B Physics: QCD Monte Carlo Model Predictions

Run 2 Workshop on QCD
CDF B-Group Meeting
Run 2 Workshop of B Physics

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and
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http://www.phys.ufl.edu/~rfield/cdf/Bplots_feb25.pdf

Goals:

- Compare the LO parton level predictions of Herwig, Isajet, and Pythia with the NLO MRSR2 predictions.
- Compare the LO parton level predictions with the LO hadron level predictions (Herwig, Isajet, Pythia).
- Compare the LO hadron level predictions of Herwig, Isajet, and Pythia.

63 Plots!

Outline:

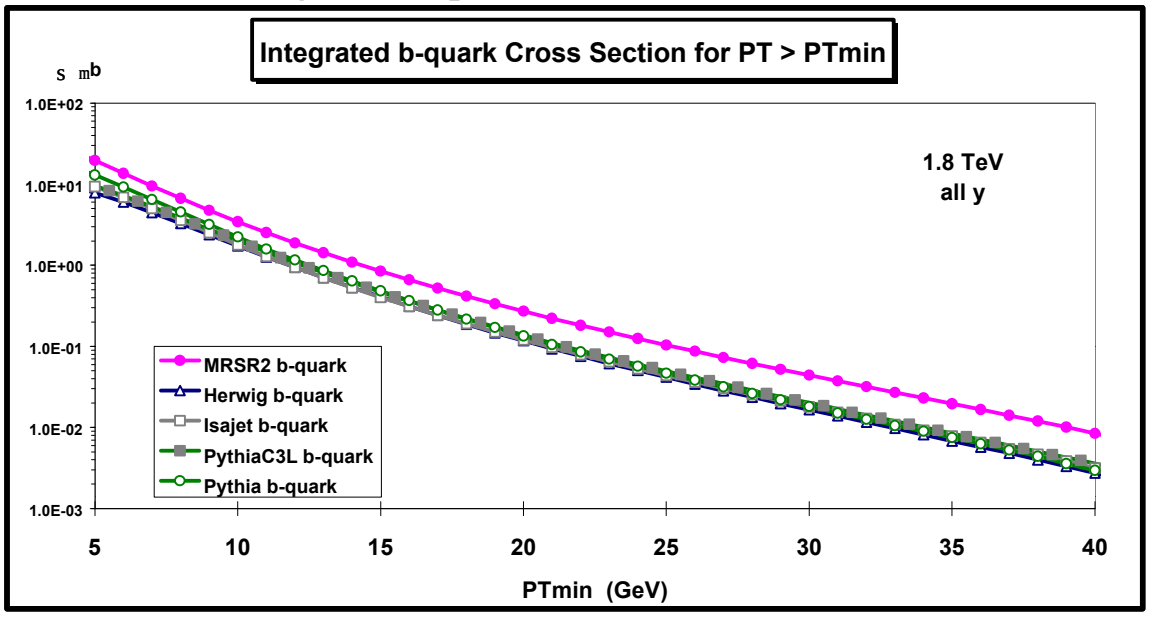
- Integrated Cross Sections (parton level)
- Transverse Momentum Distributions (parton level)
- Pseudo-Rapidity & Rapidity Distributions (parton level)
- Integrated Cross Sections (hadron level)
- Transverse Momentum Distributions (hadron level)
- PT Distributions Parton/Hadron (fragmentation)
- Strange Quark Production fs/(fu+fd) (fragmentation)
- Y and h Distributions Hadron versus Parton
- Comparisons between 1.8 TeV and 2.0 TeV
- Azimuthal Df Correlations Hadron and Parton
- PT Correlations Hadron and Parton (PT_1-PT_2)
- Pseudo-Rapidity Correlations: ds/dh_1dh_2 & $R(h_1,h_2)$

This Talk

QCD Monte Carlo Models (default parameters):
Herwig 5.9 (DO1.1, L = 0.18 GeV)
Isajet 7.32 (CTEQ3L, L = 0.20 GeV)
Pythia 6.115 (GRV94LO, L = 0.23 GeV)
Pythia 6.115 (CTEQ3L, L = 0.18 GeV)

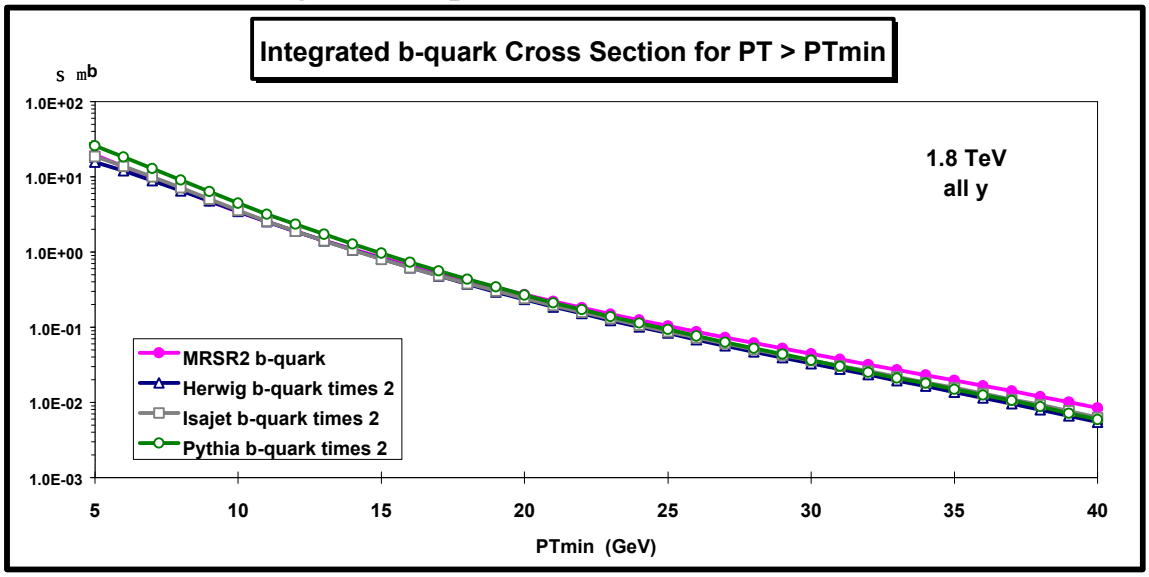
B Physics: Cross Sections

Parton Level: Integrated b-quark Cross Section for PT > PTmin



Plot shows s(PT>PTmin) (in mb) for b-quarks at 1.8 TeV (all Y).

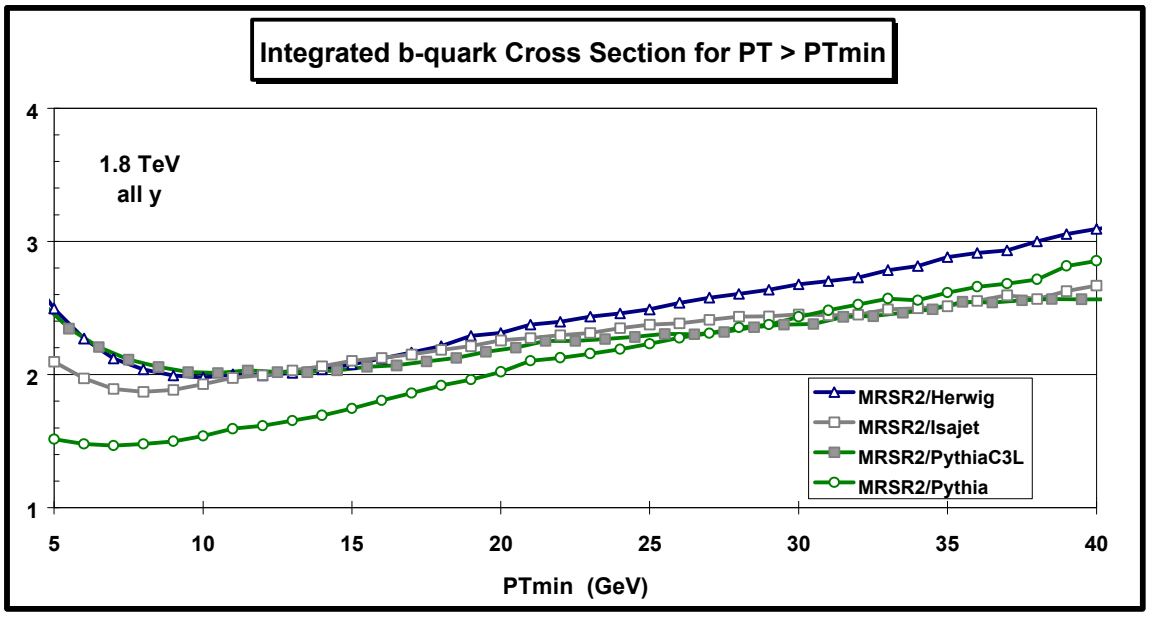
Parton Level: Integrated b-quark Cross Section for PT > PTmin



Plot shows s(PT>PTmin) (in mb) for b-quarks at 1.8 TeV (all Y). Herwig, Isajet, and Pythia have been increased by a factor of two.

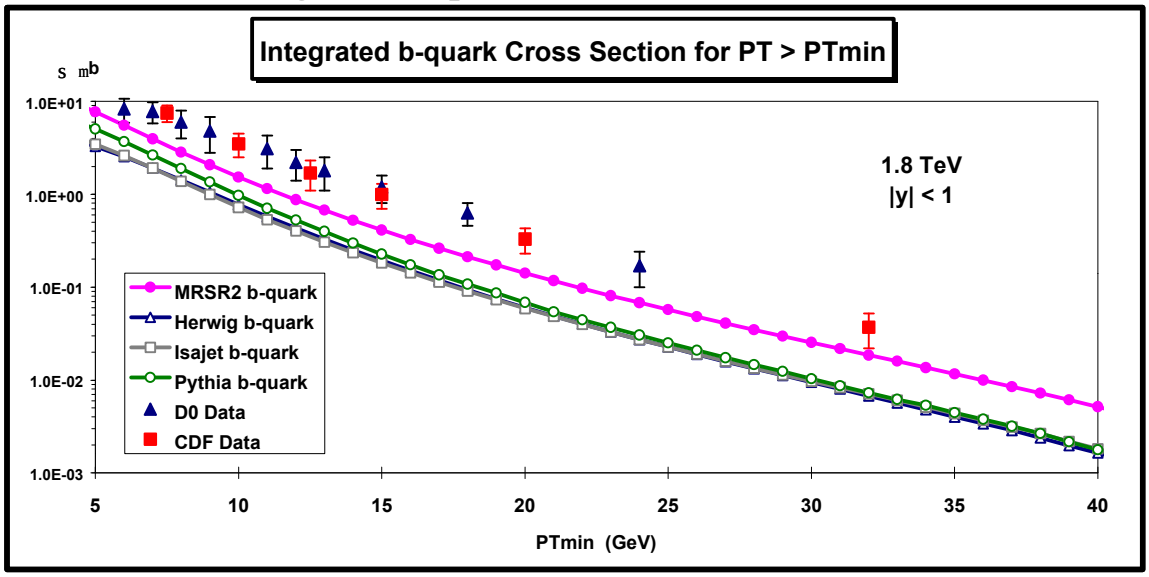
B Physics: Cross Sections

Parton Level: Ratio MRSR2/Monte-Carlos



Plot shows the ratio of s(PT>PTmin) for b-quarks at 1.8 TeV (all Y) from MRSR2 to Herwig, Isajet, Pythia, and PythiaC3L.

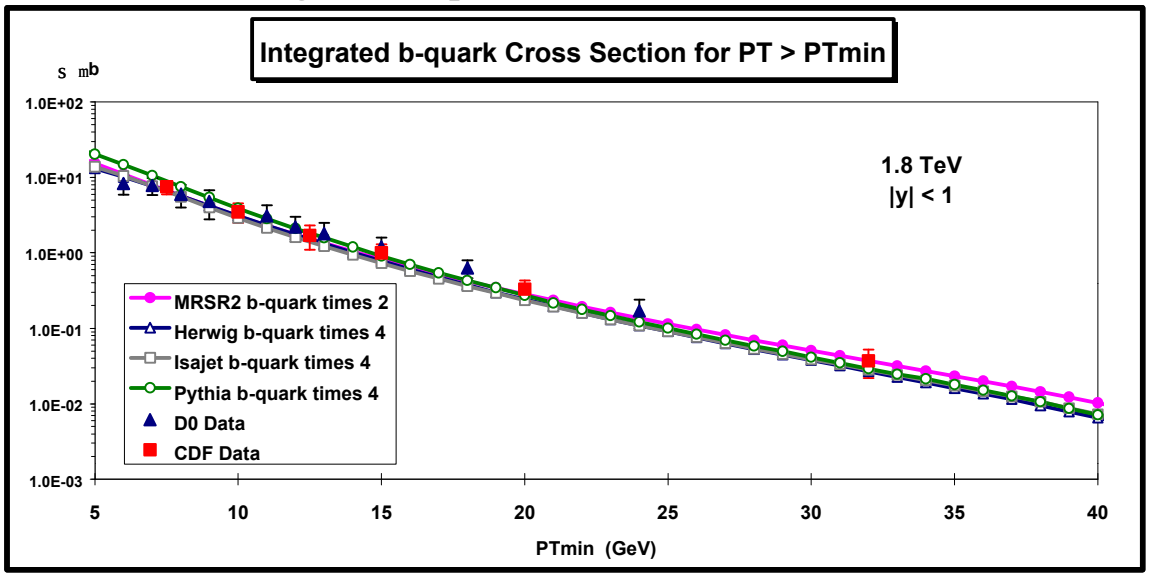
Parton Level: Integrated b-quark Cross Section for PT > PTmin



Plot shows s(PT>PTmin) (in mb) for b-quarks at 1.8 TeV (|Y|<1).

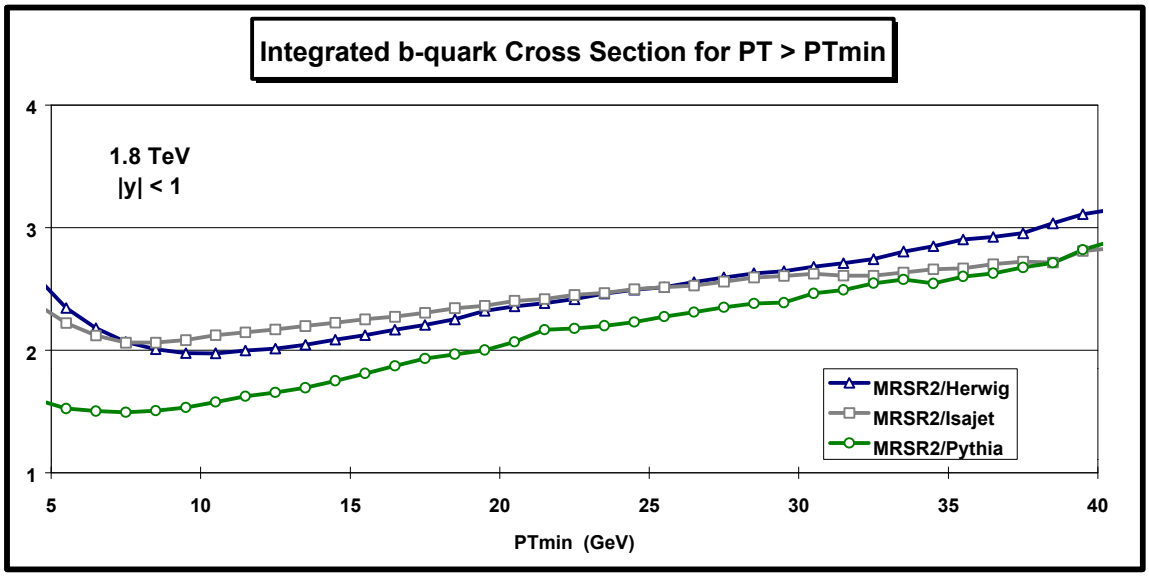
B Physics: Cross Sections

Parton Level: Integrated b-quark Cross Section for PT > PTmin



Plot shows s(PT>PTmin) (in mb) for b-quarks at 1.8 TeV (|Y|<1). MRSR2 has been increased by a factor of two and Herwig, Isajet, and Pythia have been increased by a factor of four.

