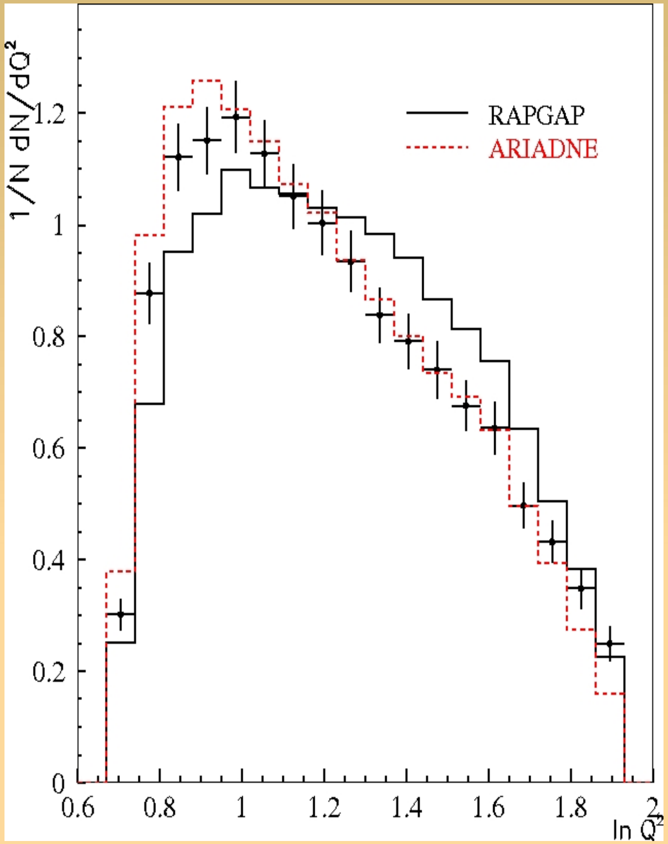
Jet sample – control plots

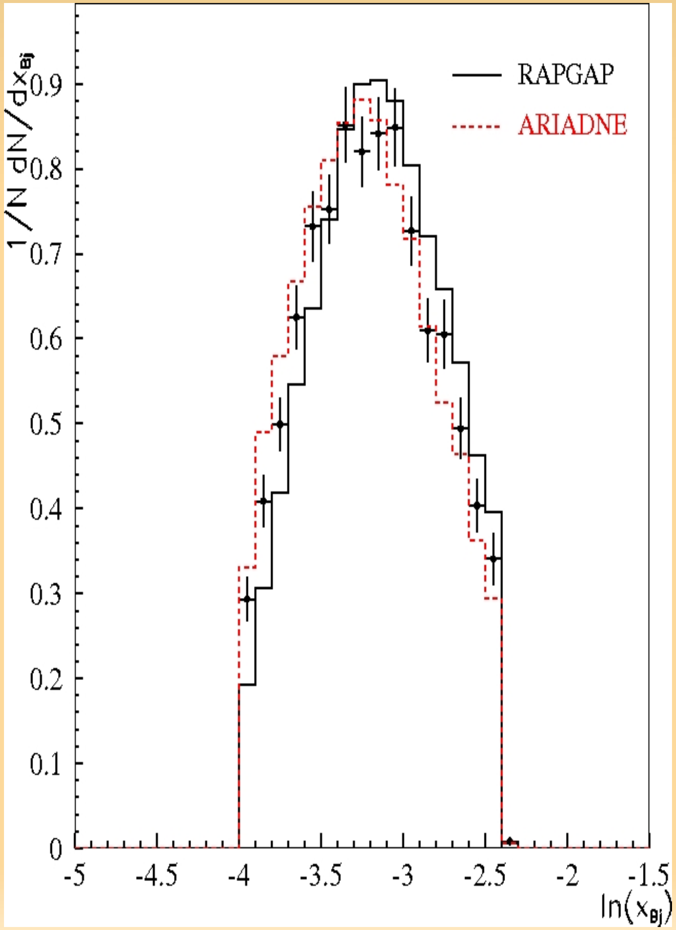


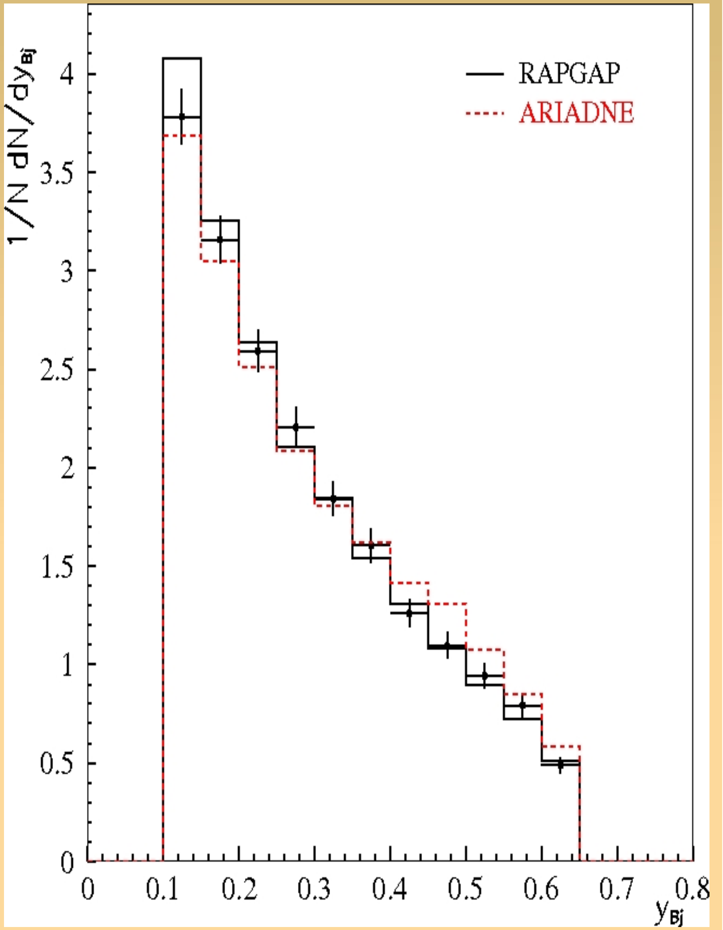




Jet sample – control plots

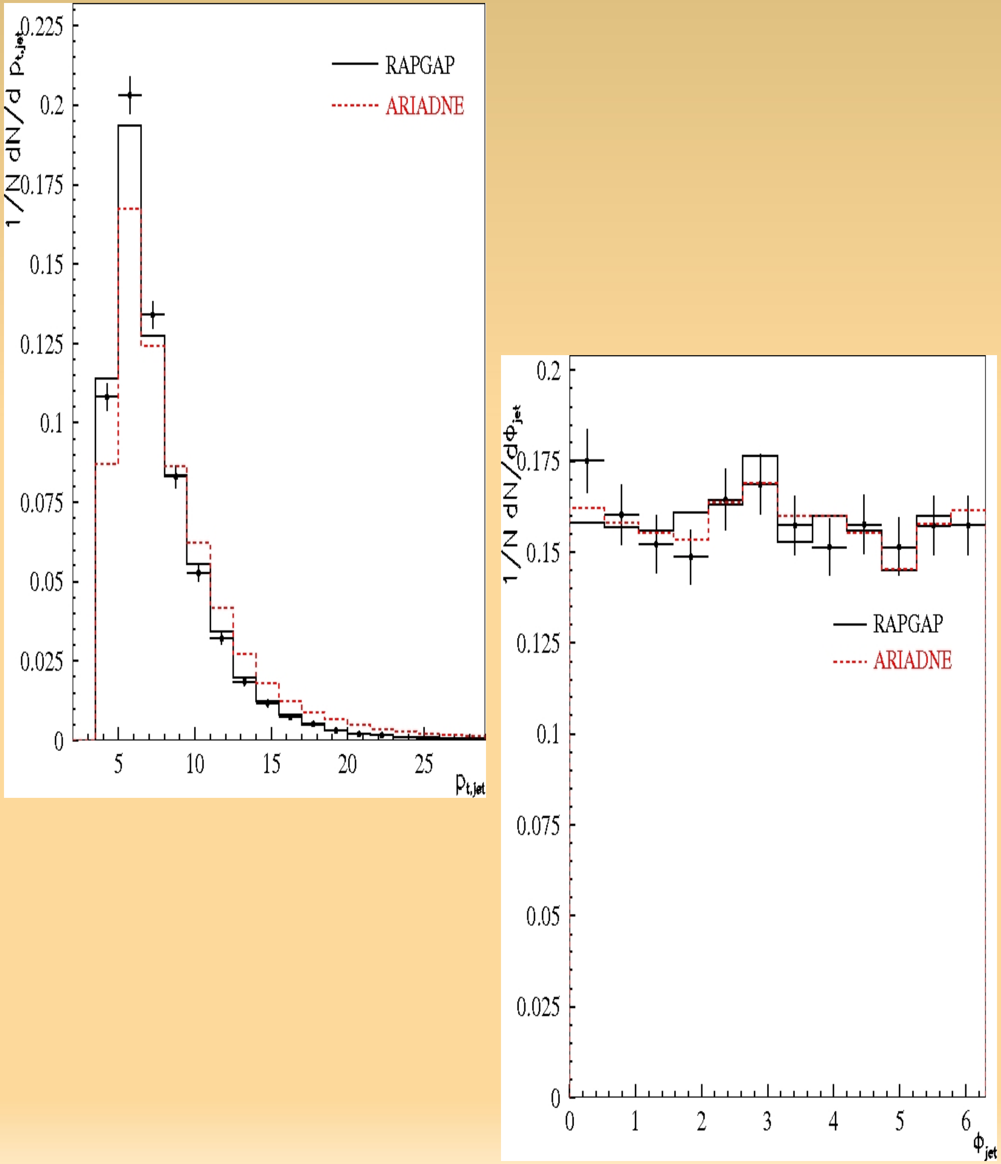




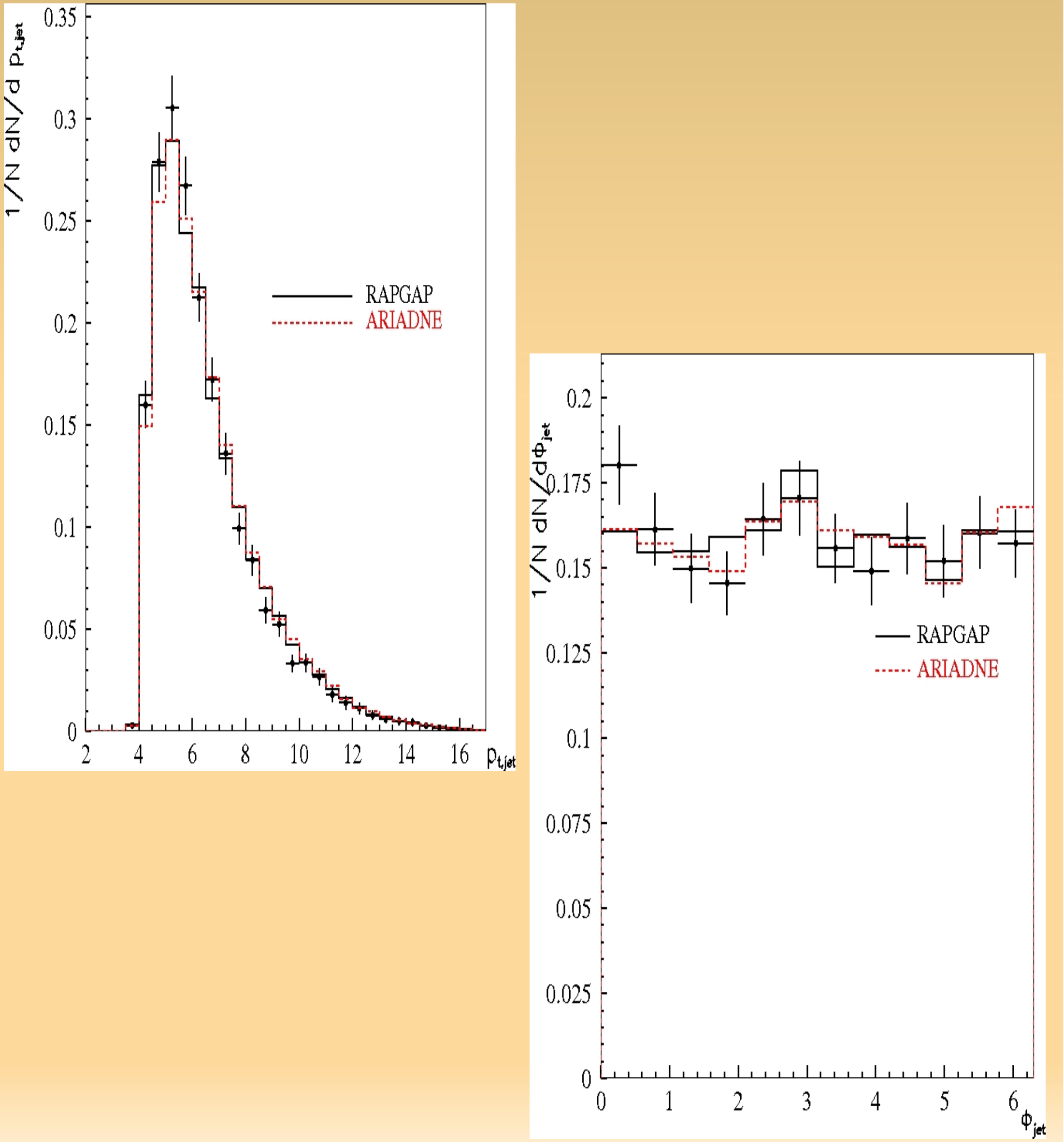


Jet sample – control plots

$no\, p_t^2/Q^2\, cut$

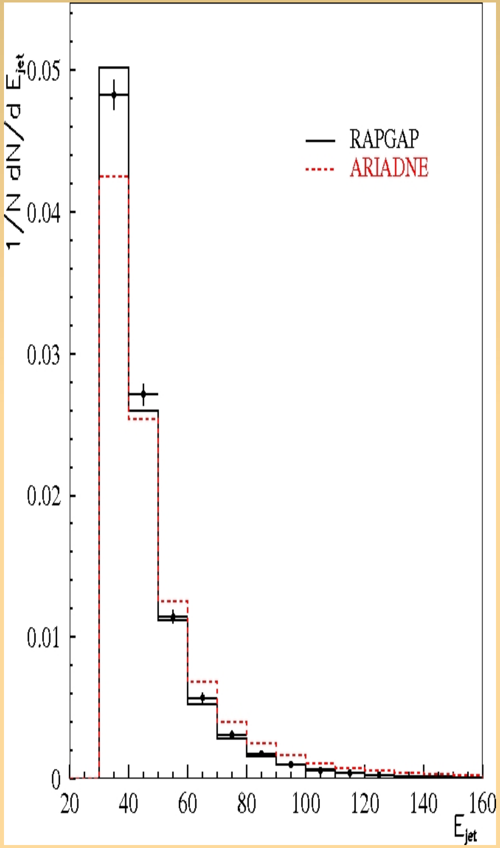


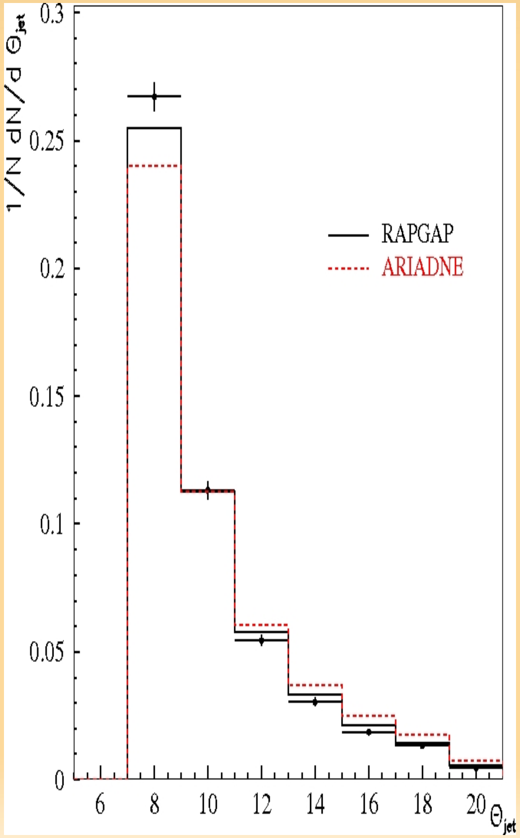
$0.5 < p_t^2/Q^2 < 5.0$



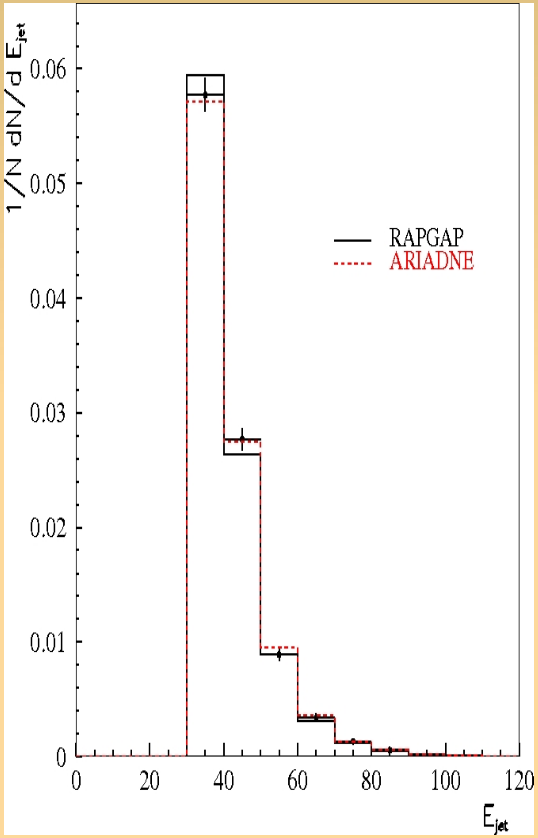
Jet sample – control plots

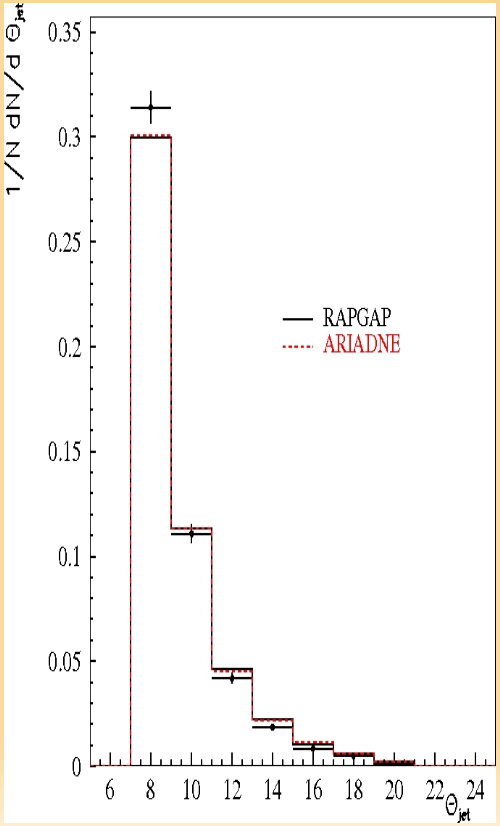
$no\ p_t^2/Q^2\ cut$



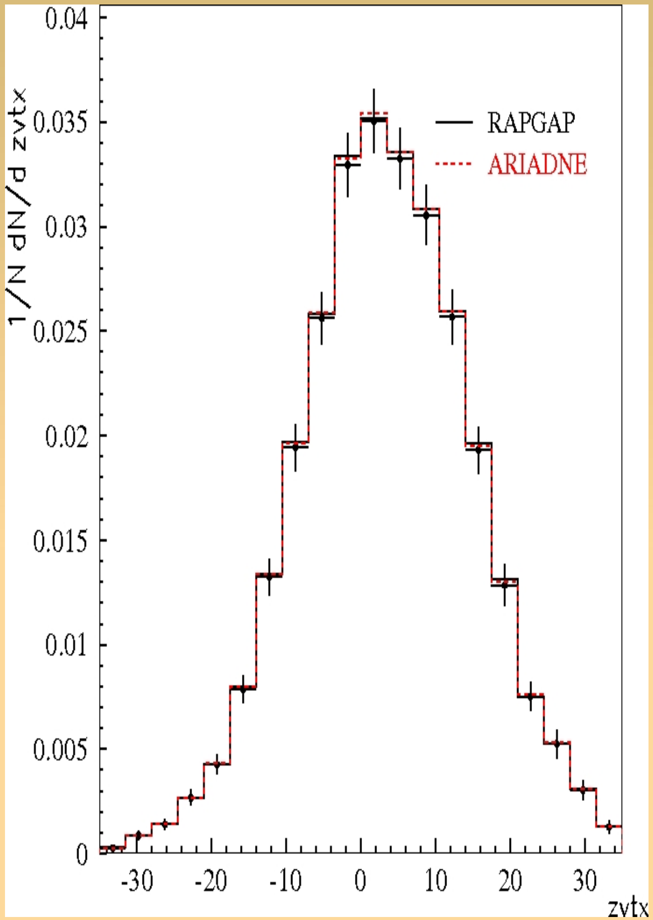


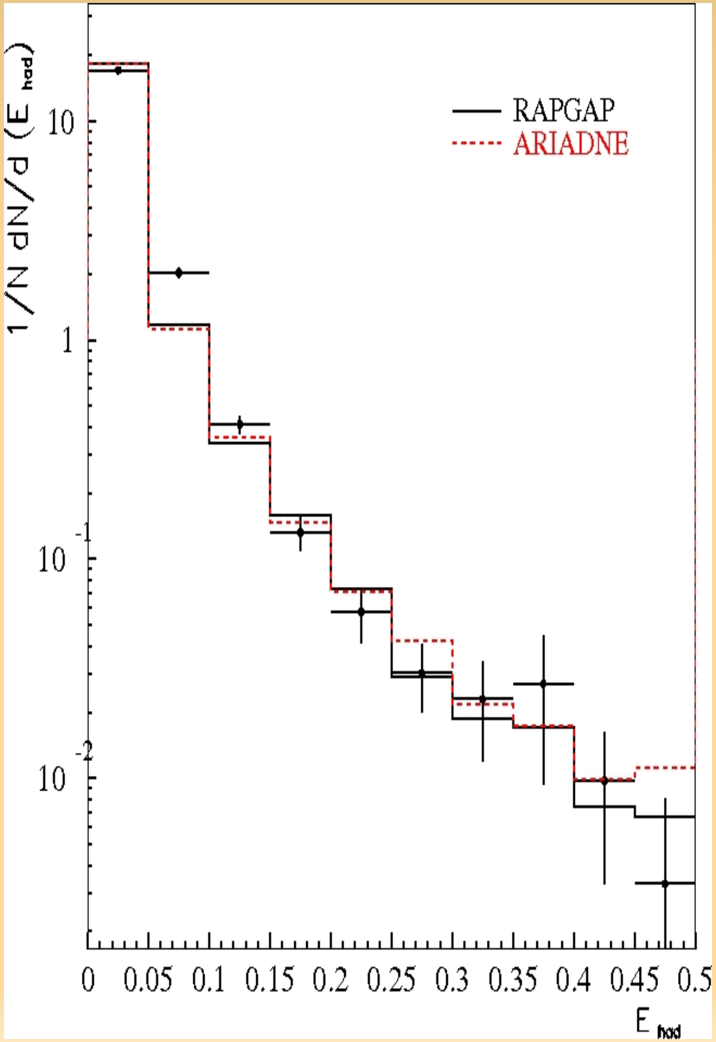
$0.5 < p_t^2/Q^2 < 5.0$

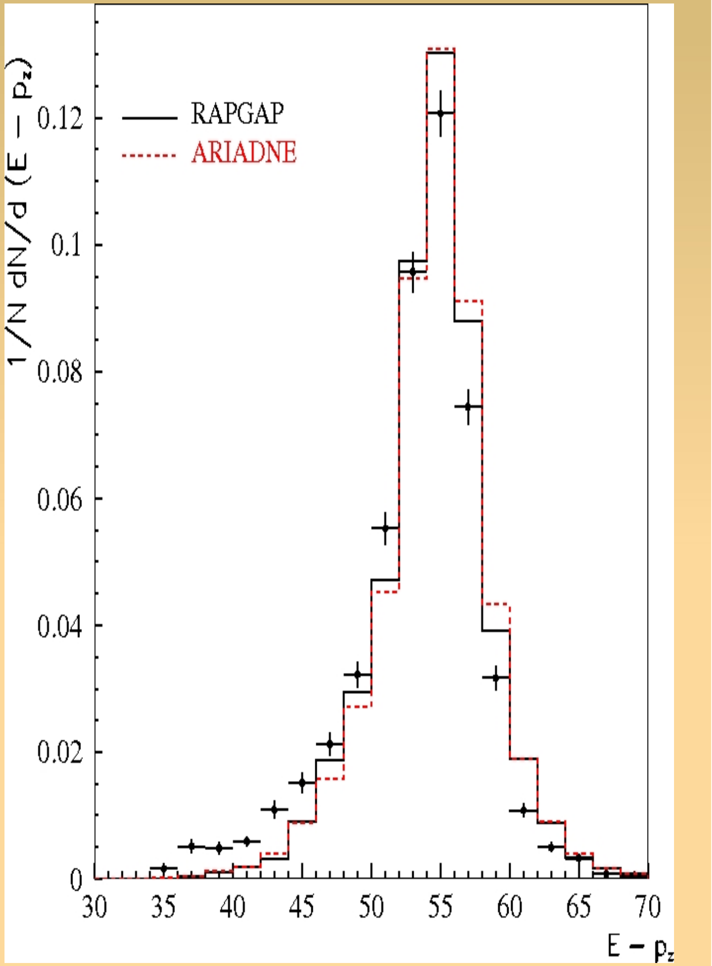




Jet sample – control plots

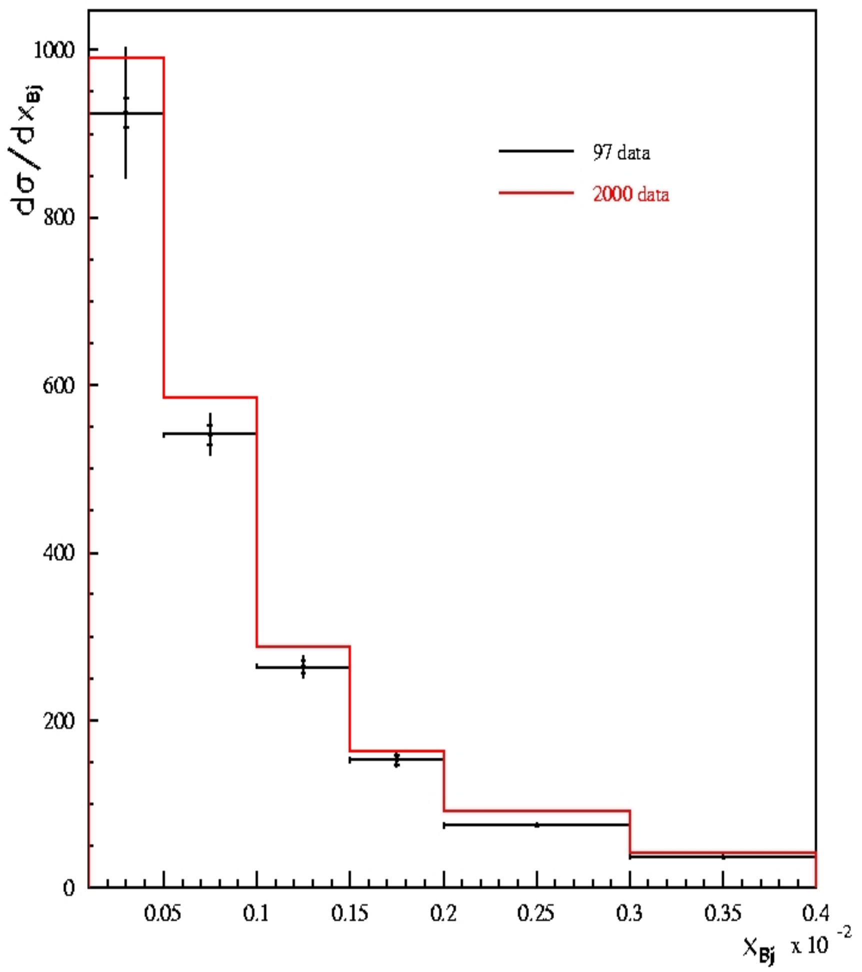


