ISR studies on Drell-Yan

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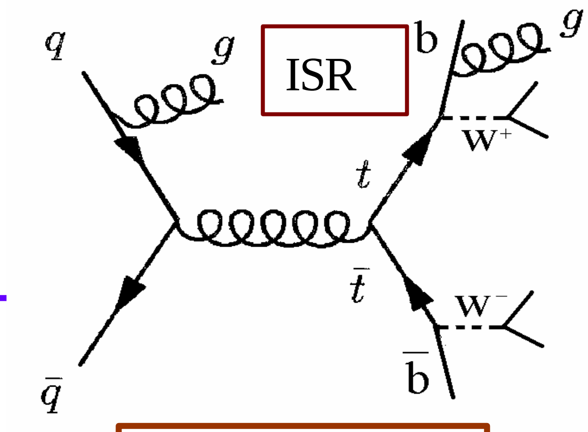
Why we care about ISR?

- Initial State Radiations (ISR) gluon plays important roles in many physics measurements.

  - W mass: more ISRs, higher Pt of W
  - Top mass: RunII goal 2-3 GeV for ?Mtop, but ?M=2.5 GeV for ISR/FSR in summer analysis. (ISR is identfied as W daughter or 2nd bjet).
  - LHC is a top factory, ttbar+njet is a major background to many EWK processes.
    (crucial for Top-Yukawa coupling, ttH)
  - …



lep-jet: lepton +4jets(bbqq)

Example: top mass analysis (lepton-jet)

- ISR: switch on/off using PYTHIA
  - Good for understanding possible size of each effects in top mass measuremnts, but not clear what one sigma really is.
  - RunII : only ?Mtop=0.22+-0.30 GeV in top mass (Run II)
  - Run I : but 2.6 GeV, (1.3 from RunII MC with Run I setting)
- Issue
  - Could return underestimated error

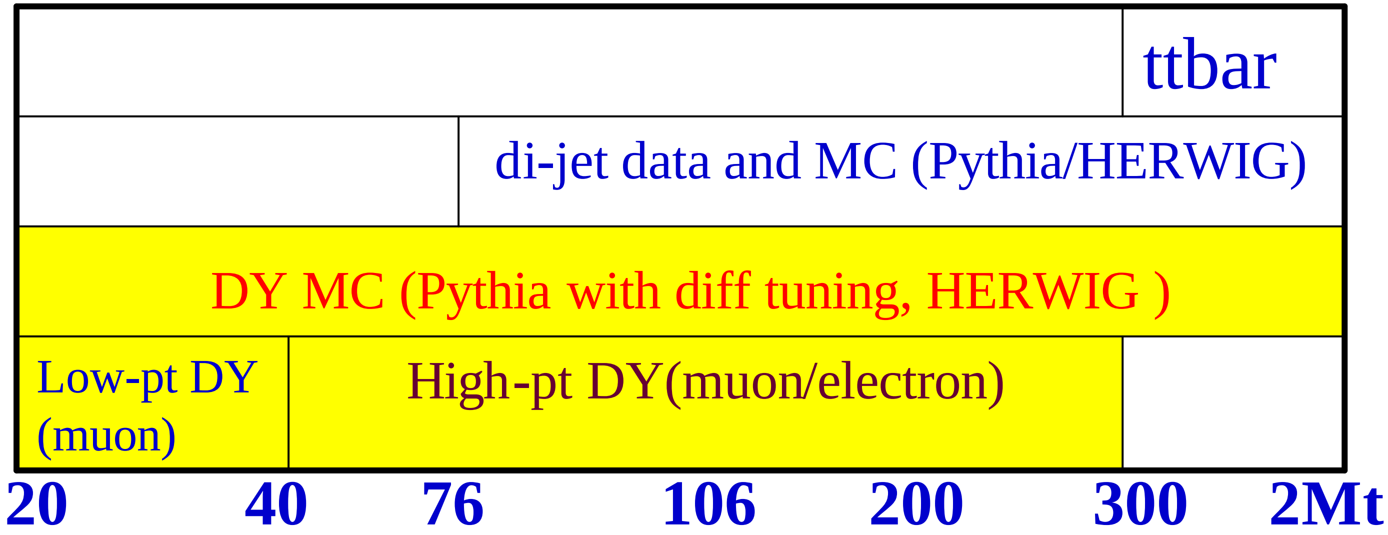
    if your underlying events are overestimated.
  - ISR effect is not an isolated problem, but correlated with Q2 scale, PDF, and underlying events issues. (thus, ISR effects for RunI and RunII could be different, underlying events are different)

Systematic approach for ISR

- Basically, ISR/FSR effects are governed by DGALP evolution equations.
  - Probability for a quark to radiate a gluon is ? ?Q2)*P(x/y:q->qg)
  - Change in probability of quark: [? ?Q2)*P(x/y:q->qg) x fpdf (y, Q2)]
  - Thus, uncertainty come from Q^2, pdf, Lambda QCD, splitting functions (LO vs NLO)

- Use DY data (no FSR) to study this ISR effect by looking at different Q2 scale (~different DY mass region)
  - Pt of dileptons
  - Njet dist. for soft jets (4< Et < 15 for |eta|<2)
  - Eta dist. of jet (weighted with jet energy)

