SCIENTIFIC REPORT

concerning the project implementation during the period October – December 2011

Comprehensive set of experimental data on alpha decay, heavy particle decay and spontaneous fission of even-even, even-odd, odd-even and odd-odd parent nuclei.

During the first stage of the project we edited, using various sources, tables of experimental data for alpha decay, cluster decay and spontaneous fission in four groups of parent nuclei (even-even, even-odd, odd-even and odd-odd). These tables will be of great help in the future to

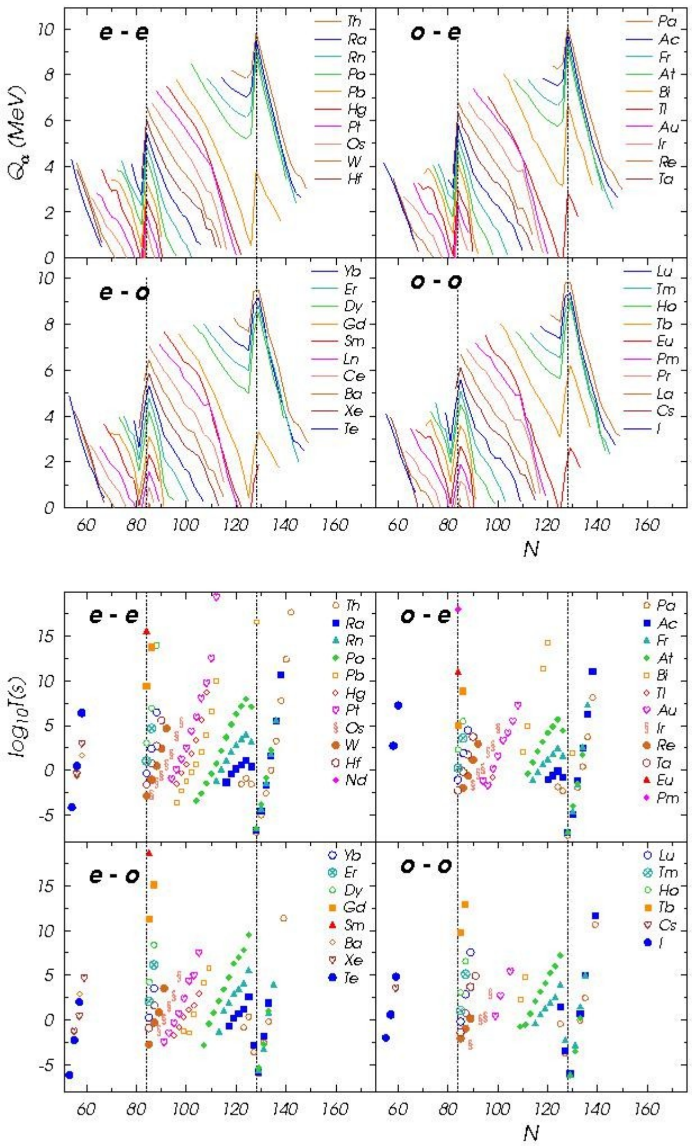

Figure 1. Q_α values calculated using the latest atomic mass tables [1] (top) and the experimental half-lives against alpha decay for parent nuclei with Z=52-91 (bottom) versus the neutron number of the parent nucleus. The dashed vertical lines correspond to N=84 and 128 for which the daughter nucleus will have magic numbers of neutrons 82 and 126, respectively.

compare our calculations with experimental data. We plotted in figure 1 experimental data for parent nuclei with Z=52-91 and in figure 2 for heavy and superheavy parents with Z=92-118. We already know the data for 534 nuclides (173 even-even, 134 even-odd, 123 odd-even and 104 odd-odd).

