

Lezione 22

Quarkonia

$$\phi(1020) \ (s, \bar{s}) \qquad J/\psi(3096) \ (c, \bar{c}) \qquad \Upsilon(9460) \ (b, \bar{b})$$

Masse di J/ψ e Υ molto grandi.

Piccolo accoppiamento con quark u, d, s .

Vista la massa grande sono trattati con modelli di MQ non relativistica.

Analogia con sistemi noti, **positronio**.

Positronio

Sistema legato e^{-}, e^{+} , vita media 10^{-10} s .

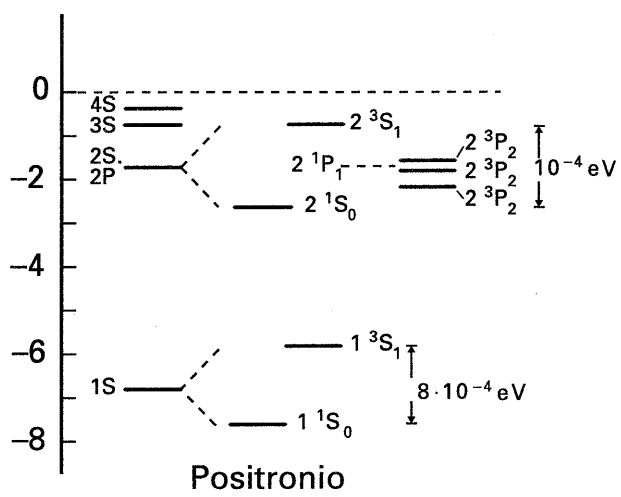
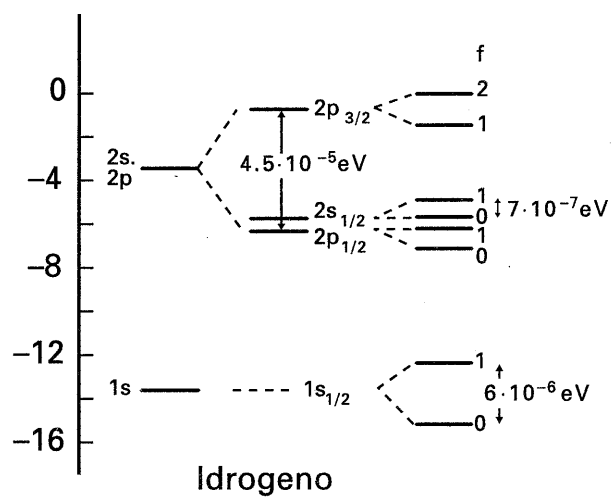
Gli spin possono formare sistemi con $S = 0$ oppure $S = 1$.

Lo stato con $S = 0$ decade in due fotoni per conservare il momento angolare.

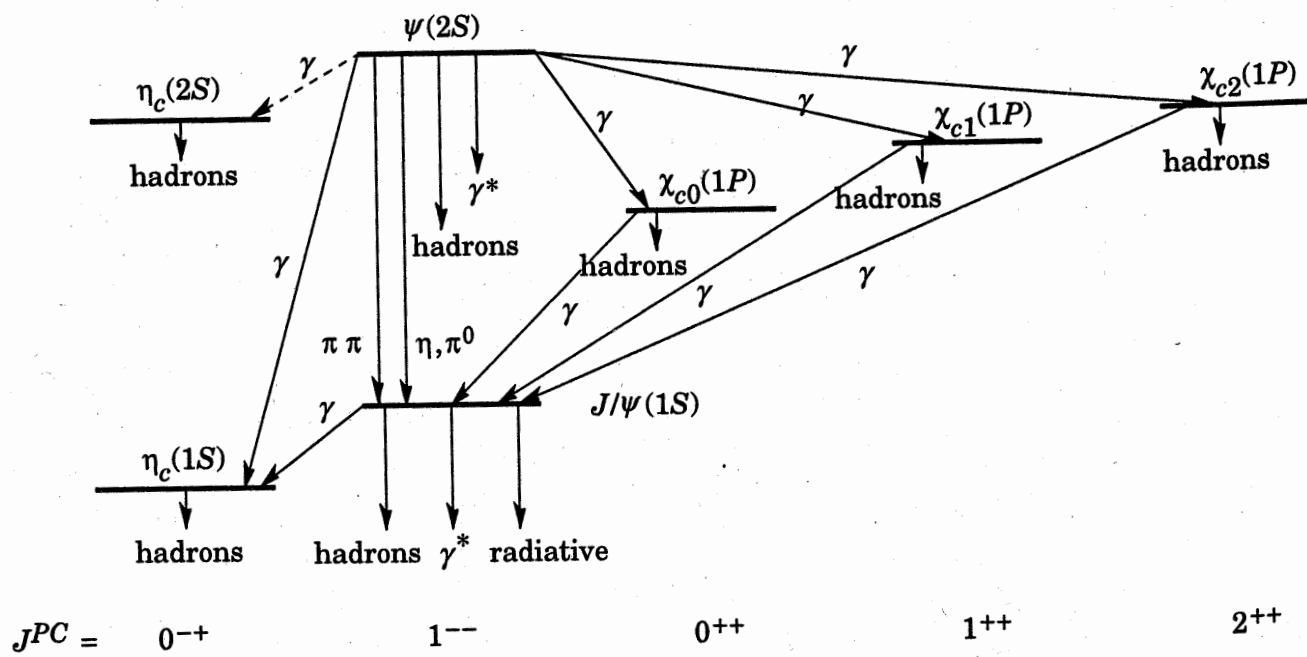
Lo stato con $S = 1$ decade in tre fotoni. Non può decadere in un singolo fotone per conservazione di energia e impulso.

