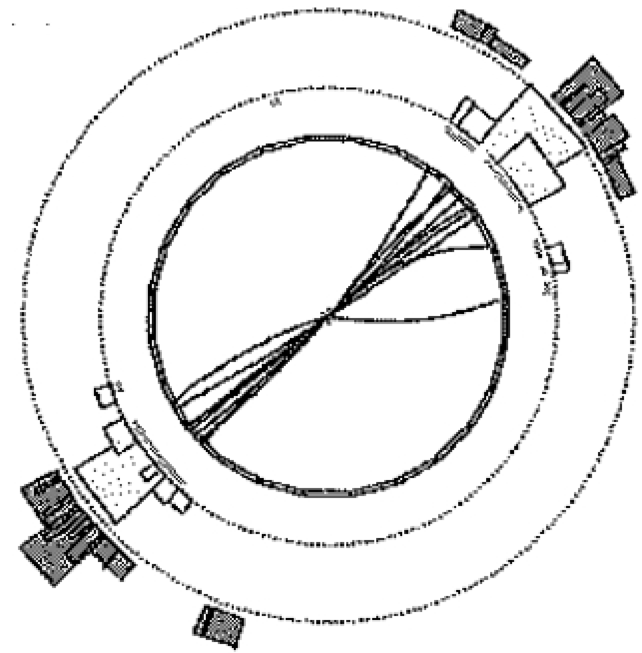
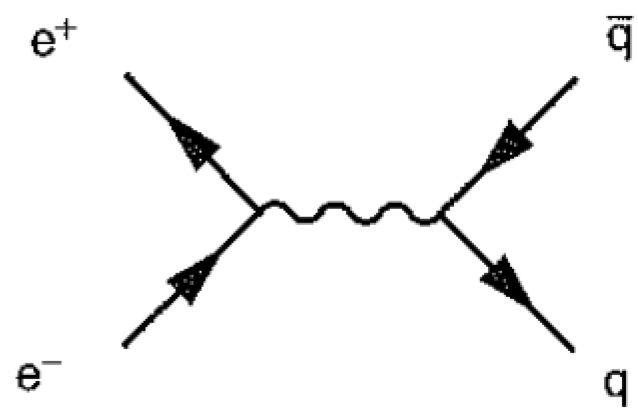
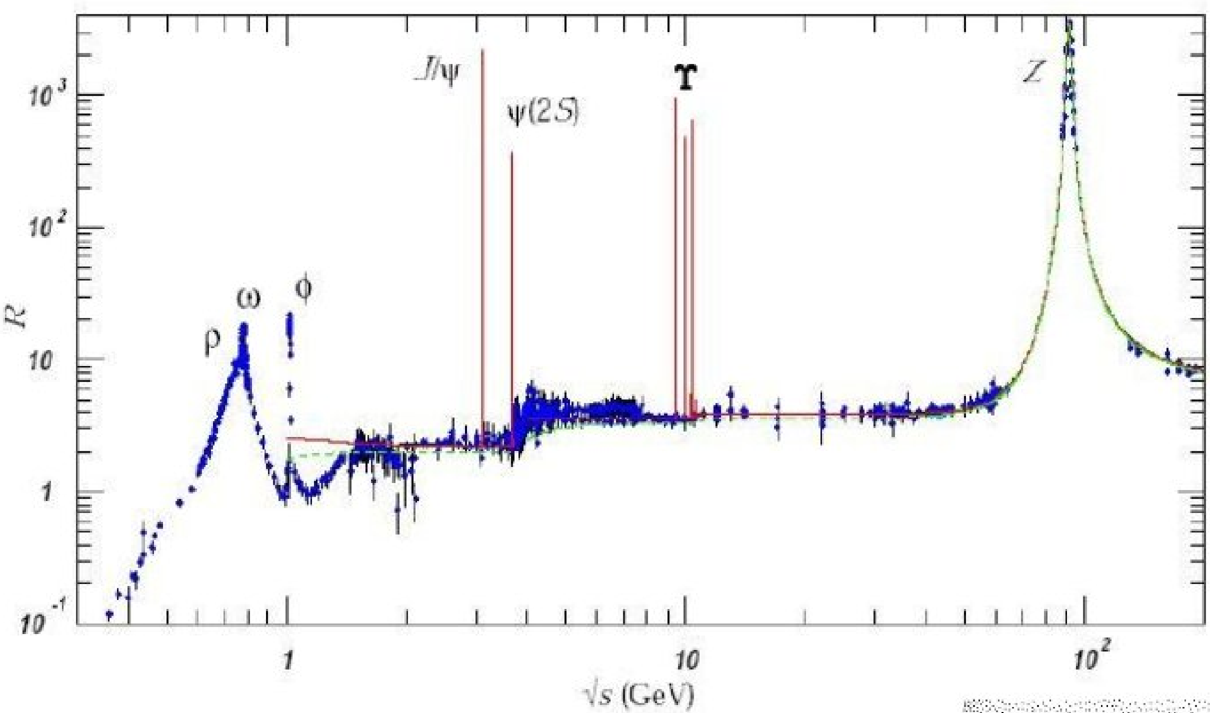
$e^+e^- \rightarrow q\,\bar{q}$ Ereignis





