HYDJET muons

Sept 8th, 2010

https://twiki.cern.ch/twiki/bin/view/Main/HIMuons

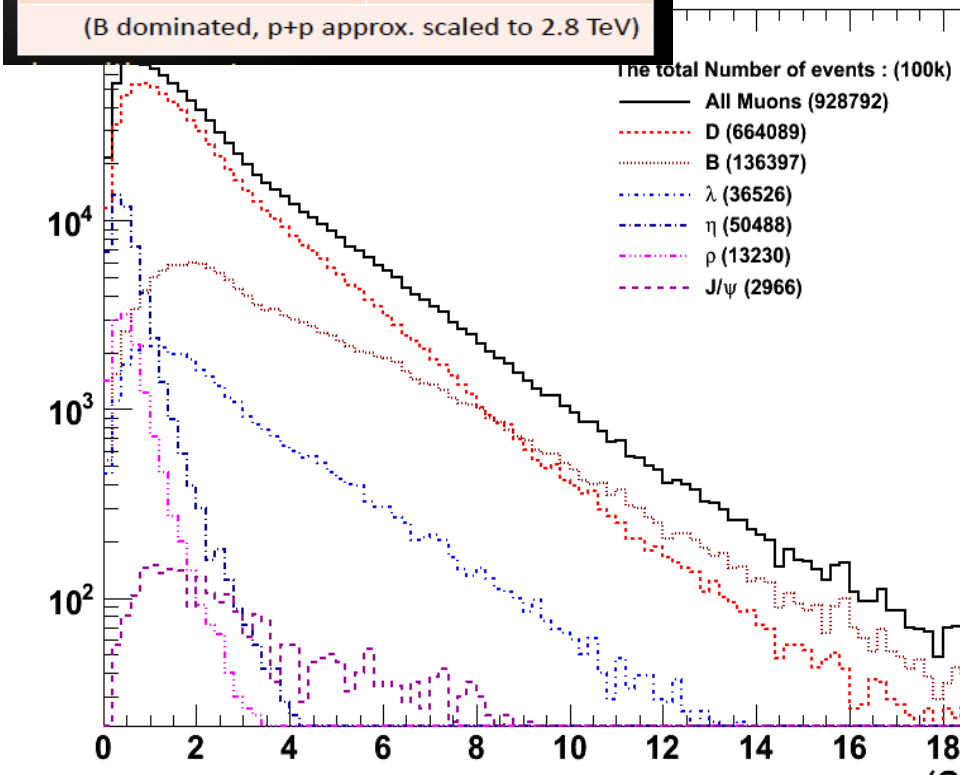
Starting discussion …

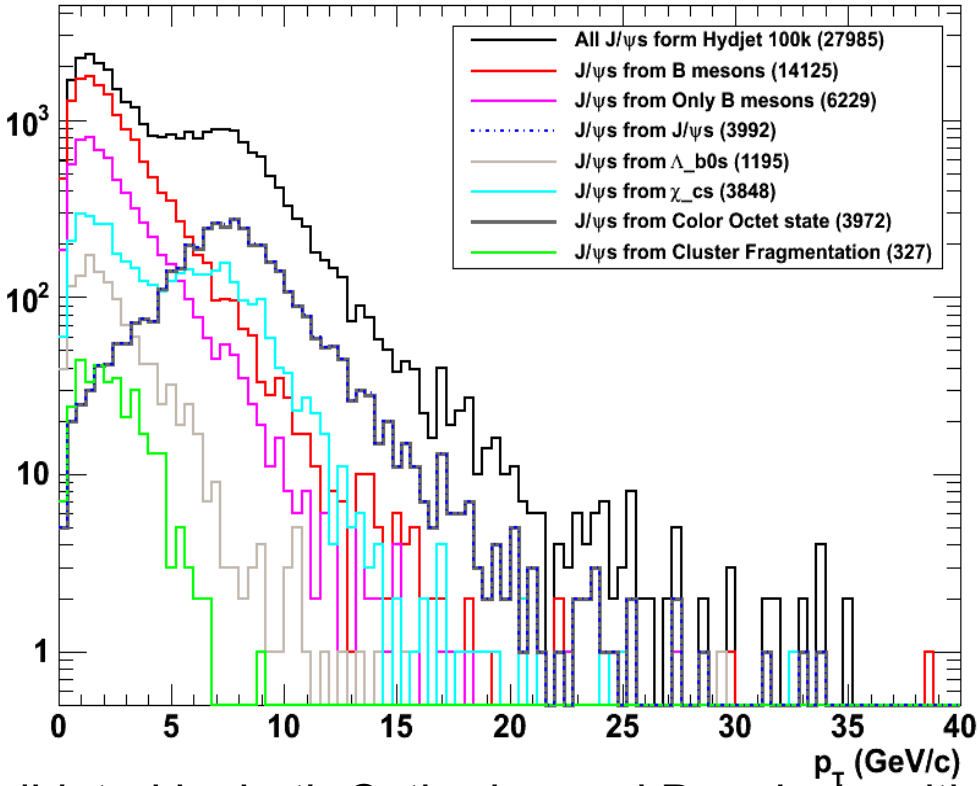
Reference	μ of p_T > 10 GeV/c
AN2009-126 (10 TeV sim)	14 Rec / N_{coll} kevts
MUO-10-002 (7 TeV data)	6 Glb / N_{coll} kevts
Hydjet, Nov. (4 TeV)	150 Gen / kevts
Hydjet, Today (2.8 TeV)	0.4 Gen / kevts
AMPT, July ex (2.8 TeV)	0.03 Gen / kevts
(B dominated, p+p approx. scaled to 2.8 TeV)	

?

