TeV4LHC Workshop





Talk #1

Rick Field University of Florida

Tel4HC







CDF Run 2 Monte Carlo Tunes









Outline of Talk

- P_T(Z-boson): Tuning to fit the P_T(Z) distribution.
- Drell-Yan: Tuning to fit the "underlying event" in Drell-Yan production.



- Jet Production: Tuning to fit the "underlying event" is high P_T jet production.
 - **Energy:** Tuning to fit the energy in the "underlying event".

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Intrensic KT



Intrensic KT



October 20, 2005



	PYTH	CD 1A 6.2 C	DF TEQ5L	Run 1 P _T (Z)		
	Parameter	Tune A25	Tune AW	Z-Boson Transverse Momentum		
UE Parameters MSTP(81) 1 MSTP(82) 4 PARP(82) 2.0 GeV 2 PARP(83) 0.5 PARP(84) 0.4	MSTP(81)	1	1	$0.12 \Box CDF \text{ Run 1 Data}$		
	MSTP(82)	4	4	PYTHIA Tune A25 CDF Run 1 published		
	PARP(82)	2.0 GeV	2.0 GeV			
	PARP(83)	0.5	0.5			
	0.4					
	PARP(85)	0.9	0.9			
	PARP(86)	0.95	0.95			
ISR Parameters	PARP(89)	1.8 TeV	1.8 TeV	0 2 4 6 8 10 12 14 16 18 20		
	PARP(90) 0.25 0.25 Z-Boson PT (GeV/c)	Z-Boson PT (GeV/c)				
	PARP(62)	1.0	1.25	Shows the Run 1 Z-boson p _T distribution (<p<sub>T(Z)> ≈ 11.5 GeV/c) compared with PYTHIA Tune AW (<p<sub>T(Z)> = 11.7 GeV/c) and</p<sub></p<sub>		
	PARP(64)	1.0	0.2			
	PARP(67)	4.0	4.0			
	MSTP(91)	1) 1 1 PYTHIA Tune A25 ($< p_T(Z) > = 10.1 \text{ GeV/c}$	PYTHIA Tune A25 ($< p_T(Z) > = 10.1 \text{ GeV/c}$).			
	PARP(91)	2.5	2.1			
Intrensic KT	PARP(93)	5.0	15.0			

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Parameter Tune A25 Tune AW UE Parameters MSTP(81) 1 1 1 MSTP(82) 4 4 4 4 PARP(82) 2.0 GeV 2.0 GeV 1.0E+00 • PYTHIA Tune A25 PYTHIA Tune AW RDF Preliminary generator level PARP(83) 0.5 0.5 0.5 1.0E-01 • Normalized to 1 I.0E-02 1.0E-03 1.0E-03 • PYTHIA Tune AW • PYTHIA Tune AW
UE Parameters MSTP(81) 1 1 1 1 1 1 1 1.0E+00 • PYTHIA Tune A25 RDF Preliminary generator level • PYTHIA Tune AW • PYTHIA TUNE AW
MSTP(82) 4 4 4 • PYTHIA Tune A25 PYTHIA Tune AW RDF Preliminary generator level PARP(82) 2.0 GeV 2.0 GeV 1.0E-01 1.0E-02 1.0E-02 1.0E-02 PARP(83) 0.5 0.5 1.0E-03 1.0E-03 Normalized to 1
PARP(82) 2.0 GeV 2.0 GeV 1.8 TeV PARP(83) 0.5 0.5 0.1 Normalized to 1 PARP(84) 0.4 0.4 1.0E-03 1.0E-03
PARP(83) 0.5 0.5 interval interval Normalized to 1 PARP(84) 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.5 <t< th=""></t<>
PARP(84) 0.4 0.4 1.0E-03
PARP(85) 0.9 0.9
PARP(86) 0.95 0.95
ISR Parameters PARP(89) 1.8 TeV 1.8 TeV 0 10 20 30 40 50 60 70 80 90 10
PARP(90) 0.25 0.25 Z-Boson PT (GeV/c)
PARP(62) 1.0 1.25 Compares PYTHIA Tune AW with PYTHIA
PARP(64) 1.0 0.2 Tune A25 (both normalized to one).
PARP(67) 4.0 4.0
MSTP(91) 1 1
PARP(91) 2.5 2.1
Intrensic KT PARP(93) 5.0 15.0

	PYTH	<mark>СЪ</mark> 1А 6.2 С) R' feq5l	Run 1 P _T (Z)	
	Parameter	Tune A25	Tune AW	Z-Boson Transverse Momentum	
UE Parameters	MSTP(81)	1	1	1.0E+00	
	MSTP(82)	4	4	PYTHIA Tune A25 RDF Preliminary PYTHIA Tune AW Second s	
	PARP(82)	2.0 GeV	2.0 GeV	1.8 TeV	
	PARP(83)	0.5	0.5	1.0E-02 Arbitrary Normalization	
	PARP(84)	0.4	0.4	1.0E-03	
	PARP(85)	0.9	0.9		
	PARP(86)	0.95	0.95	Ε	
	PARP(89)	1.8 TeV	1.8 TeV	1.0E-05	
	PARP(90)	0.25	0.25	Z-Boson PT (GeV/c)	
	PARP(62)	1.0	1.25	Compares PYTHIA Tune AW with PYTHIA Tune A25 (normalized to agree at high P _T (Z)).	
	PARP(64)	1.0	0.2		
	PARP(67)	4.0	4.0		
	MSTP(91)	1	1		
	PARP(91)	2.5	2.1		
Intrensic KT	PARP(93)	5.0	15.0		