Die beiden Quarks bilden Jets („Bündel von Teilchen“) im Detektor



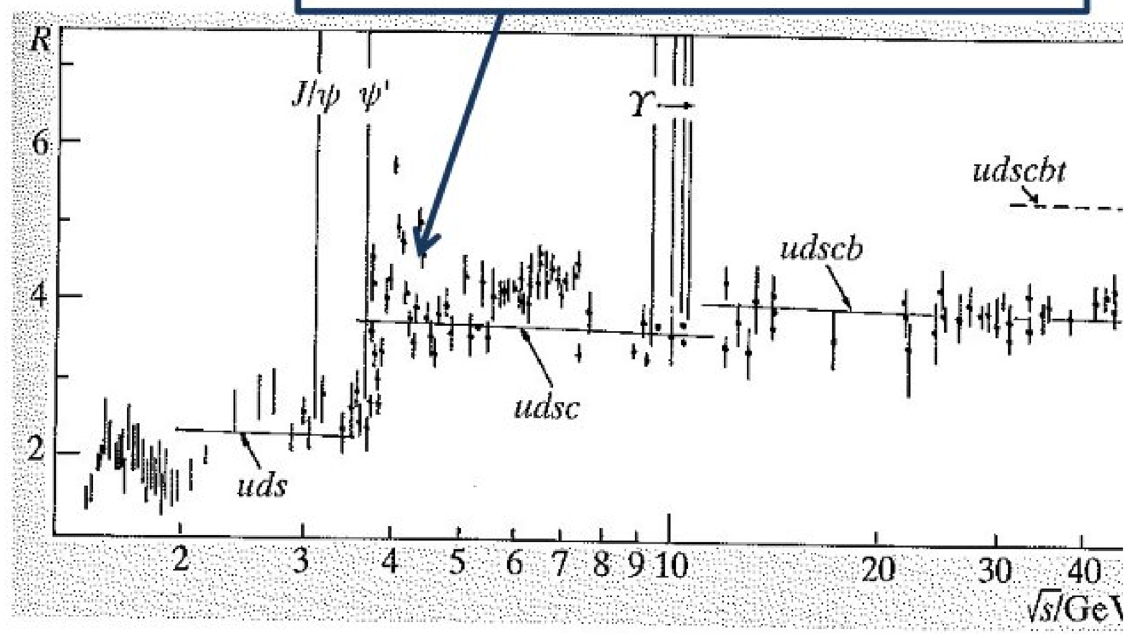
$$R = \frac{\sigma(e^+e^- \to hadrons)}{\sigma(e^+e^- \to \mu^+\mu^-)}$$

$$= N_c \sum_i Z_i^2$$

q	Z_i^2	R[$\sqrt{s} \leq 2m(q)$]
u	4/9	4/3
d	1/9	5/3
s	1/9	2
c	4/9	10/3
b	1/9	11/3
t	4/9	5

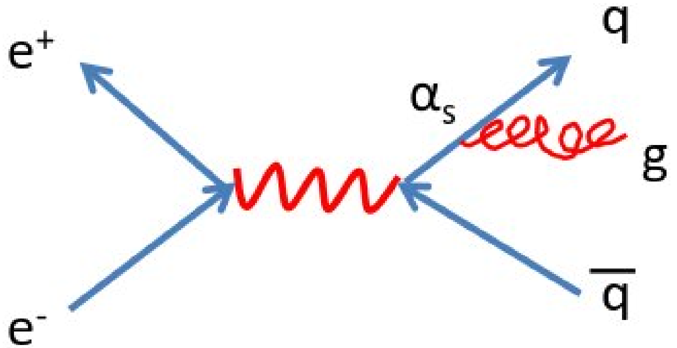
N_c=3 „more or less“ confirmed by data!

