Nuclear transmutation of radioactive isotopes and reactor waste deactivation in biological systems

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Experimental investigation of fusion of iron-region stable isotopes in "one-line" growing microbiological cultures (1994-2000)

A typical series of experiments concerning nuclear transmutation of elements consisted in growing of microbiological culture in 3 disks

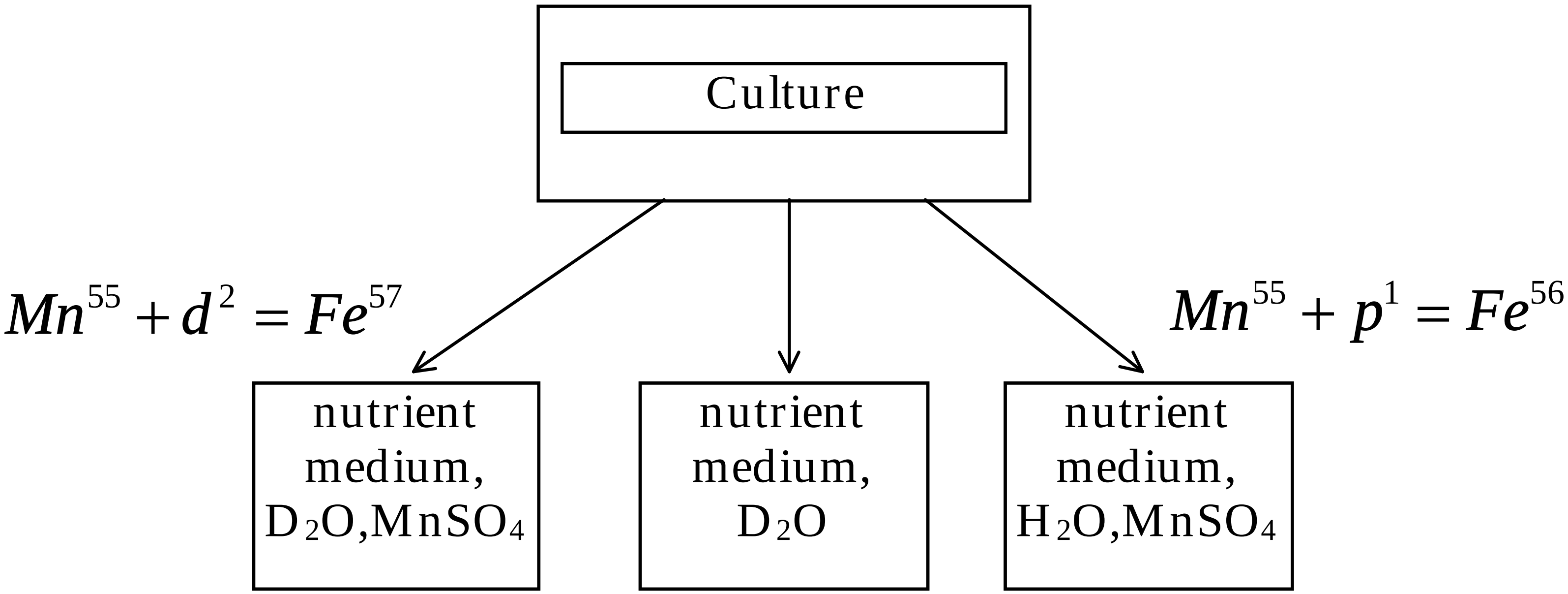
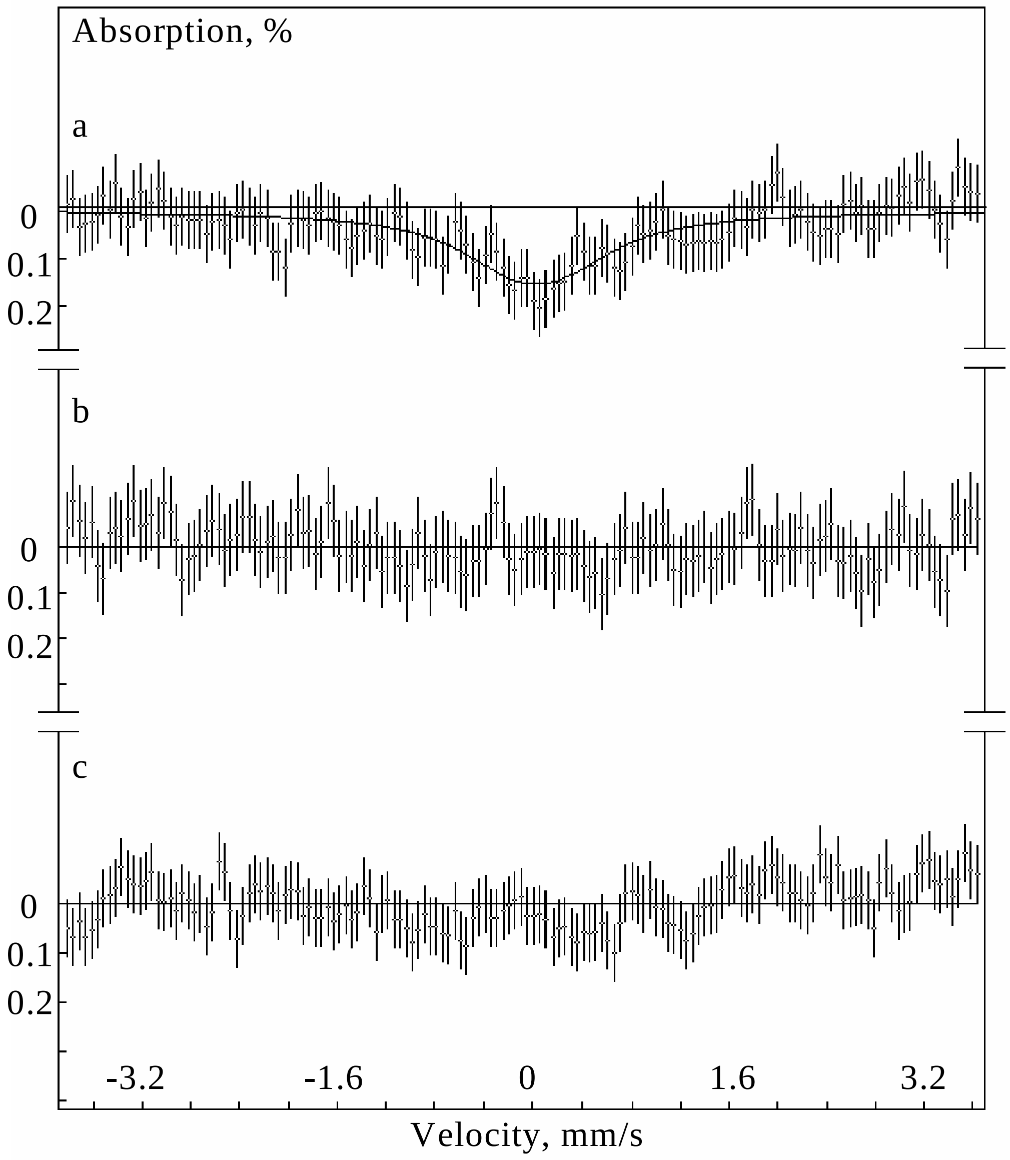