Misura γ spettro di eccitazione del sistema.

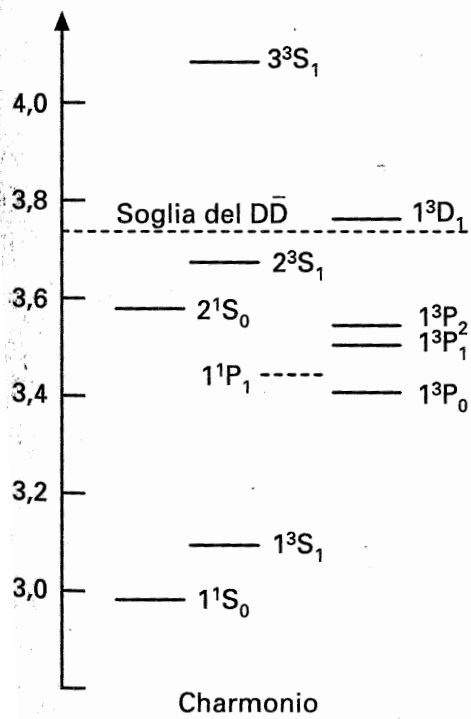
Confronto con l'atomo di idrogeno.



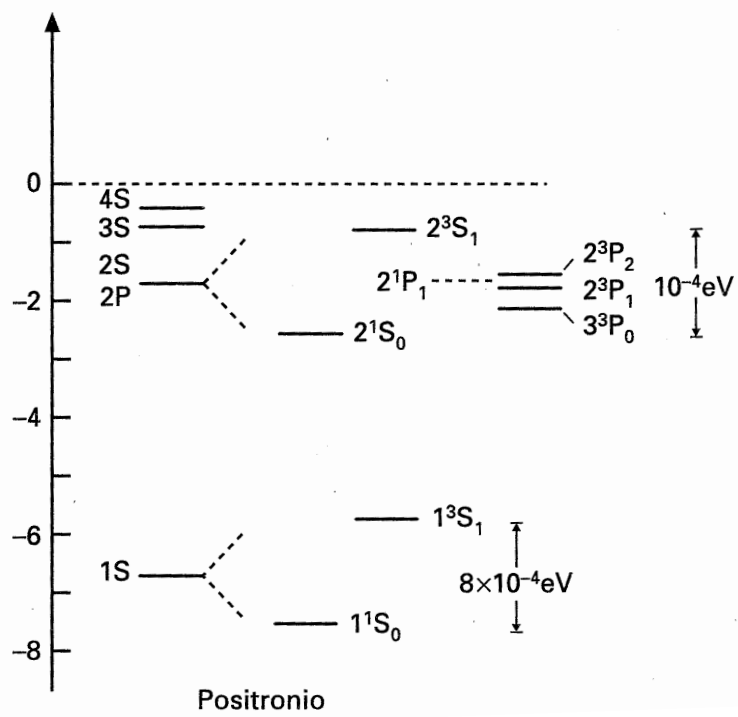
THE CHARMONIUM SYSTEM



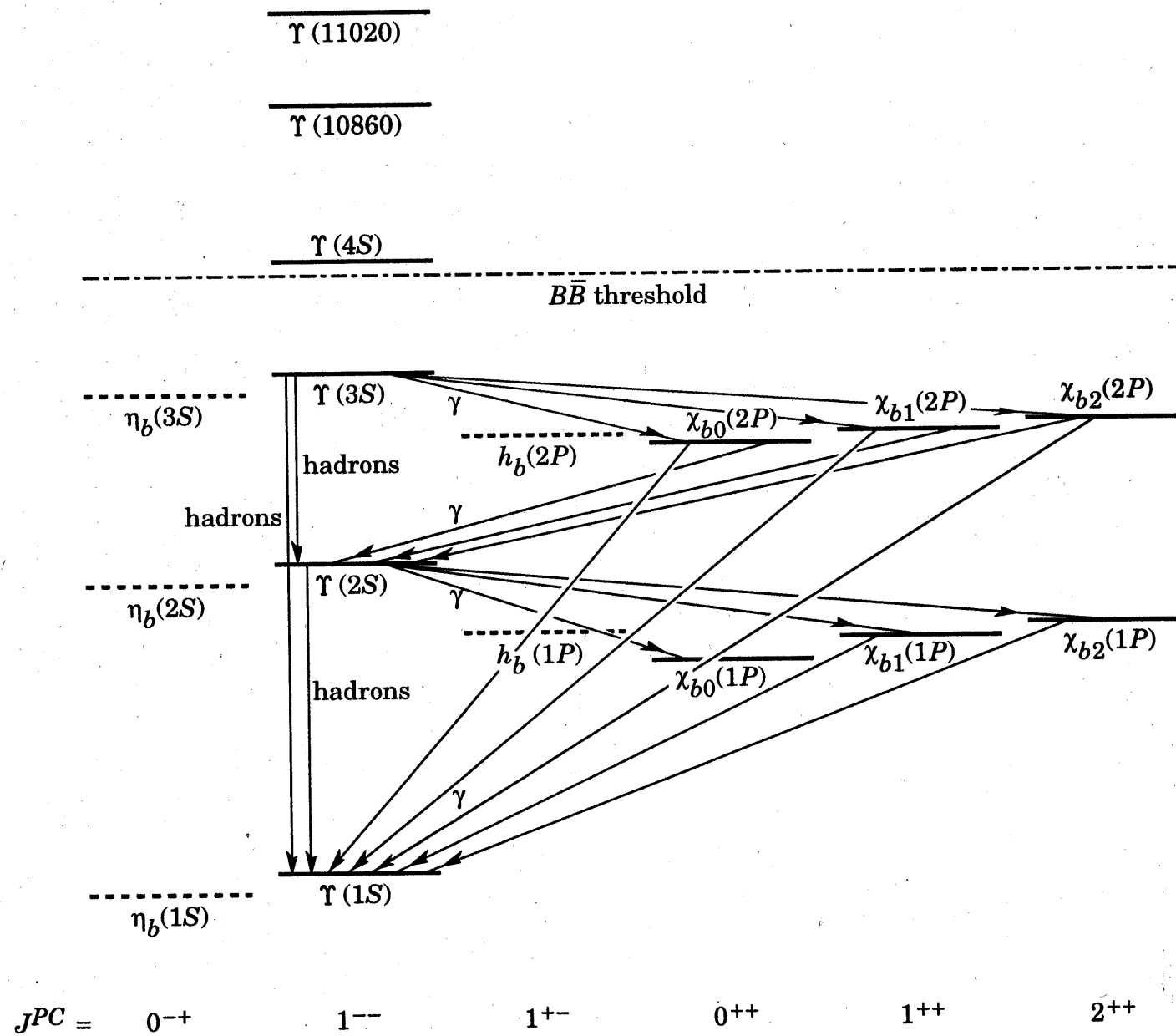
Massa [GeV/c^2]