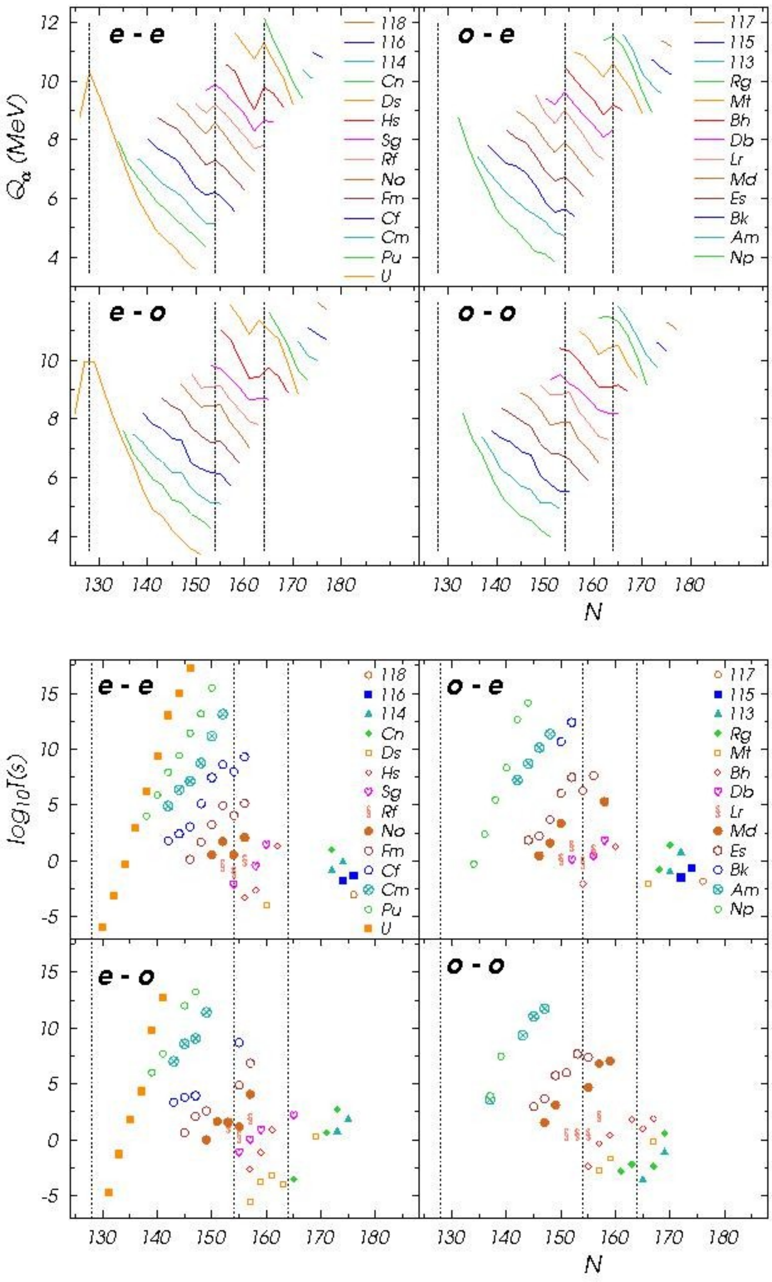

Figure 2. Q_α values calculated using the latest atomic mass tables [1] (top) and the experimental half-lives against alpha decay for parent nuclei with Z=92-118 (bottom) versus the neutron number of the parent nucleus. The dashed vertical lines correspond to N=128, 154, 164 for which the daughter nucleus will have magic numbers of neutrons 126, 152 and 162, respectively.

Table 1 Half-lives and branching ratios for spontaneous emission of heavy particle from nuclei (cluster decay) Successful experiments.

Z	A	Ze	Ae	Q(MeV)	logT(s)	logTa(s)	logb
88	222	6	14	33.049	11.01	1.58	-9.43
88	224	6	14	30.530	15.86	5.50	-10.36
88	226	6	14	28.202	21.19	10.70	-10.49
90	228	8	20	44.719	20.72	7.78	-12.94
92	230	10	22	61.386	19.57	6.26	-13.31
90	230	10	24	57.759	24.61	12.38	-12.23
92	232	10	24	62.304	20.40	9.34	-11.06
92	234	10	24	58.827	25.88	13.04	-12.84
92	234	10	26	59.418	25.88	13.04	-12.84
92	234	12	28	74.111	25.14	13.04	-12.10
92	236	12	28	70.730	27.58	14.99	-12.59
94	236	12	28	79.663	21.52	7.95	-13.57
94	238	12	28	75.912	25.70	9.44	-16.26
92	236	12	30	72.286	27.58	14.99	-12.59
94	238	12	30	76.807	25.70	9.44	-16.26
94	238	14	32	91.188	25.27	9.44	-15.83
96	242	14	34	96.511	23.15	7.15	-16.00
88	221	6	14	32.394	13.39	1.90	-11.49
88	223	6	14	31.830	15.04	6.27	-8.77
92	233	10	24	60.486	24.84	12.78	-12.06
92	235	10	24	57.363	27.42	16.57	-10.85
92	233	10	25	60.728	24.84	12.78	-12.06
92	235	10	25	57.709	27.42	16.57	-10.85
87	221	6	14	31.292	14.52	2.55	-11.97
89	223	6	14	33.065	12.96	2.48	-10.48
89	225	6	14	30.475	17.28	6.23	-11.05
91	231	9	23	51.865	26.02	12.00	-14.02

Table 2 Half-lives and branching ratios for cluster decay. Experiments in which only a limit could be determined.

