The veto algorithm in updfevolv

February 20, 2020

Recap: Why using veto

Sudakov Form Factor: probability not to split between two scales
$\rightarrow$ used for scale generation

Normally the Sudakov Form Factor depends only on the scale $\rightarrow$ can be calculated in table

When we want a Sudakov form fact that depeds on other parameters (such as $k_\perp$ of the parton), table doesn't work $\rightarrow$ veto algorithm can be used

Generation of branching scale

$$\Delta_a(\mu^2) = \exp\left(-\sum_b \int_{\mu_0^2}^{\mu^2} \frac{d\mu'^2}{\mu'^2} \int_0^{z_M} dz\ z\ P_{ba}^R(z)\right) = \exp\left(-\int_{t_0}^{t} dt'\ f(t')\right)$$

with $f(t) = \sum_b \int_0^{z_M} dz\ z\ P_{ba}^R(z) \rightarrow$ probability that a branching wil happen and $t = \ln(\mu)$

Differential probability that a branching happens:
$\mathcal{P}(t) = -\frac{d\Delta_a}{dt} = f(t)\Delta_a(t) = f(t)\exp\left(-\int_{t_0}^{t} dt\ f(t)\right)$

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Select t through:
$R = \int_{t_0}^t \mathcal{P}(t')dt' = \Delta_a(t_0) - \Delta_a(t) = 1 - \Delta_a(t)$

Veto algorithm

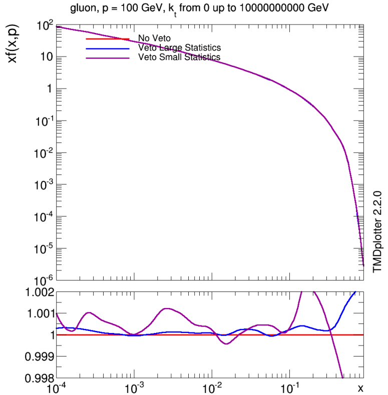
One can use a simplified function to generate the scale
Condition $g(t) \geq f(t)$ for all t
Since $g(t) \geq f(t)$, there will be more branchings. Some branchings will be refused

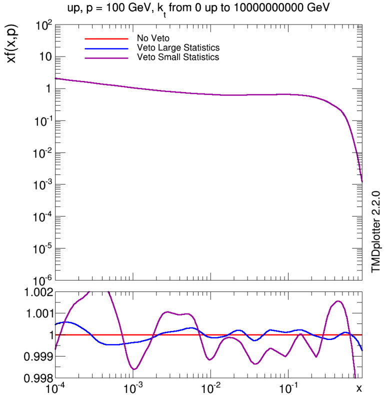
Algorithm:

1. Start with $i = 0$, $t_i = t_0$
2. i=i+1. Select $t_i > t_{i-1}$ according to g(t)
3. if $f(t_i)/g(t_i) \leq R$ go to 2
4. else: t_i is generated scale

Veto-Algorithm

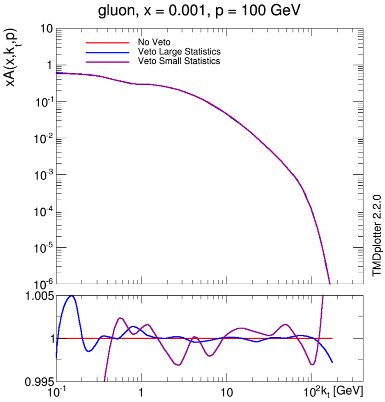
Check: veto in implementation with TMD P, but collinear sudakov

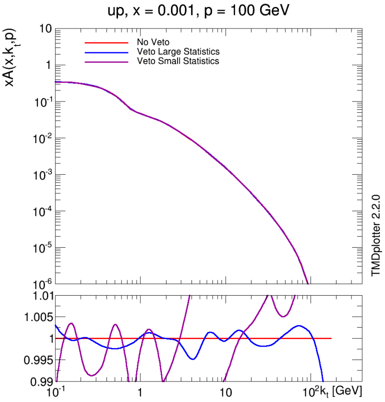




Small statistics: 200 x 10^6, Large Statistics: 1759 x 5x10^6=8.795x10^9 Small statistics has Sudakov Table of 65536, large statistics of262144