Fig.1 The scheme of experiment.

Such series of experiments was held for different cultures, different time of growth Δt (24, 48 and 72 hours) and different growth modes (in still disks and media and in suspension stirring mode using magnet stirring device).

Bacteria and yeast were grown in a thermostat at optimal temperature 32 C.



Mossbauer investigation of isotope transmutation

It was shown that the transmutation process during the growth of such microbiological cultures had taken place, but its effectiveness had been low:

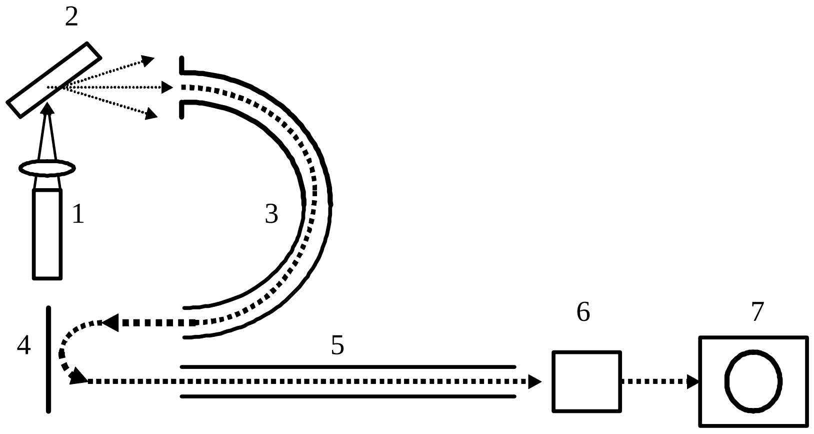
$$l = \frac{\Delta N(Fe^{57})}{N(Mn^{55})\Delta t} \approx 10^{-8}$$