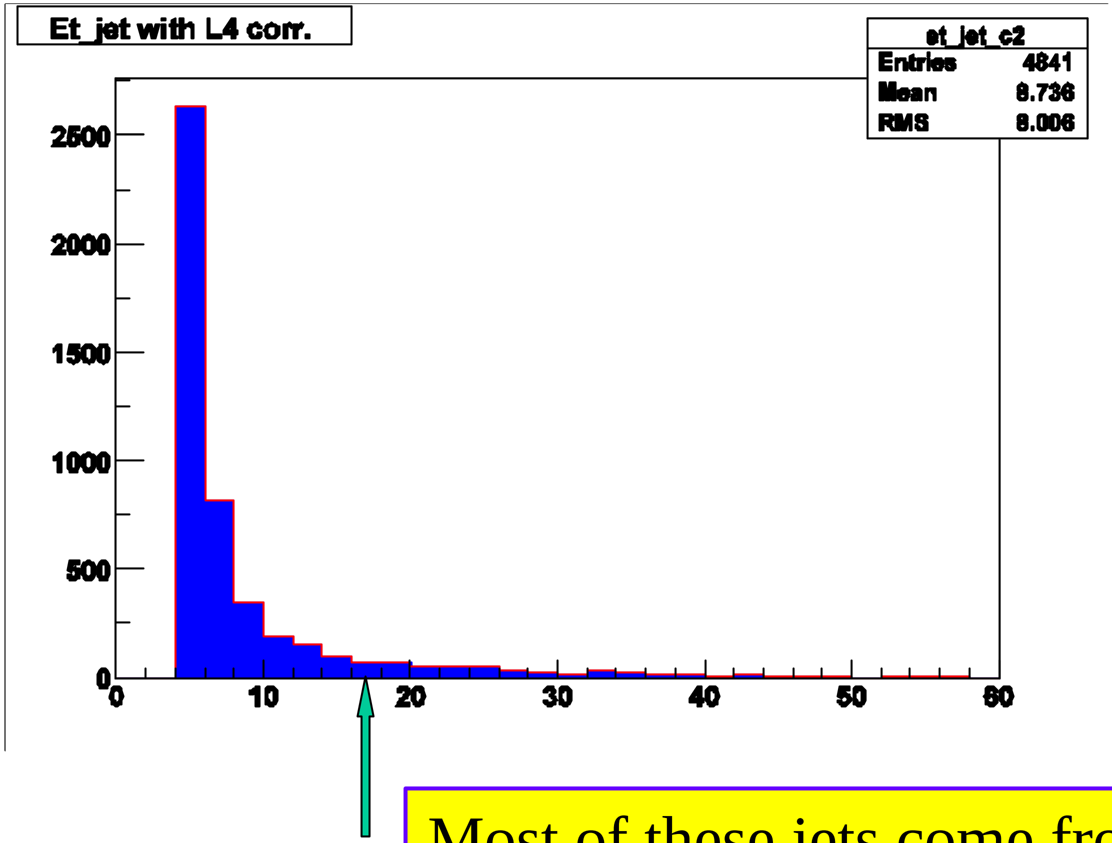
Datasets



- **DY data: low-pt dimuon (Pt>8), high-pt dilepton (e/mu) (Pt>20)**
  MC : low-pt, hi-pt Pythia, HERWIG.

- **Analysis cut: low-pt dimuon: both tight-central muons (pt>10)**
  hi-pt leptons : both tight-central leptons
  (pt1>20,pt2>10)
  + MET<25

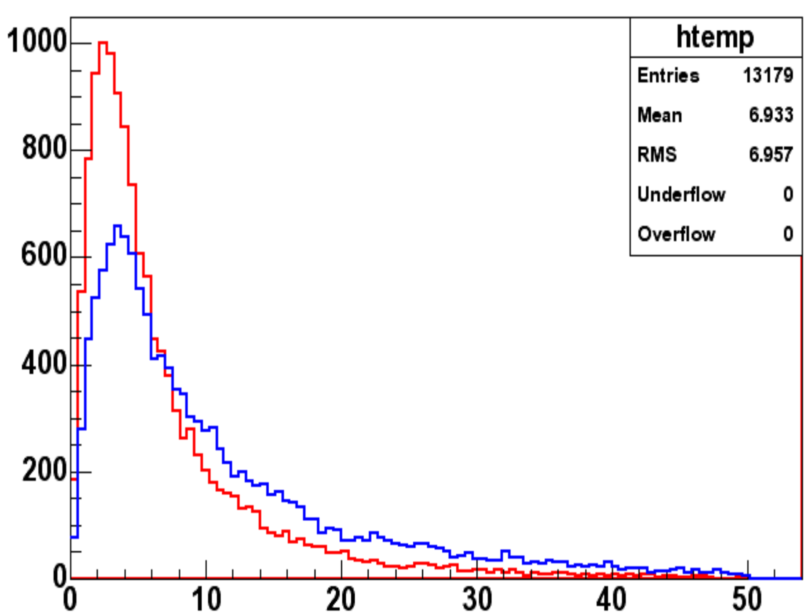
Jet energy dist. from DY data



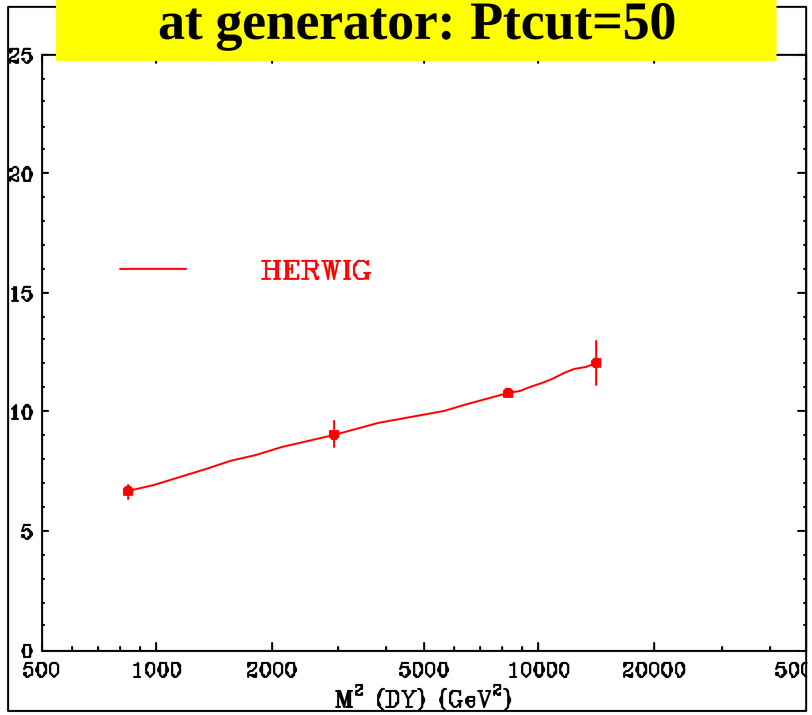
Most of these jets come from ISR.
dominant ISR region ✍ soft jet region (4<Et<15),
(issue: jet energy response at low energy)

