

# Experimental evidence for an $\alpha$ -dependence in the lifetimes and masses of the pseudoscalar mesons

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The nonet of pseudoscalar (PS) mesons are the lowest-mass, and hence in some sense the most "fundamental", hadronic elementary particles. When the lifetimes of the non-strange  $\pi^\pm$ ,  $\pi^0$ ,  $\eta$ ,  $\eta'$  PS mesons are plotted together on a logarithmic scale, they are seen to exhibit an accurate scaling in powers of the fine structure constant  $\alpha = e^2/\hbar c$ . This scaling extends over 6 powers of  $\alpha$ , or more than 12 orders of magnitude. When the lifetimes of the strange  $K^\pm$ ,  $K_S^0$ ,  $K_L^0$  PS mesons are added in, they fit this same lifetime scaling, but with an accurate factor-of-2 hyperfine structure superimposed. Quantum mechanically, time and energy are conjugate variables, so it is relevant to examine the PS mass values for evidence of a reciprocal  $\alpha^{-1} \cong 137$  dependence. A plot of the  $\pi^\pm$ ,  $\pi^0$ ,  $\eta$ ,  $\eta'$  mass values on a 137 MeV/c<sup>2</sup> mass grid shows a clear-cut mass quantization at an accuracy level of 1 per cent. The reason the 137 MeV/c<sup>2</sup> mass grid works out so fortuitously can be attributed to the fact that an electron-positron pair, which plays the role of "ground state" for an  $\alpha^{-1}$  scaling of the PS masses, has a mass of almost unity in these units. These conjugate  $\alpha$ -dependences, which are clearly in evidence in the PS mesons, actually span the whole hadronic spectrum. In particular, the lifetime  $\alpha$ -scaling extends across the regions of the weak and electromagnetic decays. The presence of the QED coupling constant  $\alpha$  in these domains suggests that the short-ranged hadronic forces associated with fractionally charged quarks may have an electromagnetic origin.

- [1] M. H. Mac Gregor, "Electron Generation of Leptons and Hadrons with Conjugate  $\alpha$ -Quantized Lifetimes and Masses", International Journal of Modern Physics A, Vol. 20, No. 4, 719-798 (2005); Addendum Vol. 20, No. 13, 2893-2894 (2005).
- [2] M. H. Mac Gregor, "The Power of  $\alpha$ : Electron Elementary Particle Generation with  $\alpha$ -Quantized Lifetimes and Masses", World Scientific (in press).

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