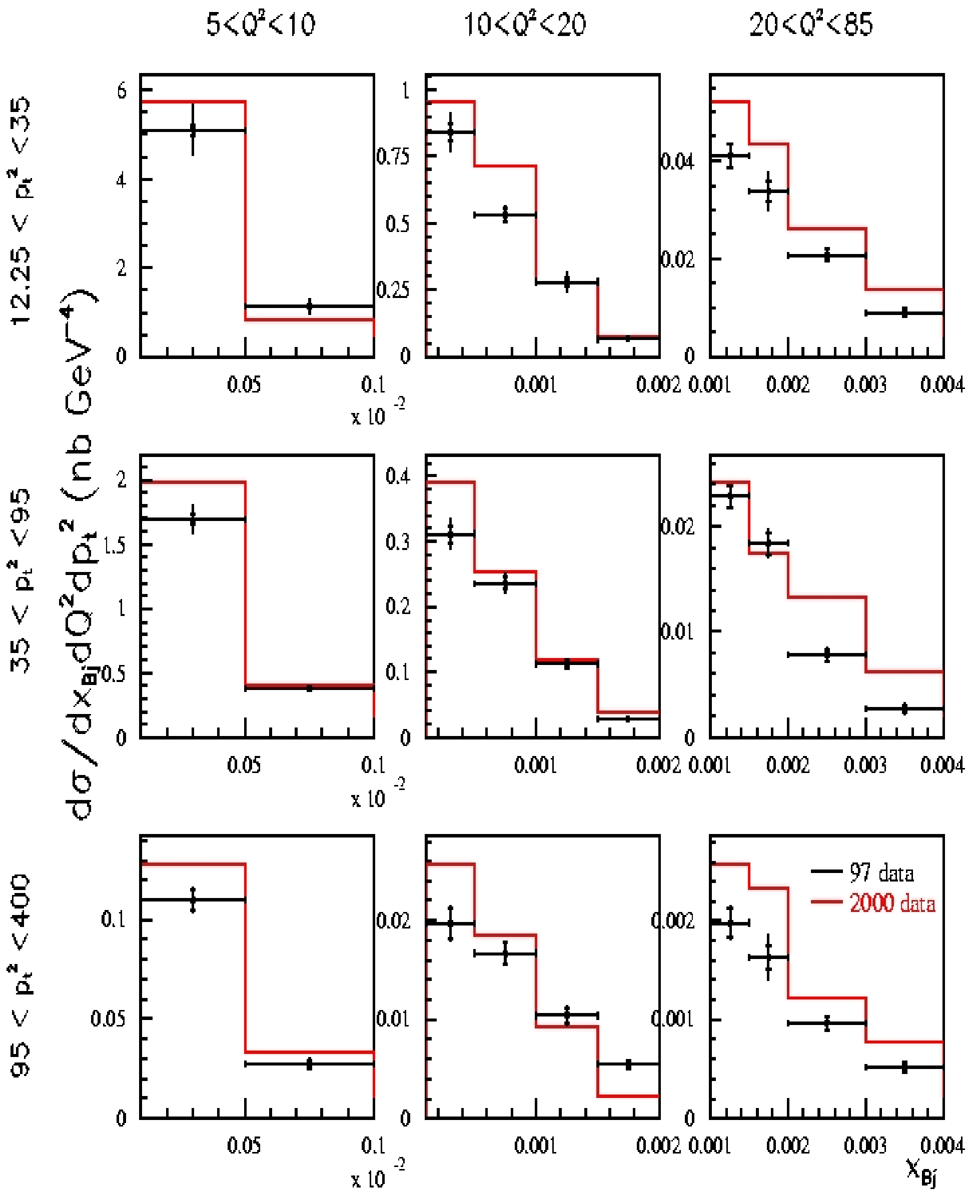




zvtx reweighted in
RAPGAP and ARIADNE

97 – 00 cross-section comparison



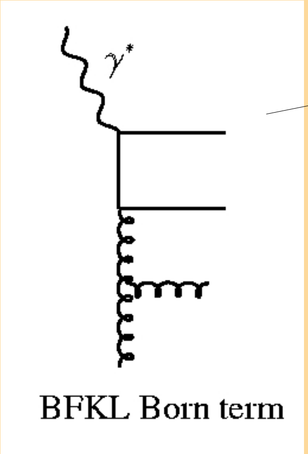


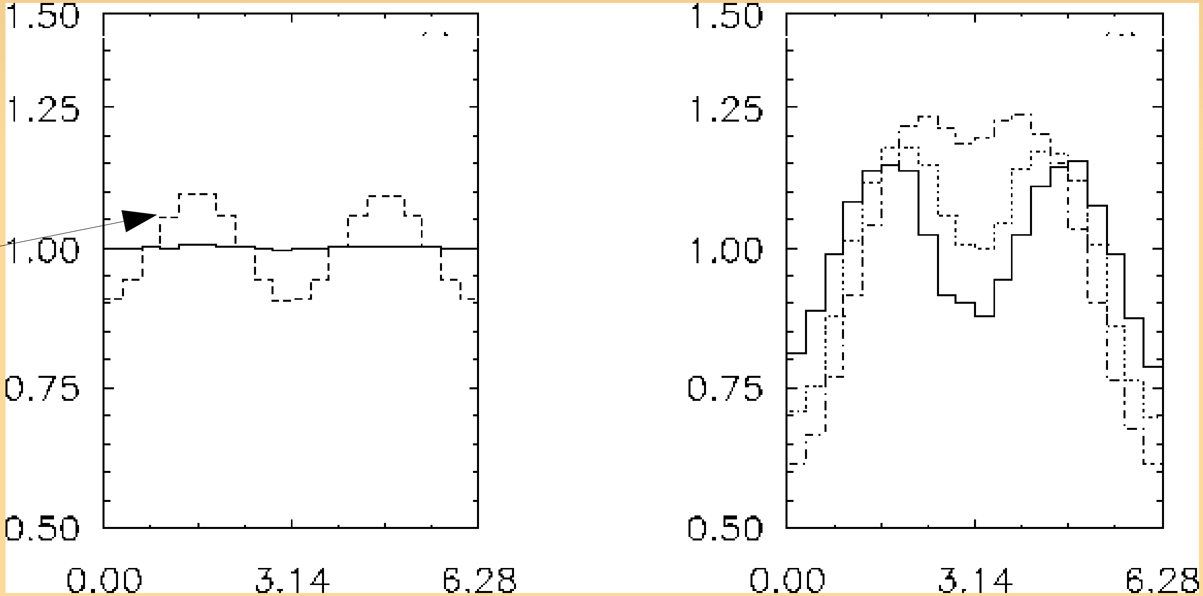
For 2000 data no error plotted

Azimuthal (de)correlations

BFKL: with increasing rapidity distance between fwd jet and current jets, fwd jet „forgets" about the azimuthal direction defined by outgoing lepton. Cross-section becomes ΔΦ - independent.

$\Delta\Phi = \Phi_{el} - \Phi_{jet}$

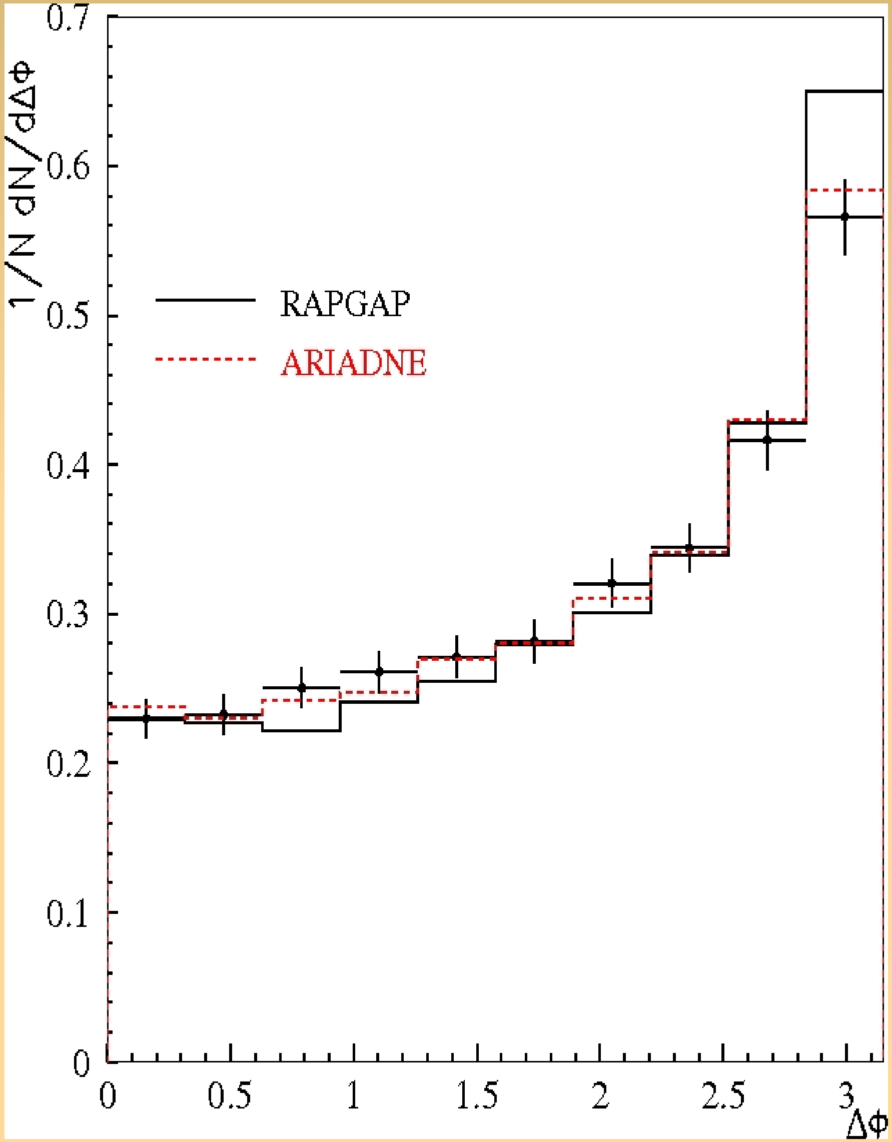


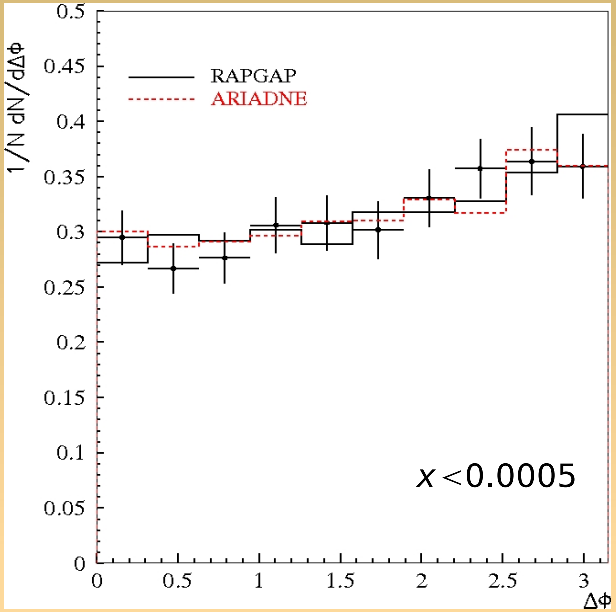

Bartels et al, 1996, *LO BFKL*

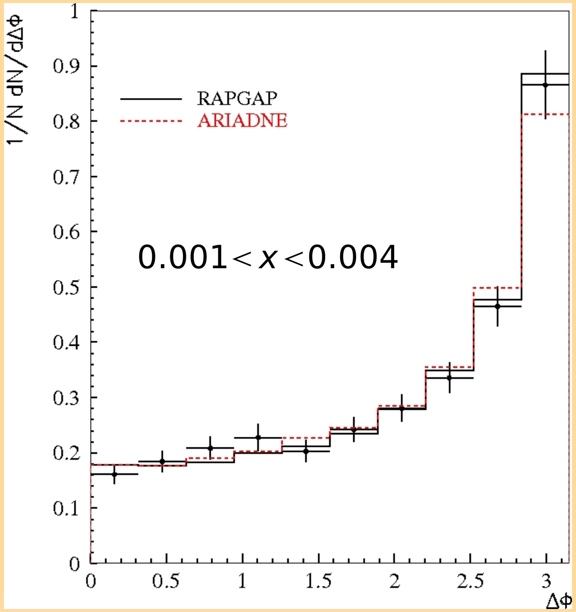
Fixed order $O(\alpha_s^2)$