Z	A	Ze	Ae	Q(MeV)	>logT(s)	logTa(s)	< logb
56	114	6	12	18.974	4.10	1.68	-2.42
90	226	8	18	45.726	16.76	3.27	-13.49
90	232	10	24	54.668	29.20	17.65	-11.55
92	236	10	24	55.951	25.90	14.99	-10.91
90	232	10	26	55.920	29.20	17.65	-11.55
92	236	10	26	56.698	25.90	14.99	-10.91
92	232	12	28	74.312	22.26	9.34	-12.92
94	240	14	34	91.029	25.52	11.45	-14.07
92	233	12	28	74.224	27.59	12.78	-14.81
92	235	12	28	72.158	28.09	16.57	-11.52
92	235	12	29	72.469	28.09	16.57	-11.52
89	223	7	15	39.474	15.12	2.48	-12.64
93	237	12	30	74.801	27.57	14.16	-13.41
95	241	14	34	93.926	25.26	10.14	-15.12

For cluster decay modes the complete set of experimental data are given in tables 1 and 2. No odd-odd emitter of clusters had been found up to now. Everywhere in figures and tables by log we denote the decimal logarithm.

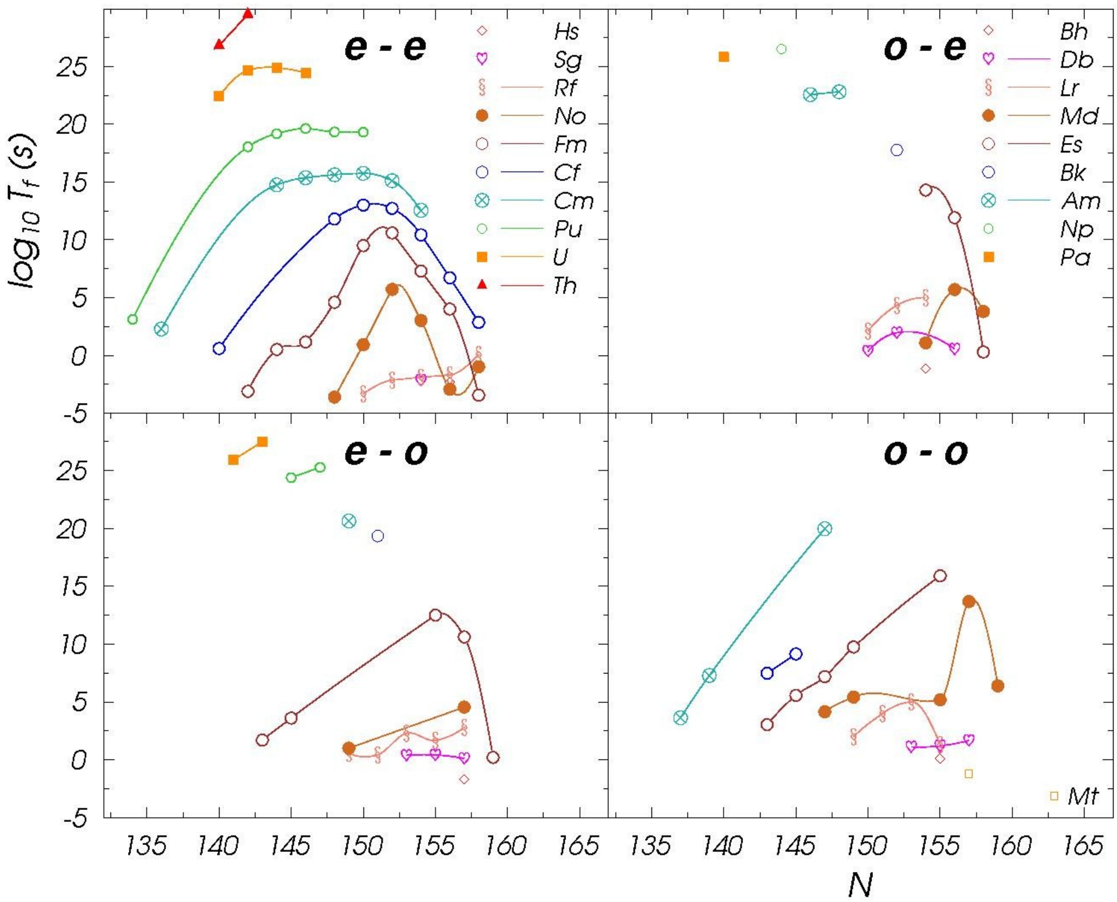

Figure 3. Experimental half-lives against spontaneous fission for nuclides with Z=90-108 versus the neutron number of the parent nucleus.

Experimental data for spontaneous fission half-lives of nuclei with atomic numbers from 90 to 108 are given in figure 3.

This year we succeeded to publish an article [2] in the prestigious Journal *Physical Review Letters* and another [3] in Physical Review C.

Also we have been invited to present invited talks at several International Scientific Meetings [4-9]. Particularly remarkable is The Centenary of Atomic Nucleus [4] where the company was very selected (well known scientists from Russia).

One consequence of our publication in Phys. Rev. Lett. Has been the invitation for a seminar talk at the Pluridisciplinar Institute “Hubert Curien” from Strasbourg, France, on 29 Nov. 2011 [10].

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