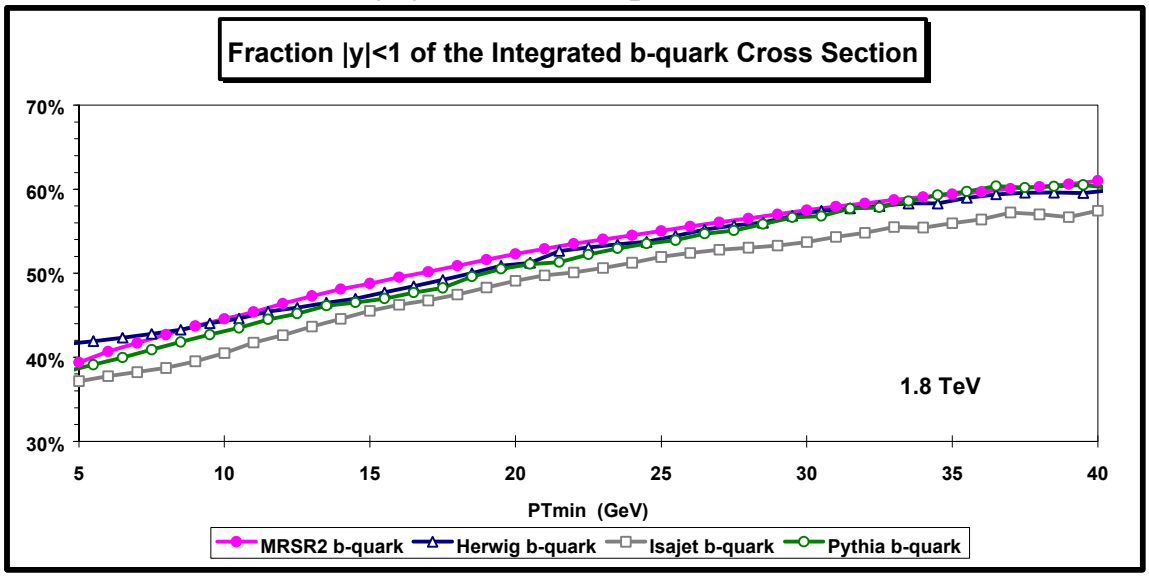
Parton Level: Ratio MRSR2/Monte-Carlos



Plot shows the ratio of s(PT>PTmin) for b-quarks at 1.8 TeV (|Y| < 1) from MRSR2 to Herwig, Isajet, and Pythia.

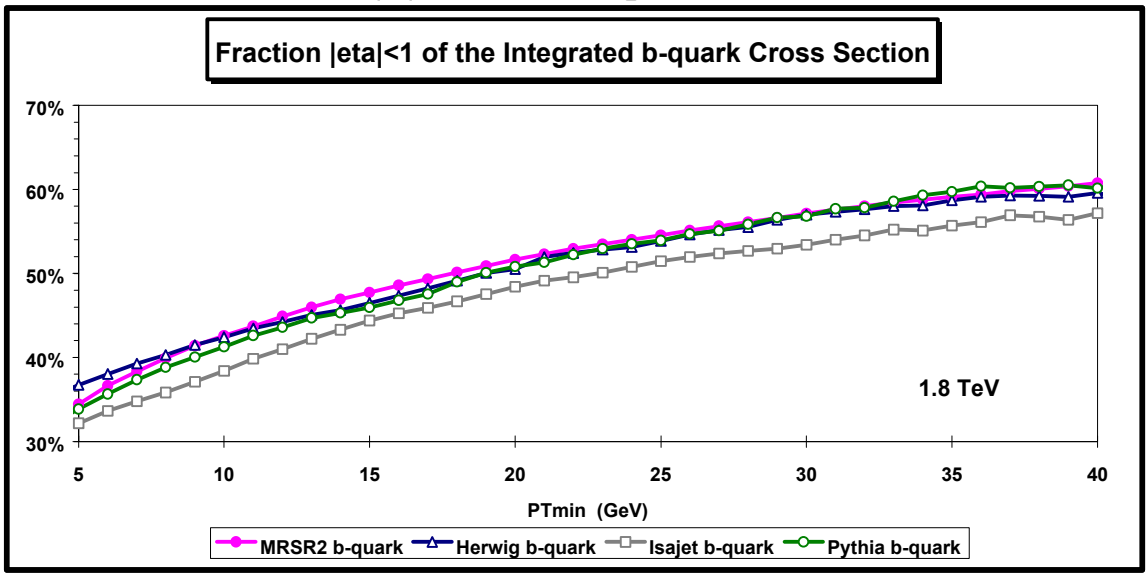
B Physics: Cross Sections

Parton Level: Fraction |Y| < 1 of the b-quark Cross Section



Plot shows the fraction |Y| < 1 of the b-quark integrated cross section (PT < PTmin).

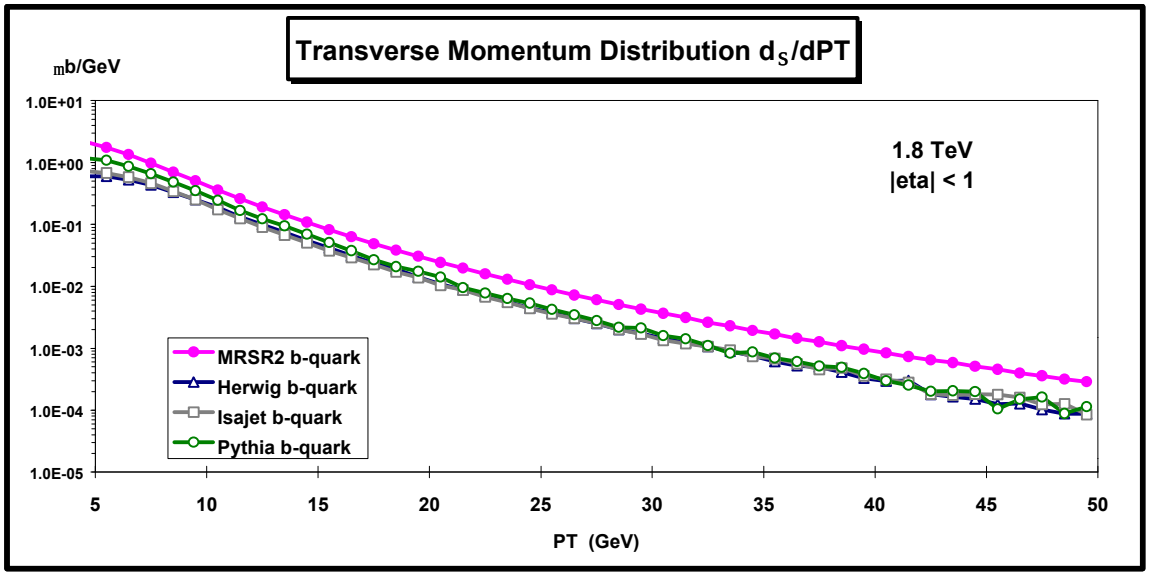
Parton Level: Fraction |h| < 1 of the b-quark Cross Section



Plot shows the fraction |h| < 1 of the b-quark integrated cross section (PT < PTmin).

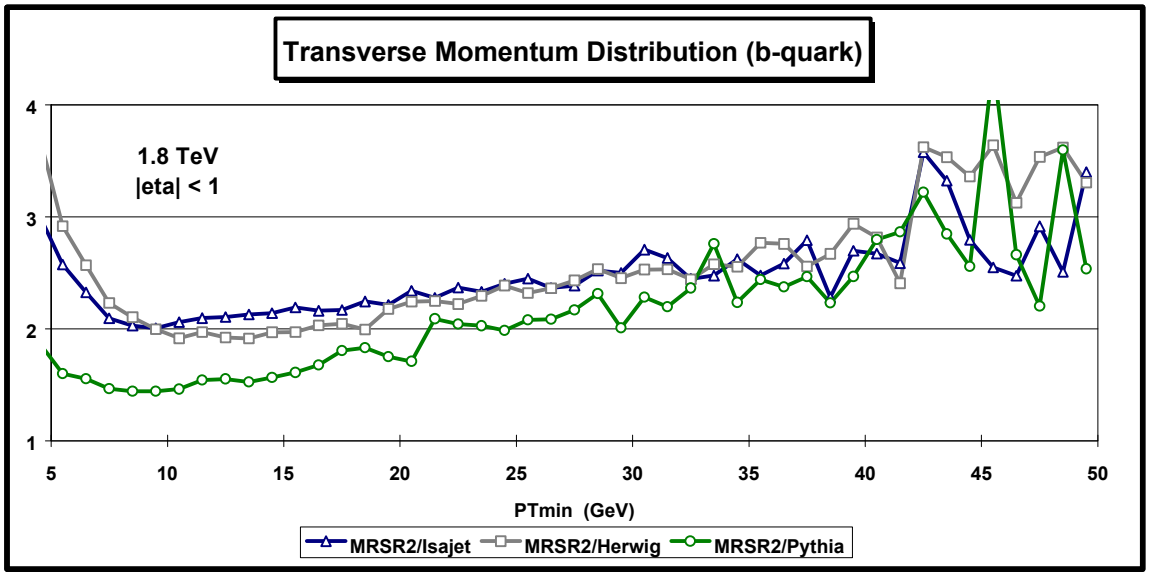
B Physics: PT Distributions

Parton Level: Transverse Momentum Distribution (|h| < 1)



Plot shows dσ/dPT (in mb/GeV) for b-quarks at 1.8 TeV (|h|<1).

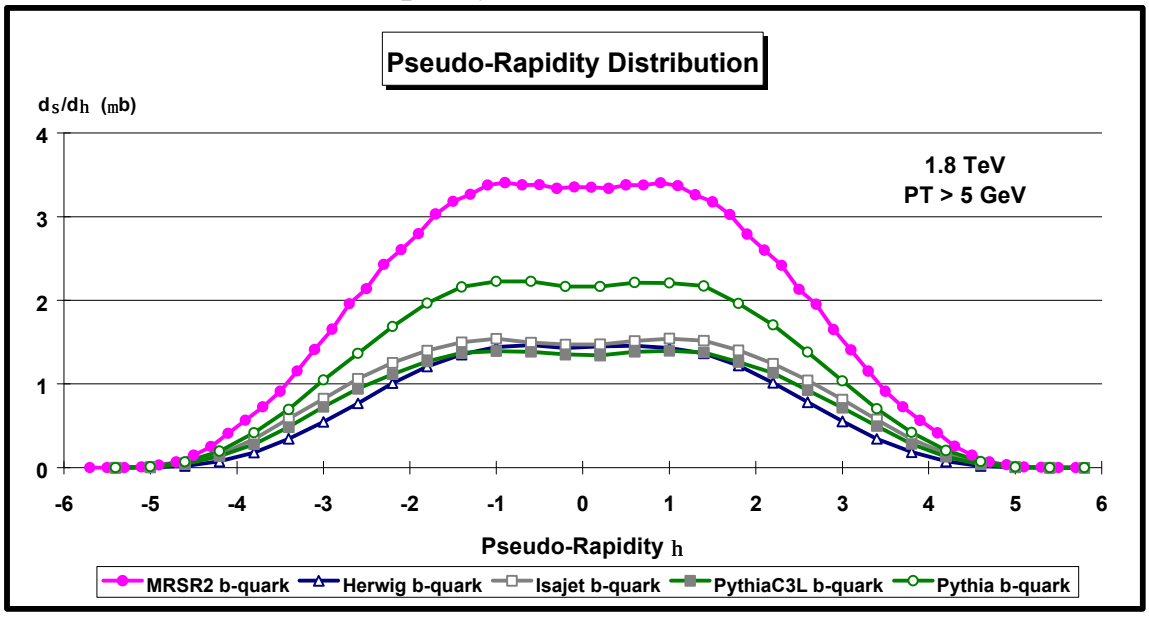
Parton Level: Transverse Momentum Distribution (|h| < 1)



Plot shows the ratio of dσ/dPT for b-quarks at 1.8 TeV (|h| < 1) from MRSR2 to Herwig, Isajet, and Pythia.

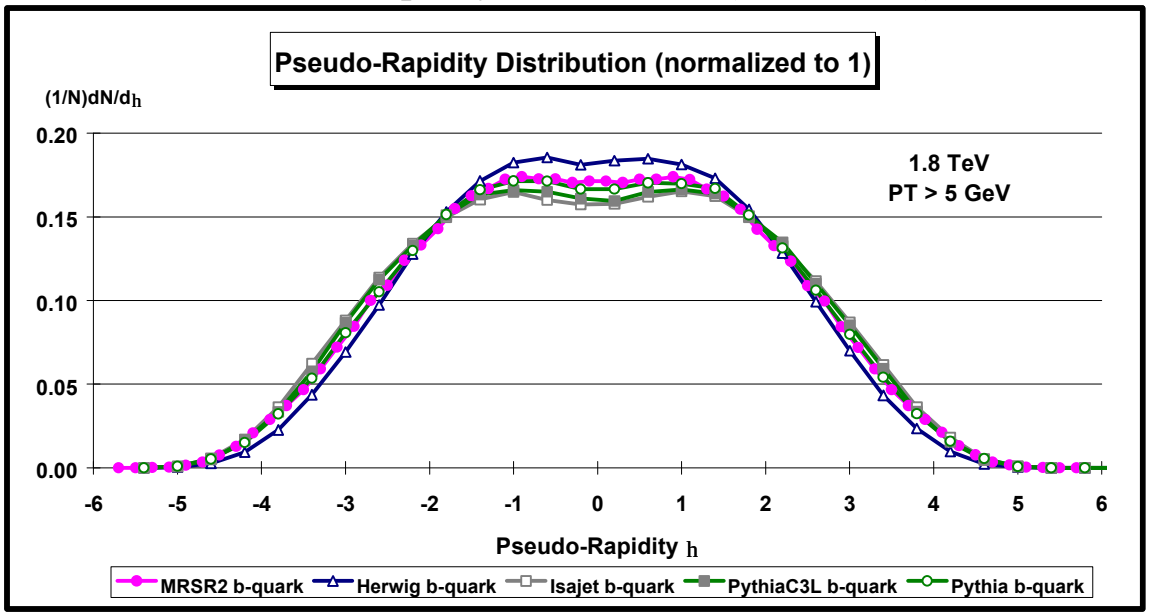
B Physics: Pseudo-Rapidity Distributions

Parton Level: Pseudo-Rapidity Distributions (PT > 5 GeV)



Plot shows ds/dh (in mb) for b-quarks at 1.8 TeV (PT > 5 GeV).

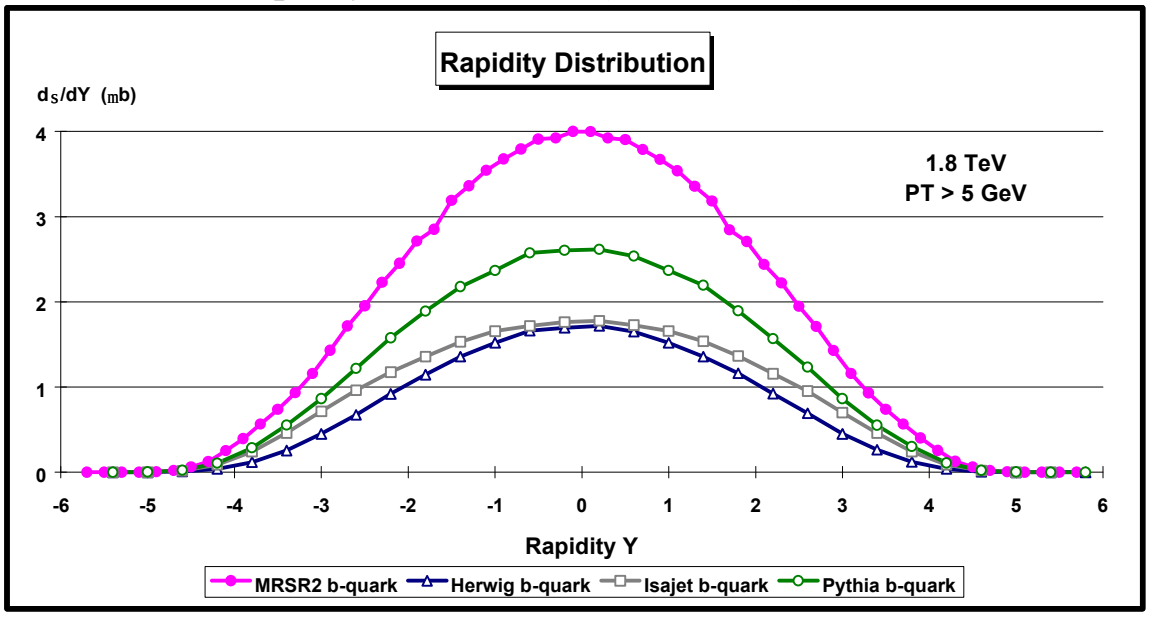
Parton Level: Pseudo-Rapidity Distributions (PT > 5 GeV)



Plot shows (1/N)dN/dh (normalized to 1) for b-quarks at 1.8 TeV (PT > 5 GeV).

