

An empirical mass formula for μ and τ leptons and some remarks on trident production

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Abstract

For integer values of its free parameter, an empirical formula reproduces fairly well the mass values of the μ and τ leptons as if they were excited states of the electron. Trident production might possibly be due to constituent collisions.

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An empirical mass formula

Three charged leptons are known, the electron and the heavier μ and τ leptons [1]. Relations between their mass values have been proposed [2]. It is therefore interesting to note that the empirical formula

$$m(n) = 3^{n/4}(4\pi)^{1+n}m_e,$$

where m_e is the mass of the electron, gives

$$m(1) = 106.199 \text{ MeV}/c^2$$

which is 0.5 per cent off the mass of the μ -lepton [1], and

$$m(2) = 1756.35 \text{ MeV}/c^2$$

which is 1.2 per cent off the mass of the τ -lepton [1]. That this formula reproduces the mass values of μ and of τ fairly well for integer values of n as if n is a quantum number suggests that μ and τ are excited states of the electron. If so, the electron would have to be a complex system of some constituents, e.g. rishons/preons [3, 4, 5].

Remarks on trident production

The electron and the proton are both stable particles. While a proton has constituents, has an electron constituents ?

If so, and if they by analogy to the three quarks in a proton were two x with electric charge $-2e/3$ each, and one y with electric charge $+e/3$, where each x and y has lepton number $1/3$, then a system with one x and two y could correspond to a neutrino.

An $x\bar{x}$ system with lepton number zero could correspond to a boson. If x and \bar{x} analogous to quarks may be “dressed” as proposed in Fig. 1, an $x\bar{x}$ system may decay to a e^-e^+ pair.

“Spectators” and “leading particles” are seen in pd reactions where a beam proton collides with the neutron in the deuteron with its proton as spectator [6], and in $\bar{p}p$ reactions with a leading meson due to a dressed spectator quark [7]. If e^- and e^+ have some structure, leading spectator constituents could by analogy be expected also in e.g. e^-e^+ collisions. If they by analogy to quarks may be “dressed”, they may be observed.

If one x of a colliding e^- is scattered and dressed to be an $x\bar{x}$ boson which decays to an e^-e^+ pair, with the remaining xy system as a spectator which is dressed to be an xy electron as proposed in Fig. 2, the result is trident production, i.e.

$$e^- \rightarrow e^-e^+e^-.$$

Tridents have been observed [8] and discussed from theoretical point of view [9]. Our Fig. 2 suggests an additional production model.

Summary

Our empirical mass formula and model for trident production suggest that electrons may have an inner structure and some constituents.

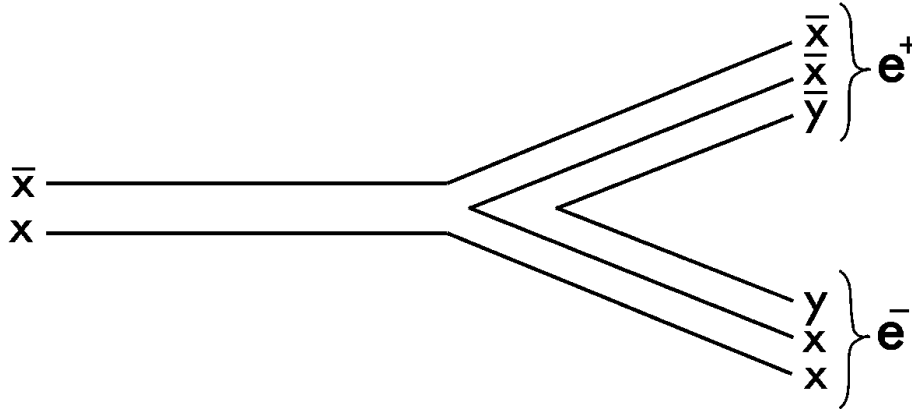


Fig. 1.

Dressing of $x\bar{x}$ to an e^-e^+ pair as proposed in the text.

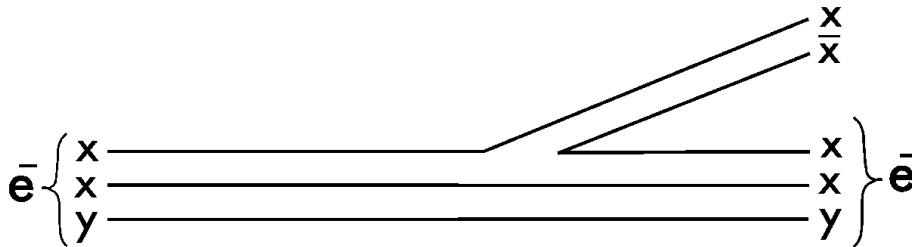


Fig. 2.

Separation and dressing of the assumed constituents of an electron to an electron and an $x\bar{x}$ pair as proposed in the text.

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