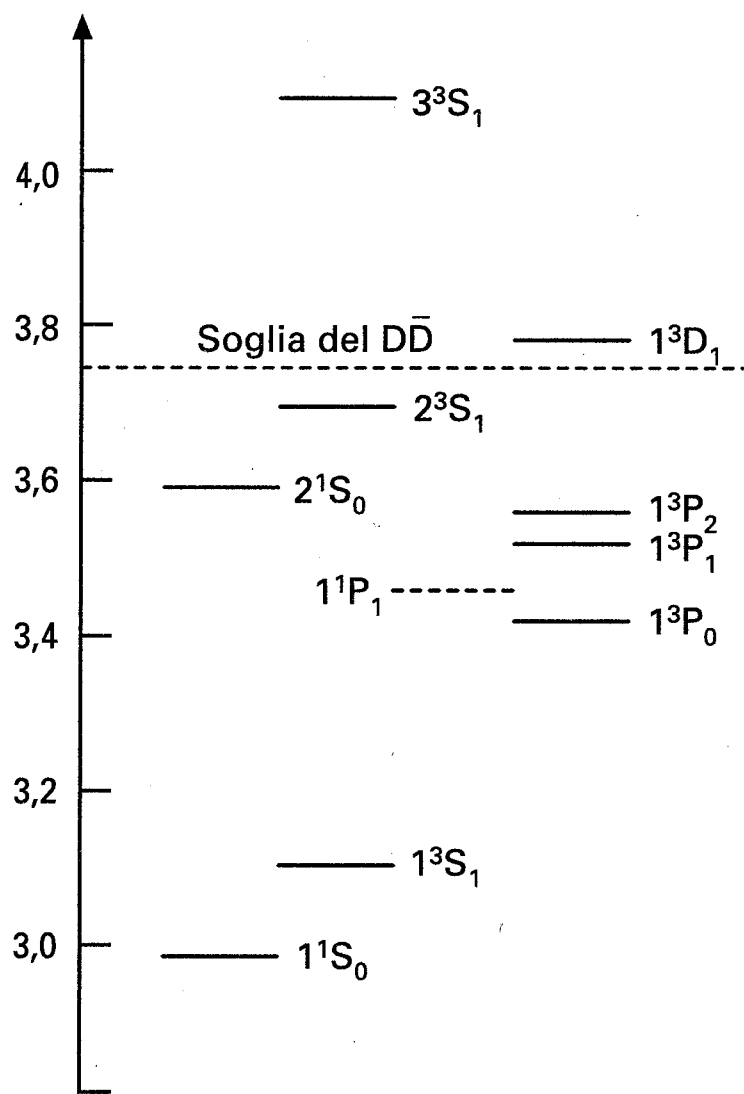
Energia di legame [eV]



Bottomio

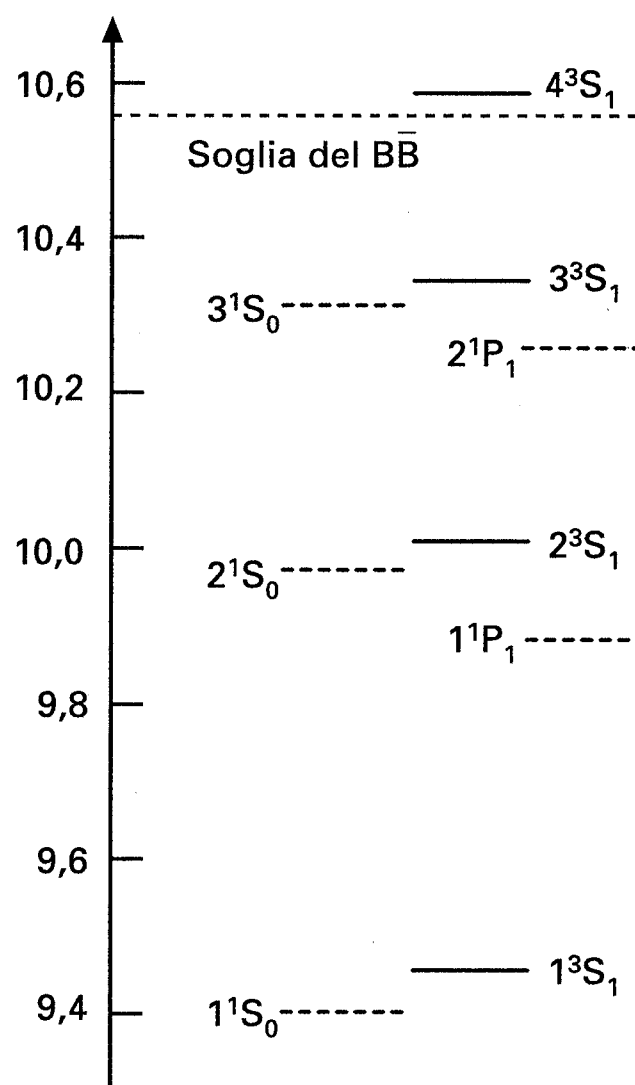


Massa [GeV/c²]