synthesized Fe^{57} nuclei per s and per single Mn^{55} isotope

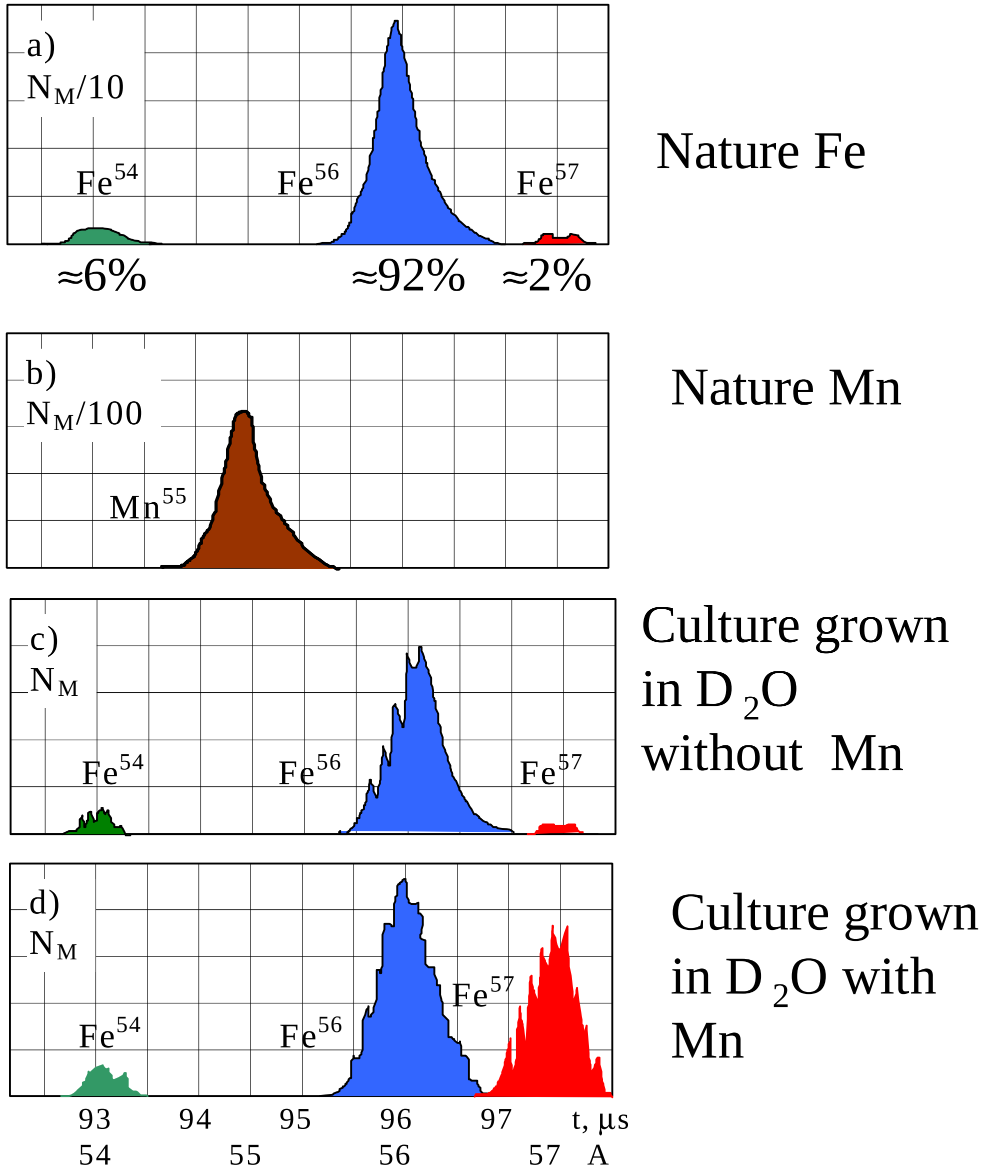
The Mossbauer specter for the grown culture S*accharomyces cerevisiae T-8:*
a) in D_2O with Mn^{55}; *b*) in H_2O with Mn^{55}; *c*) in D_2O without Mn^{55}

Studying of a transmutation of light and intermediate isotopes in growing microbiological culture by laser time-of-flight mass spectrometer

$$Mn^{55} + d^{2} = Fe^{57}$$



Laser time-of-flight mass-spectrometer



Fusion of iron-region stable isotopes in optimal growing microbiological associations (2000-2006)

The relatively low efficiency of these reactions is the result of the relative narrow interval of optimal functional individual characteristics for supporting of nuclear activity in any "one-line" type of culture. During the growth of a "one-line" culture, we hypothesize that processes involving forms of auto-intoxication of nutrient media by metabolic products take place.

In a contrast to these "one-line" cultures, we have investigated microbe syntrophin associations that include great numbers of types of different cultures that are in the state of complete symbiosis.

The ***MCT*** (microbial catalyst-transmutator) compound is the special granules that include:

1. concentrated biomass of metabolically active microorganisms (microbe syntrophin associations);
2. sources of carbon and energy, phosphorus, nitrogen, etc.;
3. gluing substances.