Based on figs from here:
http://www.cms-kr.org/twiki/bin/view/HeavyIon/Hydjet_Study_2

Done during HYDJET comparison between CMSSW 22X and 31X





Jpsi plot (and implicitly the muon plot) was invalidated by both Catherine and Dongho(multiple counting): http://indico.cern.ch/conferenceDisplay.py?confId=61356

==> NO issue between HYDJET versions! (multiple checks done to confirm)

Muons excess in Dongho's plots

Fixed

http://indico.cern.ch/getFile.py/access?resId=0&materialId=minutes&confId=61356

```
Dileptons (15') Dong Ho Moon:
He does seem to see a kink at pt=5GeV but there was some question about weather the error bars are
correct. (Note in old software quarkonia and Z0 were artifically increased by a factor of 10).
Generally things look good but 3_1_10 produces a few more quarkonia.

Checking Dilepton rates: Catherine Silvestre
Branching ratios are in good aggreement with particle data book and rates are consistent between
2_2_x and 3_1_10_pre7.
```

Double counting

http://indico.cern.ch/conferenceDisplay.py?confId=58075

DongHo - Status of hydjet generation and embedding

==========

DongHo looked at 100k hydjet events to look for dilepton related observables, at the generator level.

S2. J/psi mothers exihit that low pt direct J/psi are missed, probably because of the initial pt cut in the hard part of hydjet.
Also, beware of the chain color octet -> J/psi -> J/psi + X, and don't double count the J/psi.
You need to check the grand mother to decide if it is primary. Camelia will send example code to Dong Ho.
S3. Check slide to know where J/psi come from. BTW : no psi'...
S4. J/psi branching ratio is ok (5.95 pm 0.01 % vs pdg 5.94 pm 0.06 %)
S5-6. Upsilon, same problem with pt cut.
S7. Low statistics, but branching ratio is not far off (1.2 pm 0.4 vs pdg 2.5 % for the muons, 2.9 pm 0.6 vs pdg 2.4% for the electrons)
S8. Couple of Z° to e+e- and mu+mu-.
!!!! Strange virtual Z° at m=20GeV/c2 !!!!
S9-10. B->J/psi. 396 in two muons, vs 1483 makes 26%, wich is not crazy (maybe the pt bias plays a similar role)
S11&13. Look at the overall dimuon spectrum. Clear background, clear J/psi.
S12. Low mass unlike / like signs, maybe some structure. Kaons do not go to dimuon, but rho and omega do...

HYDJET vs HYDJET

Hydjet, Nov. (4 TeV)	150 Gen / kevts
Hydjet, Today (2.8 TeV)	0.4 Gen / kevts

pt_mu>10GeV/c ?

→ influence of the settings that were different between the 2 samples: collisionalEnergyLoss, Quarkonia+Bosons in, and different pt_hat_cut

En(GeV) 2760	#ev with pt_hat>6GeV/c	#mu/ev	#mu/ev 1e-3 pt>10 Gev/c	#mu/ev 1e-3 pt>10GeV/c, |eta|<2.4
collEnLossFalse_mbJPhQBin	76000	.956 (72635)	0.29(22)	0.28(21)
collEnLossTrue_mbJPhQBin	71000	.948 (67342)	0.34(24)	0.31(22)
collEnLossFalse_mbJPhin	79000	.947 (74848)	0.33(26)	0.32(25)
collEnLossTrue_mbJPhin	70000	.950 (66501)	0.21(15)	0.2(14)

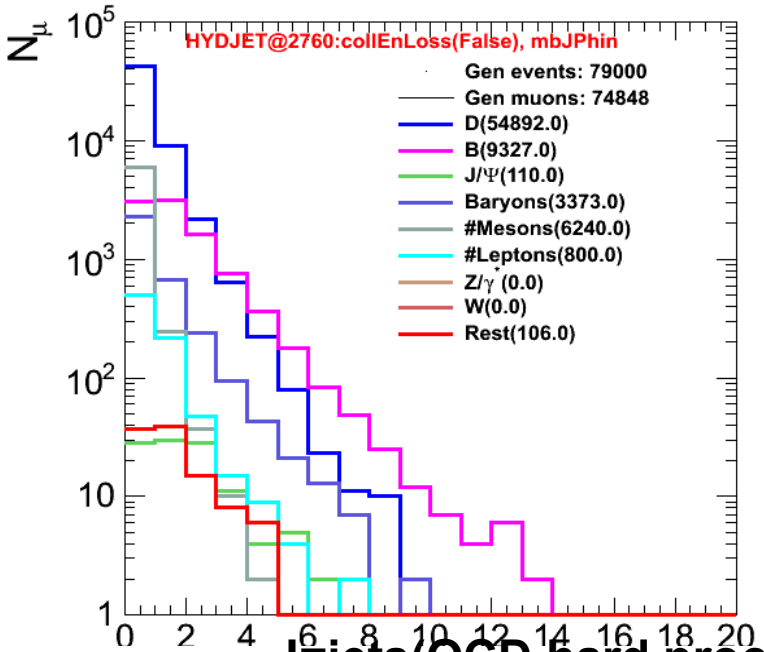
J=jets(QCD hard processes,Ph=photon jets, Q=quarqonia, B=Z/W

		col1 mu	col2 mu pt>10GeV/c |eta|<2.4
CollEnLoss (off-on)/off	JphQB (1-2)/1 Jph (3-4)/3	0.008 -0.003	-0.1 0.4
QB (in-out)/in	CollEnLoss False (1-3)/1 CollEnLoss True (2-4)/2	0.009 -0.002	-0.1 0.4

