Jet–Gap–Jet Production at the LHC

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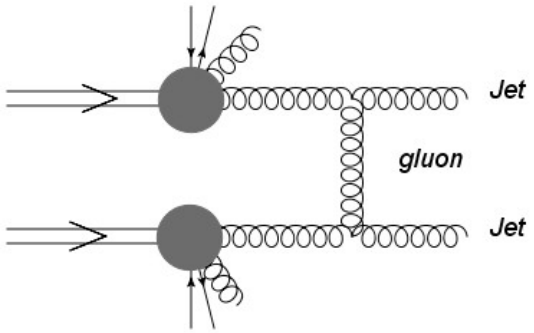
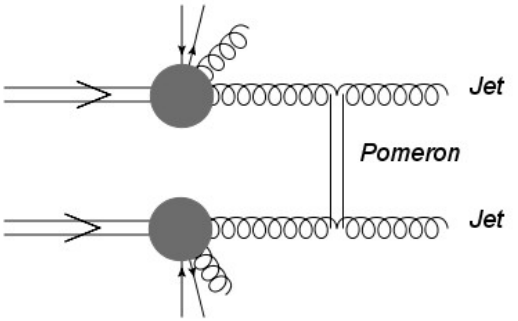
IFJ PAN

Jet Production at the LHC

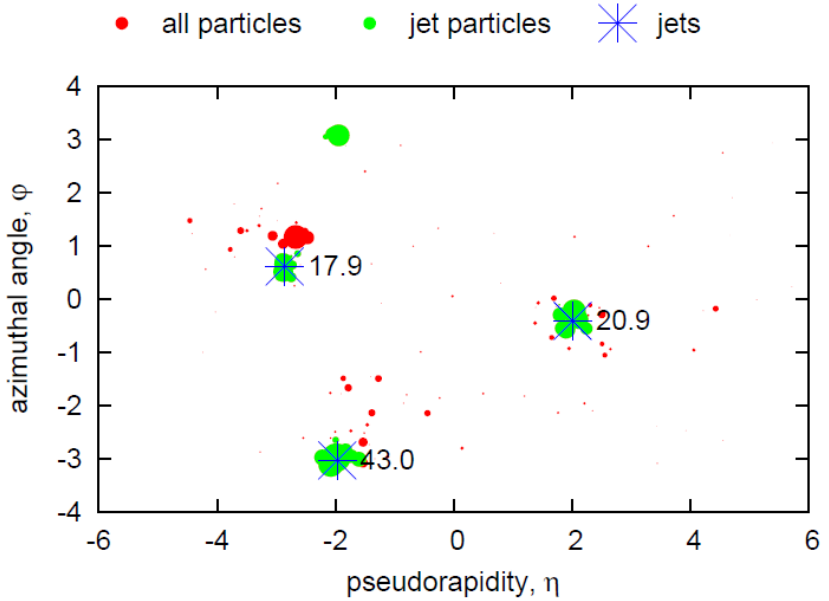
Non-Diffractive (ND) Jet production



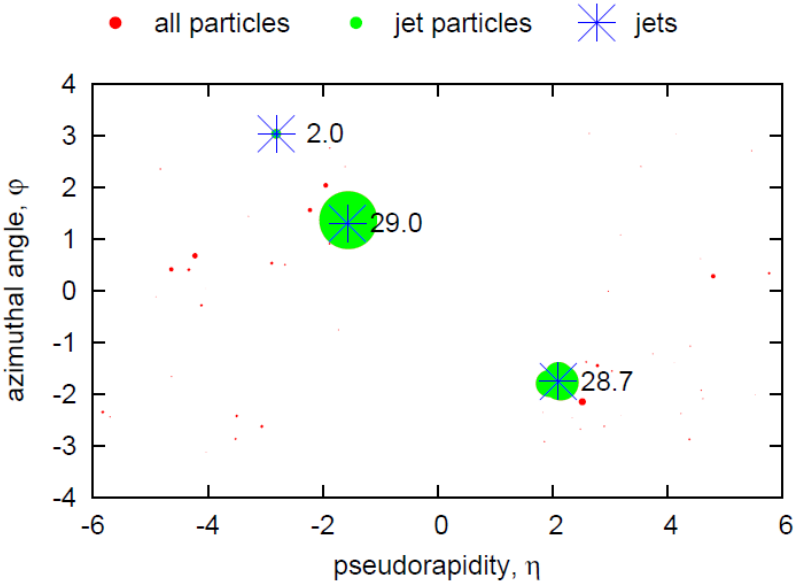
Jet-Gap-Jet (JGJ) production



2 jets, remaining particles are produced in all η−ϕ range



2 jets, there are no particles between jets in η



Jet-Gap-Jet Production - Phenomenology

Gaps between jets at hadron colliders in the next-to-leading BFKL framework

F. Chevallier,[1,*] O. Kepka,[1,2,3,†] C. Marquet,[4,5,‡] and C. Royon[1,§]

Phys.Rev.D79:094019,2009

Gaps between jets in hadronic collisions

O. Kepka,[1,2,*] C. Marquet,[3,†] and C. Royon[4,‡]

Phys.Rev.D83:034036,2011

Gaps between jets in double-Pomeron-exchange processes at the LHC

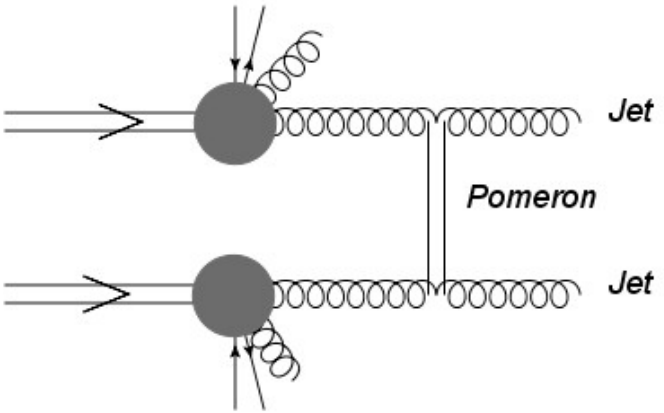
C. Marquet,[1,2,*] C. Royon,[3,†] M. Trzebiński,[4,‡] and R. Žlebčík[5,§]

arXiv:1212.2059

Jet-Gap-Jet Production

Cross section of dijets production:

$$\frac{d\sigma^{pp\to XJJY}}{dx_1 dx_2 dp_T^2} = \mathcal{S} f_{eff}(x_1, p_T^2) f_{eff}(x_2, p_T^2) \frac{d\sigma^{gg\to gg}}{dp_T^2},$$



where:

S – gap survival probability,

$f_{eff}(x, p_T^2)$ – effective parton distributions,

$\frac{d\sigma^{gg\to gg}}{dp_T^2} = \frac{1}{16\pi} \left|A(\Delta\eta, p_T^2)\right|^2$ – cross section for gg → gg distribution,

Scattering amplitude can be defined as:

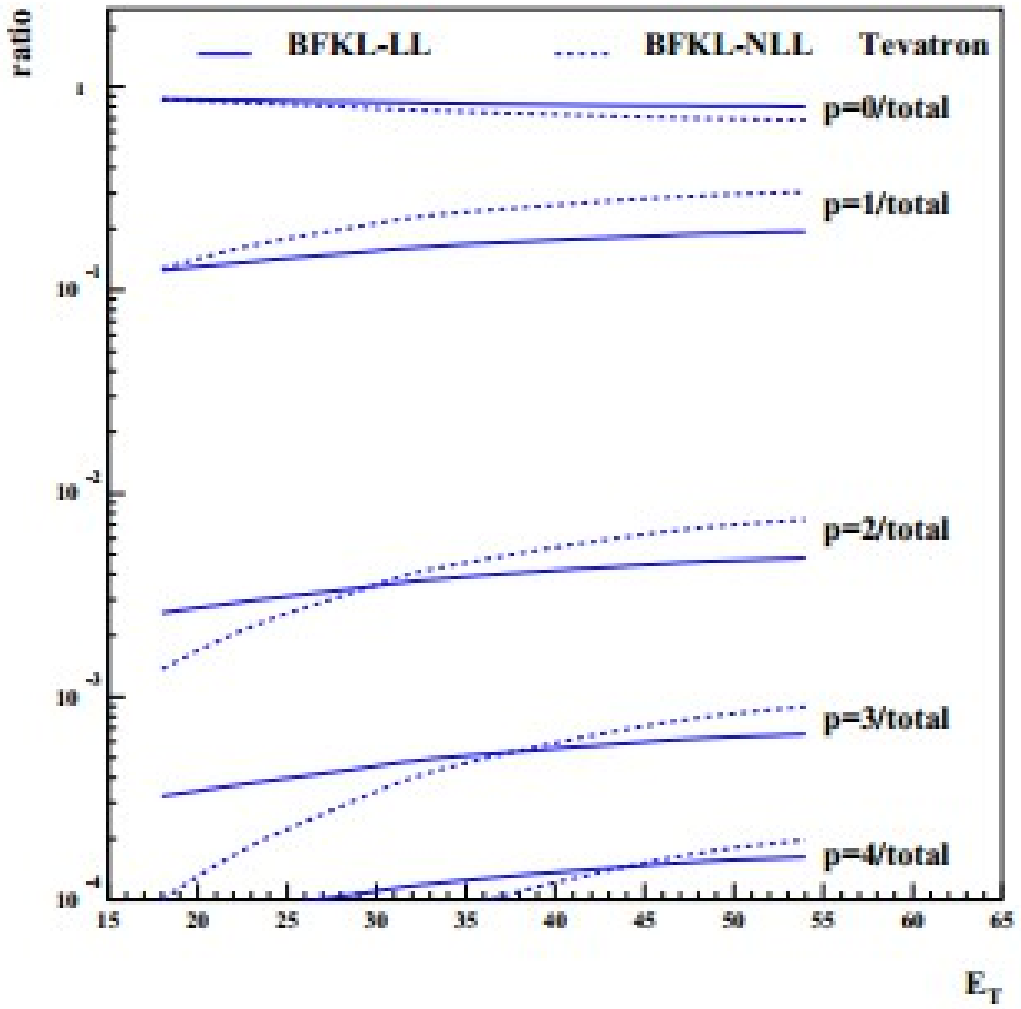
$$A(\Delta\eta, p_T^2) = \frac{16 N_c \pi \alpha_s^2}{C_F p_T^2} \sum_{p=-\infty}^{\infty} \int \frac{d\gamma}{2i\pi} \frac{[p^2 - (\gamma - 1/2)^2] \exp\left\{\bar{\alpha}(p_T^2)\chi_{eff}[2p, \gamma, \bar{\alpha}(p_T^2)]\Delta\eta\right\}}{[(\gamma - 1/2)^2 - (p - 1/2)^2][(\gamma - 1/2)^2 - (p + 1/2)^2]}$$