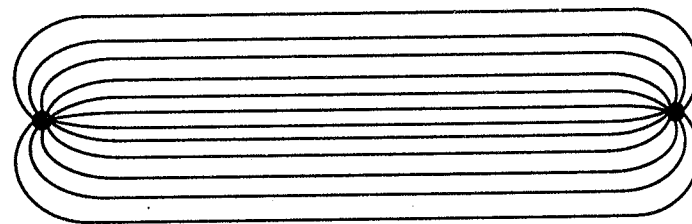
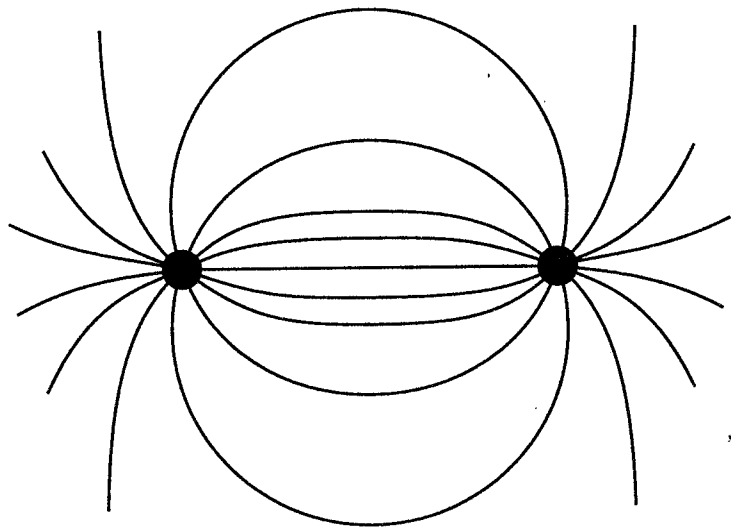


Charmonio

Massa [GeV/c²]

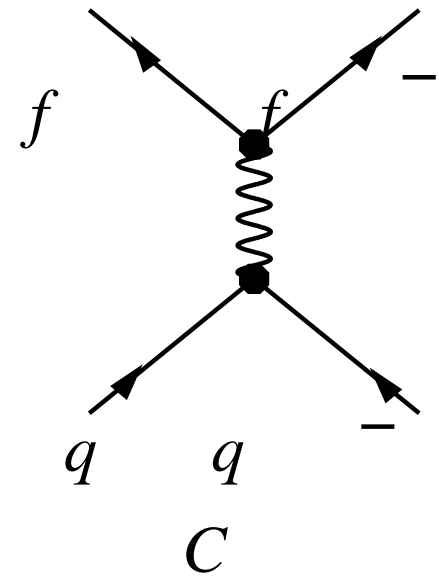
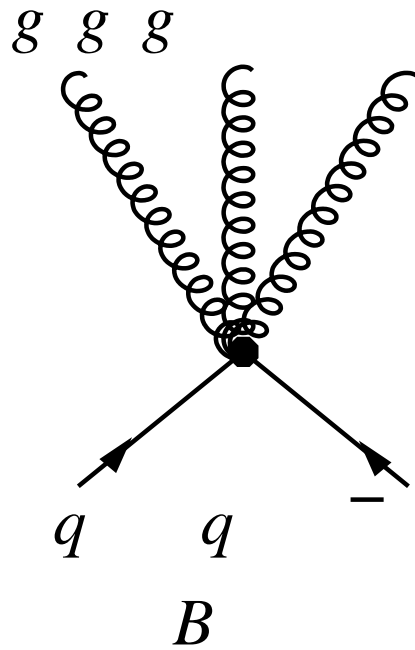
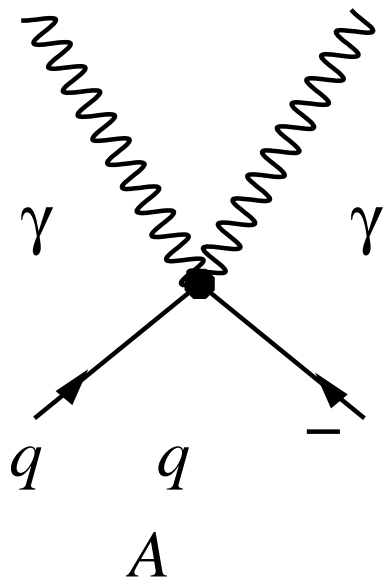


