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.

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 η Distributions Hadron versus Parton
• Azimuthal Δϕ Correlations Hadron versus Parton
• PT Correlations Hadron versus Parton (PT₁-PT₂)
• Pseudo-Rapidity Correlations: dσ/dη₁dη₂ & R(η₁,η₂)
• Comparisons between 1.8 TeV and 2.0 TeV

QCD Monte Carlo Models (default parameters):
Herwig 5.9 (DO1.1, Λ = 0.18 GeV)
Isajet 7.32 (CTEQ3L, Λ = 0.20 GeV)
Pythia 6.115 (GRV94LO, Λ = 0.23 GeV)
Pythia 6.115 (CTEQ3L, Λ = 0.18 GeV)
Parton Level: Integrated b-quark Cross Section for PT > PT$_{\text{min}}$

Plot shows $\sigma(PT>PT_{\text{min}})$ (in $\mu$b) for b-quarks at 1.8 TeV (all Y).

Plot shows $\sigma(PT>PT_{\text{min}})$ (in $\mu$b) for b-quarks at 1.8 TeV (all Y). Herwig, Isajet, and Pythia have been increased by a factor of two.
Parton Level: Ratio MRSR2/Monte-Carlos

Plot shows the ratio of $\sigma(PT>PT_{\text{min}})$ 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 > PT_{\text{min}}

Plot shows $\sigma(PT>PT_{\text{min}})$ (in $\mu b$) for b-quarks at 1.8 TeV ($|Y|<1$).
**Parton Level: Integrated b-quark Cross Section for PT > PTmin**

Plot shows $\sigma(PT>PT_{min})$ (in $\mu b$) 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 $\sigma(PT>PT_{min})$ for b-quarks at 1.8 TeV ($|y| < 1$) from MRSR2 to Herwig, Isajet, and Pythia.
**Parton Level: Fraction $|Y| < 1$ of the b-quark Cross Section**

Plot shows the fraction $|Y| < 1$ of the b-quark integrated cross section ($PT < PT_{min}$).

**Parton Level: Fraction $|\eta| < 1$ of the b-quark Cross Section**

Plot shows the fraction $|\eta| < 1$ of the b-quark integrated cross section ($PT < PT_{min}$).
Parton Level: Transverse Momentum Distribution ($|\eta| < 1$)

Plot shows $d\sigma/dPT$ (in $\mu$b/GeV) for b-quarks at 1.8 TeV ($|\eta|<1$).

Plot shows the ratio of $d\sigma/dPT$ for b-quarks at 1.8 TeV ($|\eta| < 1$) from MRSR2 to Herwig, Isajet, and Pythia.
Parton Level: Pseudo-Rapidity Distributions (PT > 5 GeV)

Plot shows $d\sigma/d\eta$ (in $\mu$b) for b-quarks at 1.8 TeV (PT > 5 GeV).

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

Plot shows $(1/N)dN/d\eta$ (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 $d\sigma/dY$ (in $\mu b$) 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 > PT\(_{\text{min}}\)**

The plot shows \(\sigma(PT > PT_{\text{min}})\) (in \(\mu b\)) for B-mesons \((B^+, B^0, B_s^0)\) and b-quarks at 1.8 TeV \((|\eta| < 1)\).

**Hadron Level: Integrated B-quark Cross Section for PT > PT\(_{\text{min}}\)**

The plot also shows \(\sigma(PT > PT_{\text{min}})\) (in \(\mu b\)) for B-mesons \((B^+, B^0, B_s^0)\) from b and t-quarks at 1.8 TeV \((|\eta| < 1)\).
**B Physics: PT Distributions**

**Parton & Hadron Level: Transverse Momentum Distribution ($|\eta| < 1$)**

Plot shows $d\sigma/dPT$ (in $\mu b$/GeV) for B-mesons ($B^+,B^0,B_{s0}^0$) and for the b-quark at 1.8 TeV ($|\eta|<1$).

