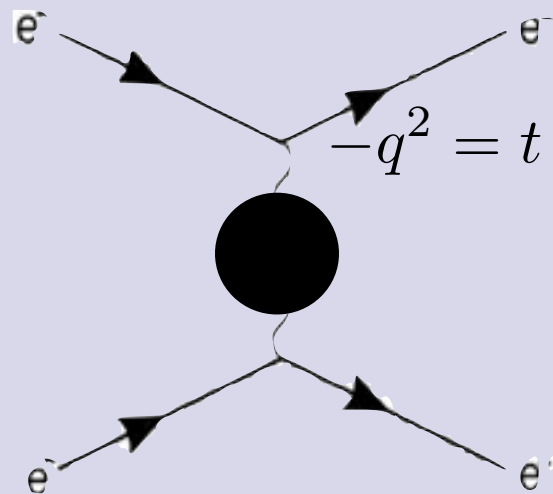


Lessons from QED

In the (physical) Gell Mann-Low scheme, the momentum scale of the running coupling is the virtuality of the exchanged photon; independent of initial scale.

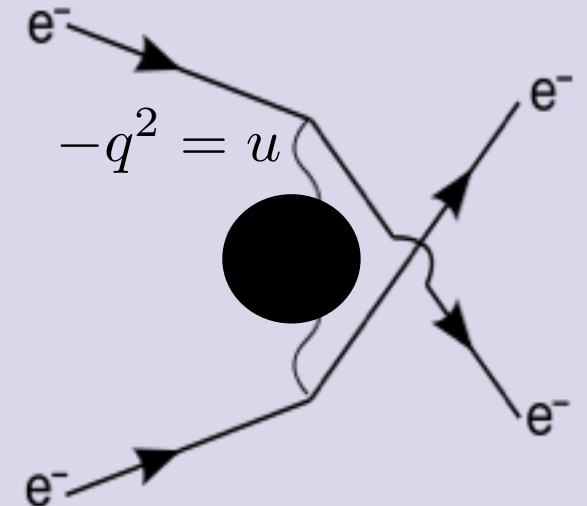
$$\alpha(t) = \frac{\alpha(t_0)}{1 - \Pi(t, t_0)} \quad \Pi(t, t_0) = \frac{\Pi(t) - \Pi(t_0)}{1 - \Pi(t_0)}$$

Example: ee-scattering



$$\mathcal{M}_{ee \rightarrow ee} = \frac{8\pi s}{t} \alpha(t) + \frac{8\pi s}{u} \alpha(u)$$

Two separate scales;
one for each skeleton graph.



For any other scale choice an infinite set of diagrams must be taken into account to obtain the correct result!

In any other scheme, the correct scale displacement must be used

$$\log \frac{\mu_{MS}^2}{m_\ell^2} = 6 \int_0^1 dx x(1-x) \log \frac{m_\ell^2 + Q^2 x(1-x)}{m_\ell^2}, \quad Q^2 \gg m_\ell^2 \longrightarrow \log \frac{Q^2}{m_\ell^2} - \frac{5}{3}$$

$$\alpha_{\overline{MS}}(e^{-5/3} q^2) = \alpha_{GM-L}(q^2).$$