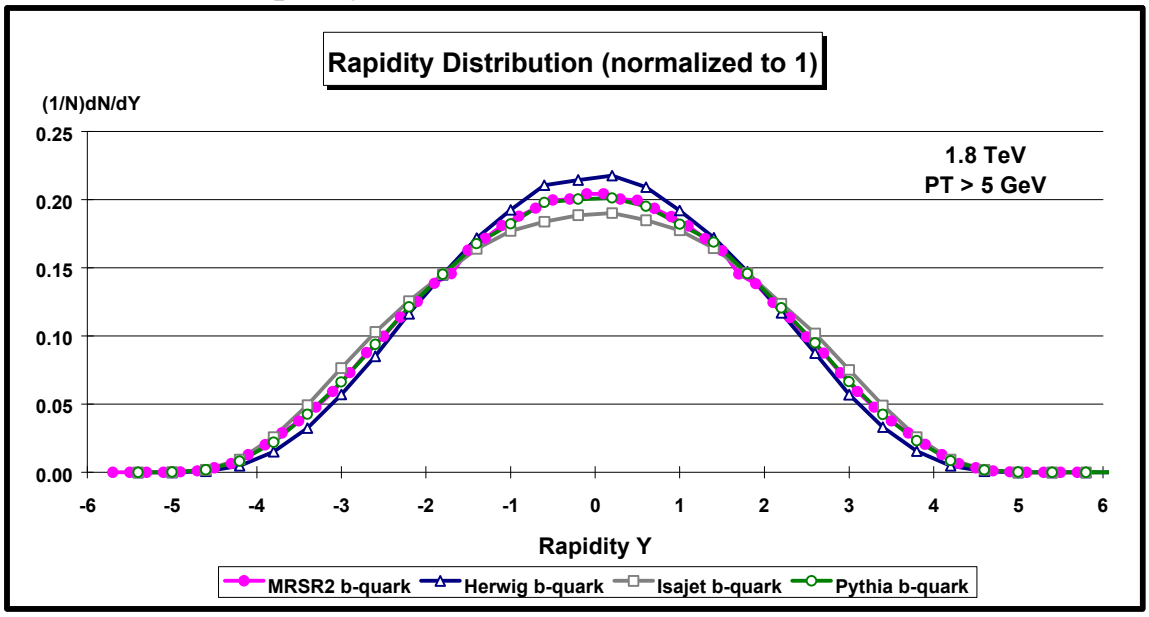
B Physics: Rapidity Distributions

Parton Level: Rapidity Distributions (PT > 5 GeV)



Plot shows ds/dY (in mb) for b-quarks at 1.8 TeV (PT > 5 GeV).

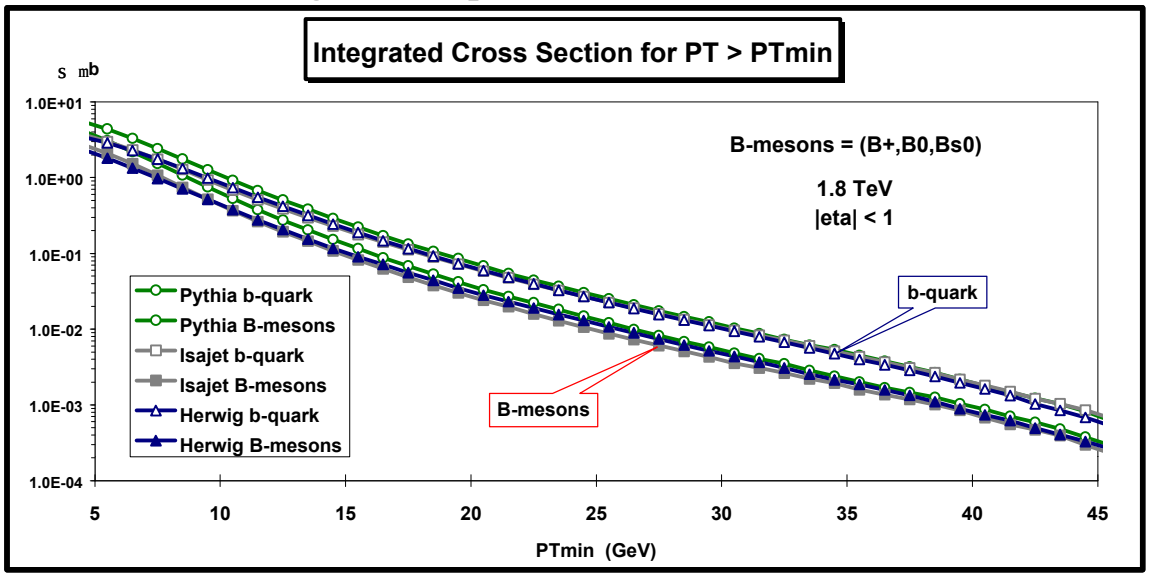
Parton Level: Rapidity Distributions (PT > 5 GeV)



Plot shows (1/N)dN/dY (normalized to 1) for b-quarks at 1.8 TeV (PT > 5 GeV).

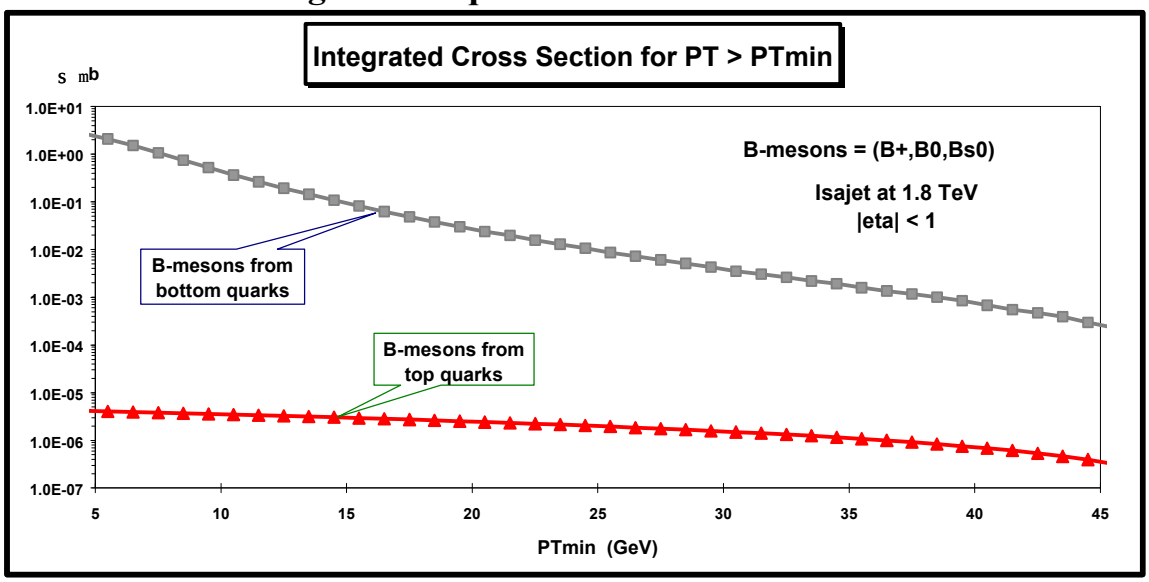
B Physics: Cross Sections

Hadron Level: Integrated B-quark Cross Section for PT > PTmin



Plot shows σ(PT>PTmin) (in mb) for B-mesons (B^+,B^0,B_s^0) and b-quarks at 1.8 TeV (|h| < 1).

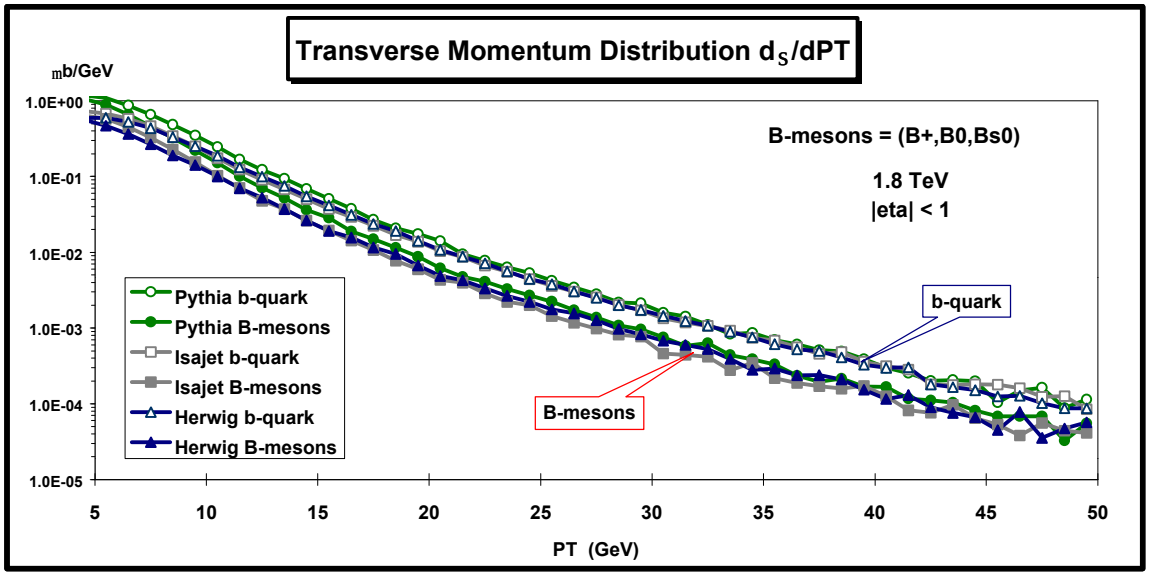
Hadron Level: Integrated B-quark Cross Section for PT > PTmin



Plot shows σ(PT>PTmin) (in mb) for B-mesons (B^+,B^0,B_s^0) from b and t-quarks 1.8 TeV (|h| < 1).

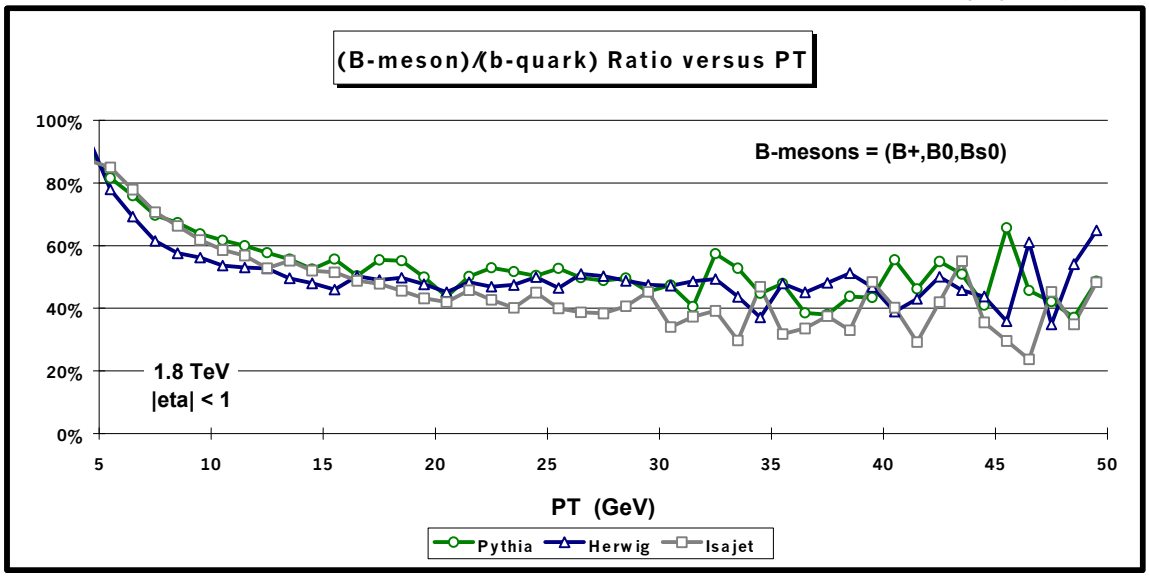
B Physics: PT Distributions

Parton & Hadron Level: Transverse Momentum Distribution (|h| < 1)



Plot shows ds/dPT (in mb/GeV) for B-mesons (B^+,B^0,B_s^0) and for the b-quark at 1.8 TeV (|h|<1).

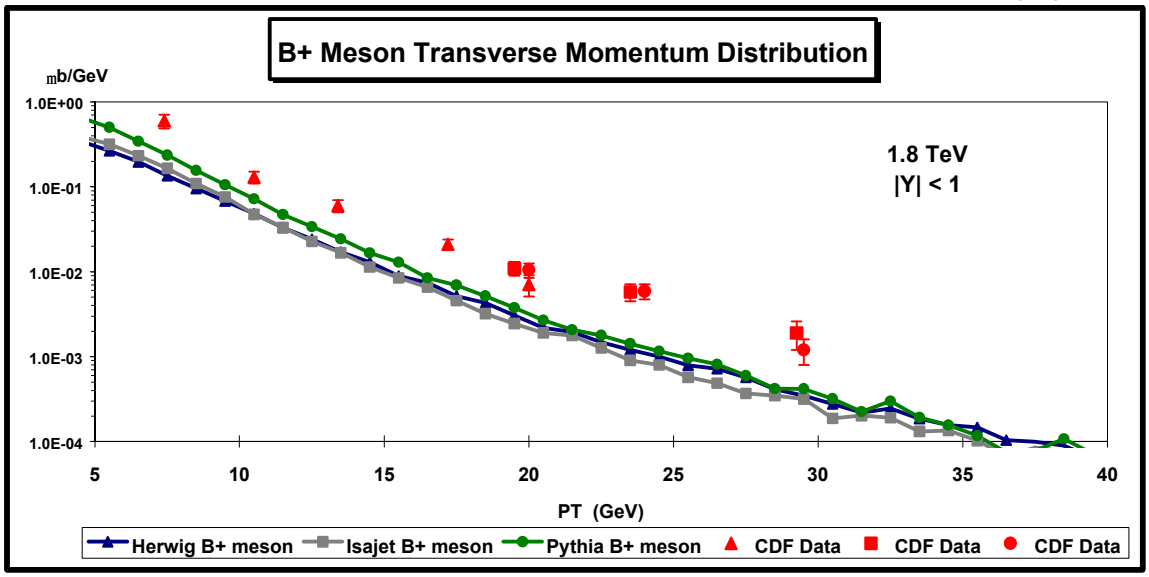
Hadron/Parton Level: Transverse Momentum Distribution (|h| < 1)



Plot shows the ratio of ds/dPT (|h| < 1) for B-mesons (B^+,B^0,B_s^0) to b-quark at 1.8 TeV.

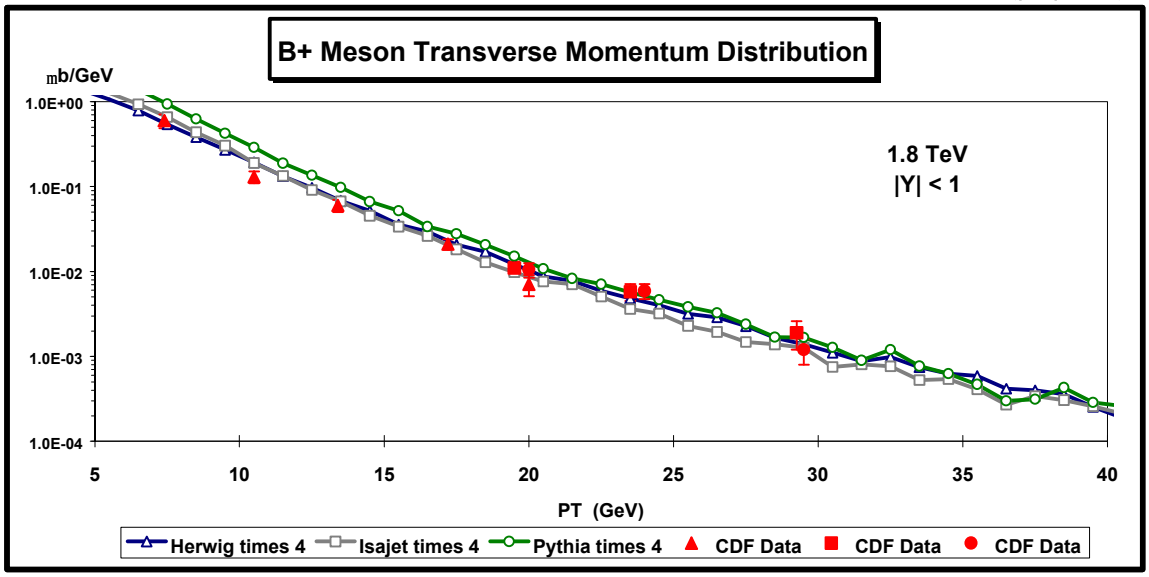
B Physics: PT Distributions

Hadron Level: B+ Meson Transverse Momentum Distribution (|Y| < 1)



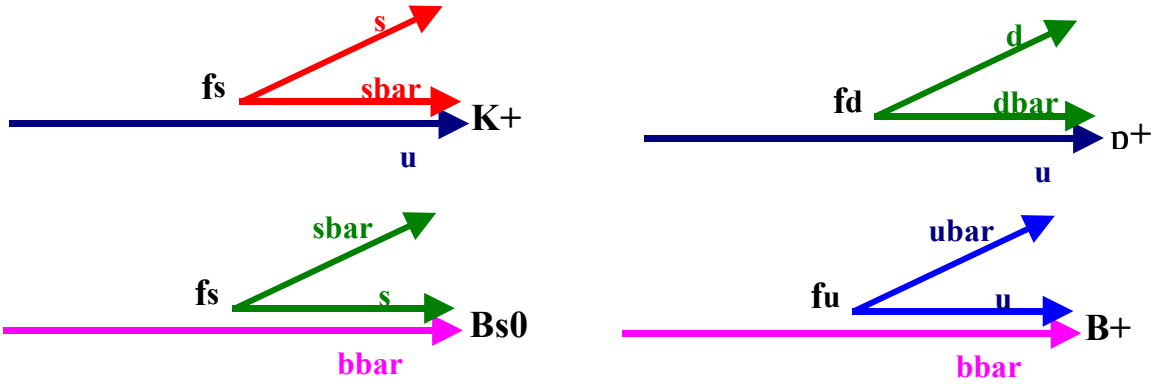
Plot shows $d\sigma/dPT$ (in mb/GeV) for B^+ mesons at 1.8 TeV (|Y| < 1).