Dependence on the difference in azimuthal angles of the outgoing electron and the fwd jet. The left hand figure: solid line – the BFKL result, dashed line – the approximative analytical Born predictions; $0.2*10^{-3} < x_B < 0.4*10^{-3}$. The right hand side figure: fixed order results : $0.2*10^{-3} < x_B < 0.4*10^{-3}$ – solid line, $1.8*10^{-3} < x_B < 2.0*10^{-3}$ dashed, $3.4*10^{-3} < x_B < 3.6*10^{-4}$ - dotted.

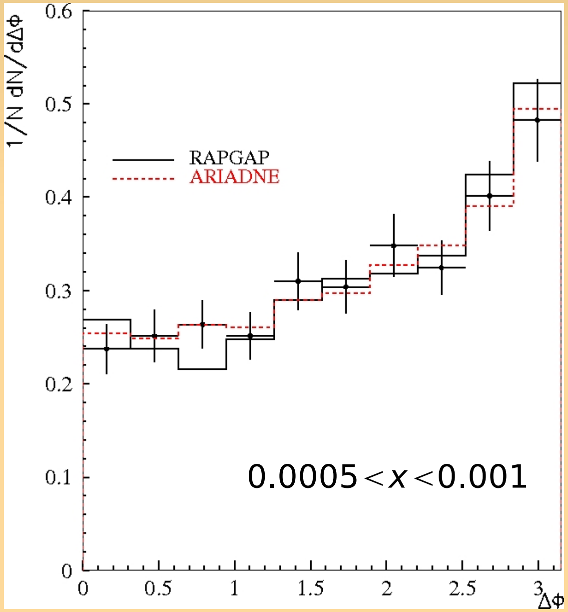
Azimuthal correlations







The lower values of x the flatter the ΔΦ distribution



Azimuthal correlations
Florian Schwensen' PhD

$$\frac{d\sigma}{dY d\Phi} =: C_0(Y) + C_2(Y) cos2\Phi$$

$$\langle \cos(2\Delta\Phi) \rangle = \frac{C_2}{C_0}$$

<cos2Φ> at the ep collider HERA at

leading(solid), next to leading order

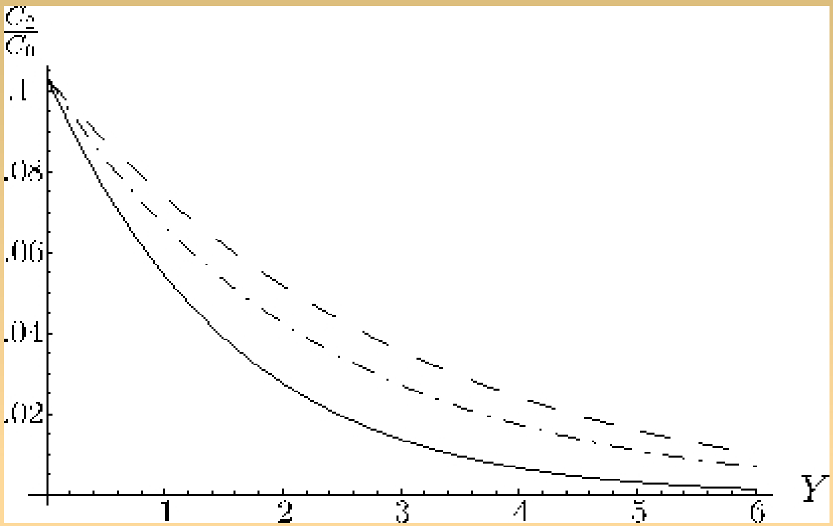
(dashed), and for resummed kernel

Calculations for ZEUS kinematical cuts:

