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Some corrections to Fermi-functions and neutrino capture cross-sections

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Neutrino capture cross-section, which depend on the incident-neutrino energy E_ν, has the form:
$\sigma(E_\nu) = \frac{(G_F g_A)^2}{\pi c^3 \hbar^4} \int_0^{W-Q} W p_e F(Z, A, W) S(x) dx$
where $S(E)$ is the charge-exchange strength function, $G_F/(\hbar c)^3 = 1.1663787(6) \times 10^{-5}\ GeV^{-2}$ is the weak coupling constant, $g_A = -1.2723$ is the axial-vector constant and $F(Z, A, W)$ is the Fermi-function, which takes into account the Coulomb interaction between beta-particle and the daughter nucleus. The change in the Fermi-function is practically proportional to the change in the cross-section. Since the founding work of Fermi [1] which presented the Fermi-function for point-like nucleus there have been many works describing corrections to the Fermi-function including finite nuclear size, charge distribution, screening etc. One can see a good review of different types of them in [2].

In this work we present the influence of finite nuclear size, screening etc. corrections to the Fermi-function and consequently to cross-section as an example of the ^{127}I [3]. Particular attention is paid to the dependence of Fermi-function on the nuclear charge radius R_C . Recent experimental results of isotopic dependence of the charge radii for K, Cu, Sn together with theoretical calculations based on the self-consistent theory of finite Fermi-systems with the Fayans density functional was taken into account [4], [5].

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