EXPERIMENTAL OBSERVATION AND A POSSIBLE WAY TO THE CREATE ANOMALOUS ISOTOPES AND STABLE SUPERHEAVY NUCLEI VIA ELECTRON-NUCLEUS COLLAPSE

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The problem of supercompression of a solid target to a collapse state is considered. The basic principles of construction and the parameters of an experimental setup ensuring such a supercompression are described. The model and method of creation and evolution of superheavy nuclear clusters with $250 < A < 500$ and $A > 3000 - 5000$ in the controlled collapse zone and in the volume of a remote accumulating screen are discussed. The evolution of such clusters results in the synthesis of isotopes with $1 < A < 500$, and with anomalous spatial distribution in the volume of a remote screen. These phenomena were interpreted in terms of the concept of the formation of a self-organizing and self-supporting collapse of the electron-nucleus plasma under the action of a coherent driver up to a state close to that of nuclear matter.

1. Introduction

The investigation of extreme states of matter under extremely high compression is one of the most important areas of fundamental science. Especially important and interesting is the search for ways to form "stellar" states of matter, with parameters close to those which occur in astrophysical objects such as white dwarfs and neutron stars, under the conditions of a terrestrial laboratory. Various theoretical models predict the anomalous properties of both the very process of supercompression and the synthesized superdense matter, including the possibility of great energy release accompanying the process of self-supporting matter compression, the neutralization of radioactive nuclei, and the formation of superheavy quasistable nuclei.

The problems of formation of extreme states of matter, and its use in solving the applied tasks of nuclear physics, power engineering, and radiation ecology, are the priority directions of the activity of a specialized laboratory for electrodynamical studies of the "Proton-21" firm established in Kiev in 1999.
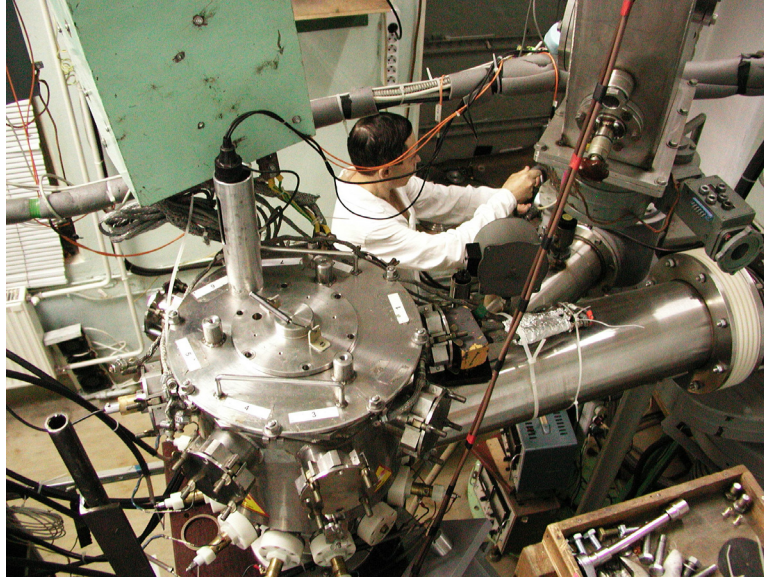
Figure 1.   Proton-21 facility upgrade.

2. Facilities, methods, and main results of experiments

2.1. *Facility*

In the course of creation of the experimental base of the laboratory, the best available methods for extremely strong matter compression were employed. At the same time, while designing the experimental setup, a special emphasis was put on the realization of scientific ideas developed by the creative staff and the laboratory administration.[1] We posed the problem of creating a setup which is able to ensure a high energy concentration (from a coherent driver) in a solid target (with size of at most 10–$100\,\mu$m) in the first stage of the impulse process. At the second stage, the further self-supporting compression of this region up to a state of collapse on the subangstrom-scale, and the attainment of the "stellar" matter state should occur.

In the experimental setup (see Figure 1), an impulse electron beam with a total energy of at most 1 kJ was used as a coherent driver in each cycle of supercompression (a schematic of the basic experiment under discussion in this paper is shown in Figure 2). Both the compressed target, and the driver system ensuring the supercompression, were in a vacuum system. This guarantees maximum purity, control over experiments, their reproducibility.[1,2]

The expected results concerning matter supercompression were derived on 24 February 2000.

The optimized structure of the experimental setup allows us to perform at least 10 different experiments on the supercompression of different targets in a day. At present, the total number of experiments exceeds 5000. As target materials, we have used practically all chemical elements from which one can manufacture a solid

Anode

Electron beam
0.1...1 kJ
20-30 ns
Average energy 0.3...0.5 MeV

Collapse zone in a
target (cathode)