Investigation of nuclear reaction $Mn^{55} + d^{2} = Fe^{57}$ with MCT

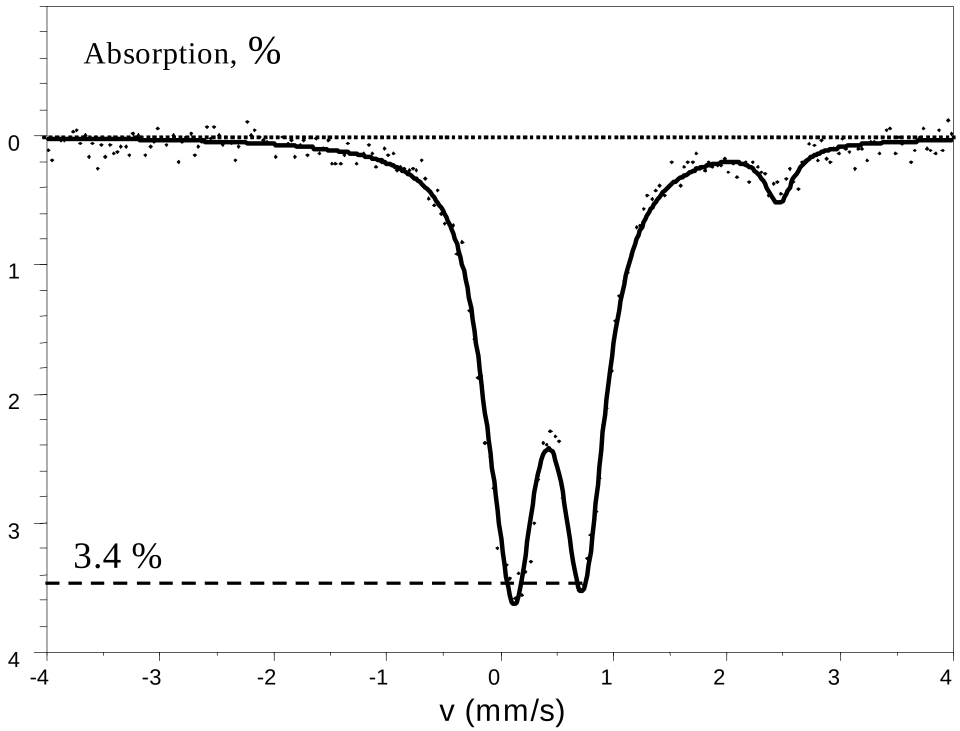
MCT

$Mn^{55} + p^{1} = Fe^{56}$

nutrient medium H_2O	nutrient medium $H_2O + MnSO_4$	nutrient medium D_2O	nutrient medium $D_2O + MnSO_4$

$Mn^{55} + d^{2} = Fe^{57}$

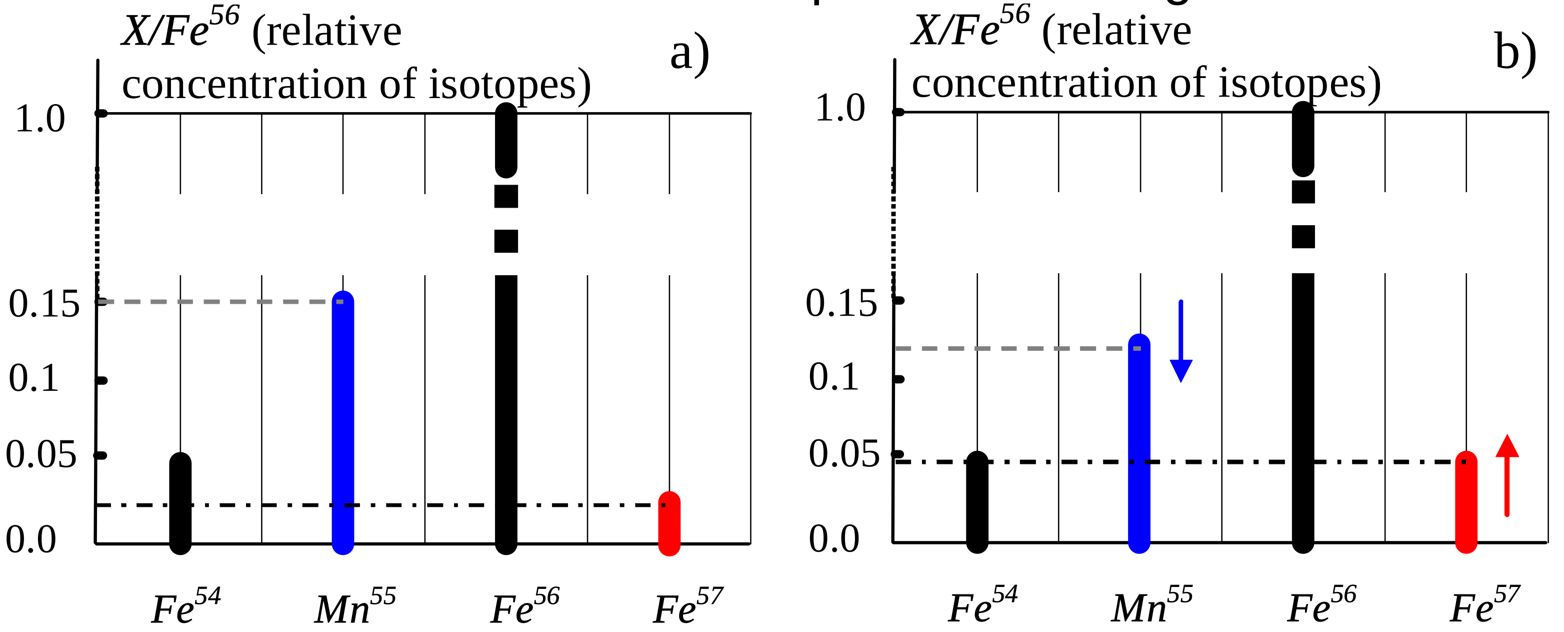
In these experiments the very large increasing of transmutation efficiency (by 100 times) was observed!