Evolutions of <Pt> and Njets as a function of DY mass^2

Pt of DY at generator (M=30 vs 90 GeV)

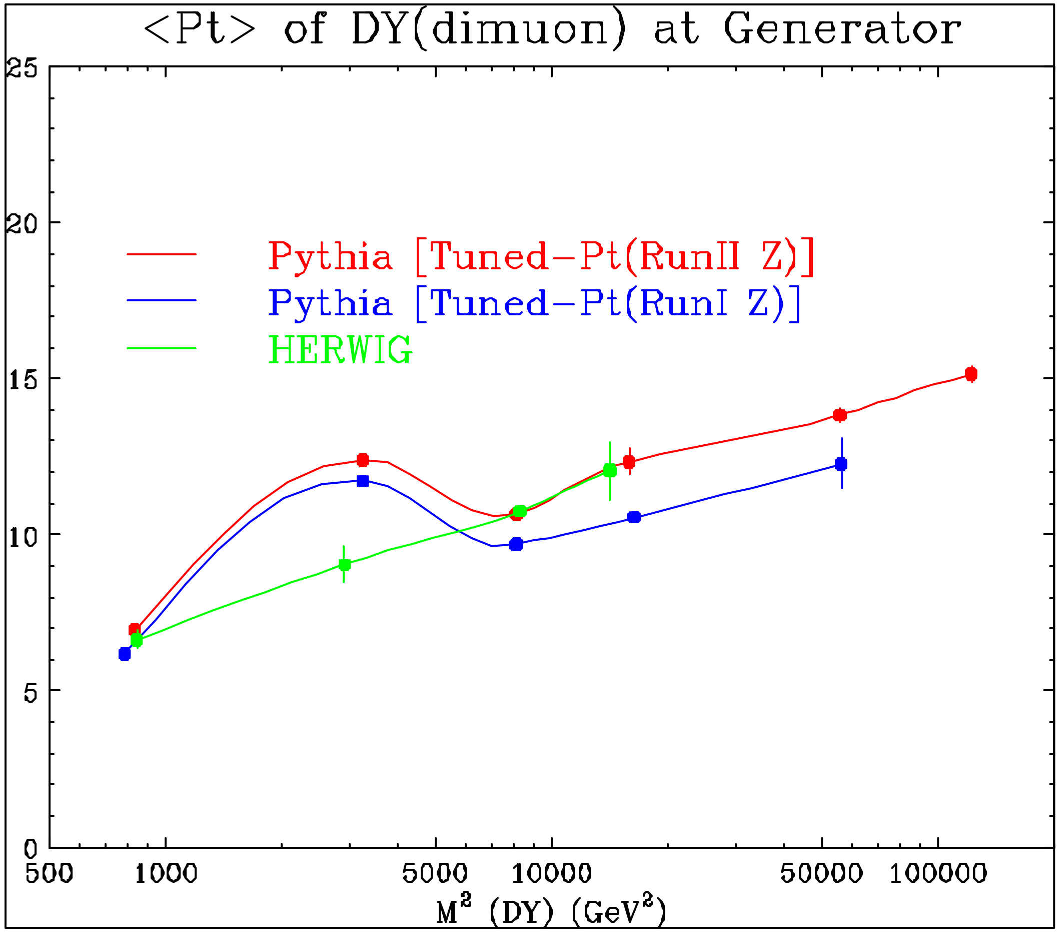


<Pt(DY)> [M^2] at generator: Ptcut=50



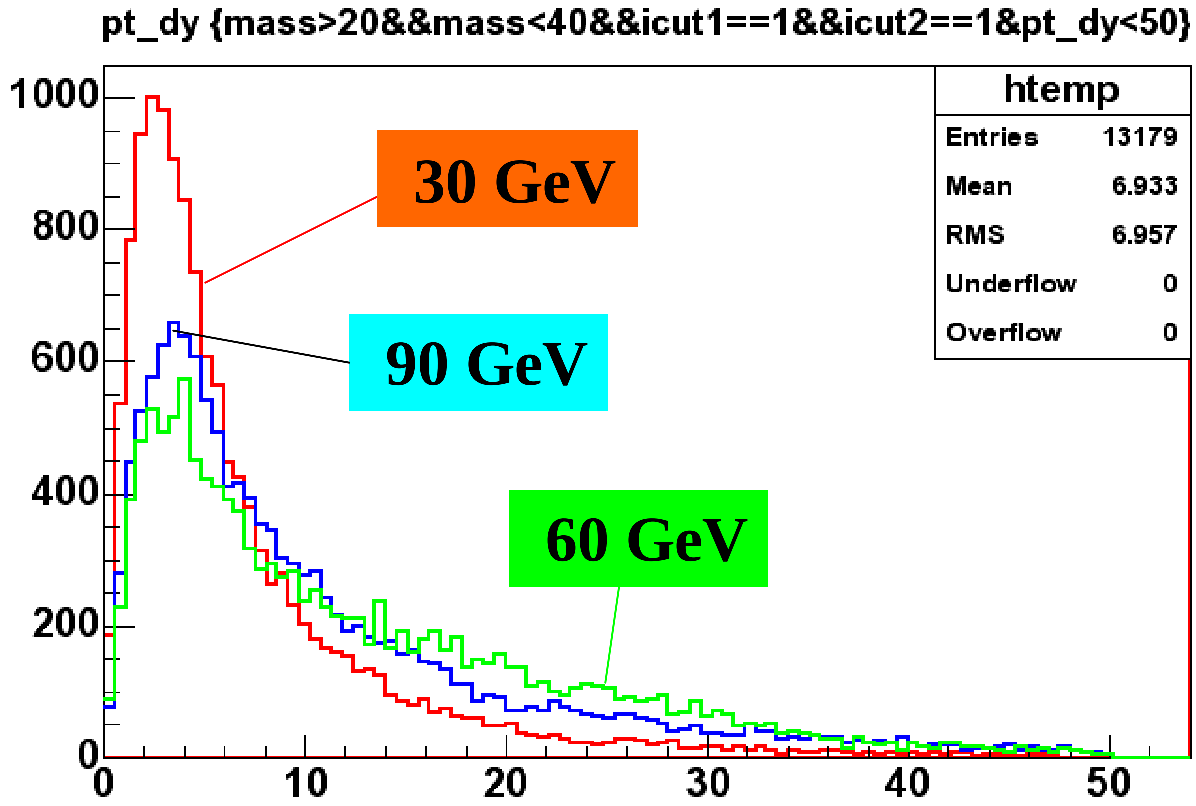
<Pt(DY>: a good logarithmic dependence on DY mass^2 in Herwig