Sum over conformal spins

χ_{eff} - effective BFKL kernel

Conformal Spins

Contributions of each conformal spin to full amplitude for LL and NLL



Rapidity Gap

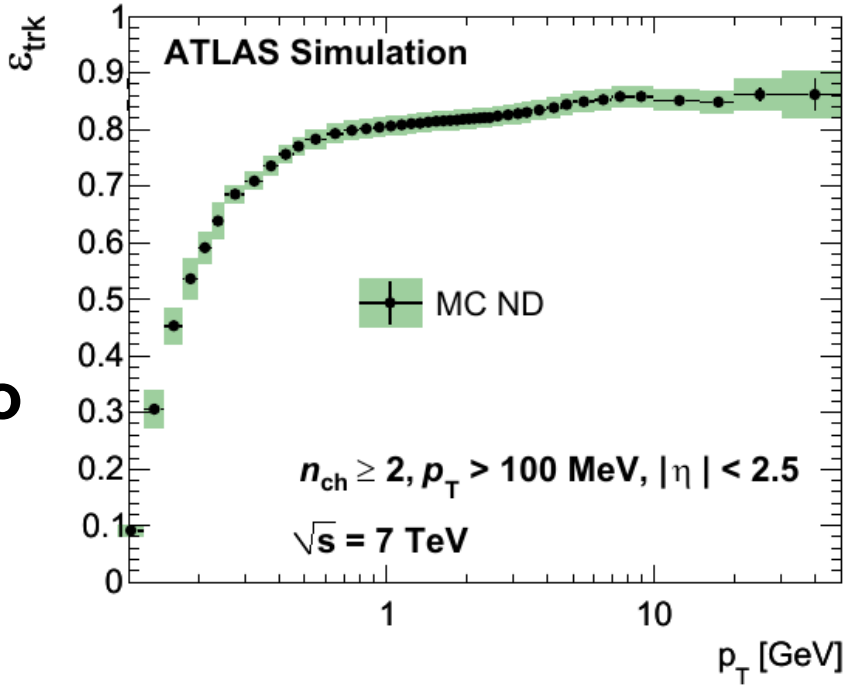
Theory: space in rapidity devoid of particles.
Experiment: space in rapidity devoid of reconstructed objects.

Assumptions

charged	
pT <100 MeV 100MeV<pT<500 MeV pT>500 MeV	P(reco)=0, P(reco)=0.5, P(reco)=0.85.

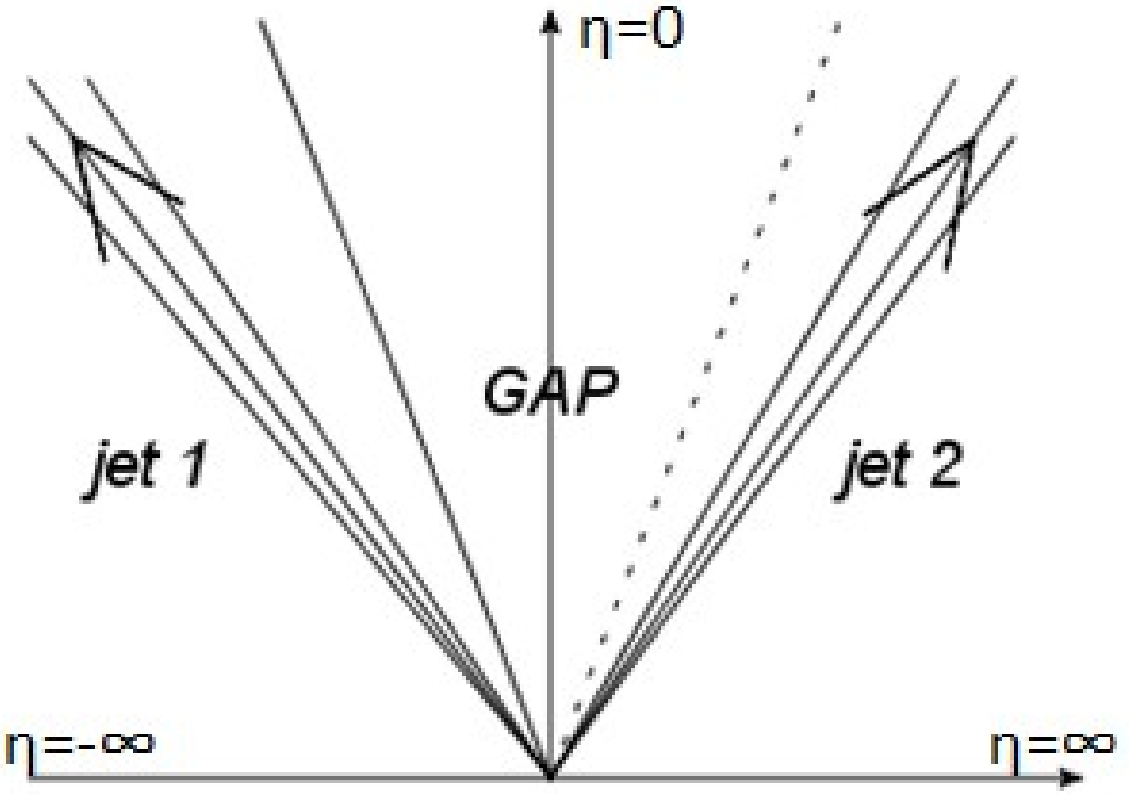
neutral
E>200MeV, E>500MeV, E>1000MeV.

Thresholds due to calorimeter noise



Event Selection

- minimum 2 reconstructed jets, with pT>20 GeV,
- $|\eta_{j1}|>1$ and $|\eta_{j2}|>1$,
- $\eta_{j1}*\eta_{j2}<0$.



Gap size definition: distance from η=0 to closest reconstructed object

Monte Carlo Generator

FPMC : a generator for forward physics

M. Boonekamp[a], A. Dechambre[a], V. Juranek[b], O. Kepka[b], M. Rangel[c], C. Royon[a], R. Staszewski[d]

arXiv:1102.2531

FPMC – Forward Physics Monte Carlo:

- Based on Herwig MC generator,
- Standard JGJ process (LL, p=0) implemented in Herwig was modified in order to generate:

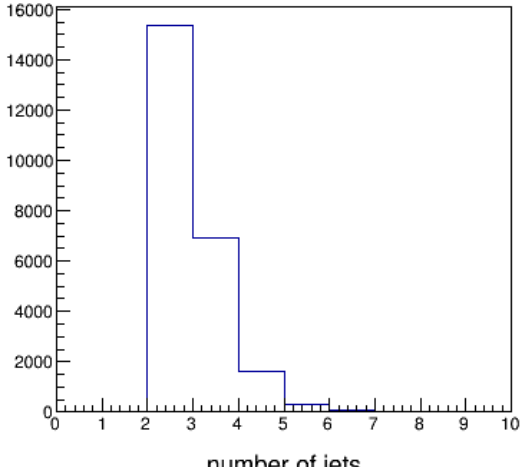
	LL	NLL
p=0	Mod1	Mod3
All p	Mod2	Mod4

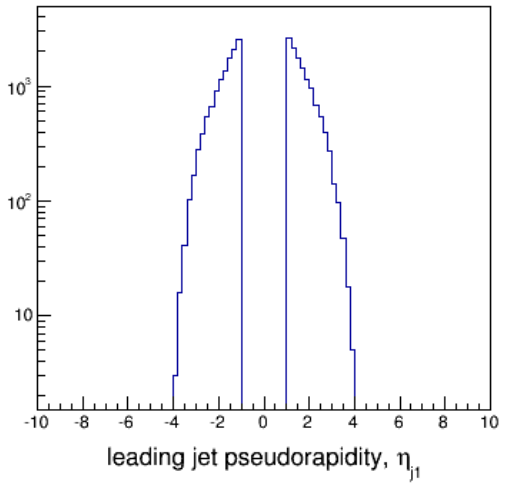
Implemented algorithm for the reconstruction of jets: CONE (R=0.7).

