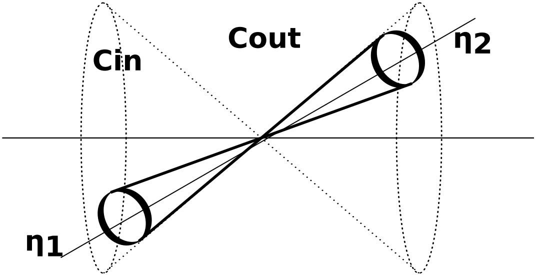
Jet Veto at LHC

Low-X 2012
Dominik Werder
Uppsala Universitet

- Jet Veto data from ATLAS
- Possibility to observe BFKL dynamics
- BMS equation
- Comparison with ATLAS data
- Conclusions and Outlook

Jet Veto Observable

- Two hard jets at $\eta_{1/2}$, radius R
- Separated by $\Delta\eta$
- Define forward and backward cone around beam axis
- Defines solid angles C_{in} and C_{out}
- Veto on energy flow in E_{out} region



Jet Veto Observable

- Observable for perturbative QCD effects
- Sensitivity to BFKL like dynamics for jets with large $\Delta\eta$
- Probing wide angle soft gluon emission for $E_T \gg E_{\text{out}}$
- Data: ATLAS arXiv:1107.1641v2 $E_{\text{out}} \leq 20\,\mathrm{GeV}$
  Jet-Veto-Jet measurement
- Condition: $E_{\text{jet}} \gg E_{\text{out}} \gg \Lambda_{\text{QCD}}$

BMS equation

- Banfi, Marchesini, Smye hep-ph/0206076
  $P_\tau(\Omega_\alpha, \Omega_\beta)$: probability of perturbative radiation above a threshold E_{out} such that

$$\sum_{C_{\text{out}}} E_i < E_{\text{out}}$$

- and $\tau = \bar{\alpha}_s \ln \frac{E}{E_{\text{out}}}$ for two jets with invariant mass $2E$
- Perturbative setup: $E_{\text{out}} \gg \Lambda_{\text{QCD}}$

BMS equation

- Probability P_τ obeys differential BMS evolution equation:

$$\partial_\tau P_\tau(\Omega_\alpha, \Omega_\beta) = -\int_{C_{\text{out}}} \frac{d^2\Omega_\gamma}{4\pi} \frac{1-\cos\Theta_{\alpha\beta}}{(1-\cos\Theta_{\alpha\gamma})(1-\cos\Theta_{\gamma\beta})} P_\tau(\Omega_\alpha, \Omega_\beta)$$
$$+\int_{C_{\text{in}}} \frac{d^2\Omega_\gamma}{4\pi} \frac{1-\cos\Theta_{\alpha\beta}}{(1-\cos\Theta_{\alpha\gamma})(1-\cos\Theta_{\gamma\beta})} \left(P_\tau(\Omega_\alpha, \Omega_\gamma) P_\tau(\Omega_\gamma, \Omega_\beta) - P_\tau(\Omega_\alpha, \Omega_\beta)\right)$$

- 1st term: Sudakov logs from soft gluon emissions from primary partons
- 2nd term: Non-global logs from soft large angle gluon emission from 2nd, 3rd, etc.

BMS equation

- $\tau = \bar{\alpha_s} \ln \frac{E}{E_{\text{out}}}$
- 1st boundary condition: $P_{\tau=0} = 1$
- 2nd boundary condition: $P_\tau(\Omega, \Omega) = 1$

- Probability can then be determined numerically
  Hatta, Ueda arXiv:0909.0056v2

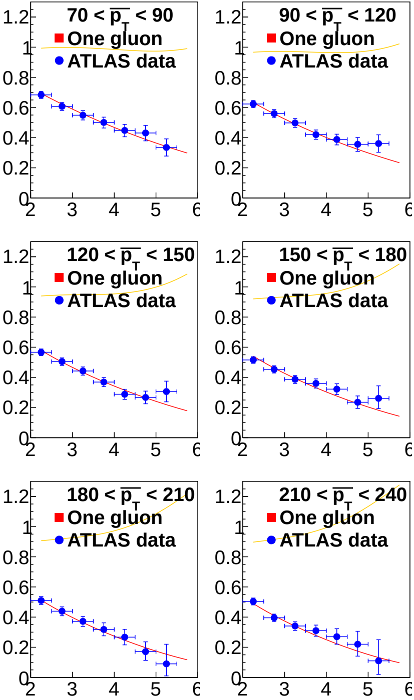
Description of the ATLAS data

- Color Octet contribution
- LO calculation $2 \to 2$ process, $qq \to qq$, $qg \to qg$, $gg \to gg$...
- MRST 2004 PDFs
- Probability of staying below E_{out} threshold from BMS

- Inclusive dijet cross section obtained from NLOJet++
- Bins in jet p_T and ΔY

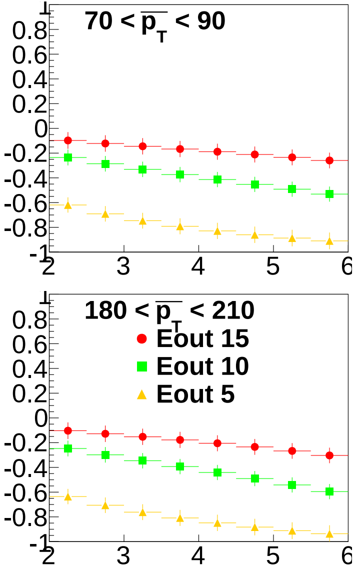
Comparison

- Compare color octet contribution with measurement
- Jet veto event fraction
- Data for bins in jet p_T, ΔY
- Normalisation of first bin fixed against data
- Same normalisation for remaining bins, $\mathcal{O}(1)$



Suppression of octet contribution

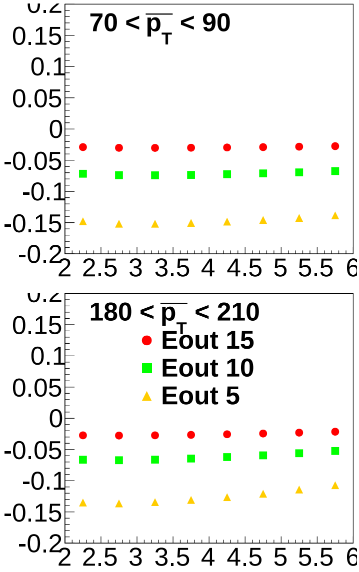
- Relative suppression of octet CS compared to $E_{\text{out}} = 20\,\mathrm{GeV}$
- Smaller E_{out}, color octet contribution suppressed
- Stay within perturbative QCD: Down to $E_{\text{out}} = 5\,\mathrm{GeV}$
- Suppression increases with ΔY for the octet contribution



Veto Threshold BFKL

- BFKL calculation with NLL effects, summation of conformal spins
  Marquet, Royon, Phys. Rev. D 79, 034028 (2009)

  A. Sabio Vera, Nucl. Phys. B 746, 1 (2006)
- Relative suppression of BFKL CS compared to $E_{\text{out}} = 20\,\mathrm{GeV}$
- Suppression from smaller threshold much smaller compared to octet
- No extra suppression from large $\Delta\eta$



Conclusions and Outlook

- BMS equation describes probability for perturbative emissions from $2 \to 2$ events
- Jet veto data may be sensitive to BFKL dynamics
- ATLAS data well described by color octet contribution
- Future search to enhance BFKL signal using lower veto threshold, large $\Delta\eta$