Herwig vs Pythia with diff. tunning



Strange behaviour at M=60 in Pythia?

Comparison of Pt dist. for diff. mass regions

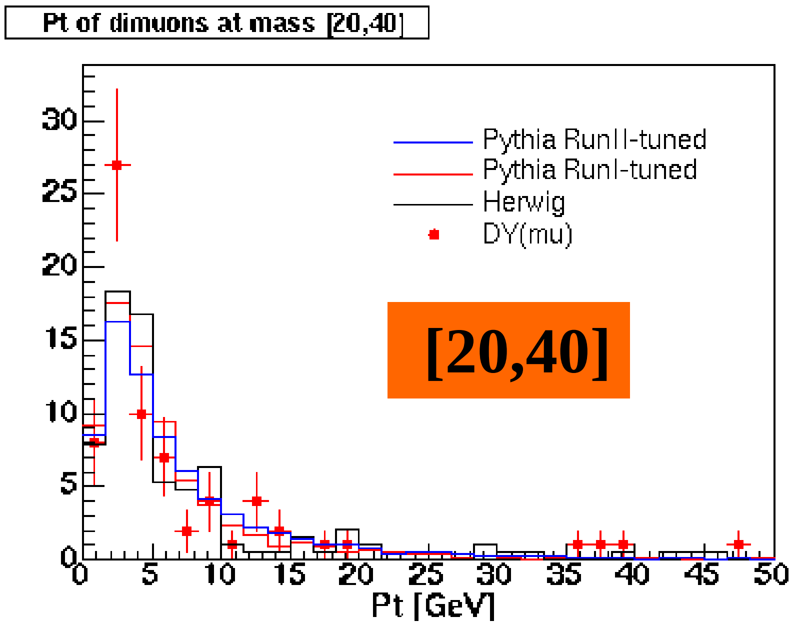


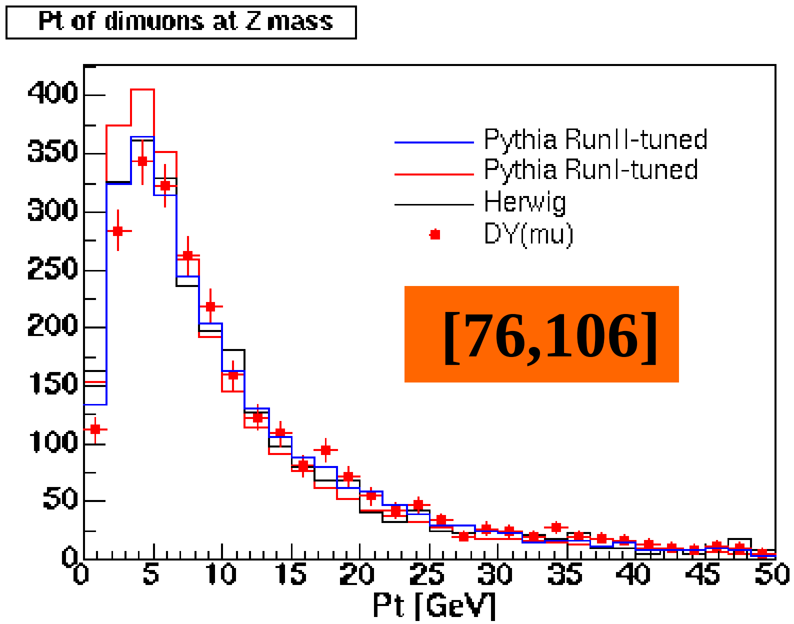
Why 60 GeV case is harder than 90 GeV case?
(due to tuning or other problem??)