**Hadron/Parton Level: Transverse Momentum Distribution ($|\eta| < 1$)**

Plot shows the ratio of $d\sigma/dPT$ ($|\eta| < 1$) for B-mesons ($B^+,B^0,B_{s0}^0$) to b-quark at 1.8 TeV.
Plot shows $d\sigma/dPT$ (in $\mu b$/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

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<tr>
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<tr>
<td>fs/(fu+fd)</td>
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</table>

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

Plot shows the ratio fs/(fu+fd) at 1.8 TeV (|η| < 1), where fs = dσ/dPT(Bs^0), fu = dσ/dPT(B^+), and fd = dσ/dPT(B^0).
B Physics: Y and $\eta$ Distributions

Parton & Hadron Level: Pseudo-Rapidity Distribution

Plot shows $(1/N)dN/d\eta$ (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 η Distributions**

**Parton & Hadron Level: Pseudo-Rapidity Distribution**

Plot shows \((1/N)dN/d\eta\) (normalized to 1) for B-mesons \((B^+,B^0,B_{s0})\) 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 \((B^+,B^0,B_{s0})\) and for the b-quark at 1.8 TeV (PT > 5 GeV and PT > 10 GeV).
Parton & Hadron Level: Pseudo-Rapidity Distribution

Plot shows \((1/N)dN/d\eta\) (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).
Parton Level: Azimuthal $\Delta \phi$ Distribution

Plot shows $(1/N) dN/d\Delta \phi$ (normalized to 1), where $\Delta \phi = |\phi_2 - \phi_1|$ for $1 = b$-quark and $2 = b\bar{b}$-quark at 1.8 TeV with $|\eta_1| < 1$, $|\eta_2| < 1$, and $PT_1 > 5$ GeV.

Hadron Level: Azimuthal $\Delta \phi$ Distribution

Plot shows $(1/N) dN/d\Delta \phi$ (normalized to 1), where $\Delta \phi = |\phi_2 - \phi_1|$ for $1 = B$-mesons ($B^+, B^0, B_s^0$) and $2 = B\bar{b}$-mesons at 1.8 TeV with $|\eta_1| < 1$, $|\eta_2| < 1$, and $PT_1 > 5$ GeV.
B Physics: Azimuthal Correlations

Parton & Hadron Level: Azimuthal $\Delta \phi$ Distribution

Plot shows $(1/N)dN/d\Delta \phi$ (normalized to 1), where $\Delta \phi = |\phi_2 - \phi_1|$ for $1 = b$-quark and $2 = b\bar{b}$-quark and for $1 = B$-mesons ($B^+, B^0, B_s^0$) and $2 = B\bar{b}$-mesons at 1.8 TeV with $|\eta_1| < 1, |\eta_2| < 1$, and $PT_1 > 5$ GeV.

Parton & Hadron Level: Azimuthal $\Delta \phi$ Distribution

Plot shows $(1/N)dN/d\Delta \phi$ (normalized to 1), where $\Delta \phi = |\phi_2 - \phi_1|$ for $1 = b$-quark and $2 = b\bar{b}$-quark and for $1 = B$-mesons ($B^+, B^0, B_s^0$) and $2 = B\bar{b}$-mesons at 1.8 TeV with $|\eta_1| < 1, |\eta_2| < 1$, and $PT_1 > 5$ GeV.
**B Physics: PT Correlations**

**Parton Level: Transverse Momentum Correlations**

Plot shows $d\sigma/d\Delta PT (\mu b/\text{GeV})$, where $\Delta PT = PT_1 - PT_2$ for $1 = b$-quark and $2 = b\bar{b}$-quark at 1.8 TeV with $|\eta_1| < 1$, $|\eta_2| < 1$, $|\phi_1 - \phi_2| > 90^\circ$, and $PT_2 > 5 \text{ GeV}$.

