Direct simulation of Δ_{ns}/z in CCFM evolution

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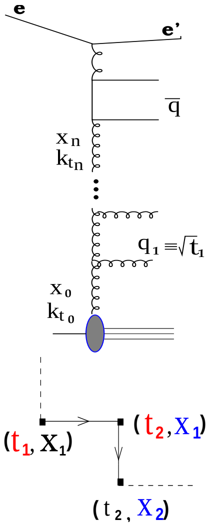


- Initial distributions:
  $xF(x) \sim (1-x)^4$, $x_{min} = 10^{-7}$, intrinsic k_T

- Sudakov form factor $\Delta_S(q_i, z_i q_{i-1}) =$
  $$\exp\left\{-\int_{(z_{i-1}q_{i-1})^2}^{{q_i}^2} \frac{dq^2}{q^2} \int_0^{1-Q_0/q} dz\, \frac{\bar{\alpha}_S(q^2(1-z)^2)}{1-z}\right\},$$

  $R = \Delta(t_1, t_2)$ - analytical calc. + bisection method

  $q_i = \frac{p_{ti}}{1-z_i}$, $\bar{\alpha}_S(\mu) = \frac{6}{11-\frac{2}{3}n_f} \cdot \frac{1}{\ln\frac{\mu}{\Lambda}}$

- $\int_\epsilon^z dz\, \frac{\alpha_S}{2\pi} \tilde{P}_{gg} = R \int_\epsilon^{1-\epsilon} dz\, \frac{\alpha_S}{2\pi} \tilde{P}_{gg}$

  $$\tilde{P}_{gg}(z, q_t, k_t) = \bar{\alpha}_S(k_t^2) \frac{\Delta_{ns}(z, k_t, q_t)}{z} + \frac{\bar{\alpha}_S(q_t^2(1-z)^2)}{1-z},$$

  if $\frac{g_1}{g_{tot}} < R \Rightarrow$ z generated according to second term (analytical calculation)
  else z generated according to first term (next slide) .

$$\Delta_{ns}(z,\frac{k_t}{q}) = \begin{cases} \exp(-\bar{\alpha_s}(k_t^2)\ln\frac{1}{z}\ln\frac{k_t^2}{zq^2})\,, & \text{if } 1 \leq \frac{k_t}{q}\,, \\ \exp(-\bar{\alpha_s}(k_t^2)\ln^2\frac{k_t}{qz})\,, & \text{if } z \leq \frac{k_t}{q} < 1\,, \\ 1\,, & \text{if } \frac{k_t}{q} < z < 1\,. \end{cases}$$

$$R\int_0^1 dz'\frac{\Delta_{ns}(z')}{z'} = \int_0^z dz'\frac{\Delta_{ns}(z')}{z'}$$

$\longrightarrow$ z is distributed according to $\Delta_s(z)/z$

It is exactly what is realized in small-x code

$$\int_0^1 dz'\frac{\Delta_{ns}(z')}{z'} = \frac{\sqrt{2\pi}}{\sqrt{2\bar{\alpha_s}}} freq(\sqrt{2\bar{\alpha_s}}\ln\frac{q}{k_t})\,,$$

where $0 \leq freq(x) \leq 1$:

$$freq(x) = \frac{1}{\sqrt{2\pi}}\int_{-\infty}^{x} dx'\exp(-\frac{x'^2}{2})\,.$$

$$z = \frac{k_t}{q}\exp\left(\frac{gausin(R\cdot freq(\sqrt{2\bar{\alpha_s}}\ln\frac{q}{k_t}))}{\sqrt{2\bar{\alpha_s}}}\right)\,,$$

where
gausin - inverse of normal frequency function

Let us introduce

$$C = \ln \frac{k_t}{q} , \qquad t = C - \ln z \ \rightarrow \ z = e^{C-t} .$$

then

$$\Delta_{ns}(t, C) = \begin{cases} \exp(-\bar{\alpha}_s(t^2 - C^2)) , & \textit{if } t \geq C \geq 0 , \\ \exp(-\bar{\alpha}_s t^2) , & \textit{if } t \geq 0 > C , \\ 1 , & \textit{if } 0 > t \geq C . \end{cases}$$

and

$$\left(\frac{\Delta_{ns}}{z}\right)(t, C) = \begin{cases} e^{\bar{\alpha}_s(t_0 - C)^2} e^{-\bar{\alpha}_s(t - t_0)^2} , & \textit{if } t \geq C \geq 0 , \\ e^{-\bar{\alpha}_s(t - t_0)^2} , & \textit{if } t \geq 0 > C , \\ e^{t - c} , & \textit{if } 0 > t \geq C . \end{cases} ,$$

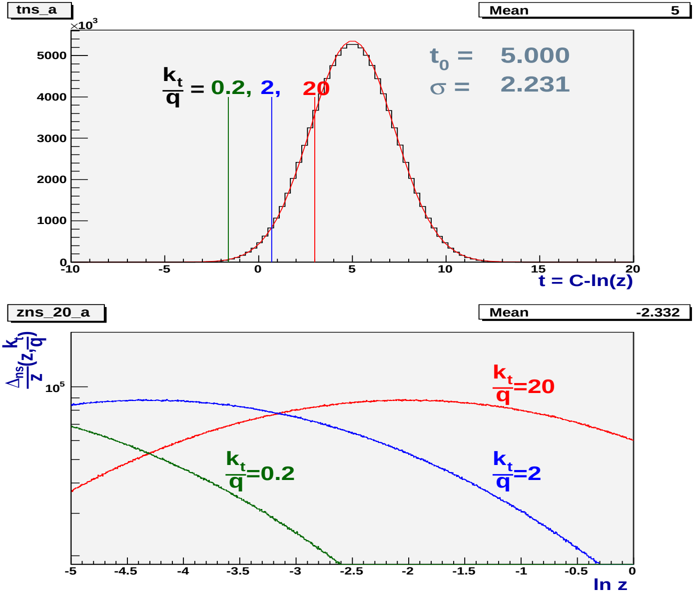
where

$$t_0 = \frac{1}{2\bar{\alpha}_s} .$$

That is function $\frac{\Delta_{ns}}{z}(t)$ is the Gaussian with

$$\mu = t_0 \text{ and } \sigma = \frac{1}{\sqrt{2\bar{\alpha}_s}} = \sqrt{t_0}.$$

Gaussian distribution for Δ_{ns}/z generation



Comparison of two z generation methods