New kinds of
radiation

Remote screens
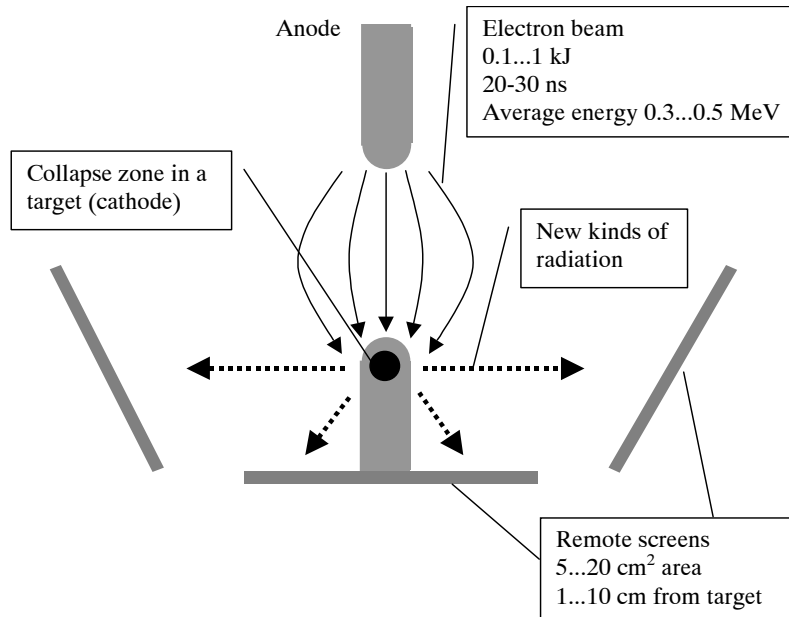5...20 cm^2 area
1...10 cm from target

Figure 2.   Schematic of experiment.

target. The majority of the targets under study were produced from chemically pure elements, such as Cu (purity of 99.99%), Al(99.99%), Ta (99.97%), Pb (99.75%), and Ag (99.99%).

The achieved understanding of the physical processes running during every experiment allows us to predict reliably (with a probability of about 100%) the results of experiments for all variations in the operation modes of the setup, and in the characteristics of targets under study.

2.2. *Measurement systems*

The results of action of a coherent driver in the experimental setup were investigated with the use of several independent measurement systems:

- After every experiment, the chemical, isotopic, radiometric, and structural analyses of the target materials were carried out; also analyses of the chamber walls and special accumulating screens with different forms, materials, and structures which were positioned in the vacuum region of the experimental setup, were carried out.

- We measured the spectra of electromagnetic radiation from the collapse zone in the microwave, visible, and gamma regimes.

- We analyzed the products emitted from the collapse zone (electrons, positrons, ions, charged and neutral nuclear particles and clusters) in real time.

Table 1.   Samples and analyses.

method(s) used	number of samples	number of analyses
LMS	20	297
AES	25	474
SIMS	24	399
RBS	40	40
TIMS	13	280
EPMA + LMS	38	1227
EPMA + AES	44	1522
EPMA + SIMS	21	619
LMS + AES	1	29
AES + SIMS	2	102
EPMA + LMS + AES	4	164
EPMA + LMS + SIMS	2	57
EPMA + AES + SIMS	7	316
EPMA + LMS + AES + SIMS	1	43

In the implementation of the element and isotope analyses, the following methods based on relevant facilities were used:

- Electron probe microanalysis (EPMA)—analyzer REMMA 102 (Ukraine).

- Auger-electron spectroscopy (AES)—Auger spectroscope JAMP-10S (JEON, Japan).

- Secondary ion mass-spectrometry (SIMS)—SIMS analyzer IMS 4f (Cameca, France).

- Laser mass-spectrometry (LMS).

- Integral thermal ion mass-spectrometry (TIMS)—thermal ion mass-spectroscope "Finnigan MAT-262."

- Glow discharge mass-spectrometer VG 9000 (Thermo Elemental, UK).

- Rutherford backscattering of accelerated α-particles (RBS).

All together, more than 15 000 element and isotope analyses were performed, including those listed in Table 1:

2.3. *Observations*

During the experiments (on solid target supercompression to the collapsed state), several anomalous phenomena were observed:

- In the process of the collapse formation, and during its subsequent evolution for 100 ns, intense x-ray and gamma radiation (in the energy range from 2–3 keV to 10 MeV, with a maximum near 30 keV). The total radiation dose in the range 30–100 keV exceeded 50–100 krad at a distance of 10 cm from the active region.

- Synthesis of light, medium, and heavy chemical elements and isotopes (with $1 \leq A \leq 240$); and fusion of superheavy transuranium elements (with $250 \leq A \leq 500$) in the area near the collapse zone. Some of these results are considered below.

- All of the created elements and isotopes were stable (without alpha, beta, or gamma activities).

- Transformation of any radioactive nuclei to stable nuclei in the collapse zone. The utilization efficiency of radionuclides per $1\,\mathrm{kJ}$ of the driver energy corresponds to the transmutation of about 10^{18} target nuclei (e.g. $^{60}\mathrm{Co}$) into nonradioactive isotopes of other nuclei.

- Unique spatial distribution of different chemical elements and isotopes (with $1 \leq A \leq 240$) in the volume of an accumulating screen, which was made of a chemically pure element and which was remote from the collapse zone (all the created elements and isotopes were situated in the same thin layer, or several thin layers, inside of the screen).

