RELATIVISTIC CALCULATION OF THE BETA DECAY PROBABILITIES IN OPTIMIZED MODEL OF THE DIRAC-FOCK ATOM AND CHEMICAL ENVIRONMENT EFFECT

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New theoretical schemes for an account for the atomic chemical environment effect on the β decay characteristics are proposed. As method of calculation of the relativistic atomic fields and electron wave functions, the gauge invariant Dirac-Fock (GIDF)type and Dirac-Kohn-Sham (GIDKS) approaches are used [1,2]. The numerical results for atomic chemical environment effect on the β decay of the sulfur and plutonium are presented. We present the results of calculating the beta-decay probabilities and atomic chemical environment effect on the β decays: $^{33}P \rightarrow ^{33}S$, $^{35}S \rightarrow ^{35}Cl$ and $^{63}Ni \rightarrow ^{63}Cu$ These transition are permitted. We also have considered the β decay: $^{241}Pu \rightarrow ^{241}Am$. The transition $^{241}Pu \rightarrow ^{241}Am$ is non-unique of the first forbidding. Comparison of the Fermi function values is carried out for different approximations of the exchange effect account, calculation with using wave functions on the boundary of the charged spherical nucleus and with using squires of the amplitudes of expansion of these functions near zero. As example, some data of our calculation are presented in the table 1.

Table 1. The atomic chemical environment effect on the β decay probability

Decay of neutral atom			Decay of ionized atom			Present Calculation Scheme
At.	E_{bn}, eV	f(E_{bn} ,Z)	At.	$E_{\partial p}$, eV	f (E_{bn} ,Z)	
$S^{(0)}$	167420 167450	1,36849(-2) 1,36935(-2)	$S^{(2+)}$	167390 167420	1,36798(-2) 1,36884(-2)	GIDF
$S^{(0)}$	167420 167450	1,37982(-2) 1,38069(-2)	$S^{(2+)}$	167390 167420	1,37927(-2) 1,38014(-2)	GIDKS

The value 167450eV is accepted for the boundary energy under of decay of the $S^{(0)}$. Analogously the value 167420eV was used for decay of the $S^{(+2)}$ in the first variant of calculation. The pair of the energy values: 167420eV and 167390eV has been chosen in the second variant of calculation correspondingly. The experimental value for E_{bn} is as follows: 167400±100eV. Two versions of calculation give practically the same values for changing half decay period under changing the ionic feature: $\Delta f/f=0,037$ % (GIDF scheme) and $\Delta f/f=0,039\%$ (GIDKS scheme).

References:

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