Properties of JGJ Production

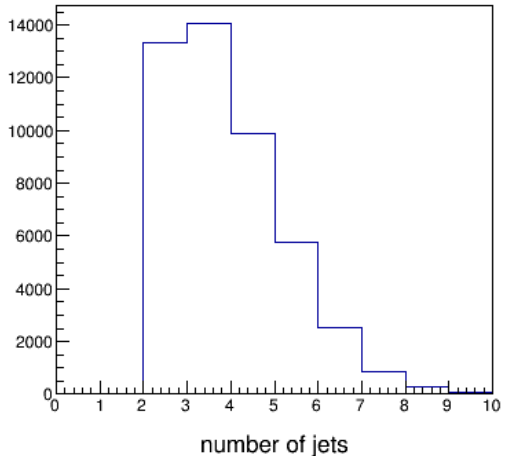
After selection

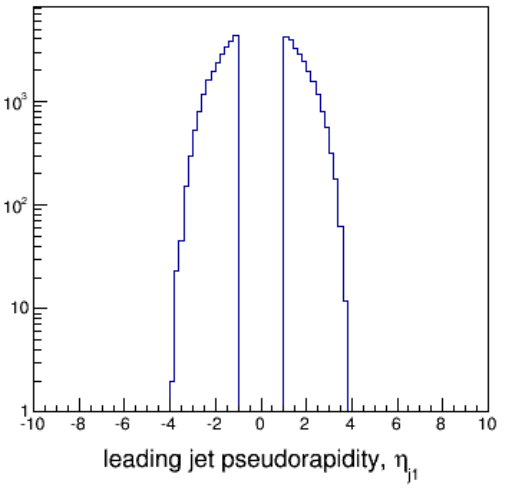
- Diffractive (JGJ)





- Non-Diffractive (ND)



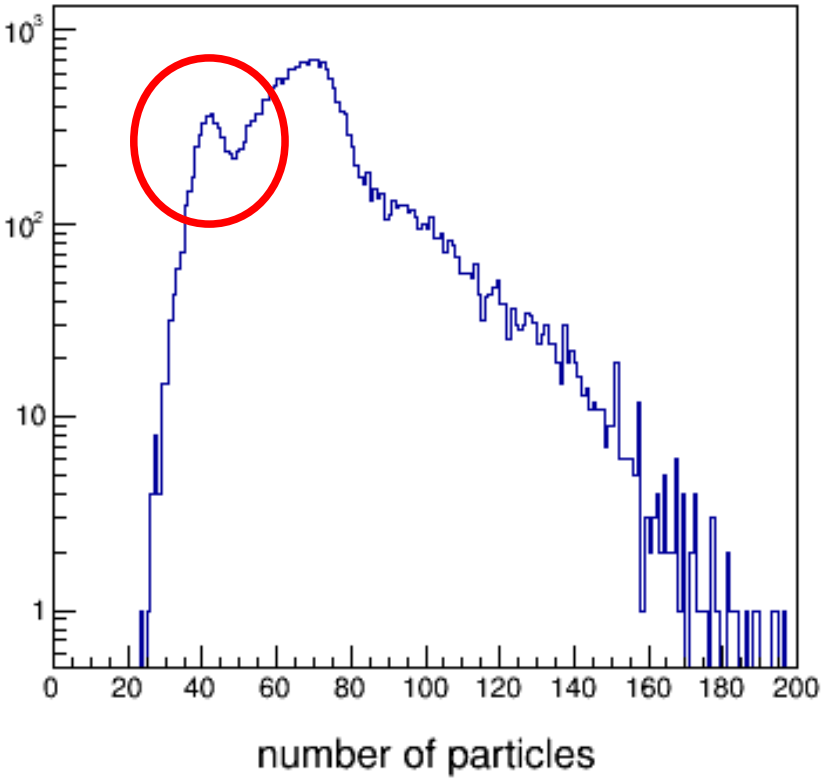


Jet reconstruction algorithm: CONE,R=0.7 (implemented in FPMC).

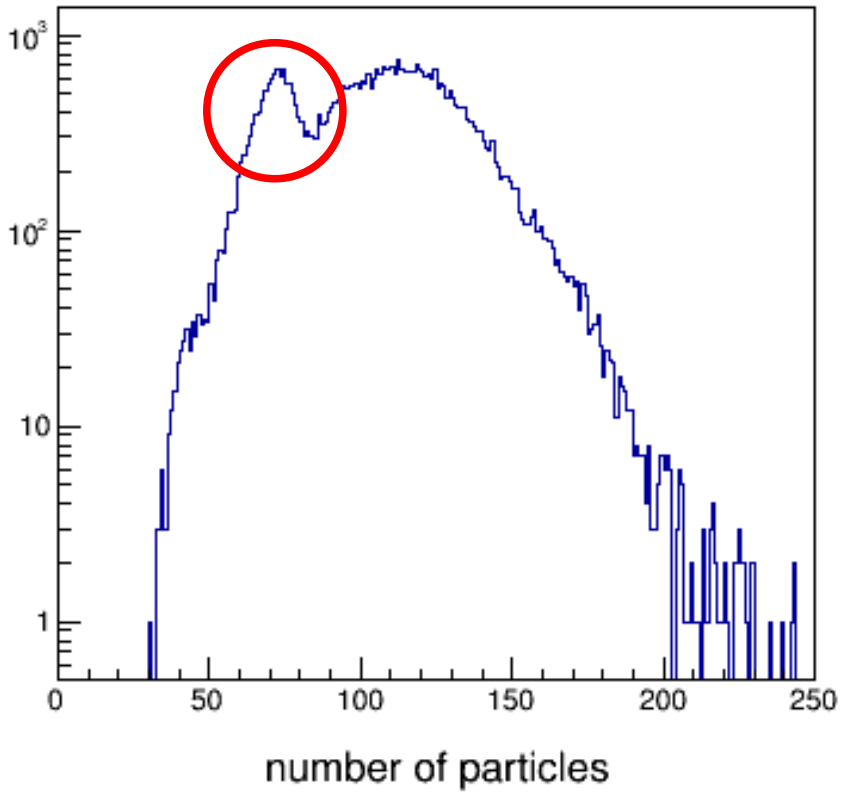
Properties of JGJ Production

After selection

- Diffractive (JGJ)



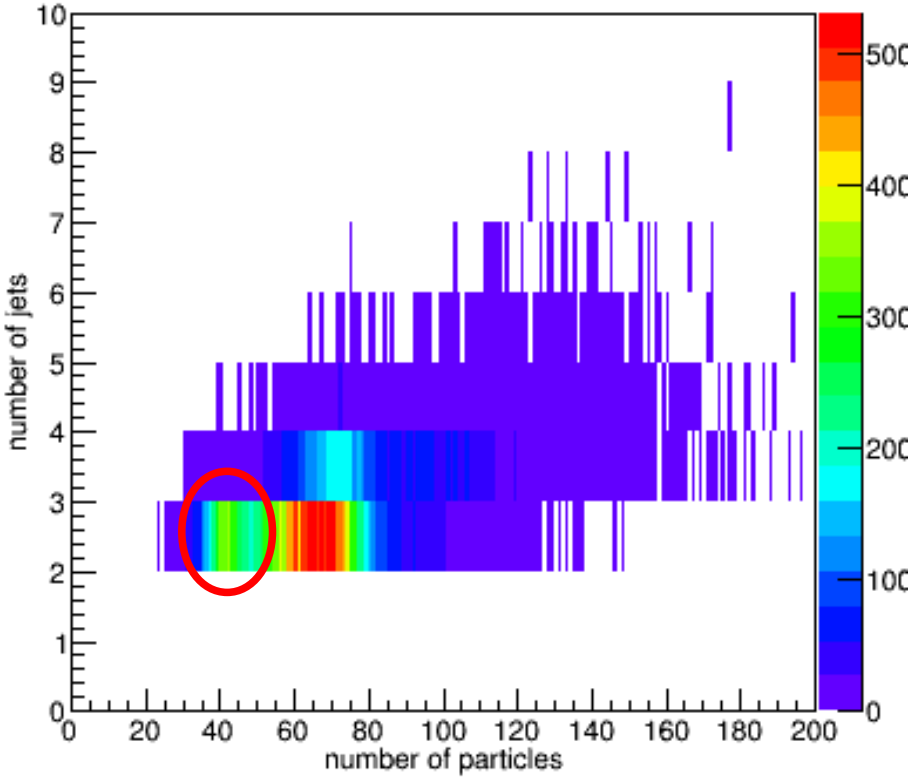
- Non-Diffractive (ND)