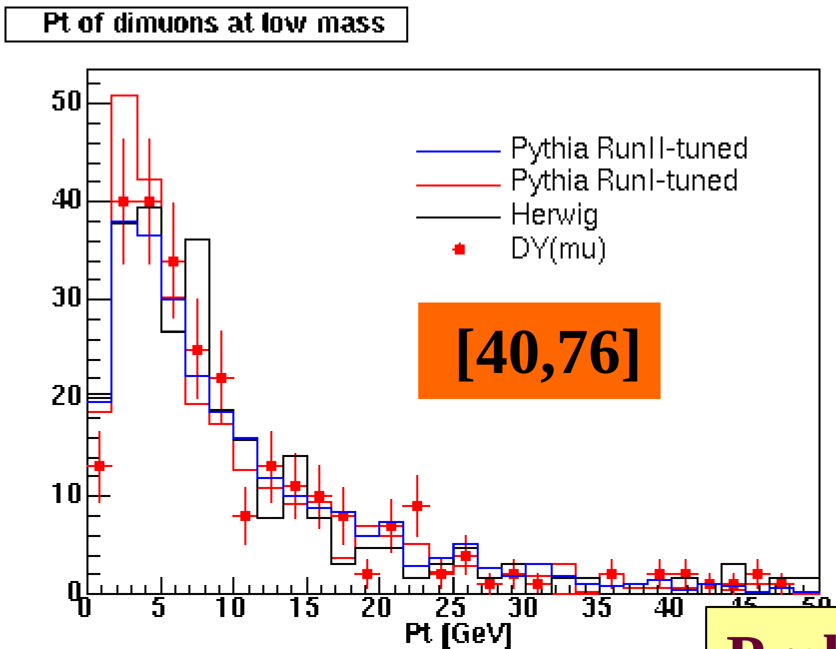
Comparison of Herwig and Pythia with diff. tuning [parameters]

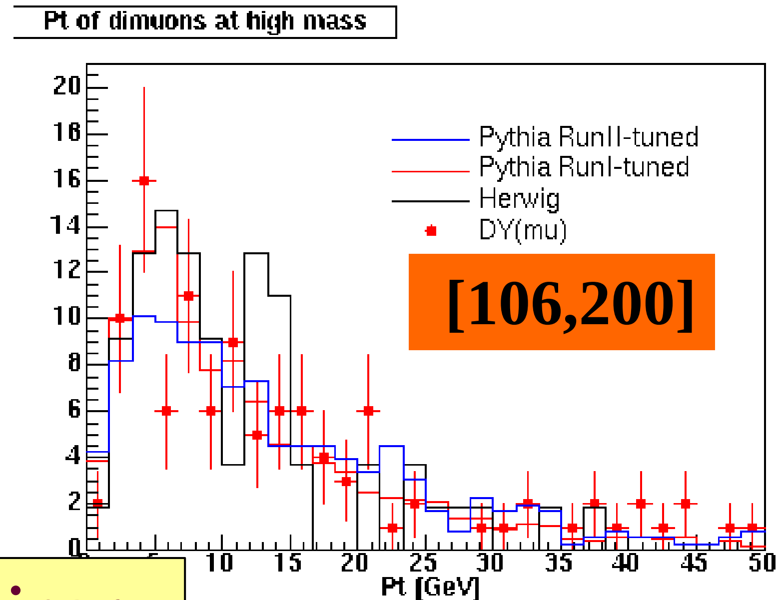
CDF standard setting for top/ewk groups	Pythia 6.2 (RunI Zpt)	Pythia 6.2 (RunII Zpt)	Herwig 6.4
Q^2 min (cut-off for space-like evol.)	1.25 (D=1) parp(62)	1.25	1.18**2 (D=0)
K facotor for space-like evol. scale	1 (=D) parp(64)	0.2	1
Kt_sigma (intrinsic parton pt in proton)	2.50 (D=1) parp(91)	2.50	1.45
Kt_max (Kt cut-off)	15 (D=5) parp(93)	15	