The Mossbauer specter for **growing microbiological associations** in D_2O with Mn55

For verification of these results, additional examinations of the isotopic ratio of the same dried biological substances (both control and transmutated) were conducted by TIMS (**Thermal Ion Mass Spectroscopy**, «Finnigan» MAT-262.

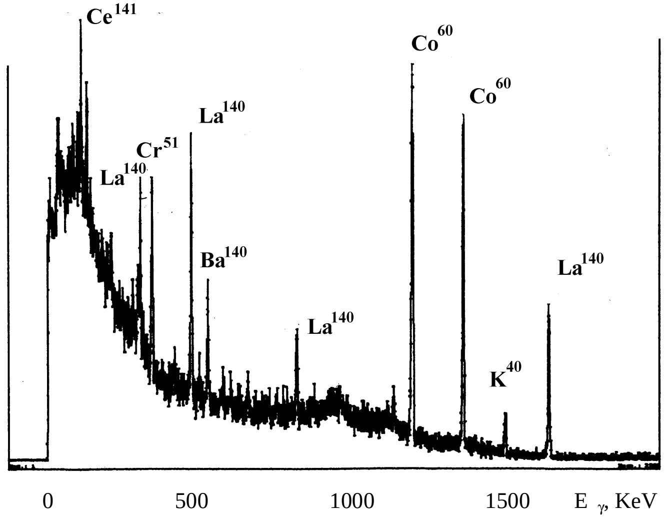
The results of TIMS measurements presented in Figure



$$Mn^{55} + d^2 = Fe^{57}$$

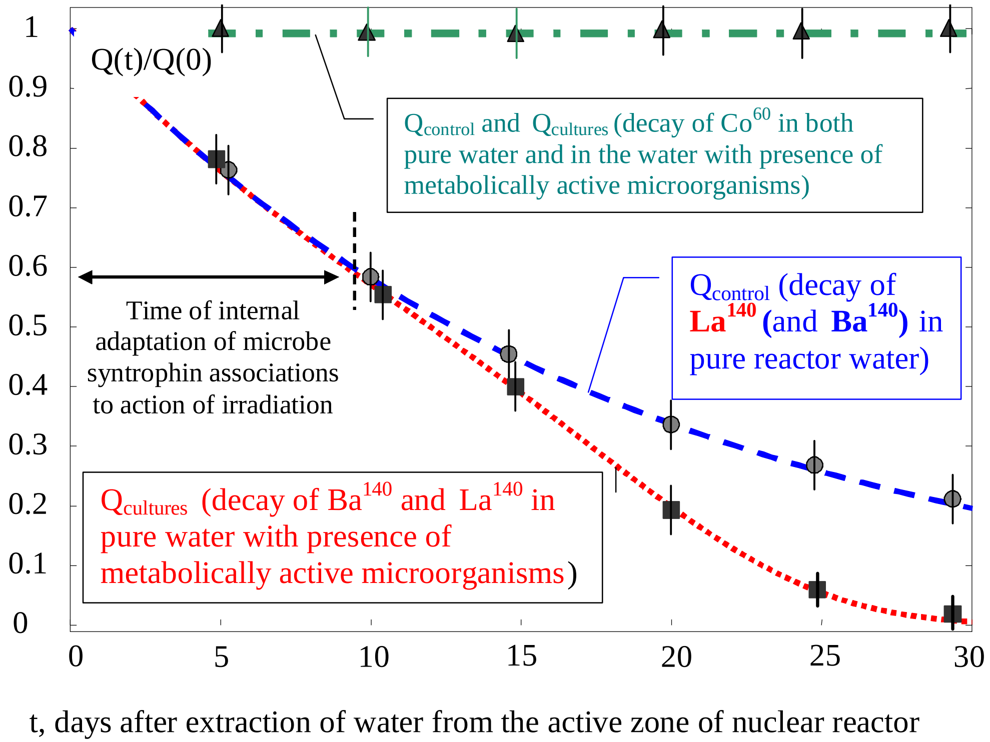
Mass-spectrum of iron-region of microbiological associations (dried biological substances) that were grown in control nutrient medium with H_2O and Mn^{55} (case a)) and in experimental nutrient medium with D_2O and the same quantity of Mn^{55} isotope (case b)) .Here $X=Fe^{54}$;Mn^{55}; Fe^{57} ***The process of increasing (-) of concentration of Fe^{57} isotope is accompanied by decreasing (¯) of concentration of Mn^{55} isotope***

Experiments on controlled decontamination of active isotopes in biological cells (2003-2010)



a) Deactivation of reactor water in biological cells

Spectrum of gamma-radiation of distilled water from first contour of water-water atomic reactor of Kiev Institute for Nuclear Research (10th day after extraction from the active zone).