Hadron Level: B+ Meson Transverse Momentum Distribution (|Y| < 1)



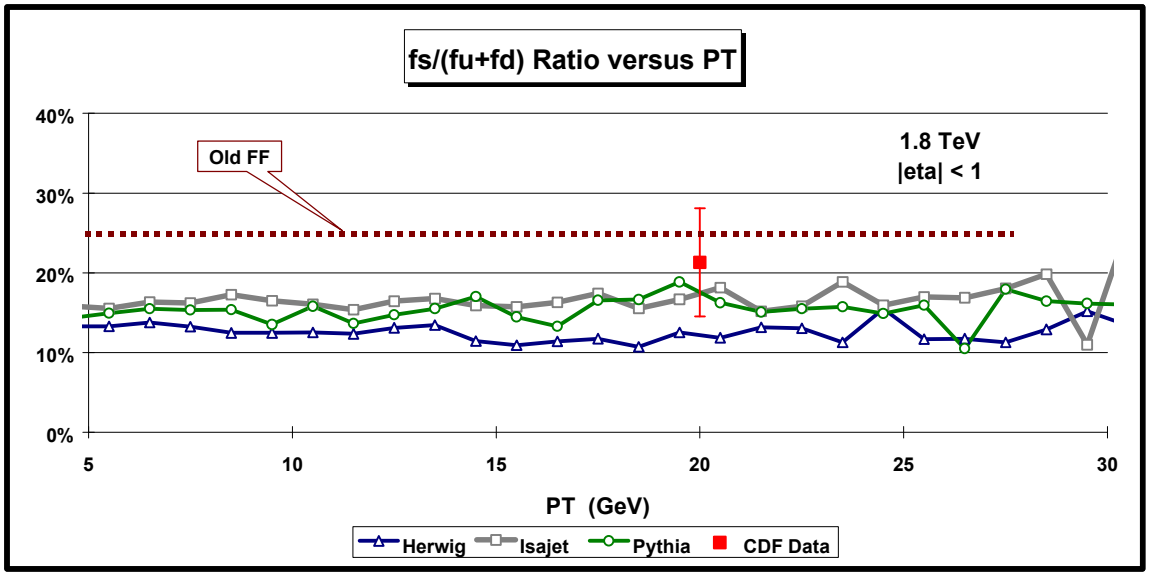
Plot shows $d\sigma/dPT$ (in mb/GeV) for B^+ mesons at 1.8 TeV (|Y| < 1). The QCD Monte-Carlo predictions have been increased by a factor of four.

B Physics: Fragmentation



	CDF Run I	Old FF
fu	0.408+/-0.068	0.4
fd	0.344+/-0.039	0.4
fs	0.159+/-0.026	0.2
fbaryon	0.089+/-0.029	0.0
fs/(fu+fd)	0.213+/-0.068	0.25

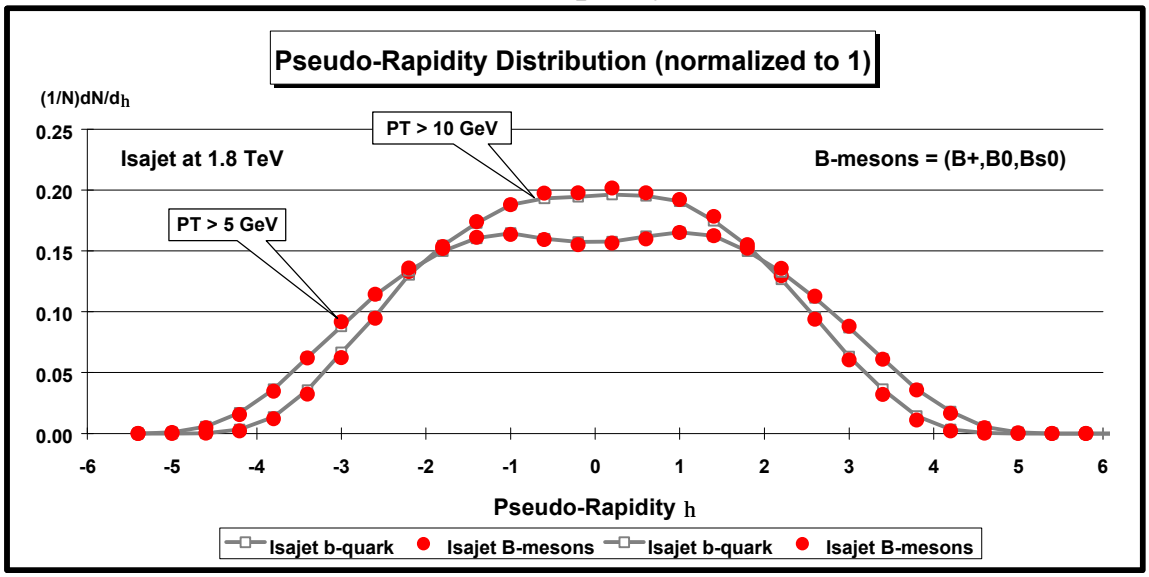
Hadron Level: fs/(fu+fd) Ration versus PT (|h| < 1)



Plot shows the ratio fs/(fu+fd) at 1.8 TeV (|h| < 1), where fs = ds/dPT(B_s^0), fu = ds/dPT(B^+), and fd = ds/dPT(B^0).

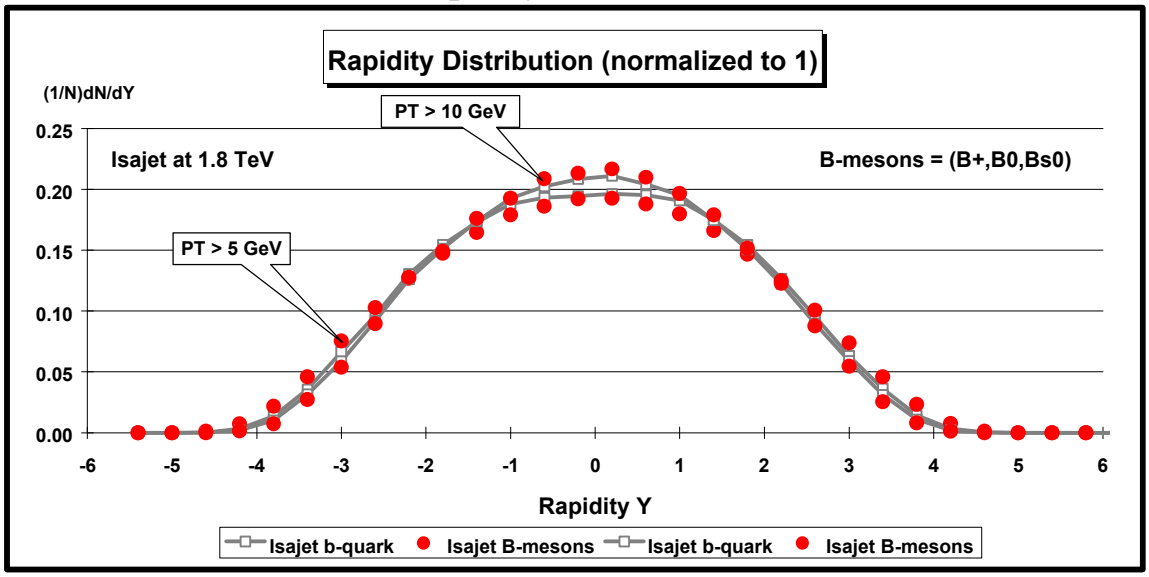
B Physics: Y and h Distributions

Parton & Hadron Level: Pseudo-Rapidity Distribution



Plot shows (1/N)dN/dh (normalized to 1) for B-mesons (B^+,B^0,B_s^0) and for the b-quark at 1.8 TeV (PT > 5 GeV and PT > 10 GeV).

Parton & Hadron Level: Rapidity Distribution



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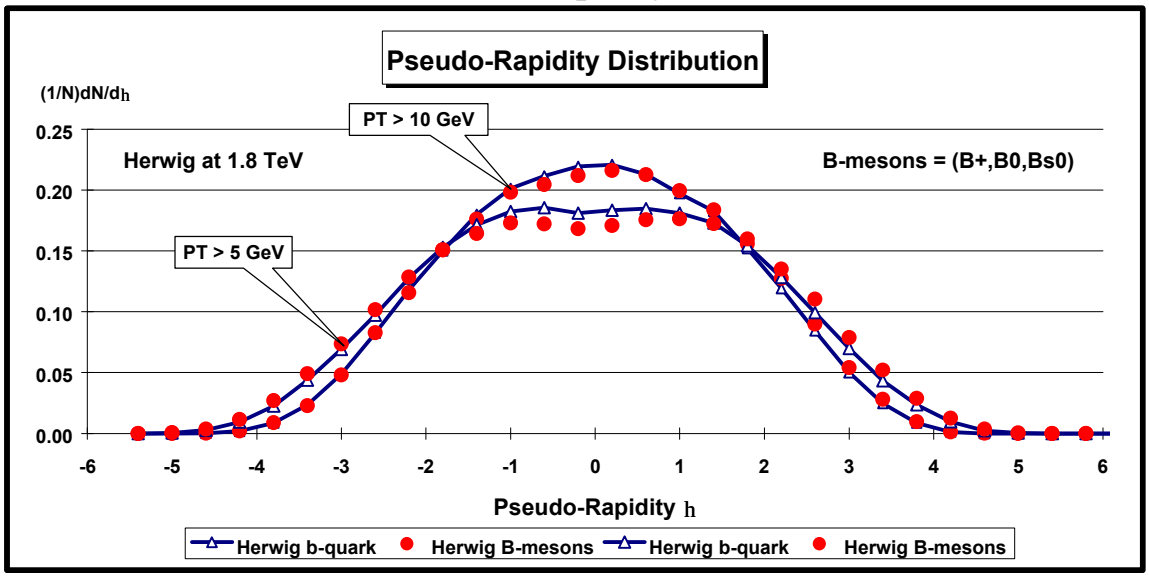
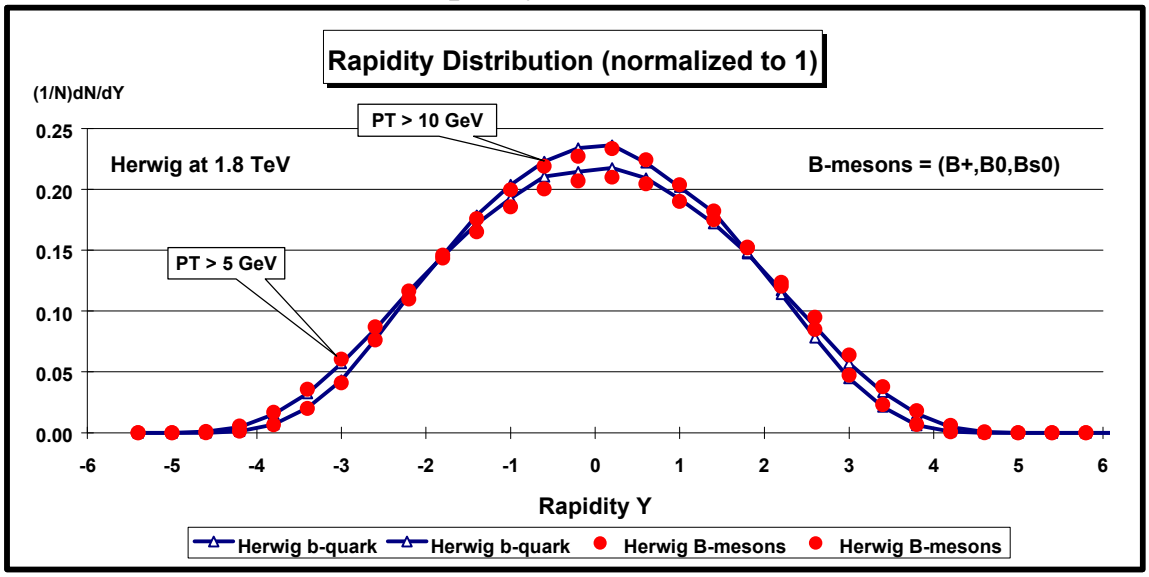
B Physics: Y and h Distributions

Parton & Hadron Level: Pseudo-Rapidity Distribution



Plot shows (1/N)dN/dh (normalized to 1) for B-mesons (B^+,B^0,B_s^0) and for the b-quark at 1.8 TeV (PT > 5 GeV and PT > 10 GeV).

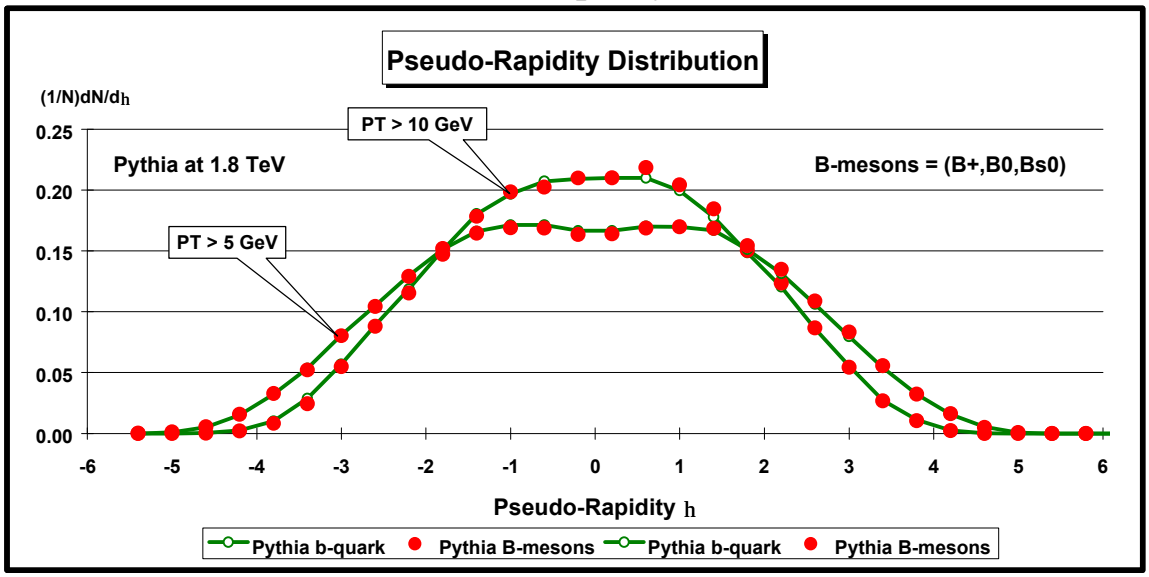
Parton & Hadron Level: Rapidity Distribution



Plot shows (1/N)dN/dY (normalized to 1) for B-mesons (B^+,B^0,B_s^0) and for the b-quark at 1.8 TeV (PT > 5 GeV and PT > 10 GeV).