**Plot shows** $d\sigma/d\Delta PT (\mu b/\text{GeV})$, where $\Delta PT = PT_1 - PT_2$ for $1 = b$-quark and $2 = b\bar{b}$-quark at 1.8 TeV with $|\eta_1| < 1$, $|\eta_2| < 1$, $|\phi_1 - \phi_2| > 90^\circ$, and $PT_2 > 5 \text{ GeV}$. 
Hadron Level: Transverse Momentum Correlations

Plot shows $d\sigma/d\Delta P_T (\mu b/GeV)$, where $\Delta P_T = P_{T1}-P_{T2}$ for 1 = B-mesons ($B^+, B^0, B_s^0$) and 2 = Bbar-mesons at 1.8 TeV with $|\eta_1| < 1, |\eta_2| < 1, |\phi_1-\phi_2| > 90^\circ$, and $P_{T2} > 5$ GeV.

Parton & Hadron Level: Transverse Momentum Correlations

Plot shows $d\sigma/d\Delta P_T (\mu b/GeV)$, where $\Delta P_T = P_{T1}-P_{T2}$ 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 $|\eta_1| < 1, |\eta_2| < 1, |\phi_1-\phi_2| > 90^\circ$, and $P_{T2} > 5$ GeV.
B Physics: Pseudo-Rapidity Correlations

Correlation Functions:

\[ C(\eta_1, \eta_2) = \frac{1}{\sigma} \frac{d\sigma}{d\eta_1 d\eta_2} - \frac{1}{\sigma^2} \frac{d\sigma}{d\eta_1} \frac{d\sigma}{d\eta_2} \]

“Normalized” Correlation Functions:

\[ R(\eta_1, \eta_2) = \left( \frac{1}{\sigma} \frac{d\sigma}{d\eta_1 d\eta_2} - \frac{1}{\sigma^2} \frac{d\sigma}{d\eta_1} \frac{d\sigma}{d\eta_2} \right) / \left( \frac{1}{\sigma^2} \frac{d\sigma}{d\eta_1} \frac{d\sigma}{d\eta_2} \right) \]

“Integrated” (a < \eta_2 < b) Normalized Correlation Functions:

\[ R(\eta_1) = \int_a^b \left( \frac{1}{\sigma} \frac{d\sigma}{d\eta_1 d\eta_2} - \frac{1}{\sigma^2} \frac{d\sigma}{d\eta_1} \frac{d\sigma}{d\eta_2} \right) d\eta_2 \]

Hadron Level: Pseudo-Rapidity Correlations (|\eta_2| < 0.5)

Plot shows \((1/\sigma) d\sigma/d\eta_1 d\eta_2\) versus \(\eta_1\), for 1 = B-mesons \((B^+, B^0, B_s^0)\) and 2 = Bbar-mesons at 1.8 TeV with |\eta_2| < 0.5, |\phi_1 - \phi_2| > 90°, PT_1 > 5 GeV, and PT_2 > 5 GeV.
**B Physics: Pseudo-Rapidity Correlations**

**Hadron Level: Pseudo-Rapidity Correlations (1 < |\(\eta_2| < 2\))**

Plot shows \((1/\sigma)d\sigma/d\eta_1d\eta_2\) versus \(\eta_1\), for \(1 = B\)-mesons \((B^+, B^0, B_s^0)\) and \(2 = B\)-bar-mesons at 1.8 TeV with \(1 < |\eta_2| < 2\), \(|\phi_1-\phi_2| > 90^\circ\), \(PT_1 > 5\ GeV\), and \(PT_2 > 5\ GeV\).

**Parton & Hadron Level: Pseudo-Rapidity Correlations**

Plot shows \((1/\sigma)d\sigma/d\eta_1d\eta_2\) versus \(\eta_1\), for \(1 = b\)-quark or \(B\)-mesons and \(2 = b\)-bar quark or \(B\)-bar-mesons at 1.8 TeV with \(||\eta_2| < 0.5\rangle\) and with \(1 < |\eta_2| < 2\) and \(|\phi_1-\phi_2| > 90^\circ\), \(PT_1 > 5\ GeV\), and \(PT_2 > 5\ GeV\).
B Physics: Pseudo-Rapidity Correlations

