Arguments by A.C. Sturt submitted by him as the inventor through Reddie and Grose in response to the Final Office action of United States Patent Application No. 12/312902 Process for Destroying Radioactive Materials of Alan Charles Sturt

Literature cited by examiner:

1. Über den Bau der Atomkerne. I. von W. Heisenberg in Leipzig 1932
2. Gehorchen die Stickstoffkerne der Boseschen Statistik? Ladislaus Farkas, Paul Goldfinger and Fritz Haber 1929
3. Über die Rotations-Ramanspektren von Stickstoff und Sauerstoff von Rasetti 1930
4. K-Electron Capture in Radioactive Argon A^{37}. Weimer, Kurbatov and Pool Physical Review 1944
5. Notes on the Statistics of Nuclei. Ehrenfest, Oppenheimer The Physical Review 1931
6. On the Theory of Slow Neutron Scattering by Liquid Helium. Goldstein, Sweeney and Goldstein Physical Review 1950
7. Cross Section Evaluations to 150 MeV for Accelerator-Driven Systems and Implementation in MCNPX Chadwick et al. Nuclear Science and Engineering 1999
8. Cross Section Evaluations to 150 MeV for Accelerator-Driven Systems and Implementation in MCNPX Chadwick et al. Nuclear Science and Engineering 1999

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My United States Patent Application No. 12/312 902
Process for Destroying Radioactive Materials - Final Office action

This is my reply to the further Office Action, which is the final rejection.

There is only one fundamental objection that the examiner states time and again throughout the document. He thinks my model of the nucleus is wrong, because “there are no electrons in the nucleus”. He produces literature going back to 1930, including a paper by Heisenberg, no less. I will discuss the papers, and address his objections in detail, but first, since we are into history, I will start at the beginning with Rutherford.

A. History

In 1897 J. J. Thompson discovered the electron, and found that all electrons from all atoms were identical. This posed a problem for the model of the atom, which was a new phenomenon at the time, because the negative electrons must have an equal and positive counterpart in a neutral atom. The question was, where was it located? One theory was that the atom was a kind of plum pudding, with charges sprinkled around inside it.

In 1908 -12 Rutherford showed that this was not so. He fired alpha particles from radium at gold foil, and discovered that most passed through or were deflected, but occasionally one bounced straight back as if it had hit a brick wall. He concluded that the alpha particle had hit a point-like positively charged nucleus, in which most of the mass of the atom was concentrated. This was surrounded by electrons with a negative charge which was equal in total, giving a neutral atom. All atoms had this arrangement. He reasoned that the nucleus of the hydrogen atom, which he called the proton, was the building block for all other species of nuclei. However, this could not be the whole answer, because the masses of other nuclei were much greater than this would predict. Since the number of protons in the nucleus had to balance the number of electrons around it, there must be neutral particles inside the nucleus. In accordance with his concept that bigger nuclei were built up by adding protons, he thought that they must have a mass nearly equal to that of the proton. He coined the term ‘neutrons’.

In 1932 Chadwick, who was a protégé of Rutherford’s, succeeded in isolating neutrons. He fired alpha particles at a target of beryllium which released unknown neutral particles. Using a cloud chamber, he showed that these matched Rutherford’s prediction for the mass of the neutron particle.

This is where the opportunity for debate begins. Everyone concluded, like Rutherford, that neutrons therefore existed as such in the nuclei of beryllium, but there was, and is, no way of knowing, because you cannot look at the neutron inside the nucleus to see whether it can be distinguished from its neighbouring protons in some way. All we know is that, if it exists as such an entity, it has mass about the same as a proton, but no charge. What prevents the protons in the nucleus from flying apart because of their like charges, is said to be the ‘strong nuclear force’. However, the definition of the strong nuclear force is that it binds the nucleons together, which is a circular argument. This force and the energy which it embodies can then be turned into mass using Einstein’s equation.

B. An alternative model

There is, however, another possible explanation. Neutrons are formed only in stars, which have the required temperatures and pressures. Neutrons such as those discovered by Chadwick were made in stars, just as were those in all the elements which exist on Earth. No one can make neutrons on Earth; all studies involving neutrons use neutrons liberated from nuclei ready-made elsewhere.

