$x =$
(ct, x, y, z)
$p =$
$(E/c, p_x, p_y, p_z) =$
$(E/c, , p_z)$
x
z
??
φ
η
$x \equiv$
$y \equiv$
$z =$
0
θ
$\eta =$
$-\ln(\tan(\theta/2)).$
$p >$
$\frac{mc}{2\ln\frac{E+p_z c}{E-p_z c}}.$
$x =$
$|| \cos\varphi\,, p_y =$
$|| \sin\varphi\,, p_z =$
$|\vec{p}\,| \sinh\eta\,.$
$\rangle_{\text{phys}} =$
$|\text{e}\rangle +$
$|\text{e}\gamma\rangle +$
$|\text{e}\gamma\gamma\rangle +$
ω
k_{T}
$\tau \approx$
$\frac{\omega}{k_{\text{T}}}.$
k_{T}
??
For hard, wide angle emissions, cross sections can be calculated perturbatively at fixed orders
$\propto$
$\frac{1}{\omega} \propto$
$\frac{1}{k_{\text{T}}^2}$
x
${}_{\text{e}}(x) =$
$\delta(1-$
$x)\,, f_\gamma(x) =$
$0\,,$
Q^2
$$\partial \frac{}{\partial \ln Q^2 \left(f \right)_e (x,Q^2) f_\gamma(x,Q^2) = \frac{\alpha_{\text{em}}}{2\pi} \int_x^1 \frac{dz}{z} \left(P \right)_{ee}(z) P_{e\gamma}(z) P_{\gamma e}(z) P_{\gamma\gamma}(z) \left(f \right)_e \left(\frac{x}{z}, Q^2 \right) f_\gamma \left(\frac{x}{z}, Q^2 \right),}$$
$P_{ij}(z)$
i
j
$\alpha_{\text{em}} \to$
α_s
$e \to$
q
$\gamma \to$
g
??
x
Q^2
1
$\sigma =$
$f_i^A(x_i, \mu_F) f_j^B(x_j, \mu_F) \otimes$
$\hat{\sigma}_{ij\to n}(\mu_F, \mu_R) \otimes$
$D_{n\to n'}\,.$
i
j
$\hat{\sigma}_{ij\to n}$
$D_{n\to n'}$
n
n'
μ_F
μ_R
μ_F
??
??
x
x^{O}
$x \propto$
$\frac{1}{\sqrt{s e^y}}$
$x \to$
0