+ Rick's underlying evts tunning Ffor Pythia



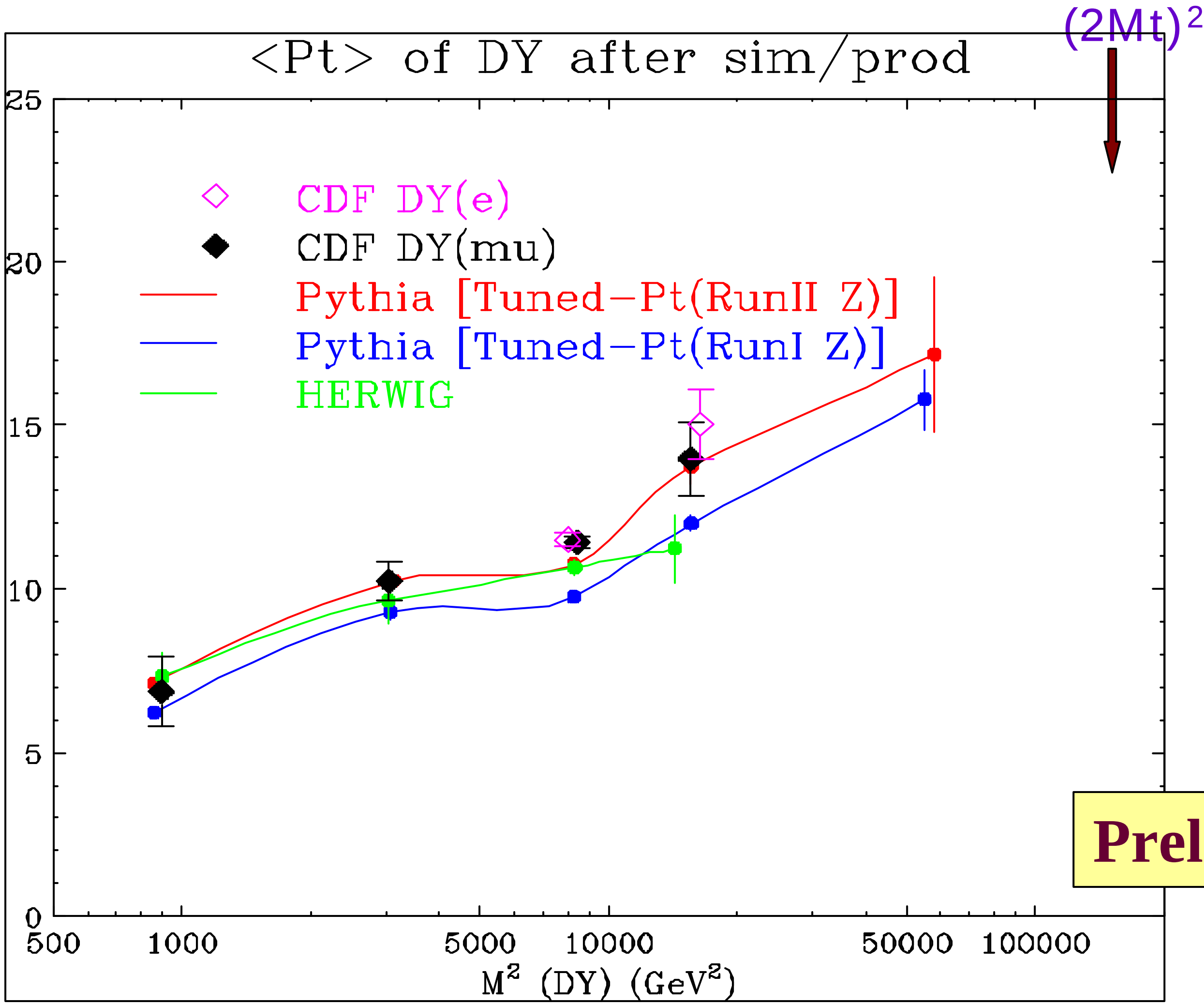




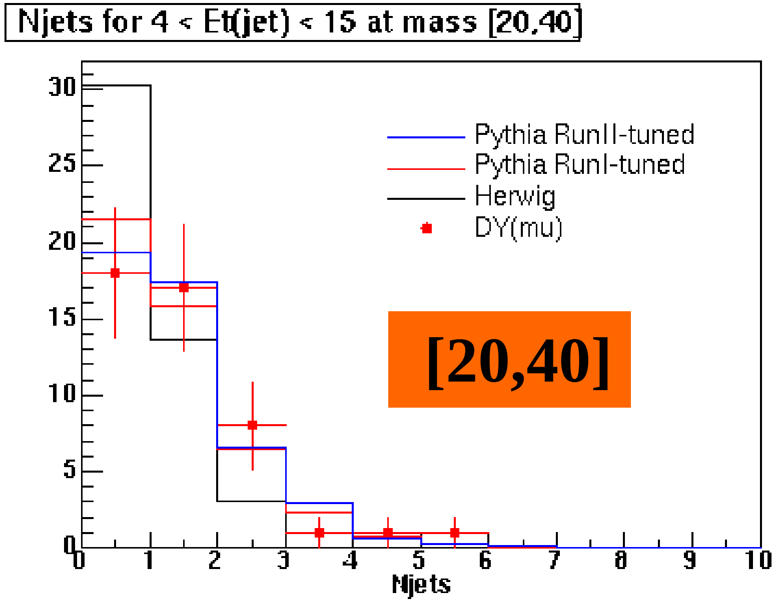


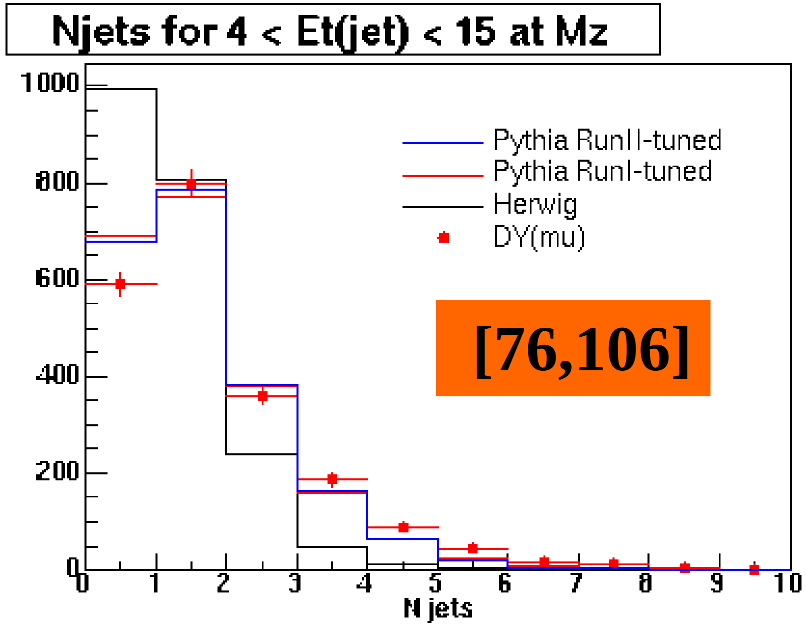
Preliminary

Evolutions of Pt as M^2(DY)