Neutrons are made from electrons and protons. Electrons are fundamental particles, which cannot be broken even by nuclear physics. Protons are not quite as fundamental, because they can be smashed into smaller particles, as at CERN, but they are extremely stable in a chemical world, and they too are made in stars. I have proposed that the pressures and temperatures of stars force protons close enough together to form the structures which we see as nuclei. Sometimes, but very rarely, they are held by chance in a stable configuration by electrons which thread through the structure, circulating around and between protons so closely that their negative charges pull the protons back together as fast as they try to separate. It is the pressure of stars which forces particles close enough to do this. These are the stable configurations of nuclei being built from the ground up. The more complicated a particular configuration, then statistically the more rarely it occurs, and so the abundance of the higher elements is less. The force which holds the protons together is the electrostatic attraction between electrons and protons in very close proximity. If the distance between charges becomes zero, the inverse square-law predicts that such a force becomes infinitely large. Of course this never happens, but it may come very close. This is the origin of the very strong nuclear force.

There are no particles in this model other than electrons and protons, and when matter is thrown off stars by supernova explosion, it cools and freezes containing the elements of which the Earth consists, and of course us too; we are made of stardust. Thus the nuclei of all the elements which we see around us contain only protons fixed in particular configurations, still held there by the electrons which were in at their beginning. Such configurations vary in stability, and may become quite unstable when they are very large. In the course of time collisions may cause some to emit a proton, and as it emerges it takes a nearby electron with it. The electron will be in the very close orbit into which it was forced by the pressure of a star. Together they form a neutral entity which we call a neutron. This phenomenon may include what we call radioactivity.

When a neutron is ejected into space, it is freed from the constraints imposed by the other particles in the configuration, the neutron collides with other particles either on the way out or in the space or in the walls of the container in the laboratory, and the interaction disturbs the close orbit of the electron. It begins to unwind, faster for some electrons than for others, depending on the extent of its disturbance. This is the process of neutron decay which has a half-life of about 10 minutes in the conditions of the laboratory. The result is a proton, or nucleus of a hydrogen atom, and an electron. Depending on the conditions, this may form a hydrogen atom and then a hydrogen molecule.

It will not have escaped notice that this electron is one of those which bound the protons together in the nucleus, as it formed in a star. It is an intranuclear electron. There are electrons held inside nuclei, until they are liberated when the nucleus is smashed into component particles.

C. Forces

In physics there are four forces found in nature: gravity, electromagnetic, the strong nuclear force holding neutrons and protons together in the nucleus, and the weak nuclear force responsible for changing neutrons into protons in beta decay.

I have described the origin of the strong nuclear force in terms of electrostatic force at very short distances between charges.

In the nineteenth century James Clark Maxwell proved that electric and magnetic forces are the same type of force. In particle physics electromagnetic forces are responsible for charged particles attracting or repelling each other. Recent experiments have shown that electromagnetism and the weak nuclear force are the same type of force, now often referred to as the electroweak force. Attempts have been made to put the strong and electroweak forces onto a common basis. This is what my model achieves, because it explains how the strong nuclear force, the weak nuclear force and electromagnetism are all the result of attraction between opposite charges or repulsion between like charges. The difference is the distance between the charges: almost zero for the strong force, and much greater for the electroweak force.

The weak nuclear force is responsible for processes such as beta decay. The theory is that when a neutron changes to a proton, a charged particle called a W-boson is emitted (where does that come from?). This then decays into a beta minus particle and an electron neutrino. W-bosons are confirmed by identifying statistical aberrations in particles resulting from collisions in accelerators, though not yet for the all important Higgs. A beta minus particle is of course an electron, and according to no less a nuclear physicist than Otto Frisch, 'the neutrino was invented to account for the discrepancy of energy when a fast electron was released from a nucleus. A distribution of energies was produced.' There is enough uncertainty in these explanations to accommodate alternatives.