τ$\bar{\tau}$ treshold, however not all τ decay into hadronic jets



Discovery of the Gluon

discovery of 3-jet events by Tasso collaboration in 1977 at PETRA ($\sqrt{s} \sim 20\ GeV$)



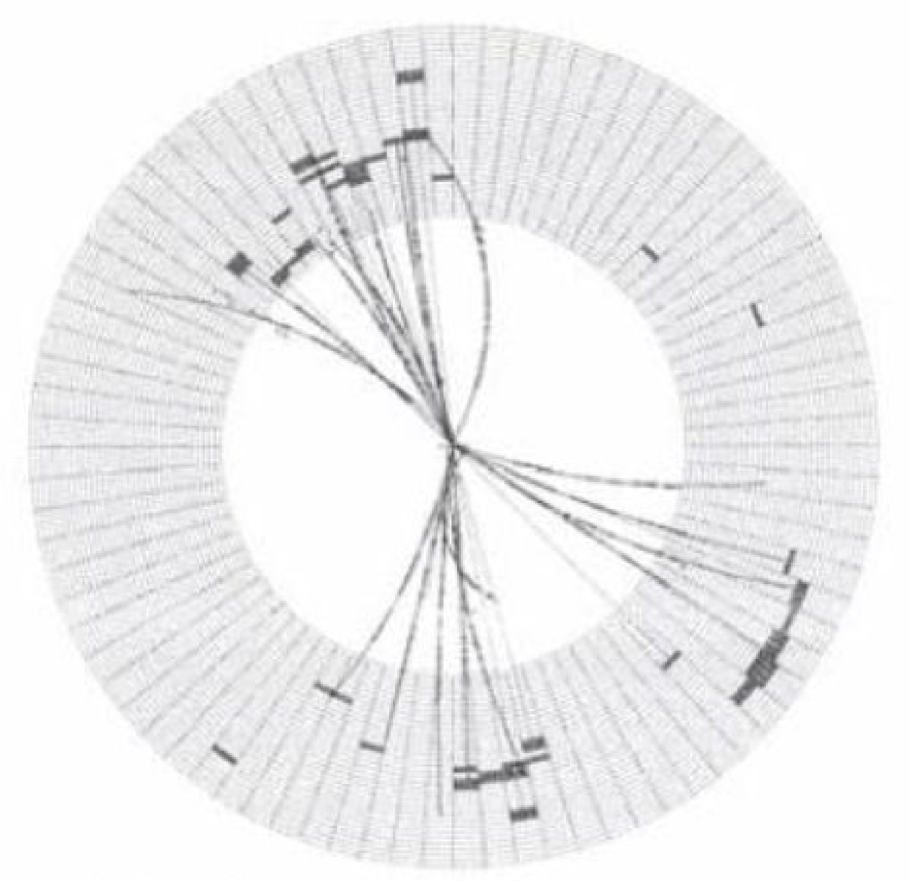


Fig. 11.12 A three-jet event observed by the JADE detector at PETRA.

Interpreted as quark anti-quark pair which emits an additional hard gluon.

$$\frac{\#\, of\ three\ jet\ events}{\#\, of\ two\ jet\ events} \sim 0.15$$

→ α_s is large!