$20. < Q^2 < 100.$ GeV

$0.05 < y < 0.7$

$5*10^{-3} < x_{Bj} < 4*10^{-4}$

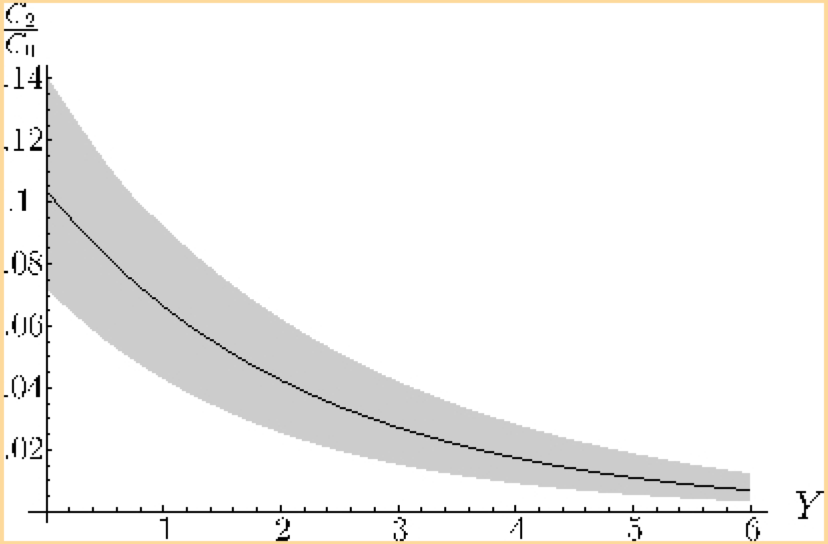


$$Y = \ln \frac{x_{FJ}}{x_{Bj}}$$

<cos2Φ> at the ep collider HERA for

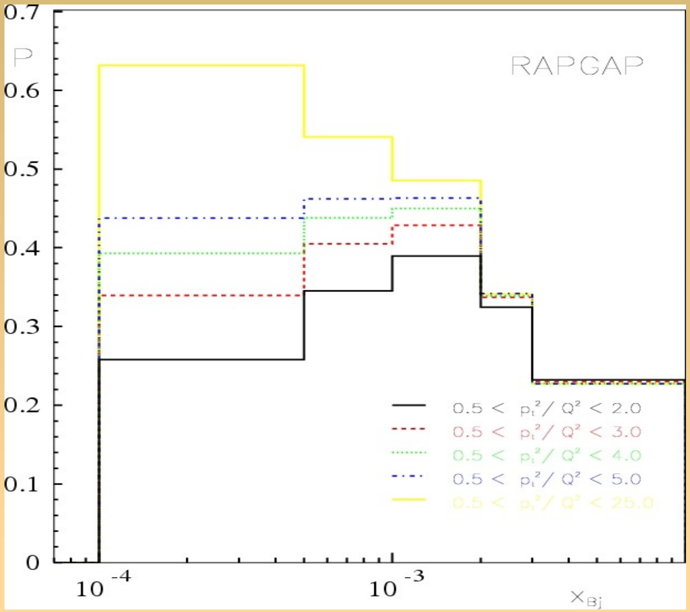
resummed kernel. The gray band reflects

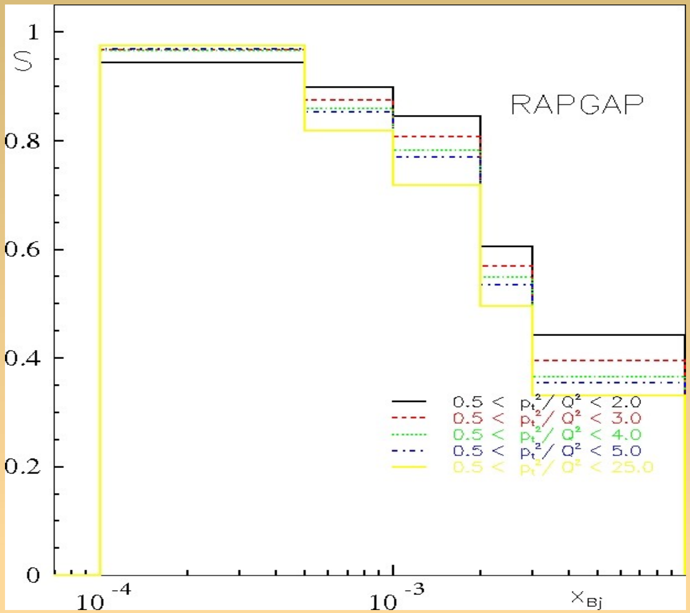
the uncertainty in renormalization scale μ

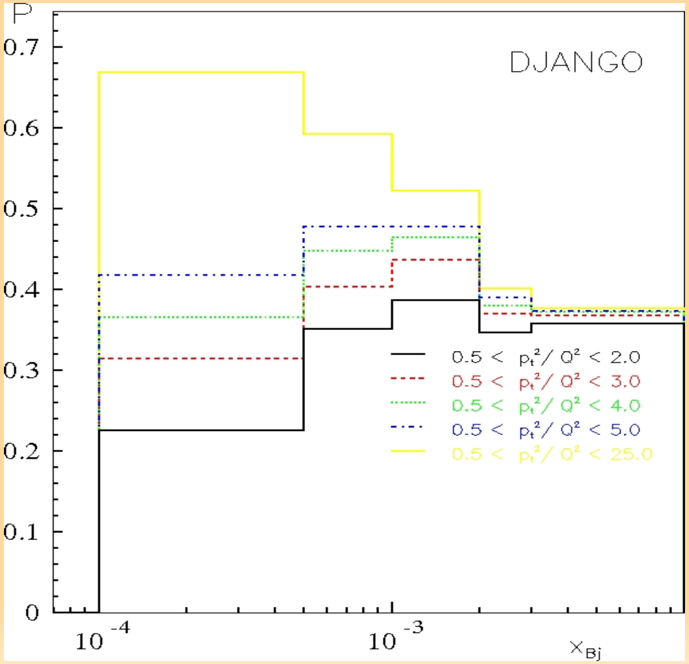


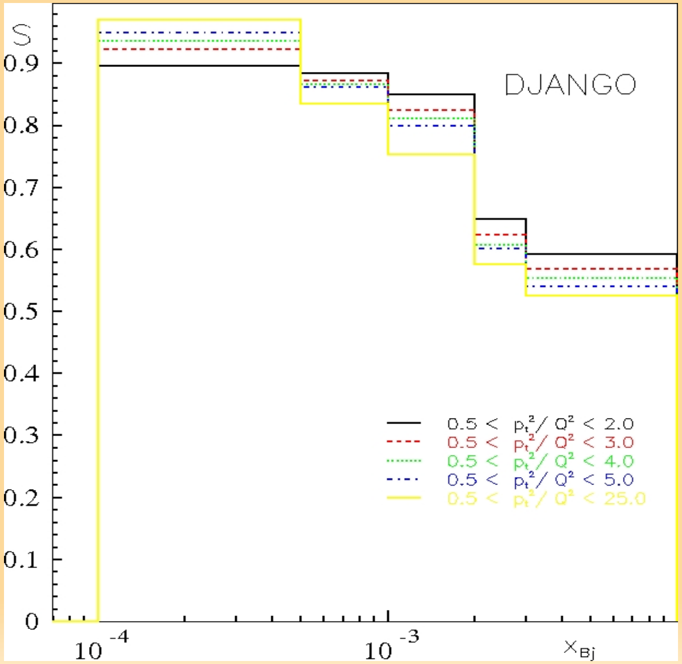
Calculations NLO BFKL

Stability and purity – different p_t^2/Q^2 cuts









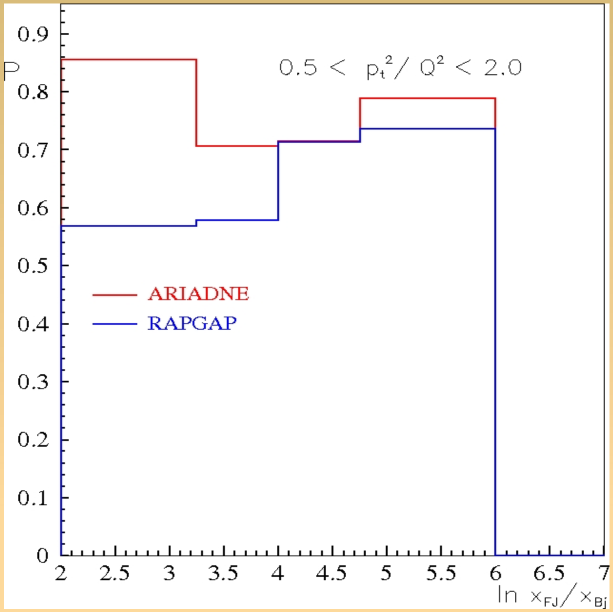
$$P = \frac{N_{HAD\wedge DET}}{N_{DET}} \left(HAD \wedge DET\right)$$

$$S = \frac{N_{HAD\wedge DET}}{N_{HAD}} \left(HAD \wedge DET\right)$$

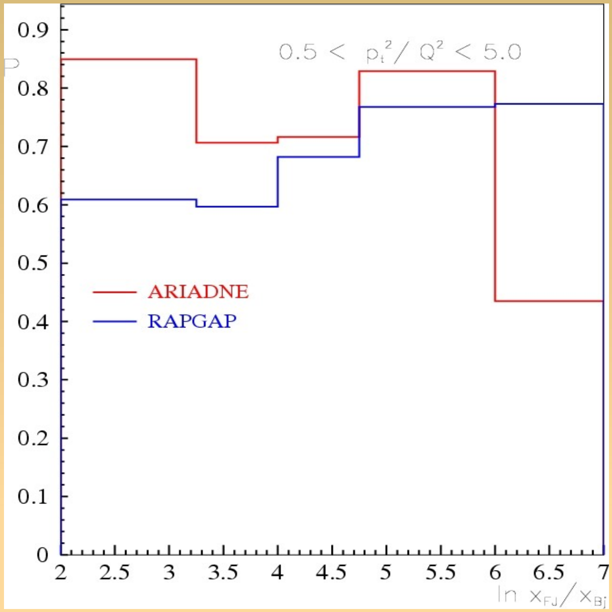
Low P especially for

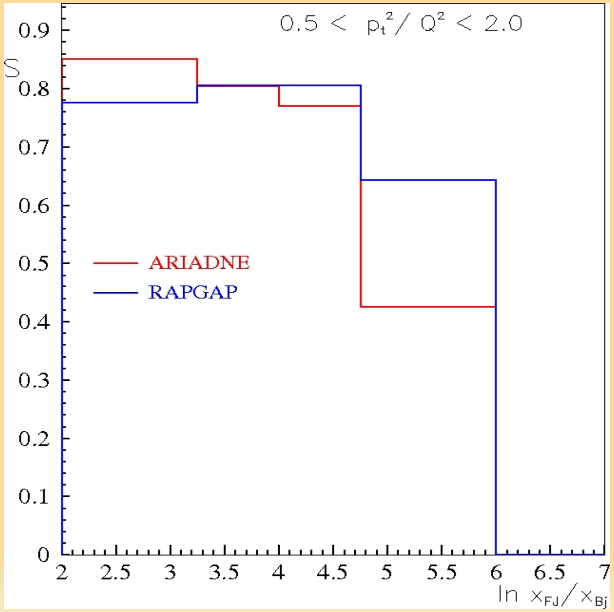
$0.5 < p_t^2/Q^2 < 2.0$

Stability and purity – ln (x_{jet}/x_{Bj})

