The miniBETA spectrometer for the determination of weak magnetism and the Fierz interference term

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Physics from precision measurements of the beta spectrum shape

Fierz interference
• search for tensor and scalar weak coupling constants
• multiplicative factor in the expression of spectrum shape $\frac{1}{1 - q^2}$
• current limits on the percent level for tensor type coupling constants
• candidate isotope: $^{40}$Ca

Electron scattering studies
• record high precision electron scattering and transmission data
• compare it with Geant4 simulations

Effect of Fierz interference term on the beta spectrum of $^{40}$Ca

Weak magnetism
• the effect of the strong interaction on the decaying quarks
• multiplicative factor in the expression of spectrum shape $\frac{1}{1 - q^2}$
• also influences the values of correlation coefficients in $B$ decay up to a percent level
• candidate isotopes: $^{32}$P, $^{46}$Co, $^{11}$H

Other
• spectrum shape of highly retarded allowed decays: $^{14}$C, $^{32}$P, $^{46}$Co...
• spectrum shape of first and second forbidden transitions
• determination of antineutrino spectra

The miniBETA spectrometer

Properties
• drift chamber for high precision X-Y positioning
• Z position (along the wire) by the charge division technique
• hexagonal cell structure - minimize amount of wires
• plastic scintillators provide common STOP signal
• magnetic field to obtain energy from curved electron tracks

Preamplifiers
• charge sensitive
• custom made
• 2x per wire
• their signals are combined in custom made units

Commissioning ongoing

Modes of operation

Spectrum shape measurements
• electron energy from the track curvature
• scintillator provides STOP signal
• depending on endpoint energy, extract Fierz term or weak magnetism from spectrum shape

Electron scattering studies
• initial electron energy from detector + track curvature
• conversion electrons for high precision measurement of the backscattering probability

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