Hadronisierung, Bildung von Jets

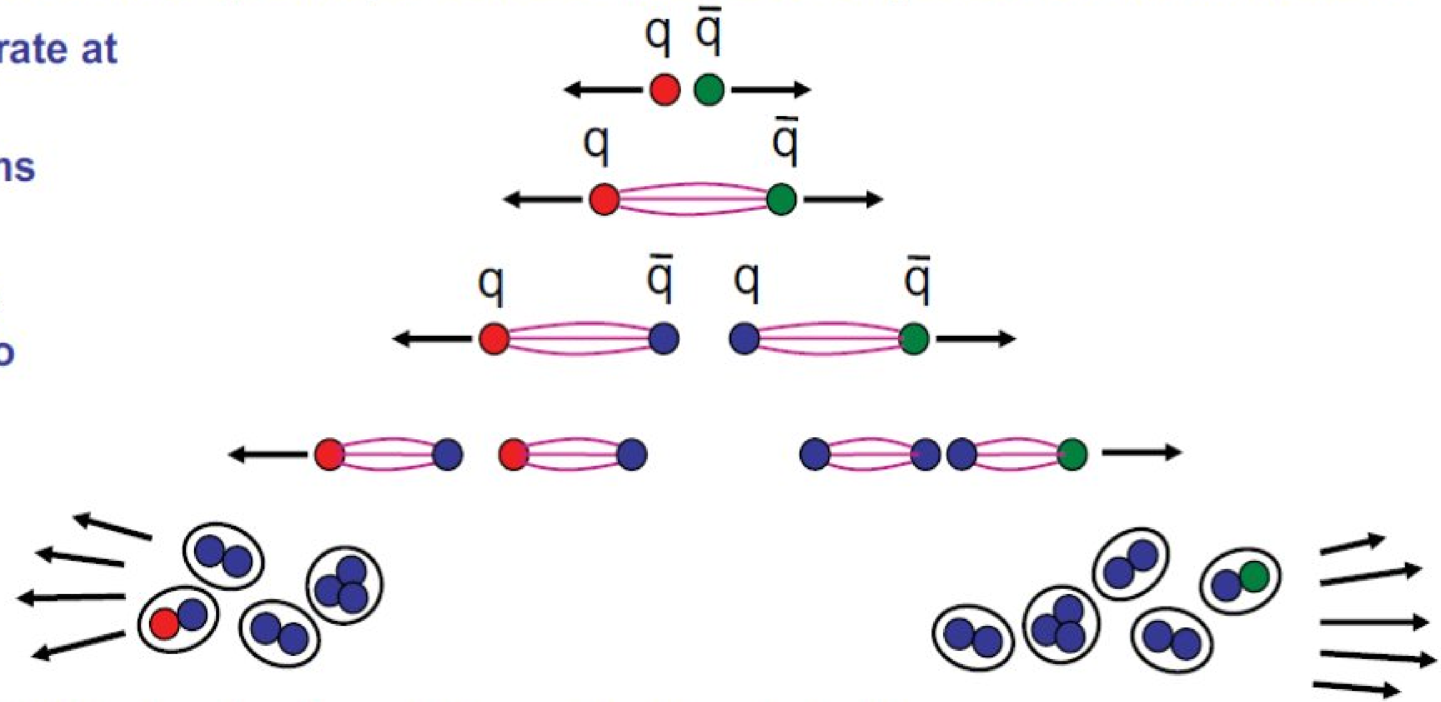
★ Consider a quark and anti-quark produced in electron positron annihilation

i) Initially Quarks separate at high velocity

ii) Colour flux tube forms between quarks

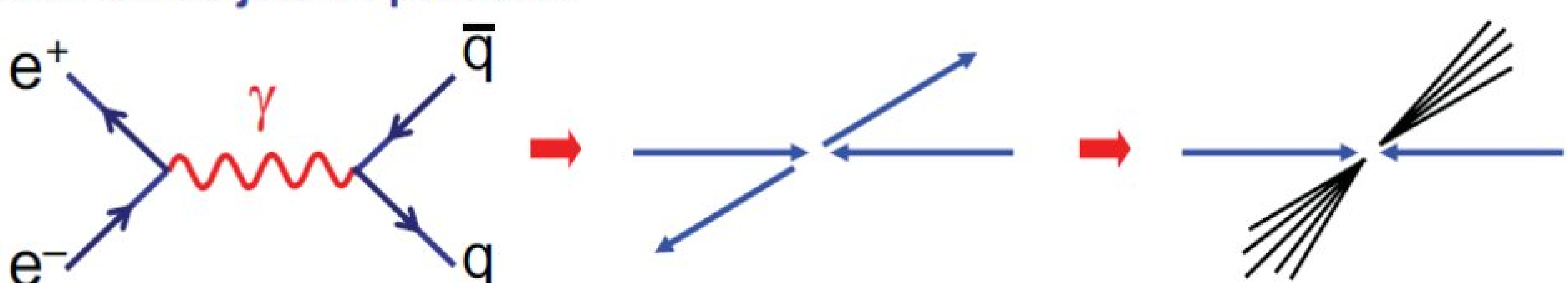
iii) Energy stored in the flux tube sufficient to produce $q\bar{q}$ pairs

