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Cosmic Ray Muons in the Standard Model of Fundamental Particles CIOLI BARAZANDEH, HANNAH GLASER, ROBERTO RIVAS, ANGEL GUTARRA-LEON, WALERIAN MAJEWSKI, Northern Virginia Community College — Muons are one of the twelve fundamental particle types of matter, having the longest free-particle lifetime. It decays into three other leptons through an exchange of the weak vector bosons W + /W -. Muons are present in cosmic ray showers in the atmosphere, and reach the sea level. Cosmic rays are a natural "poor man's accelerator" for community colleges. By detecting the delay time between arrival of the muon and appearance of the decay electron in our single scintillation detector, we measured the muon's lifetime at rest in the material of our detector. After correcting it by the known ratio of positive and negative muons in the flux and accounting for rates of muon capture in the material, we extracted the lifetime of the free positive muon, identical to the lifetime of both muons in vacuum, which compares well. Using literature data on muon fluxes at different heights in the atmosphere, we estimated the relativistic time dilation of muons. From our lifetime measurement we calculated the ratio of g w/M W for the weak coupling constant g w to the mass of the W-boson M W. Using further Standard Model relations and an experimental value for M W, we calculated the weak coupling constant, the electric charge of the muon, and the vacuum expectation value of the Higgs field. We also measured the sea-level flux of low-energy (below 160 MeV) muons which are slow enough to stop in our detector. We found the shapes of the energy spectra of low-energy muons and of their decay electrons. We did not find a systematic difference between day and night muon fluxes.

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