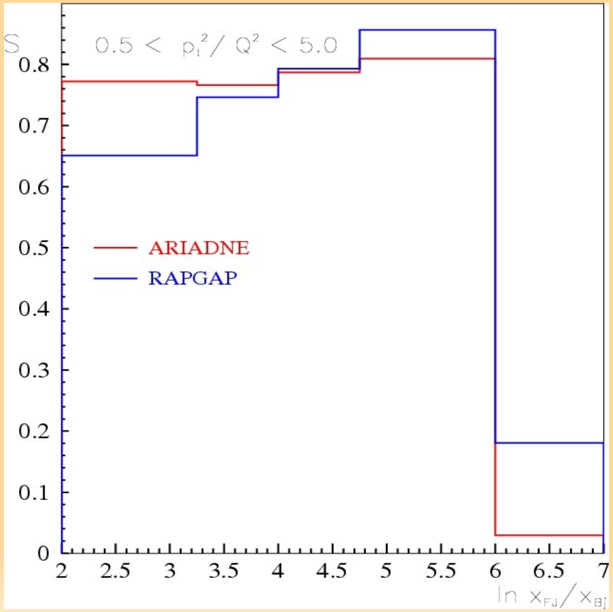


$$0.5 < \frac{p_t^2}{Q^2} < 2.0$$

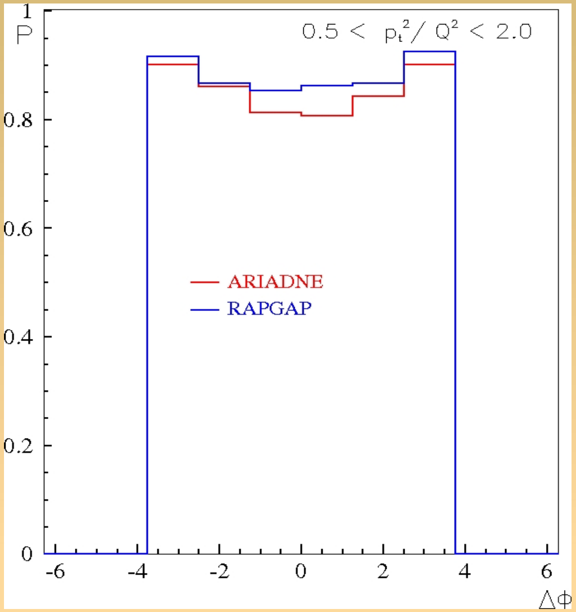




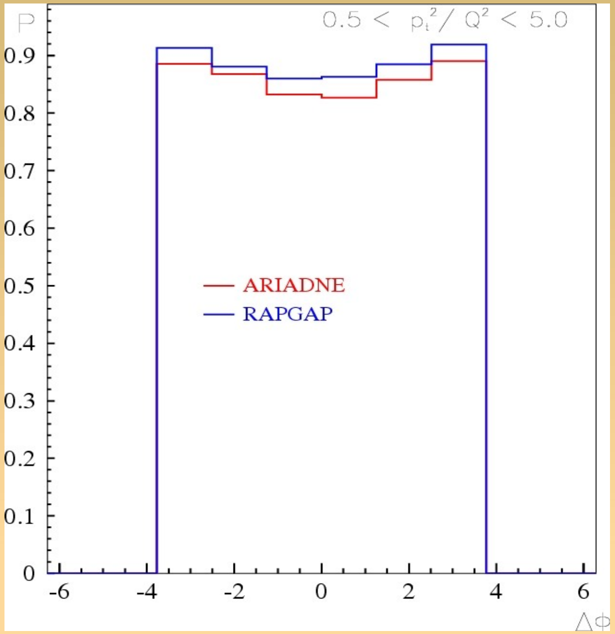
$$0.5 < \frac{p_t^2}{Q^2} < 5.0$$

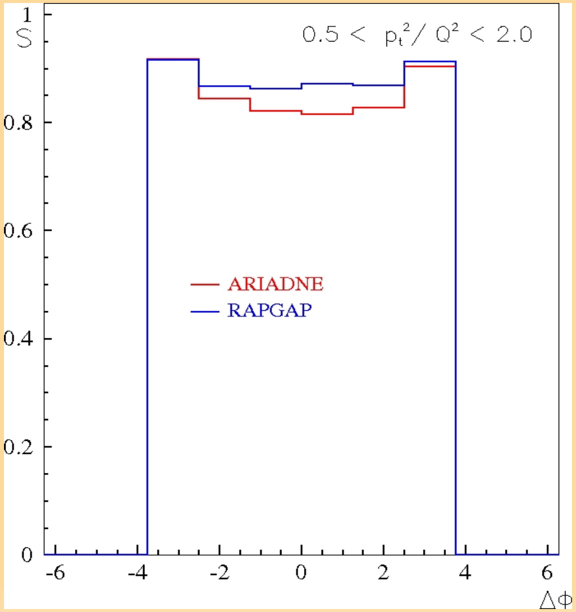


Stability and purity – Φ_{el} - Φ_{jet}

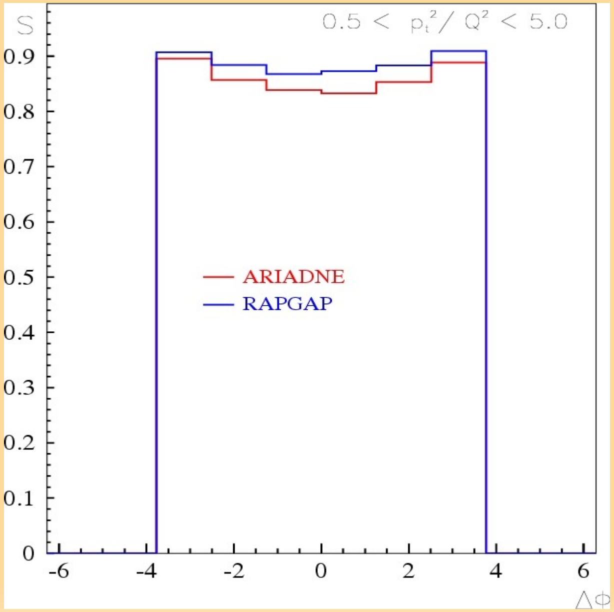


$$0.5 < \frac{p_t^2}{Q^2} < 2.0$$



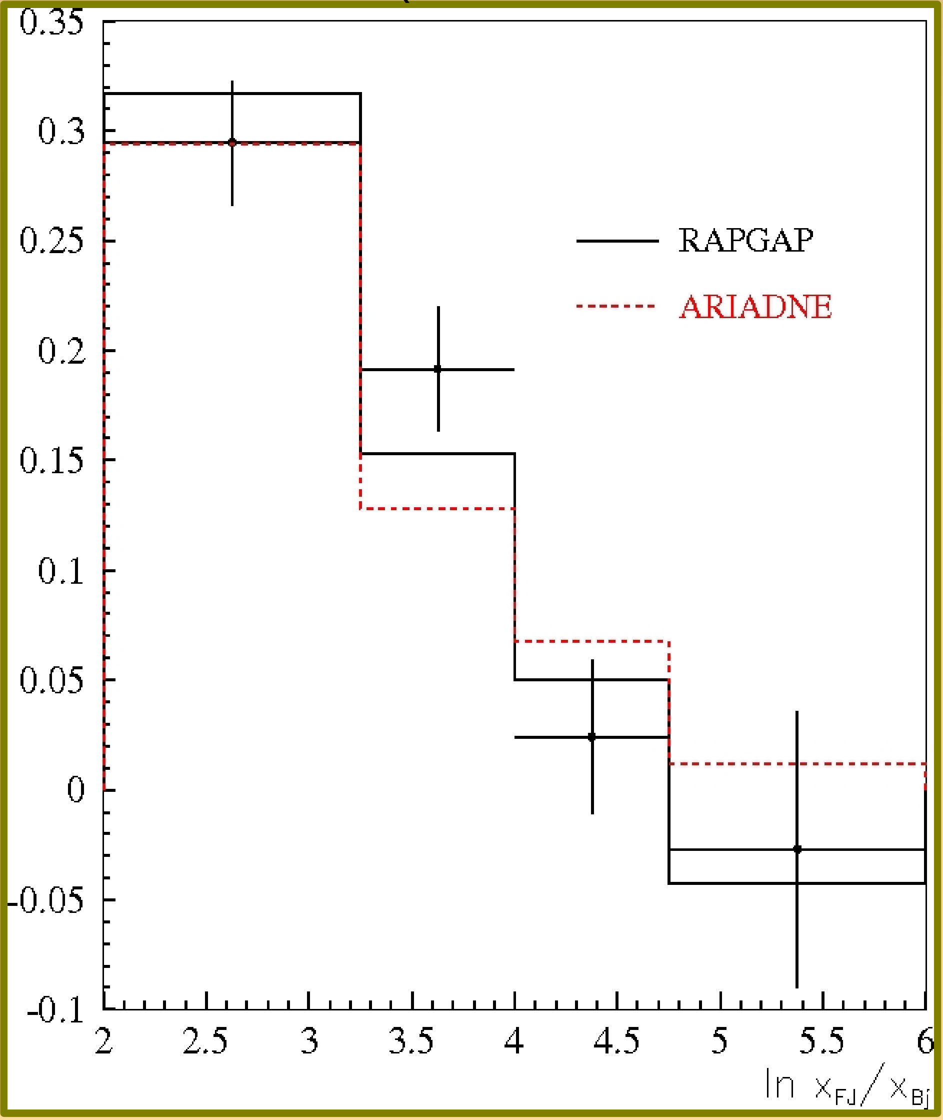


$$0.5 < \frac{p_t^2}{Q^2} < 5.0$$

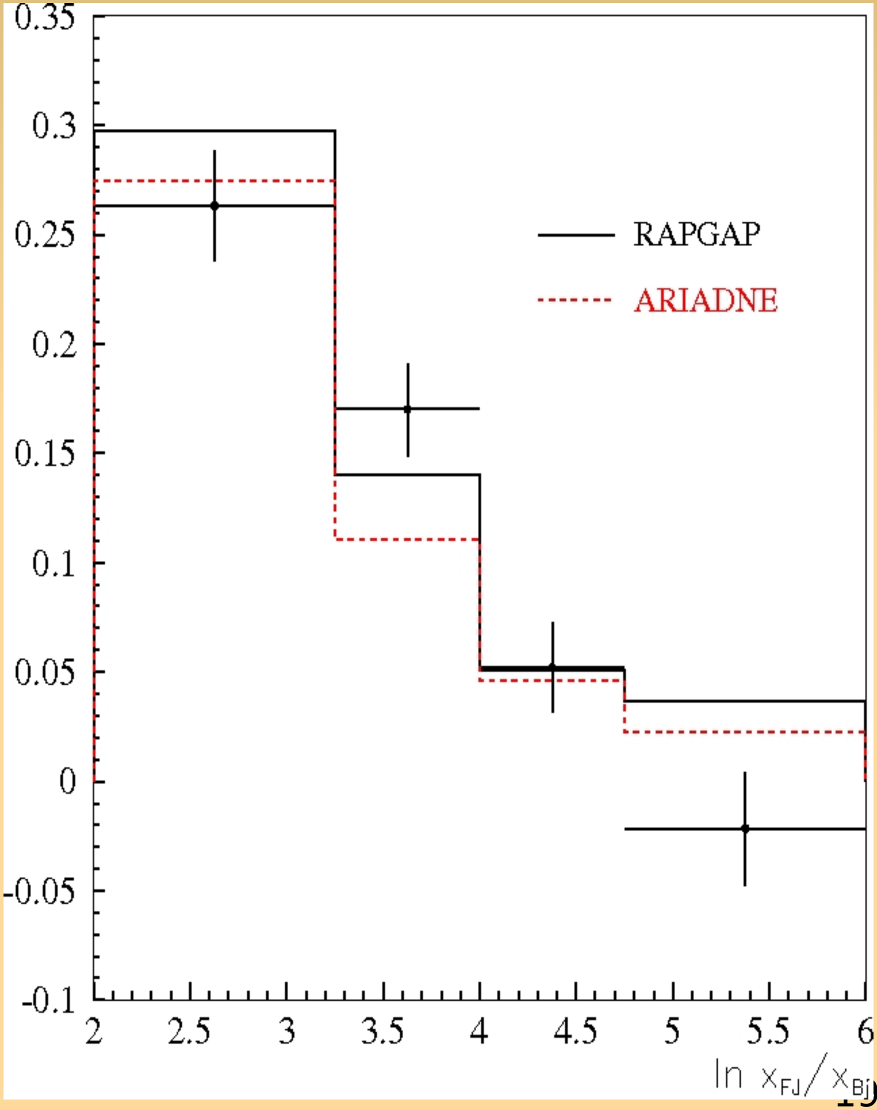


<cos (2ΔΦ)>

$0.5 < \frac{p_t^2}{Q^2} < 2.0$