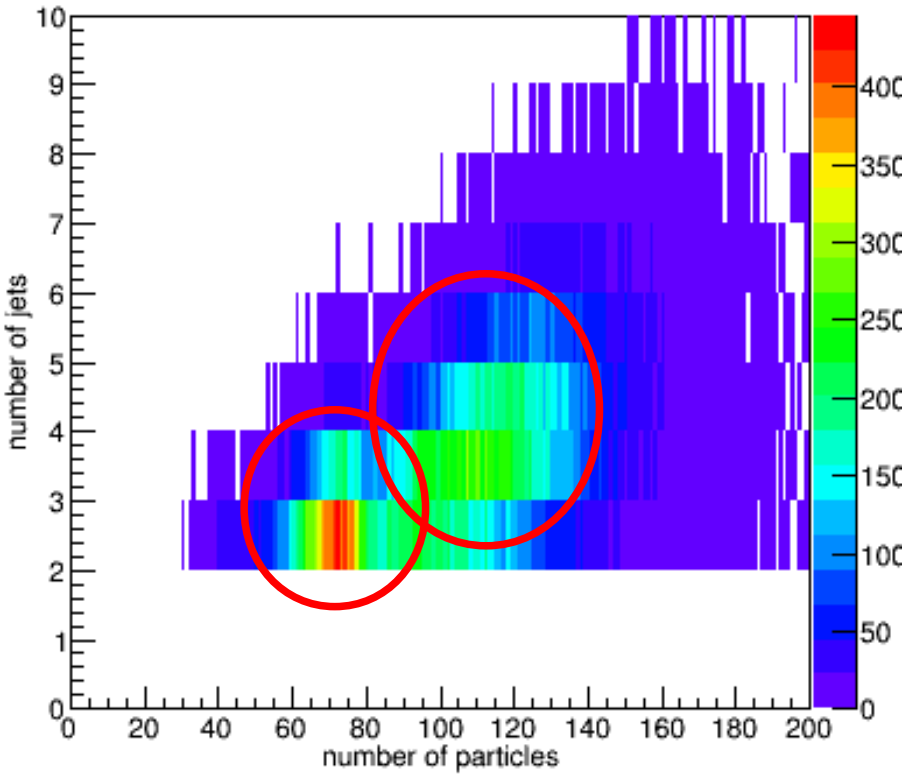
Jet reconstruction algorithm: CONE,R=0.7 (implemented in FPMC).
Strange double peak in the destribution fo number of particles

Hypotesis: 3rd Jet.

- JGJ - CONE



- ND - CONE



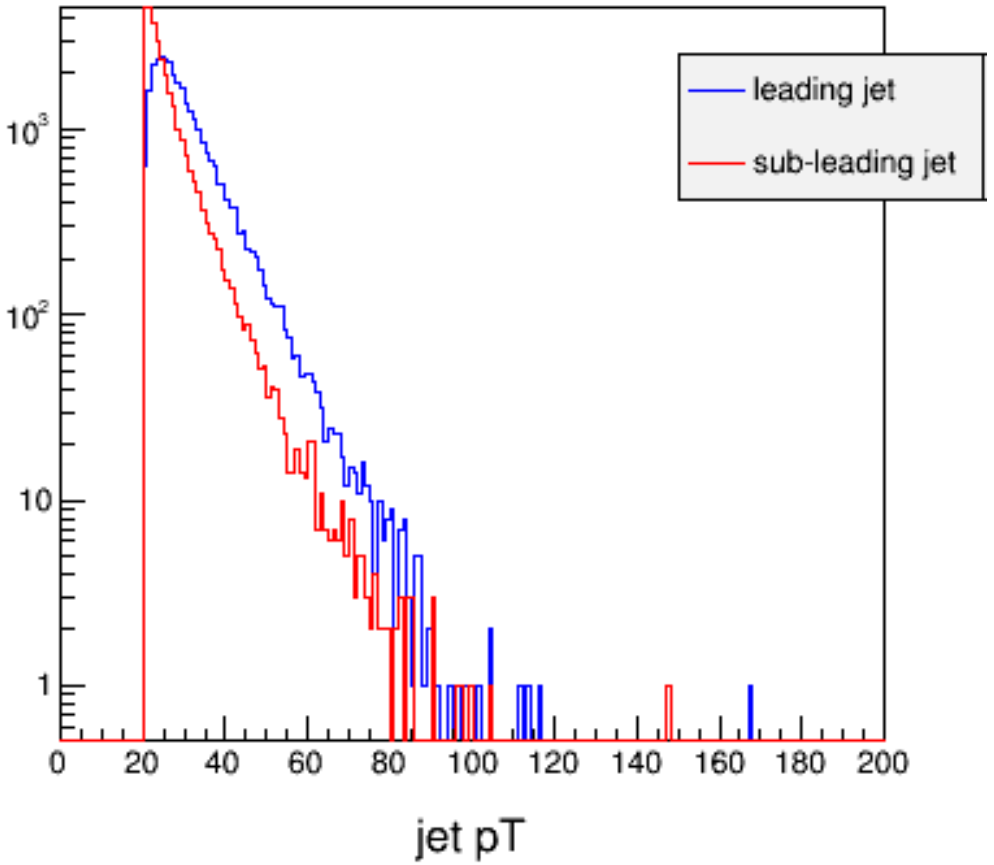
In the case of non-diffractive production the structure can be explained by the presence of the third (Fourth, etc.) jet.
This is not true in JGJ case.

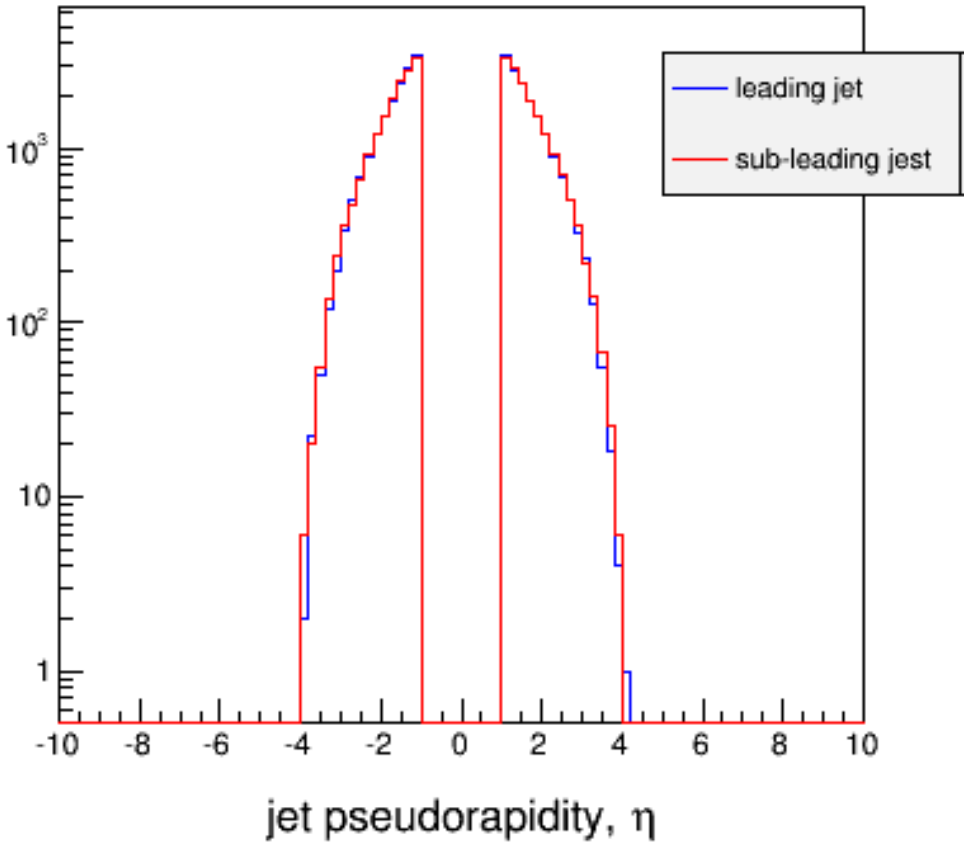
AntiKt Algorithm

FastJet user manual
(for version 3.0.1)

Matteo Cacciari,[1,2] Gavin P. Salam[3,4,1] and Gregory Soyez[5]