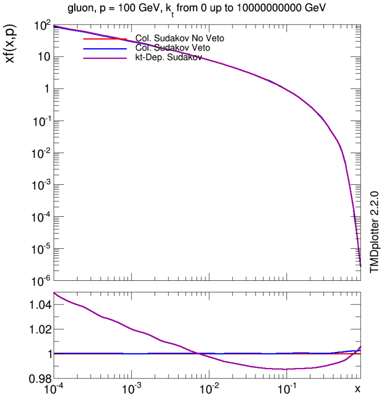
Veto-Algorithm in TMDs vs $k_\perp$

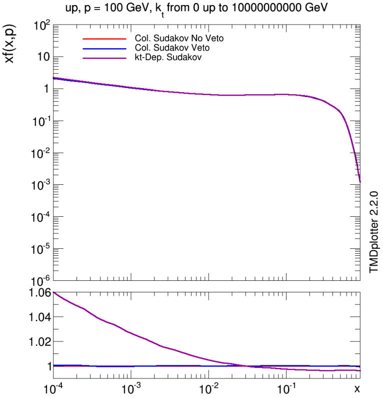




- Gluon: Fluctations smaller than 0.5%, often <0.1%
- Up: fluctuations smaller than 1%
- Improvement in fluctuations compared to small statistics

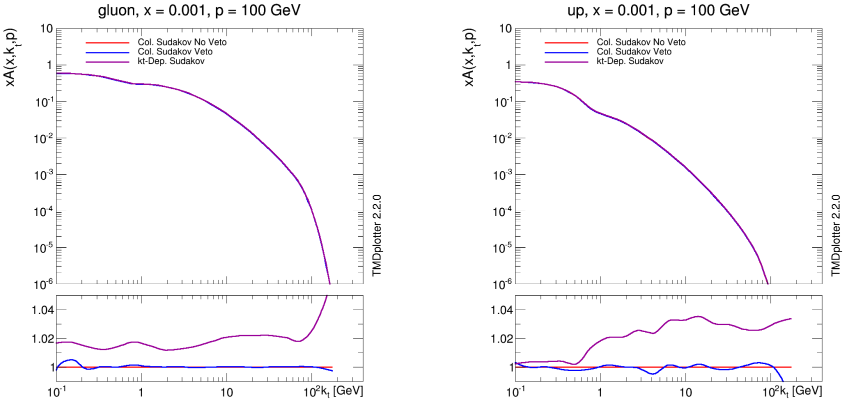
Veto vs kt-dep sudakov effects: iTMDs



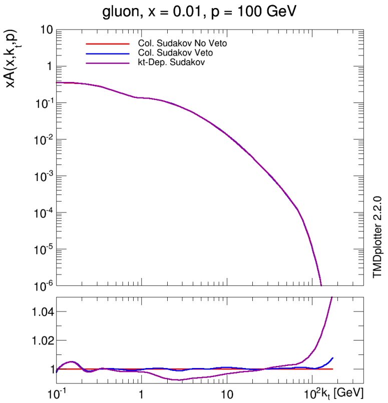


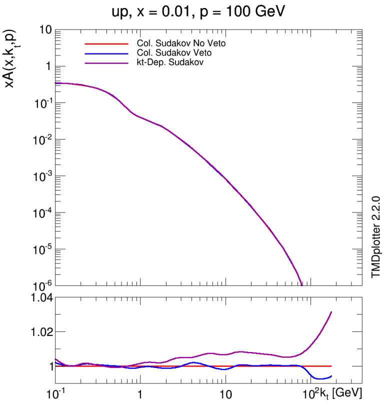
In whole x-region $k_\perp$-sudakov effects are larger than fluctations

Veto vs kt-dep sudakov effects: TMDs vs kt



Veto vs kt-dep sudakov effects: TMDs vs kt (2)





Even in the region where the effets of $k_{\perp}$-sudakov are small in the integrated distribution, one can observe effects larger than fluctuations of the veto-algorithm in the TMDs