Change of activity Q(t) of the same reactor Ba^{140}, La^{140} and Co^{60} isotopes in the experiment on transmutation (activity $Q_{cultures}$ in pure reactor water with presence of metabolically active microorganisms) and in the control one (activity $Q_{control}$ in the same pure reactor water without microorganisms)

Studied La-140 isotope has short life-time 40.3 hours and is nonstable daughter isotope of Ba-140 radioactive isotope that has life-time about τ_{Ba140}= 12.7 days: Ba-140 $\rightarrow$ La-140 + β- + ν* $\rightarrow$ Ce-140 (stable) + β- + ν*

Initial activities of the Ba-140 and La-140 isotopes (on the 10th day after extraction of water from the active zone of the nuclear reactor) were

$$Q_{Ba-140} = 1.46.10^{-6} Curie / l$$

$$Q_{La-140} = 2.31.10^{-7} Curie / l$$

The possible way of radioactive Ba^{140} isotope transmutation to the stable state is

$Ba^{140} + C^{12} = Sm^{152} + \Delta E$

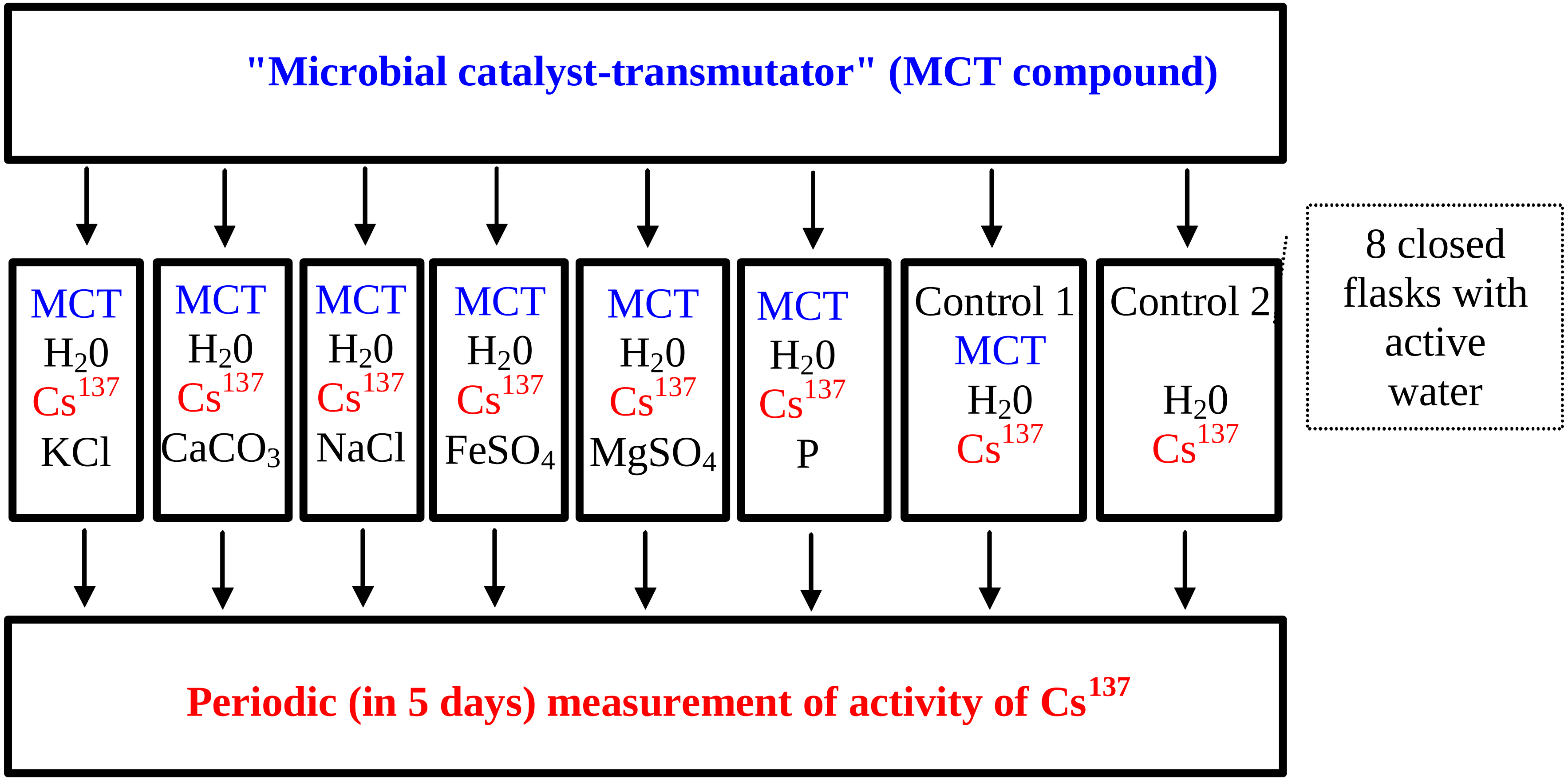
These reactions are energy favourable and

$\Delta E = E(A_{Ba}, Z_{Ba}) + E(A_C, Z_C) - E(A_{Sm}, Z_{Sm}) = 8.5$ MeV is positive.

