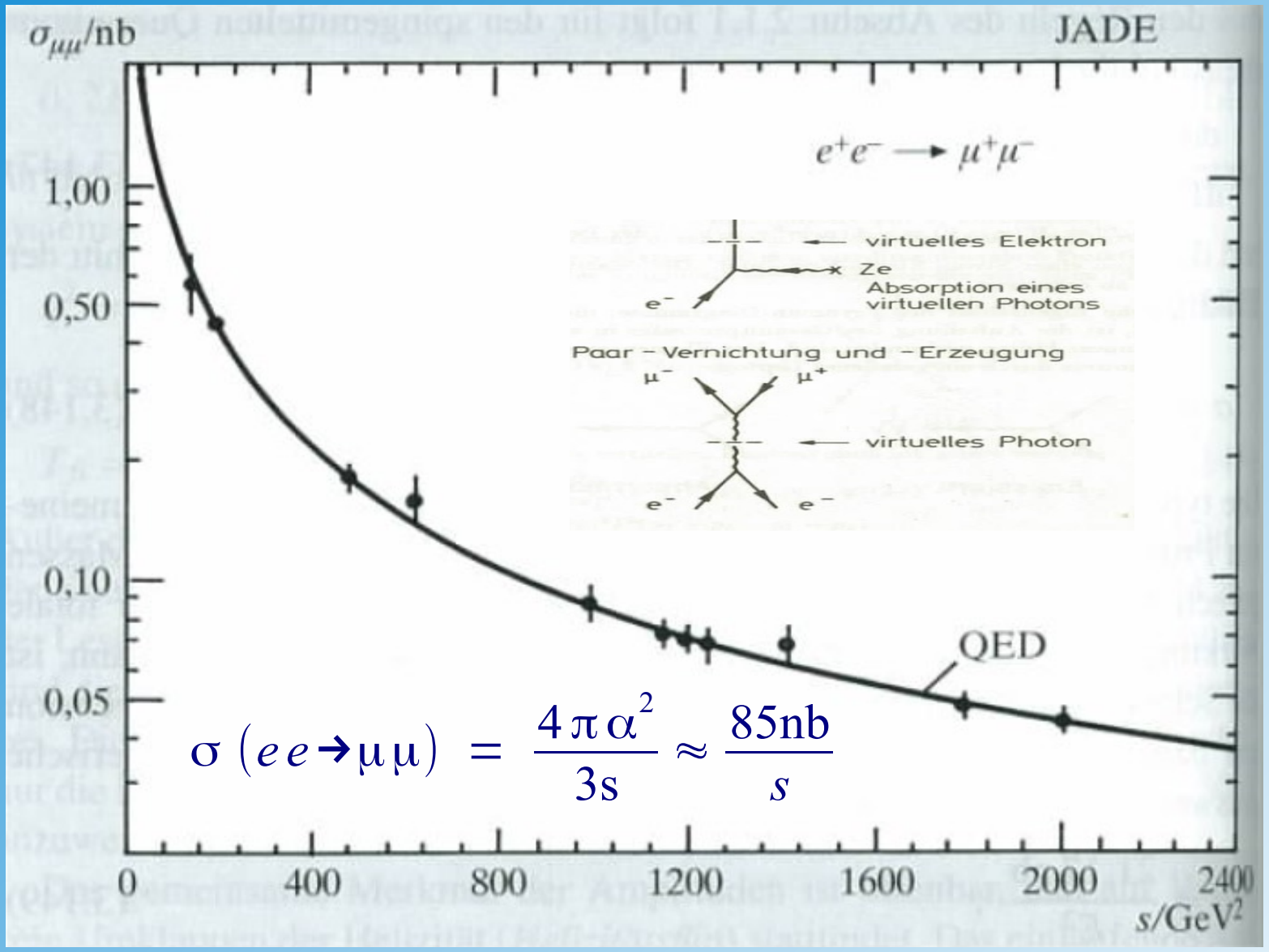
QED Processes

- Matrix Element
- Non-relativistic Electrons Scattering
- Relativistic Electrons Scattering
- Fermion-Fermion Scattering
- Crossing Symmetries
- Electron-Myon Scattering and Annihilation
- Möller Scattering
- Bhabha Scattering
- Compton Scattering

Myon Pair Production



PETRA accelerator (DESY)