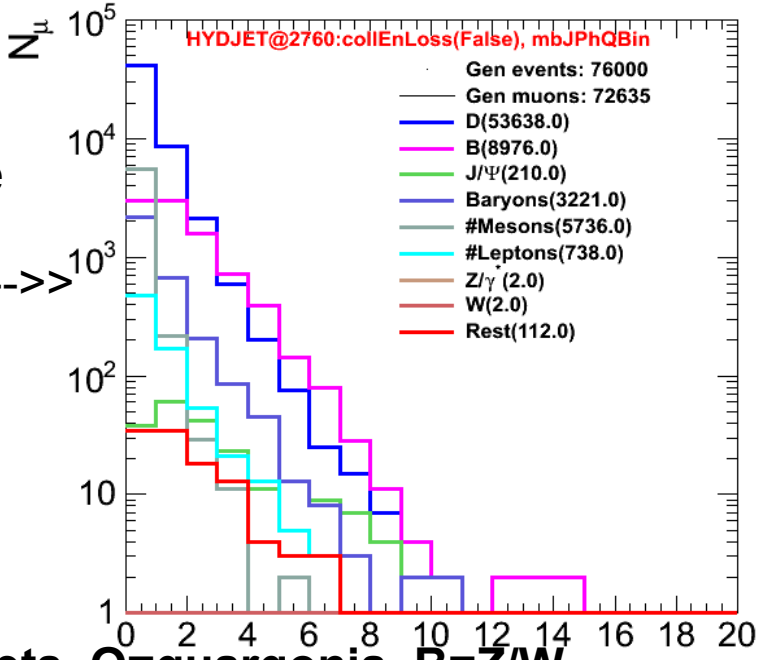
row1
row2
row3
row4

< 0.8-40% effects

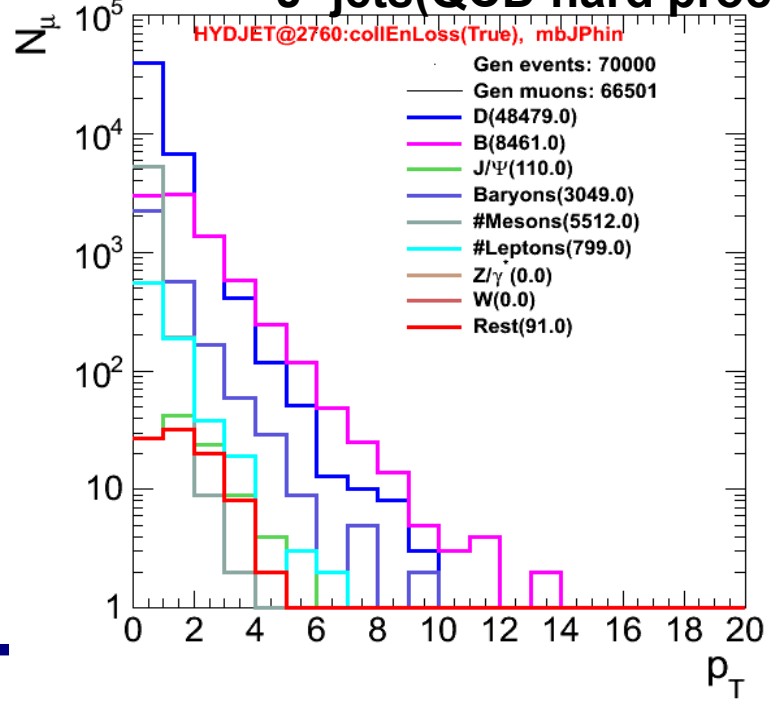
HYDJET vs HYDJET:



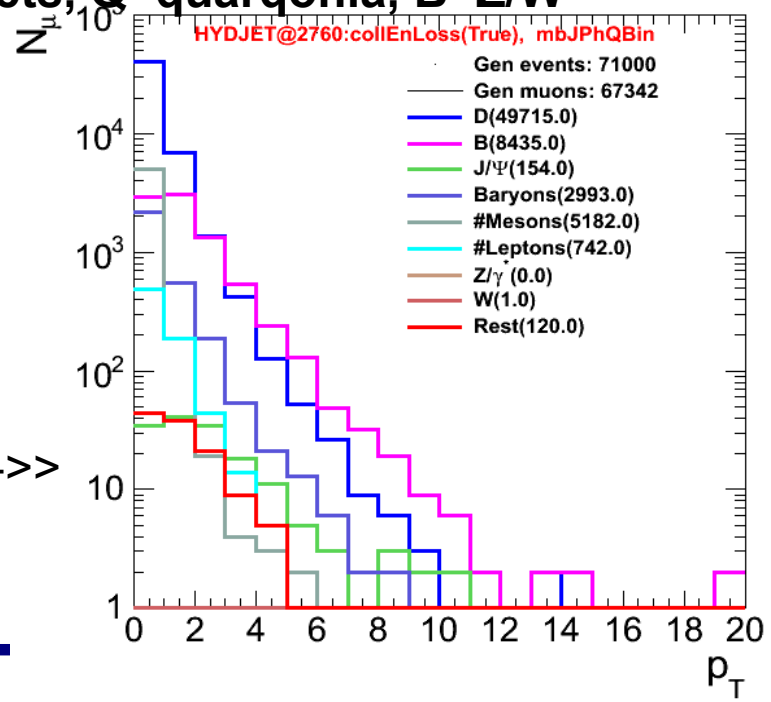
CollEnLoss = False
<<-- w/o QB
w/ QB -->>



J=jets(QCD hard processes,Ph=photon jets, Q=quarqonia, B=Z/W



CollEnLoss = True
<<-- w/o QB
w/ QB -->>



HYDJET vs HYDJET

Hydjet, Nov. (4 TeV)	150 Gen / kevts
Hydjet, Today (2.8 TeV)	0.4 Gen / kevts

pt_mu>10GeV/c ?