The Sm(2+) and Ca(2+) ions are chemically alike and have the approximately same ionic radiuses of divalent state (R_{Sm} » 1.2 A, R_{Ca} » 1.06 A).
Substituted element Ca is among several vitally necessary elements. Ions of created Sm(2+) elements can substitute Ca(2+) ions while microbiological cultures are growing.

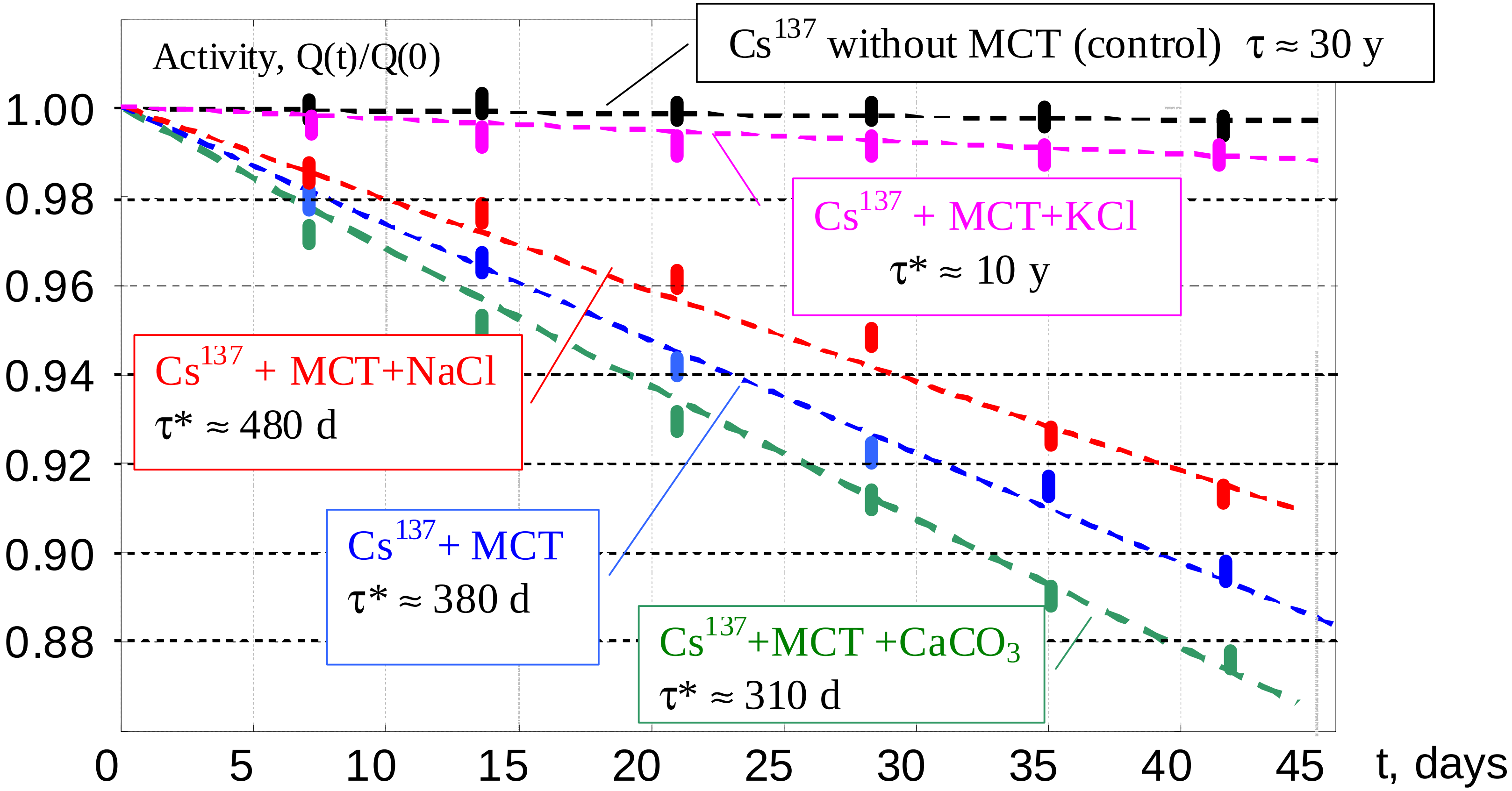
b) Deactivation of reactor Cs^{137} isotope in biological cells

The research has been carried out on the basis of the same distilled water that contained long-lived reactor isotope Cs^{137} (activity ≈ 2.10^4 bq), In our experiments 8 identical closed glass flasks with very thin walls and with 10 ml of the same active water in each were used. The MCT was placed in 7 glass flasks.



