MESON-EXCHANGE CURRENTS OF 1^RST^-FORBIDDEN β DECAY

SUPERVISOR: FRANCOIS DIDIERJEAN
IPHC, 23, RUE DU LOESS, 67037 STRASBOURG CEDEX 2
TEL: 03 88 10 66 72 ; E-MAIL: FRANCOIS.DIDIERJEAN@IPHC.CNRS.FR

The weak interaction is responsible of the nuclear β decay. The β transitions between 0^+ and 0^- states are particularly interesting because an enhancement of the β-decay rate by mesonic exchange currents (MEC) is predicted and explained as a contribution of the meson exchange to the time-like component of the weak axial current.

The theoretical calculation of the rank-zero, β-decay matrix element is given by equation (1).

$$M^{th} = M^T + a_s . M^S \qquad (1)$$

where M^T and M^S are the impulse approximation of the time-like and the space-like components of the axial current, respectively, and a_s is a kinematical factor.

The experimental measurement of *ft* enables to determine the transition strength of the first-forbidden β decay (equation 2).

$$B_1^{(0)} = [M^{exp}]^2 = 9195 . 10^5/ft \qquad (2)$$

where *t* is the partial lifetime of the β transition and *f* the phase-space factor.

An experimental matrix element, M^{exp}, is deduced from equation (1) by introducing an enhancement factor, ε_{MEC}, on the impulse approximation according to equation (3) and using equation (2).

$$M^{th} = \varepsilon_{MEC} . M^T + a_s . M^S \qquad (3)$$

The ε_{MEC} values obtained in the A = 16, 50 and 96 regions are all of the same order of magnitude around ε_{MEC} = 1.64. However, studies in lead region have established a larger enhancement factor which is explained by extra meson exchange contributions coming from ρ and Δ mesons.

Previous experimental results around ^{132}Sn give ε_{MEC} values between 1.74 ± 0.07 and 2.16 ± 0.29. Extra measurements are needed to conclude to a discrepancy with the predicted value especially for the $^{134}Sn(0^+) \rightarrow {}^{134}Sb(0^-)$ transition for which the ε_{MEC} factor has a poor accuracy.

The goal is to measure the direct β branching ratio of the $^{134}Sn(0^+)$ ground state to its daughter $^{134}Sb(0^-)$ ground state. The direct feeding of the ground state will be inferred from observable activities in β-γ, β-n and β-n-γ channels. The ion beam of ^{134}Sn, produced at ALTO facility, will be directed to the collection point surrounded by a detection station allowing the counting of the β by plastic scintillators, the counting of the γ by Ge detectors and the counting of the neutrons by TETRA.

The objective of the internship is to developpe simulation software with GEANT4 in order to prepare the TETRA experiment at the ALTO facility in Orsay.

This internship can be followed by a PhD.