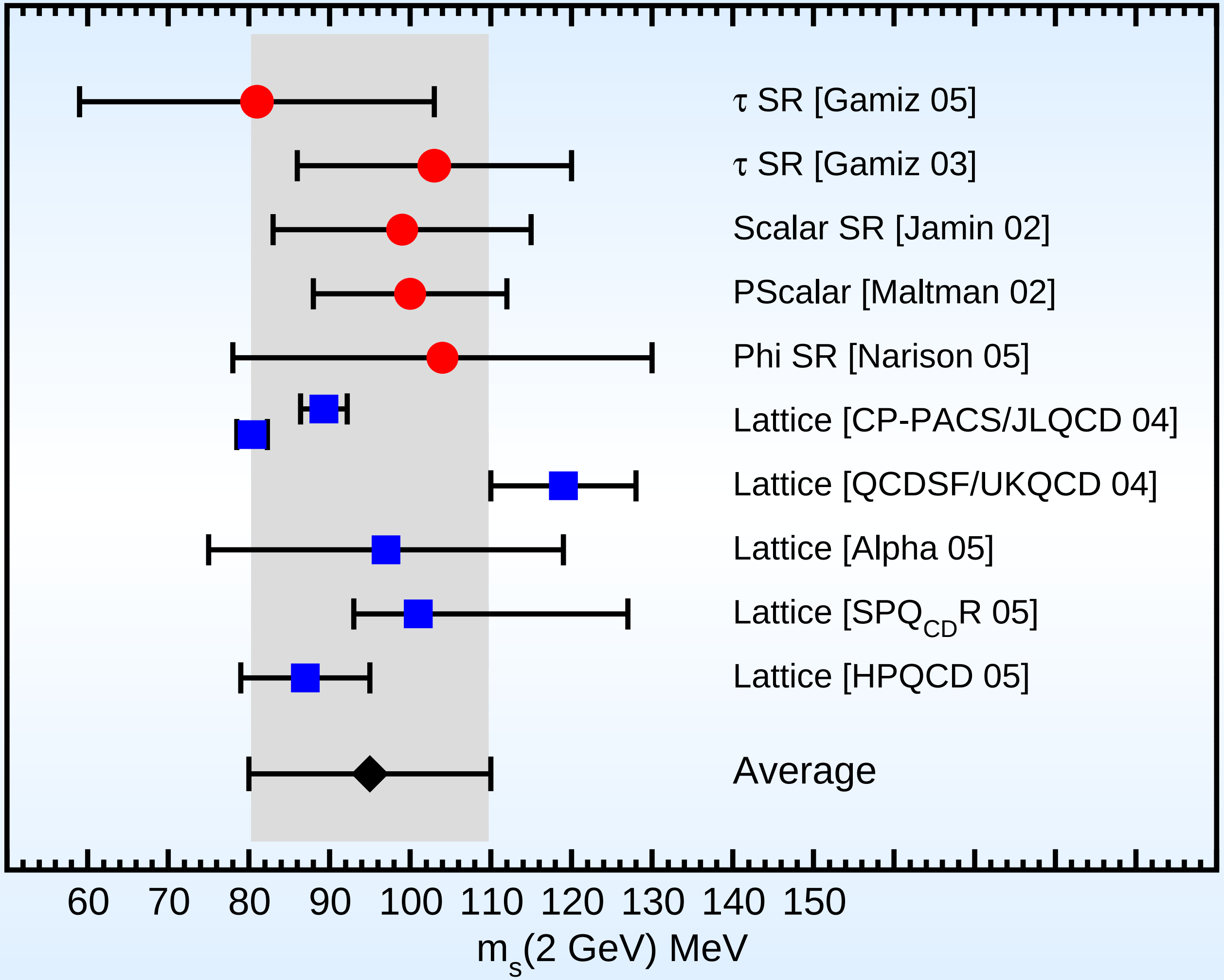
Strange quark mass



$\Rightarrow$ Average: $m_s(2\,\text{GeV}) = 95 \pm 15$ MeV

V_{us} from R_τ

Our starting point is the SU(3)-breaking difference:

$$\delta R_\tau \equiv \frac{R_{\tau,NS}}{|V_{ud}|^2} - \frac{R_{\tau,S}}{|V_{us}|^2} = N_c \sum_{D\geq 2} \left(\delta_{ud}^{(D)} - \delta_{us}^{(D)} \right).$$

Given m_s, we are in a position to predict δR_τ from theory:

$$\delta R_{\tau,th} = 0.162 + 6.12\, m_s^2 - 7.78\, m_s^4 = 0.218 \pm 0.026\,.$$

Let us now reconsider the equation for δR_τ:

$$|V_{us}| = \sqrt{\frac{R_{\tau,S}}{\underbrace{R_{\tau,NS}/|V_{ud}|^2}_{\approx 3.658} - \delta R_{\tau,th}}}$$

Thus the theoretically derived quantity $\delta R_{\tau,th}$ only gives a small correction to experimentally measured quantities.

V_{us} from R_τ

Together with the experimental results $R_{\tau,NS} = 3.469 \pm 0.014$ as well as $R_{\tau,S} = 0.1677 \pm 0.0050$, V_{us} can be determined:

$$|V_{us}| = 0.2208 \pm 0.0033_{\rm exp} \pm 0.0009_{\rm th} = \boxed{0.2208 \pm 0.0034}$$

The uncertainty on V_{us} is dominated by the experimental error on $R_{\tau,S}$. The theoretical error by our knowledge of m_s.

In the near future, it should be possible to reduce the uncertainty with the τ-data sets from BABAR and BELLE.

If the experimental value $B(\tau \to K\nu_\tau) = (0.686 \pm 0.023)$% is replaced by the theoretical prediction (0.715 ± 0.004)% based on $K_{\mu 2}$ decays, one finds $|V_{us}| = \boxed{0.2219 \pm 0.0034}$.