

$$\alpha_{\text{GUT}} = \frac{1}{40} = 0,025$$

$$\Lambda_{\text{QCD}} = 100 \text{ MeV}$$

$$\alpha_s(Q) = \frac{12\pi}{(33 - 2n_f) \ln \frac{Q^2}{\Lambda_{\text{QCD}}}}$$

in our case:
 $n_f = 2$

$$\text{if } \alpha_s = \alpha_{\text{GUT}} = \frac{1}{40} = \frac{12\pi}{(33 - 2 \cdot 2) \ln \frac{Q^2}{\Lambda_{\text{QCD}}}}$$

$$\ln \left(\frac{Q^2}{10^8} \right) = \frac{1}{40} \cdot \frac{(33 - 2 \cdot 2)}{12\pi}$$

$$Q^2 = 10^8 \cdot e^{\frac{33-4}{40 \cdot 12\pi}}$$

$$Q = \sqrt{e^{\frac{29}{40 \cdot 12\pi}} \cdot 10^8} \approx 10^4 \text{ eV} = \underline{10 \text{ MeV}}$$

in our world QCD scale is $218 \pm 24 \text{ MeV}$