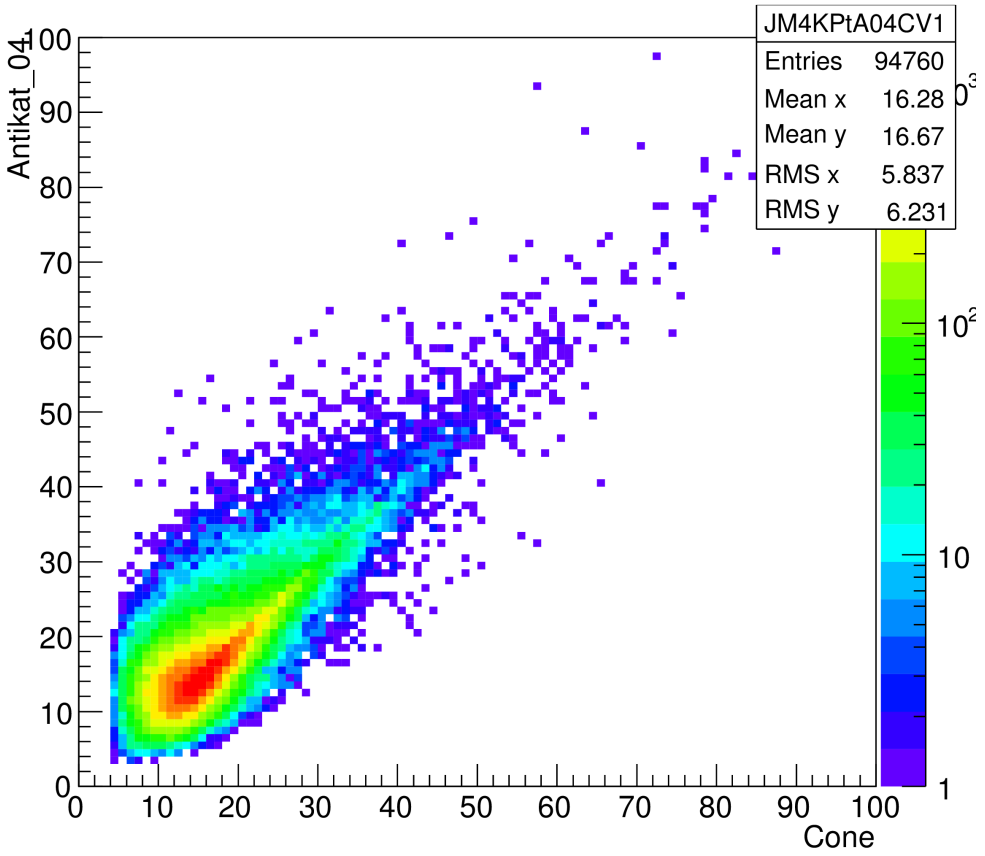
CERN-PH-TH/2011-297



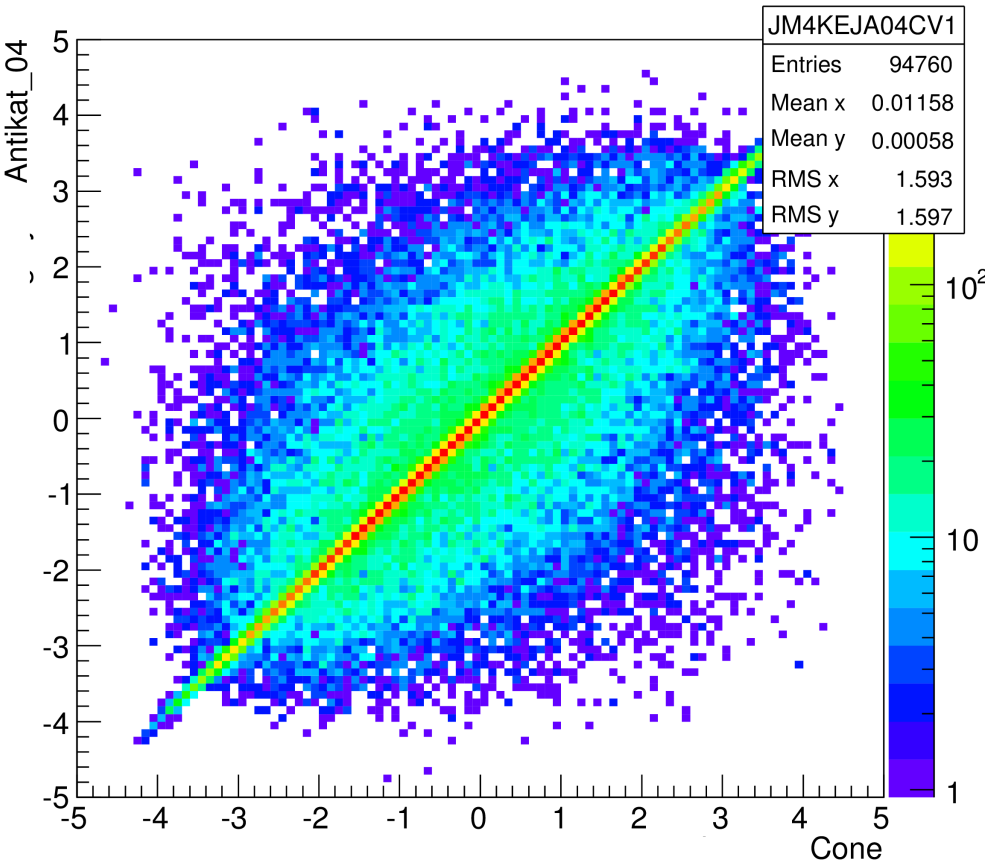


Jet Algorithms – Comparision

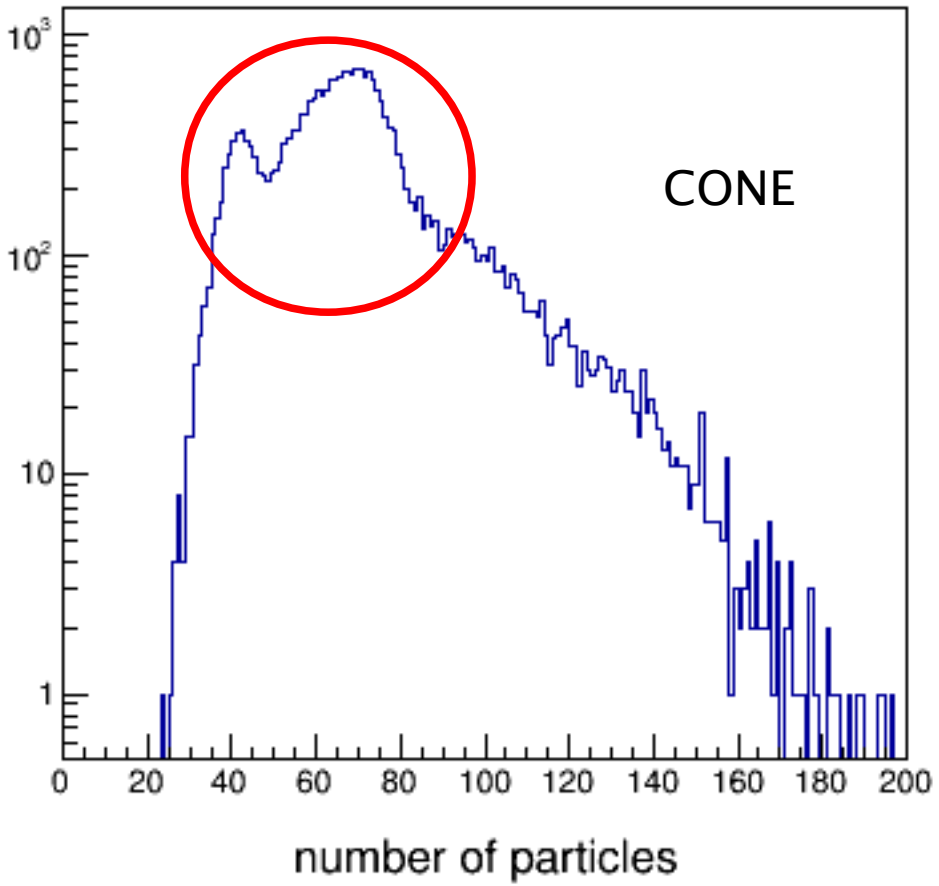
Comparision of pT of leading jet

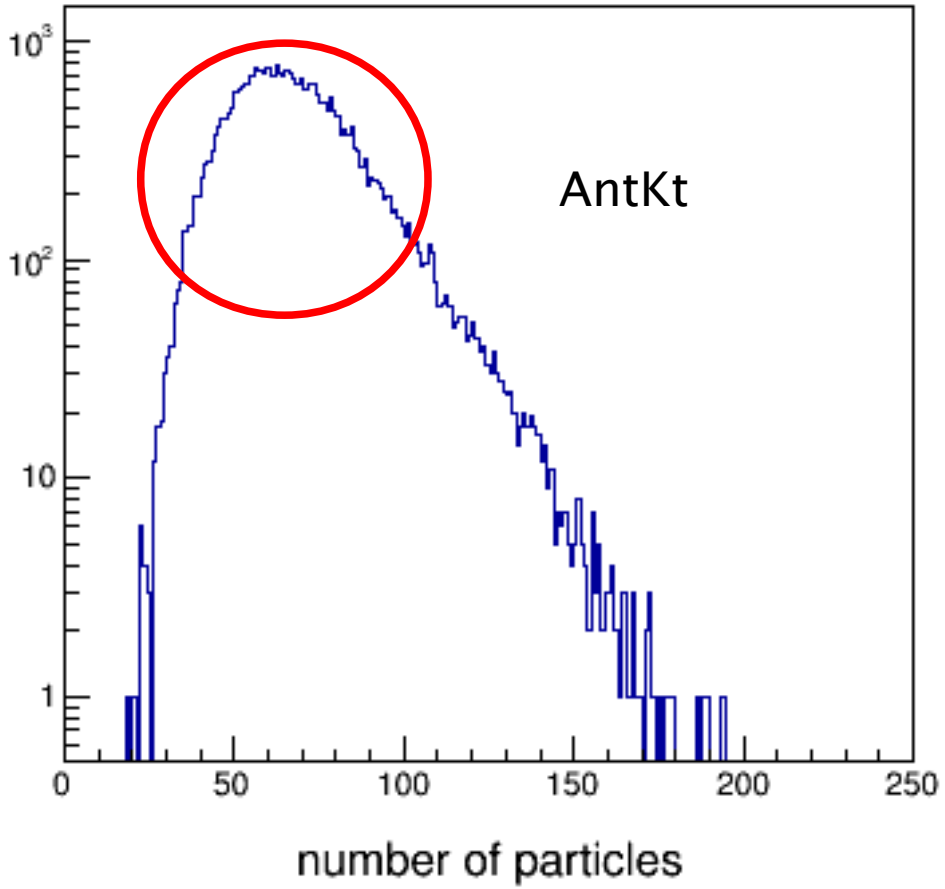


Comparision of η_{j1} of leading jet