→ influence of the ptyhia settings, multiplicity, longitudinal_y

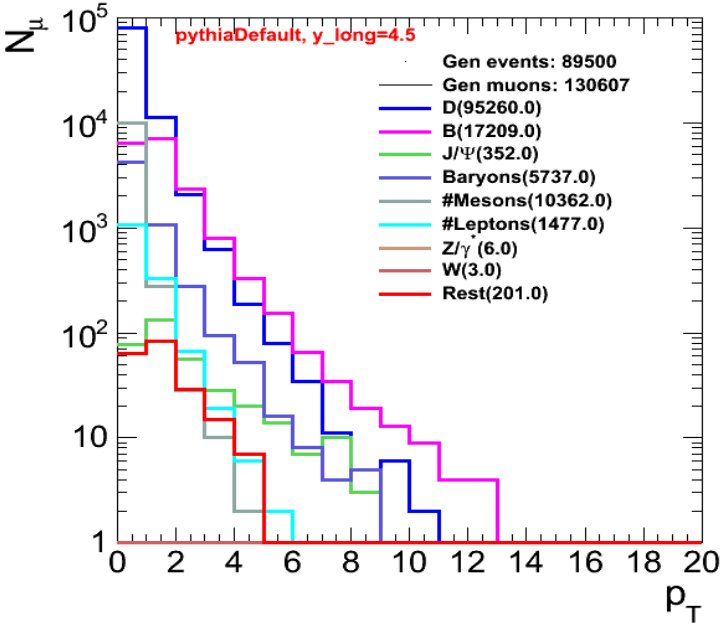
En(GeV) 4000	#ev with pt_hat>6GeV/c	#mu/ev	#mu/ev 1e-3 pt>10 Gev/c	#mu/ev 1e-3 pt>10GeV/c, |eta|<2.4
pythiaDefault_ylong3.75	92000	1.46 (134509)	0.37(34)	0.28(26)
pythiaDefault_ylong4.5	89500	1.46 (130607)	0.37(33)	0.27(24)
pythiaUEsettings_ylong3.75	87000	1.63 (141845)	0.7(61)	0.63(55)
pythiaUEsettings_ylong4.5	91500	1.63 (149423)	0.59(54)	0.52(48)

J=jets(QCD hard processes,Ph=photon jets, Q=quarqonia, B=Z/W

PYTHIA settings		mu	mu pt>10GeV/c |eta|<2.4
(UE-Default)/Default	y_long = 3.75 (3-1)/3 y_long=4.75 (4-2)/4	0.1 0.1	1.25 0.93

< 10-125% effects

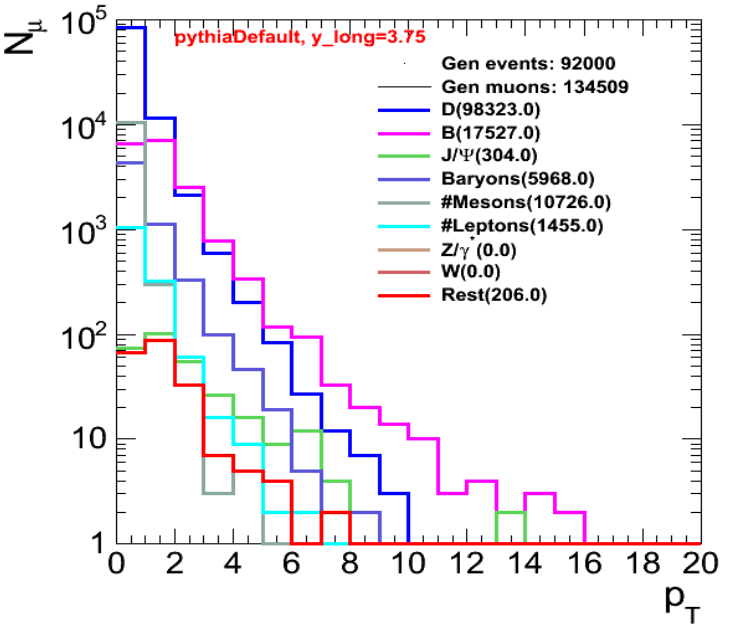
HYDJET vs HYDJET: pythia settings, y_long

