LEPTON CONSERVATION TESTS AT HIGH MOMENTUM TRANSFER
USING THE $\nu$ SHIELD

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We propose that the energy spectrum and charge spectrum of $\mu$'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 ($\pi$ or $K$) be of one charge, thus, producing $\nu_\mu$ or $\bar{\nu}_\mu$ predominantly. Experimentally, the spectrum of $\mu$'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 $\mu$'s. Since on average $(20-80) \mu$'s will come out of the shield for a reasonable $\nu$ beam, the accumulation of 100,000 pulses of the bubble chamber is equivalent to the observation of $(2-8) \times 10^6 \nu-\mu$ 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

$$ \nu_\mu + Z \rightarrow \mu^+ + (Z - 1), \quad (1) $$

as compared to the ordinary process

$$ \nu_\mu + Z \rightarrow \mu^- (Z + 1). \quad (2) $$
One background for these processes would come from

\[ \nu_\mu + Z \rightarrow \mu^+ \mu^- \nu_\mu Z, \quad (3) \]

with the \( \mu^+ \) penetrating the shield and the \( \mu^- \) being stopped. Since the cross section for Eq. (3) is \( \sim 10^{-40} \text{ cm}^2 \text{/nucleus} \) for iron with \( E_\nu > 10 \text{ BeV/c} \), compared to \( \sigma > 10^{-38} \text{ /nucleus} \) 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 \( \nu_\mu \) and the shield density any breakdown of lepton conservation can be traced as to the general momentum transfer at which the breakdown occurs.