iv) Process continues until quarks pair up into jets of colourless hadrons



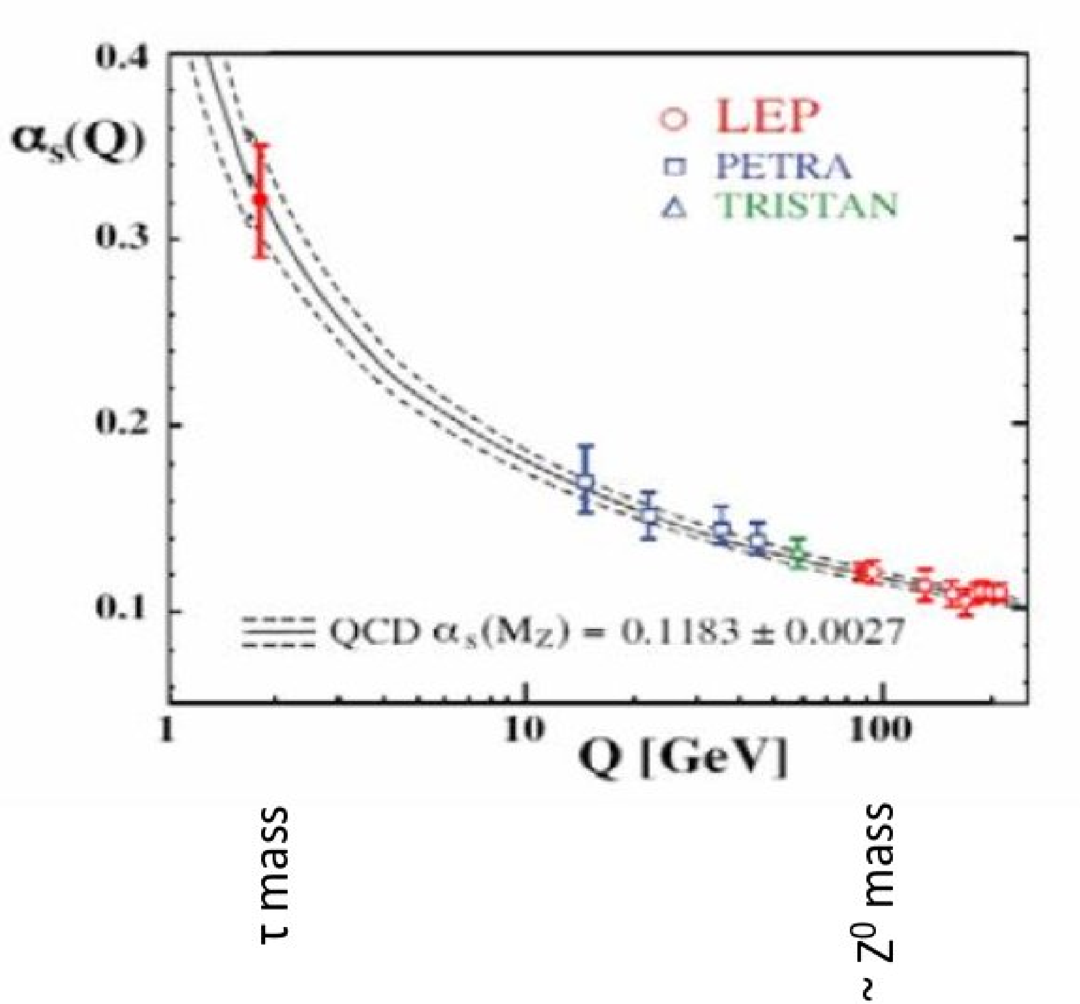
★ This process is called hadronisation. It is not (yet) calculable.

