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LEPTON CONSERVATION TESTS AT HIGH MOMENTUM TRANSFER USING THE ν SHIELD

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We propose that the energy spectrum and charge spectrum of μ's coming out of the back of the shield and passing through the bubble chamber should provide the possibility of testing lepton conservation at high-momentum transfer. In order for this to be a meaningful test, it is essential that the parent hadron beam (π or K) be of one charge, thus, producing ν_μ or $\bar{\nu}_\mu$ predominantly. Experimentally, the spectrum of μ's coming from the shield wall is measured in the bubble chamber, using the spark chamber behind the bubble chamber to prove that the charged particles are indeed μ's. Since on average ~ (20-80) μ's will come out of the shield for a reasonable ν beam, the accumulation of 100,000 pulses of the bubble chamber is equivalent to the observation of $(2\text{-}8) \times 10^6$ ν-μ interactions. A sizable fraction of these events will come from relatively high momentum transfer. Breakdown at high momentum transfers of lepton conservation would presumably result in the occurrence of the process

$$\nu_\mu + Z \rightarrow \mu^+ + (Z - 1), \tag{1}$$

as compared to the ordinary process

$$\nu_\mu + Z \rightarrow \mu^- (Z + 1). \tag{2}$$

One background for these processes would come from

$$\nu_\mu + Z \rightarrow \mu^+ \mu^- \nu_\mu Z, \tag{3}$$

with the μ^+ penetrating the shield and the μ^- being stopped. Since the cross section for Eq. (3) is $\sim 10^{-40}$ cm^2/nucleus for iron with $E_\nu > 10$ BeV/c, compared to $\sigma > 10^{-38}$/nucleus for Eq. (2), the background from such processes should be small. At any rate, the background from Eq. (3) is probably calculable. By knowing the spectrum of ν_μ and the shield density any breakdown of lepton conservation can be traced as to the general momentum transfer at which the breakdown occurs.