Bottonio



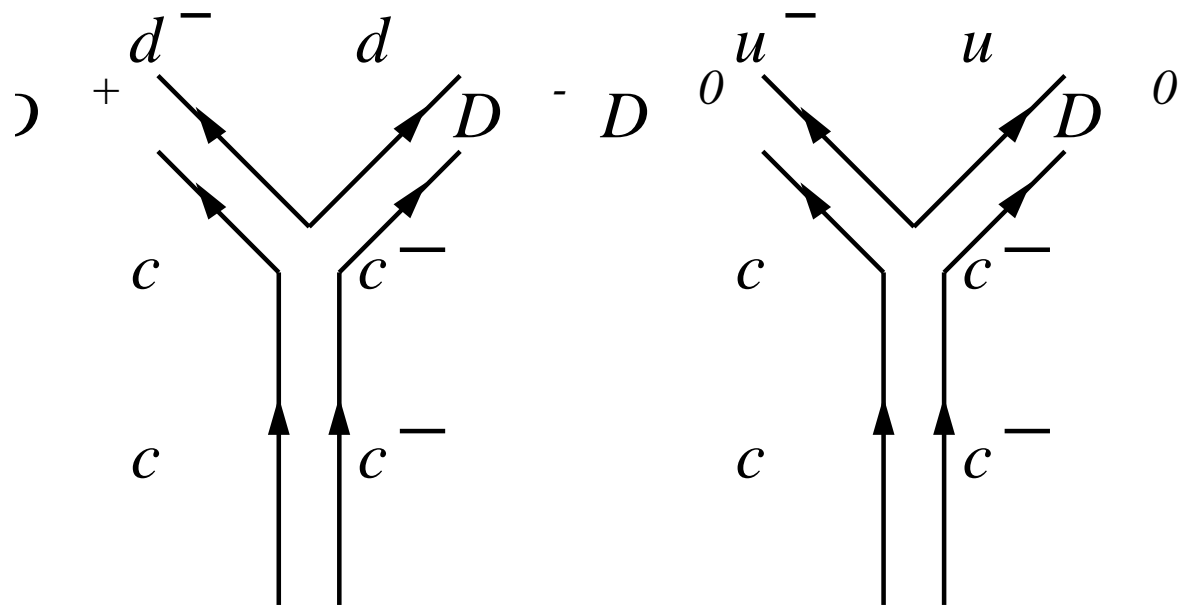
$$V = -\frac{4}{3} \frac{\alpha_s \hbar c}{r} + kr$$

Decadimento quarkonia



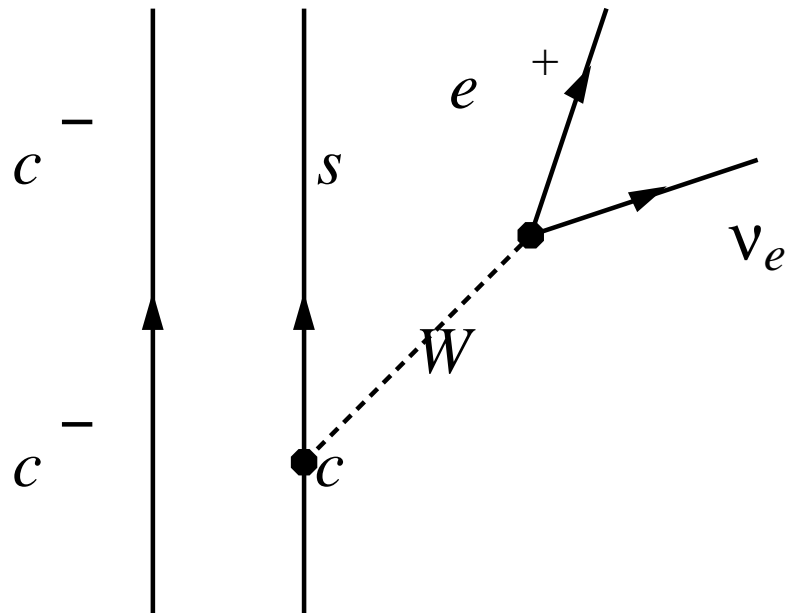
annichilazione

Decadimento quarkonia



Creazione di una coppia $q \bar{q}$

Decadimento quarkonia



Decadimento debole, di almeno un quark

Domande

[P1-7] Cosa sono il bottonio e charmonio ?