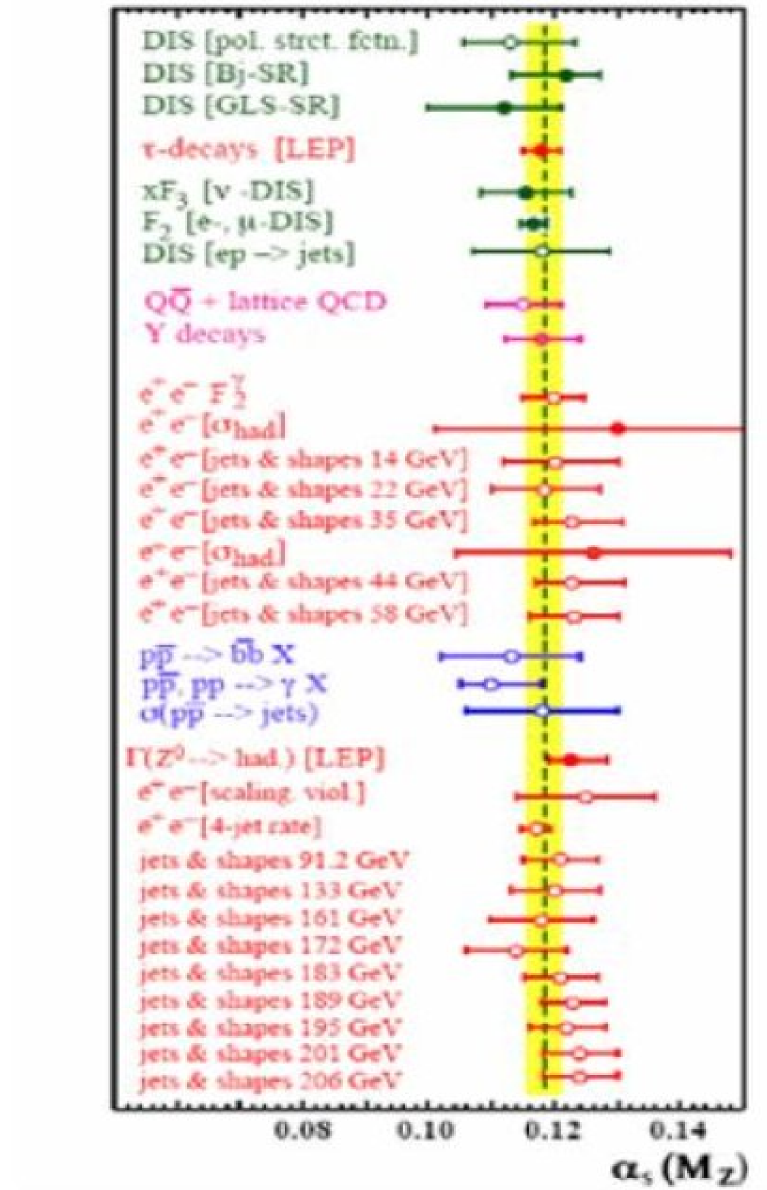
★ The main consequence is that at collider experiments quarks and gluons observed as jets of particles



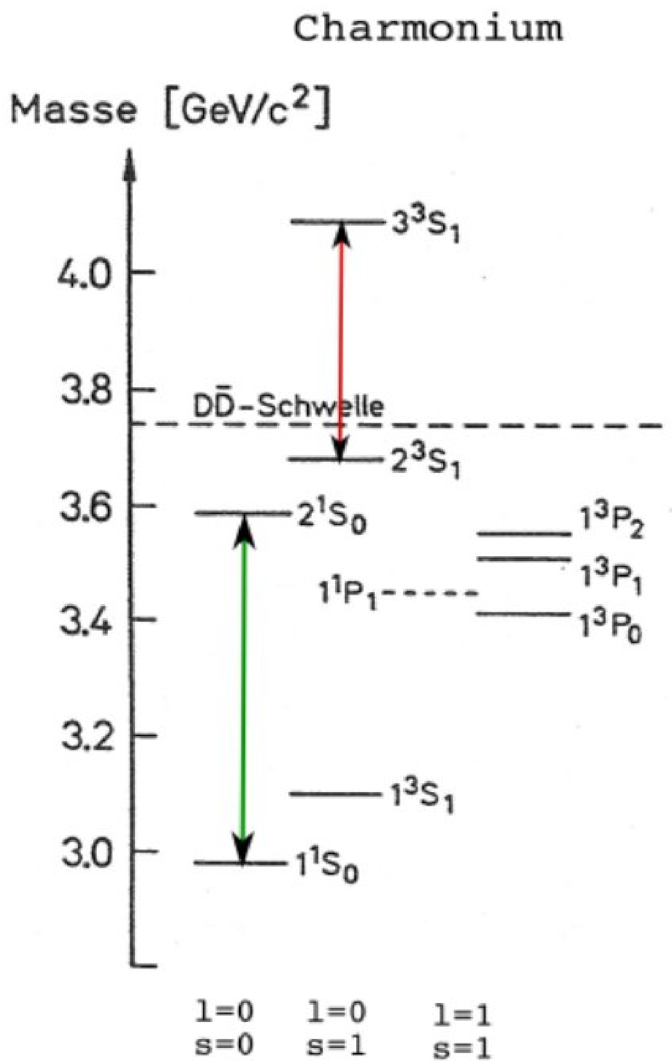
Laufende Kopplungskonstante der starkten WW