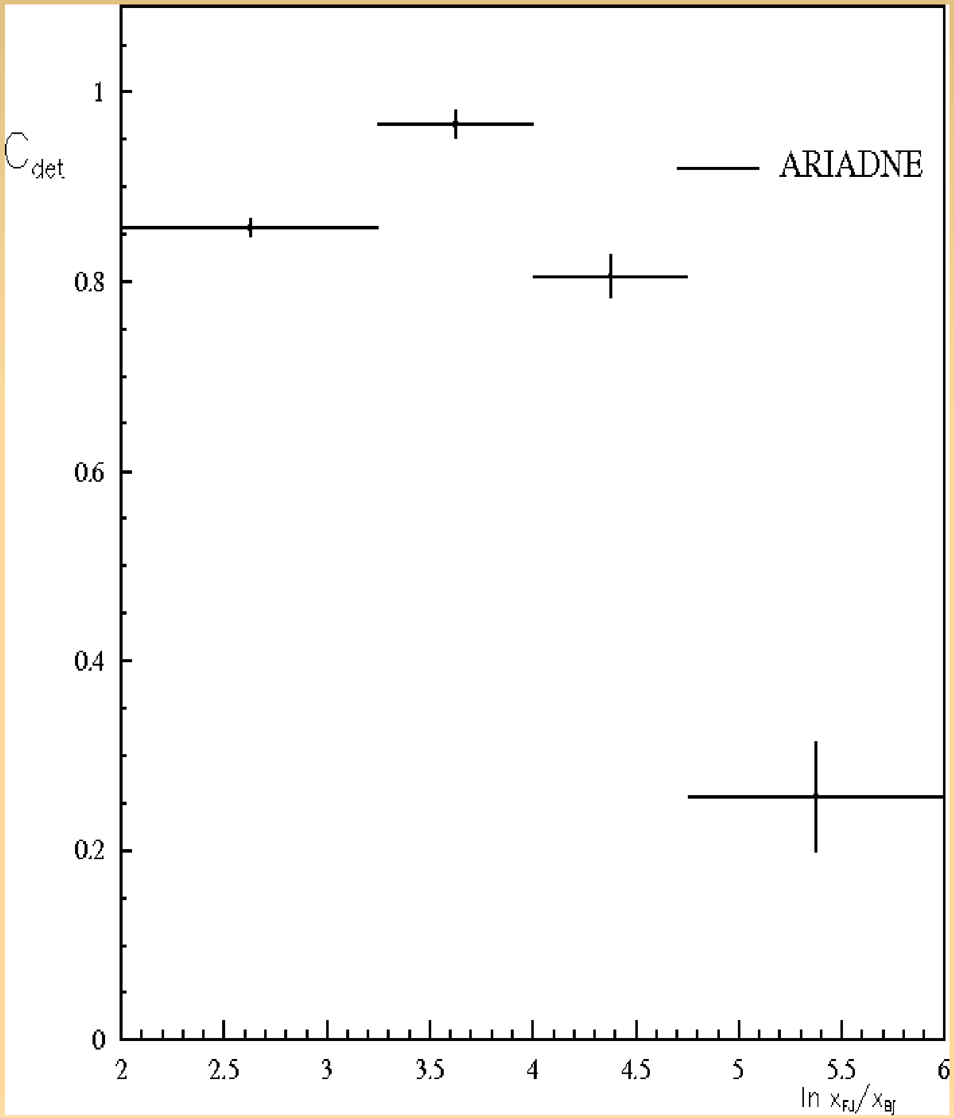
$0.5 < \frac{p_t^2}{Q^2} < 5.0$



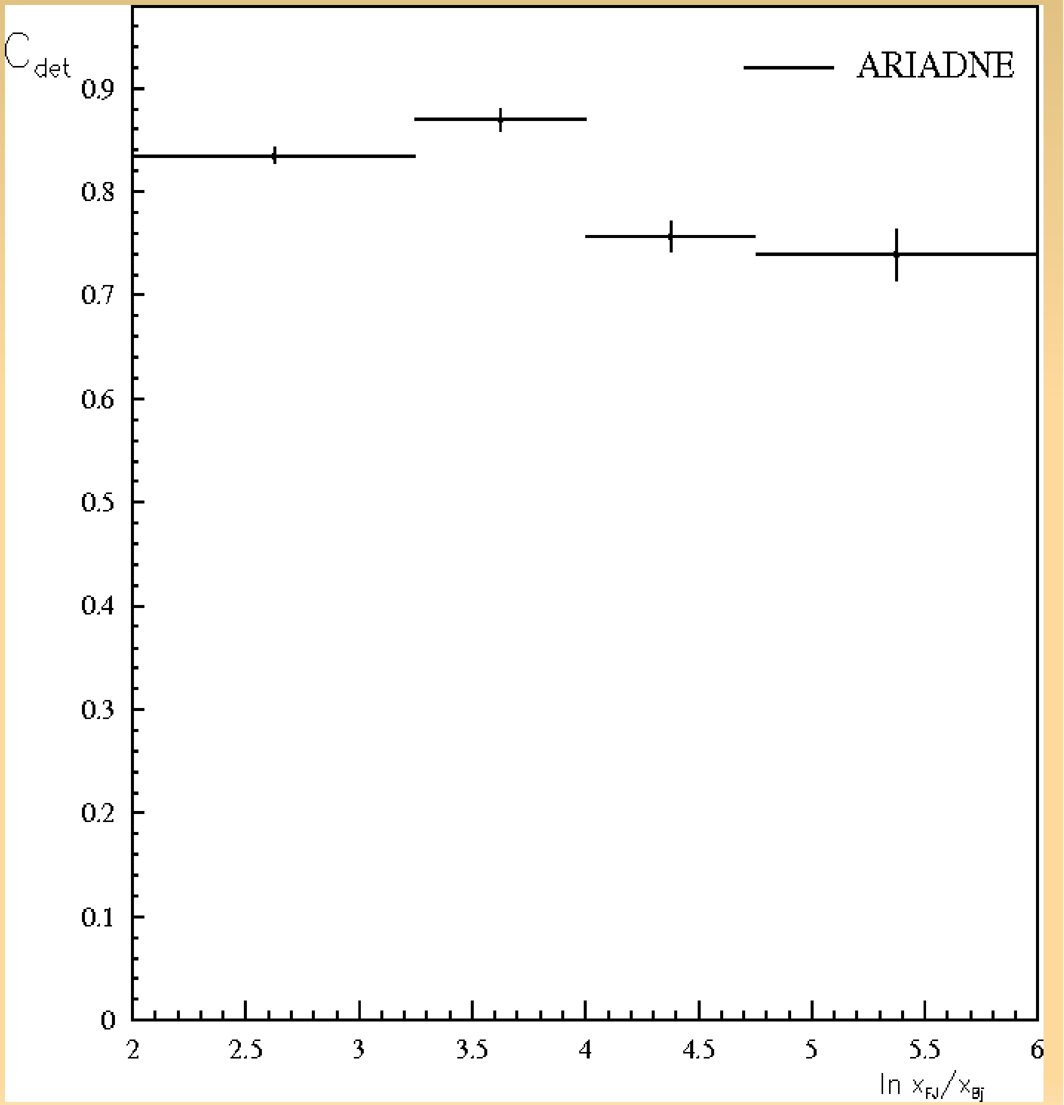
$\Delta\Phi = \Phi_{el} - \Phi_{jet}$

Detector correction for <cos 2 ΔΦ >

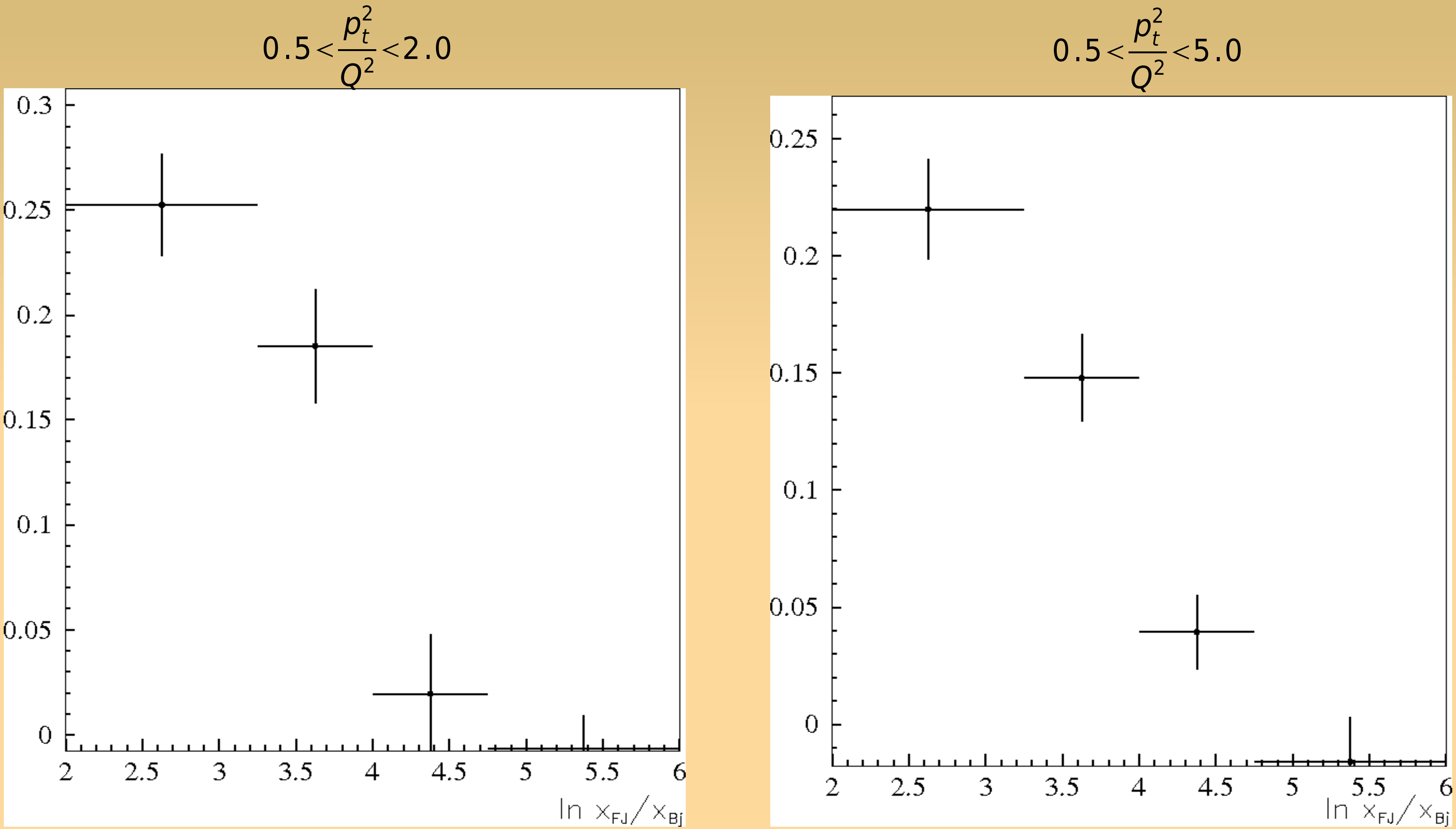
$$0.5 < \frac{p_t^2}{Q^2} < 2.0$$



$$0.5 < \frac{p_t^2}{Q^2} < 5.0$$



< cos 2ΔΦ > at hadron level

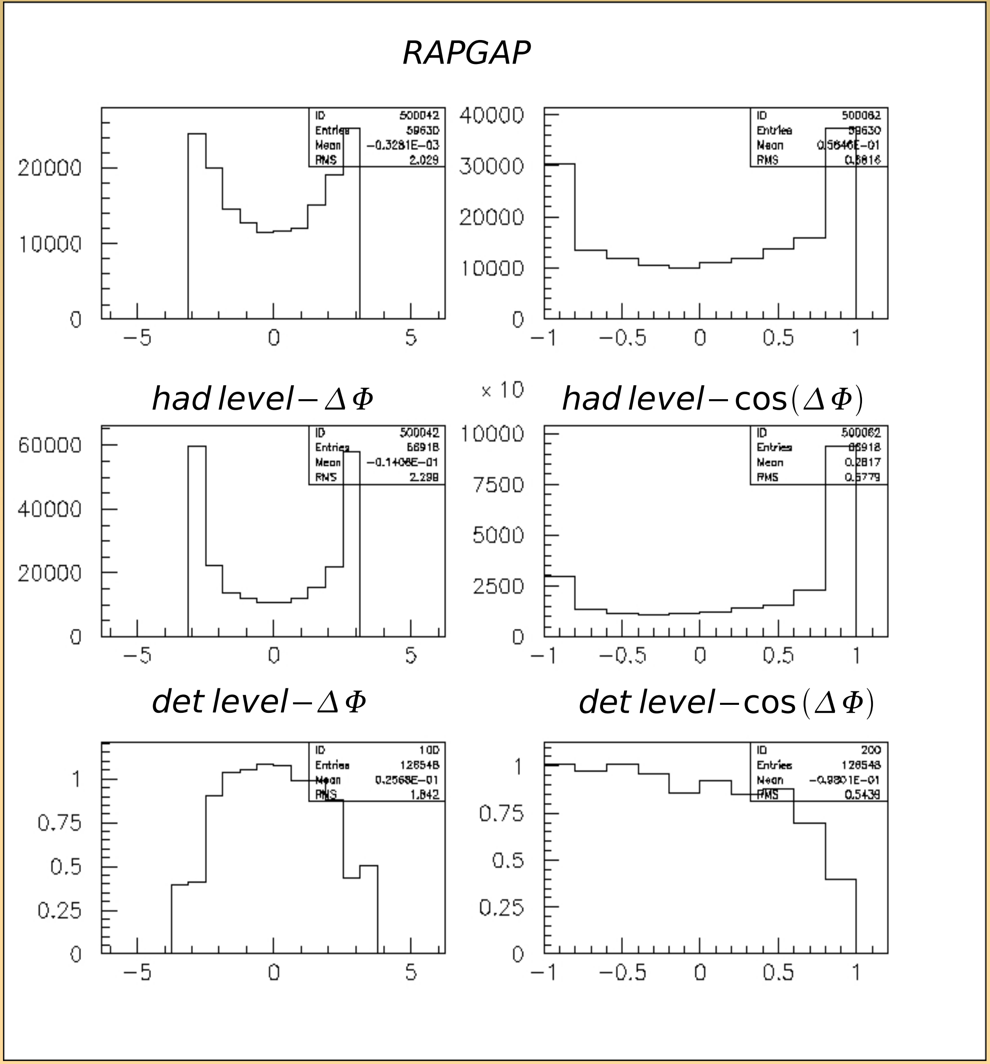


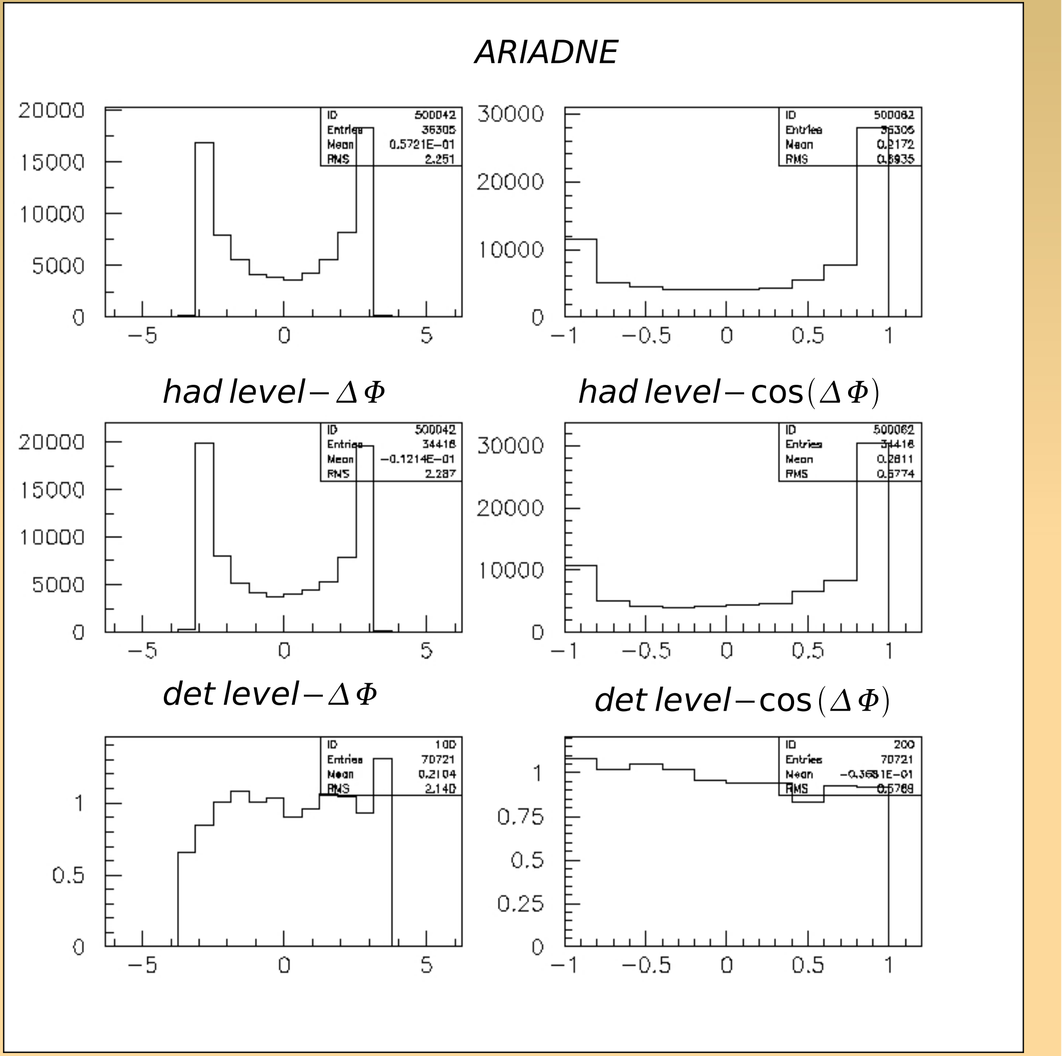
$0.5 < \frac{p_t^2}{Q^2} < 2.0$

$0.5 < \frac{p_t^2}{Q^2} < 5.0$

No radiative corrections yet!