2.4. *Results due to a new physical process*

These results indicate that a previously unknown physical process, namely the artificially-induced collapse of part of the target material, was realized at our laboratory for the first time. In every experiment, the collapse is completed by both the full nuclear regeneration of a portion of the initial substance of the target with a mass of 0.5–1 mg and the formation of artificially derived chemical elements instead of the initial atoms, including the long-lived and stable isotopes of superheavy chemical elements which are not found on earth or in near space.

These phenomena can be interpreted (with a high probability) on the basis of the idea of the creation and evolution of a self-organizing and self-supporting collapse state of the electron-nucleus plasma (of an initial solid substance); to a state of electron-nucleus clusters (with the density close to that of the nuclear substance) under the action of a coherent driver. During the evolution of such a collapse, the processes of fast fusion and creation of different isotopes (including trarnsuranium ones), take place. After the end of the collapse, synthesized isotopes were detected near the collapse zone, on the surface and in the volume of the remote accumulating screen.

It was also suggested that, during the evolution of this cluster, the process of emission of superheavy neutral nuclear clusters with $A > 3000$–5000 takes place.

3. Fusion of light, medium, and heavy nuclei

By analyzing the results of all experiments, we found a great number of elemental and isotopic anomalies. The measurements were carried out at the institutes of the National Academy of Sciences of Ukraine; at the Taras Shevchenko Kiev National University; at one of the leading enterprises of the Ministry of Atomic Industry of the Russian Federation; and at specialized mass-spectrometric laboratory of United Metals Inc (USA).

Table 2. Number of atoms in the surface layer of accumulating screen

Element	Z	Initial Cu target	screen	Element	Z	Initial Cu target	screen
Li	3	1.7E+12	6.0E+11	Fe	26	1.3E+15	8.7E+16
Be	4	6.1E+11	1.3E+14	Co	27	l.0E+12	3.9E+14
B	5	2.1E+12	4.1E+13	Ni	28	3.8E+14	2.0E+14
C	6	–	9.5E+17	Zn	30	5.5E+13	7.5E+16
N	7	–	1.1E+15	Y	39	1.9E+10	2.0E+14
O	8	–	4.3E+15	Zr	40	5.9E+10	2.8E+13
Na	11	6.5E+13	1.3E+16	Ag	47	8.5E+13	6.4E+15
Mg	12	3.6E+13	3.3E+15	Cd	48	1.1E+12	2.2E+15
Al	13	3.9E+14	3.3E+17	In	49	9.7E+11	1.9E+15
Si	14	3.8E+13	9.8E+16	Sn	50	2.0E+13	1.6E+16
P	15	6.5E+14	2.0E+16	Te	52	8.6E+12	1.4E+15
S	16	3.4E+14	1.2E+17	Ba	56	3.2E+11	2.4E+15
Cl	17	2.4E+10	1.5E+17	La	57	1.4E+10	7.2E+14
K	19	–	5.3E+16	Ce	58	2.2E+10	2.5E+15
Ca	20	3.2E+14	1.8E+16	Pr	59	2.6E+10	1.5E+14
Ti	22	2.3E+12	3.8E+15	Ta	73	–	4.2E+15
V	23	1.1E+11	9.1E+13	W	74	3.1E+11	2.3E+16
Cr	24	3.3E+12	2.5E+15	An	79	1.0E+11	5.8E+15
Mn	25	2.4E+13	1.5E+15	Pb	82	2.5E+13	2.0E+17
				Total		3.7E+15	2.2E+18

After the implementation of every experiment, many chemical elements (with atomic numbers both greater and smaller than those of initial chemically pure material) was measured on the target surface, and on the surface and in the volume of accumulating screens. This amount is much larger than that of admixtures in the initial materials of the target and accumulating screens (see, e.g. Table 2).

For the majority of the synthesized chemical elements, we observed a significant deviation from the natural isotope ratio. For many elements, this ratio is changed by 5–100 times (it can increase or decrease). Fig. 3 shows an example of a change in the isotope ratio for certain elements registered after experiments. While analyzing the samples, we found many nonidentified atomic masses in the transuranium region with $A > 250$.

3.1. *Single ions and molecular clusters*

Performing the spectrometry of superheavy masses, we implemented special measures allowing us to prevent the appearance of molecular clusters:

- We carried out a complex study of the same sample on several mass-spectrometers of different types.

- We used a special operation mode, "offset," in a SIMS analyzer IMS 4f which allowed us to highly efficiently separate molecular clusters and single ions.