Preliminary





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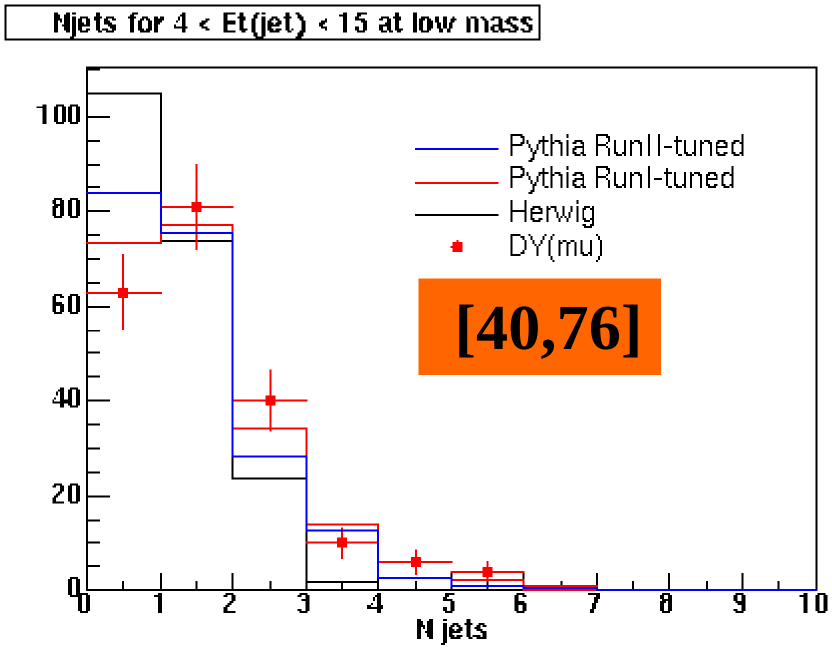
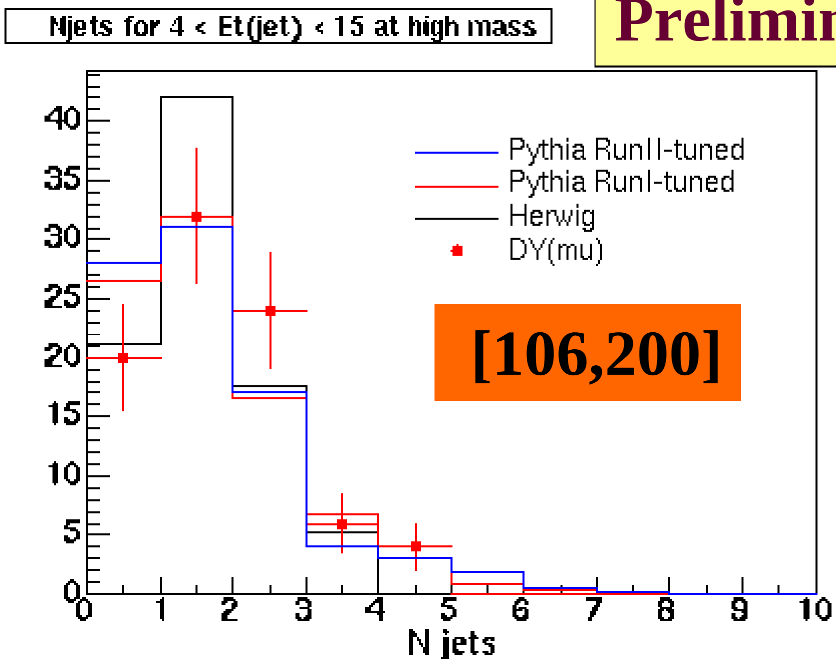
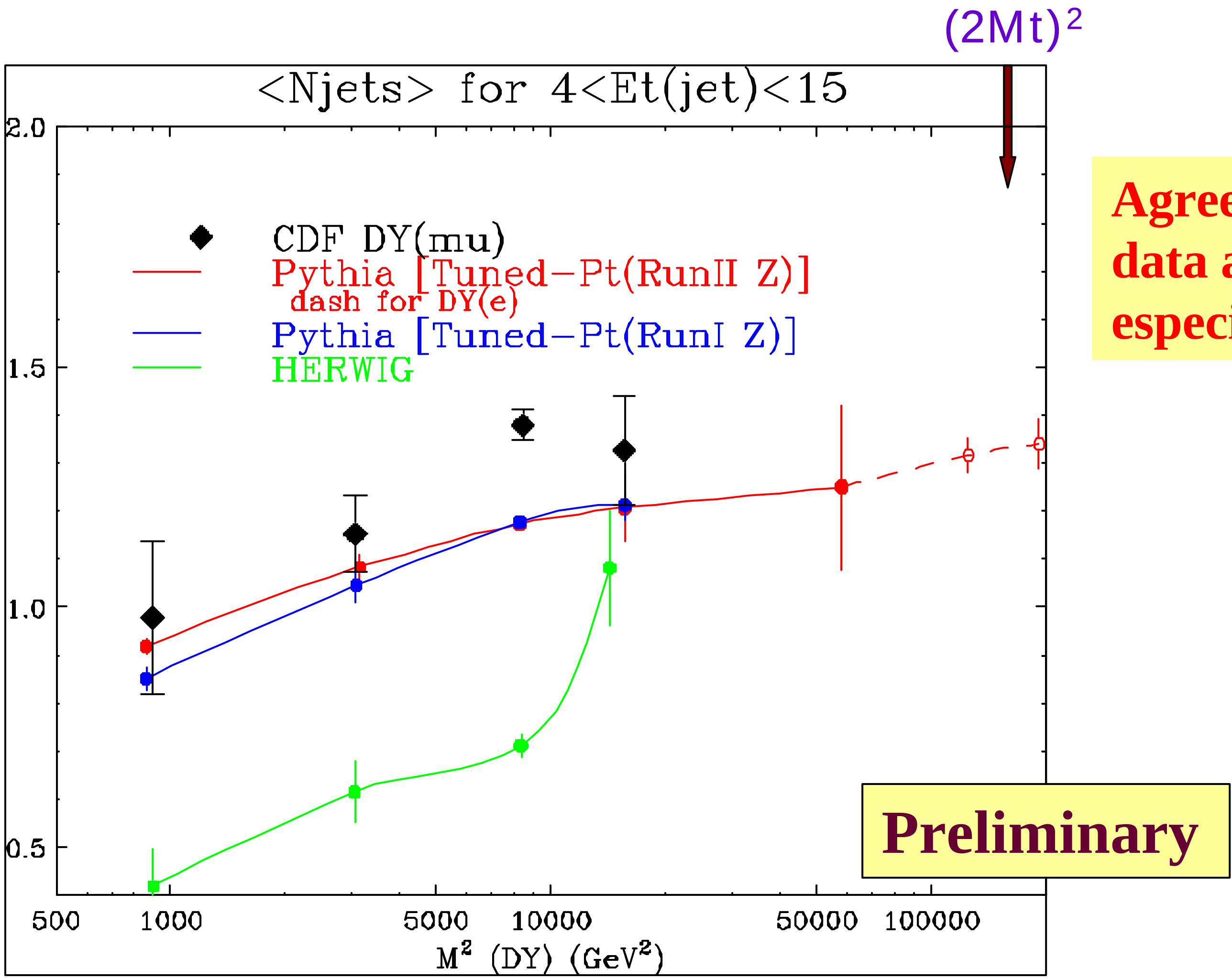