Problem with RAPGAP

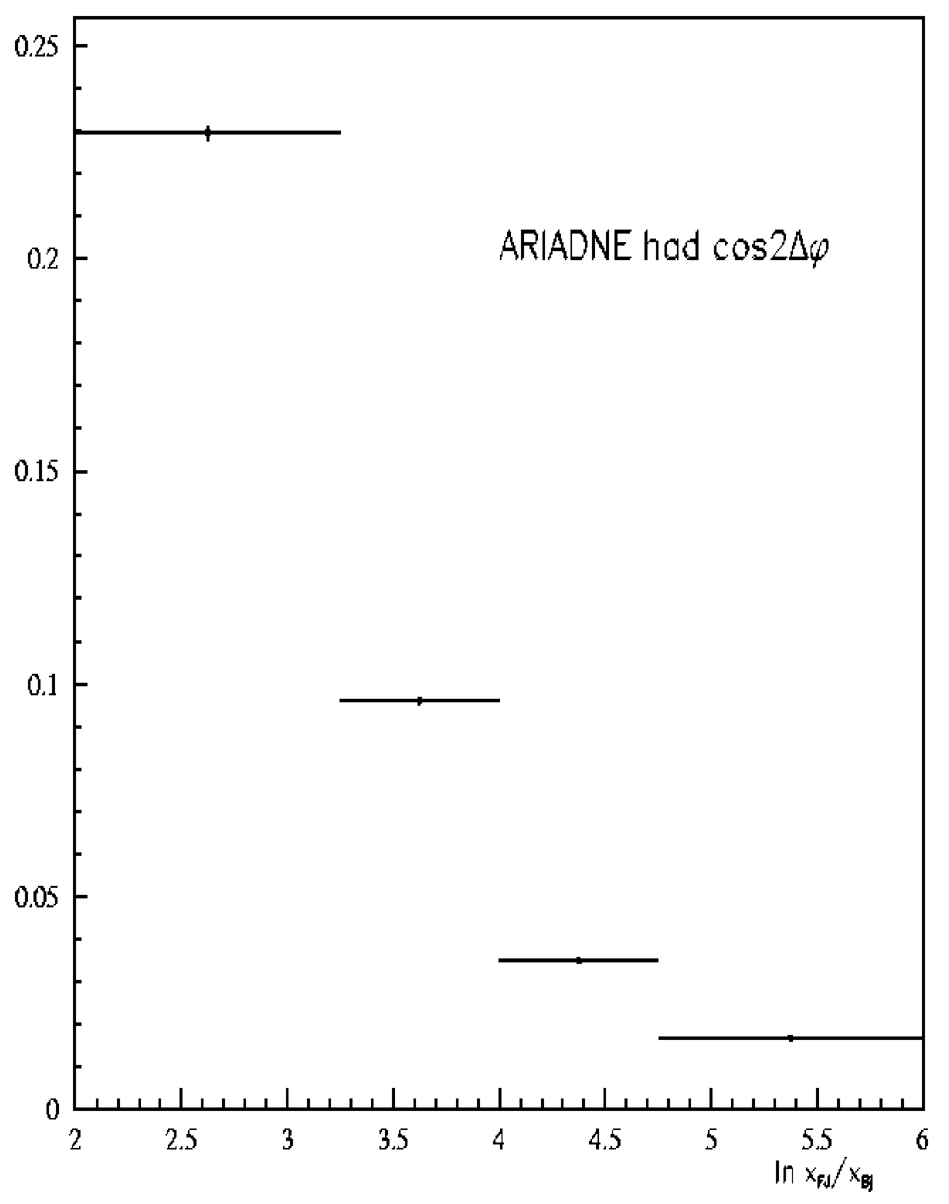


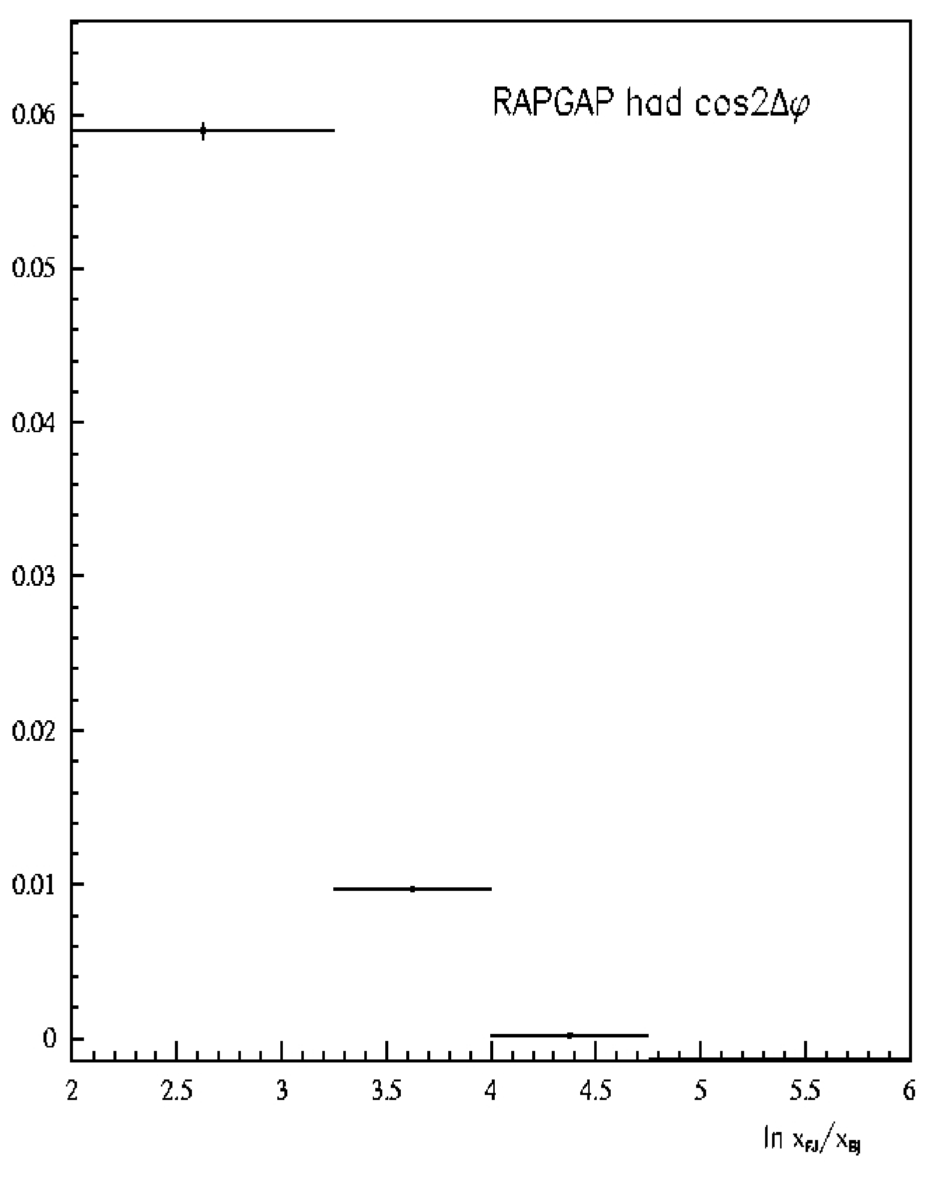


It looks like events where ΔΦ ~ π in RAPGAP at hadron level are not accepted (more events

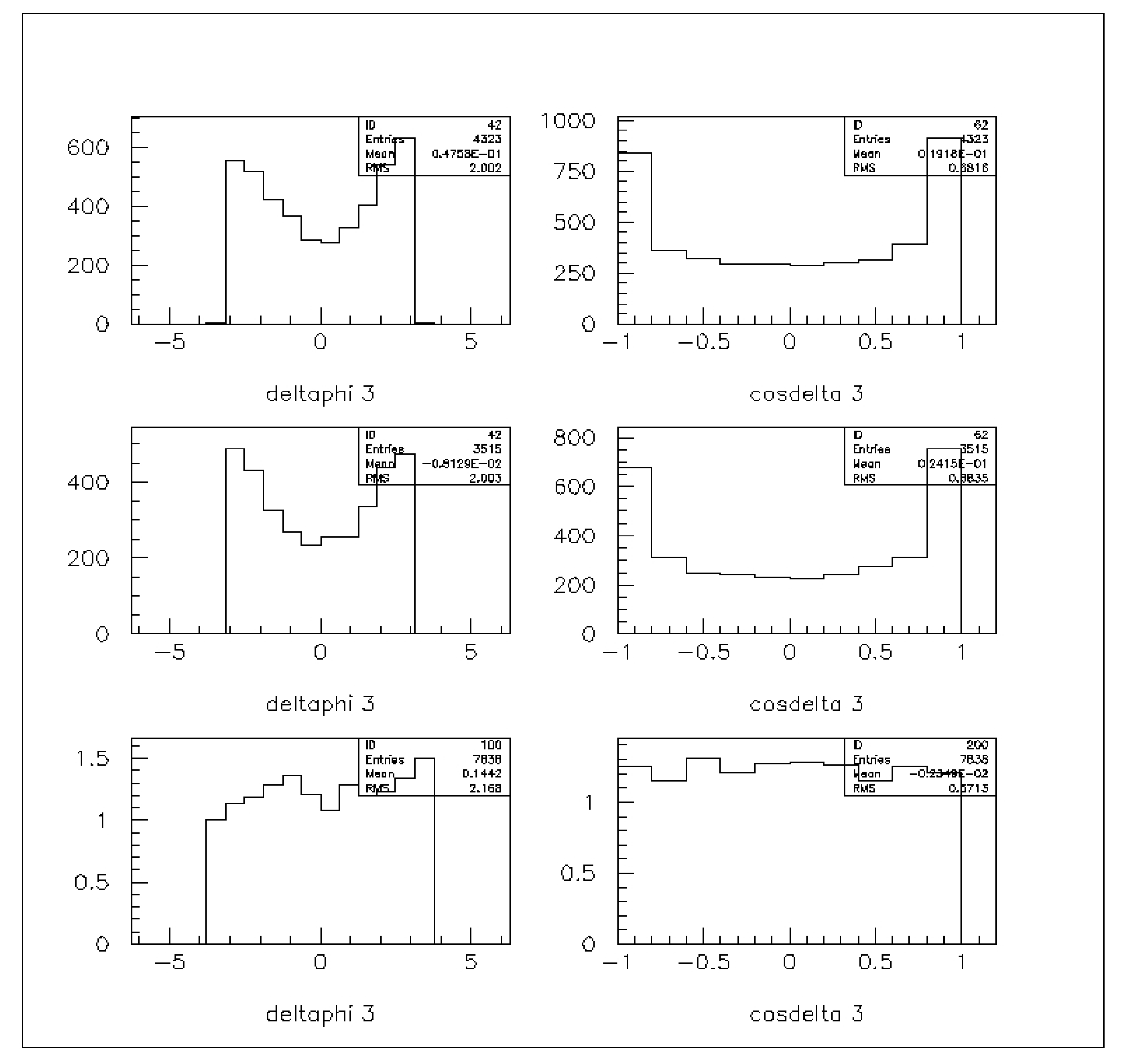
at detector level), this leads to a large difference in detector corrections in comparison to ARIADNE.

Problems with RG



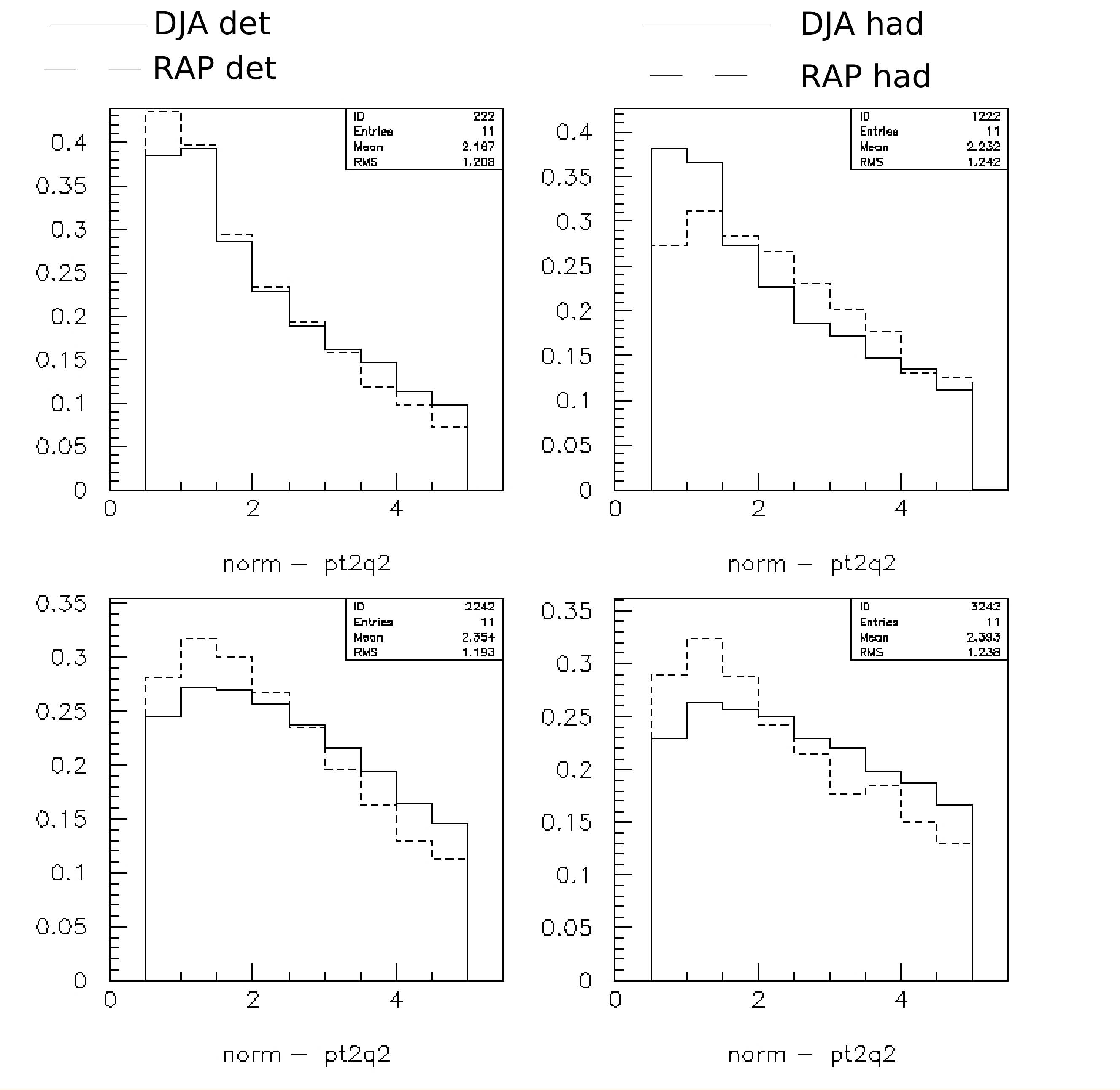


Problem with RG



Comparison of nonradiative (upper histos) and radiative (middle ones) RG.
Distributions in all bins of $\ln(x_{jet}/x_{Bj})$ very similar.
Looks like there is another reason for such a difference between Django and Rapgap.

Control distributions



Control distributions on hadron and detector level in Django and Rapgap look mostly very similar.