- While using a mass-spectrometer, we used the operation mode with a high temperature (about 100 eV) at the laser focus on the surface of the samples under
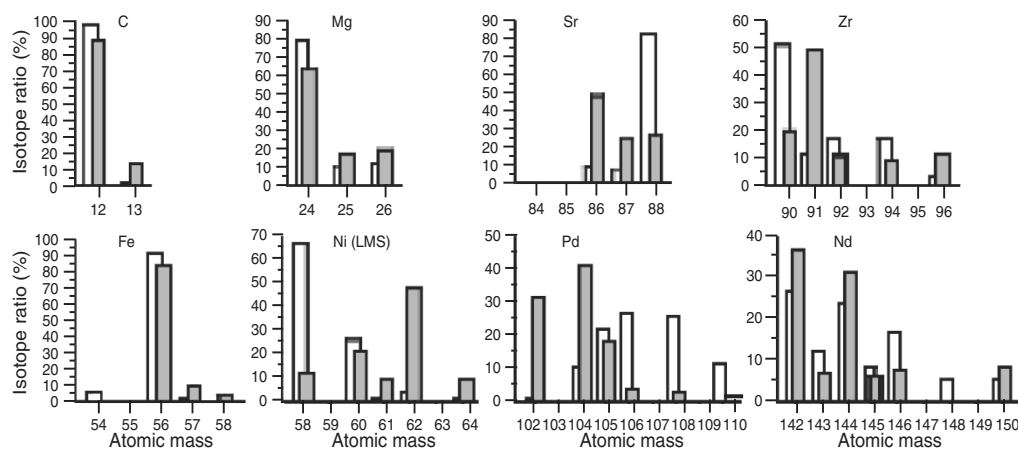
Figure 3. Isotopic composition of some elements measured with LMS (indicated) and SIMS (others). Natural composition is depicted with empty bars, the composition of synthesized elements with hatched bars.

study. At this temperature, molecular complexes cannot exist and such a mass-spectrometer will register only single ions.

- The investigation of superhigh masses was performed with the use of Rutherford backscattering of accelerated alpha particles with an energy of 27.2 MeV derived on a U-120 cyclotron. This method allows one to register only single ions. The
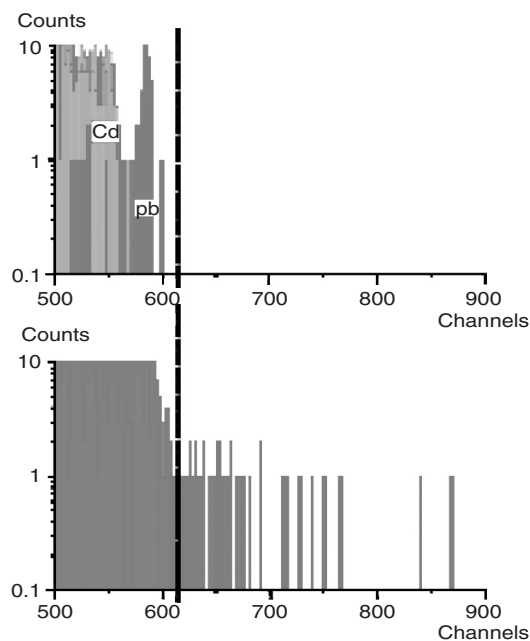

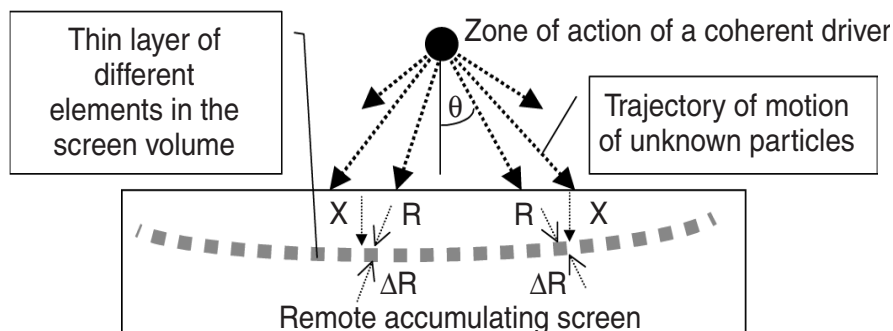Figure 4. Rutherford backscattering data; initial material (above) and after the impact (below).

Figure 5. The typical scheme of formation of thin layer in the volume of an accumulating screen.

results of a measurement of the backscattering spectrum are presented in Fig. 4 [Ref. 3].

These precautions enable us to assert that we detected nonidentified stable atomic masses in the transuranium region with $250 < A < 500$ on the samples located near the action zone of the coherent driver. After every experiment, about 10–20 types of superhigh masses (superheavy nuclei) were measured; moreover, a representative number of superheavy nuclei of each type equaled 10^7 to 10^{10}. The number of superheavy nuclei formed increases with use of a target made of heavy atoms (e.g. Pb). Most frequently are registered superheavy nuclei with $A = 271$, 272, 330, 341, 343, 394, 433. The same superheavy nuclei were registered on the same samples during repeated measurements over time intervals of a few months.

4. Spatial distribution

4.1. Anomalous atom distributions

While investigating the spatial distribution of products of the nucleosynthesis in the volume of accumulating screens made of chemically pure materials (mainly Cu), we found alien chemical elements (from H to Pb) in the amount which exceeded their initial total amount in the form of admixtures by several orders (Table 2). All these elements were positioned in several thin concentric layers. The first (superficial) layer, about 200 Å thick, contained about 3×10^{18} atoms of all elements. The second was located at a depth $X \approx 0.3$ μm, and contained about 10^{18} atoms. And the third was at $X \approx 7$ μm. At the same time, we found a decrease in the concentration of the initial material of a target in the volumes of these layers.