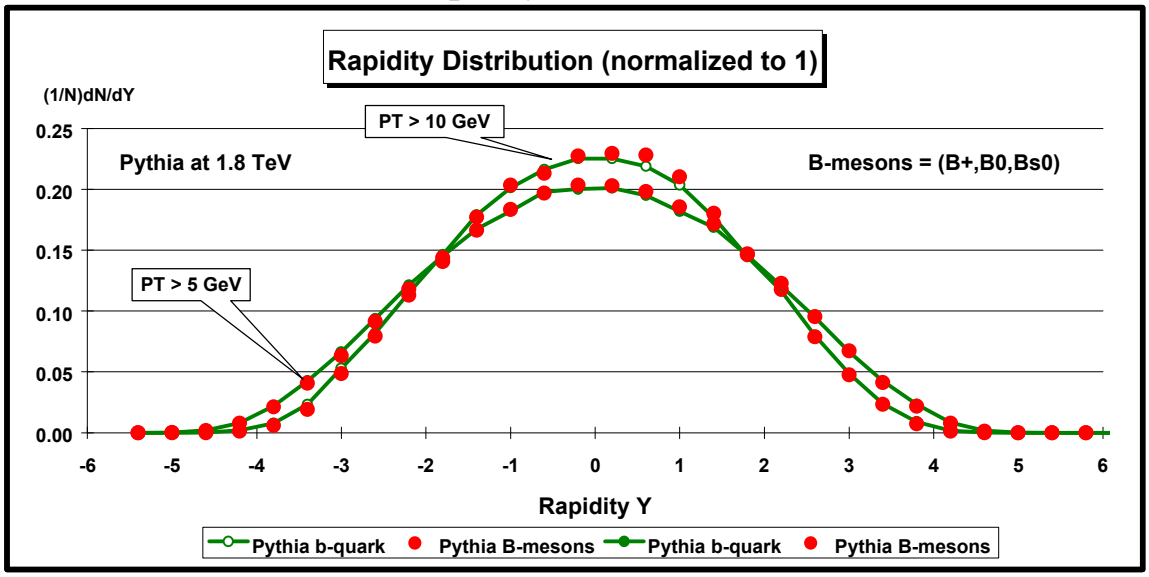
B Physics: Y and h Distributions

Parton & Hadron Level: Pseudo-Rapidity Distribution



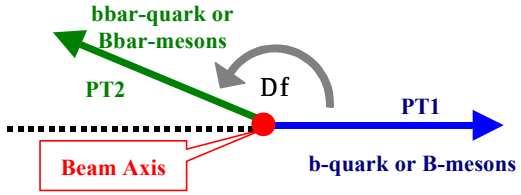
Plot shows (1/N)dN/dh (normalized to 1) for B-mesons (B^+,B^0,B_s^0) and for the b-quark at 1.8 TeV (PT > 5 GeV and PT > 10 GeV).

Parton & Hadron Level: Rapidity Distribution

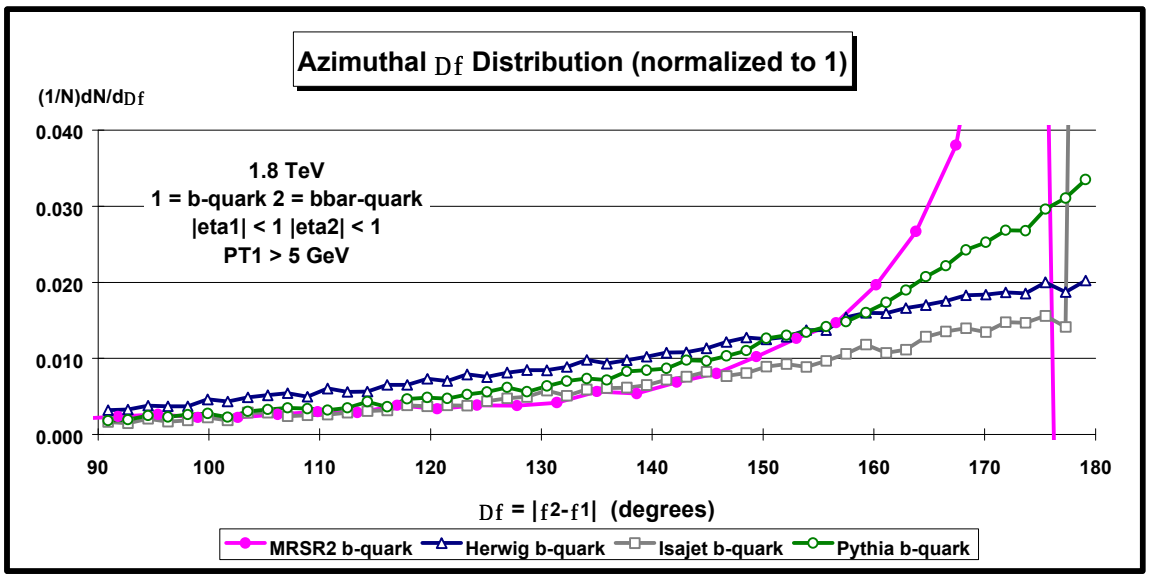


Plot shows (1/N)dN/dY (normalized to 1) for B-mesons (B^+,B^0,B_s^0) and for the b-quark at 1.8 TeV (PT > 5 GeV and PT > 10 GeV).

B Physics: Azimuthal Correlations



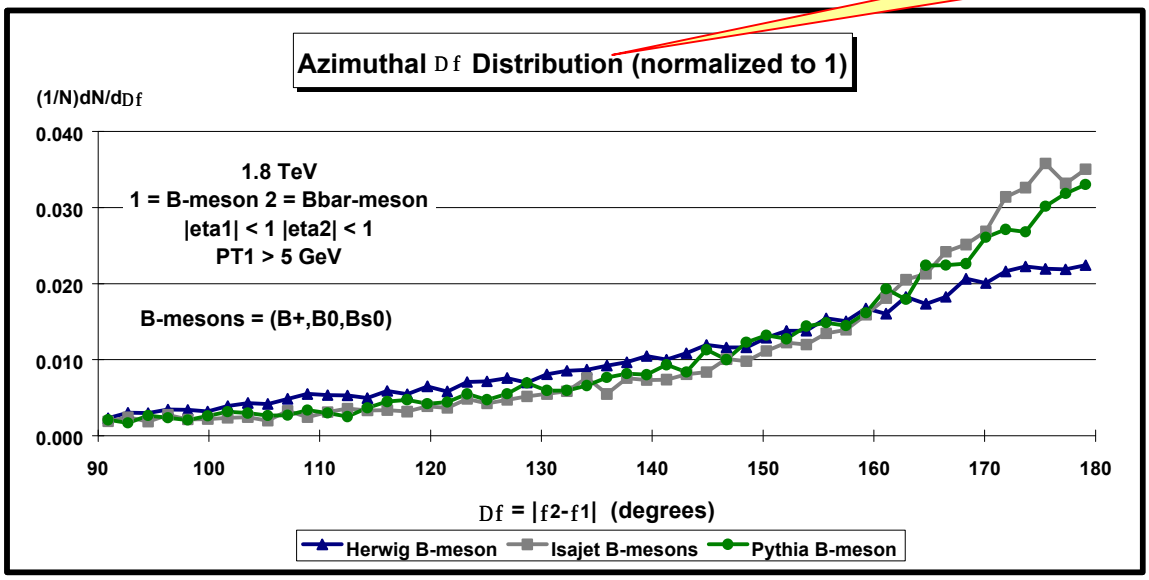
Parton Level: Azimuthal Df Distribution



Plot shows (1/N)dN/dDf (normalized to 1), where $Df = |f_2-f_1|$ for 1 = b-quark and 2 = bbar-quark at 1.8 TeV with $|h_1| < 1$, $|h_2| < 1$, and $PT_1 > 5$ GeV.

Measures intrensic PT, gluon radiation, fragmentation.

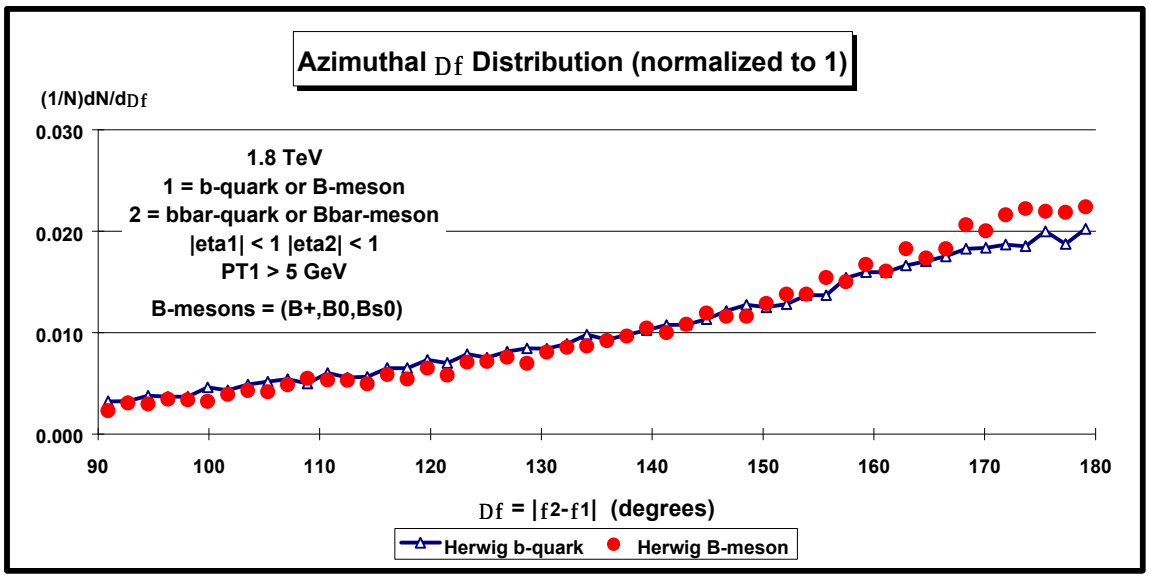
Hadron Level: Azimuthal Df Distribution



Plot shows (1/N)dN/dDf (normalized to 1), where $Df = |f_2-f_1|$ for 1 = B-mesons (B^+,B^0,B_s^0) and 2 = Bbar-mesons at 1.8 TeV with $|h_1| < 1$, $|h_2| < 1$, and $PT_1 > 5$ GeV.

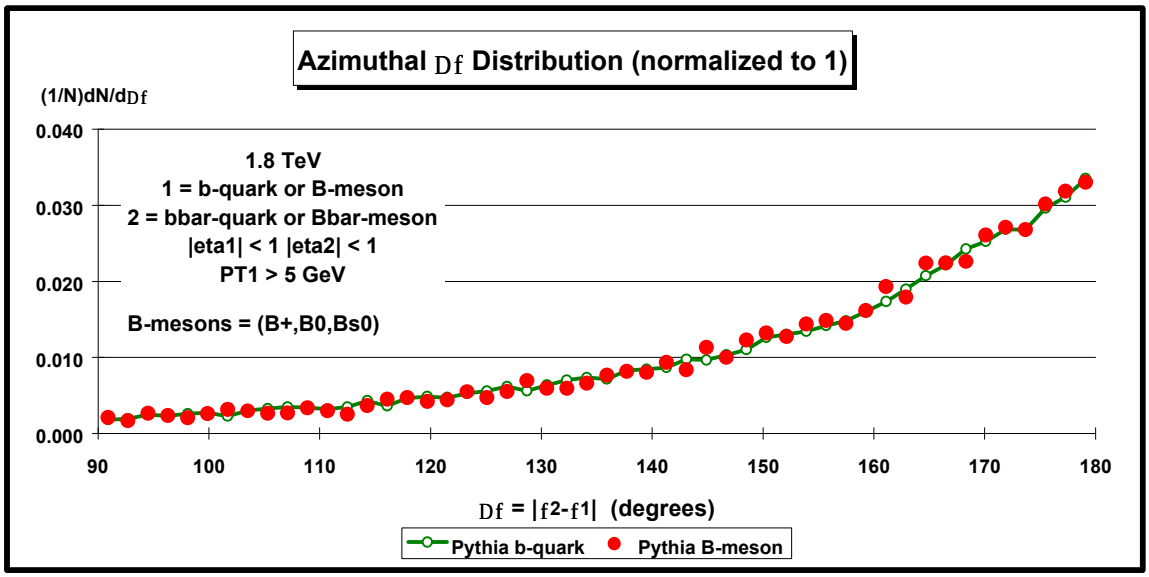
B Physics: Azimuthal Correlations

Parton & Hadron Level: Azimuthal Df Distribution



Plot shows (1/N)dN/dDf (normalized to 1), where $Df = |f_2 - f_1|$ for 1 = b-quark and 2 = bbar-quark and for 1 = B-mesons (B^+,B^0,B_s^0) and 2 = Bbar-mesons at 1.8 TeV with $|h_1| < 1$, $|h_2| < 1$, and $PT_1 > 5$ GeV.

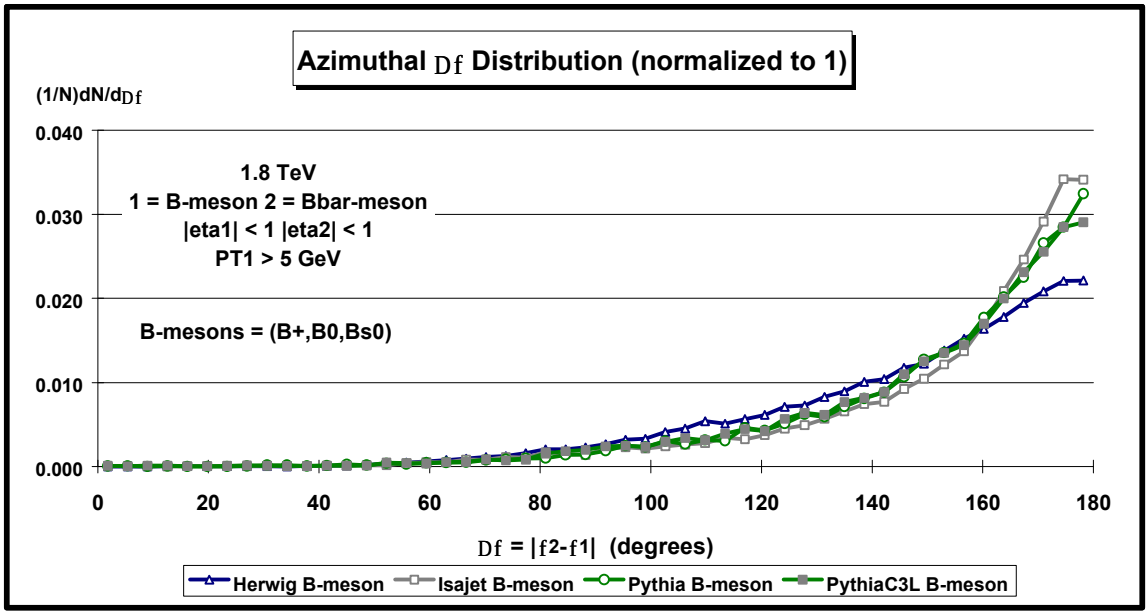
Parton & Hadron Level: Azimuthal Df Distribution



Plot shows (1/N)dN/dDf (normalized to 1), where $Df = |f_2 - f_1|$ for 1 = b-quark and 2 = bbar-quark and for 1 = B-mesons (B^+,B^0,B_s^0) and 2 = Bbar-mesons at 1.8 TeV with $|h_1| < 1$, $|h_2| < 1$, and $PT_1 > 5$ GeV.

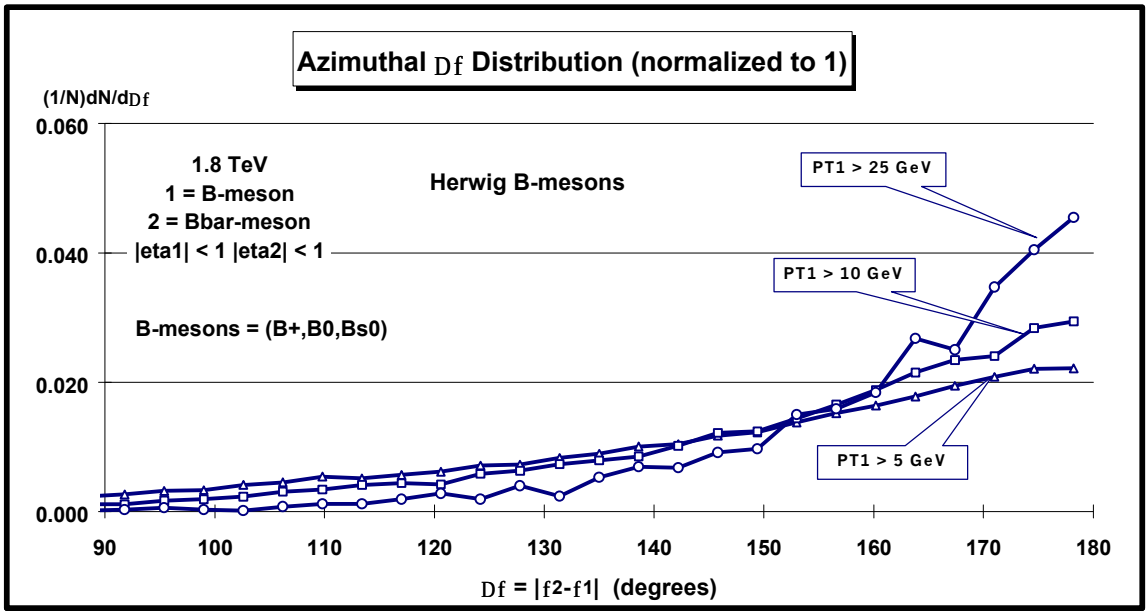
B Physics: Azimuthal Correlations

Hadron Level: Azimuthal Df Distribution



Plot shows (1/N)dN/dDf (normalized to 1), where $Df = |f_2-f_1|$ for 1 = B-mesons (B^+,B^0,B_s^0) and 2 = Bbar-mesons at 1.8 TeV with $|h_1| < 1$, $|h_2| < 1$, and $PT_1 > 5$ GeV.