AntiKt Algorithm

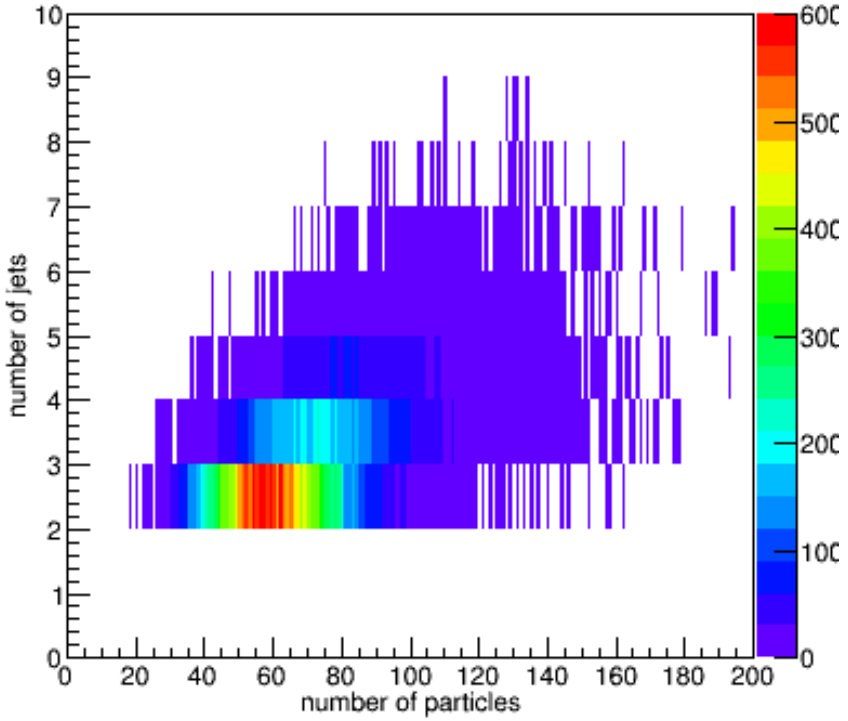


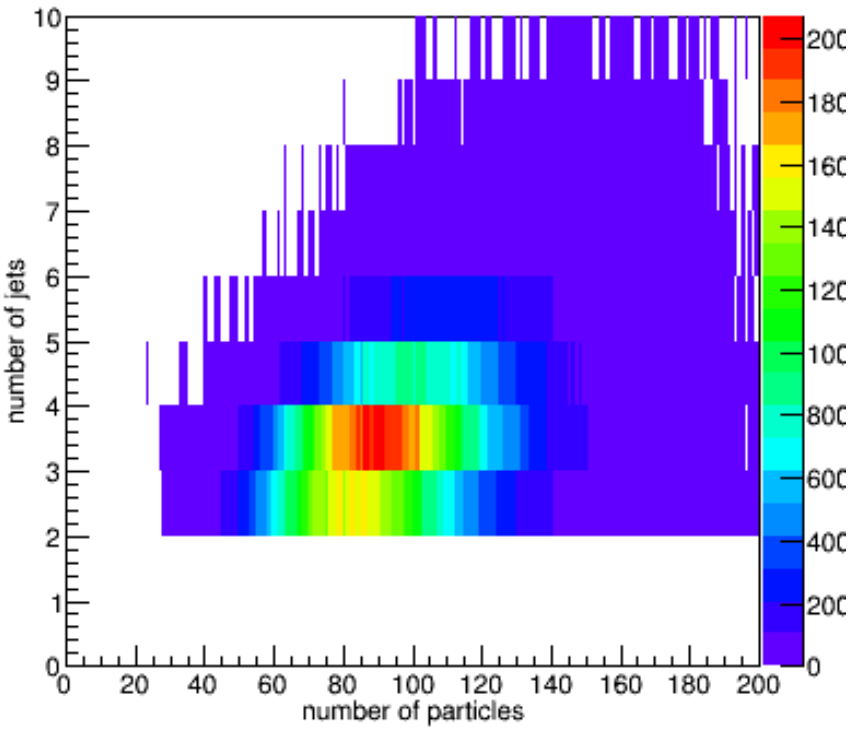


The strange double peak in structure disappears

AntiKt Algorithm: 3rd Jet

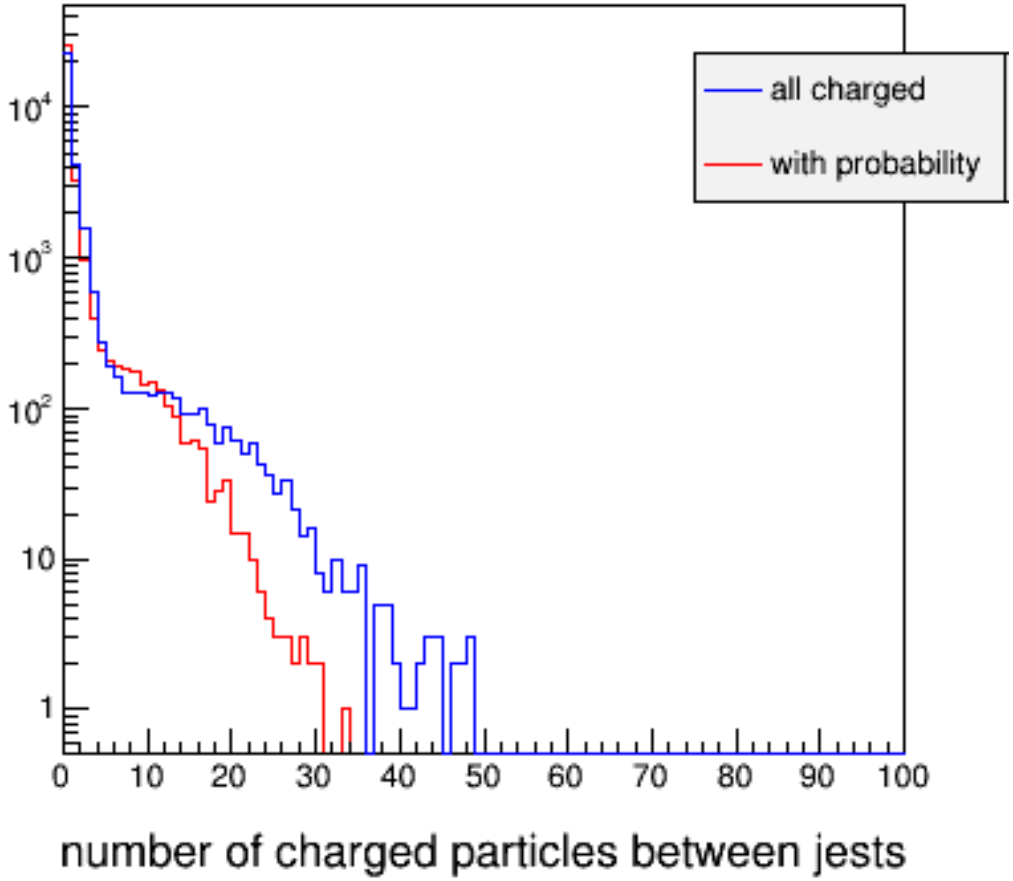
- AntiKt, JGJ Production
- AntiKt, ND Jet Production