- Shows the lepton-pair average P_T versus the lepton-pair invariant mass at 1.96 TeV for PYTHIA Tune AW and PYTHIA Tune A.
- Shows the lepton-pair average P_T versus the lepton-pair invariant mass at 1.96 TeV for PYTHIA Tune AW and PYTHIA Tune A5.



Shows the charged particle density versus the lepton-pair invariant mass at 1.96 TeV for **PYTHIA Tune AW** and **PYTHIA Tune A**.

Shows the charged PTsum density versus the lepton-pair invariant mass at 1.96 TeV for PYTHIA Tune AW and PYTHIA Tune A.

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"Toward" <Densities> vs P_T(pair)

Final-State

Radiation

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Outgoing Parton

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0.4

0.0

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PY Tune A

50

75

Lepton-Pair PT (GeV/c)

25

Initial-State Radiation

150

<u>70 < M(pair) < 110 GeV</u>

Charged Particles (|n|<1.0, PT>0.5 GeV/c)

125

100





"Transverse" < Densities> vs P_T(pair)

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"Transverse" PTsum Density (GeV/c) 7. 80 8. 7. 9.1 8. 7. 9.1

0.0

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RDF Preliminary

generator level

25

PY Tune A

50

PY Tune AW

75

Lepton-Pair PT (GeV/c)

150

Drell-Yan

1.96 TeV

125

<u>70 < M(pair) < 110 GeV</u>

Charged Particles (|n|<1.0, PT>0.5 GeV/c)

100



The "Underlying Event" in High P_T Lepton-Pair Production



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The "Underlying Event" in Lepton-Pair Production



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High P_T Jets





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The "Underlying Event" in High P_T Lepton-Pair and Jet Production



"Transverse" <Densities> vs P_T(pair)



"Transverse" <Densities> vs P_T(jet#1)



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CTEQ6.1 Tune

Parameter Tune QW Tune O **UE Parameters MSTP(81)** 1 1 **MSTP(82)** 4 4 **PARP(82)** 1.2 GeV 1.2 GeV **PARP(83)** 0.5 0.5 **PARP(84)** 0.4 0.4 **PARP(85)** 0.9 0.9 **PARP(86)** 0.95 0.95 **PARP(89)** 1.8 TeV 1.8 TeV **ISR Parameters PARP(90)** 0.25 0.25 **PARP(62)** 1.0 1.25 **PARP(64)** 1.0 0.2 4.0 **PARP(67)** 4.0 **MSTP(91)** 1 1 **PARP(91)** 2.1 1.0 **PARP(93)** 5.0 15.0 **Intrensic KT**

"Transverse" Charged Particle Density; √dø 1.0 PY Tune Q **RDF Preliminary** CTEQ61 'Transverse" Charged Density generator level 0.8 0.6 PY Tune A CTEQ5L PY Tune A 0.4 CTEQ61 "Leading Jet" 0.2 1.96 TeV Charged Particles (|n|<1.0, PT>0.5 GeV/c) 0.0 250 0 50 100 150 200 300 350 400 450 500 PT(particle jet#1) (GeV/c) "Transverse" PTsum Density: dPT/dndø 1.6 PY Tune Q CTEQ61 **RDF Preliminarv** generator level PY Tune A CTEQ5L PY Tune A CTEQ61 "Leading Jet" 1.96 TeV Charged Particles (|n|<1.0, PT>0.5 GeV/c) 0.0 50 0 100 150 200 250 300 350 400 450 500 PT(particle jet#1) (GeV/c)

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I used LHAPDF! See the next talk by Craig Group!

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- PYTHIA Tune AW correctly describes the Z-boson P_T distribution and also fits the "underlying event" as well as Tune A does! I do not see anything wrong with it, except that it may only work at the Tevatron. You can not trust the energy dependence!
- PYTHIA Tune Q works as well as Tune A but uses CTEQ6.1! At the Tevatron use Tune QW!
- Default JIMMY (PTJIM = 2.5 GeV/c) does not fit the CDF "underlying event" data! Default JIMMY's "underlying event" is much too active!
- JIMMY 325 (PTJIM = 3.25 GeV/c) fits the energy in the "underlying event" but does so by producing too many particles (*i.e.* it is too soft). See my talk tomorrow!
- We are making good progress in understanding and modeling the "underlying event". However, we do not yet have a perfect fit to all the features of the "underlying event". PYTHIA Tune A does not produce enough energy in the "underlying event"! See my talk tomorrow!

Proton Underlying Event Underlying Event Anti-Lepton