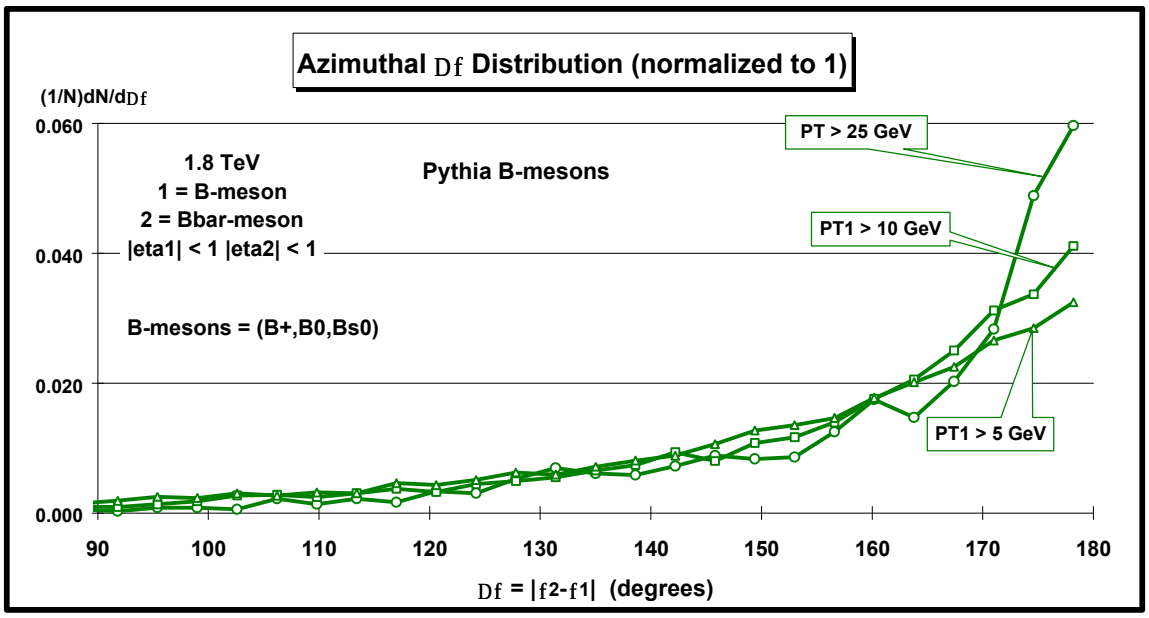
Hadron Level: Azimuthal Df Distribution



Plot shows (1/N)dN/dDf (normalized to 1), where $Df = |f_2-f_1|$ for 1 = B-mesons (B^+,B^0,B_s^0) and 2 = Bbar-mesons at 1.8 TeV with $|h_1| < 1$, $|h_2| < 1$, and $PT_1 > 5$, 10, and 25 GeV.

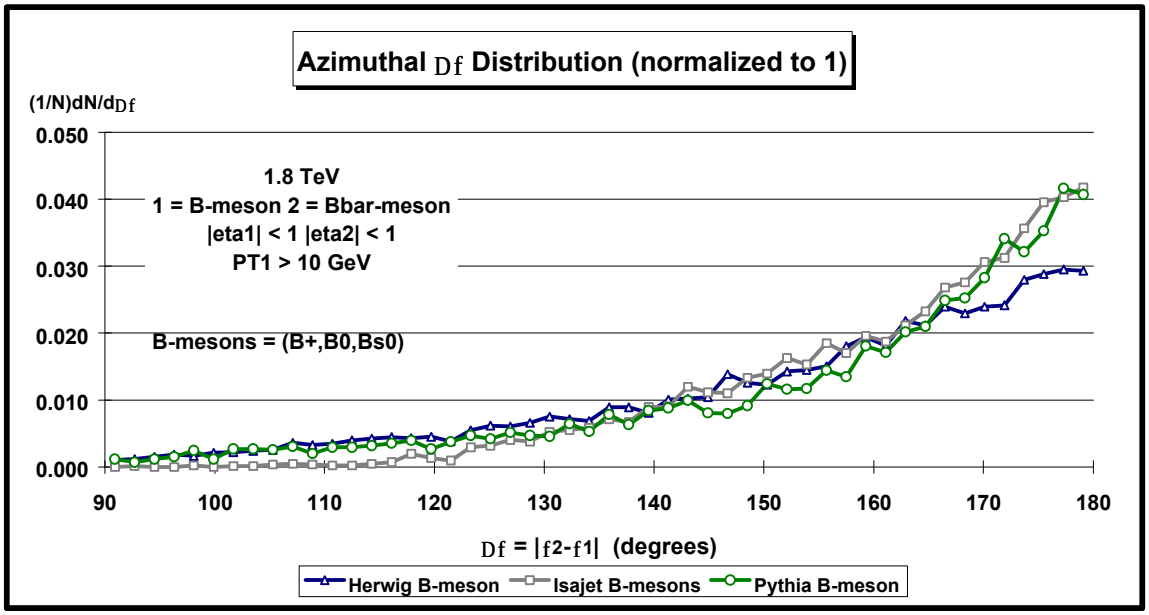
B Physics: Azimuthal Correlations

Hadron Level: Azimuthal Df Distribution



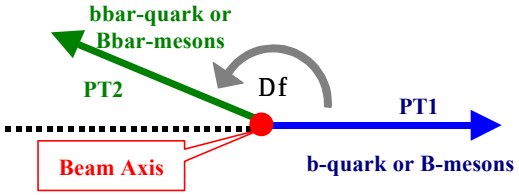
Plot shows (1/N)dN/dDf (normalized to 1), where $Df = |f_2-f_1|$ for 1 = B-mesons (B^+,B^0,B_s^0) and 2 = Bbar-mesons at 1.8 TeV with $|h_1| < 1$, $|h_2| < 1$, and $PT_1 > 5$, 10, and 25 GeV.

Hadron Level: Azimuthal Df Distribution

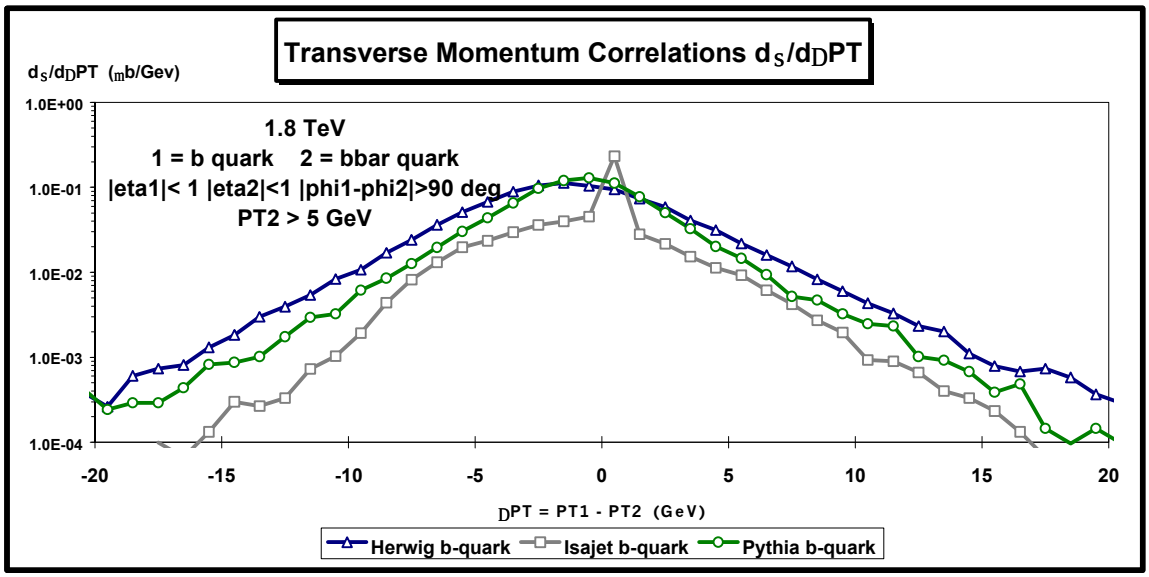


Plot shows (1/N)dN/dDf (normalized to 1), where $Df = |f_2-f_1|$ for 1 = B-mesons (B^+,B^0,B_s^0) and 2 = Bbar-mesons at 1.8 TeV with $|h_1| < 1$, $|h_2| < 1$, and $PT_1 > 10$ GeV.

B Physics: PT Correlations

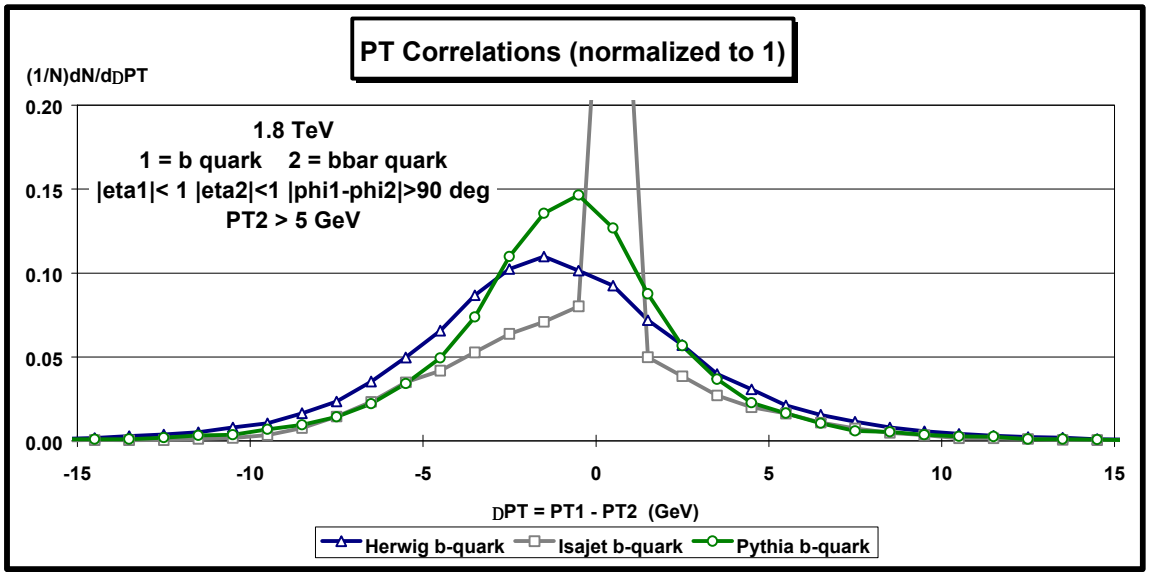


Parton Level: Transverse Momentum Correlations



Plot shows ds/dDPT (mb/GeV), where DPT = PT_1-PT_2 for 1 = b-quark and 2 = bbar-quark at 1.8 TeV with $|h_1| < 1$, $|h_2| < 1$, $|f_1-f_2| > 90^o$, and $PT_2 > 5$ GeV.

Parton Level: Transverse Momentum Correlations

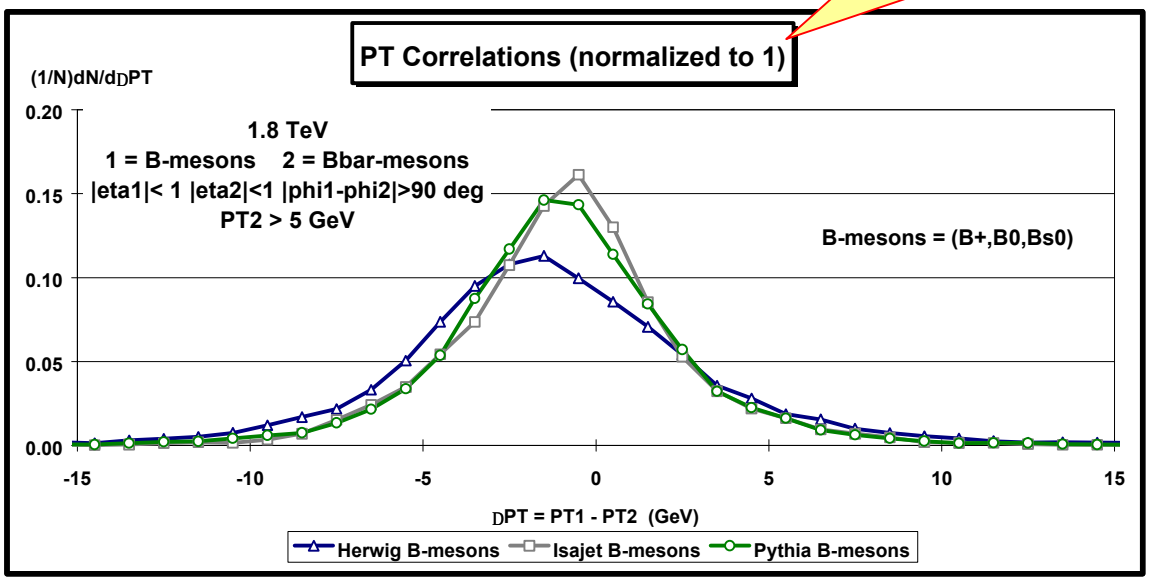


Plot shows (1/N)dN/dDPT (1/GeV), where DPT = PT_1-PT_2 for 1 = b-quark and 2 = bbar-quark at 1.8 TeV with $|h_1| < 1$, $|h_2| < 1$, $|f_1-f_2| > 90^o$, and $PT_2 > 5$ GeV.

B Physics: PT Correlations

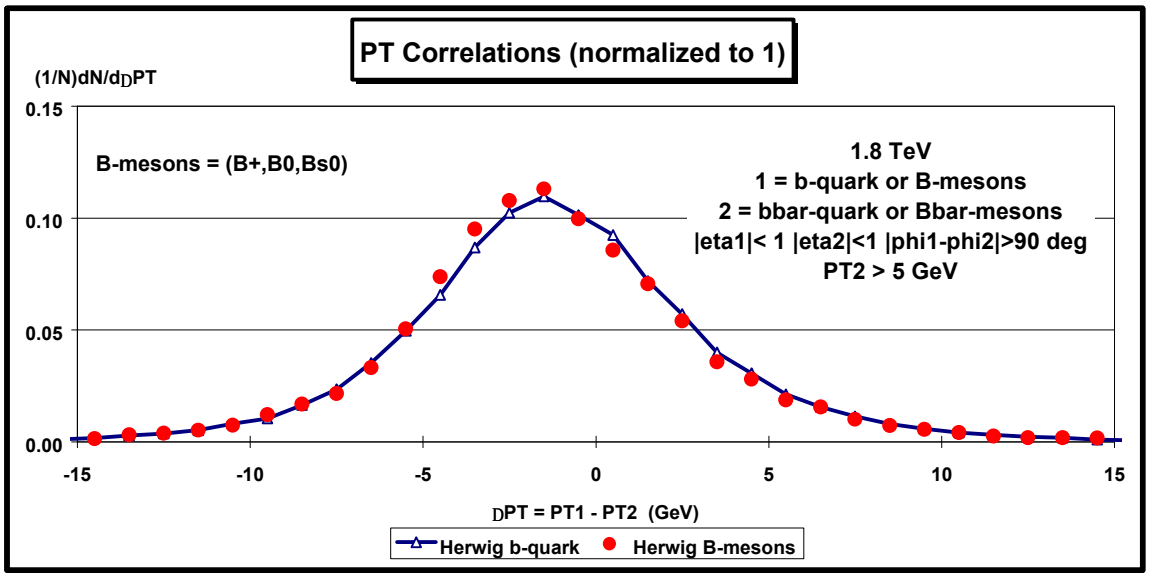
Measures intrensic PT, gluon radiation, and fragmentation.

Hadron Level: Transverse Momentum Correlations



Plot shows (1/N)dN/dDPT (1/GeV), where DPT = PT_1-PT_2 for 1 = B-mesons (B^+,B^0,B_s^0) and 2 = Bbar-mesons at 1.8 TeV with $|h_1| < 1$, $|h_2| < 1$, $|f_1-f_2| > 90^0$, and $PT_2 > 5$ GeV.

