Atmospheric Muon Lifetime, Standard Model of Particles and the Lead Stopping Power for Muons

ANGEL GUTARRA-LEON, George Mason Univ, CIOLI BARAZANDEH, WALERIAN MAJEWSKI, Northern Virginia Community College — The muon is a fundamental particle of matter. It decays into three other leptons through an exchange of the weak vector bosons $W^+/W^-$. Muons are present in the atmosphere from cosmic ray showers. By detecting the time delay between arrival of the muon and an appearance of the decay electron in our detector, we'll measure muon's lifetime at rest. From the lifetime we should be able to find the ratio $g_w/M_W$ of the weak coupling constant $g_w$ (a weak analog of the electric charge) to the mass of the $W$-boson $M_W$. Vacuum expectation value $v$ of the Higg's field, which determines the masses of all particles of the Standard Model (SM), could be then calculated from our muon experiment as $v=2M_Wc^2/g_w=(\tau m_{\mu}c^2/6\pi^2\hbar)1/4m_{\mu}c^2$ in terms of muon mass $m_{\mu}$ and muon lifetime $\tau$ only. Using known experimental value for $M_Wc^2=80.4$ GeV we'll find the weak coupling constant $g_w$. Using the SM relation $e=gwsin\theta\sqrt{hc\epsilon}$ with the experimental value of the $Z^0$-photon weak mixing angle $\theta = 29^\circ$ we could find from our muon lifetime the value of the elementary electric charge $e$. We'll determine the sea-level fluxes of low-energy and high-energy cosmic muons, then we'll shield the detector with varying thicknesses of lead plates and find the energy-dependent muon stopping power in lead.

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