Let us consider possible mechanisms for the formation of a thin layer (containing different elements and isotopes with the same spatial distribution) in the volume of an accumulating screen made of a chemically pure element (e.g. Cu), and remote from the action zone of a coherent driver in detail.[4] A typical scheme of formation of this layer in experiments is presented in Fig. 5.

The depth profile shown in Fig. 6 was typical of all experiments. It was obtained
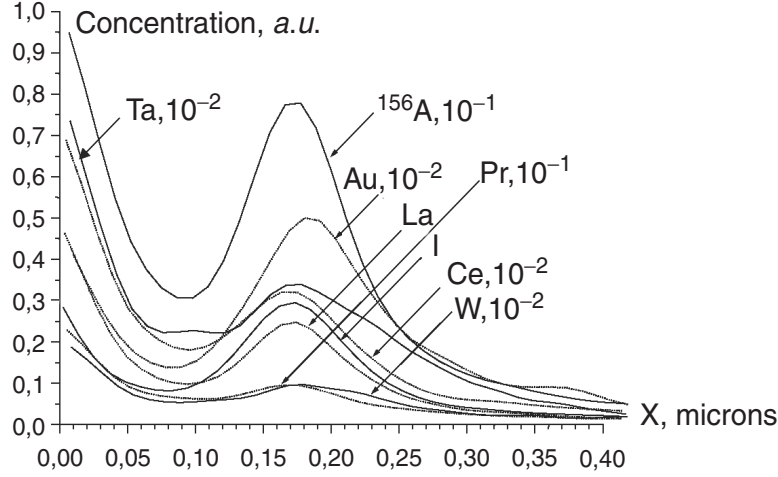
Figure 6.   Depth profile of chemical elements in an accumulating screen.

by ionic etching the surface of an accumulating screen with an ion microprobe analyzer Cameca IMS 4f. One can see in Fig. 6 that different chemical elements (e.g. Au, Pr, La, I, Ce, W, and unidentified element ^{156}A) are situated in the same thin layer (with relative thickness $\Delta R/R \approx 0.25$ and distance $R = X \cos \theta$ from the surface into the depth of the accumulating screen in the direction outwards the collapse zone). The distance R and thickness ΔR are the same for the whole layer and all chemical elements for a single experiment. For different experiments, the values of R and ΔR may be different, but the ratio $\Delta R/R$ is the same.

The synthesized elements and isotopes were distributed over the layer surface as separate clusters. At the center of the screen, the clusters overlapped. Cluster distributions for Al, B, Si, and K on the layer surface are presented in Fig. 7. Note that the distributions are the same in all details. This result can be obtained only if all detected elements were born in each cluster during the nuclear transmutation of unknown particles.

It is easy to make sure that such distributions over the surface and radius cannot be a result of the ordinary process of Coulomb deceleration for different fast ions. For such a Coulomb deceleration, the energy losses dE/dr and the deceleration distance R of an ion with mass M, charge Z, and energy E are

$$dE/dr = -(2\pi n_e M Z^2 e^4/m_e E) \ln (4m_e E/MJ), \qquad R = \int_{E}^{E_{min}} dE/(dE/dr). \quad (1)$$

Here, J is the averaged ionization potential of atoms of the screen. On the one hand, at the same deceleration distance $R = 0.3$ μm in a copper target, the values of the initial energies E are very different for different ions (e.g. we need $E_H \approx 60$ keV for H^+ and $E_{Pb} \approx 60$ MeV for Pb^+). The same dispersion of E_i will hold for ions with
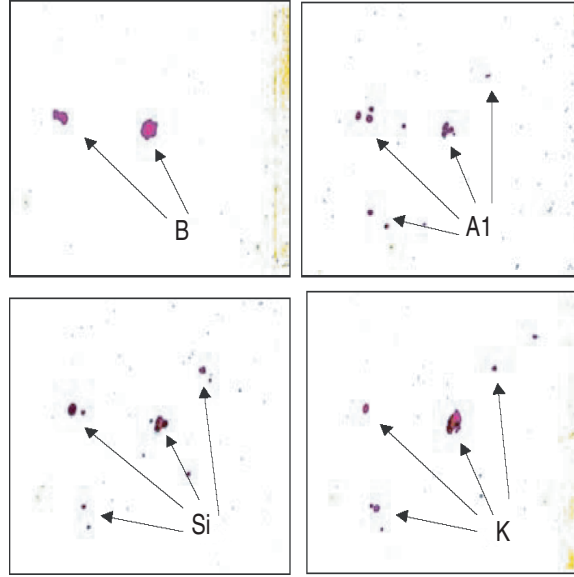
Figure 7. Distribution of clusters of chemical elements B, Al, Si, K on the same very small area on the surface of a thin layer.

different charges. On the other hand, for different ions at the same energy E, the ratio of deceleration distances R_i is also very high (e.g. for H^+ and Pb^+, we have $R_H/R_{Pb} > 20\text{--}30$).