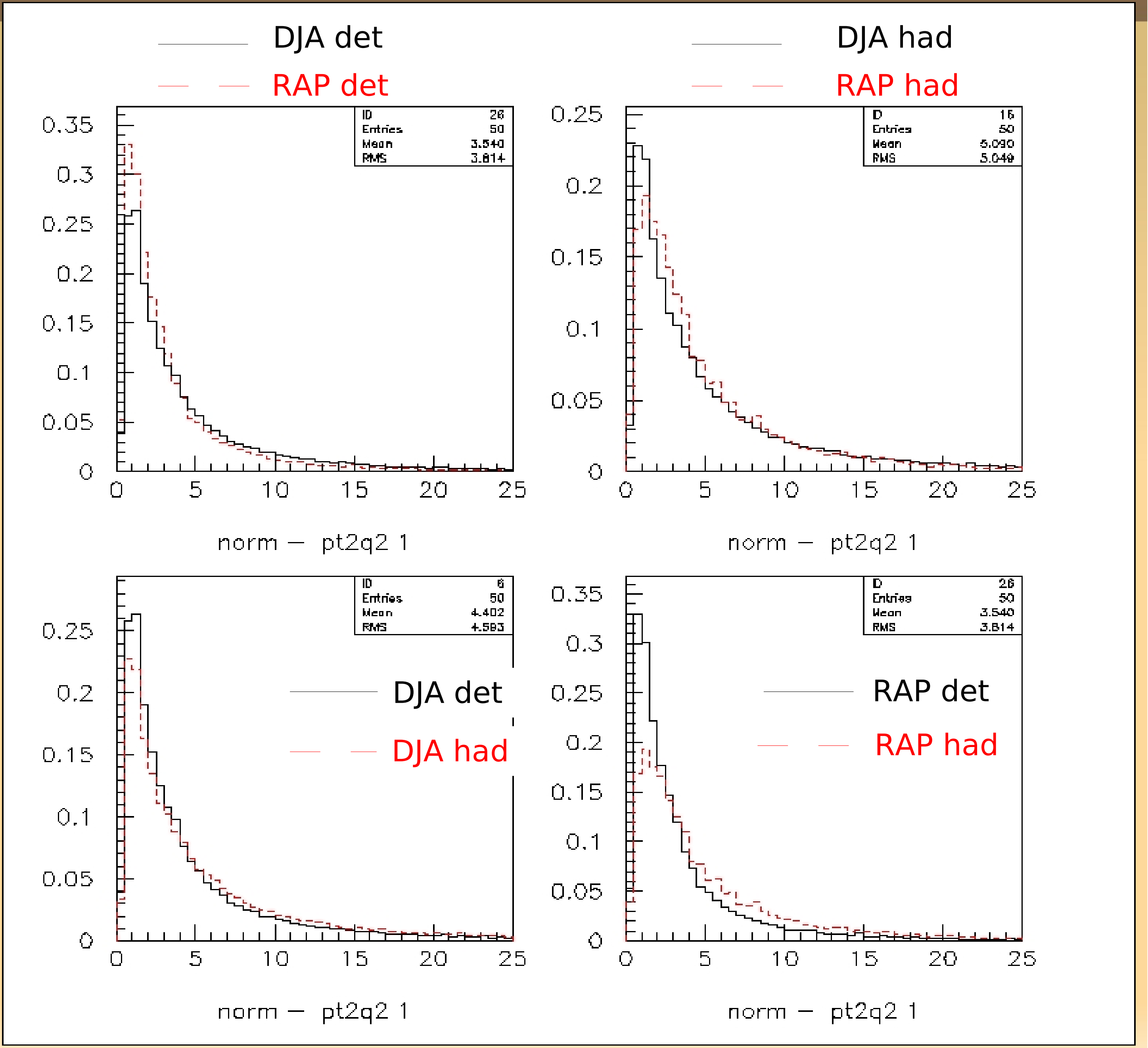
The only distribution where one can see clear difference is pt2/Q2 distribution.

Upper histos are for region where ΔΦ ~ π, bottom ones for region where ΔΦ ~ 0.

We check the distribution without pt2/Q2 cut. Broaden the range and check what the tails look like.

Control distributions II

Tails don't seem to give the difference between hadron and detector level in Rapgap



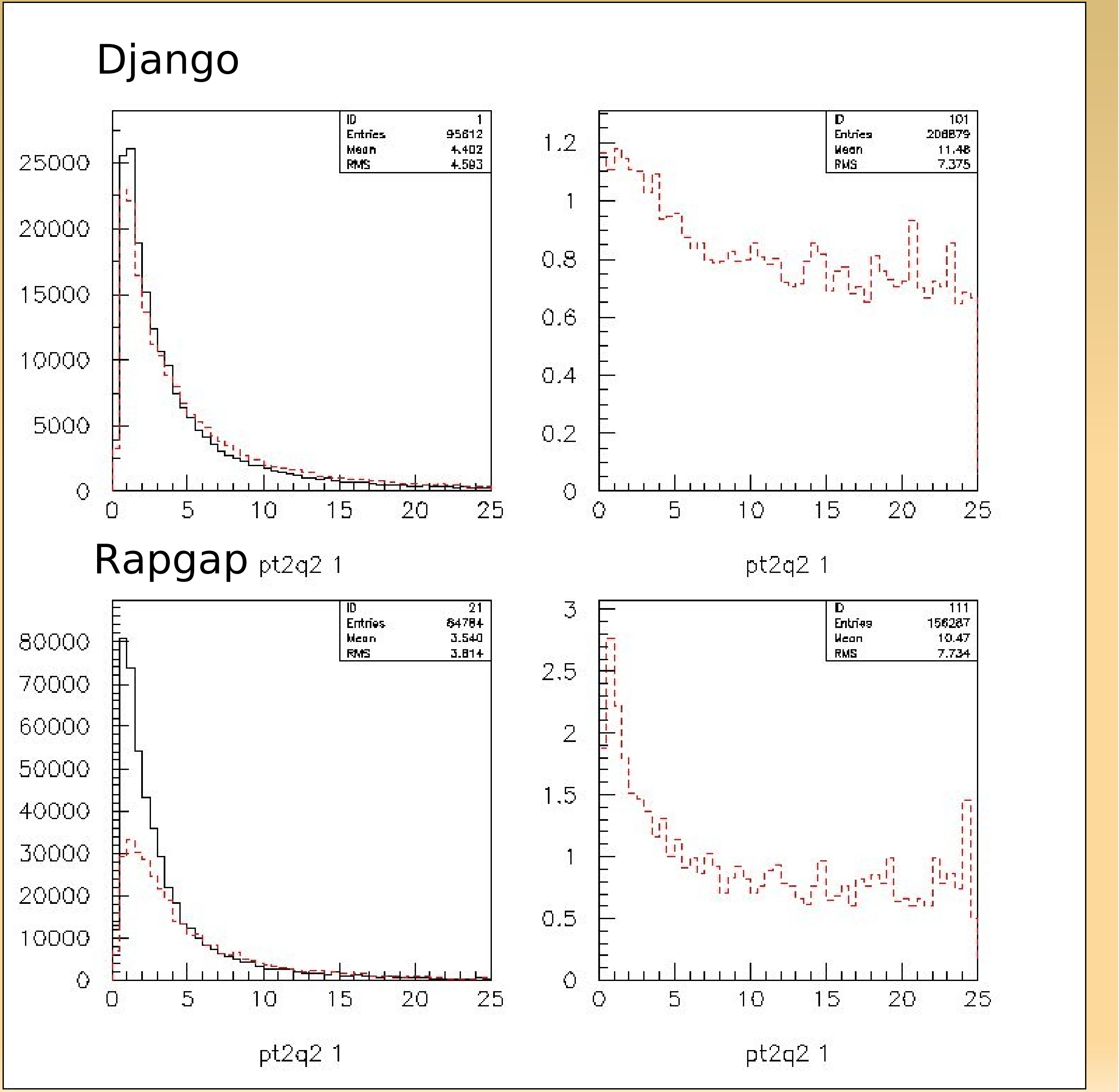
Control distributions III

We have huge difference

in number of entries in

Rapgap between hadron

and detector level.

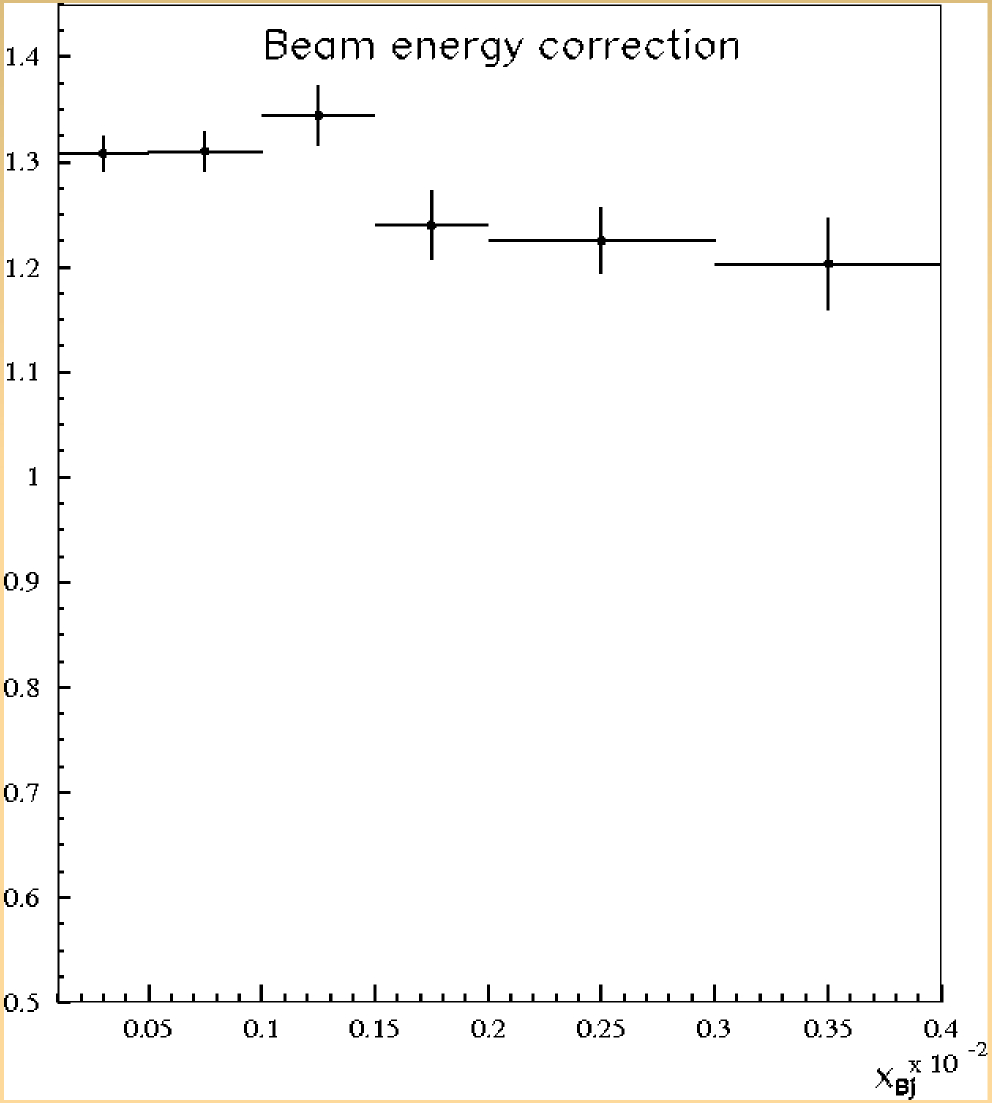


Idea ...

Jets on detector level → Look if there is a jet on hadron level. If no, check the kinematic and jet variables.

Maybe the events on hadron level will have „something” that will point out what's the problem.

Backup


Beam energy correction
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
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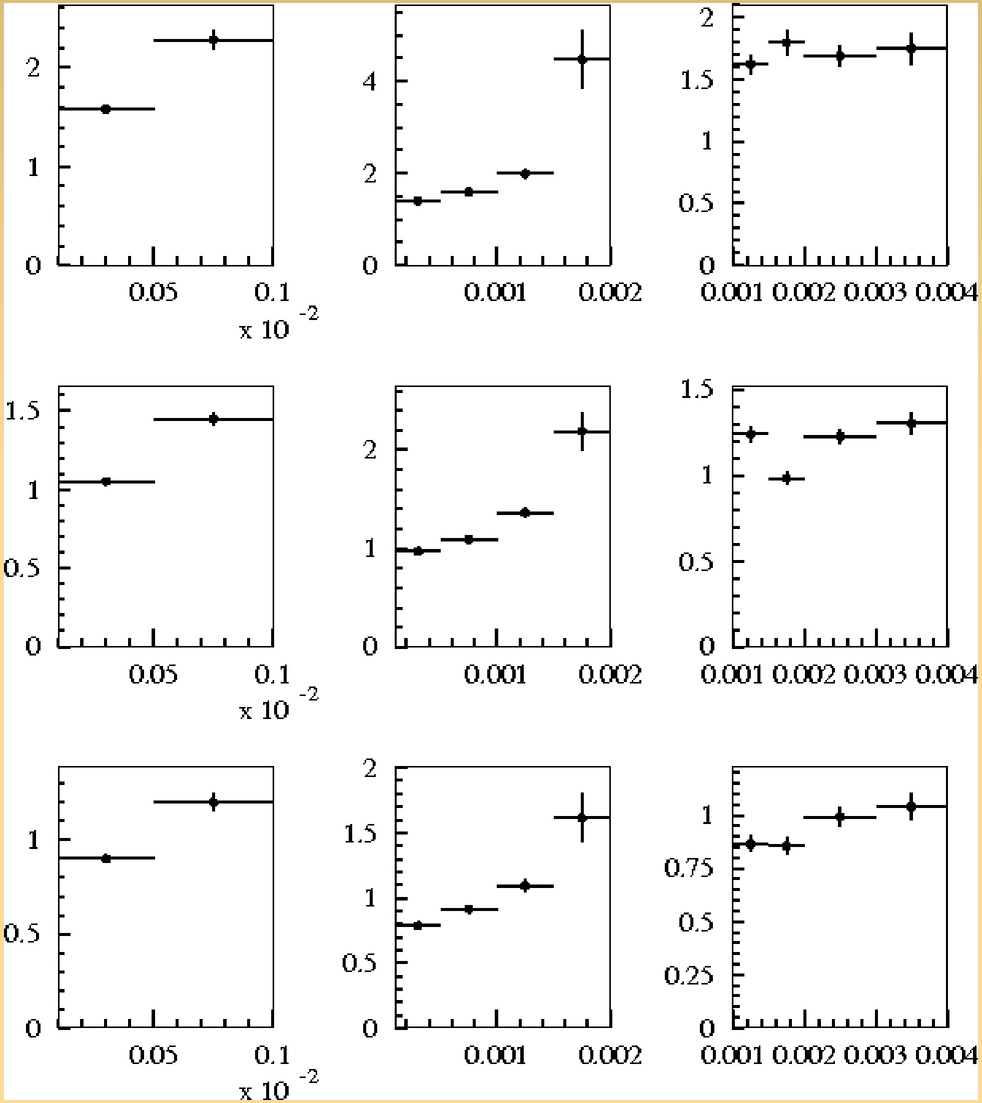
0.1
0.15
0.2
0.25
0.3
0.35
0.4
x 10 -2
X Bj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1.5
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x 10 -2
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0.001 0.002 0.003 0.004
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0.05
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x 10 -2
2
1.5
1
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0.001
0.002
1
0.75
0.5
0.25
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0.001 0.002 0.003 0.004