There is one feature of my model which distinguishes it uniquely from the conventional model of the nucleus. Why is it that orbital electrons do not simply settle on the nucleus? They ought to, because opposite charges attract. In the commonly held model, there is nothing to prevent them. In my model, however, the answer is clear and simple: whenever they approach the nucleus, they are met by an intranuclear electron, which repels them. The intranuclear electrons travel much faster than the protons, because their mass is only a two-thousandth of that of the proton. They are always there to meet the intruder, which is in any case probably approaching more slowly.

Whereas the current model is essentially static, with particles popping up from nowhere from time to time, my model is dynamic, which makes it easier to envisage physical mechanisms for inserting or losing particles, and comparing masses by deflections in magnetic fields. Equations merely summarise the eventual outcome. And to coin a phrase, who ordered all the other particles?

There is no reason to be confined by the limitations of the current consensus, which is producing increasing improbable numbers of 'fundamental' particles and 'solutions' to match. The fundamental criterion is that new processes should be consistent with the facts, rather than their current interpretations.

My model is much simpler, and fits all the facts both in astrophysics and particle physics. My model is the basis of the invention.

D. Cited papers

A collection of papers has been cited, some dating from the 1930s. There seems to be a concentration on statistical discussions of observed results, the relevance of which to the process of my invention is not clear. The aim seems to be to justify the examiner's insistence that there are no such things as intranuclear electrons. It seems to have been forgotten that the process of the application concerns acceleration of heavy nuclei for head-on collision.

1. Über den Bau der Atomkerne. I. von W. Heisenberg in Leipzig 1932

Heisenberg discusses the consequences of the finding of Chadwick, following Curie and Joliot, that atomic nuclei are composed of protons and neutrons without the involvement of electrons. If correct, he sayus, this represents an extraordinary simplification of the theory of atomic nuclei, but it raises the question: how can a neutron degrade into a proton and an electron? He asks what sort of statistics is involved, and how it fits in with quantum mechanics.

There are two points of note. First he mentions the extraordinary stability of the helium nucleus. Secondly he produces a graph which shows that the heavier the nucleus, the more neutrons it needs for stability in proportion to the protons. He also considers the problem of beta emission must be solved.

Agreed! Historically interesting, but relevance to the application?

2. Gehorchen die Stickstoffkerne der Boseschen Statistik? Ladislaus Farkas, Paul Goldfinger and Fritz Haber 1929

Does the nitrogen nucleus obey Bose statistics? Relevance to the application?

3. Über die Rotations-Ramanspektren von Stickstoff und Sauerstoff von Rasetti 1930

Concerns the Raman spectrum of oxygen and nitrogen, presumably gases. Relevance to the application?

4. K-Electron Capture in Radioactive Argon A^{37}. Weimer, Kurbatov and Pool Physical Review 1944

A radioactive gas has been produced by bombardment of solid samples containing potassium, chlorine, calcium of sulphur. The gas is presumed to be A^{37}. The introduction says that the first radioactive argon to be reported was produced by the bombardment of the gas with deuterons. This gas is comprised of single atoms i.e. not two, like hydrogen, oxygen or nitrogen. The radioactivity was assigned to A^{41}.

Presumably this meant argon Ar, and its atomic number increased by one. I am not sure I understand how that comes about, and I cannot see its relevance to the application.

5. Notes on the Statistics of Nuclei. Ehrenfest, Oppenheimer The Physical Review 1931

Starting from Pauli's exclusion principle, it tries to distinguish between Einstein-Bose and Fermi-Dirac statistics in the behaviour of clusters of protons and electrons. I cannot see the relevance of statistical descriptions to the application which concerns the production of such particles in high speed collisions.

6. On the Theory of Slow Neutron Scattering by Liquid Helium. Goldstein, Sweeney and Goldstein Physical Review 1950

I cannot see slow neutron scattering by liquid helium should be relevant to the application.

7. Cross Section Evaluations to 150 MeV for Accelerator-Driven Systems and Implementation in MCNPX Chadwick et al. Nuclear Science and Engineering 1999

This concerns accurate data needed to model the performance of the target/blanket assembly and to predict neutron production, activation, heating, shielding requirements and material damage in new accelerator-driven technologies that use neutrons, such as the production of tritium and the transmutation of radioactive waste. High current proton accelerators are being designed at Los Alamos National Laboratory for this purpose. A proton beam is fired at a tungsten target surrounded by a lead blanket.