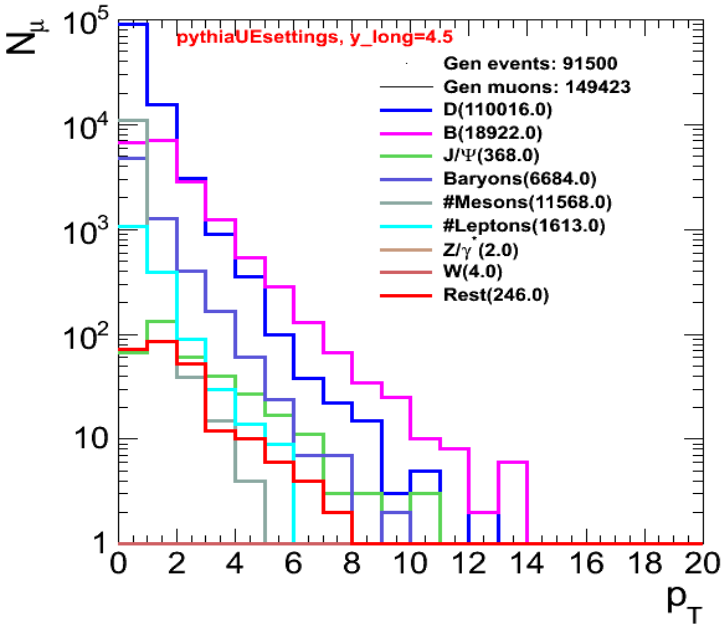


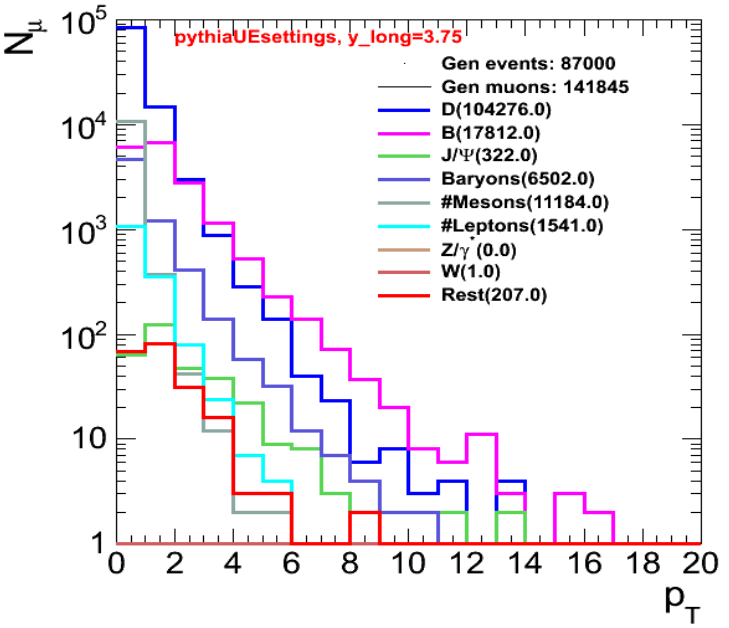
HYDJET@4TeV

<--- y_long --->

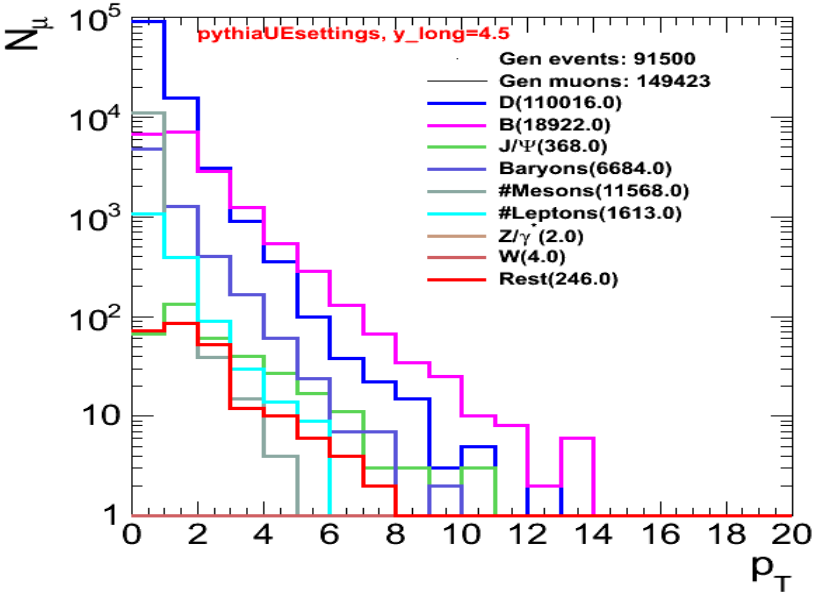
^
|
|
Pythia settings







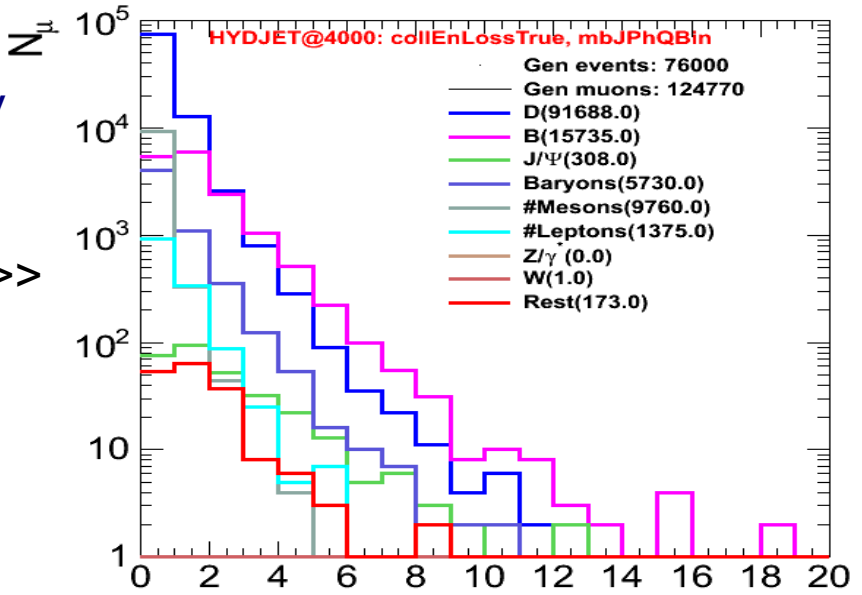
HYDJET vs HYDJET: Multiplicity dependence



HYDJET@4TeV

<<-- 26 000

21500 -->>

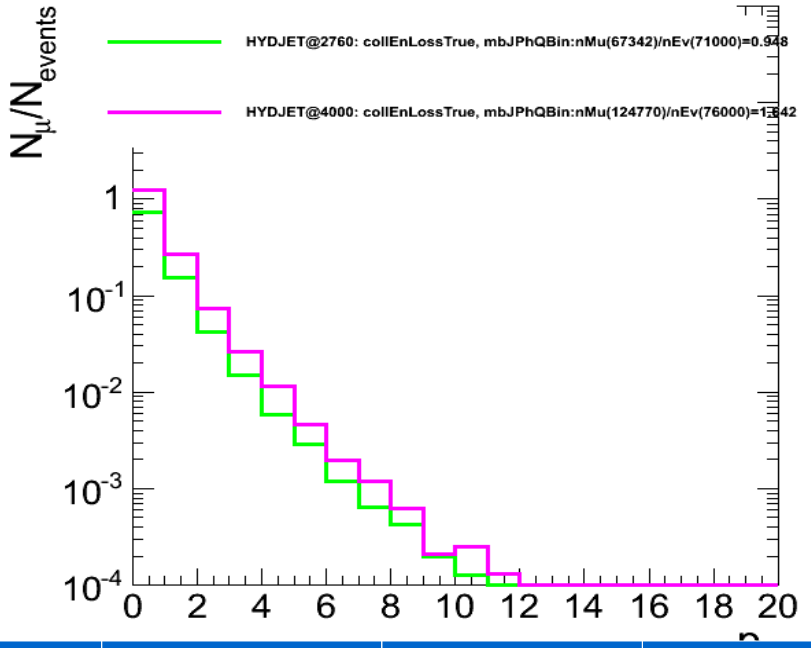


En(GeV) 4000, PythiaUESettings, mbJPhQBin, y_long=4.5, collEnLoss=true<	#ev with pt_hat>6GeV/c	#mu/ev	#mu/ev 1e-3 pt>10GeV/c, |eta|<2.4	<Ncoll>	<Npart>	<Nhard>	<b>
M=21 500	76000	1.64 (124770)	0.63(48)	312	106	58	10.38
M=26 000	91500	1.63 (149423)	0.52(48)	313	106	60	10.38

	mu	mu pt>10GeV/c |eta|<2.4
(M21-M26)/M26	(0.006)	(0.21)