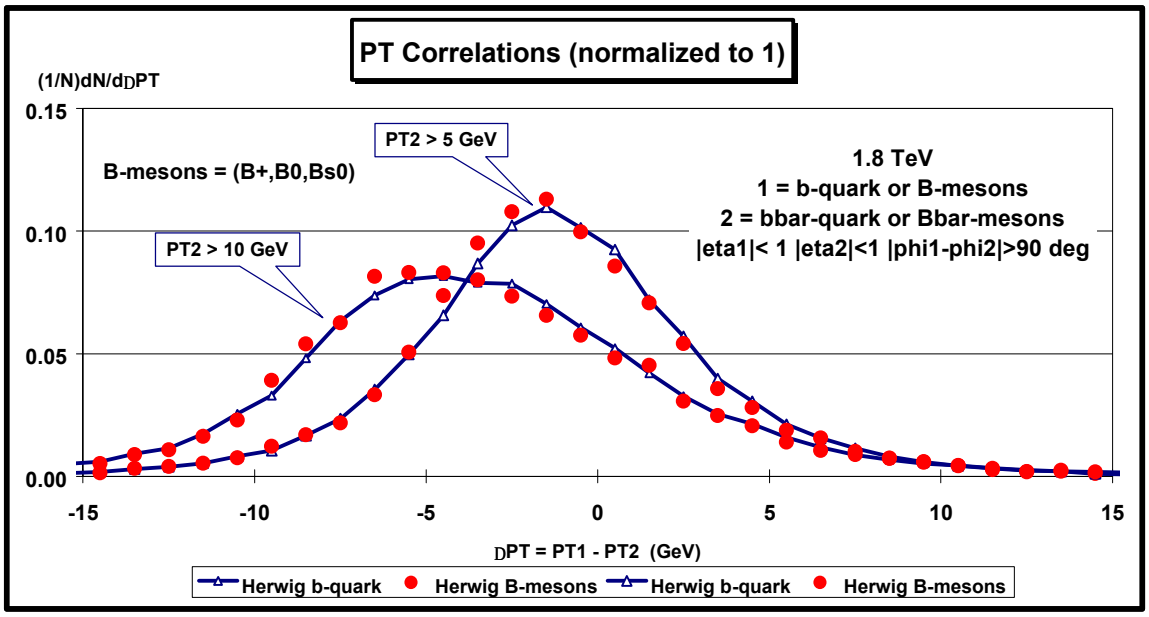
Parton & Hadron Level: Transverse Momentum Correlations



Plot shows (1/N)dN/dDPT (1/GeV), where DPT = PT_1-PT_2 for 1 = b-quark and 2 = bbar-quark and for 1 = B-mesons (B^+,B^0,B_s^0) and 2 = Bbar-mesons at 1.8 TeV with $|h_1| < 1$, $|h_2| < 1$, $|f_1-f_2| > 90^0$, and $PT_2 > 5$ GeV.

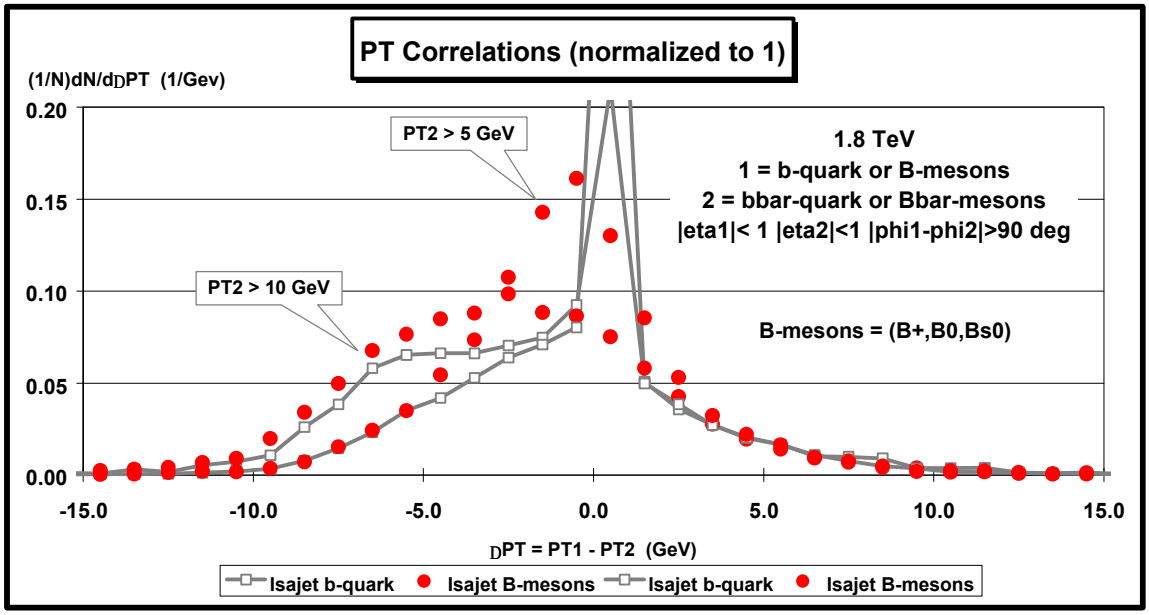
B Physics: PT Correlations

Parton & Hadron Level: Transverse Momentum Correlations



Plot shows (1/N)dN/dDPT (1/GeV), where DPT = PT_1-PT_2 for 1 = b-quark and 2 = bbar-quark and for 1 = B-mesons (B^+,B^0,B_s^0) and 2 = Bbar-mesons at 1.8 TeV with $|h_1| < 1$, $|h_2| < 1$, $|f_1-f_2| > 90^o$, and $PT_2 > 5$ and 10 GeV.

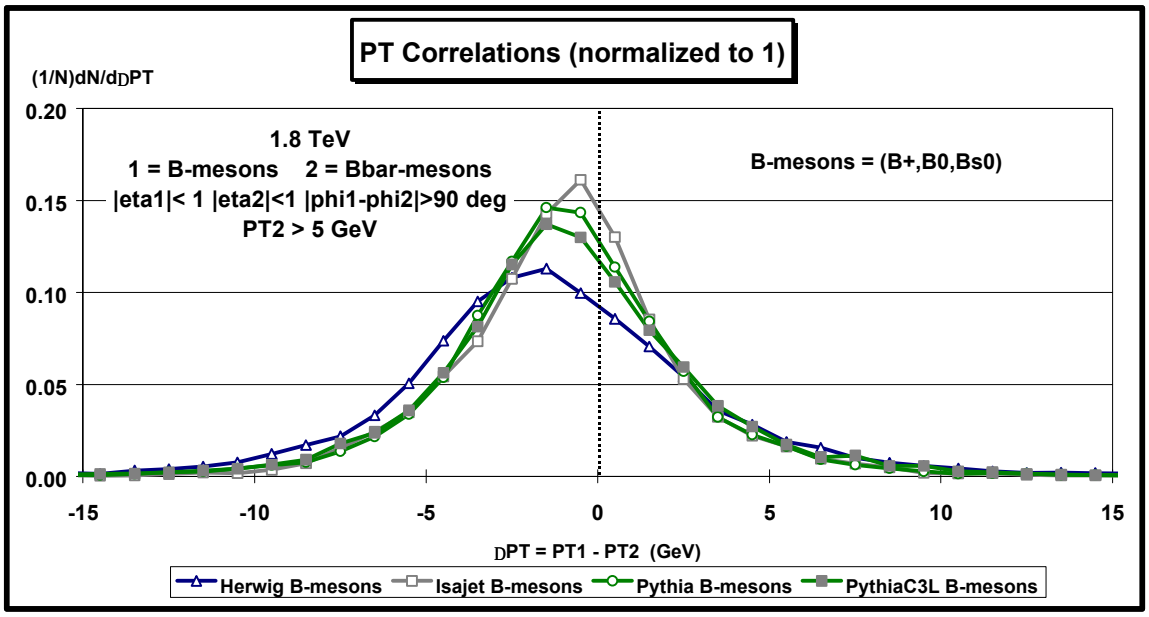
Parton & Hadron Level: Transverse Momentum Correlations



Plot shows (1/N)dN/dDPT (1//GeV), where DPT = PT_1-PT_2 for 1 = b-quark and 2 = bbar-quark and for 1 = B-mesons (B^+,B^0,B_s^0) and 2 = Bbar-mesons at 1.8 TeV with $|h_1| < 1$, $|h_2| < 1$, $|f_1-f_2| > 90^o$, and $PT_2 > 5$ and 10 GeV.

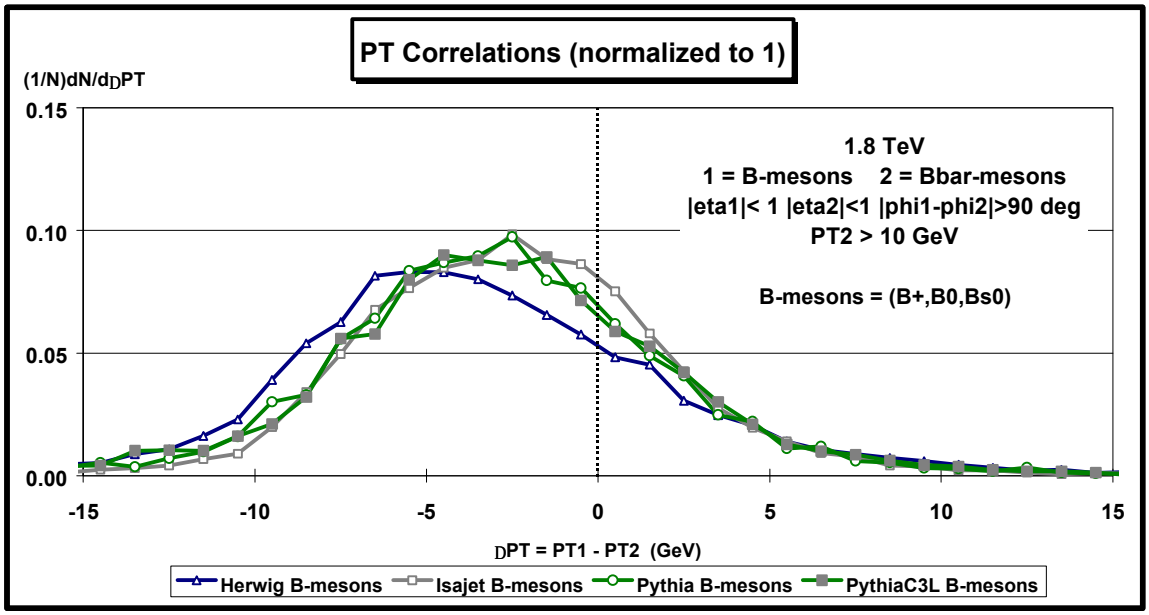
B Physics: PT Correlations

Hadron Level: Transverse Momentum Correlations



Plot shows (1/N)dN/dDPT (1/GeV), where DPT = PT_1-PT_2 for 1 = B-mesons (B^+,B^0,B_s^0) and 2 = Bbar-mesons at 1.8 TeV with $|h_1| < 1$, $|h_2| < 1$, $|f_1-f_2| > 90^0$, and $PT_2 > 5$ GeV.

Hadron Level: Transverse Momentum Correlations



Plot shows (1/N)dN/dDPT (1/GeV), where DPT = PT_1-PT_2 for 1 = B-mesons (B^+,B^0,B_s^0) and 2 = Bbar-mesons at 1.8 TeV with $|h_1| < 1$, $|h_2| < 1$, $|f_1-f_2| > 90^0$, and $PT_2 > 10$ GeV.

B Physics: Pseudo-Rapidity Correlations

Correlation Functions:

Double-Differential Cross Section

$$C(h_1,h_2)=\frac{1}{s}\frac{ds}{dh_1dh_2}-\frac{1}{s^2}\frac{ds}{dh_1}\frac{ds}{dh_2}$$

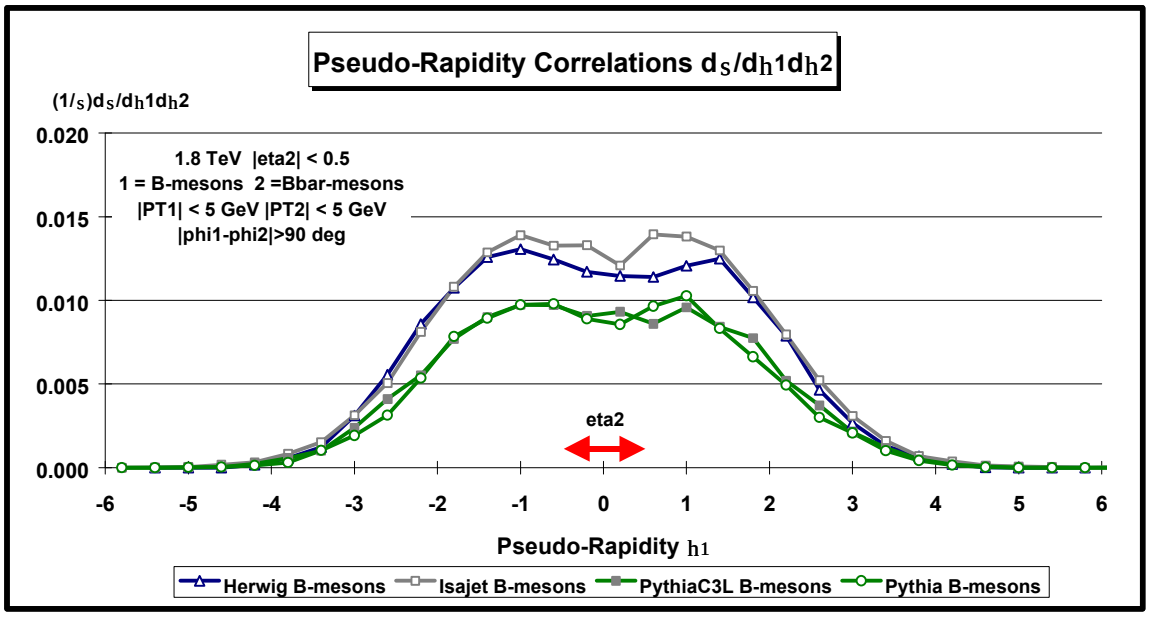
"Normalized" Correlation Functions:

$$R(h_1,h_2)=\left(\frac{1}{s}\frac{ds}{dh_1dh_2}-\frac{1}{s^2}\frac{ds}{dh_1}\frac{ds}{dh_2}\right)\Bigg/\left(\frac{1}{s^2}\frac{ds}{dh_1}\frac{ds}{dh_2}\right)$$

"Integrated" ($a < h_2 < b$) Normalized Correlation Functions:

$$R(h_1)=\int_a^b\left(\frac{1}{s}\frac{ds}{dh_1dh_2}-\frac{1}{s^2}\frac{ds}{dh_1}\frac{ds}{dh_2}\right)dh_2\Bigg/\int_a^b\left(\frac{1}{s^2}\frac{ds}{dh_1}\frac{ds}{dh_2}\right)dh_2$$

Hadron Level: Pseudo-Rapidity Correlations ($|h_2| < 0.5$)

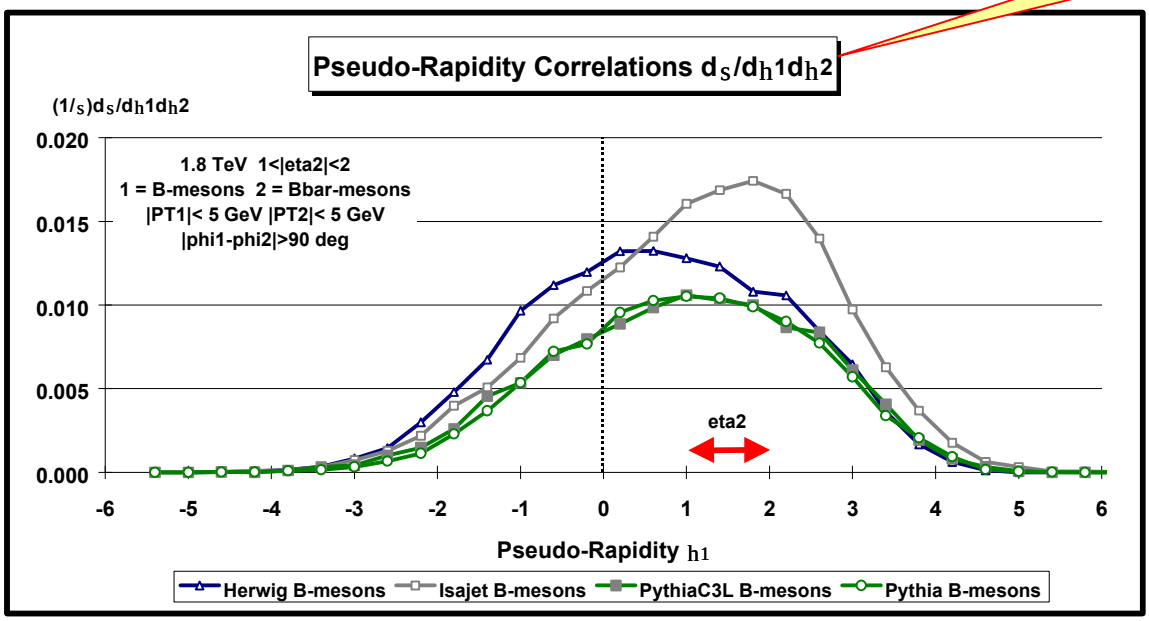


Plot shows $(1/s)ds/dh_1dh_2$ versus h_1, for 1 = B-mesons (B^+,B^0,B_s^0) and 2 = Bbar-mesons at 1.8 TeV with $|h_2| < 0.5$, $|f_1\text{-}f_2| > 90^0$, $PT_1 > 5$ GeV, and $PT_2 > 5$ GeV.