This is clearly not the process of the application, and I do not see its relevance.

E. The Office Action

Page 2
… 'electrons in the first and second particle are alleged to be comprised in the interior of the nucleus.' This has been dealt with in my model above.

Page 3
line 4, I have explained the strong nuclear force in my model above.
line 12 'applicant relies on an incorrect model of the nucleus. *In the nucleus there are no electrons.*' My model explains that there are.
line 14 Chadwick made the discovery. Heisenberg tested it fitted against two versions of the statistics, and his views may have coloured later models, but this does not affect the composition of the nucleus in the slightest.

Page 4
line 8, alpha particles are exceptionally stable, which is why Rutherford and Chadwick could use them as missiles. See also the comments of Heisenberg. The reason is that their pyramidal symmetry is extremely resistant to disintegration, and so

it would be more likely to survive the collision under the conditions of the process of the application.
last line, see the quoted comments of Otto Frisch.

Page 5
line 3. cross-sectional data are known from heavy ion collision experiments which have already been performed at CERN and Fermilab. The chances of collision are much greater in the process of the application, because there is no requirement to discriminate between the products as there is in research. All that is required is that collisions should take place, and if they do not occur for particular particles at the first try, these go round again.
line 11. as described above, electrons and protons are more stable than alpha particles, but the examiner is wrong to assert that neutrons are too. Neutrons decompose into protons and electrons with a half life of 10 minutes under laboratory conditions, and very much faster in the process of the application.
line 15. As for violating a long-standing well-established theory of the nucleus, I have simply provided an alternative, and I suggest more credible, interpretation of the facts. Theories are just that i.e. theories, however long-standing.

Page 6
line 1. The examiner is using the term 'standard model' in a sense that is specific to Heisenberg. The Standard Model of Physics is a much later development. He is using Heisenberg's model to a mean long-standing well-established theory of the nucleus. My interpretation of the facts is different and more plausible. Heisenberg's model is his theory, which does not preclude more insightful alternatives at a later stage.
line3. Causing the collision of heavy ions in an accelerator is not 'beyond the level of ordinary skill in the art'. It has been routinely performed at the large accelerators.

Page 7
No new matter has been imported. This is juggling with the order of the same nouns.

Page 8
line 3. There is no suggestion or possibility of decomposing protons in the process of the application. The velocities are nothing like high enough.

Page 10
line 10. the model which applies in the application has been described above, complete with intranuclear electrons. The fact that it differs from what the examiner calls the 'standard model', by which he means Heisenberg's interpretation, is neither here nor there.

Pages 11-14
These are the cited papers which have been discussed above and shown not to be relevant. On the point at the bottom of page 13, it is the collision of heavy ions which has been done, and this makes the objections about cross-sections irrelevant.

Page 15
line 10. This is back to the conventional model of the nucleus, which has been dealt with above.

line 18. The examiner does not accept that neutrons decompose, but that has been answered above.

Page 16
line 6. neutrons are not absent; there never were any, just instabilities in the nucleus as a whole. Nuclei which are not destroyed the first time are recycled through the process until they are deactivated in the collision zone.

Page 17
line 6. The standard neutron model is not wrong as far as it goes, but it does not apply inside the nucleus, as explained above. This cannot be determined by spectroscopic measurements on nitrogen molecules.
line 20. Pauli's theory of the exclusion principle does not prevent people from sinking through the earth. As a matter of fact, it is the mutual repulsion of orbital electrons.

Page 18
Again he rejects my model of the nucleus held together by intranuclear electrons, but that has all been dealt with above. It may not agree with Heisenberg, but it does fit the facts in more credible way than his.

I believe that this is a comprehensive rebuttal of the examiner's objections.

I do not accept that the limitations of the conventional model of the nucleus prevent my application from operating.

Please instruct the US attorney to file a notice of appeal and appeal brief. I understand that this will mean that my arguments go on to the public record, and that the examiner will have to respond.

Yours sincerely

A.C.Sturt