Review of Adamenko Book by Thomas Dolan, University of Illinois
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"Controlled Nucleosynthesis, Breakthroughs in Experiment and Theory," Stanislav Adamenko (Editor), Franco Selleri (Editor), Alwyn van der Merwe (Editor), Springer Verlag, Dordrecht, The Netherlands, 2007.
ISBN-13: 978-1402058738

This book describes a series of revolutionary experiments conducted at the Proton-21 Laboratory, Kiev, Ukraine, during 2000-2006, in which they measured nuclear transmutations induced by impact of a relativistic electron beam (REB). Chapters 1-3 discuss the history of the experiments, concepts of nucleosynthesis, and the experimental procedure. When the researchers focus a fast-rising REB onto the hemispherical end of a cylindrical metallic anode target (Cu, Fe, Pb, …) they see evidence of an explosion from the center of the anode hemisphere that peels away the metal and deposits debris on a nearby collecting plate.

Chapters 4-6 describe measurements of optical and x-ray spectra and fast particles emitted by the explosion. From the intensities of optical spectra they estimated the energy yield of the ionic component of the exploding plasma to be ~ 2 kJ (much greater than the REB energy of 300 J). They find spectra of elements that were not present in the original target or collecting plate. The spectra of X-ray emissions from 10 keV to 4 MeV are similar in shape to those of a pulsar, a quasar, and a gamma burst. Using CR-39 detectors and a Thomson mass spectrometer they found that the energy spectrum of fast ions decreases almost exponentially from 0.1 to 0.7 MeV, plus a slight peak at energies > 0.8 MeV, including some protons > 1 MeV. Although no deuterium was pre-implanted in the target, at least 1% of the particle tracks are from deuterons.

Chapters 7 and 8 describe the partial stabilization of pre-implanted radioisotopes by the explosion and the elemental and isotopic compositions of the reaction products. In Cu or Al targets with implanted specks of ^{60}Co or ^{110m}Ag the activity of the reaction products is typically ~ 5-10% lower than the initial activity, and ~ 20% lower in a few cases. Some elements, such as S, Ti, and Fe, showed significant shifts from their natural isotopic abundances.

Chapters 9 and 10 present evidence for the production of superheavy (A > 300) elements and a hypothetical model for the phenomenon. The experimental data include Auger-electron spectroscopy, x-ray spectrum analysis, CR-39 track detection, Rutherford backscattering, low-energy ion beam irradiation, and mass spectrometry. Some of the measurements were confirmed by other laboratories. Irradiation of some superheavy elements by laser beams or by ion beams caused them to decay.

Chapters 11 and 12 discuss the formation and stability of superheavy nuclei. The authors propose that the sudden REB impact creates a growing, steepening, radially converging solitary wave, which gathers material in its path and compresses it up to ultrahigh densities ($n_e > 10^{30}$ cm^{-3}). A nonlinear acoustic wave leads to a Langmuir wave collapse, which results in nuclei "swimming" in a plasma of degenerate electrons. They predict a "Coulomb collapse" at $n_e > n_{cr}$, where $n_{cr} \sim 2x10^{32}$ cm^{-3} for Z=92. Nucleon pairing leads to a phase transition analogous to the transition to superconductivity. Nuclei form fractal clusters, which have large surface areas, hence high surface binding energy terms in a modified liquid drop model. This imparts stability to converging thin cluster shells. Large, stable nuclei may evaporate from the back side of the shells, with a statistical distribution of reaction products. The optimum A for stability varies from 60 at $n_e < 10^{30}$ cm^{-3} up to very high values of A when $n_e > 10^{34}$ cm^{-3}.

This 773-page book presents unusual, new experimental data. The theories are carefully crafted, with hundreds of equations and figures. Future editions could be improved by the following:

- use of SI units
- a comprehensive Index of Topics
- a Table of Symbols, their units, meanings, and page number where introduced. For example, the Greek letter ρ usually represents mass density, but it is also used with several other meanings -- probability density (p.290), energy density (p.585), number density (p.703), radius (p.660), ρ_p as proton charge density , and ρA as a unit of thickness (p 387).
- more thorough labeling of graphs -- experimental parameters stated in the captions, and axes labeled with symbols and units.
- more editing of the English.

Whether one agrees with the theory or not, the experimental evidence is impressive, and the book deserves serious consideration.