A THEORETICAL ESTIMATE OF THE PROBABILITY OF PAIR PRODUCTION IN α-DECAY

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Although internal pair production (IPP) in β-decay does not depend explicitly on the atomic number Z it is evident that the Coulomb field will play important role in α-decay. This is because the velocity v of the α-particle is relatively small, and $2(Z-2)/137$ is not small for any α-emitter, so the normal approximation $2(Z-2)/(137\cdot v) \ll 1$ is not applicable. In our calculations the effects of the Coulomb field are taken into account approximately by assuming the wave function of the α-particle to be free and normalized on the Coulomb value at the classical turning point of the full-energy α-particle. The wave functions of the electron and positron are assumed to be plane waves normalized on the Coulomb values at the origin.

Z	W_0(MeV)	B_α^{+-}/B_α
95	5,224	$1,8\cdot10^{-9}$
	5,439	$2,2\cdot10^{-9}$
	5,482	$2,4\cdot10^{-9}$
	6,01	$7,2\cdot10^{-9}$
89	4,949	$0,98\cdot10^{-9}$
	5,54	$4,5\cdot10^{-9}$
	5,818	$8,1\cdot10^{-9}$
84	5,22	$3,4\cdot10^{-9}$
	5,68	$9,4\cdot10^{-9}$
	6,38	$32,5\cdot10^{-9}$

Table I

The only experimental value available for comparision is that obtained with ^{241}Am.[1] The experimental value is $(3,1\pm0,6)\cdot10^{-9}$ pairs per α-disintegration, and our theoretical prediction in this case is $2,3\cdot10^{-9}$ pairs per α-disintegration.

Numerical predictions for different Z and energy values are given in Table I.

Reference

1. A. Ljubičić and B.A. Logan, Phys. Rev. 7C (1973) 1541