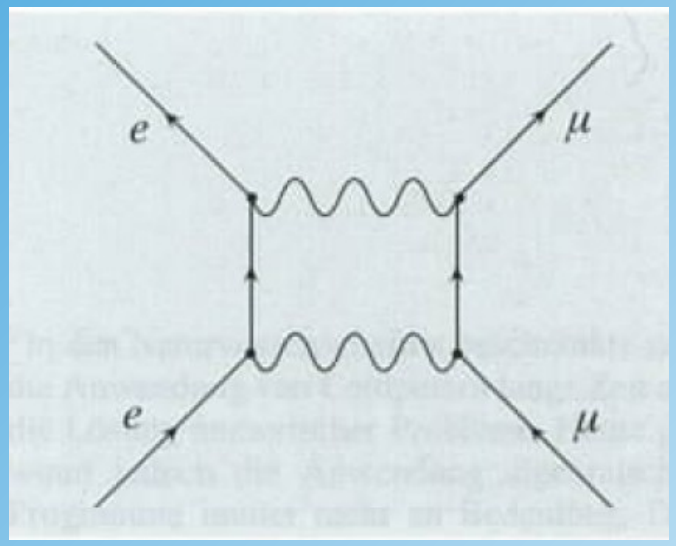
Higher Order Corrections

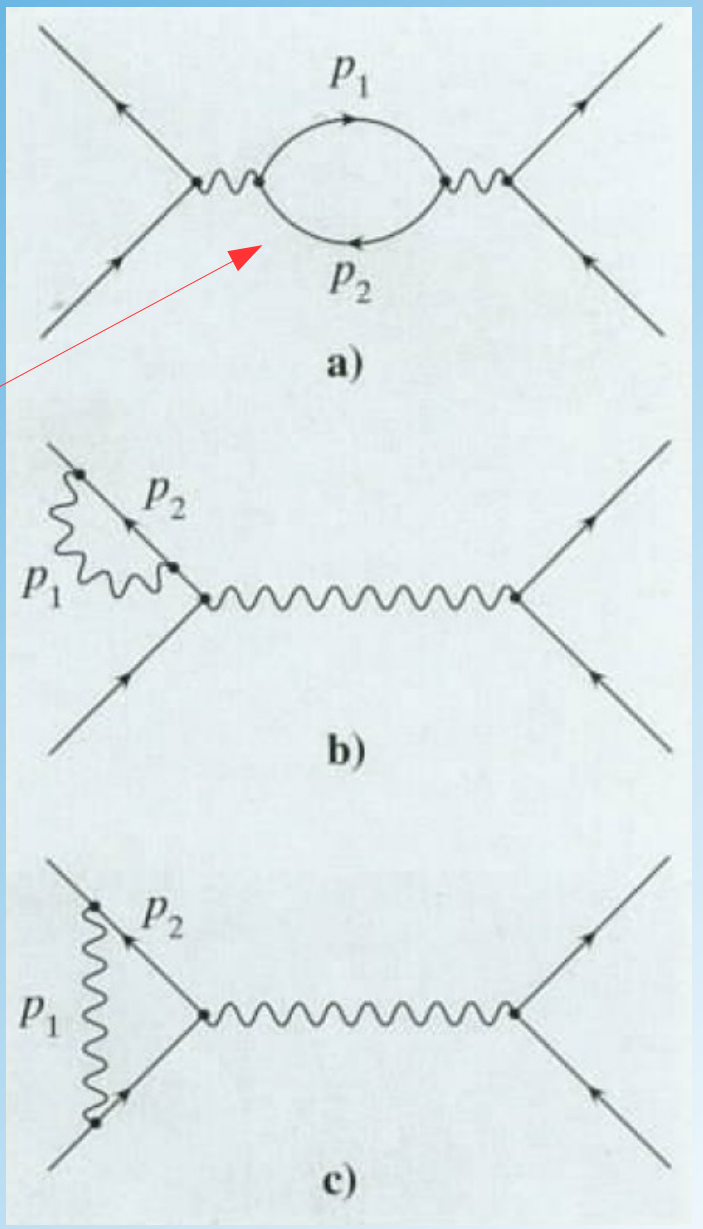
Corrections order: e^4 (α^2)

photon propagator to be replaced by:

$$\int \frac{d^4 p_1}{(2\pi)^4} \left(\frac{-i g_{\mu\rho}}{q^2} (-ie)\gamma^\rho i \frac{\not{p}_1 + m}{p_1^2 - m^2} (-ie)\gamma^\sigma i \frac{\not{p}_2 + m}{p_2^2 - m^2} \frac{-i g_{\sigma\nu}}{q^2} \right)$$

box diagram:

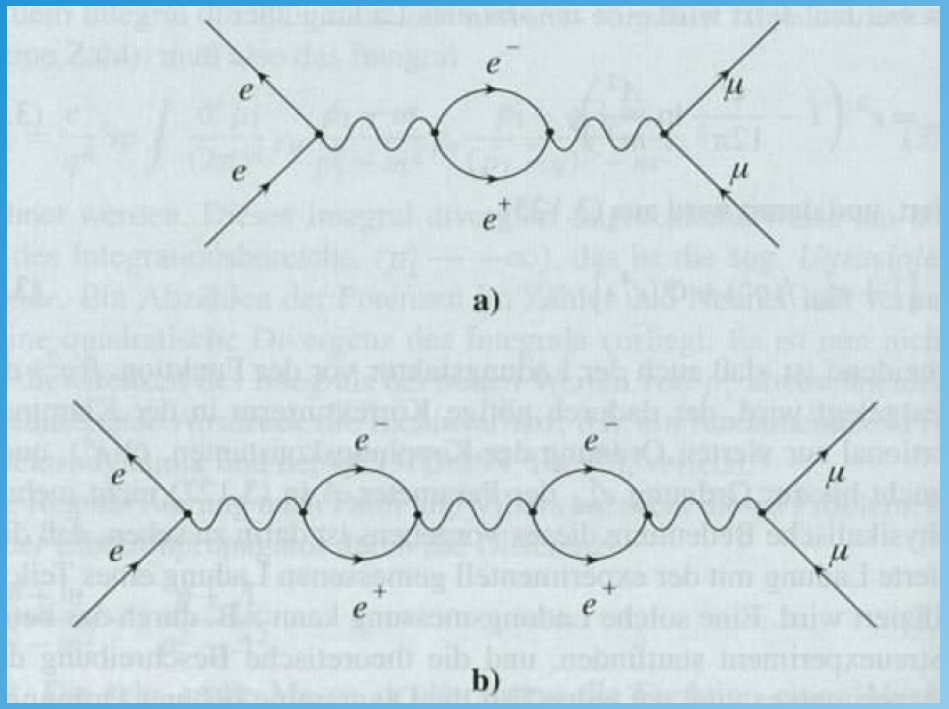


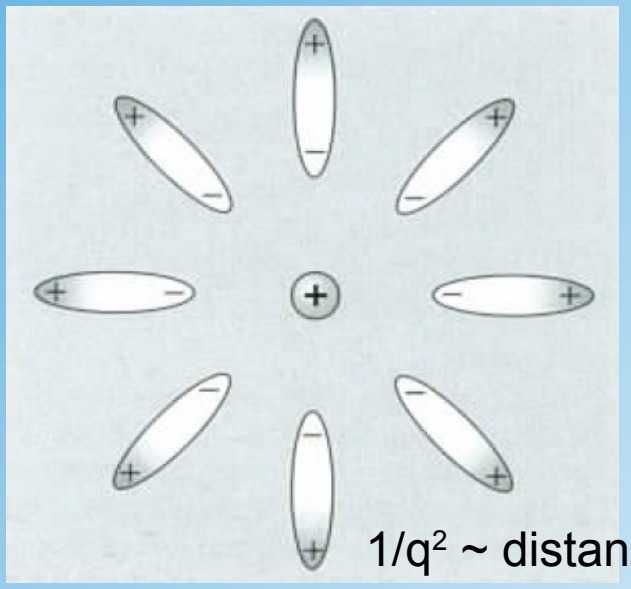


Note: higher order graphs interfere with Born graph!

Vacuum Polarisation

Effective electrical charge depends on loop corrections and therefore on q^2





$1/q^2$ ~ distance

bare electrical charge shielded by vacuum polarisation

problem: ultraviolet divergences (high energy limit) → cut off mass Λ
solution: renormalisation (Λ cancels if all higher orders are considered!)

result (first order): $$e^2_{eff}(q^2) = e^2\left(1 + \frac{e^2}{12\pi^2}\ln\frac{|q^2|}{m^2}\right)$$ e=bare electrical charge

coupling and/or mass depend on energy scale (q^2)