Study of utilization of active isotopes at different conditions

Results of experiments on accelerated deactivation (decontamination) of Cs137 isotope in “hot” water



During 100 days we have observed speeded up decay of Cs^{137} isotope (by transmutation to different stable isotope) in all experiments with MCT and with the presence of different additional salts.

The most speeded up decay with t* » 310 days (accelerated by 35 times) was observed at the presence of Ca salt - Cs^{137}+MCT +$CaCO_3$.

Deactivation of different active isotopes in most optimal experiment

(MCT + active water with presence of Cs^{137}+ $CaCO_3$ salt)

		Start of experiments	Intermediate finish (100 d)			
Isotope	Energy, keV	N_1, registered events per 10^3 s	N_2, registered events per 10^3 s	Error (absolute/ relative)	Natural decay per 100 d	Change $(N_2-N_1)/N_2$
Cs^{137}	661.7	266900	216800	±478(±0.2%)	-0.6 %	-24 %

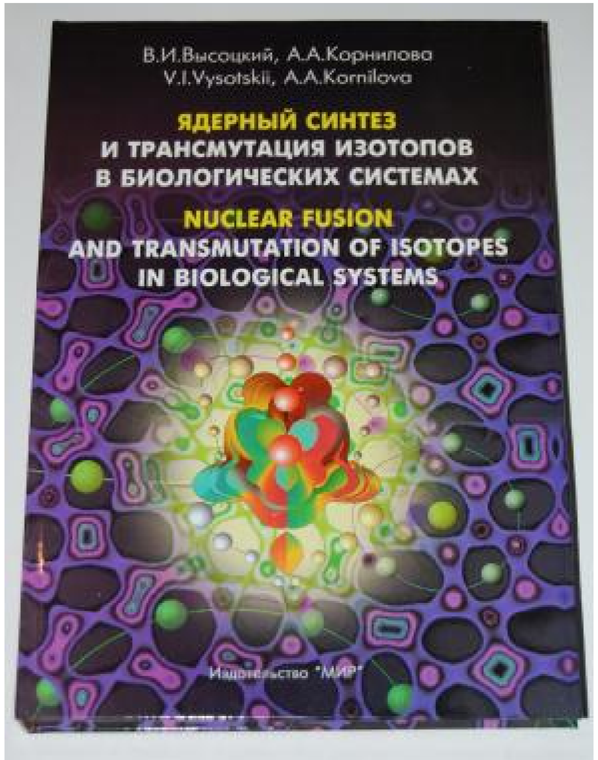
The possible reaction of Cs^{137} isotope utilization is $Cs^{137} + p^1 = Ba^{138}$ (stable) + ΔE.
The result of this reaction is the creation of stable Ba^{138} isotope. This reaction is energy favourable (ΔE = 5.58 MeV is positive).

The Ba^{2+} and K^+ ions are chemically alike and have the approximately same ionic radiuses of divalent state (R_{Ba} » 1.4 A, R_K » 1.33 A). Substituted element K is among several vitally necessary elements. Ions of created Ba^{2+} elements can substitute K^+ ions in metabolic process while microbiological cultures are growing.

The presented results show perspectives of use of the effect of stable and radioactive isotopes transmutation in biological systems for natural and industrial applications**.**

These results can give the answer to the question of the reasons of abnormal accelerated decrease of environmental radioactivity in some isolated areas inside Chernobyl NPS accident zone and after bombing of Hiroshima and Nagasaki with initial high level of radiation pollution.

Biophysical reasons and possible physical mechanisms of isotope transmutation in biological systems are described in our books:



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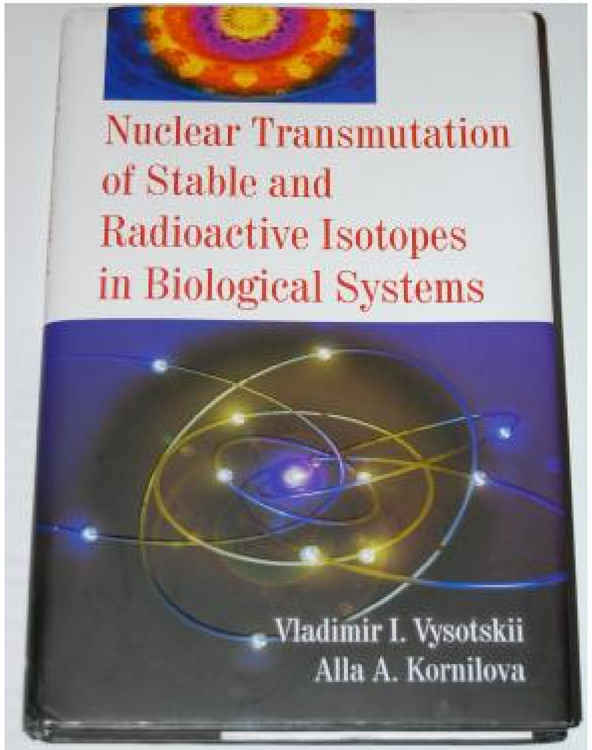

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