< 0.6-22% effect

HYDJET vs HYDJET: Energy dependence, rates



En(GeV) PythiaUESettings, mbJPhQBin, y_long=4.5, collEnLoss=true<	#ev with pt_hat>6GeV/c	#mu/ev	#mu/ev 1e-3 pt>10GeV/c, |eta|<2.4	<Ncoll>	<Npart>	<Nhard>
2760	71000	0.95 (67342)	0.31(22)	310	105	36
4000	76000	1.64 (124770)	0.63(48)	312	106	58

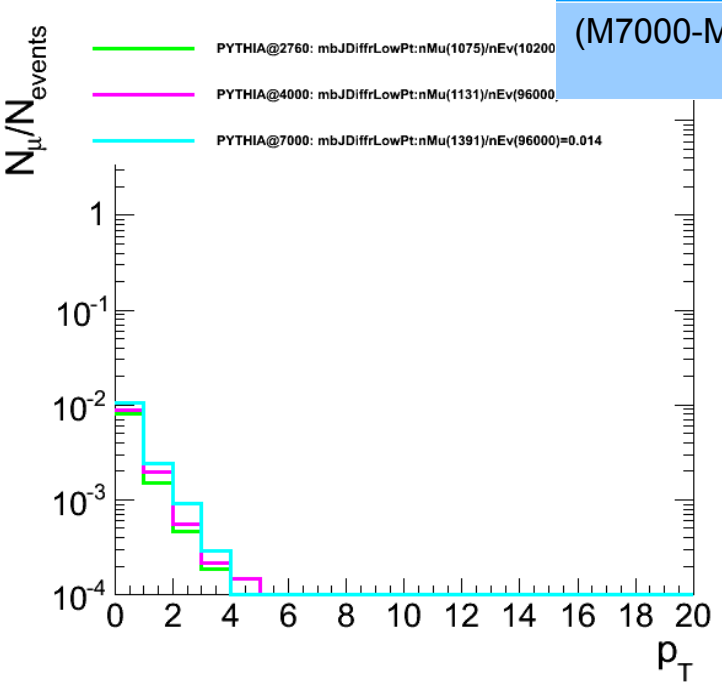
	mu	mu pt>10GeV/c |eta|<2.4
(M4000-M2760)/M2760	0.73	1.03

< 73-103% effect

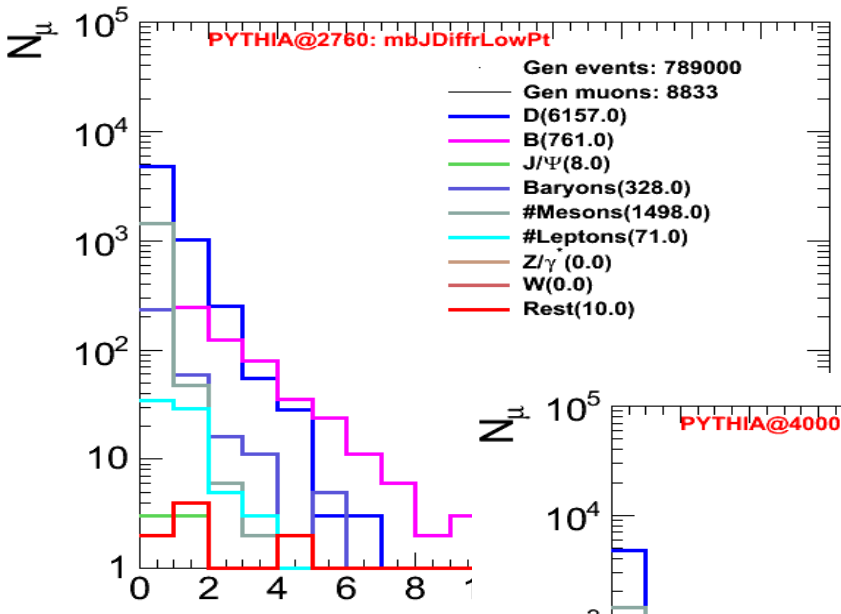
PYTHIA vs PYTHIA

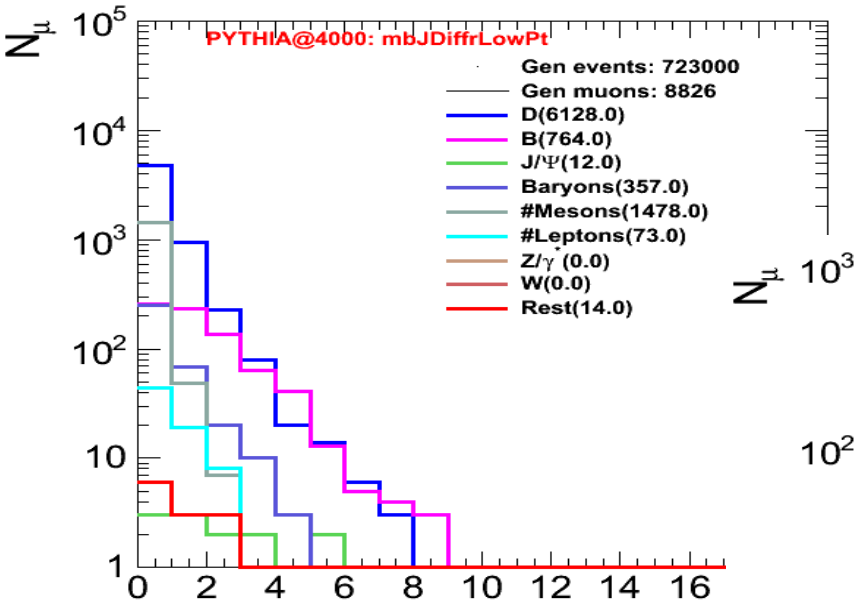
En(GeV)	#ev with pt_hat>6GeV/c	#mu/ev	#mu/ev pt>10GeV/c, |eta|<2.4 1e-6
2760	789 000	0.011(8833)	6.34(5)
4000	723 000	0.012(8826)	4.15(3)
7000	96 000	0.015(1391)	41.7(4)