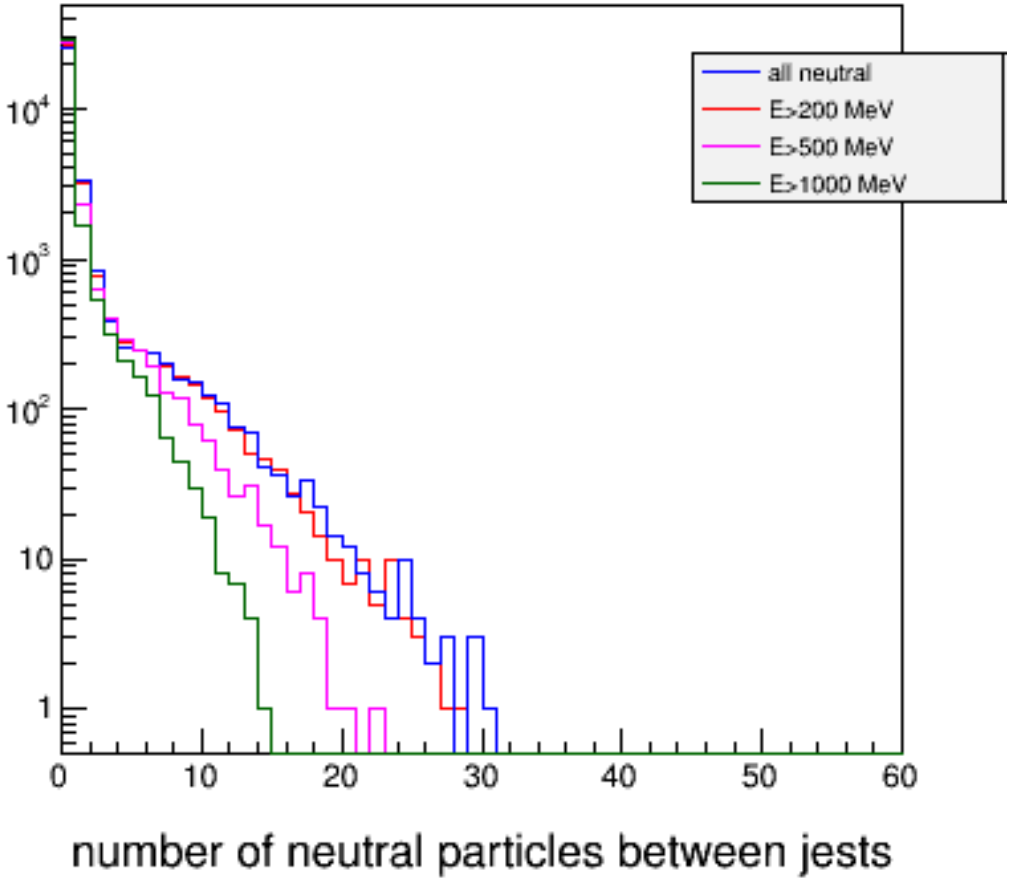




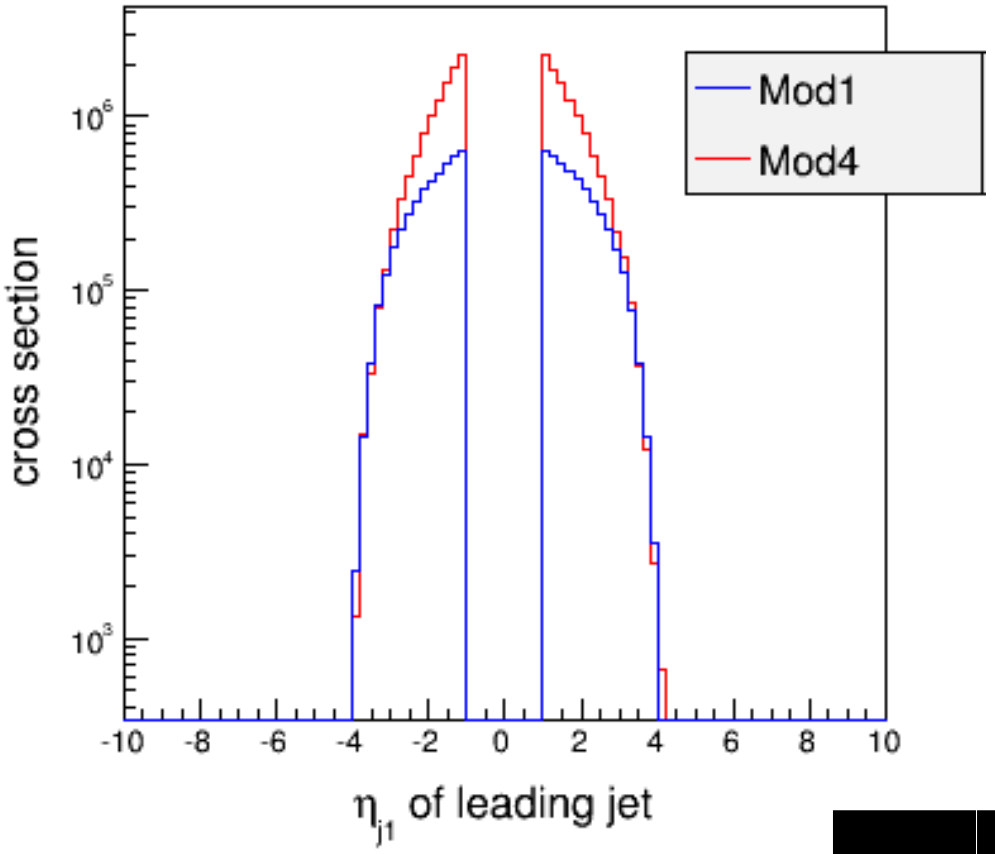
For the analysis AntiKt algorithm (R=0.4) will be used