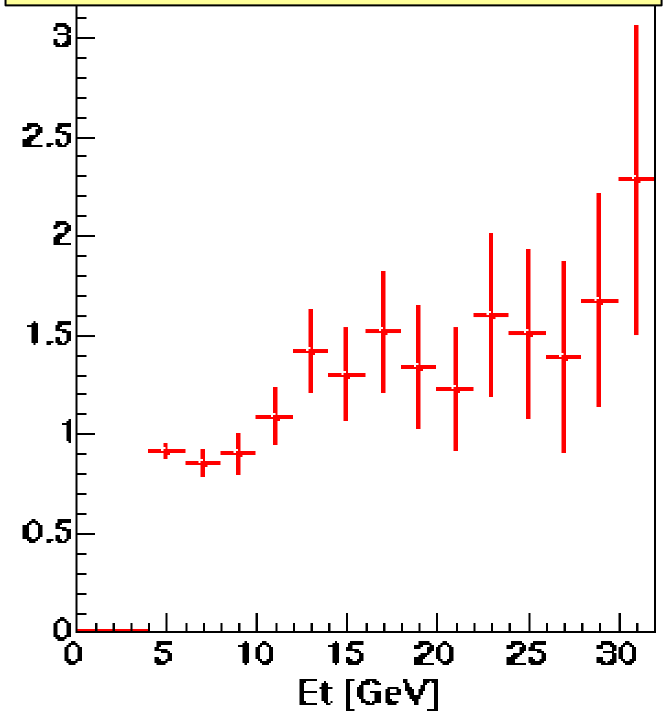
Evolutions of Njets as M^2(DY)



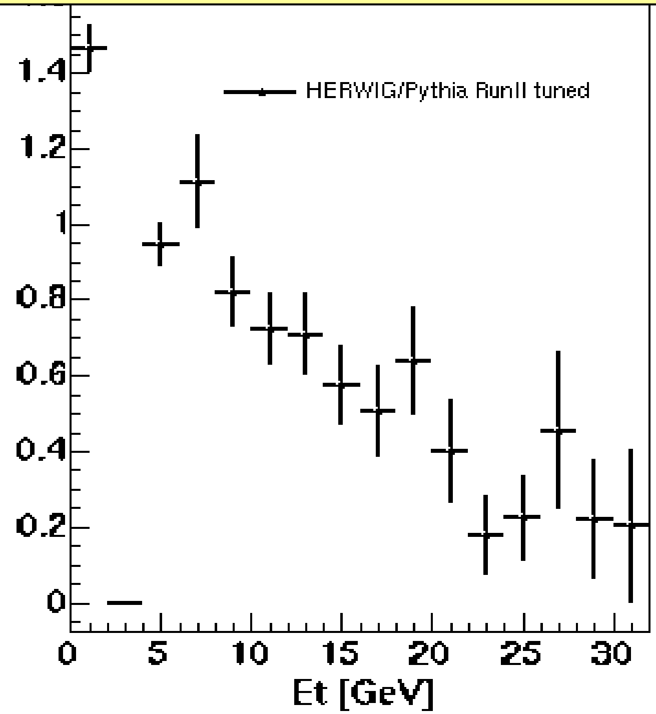
Agreement between data and MC is poor, especially, HERWIG

Herwig vs Pythia in <Njets>…

Et(jet): Herwig/Pythia



Sum of Jet Et [4<Et<15]



Number of soft jets in HEWIG is smaller, though the shape of Jet Et is harder…. (could be due to less underlying events?)

Summary and plans

- <Pt> of DY system show a good logarithmic dependence on M^2(DY).
- But Pythia (tuned for Pt(Z)) seems to show problem around M=60. Beside this, good agreement between data and MC.

  ✍ Very promising to extrapolate to top production region.

- Soft njets also show a reasonable agreement, but Herwig predicts mu ch smaller soft-jets. why?... need to check

- Plans

✍ Check out Ptcut=50 GeV effect in very high mass region (M>200).

✍ Include full dielectrons samples for high mass region.

✍ Aslo check the pt of di-jets system around top mass production region, then compare with the pt predictions of DY and ttbar…

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Measure the slope of evolution due to ISR → **Tevatron LHC**