The total number of alien atoms considerably exceeded that of the starting admixture; therefore, such a unique distribution cannot be created by the nonlinear waves of admixtures which are observed sometimes in nonequlibrium processes. In addition, the three-dimensional character of the anomalous distribution of synthesized chemical elements (different elements were located in small coincident regions on the surfaces of concentration layers) cannot be explained by the processes of transport or diffusion as well.

The observed distribution of chemical elements (the fixed values of ΔR and R for different particles in each single experiment) in the layer may appear only in the case of deceleration in the depth of the screen of identical particles with the same charge and energy. But such a distribution is observed for different elements (from H to Pb)! So, we are faced with a paradox in this case.

We suppose that such a distribution of different chemical elements and isotopes is possible only if the following conditions are met:

(1) All initial (decelerated and stopped) particles must be the same (identical).

(2) For the stability of the charge of particles, their velocities V must be lower relative to the velocity $v_0 = e^2/\hbar = 2.5 \times 10^8$ cm/s of valence electrons.

(3) For a large distance of deceleration R at a low velocity $V \ll v_0$, the mass M of an unknown particle must be very large.

(4) Different chemical elements and isotopes observed in the screen layer are created by the nuclear transmutation of these identical particles after stopping at R.

What is the nature of these unknown superheavy particles and the mechanism of the fast nuclear transmutation to different final stable nuclei? This problem will be discussed below.

4.2. *Deceleration of heavy particles by elastic scattering*

We have investigated the possible mechanism of elastic deceleration of these unknown particles, and we have calculated their parameters. The equation of motion of the unknown uncharged particles with mass M in the bulk of the screen is the following:

$$M\frac{dV}{dt} \; = \; F \; = \; -2M_0 V^2 \sigma n. \tag{2}$$

Here,

$$F \; \equiv \; \Delta p / \Delta t \; = \; -2M_0 V^2 \sigma n$$

is the mean force of elastic deceleration of the unknown heavy particle in the screen. The momentum change Δp satisfies

$$\Delta p \; = \; -\delta p \, (\Delta t / \delta t) \; = \; -(2M_0 V^2 \sigma n) \, \Delta t$$

Δp is the deceleration of the particle momentum for $\Delta t \gg \delta t$ (during $\Delta N = \Delta t / \delta t$ single collisions with ions of the target with mass M_0), where the time between single collisions is

$$\delta t \; = \; l_1 / V \; = \; \frac{1}{\sigma n V},$$

and the distance l_1 satisfies

$$l_1 \; = \; \frac{1}{\sigma n}$$

This distance is the interval between two subsequent collisions of the unknown heavy particle with ions of the target. In addition,

$$\delta p \; \approx \; 2M_0 V(t)$$

is the deceleration momentum of a particle during a single collision.

The solution of Eq. (2) is

$$V(t) \; = \; \frac{V(0)}{1 \, + \, 2M_0 \sigma n V(0) t / M}. \tag{3}$$

The deceleration terminates at a time $t = \tau$ when the kinetic energy of the particle $(MV^2(\tau))/2)$ becomes equal to the thermal energy $(M_0 v_T^2/2)$ of the atoms (ions) in the screen.

The duration of the deceleration is

$$\tau = \left[\frac{V(0)\sqrt{M}}{v_T\sqrt{M_0}} - 1 \right] \frac{M}{2M_0\sigma n V(0)}. \tag{4}$$

The deceleration distance is

$$R(\tau) = \int_0^\tau V(t)\mathrm{d}t = \frac{M}{2M_0\sigma n} \ln\left[\frac{V(0)\sqrt{M}}{v_T\sqrt{M_0}} \right]. \tag{5}$$

The mass of the unknown particle is

$$M = \frac{4R(\tau)M_0\sigma n}{\ln(T/T_0)}. \tag{6}$$

Here, $T = E(0) = MV(0)^2/3$ is the initial energy of the unknown particle after leaving the action zone of the coherent driver, and $T_0 = M_0 v_T^2/3$ is the temperature of the screen.

Let us make numerical estimates. For a screen made of chemically pure copper ($A_0 \approx 63 - 65$), the concentration and elastic scattering cross section are $n \approx 8 \times 10^{22}$ cm^{-3} and $\sigma \approx 10^{-16}$ cm^2, respectively. With an experimental value of the distance of deceleration $R(\tau) \approx 0.4$ μm and at $T_0 = 300$ K $= 0.025$ eV, and $T = 35$ keV, we have the very large mass of the unknown particle: $M \approx 91$ M_0, $A \approx 91 A_0 \approx 5700$. The initial velocity of these superheavy particles was low relative to the velocity of the valence electrons ($v_0 = e^2/\hbar = 2.5 \times 10^8$ cm/s), and was equal to $V(0) = (3T/M)^{1/2} \approx 3.7 \times 10^6$ cm/s. The total duration of particle deceleration is $\tau \approx 0.8 \times 10^{-9}$ s. In a different case (e.g. for a layer situated at a different distance of deceleration $R(\tau) \approx 7$ μm), we have $M \approx 1540 M_0$ and $A \approx 1540 A_0 \approx 100\,000$. The obtained parameters correspond to requirements (1–3).

