On the necessarily finite dimensions of the electron.

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Abstract:

In the past two years we have developed a method that allowed the association of mass, magnetic moments and elastic properties of baryons, in a way consistent with energy-flux data from protons in cosmic rays. In view of the role of Elasticity displayed in these flux data, baryons are necessarily sizeable objects (loops of charge). Electrons follow a similar behavior. However, theories involving the electron are based upon a point-like concentration of charge and mass, which is inconsistent with Elasticity. Based upon the same set of cosmic-rays data previously used for the proton we argue that these data can be applied to demonstrate the necessarily finite dimensions of an electron, here regarded as a topological stabilized modification of quarks.

The issue of the finite dimensions of the electron is at least as old as quantum electrodynamics. Being a very successful field-theory, it makes no use of dimensions for a source of such fields. Measurable interactions and correlations can be calculated also without any concern for source dimensions. In this way, scattering evidence for finite source dimensions like the Compton wavelength, and the very existence of an intrinsic magnetic moment (which in larger scale experiments is always associated with finite-sized current paths) are difficult to fit , since pictorial views of the electron are no longer considered. In field theories magnetic moments are simply a result of algebra of operators and the requirements of relativistic invariance of the theory.

However, there is no question about the finite scale of baryons and the existence of inner constituents. The proton and neutron are recognized as charge distributions of size about 1.8 fm diameter. Such charge distribution have had their profiles determined and oscillate inside the particle. The constituents (quarks) on the other hand are never detected as isolated objects, but they are indeed mobile features inside the baryons, so that they must be finite in size. There have been investigations which treated quarks and leptons on similar mathematical terms though, as faces of the same coin. If quarks (in the form of their observable conglomerates- the hadrons) and leptons can receive a similar theoretical treatment , may be there exists also experimental evidence of points in common.

The author´s [1-2] recent investigations on the formation of baryons as loops of charge , with quantitative agreement with data from cosmic rays, brings to fore the issue of the sizeable dimensions and its consequences. Sizeable charged objects do have elastic properties, without which they would have no resistance against external fields of force. Baryons are conglomerates of oppositely-charged constituents and must be very resilient against disruption under external electromagnetic fields, otherwise there would be no Matter. In view of the success of the charge-loop picture in recent work one can only wonder how constituents (loops) get such resilience. Again, one possibility is to apply Electrodynamics and consider attractive fields between point-like constituents. This is what field-theory in general has been proposing for about one century. However, as soon as one accepts constituents have dimensions, one needs to recognize they must have also physical form and topology. Such forms might entangle in rather complex ways, as considered by Jehle and Bostick[3-4]. Entanglement may also be regarded as a simple way to understand elasticity in such structures. But for that to be true, particles cannot be point-like.

Figure 1 displays a reproduction of Figure 2.1 in the book of Gasser et al. on Cosmic Rays[5]. The important point in this plotted energy-flux data is that it includes the flux of electrons, alongside protons. It is evident the profiles are very similar indeed, to the point of making obvious that these particles were generated under similar conditions in an environmente at 3.7 GeV energy. Furthermore, as discussed in our previous work[2], the peak position in the plot is associated with the accumulation of protons and electrons in a region of energies (peaking at about 0.6 GeV) in which stresses return to the elastic regime[2]. Such elasticity is very likely related to entanglement inside the respective structures, and this applies to both protons and electrons.

The data indicate that electrons would be nothing more than altered forms of quarks(or the way around)[6-7]. Possible differences in charge (fractionary or not) would be a consequence of topological differences, which might prohibit quarks to manifest as isolated forms, while electrons and other leptons can do it. It might even be speculated that quarks do not manifest in the open since their original topological forms are unable to confine magnetic flux quanta units (in spite of individual magnetic moments being attributed to quarks to justify magnetic moments of baryons), so that they morph into lepton forms, to be released from confinement

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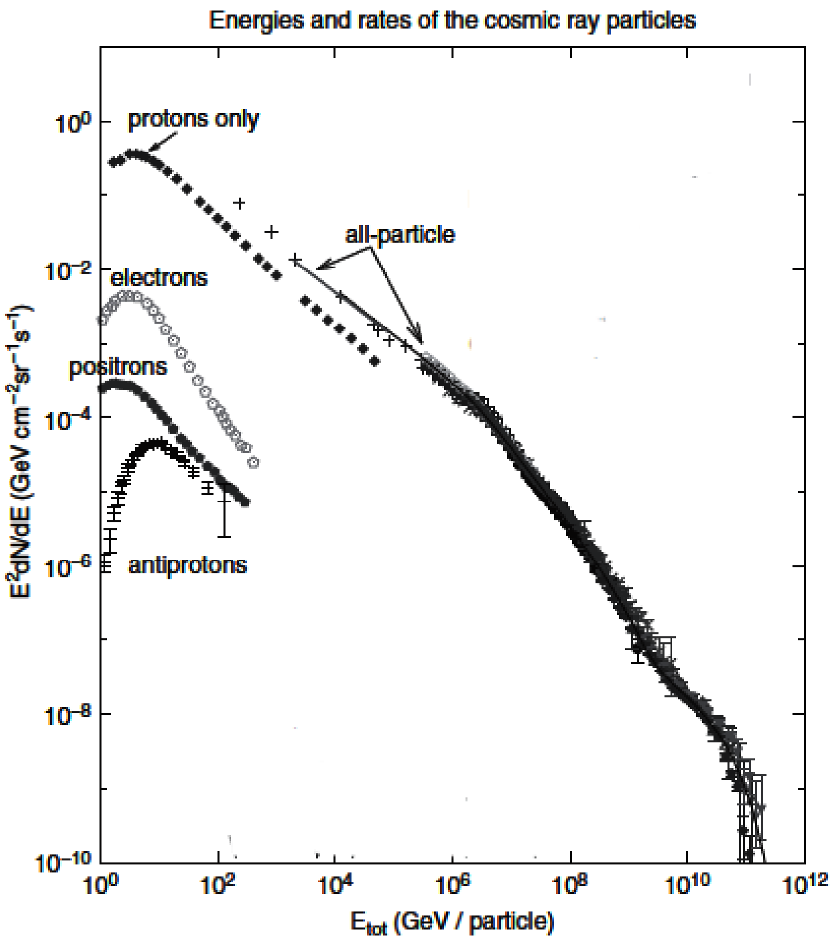
Figure 1: Flux from electrons and protons and antiparticle(adapted Figure 2.1 from [5]) peak at about the same energy, and thus were generated under similar environment conditions. From ref [2], these particles must have also similar elastic properties(related to internal entanglement) and thus finite dimensions.



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