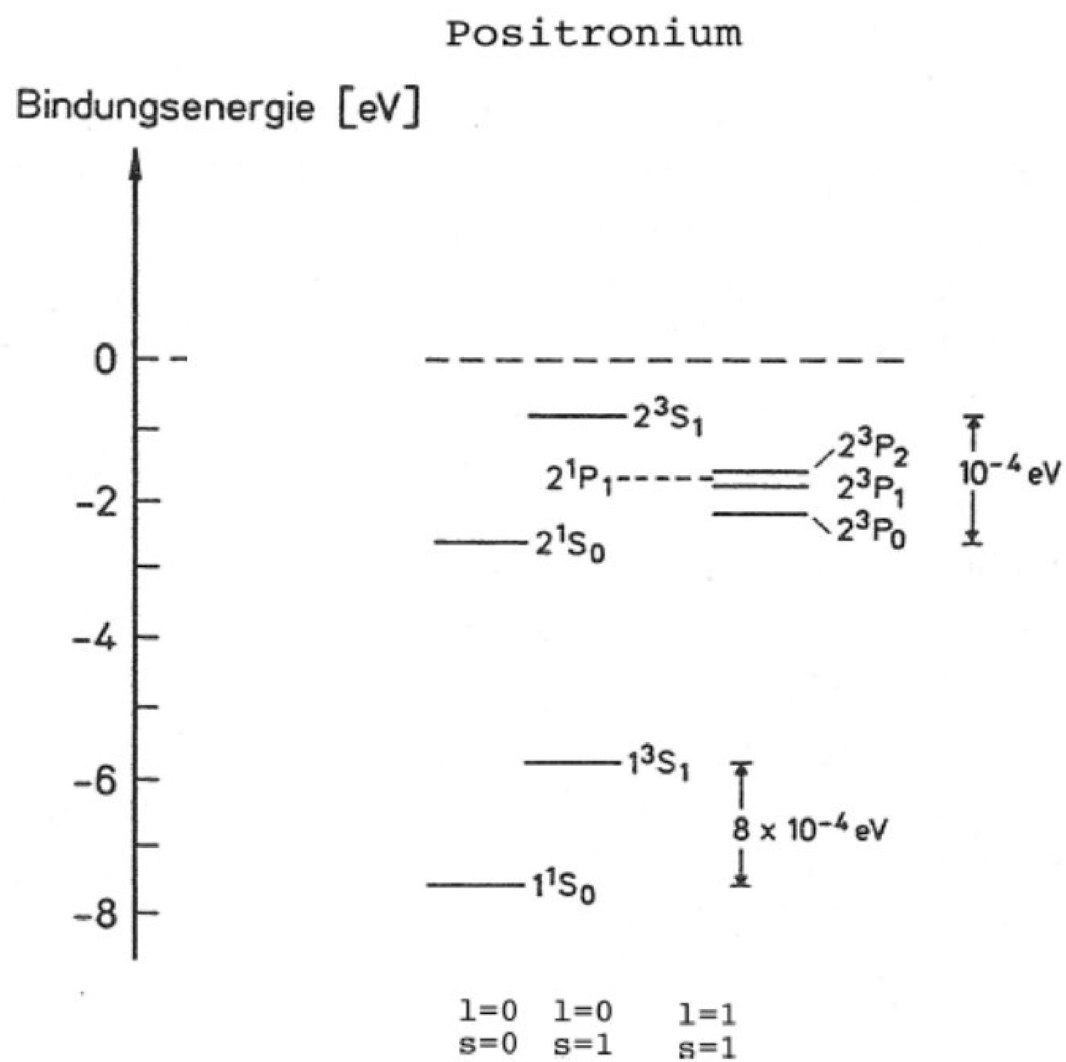
$$\alpha_s(Q^2) = \frac{1}{\beta_0 \log(Q^2/\Lambda^2_{QCD})}$$



