ОБЪЕДИНЕННЫЙ ИНСТИТУТ ЯДЕРНЫХ ИССЛЕДОВАНИЙ

Лаборатория ядерных проблем

A.E.Ignatenko, M.G.Petrashku, D.Chultem

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ELECTRON ACTIVATION OF MESIC ATOMS

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It is known that the formation and the filling of "holes" at the internal electron shells of atoms lead to multifold ionization, the violation of chemical bindings and to the discomposition effect [1]. The investigations of charge atomic distribution in radioactive transmutations show that when one "hole" is filled, atoms lose ~7 outer electrons on average. In [2] it has been shown that cascade muon transitions in mesic atoms lead, mainly, to the ionization of internal atomic shells. Thus, in Br mesic atoms in muon transitions from the shells with the basic quantum number n~ 14 to the ground state, about 5 electrons can be emitted. Consequently, in case with mesic atoms an average ion charge may be very large. The existence of the so-called phenomenon of electron activation of mesic atoms leads, e.g., to the fact that the probability of the muon transition R within the levels of hyperfine structure determined by the state of the electron shell of a mesic ion at the moment of its disintegration [3], will depend upon a kind of combination to which the atom understudy belongs. If a mesic ion is in metal, the electron shell returns to its ground state at a time t_0 which is small compared to the muon lifetime τ [1]. Therefore, due to the conversion mechanism of atomic electrons [3] the value R will always be much greater than $\frac{1}{\tau}$. On the other hand, in dielectrics (e.g., in ion crystals) the behaviour of mesic ions will be as that of contamination centres and, therefore, for them $t_0 >> \tau$ [1]. If one takes into consideration that with the decrease of the electron number in an atom the potential of ionization of inner shells increases, for dielectrics R should be much less than $\frac{1}{\tau}$. The abovesaid statements can explain the experimental fact [4], that the values of R in mesic atoms of two phosphor modifications greatly differ. Indeed, if one takes into account that for phosphor mesic atoms the interaction energy of hyperfine structure $\Delta W = 185$ ev, and the energy of the absorption edge-L in silicium (mesophosphor) $V_{2s} = 156$ ev, one may conclude that for black modification (a conductor) there is agreement of the calculating and measured values of R. Calculation [5] shows that when 3-4 eleetrons are ejected in mesic atoms, the value $V_{2s} > \Delta W$. Therefore, for red phosphor (dielectric), where $t_0 >> \tau$, the value R turns out to be less than $\frac{1}{\tau}$. In [6] it has been shown experimentally that the shell does not influence upon the muon polarization in diamagnetic metals and media. Therfore, there will be no electron shell influence in black phosphor as well [4]. The maximum electron asymmetry of $(\mu - e)$ -decay which was observed in the experiments with red phosphor [4,7] with the procession frequency of mesic nucleus spin which is two times less than the precession frequency of a free muon shows that there is no influence of the electron shell upon the muon polarization in red phosphor also.

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