

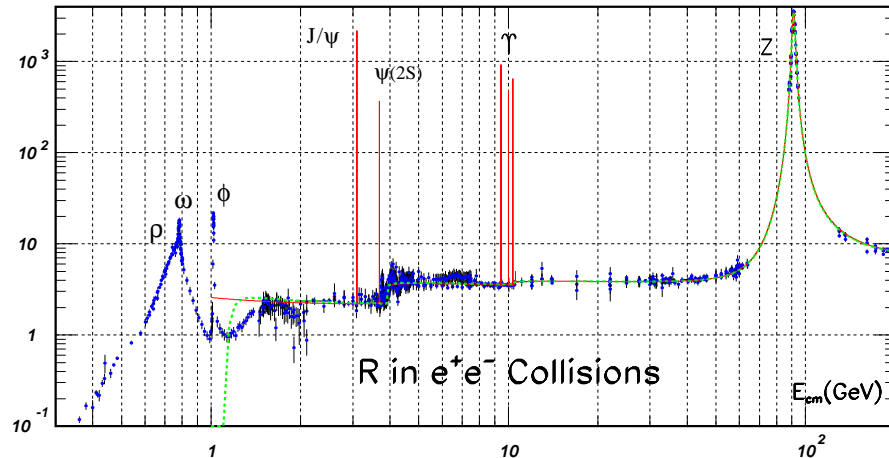
Preflight #6

We calculated the total cross section for muon-pair production in electron-positron collisions to be (with $e^2 = 4\pi\alpha$)

$$\sigma(s) = \frac{4\pi\alpha^2}{3s}$$

What do you expect for the total cross section to quark-antiquark production in e^+e^- collisions, $\sigma(e^+e^- \rightarrow q\bar{q})$ (for $\sqrt{s} \ll M_Z$ and neglecting the electron and quark masses) ?

The ratio $R(s) = \sigma(e^+e^- \rightarrow \text{hadrons}) / \sigma(e^+e^- \rightarrow \mu^+\mu^-)$ has been measured at several CMS energies, as shown in the figure below (taken from hep-ph/0202051).



In the energy range $10\text{GeV} < \sqrt{s} < 40\text{GeV}$, i.e. below the Z resonance and above the threshold for $b\bar{b}$ production (the upsilon is a $b\bar{b}$ boundstate), does your prediction for $R(s)$ agree with the data ? How about the energy range $2\text{GeV} < \sqrt{s} < 3\text{GeV}$, i.e. below the threshold for $c\bar{c}$ production (the J/Ψ is a $c\bar{c}$ boundstate) ?

(hint: use $\sigma(e^+e^- \rightarrow \text{hadrons}) = \sum_{q=u,d,\dots} \sigma(e^+e^- \rightarrow q\bar{q})$)