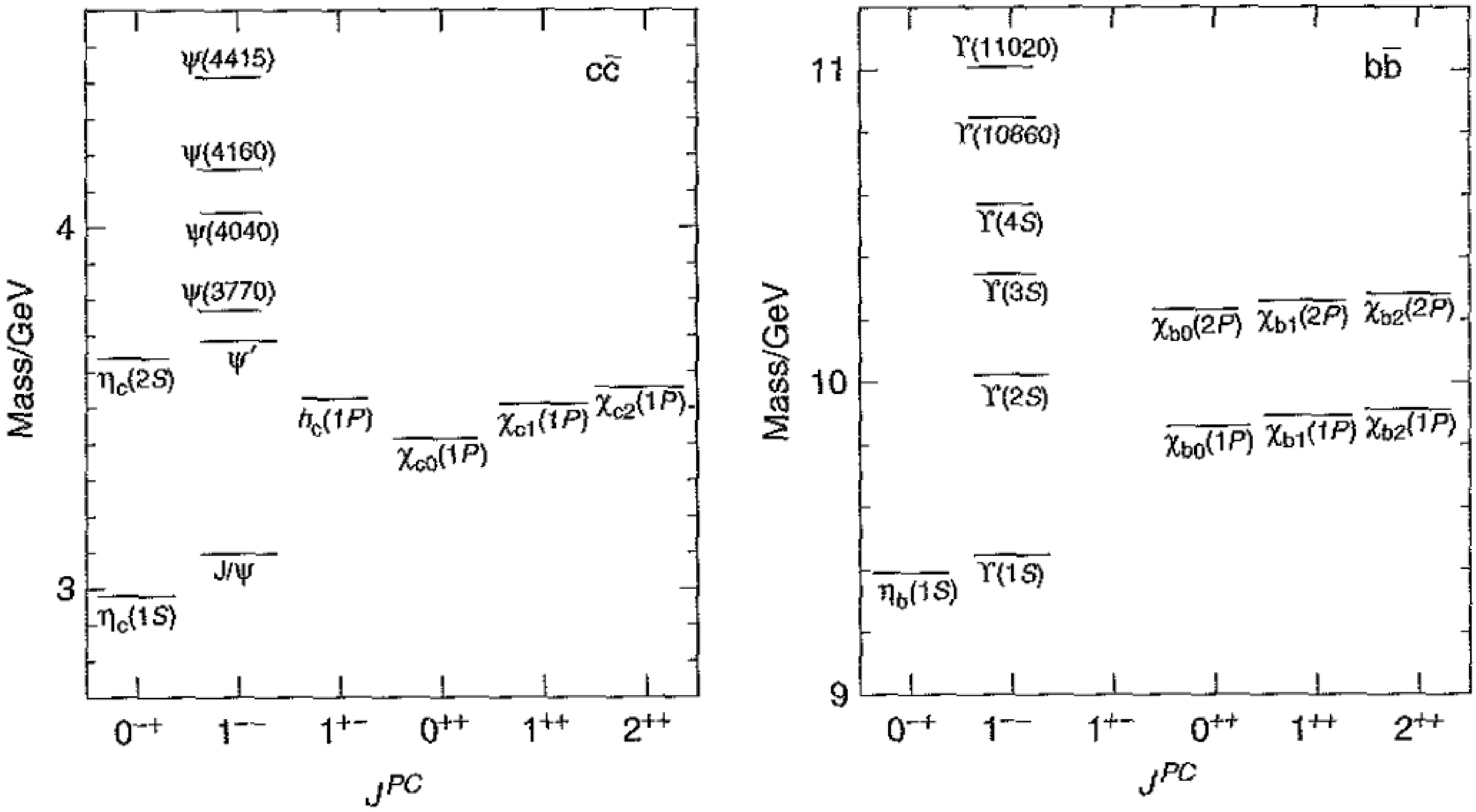


Vergleich Charmonium + Positronium Potential





Vergleich Charmonium + Bottonium



Unterschied zwischen Energienieveaus sehr ähnlich → starke WW ist flavour-blind!