Parton & Hadron Level: Pseudo-Rapidity Correlations

Plot shows \( \frac{1}{\sigma} \frac{d\sigma}{d\eta_1 d\eta_2} \) versus \( \eta_1 \), for \( 1 = b\)-quark and \( 2 = b\bar{b}\)-quark and for \( 1 = B\)-mesons \( (B^+, B^0, B_s^0) \) and \( 2 = B\bar{b}\)-mesons at 1.8 TeV with \( |\eta_2| < 0.5 \) and with \( 1 < \eta_2 < 2 \) and \( |\phi_1 - \phi_2| > 90^\circ \), \( PT_1 > 5 \text{ GeV} \), and \( PT_2 > 5 \text{ GeV} \).

Parton & Hadron Level: Pseudo-Rapidity Correlations

Plot shows \( \frac{1}{\sigma} \frac{d\sigma}{d\eta_1 d\eta_2} \) versus \( \eta_1 \), for \( 1 = b\)-quark and \( 2 = b\bar{b}\)-quark and for \( 1 = B\)-mesons \( (B^+, B^0, B_s^0) \) and \( 2 = B\bar{b}\)-mesons at 1.8 TeV with \( |\eta_2| < 0.5 \) and with \( 1 < \eta_2 < 2 \) and \( |\phi_1 - \phi_2| > 90^\circ \), \( PT_1 > 5 \text{ GeV} \), and \( PT_2 > 5 \text{ GeV} \).
**B Physics: Pseudo-Rapidity Correlations**

**Hadron Level: Pseudo-Rapidity Correlations**

Plot shows the normalized correlation function $R(\eta_1)$ versus $\eta_1$, for $1 = B$-mesons ($B^+, B^0, B_s^0$) and $2 = B\bar{b}$-mesons at 1.8 TeV with $|\eta_2| < 0.5$ and $|\phi_1-\phi_2| > 90^\circ$, $PT_1 > 5$ GeV, and $PT_2 > 5$ GeV.

**Parton & Hadron Level: Pseudo-Rapidity Correlations**

Plot shows the normalized correlation function $R(\eta_1)$ versus $\eta_1$, for $1 = B$-mesons ($B^+, B^0, B_s^0$) and $2 = B\bar{b}$-mesons at 1.8 TeV with $1 < \eta_2 < 2$ and $|\phi_1-\phi_2| > 90^\circ$, $PT_1 > 5$ GeV, and $PT_2 > 5$ GeV.
Parton Level: Integrated b-quark Cross Section Ratio for PT > PT_{min}

Plot shows the 2.0/1.9 TeV ratio of $\sigma(PT>PT_{\text{min}})$ for b-quarks (all $Y$).

Parton Level: Integrated b-quark Cross Section Ratio for PT > PT_{min}

Plot shows the 2.0/1.9 TeV ratio of $\sigma(PT>PT_{\text{min}})$ for b-quarks ($|\eta|<1$).
**B Physics: Parton 2-to-2 Cross Section Ratio**

**Parton Level: All-Parton/b-quark 2-to-2 Cross Section Ratio**

Plot shows the ratio of the cross sections of all QCD parton 2-to-2 subprocesses to the 2-to-2 b-quark production subprocesses at 1.8 and 2.0 TeV versus the hard-scattering transverse momentum cut-off.

**Parton Level: Ratio 2.0/1.8 TeV of the All/b-quark Cross Section Ratio**

Plot shows the All/b-quark 2-to-2 subprocess cross section ratio at 2.0 TeV divided by All/b-quark 2-to-2 subprocess cross section ratio at 1.8 TeV versus the hard-scattering transverse momentum cut-off (i.e. background/signal at 2.0 TeV divided by background/signal at 1.8 TeV).
Parton Level: Integrated Inclusive All/b-quark Cross Section Ratio

Plot shows the inclusive cross section $\sigma(PT>PT_{min}, |\eta|<1)$ for all partons (divided by 2) divided by $\sigma(PT>PT_{min}, |\eta|<1)$ for b-quarks at 1.8 TeV and 2.0 TeV.