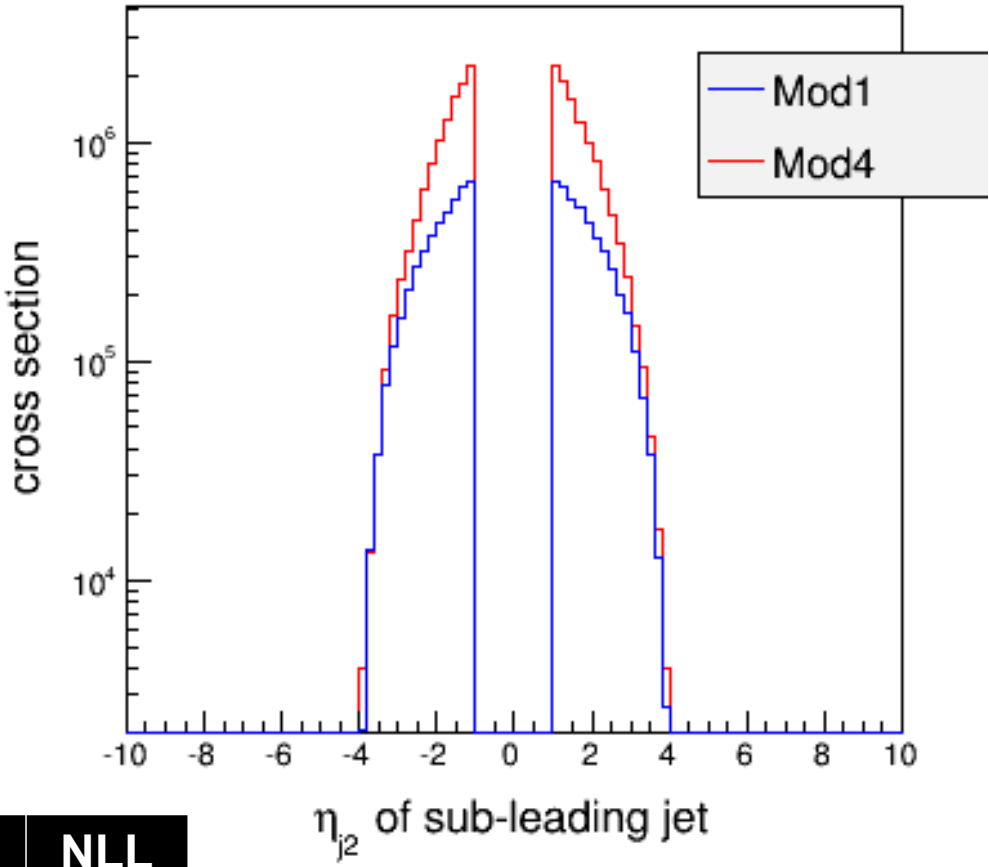
Properties of JGJ Production





Properties od JGJ Production



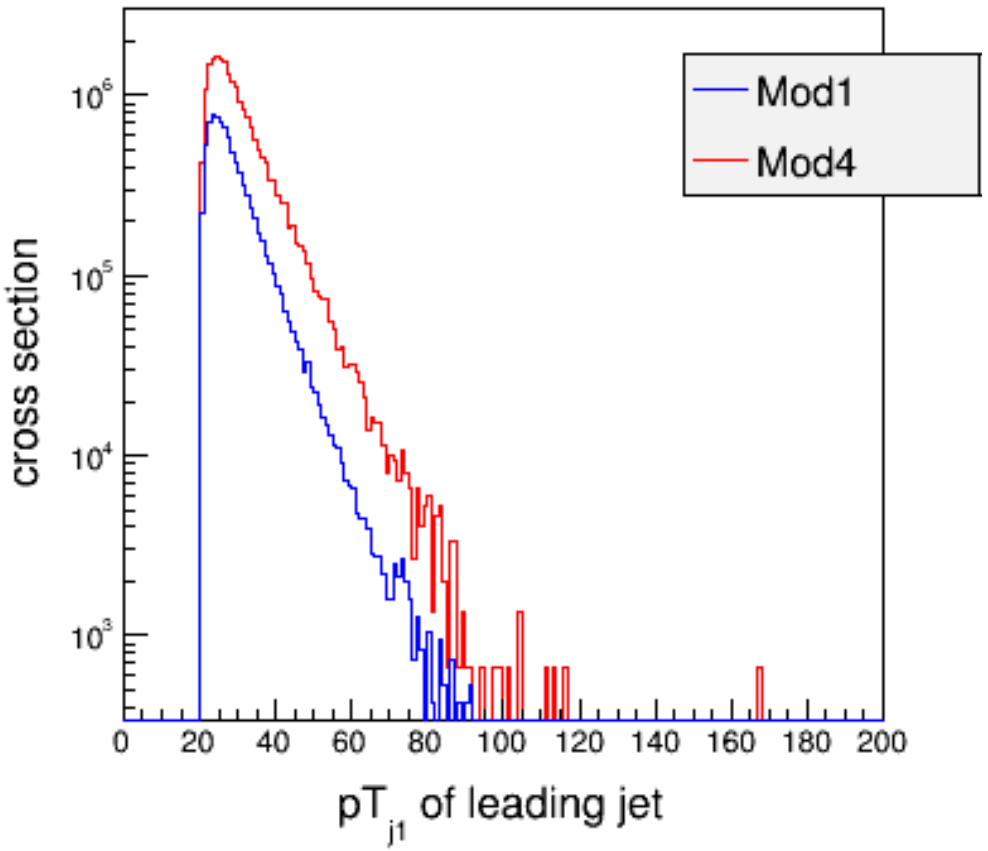


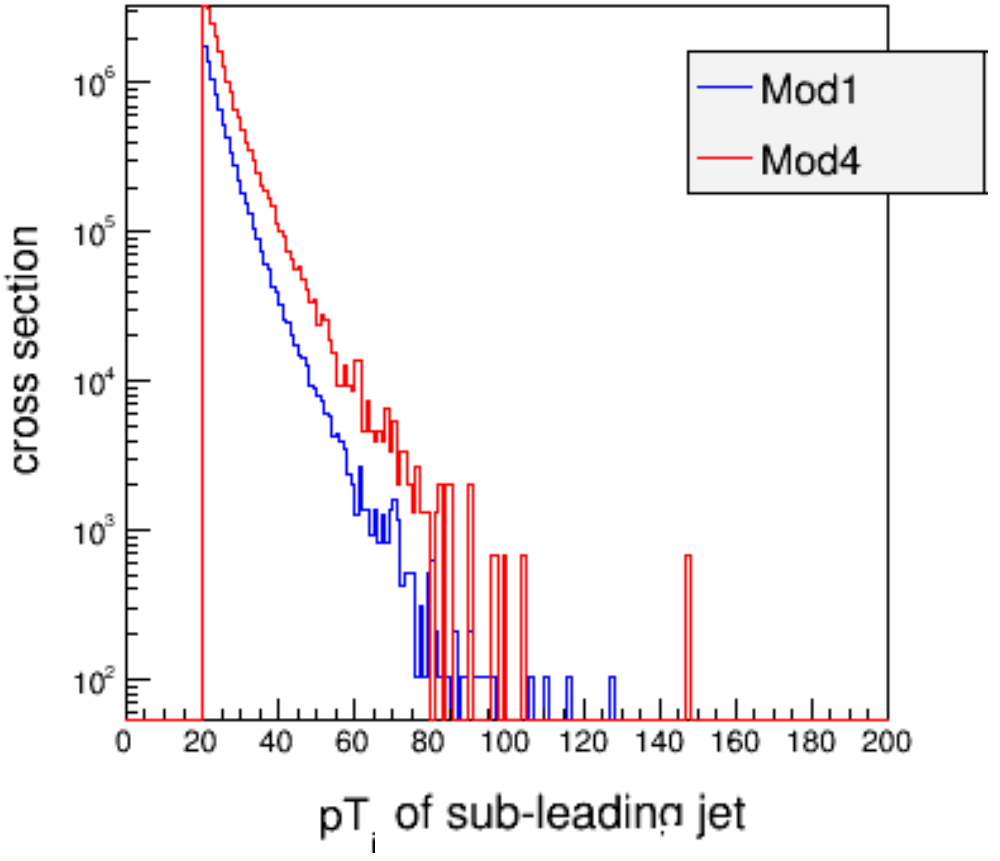
	LL	NLL
p=0	Mod1	Mod3
All p	Mod2	Mod4

Part of jets is in Tracker ($|\eta| < 2.4$) – important due to the reconstruction of the vertex detector.

All jets are produced in the calorimeters ($|\eta| < 4.9$)

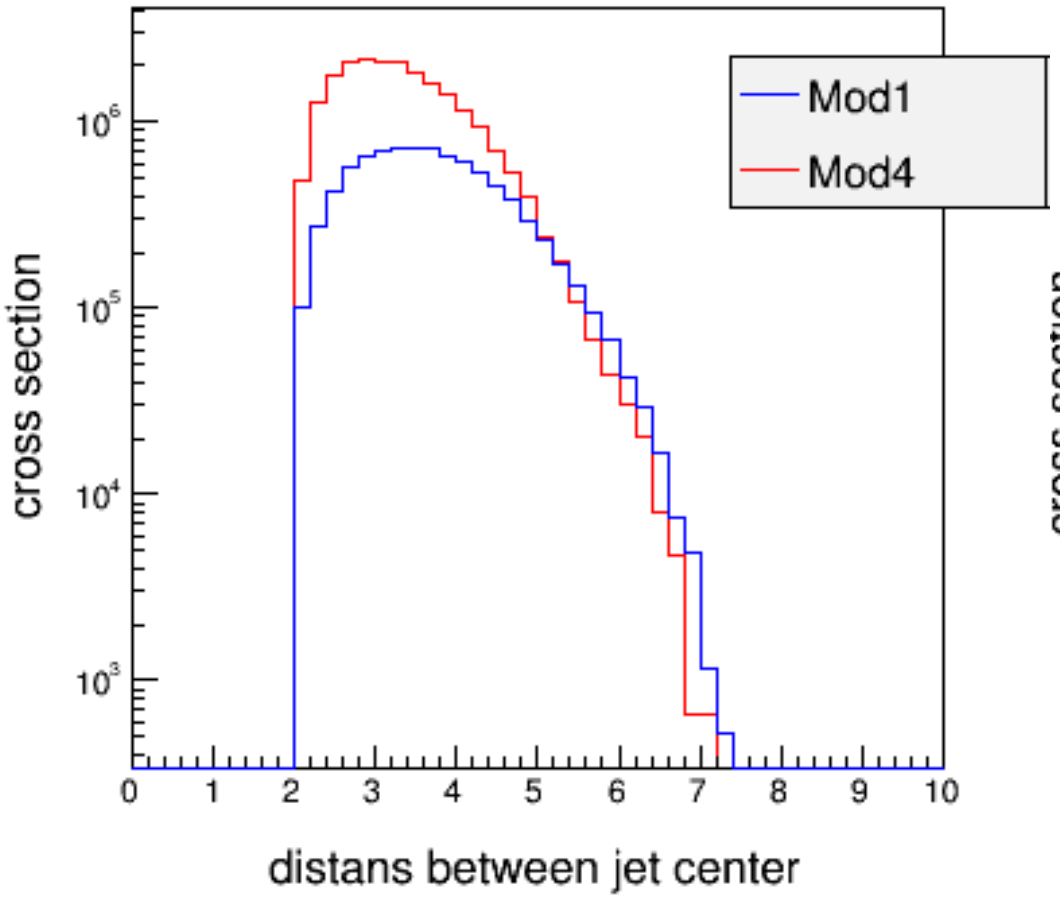
Properities od JGJ Production

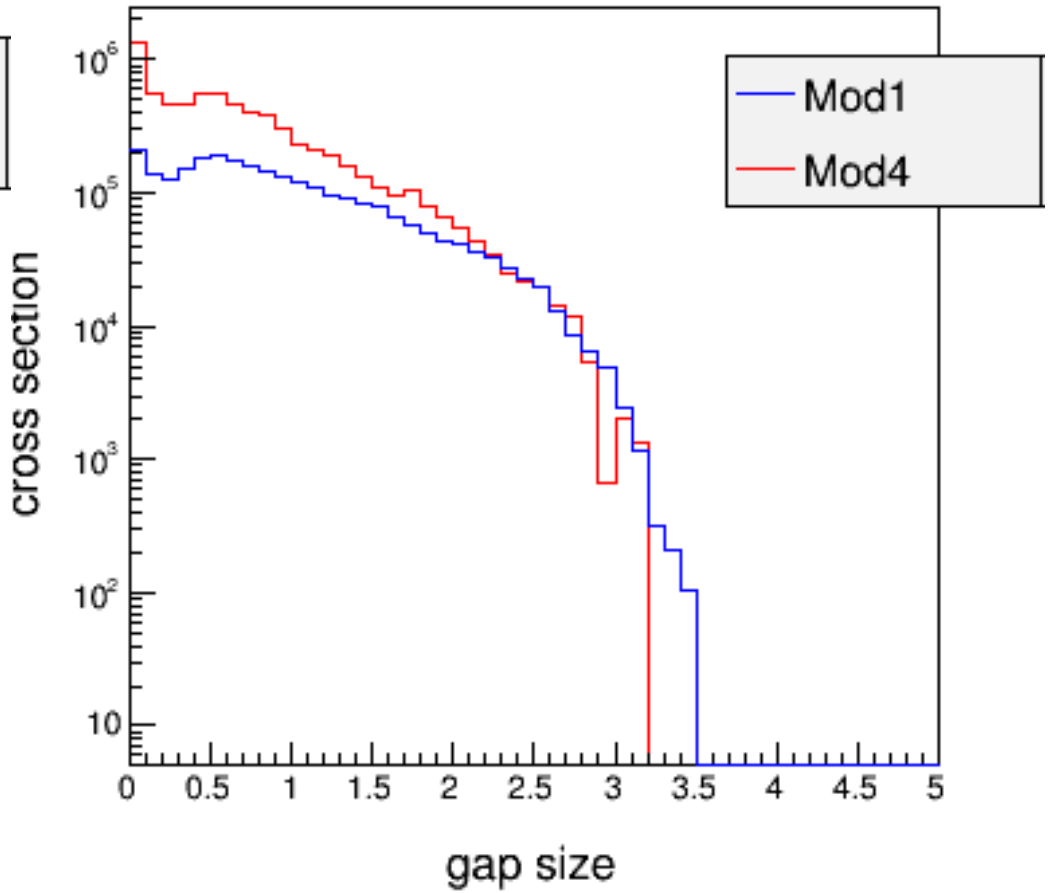




Generated samples:
10M events of MOD1 and MOD4 with pT > 20 GeV

Jet-Gap-Jet Production: Gap Size





Summary

- Getting familiar with JGJ production.
- Cone algorithm implemented in FPMC gives strange distribution after the JGJ selection.
- AntiKt seems reasonable → further investigation desirable.
- First look on properities of JGJ production in various MC models (MOD1, MOD4).
- Studies ongoing...

Thank you for your attention!