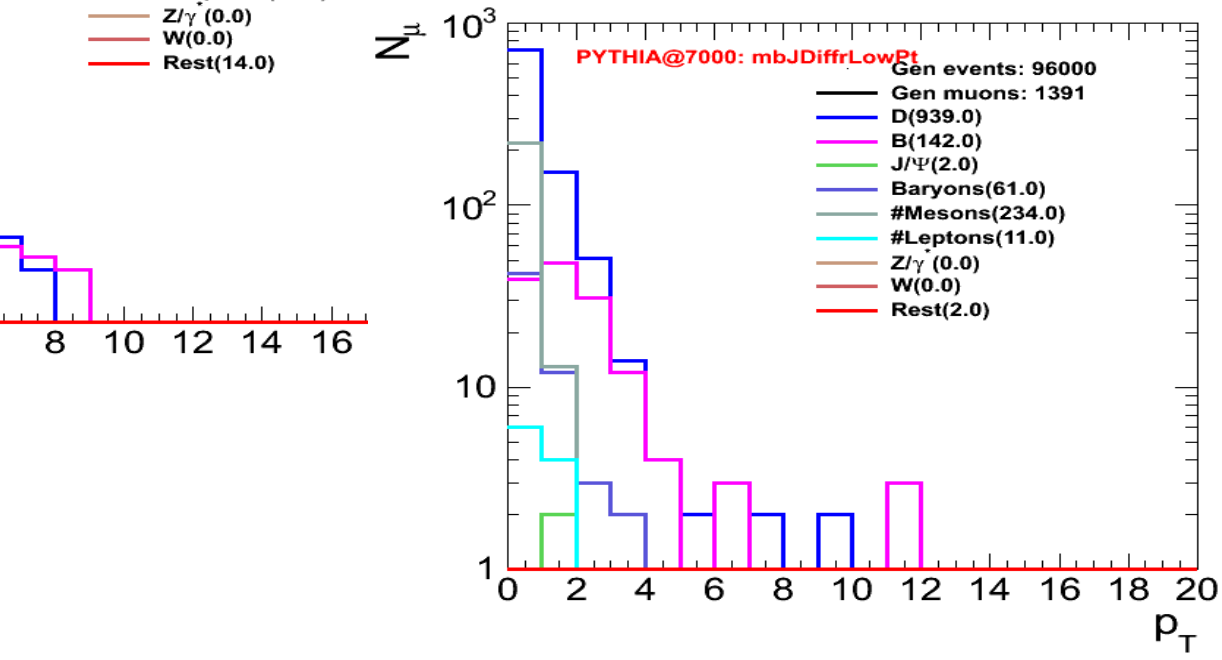
	mu%	Mu% pt>10GeV/c |eta|<2.4
(M4000-M2760)/M4000	0.083	(-0.53)
(M7000-M2760)/M7000	0.27	0.85



PYTHIA vs PYTHIA (pt_hat_gen_cut:6GeV/c)







HYDJET vs PYTHIA

MUO-10-002 (7 TeV data)	6 Glb / N_{coll} kevts
Hydjet, Nov. (4 TeV)	150 Gen / kevts
Hydjet, Today (2.8 TeV)	0.4 Gen / kevts

pT_mu>10GeV/c

?

Ncoll=313(high pT, Npart = 106 (low pT)

En(GeV) |eta|<2.4	#mu/ev 1e-3 pt>10 GeV/c,	(PY-HY)/HY	#mu/ev 1e-3 pt>5 GeV/c	(PY-HY)/HY
HYDJET@2760	0.31	5.38	4.8	3.88
PYTHIA@2760*Ncoll	1.98		23.4	
HYDJET@4000	0.63	1.06	7.9	2.95
PYTHIA@4000*Ncoll	1.3		21.2	

--> Too few high-pT mus

En(GeV)	#mu/ev	(PY-HY)/HY	#mu/ev 1e-3 pt>3.5 GeV/c	(PY-HY)/HY
HYDJET@2760	0.95	0.11	14	0.64
PYTHIA@2760*Npart	1.06		23	
HYDJET@4000	1.64		24.5	-0.13
PYTHIA@4000*Npart	1.06	.55	21.3	

