ANISOTROPIC ALPHA DECAY AND NUCLEAR DEFORMATIONS

D.S. Delion[(1)], A. Insolia[(2)] and R.J. Liotta[(3)]

(1) Institute of Atomic Physics, Bucharest, Romania
(2) Department of Physics, Univ. of Catania and INFN; I-95129 Catania, Italy
(3) Royal Institute of Technology at Frescati, S-10405 Stockholm

A renewed interest has been raised by recent experimental results on *alpha* anisotropy on Fr and Pa isotopes [1]. A miscroscopic description of the alpha decay of the odd mass nuclei for axially deformed nuclei was proposed few years ago [2]. Realistic mean field + pairing residual interaction within BCS approximation in a very large single particle basis was used. Systematic calculations for At and Rn isotopes, as well as for ^{221}Fr, were performed. The barrier penetration process is treated within the WKB approximation. In the Table the calculated widths and predicted values of the function $W(\vartheta) = 1 + \sum_{L=2,4} Q_L B_L U_L A_L P_L(cos\vartheta)$ are reported for a few selected cases. Here A_L are the theoretical A-coefficients, Q_L are coefficients that take into account the dimensions of the sourse and detectors, B_L describes the orientation of the nuclei and U_L corrects B_L for unobserved intermediate transitions. A pronounced anisotropic emission of the alpha particles is predicted, as a function of the deformation for deformed nuclei. Calculations were initially performed for At and Rn isotopes. We found that alpha decay is an excellent tool to probe intrinsic deformations in nuclei.

New calculations on Pa - isotopes, making use of a improved single particle basis [3] were performed. They show a very nice agreement with the new data [1]. The new approach uses a single particle basis consisting of two different harmonic oscillator potentials and allows to reproduce, in even-even nuclei, the experimental total widths for α decay within 20%. Comparison with other microscopic approaches will be presented.

	β_2	Γ_{exp}	Γ_{th}	A_2	A_4	$W(0^o)$	$W(90^o)$	$\frac{W(0^o)}{W(90^o)}$
$^{205}_{86}Rn$	0.005	2.68(-24)	6.76(-25)	0.022	0.000	1.022	0.989	1.034
$^{207}_{86}Rn$	0.016	8.17(-25)	8.50(-26)	0.076	0.000	1.076	0.962	1.118
$^{209}_{86}Rn$	0.023	2.62(-25)	4.27(-26)	0.111	0.001	1.112	0.944	1.177
$^{219}_{86}Rn$	0.081	1.15(-22)	2.05(-22)	0.398	0.008	1.406	0.804	1.749
$^{221}_{87}Fr$	0.069	1.55(-24)	1.08(-24)	-0.288	0.005	0.717	1.146	0.626
$^{241}_{95}Am$	$^{0.220}_{0.08}$	3.34(-34)	2.09(-34)	1.158	0.070	1.500	0.736	2.038
$^{243}_{95}Am$	$^{0.220}_{0.08}$	1.96(-33)	1.17(-33)	-	-	-	-	-

[1] P. Schuurmans et. al., (Nicole and Isolde Collaboration), Phys. Rev. Lett. **82**, 4787 (1999)

[2] D.S.Delion, A. Insolia, R.J. Liotta, Phys. Rev. C46 (1992) 1346; Phys. Rev. C46 (1992) 884, Phys. Rev. C49 (1994) 3024.

[3] D.S.Delion, A. Insolia, R.J. Liotta, Phys. Rev. C54 (1996) 292; D.S.Delion, A. Insolia, R.J. Liotta, work in progress.