B Physics: Pseudo-Rapidity Correlations

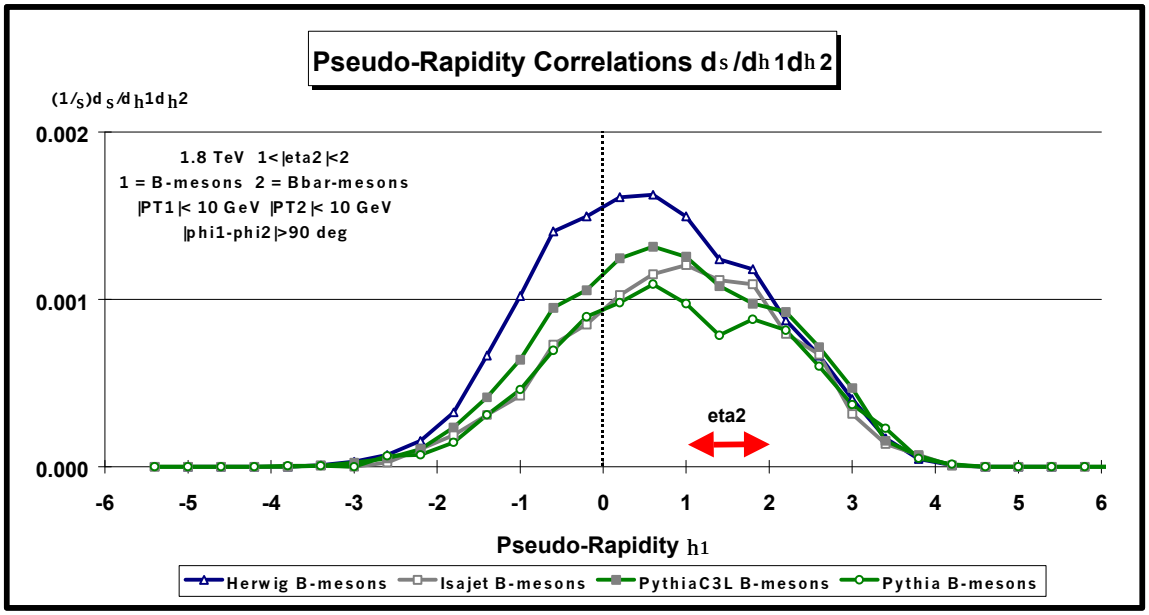
Hadron Level: Pseudo-Rapidity Correlations ($1 < |h_2| < 2$)

Measures PDF's, fragmentation.



Plot shows $(1/s)ds/dh_1dh_2$ versus h_1, for 1 = B-mesons (B^+,B^0,B_s^0) and 2 = Bbar-mesons at 1.8 TeV with $1 < |h_2| < 2$, $|f_1\text{-}f_2| > 90^o$, $PT_1 > 5$ GeV, and $PT_2 > 5$ GeV.

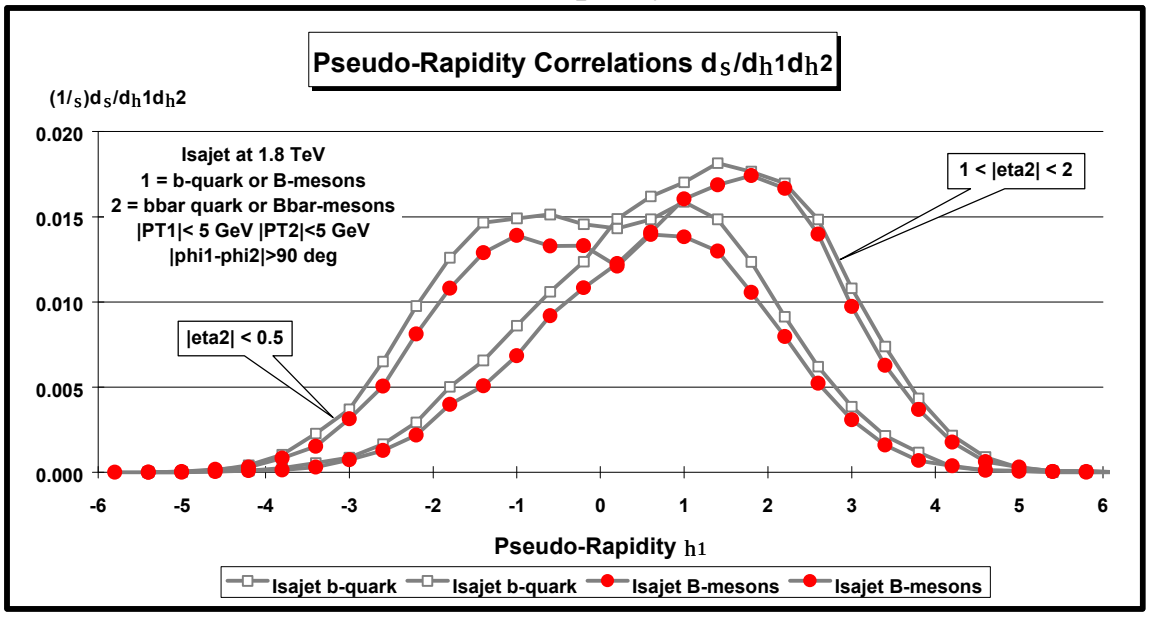
Hadron Level: Pseudo-Rapidity Correlations ($1 < |h_2| < 2$)



Plot shows $(1/s)ds/dh_1dh_2$ versus h_1, for 1 = B-mesons (B^+,B^0,B_s^0) and 2 = Bbar-mesons at 1.8 TeV with $1 < |h_2| < 2$, $|f_1\text{-}f_2| > 90^o$, $PT_1 > 10$ GeV, and $PT_2 > 10$ GeV.

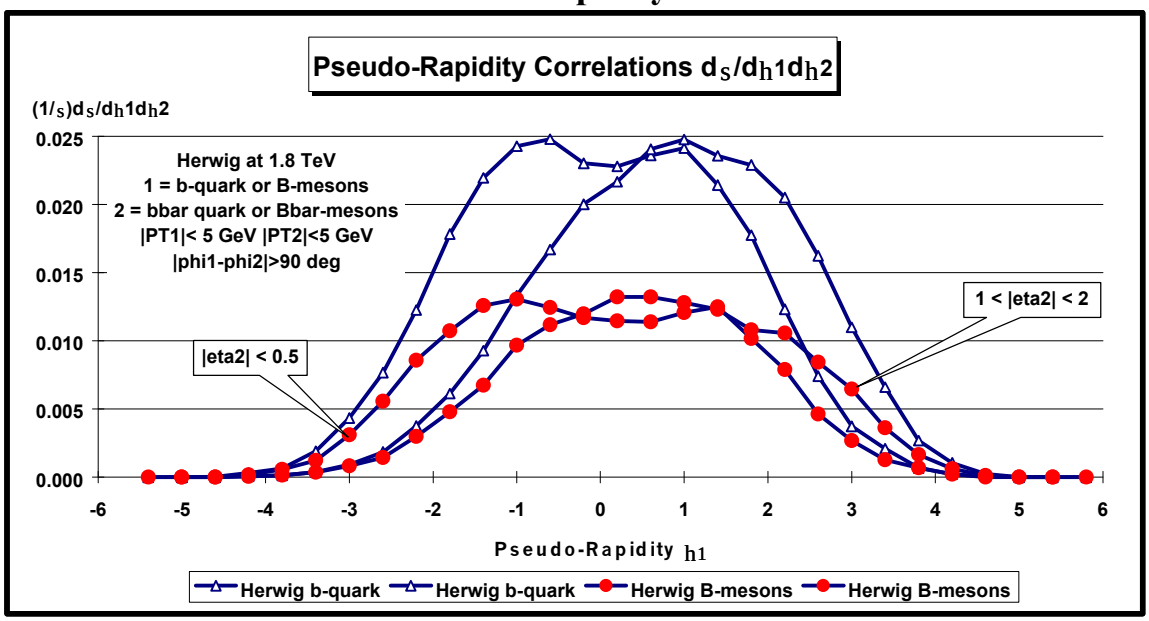
B Physics: Pseudo-Rapidity Correlations

Parton & Hadron Level: Pseudo-Rapidity Correlations



Plot shows $(1/s)ds/dh_1dh_2$ versus h_1, for 1 = b-quark and 2 = bbar-quark and for 1 = B-mesons (B^+,B^0,B_s^0) and 2 = Bbar-mesons at 1.8 TeV with $|h_2| < 0.5$ and with $1 < h_2 < 2$ and $|f_1-f_2| > 90^o$, $PT_1 > 5$ GeV, and $PT_2 > 5$ GeV.

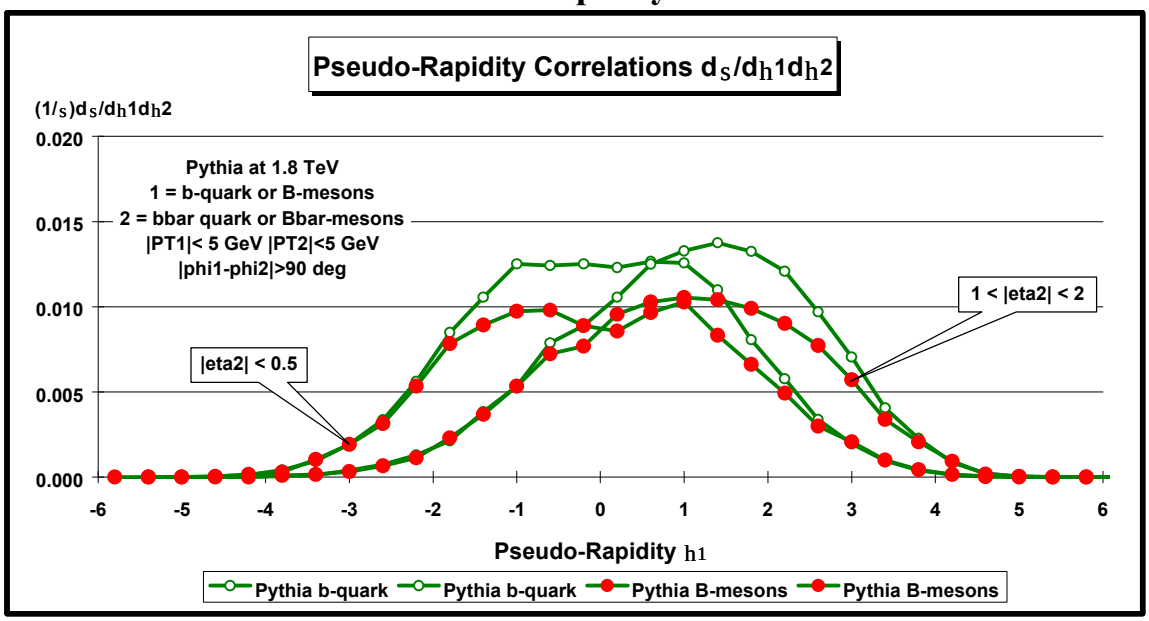
Parton & Hadron Level: Pseudo-Rapidity Correlations



Plot shows $(1/s)ds/dh_1dh_2$ versus h_1, for 1 = b-quark and 2 = bbar-quark and for 1 = B-mesons (B^+,B^0,B_s^0) and 2 = Bbar-mesons at 1.8 TeV with $|h_2| < 0.5$ and with $1 < h_2 < 2$ and $|f_1-f_2| > 90^o$, $PT_1 > 5$ GeV, and $PT_2 > 5$ GeV.

B Physics: Pseudo-Rapidity Correlations

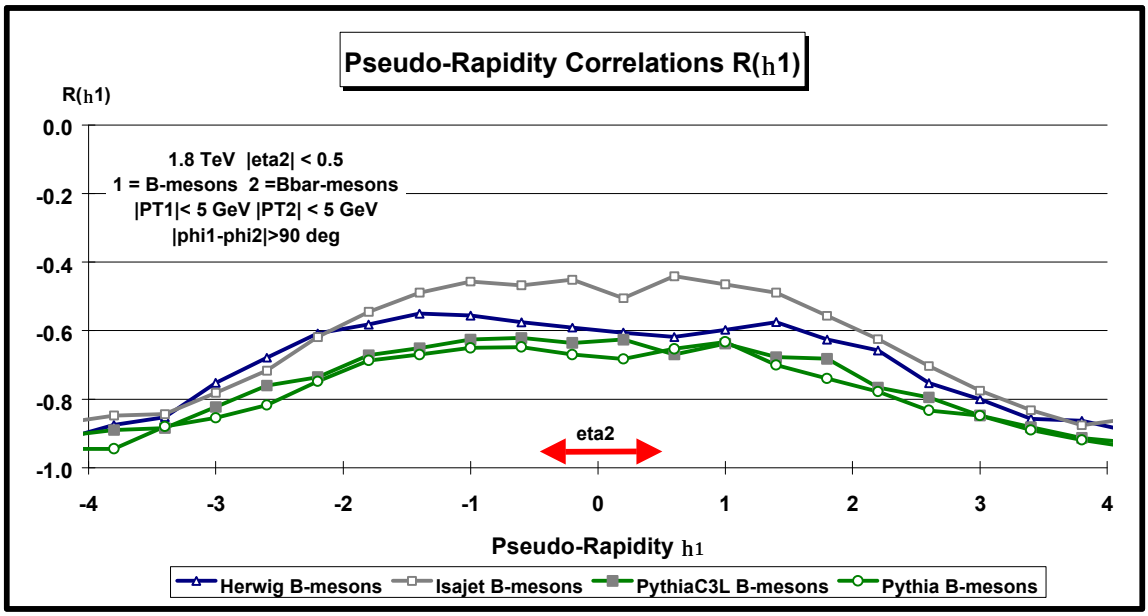
Parton & Hadron Level: Pseudo-Rapidity Correlations



Plot shows $(1/s)ds/dh_1dh_2$ versus h_1, for 1 = b-quark and 2 = bbar-quark and for 1 = B-mesons (B^+,B^0,B_s^0) and 2 = Bbar-mesons at 1.8 TeV with $|h_2| < 0.5$ and with $1 < h_2 < 2$ and $|f_1-f_2| > 90^o$, $PT_1 > 5$ GeV, and $PT_2 > 5$ GeV.

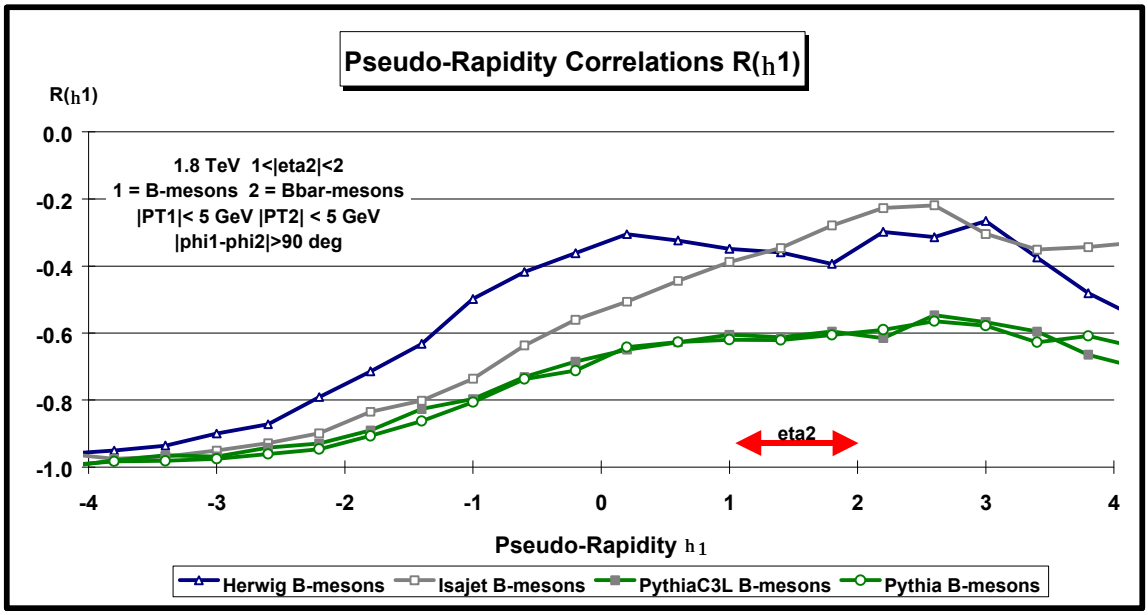
B Physics: Correlation Functions

Hadron Level: "Normalized" Correlation Function



Plot shows the normalized correlation function $R(h_1)$ versus h_1, for 1 = B-mesons (B^+,B^0,B_s^0) and 2 = Bbar-mesons at 1.8 TeV with $|h_2| < 0.5$ and $|f_1-f_2| > 90^o$, $PT_1 > 5$ GeV, and $PT_2 > 5$ GeV.

Hadron Level: "Normalized" Correlation Function



Plot shows the normalized correlation function $R(h_1)$ versus h_1, for 1 = B-mesons (B^+,B^0,B_s^0) and 2 = Bbar-mesons at 1.8 TeV with $1 < h_2 < 2$ and $|f_1-f_2| > 90^o$, $PT_1 > 5$ GeV, and $PT_2 > 5$ GeV.