--> better at low-pT

Conclusions

1. HYDJET vs HYDJET – no issue

2. HYDJET vs PYTHIA*Ncoll/Npart
   – overall (low-pT dominated) seems OK
   – high pT (largely) underestimated

Back

PYTHIA base config file

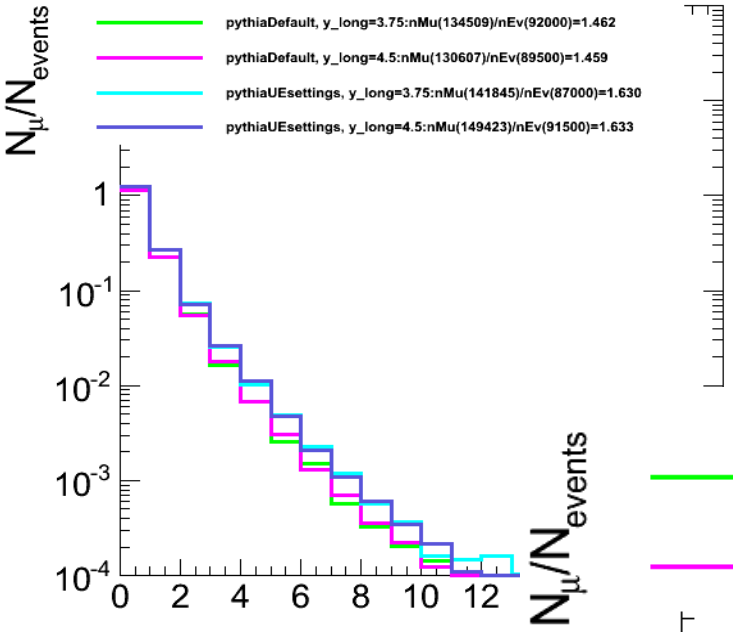
```
import FWCore.ParameterSet.Config as cms
   from Configuration.Generator.PythiaUESettings_cfi import *


generator = cms.EDFilter("Pythia6GeneratorFilter",
    pythiaHepMCVerbosity = cms.untracked.bool(False),
    maxEventsToPrint = cms.untracked.int32(0),
    pythiaPylistVerbosity = cms.untracked.int32(1),
    filterEfficiency = cms.untracked.double(1.0),
    crossSection = cms.untracked.double(71260000000.),
    comEnergy = cms.double(7000.0),
    PythiaParameters = cms.PSet(
        pythiaUESettingsBlock,
        processParameters = cms.vstring('MSEL=0         ! User defined processes',
            'MSUB(11)=1     ! Min bias process',
            'MSUB(12)=1     ! Min bias process',
            'MSUB(13)=1     ! Min bias process',
            'MSUB(28)=1     ! Min bias process',
            'MSUB(53)=1     ! Min bias process',
            'MSUB(68)=1     ! Min bias process',
            'MSUB(92)=1     ! Min bias process, single diffractive',
            'MSUB(93)=1     ! Min bias process, single diffractive',
            'MSUB(94)=1     ! Min bias process, double diffractive',
            'MSUB(95)=1     ! Min bias process'),
        # This is a vector of ParameterSet names to be read, in this order
        parameterSets = cms.vstring('pythiaUESettings',
            'processParameters')
    )
)
```

HYDJET base config file

```
import FWCore.ParameterSet.Config as cms
from Configuration.Generator.PythiaUESettings_cfi import *
collisionParameters7GeV = cms.PSet(
    aBeamTarget = cms.double(208.0), # beam/target atomic number
    comEnergy = cms.double(7000.0)   # collision en
    )
collisionParameters2760GeV = cms.PSet(
    aBeamTarget = cms.double(208.0), # beam/target atomic number
    comEnergy = cms.double(2760.0)   # collision en
    )
collisionParameters = collisionParameters2760GeV.clone()
qgpParameters = cms.PSet(qgpInitialTemperature     = cms.double(1.0), ## initial temperature of QGP; allowed range [0.2,2.0]GeV;
                         qgpProperTimeFormation    = cms.double(0.1), ## proper time of QGP formation; allowed range [0.01,10.0]fm/c;
                         hadronFreezoutTemperature = cms.double(0.14),
                         doRadiativeEnLoss         = cms.bool(True),  ## if true, perform partonic radiative en loss
                         doCollisionalEnLoss       = cms.bool(False),
                         qgpNumQuarkFlavor         = cms.int32(0),    ## num. active quark flavors in qgp; allowed values: 0,1,2,3
                         numQuarkFlavor            = cms.int32(0)     ## to be removed
                         )
pyquenParameters  = cms.PSet(doIsospin = cms.bool(True),
                             angularSpectrumSelector = cms.int32(0),           ## angular emitted gluon spectrum :
                             embeddingMode           = cms.bool(False),
                             backgroundLabel         = cms.InputTag("generator") ## ineffective in no mixing
                             )
hydjetParameters = cms.PSet(sigmaInelNN             = cms.double(58),
                            shadowingSwitch         = cms.int32(0),
                            nMultiplicity           = cms.int32(21500),
                            fracSoftMultiplicity    = cms.double(1.),
                            maxLongitudinalRapidity = cms.double(4.5),
                            maxTransverseRapidity   = cms.double(1.),
                            rotateEventPlane        = cms.bool(True),
                            allowEmptyEvents        = cms.bool(False),
                            embeddingMode           = cms.bool(False)
                            )
pyquenPythiaDefaultBlock = cms.PSet(
    pythiaUESettingsBlock,
    hydjetPythiaDefault = cms.vstring('MSEL=0        ! user processes',
                                      'CKIN(3)=6.    ! ptMin',
                                      'MSTP(81)=0    ! multiple interaction OFF'
                                      ),
    pythiaJets = cms.vstring('MSUB(11)=1', # q+q->q+q
                             'MSUB(12)=1', # q+qbar->q+qbar
                             'MSUB(13)=1', # q+qbar->g+g
                             'MSUB(28)=1', # q+g->q+g
                             'MSUB(53)=1', # g+g->q+qbar
                             'MSUB(68)=1'  # g+g->g+g
                             ),
    pythiaPromptPhotons = cms.vstring('MSUB(14)=1', # q+qbar->g+gamma
                                      'MSUB(18)=1', # q+qbar->gamma+gamma
                                      'MSUB(29)=1', # q+g->q+gamma
                                      'MSUB(114)=1', # g+g->gamma+gamma
                                      'MSUB(115)=1' # g+g->g+gamma
                                      )
    )
```

```
impactParameters = cms.PSet(cFlag = cms.int32(1),
                            bFixed = cms.double(0),
                            bMin = cms.double(0),
                            bMax = cms.double(30)
                            )
generator = cms.EDFilter("HydjetGeneratorFilter",
                         collisionParameters,
                         qgpParameters,
                         hydjetParameters,
                         impactParameters,
                         hydjetMode = cms.string('kHydroQJets'),
                         PythiaParameters = cms.PSet(pyquenPythiaDefaultBlock,
                                                     # Quarkonia and Weak Bosons added back upon dilepton group's request.
                                                     parameterSets = cms.vstring('pythiaUESettings',
                                                                                 'hydjetPythiaDefault',
                                                                                 'pythiaJets',
                                                                                 'pythiaPromptPhotons'
                                                                                 )
                                                     )
                         )
```

HYDJET vs HYDJET: Energy dependence, rates



<<--- HYDJET@4TeV

HYDJET@2.76TeV --->>