5. Possible model for evolution of neutralized superheavy nuclei

We assume that these superheavy particles are similar to abnormal superheavy neutralized nuclei that were proposed by A. Migdal about 20 years ago.[5,6] Migdal obtained the important result consisting in that the energy E/A of the nuclear substance has two minima (the first "ordinary" at $A \approx 60$, and the second "abnormal" at $A_{\max} \geq 2 \times 10^5$). Migdal suggested that the presence of the second "abnormal" minimum of energy E/A was a result of the Fermi condensation of pions in the volume of superheavy nucleus (e.g. during the action of a shock). These minima are separated by a high potential barrier at $Z_0 \approx (\hbar c/e^2)^{3/2} \approx 1600$. The mechanism for the suppression of the action of that barrier will be discussed below. If
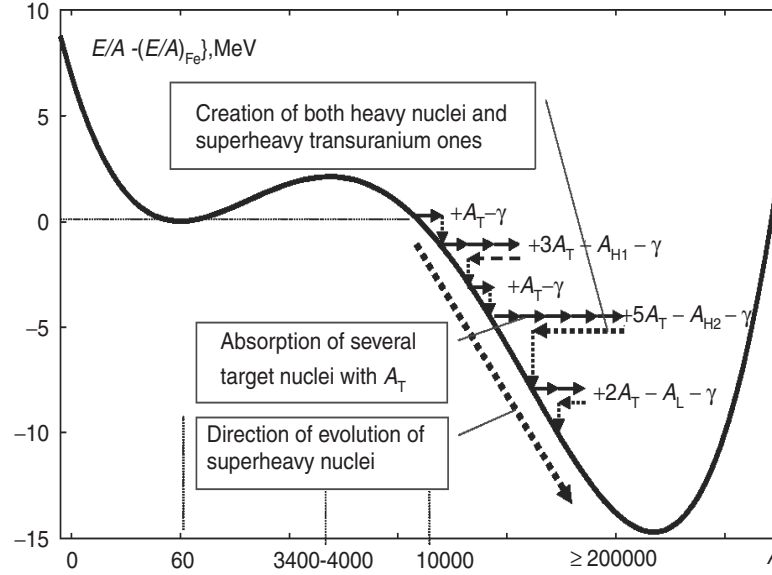
Figure 8.   Evolution of superheavy nucleus – absorption of target nuclei and creation of different nuclei (from H up to stable transuranium nuclei)

this hypothesis is correct, then superheavy neutralized nuclei created in the active zone of a coherent driver can absorb environmental "ordinary" nuclei of the target (screen). This transmutation leads to a growth of these superheavy neutralized nuclei by nuclear fusion up to $A_{\max}$.

Very few electrons are outside the volume of these nuclei in a thin skin with thickness about 10^{-12} cm. The probability of such a synthesis is very high due to the high transparency of the Coulomb barrier. Energy is released during such a fusion reaction. Different channels are available for the release of the excess energy (gamma emission, the emission of neutrons and nuclear fragments, etc.). One of the channels is connected with the creation of different "normal" nuclei, and the mission of these nuclei from the volume of a growing superheavy nucleus. For example, after the absorption of several target nuclei with $A_{\mathrm{T}} \approx 50 - 200$ in a short time, a high binding energy can lead to the emission of several light nuclei with $A_{\mathrm{L}} < A_{\mathrm{T}}$, or one heavy nucleus with $A_{\mathrm{H}} \approx 300 - -500 > A_{\mathrm{T}}$ (see Fig. 8).

The process of nucleus emission competes with other ways for cooling the nuclear substance. In this case, usual even–even nuclei (like the alpha particle, and C^{12}, $O^{16}, \ldots$, Pb^{208}) which already exist in the volume of a superheavy nucleus, are more likely to emerge and be emitted. In fact, every superheavy nucleus is a "specific microreactor" for the transmutation of "normal" target nuclei to different configurations of nucleons. In this microreactor, the transmutation process terminates after the utilization of all target nuclei, or after the evolution of a superheavy nucleus to the final stable state with $A_{\max}$. How are such superheavy nuclei created?

