THRESHOLD BEHAVIOUR OF HEAVY TOP PRODUCTION

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We feel quite confident that the sixth flavour top exists. In the framework of the standard model, the large B^0—B_0 mixing suggests that the top should be heavy: $m_t \cong 100$—140 GeV, e. g., /1/. An analysis of recent experimental data offers the restrictions /2/

$$78 \leqslant m_t \leqslant 180\text{—}200 \text{ GeV} .$$

The properties of a heavy top will be in contrast to those of charm and bottom ones. Specifically, for $m_t \sim 100$ GeV the influence of nonperturbative QCD effects is small, and the quark dynamics is governed only by electroweak and perturbative QCD effects. This has been discussed in detail in refs. /3—6/.

In the threshold region various phenomena modify the $t\bar{t}$ production.

i) As heavier and heavier top masses are considered, the top width increases rapidly /3/,

$$\Gamma_t \cong (175 \text{ MeV}) \ (m_t/m_w)^3 \quad \text{for} \quad m_t > m_w .$$

Therefore, toponium states will be increasingly broader, and eventually (at $m_t \geqslant 150$ GeV) merge into a smeared below-threshold 'continuum', when classical bound states do not have time to form before weak decays.

ii) The QCD threshold interaction can be formulated (analogously to Coulomb rescattering of the nonrelativistic particles in QED /7,8/) in terms of a potential, attractive or repulsive depending on whether the $t\bar{t}$ is in a colour singlet or octet state /3—5,9/. Singlet production is enhanced, both above the threshold and, by resonance formation, below it.

iii) For e^+e^- annihilation, the threshold behaviour is strongly influenced by QED physics of radiative tails /4/.

In papers /4,5/ the detailed study of threshold behaviour for the process $e^+e^- \to t\bar{t}$ was performed. The phenomenological study of consequences for heavy top threshold production in hadron colliders was done in refs /5,6/. In the vector colour singlet channel the account for the Coulomb gluon exchanges and for the effects of Γ_t is expressed through the replacement of the standard threshold factor $\rho_v^{(0)} = \beta_t = \sqrt{1 - \frac{4m_t^2}{s}}$ by $\rho_v = 4\pi/m_t^2 \cdot Im G_{E+i\Gamma_t}(0,0)$, where $G_{E+i\Gamma_t}(\vec{r},\vec{r}\,')$ is the Green function of the $t\bar{t}$ system. The analytical results are given for the threshold factor formulae both for e^+e^- and hadron colliders which could be useful for the present and future machines.

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