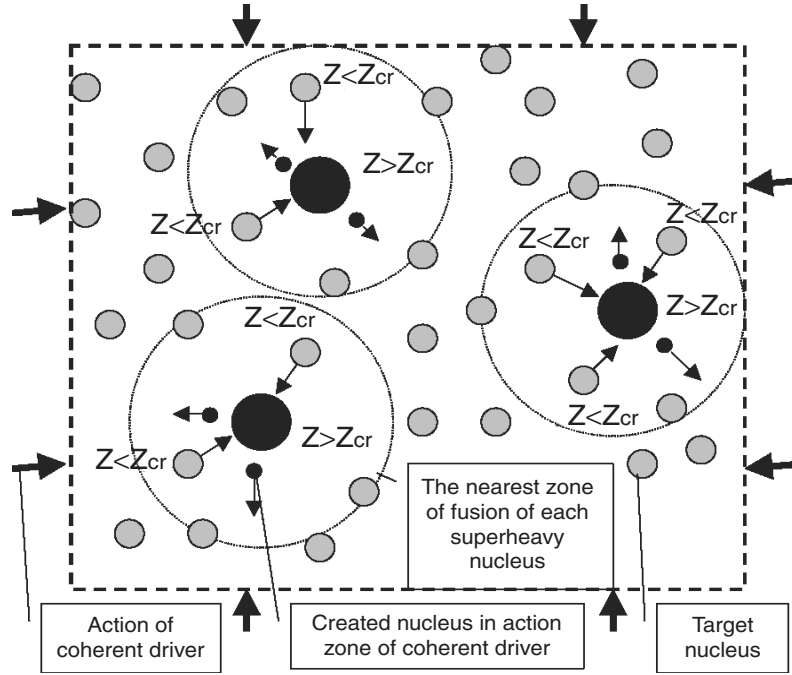We have carried out an analysis of the evolution of nuclei in the action zone

Figure 9. Tramsmutation of target nuclei ($Z < Z_{cr}$) to different nuclei ($1< A <500$) in zone of collapse.

of the coherent driver. It follows from our calculation that for some usual (not superheavys) but "critical" nuclei (e.g. at $Z > Z_{cr} \approx 92$) at special parameters of the coherent driver, the process of fast and self-controlling change (decrease) of the energy of nucleons (an increase in the binding energy) takes place. The value Z_{cr} depends on the driver parameters. For a more intense driver, Z_{cr} will be less. It also follows that the minimum of this energy is changed in time from the initial (usual) value at $A_{opt} \approx 60$ to $A_{opt} \geq 10^4$. All "subcritical" nuclei with $Z < Z_{cr}$ have stable minimum of energy at $A_{opt} \approx 60$. This effect is connected with the self-similar processes in the superdense degenerate electron-nucleon plasma with a suppressed influence of the Coulomb interaction between protons in the volume of a superheavy nucleus. The coherent driver should start this self-amplifying process of nuclear transformation for "critical" nuclei.

We have calculated the energy change per nucleon (E/A) for different relations of the electron and proton concentrations for "critical" nuclei at $30< A < 2 \times 10^5$. During the initial phase of the process (at the shift of the minimum of the energy per nucleon E/A to $A_{opt} \approx 5000 - -10,000$), the role of pionic condensation is slight, but it becomes critical at $A_{opt} \geq 10^5$. The degenerate electron-nucleus plasma initially includes a mixture of all nuclei (normal stable nuclei, and growing superheavy ones) and electrons, and is prevented from decaying due to the action (pressure) of the coherent driver. The description of such processes will be presented

elsewhere.

During such a change of the E/A ratio for superheavy nuclei, the fusion process for target nuclei (the absorption of target nuclei with "subcritical charge" $Z < Z_{\mathrm{cr}}$, and the growth of "critical" nuclei with $Z > Z_{\mathrm{cr}}$) in the action zone of the coherent driver becomes possible (see Fig. 9). This fusion leads to a fast growth of initial "critical" nuclei up to $A \approx 10^4 - 10^5$ during the action time of the coherent driver (about $\Delta t_{\mathrm{d}} \leq 100$ ns) with velocity $(\mathrm{d}A/\mathrm{d}t)_{\mathrm{collapse}} \approx A/\Delta t_{\mathrm{d}} \approx 10^{12}$ to 10^{13} s^{-1}. This velocity is proportional to the concentration of nuclei in the target. This process may lead to the creation of nuclei with $1 < A < 300 - 500$. The scheme of creation of these nuclei and the scheme reviewed above during the analysis of the processes occurring in the accumulating screen are the same.

After the termination of the compressing action of a coherent driver, the process of decay of the degenerate electron-nucleus plasma, which includes the mixture of all nuclei (normal stable nuclei of the target, growing superheavy nuclei, and created nuclei) due to nuclear reactions, takes place. Some of these superheavy nuclei hit the remote accumulating screen and are decelerated there.

The growth velocity of these nuclei in the volume of a solid accumulating screen is proportional to the concentration of nuclei n_{screen} and equals

$$\left(\frac{dA}{dt}\right)_{\mathrm{screen}} \approx \left(\frac{n_{\mathrm{screen}}}{n_{\mathrm{collapse}}}\right)\left(\frac{dA}{dt}\right)_{\mathrm{collapse}} \approx 10^8 \text{ s}^{-1}.$$

After the deceleration of these superheavy nuclei in the screen during $\tau \approx 10^{-9}$ s, the process of growth proceeds for

$$\Delta T \approx \frac{A_{\mathrm{max}}}{(\mathrm{d}A/\mathrm{d}t)_{\mathrm{screen}}} \geq 10^{-3} \text{ s}.$$

We suppose that the above scenario gives a quite full explanation for all the abnormal results obtained in the course of experiments. The full theory of formation of laboratory electron-nuclear collapse in volume of condensed target and the ways of transmutation of nuclear subsystem in such collapse area are presented in [7-9].

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