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Nuclear or not nuclear: how to decide?

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Abstract

A recent claim demonstrating a nuclear process triggered by electrolysis is challenged. An analysis, based on relative diameters, is used to demonstrate that predominant pits could not possibly be attributed to alpha particles, or to less massive nuclear projectiles. This conclusion is supported not only by positive results from a replication experiment, but also by results from the experiment on which the original claim was based. While the numerous SPAWAR-type pits seem to be highly reproducible, their interpretation is not yet clear. The SPAWAR discovery can be called scientific (rather than protoscientific) because it is reproducible.

Introduction

The first version of this paper was devoted to my participation in The Galileo Project. More specifically I wanted to explain why, in my opinion, alpha particles, or less massive nuclear projectiles, could not be responsible for copious pits discovered by the SPAWAR team. I wanted to justify this conclusion not only on the basis of my own experimental data but also on the basis of SPAWAR results published in (1). It occurred to me, after writing the first version, that my manuscript could be published in a mainstream journal.

Not counting on success, I decided to submit the paper as soon as possible. Surprisingly, my paper (2) was accepted; it will probably be published in September or November of 2008. This presentation briefly summarizes my investigations of SPAWAR results and addresses some topics of general interest.

Investigations of SPAWAR results

In 2007 I was one of several researchers who used SPAWAR protocol, distributed by Steve Krivit, and reported the results (3) at the APS Winter Meeting (Denver, 2007). These results, and results reported by other researchers, demonstrated that dominant pits discovered by SPAWAR researchers are reproducible. No one disputed this fact. As far as I know, everyone who used the protocol observed copious pits on the face of the CR-39 detector that was in contact with the silver cathode during electrolysis.

But disagreements emerged about how to explain these pits. Are they due to nuclear projectiles created during electrolysis or are they due to something else? If copious pits are due to nuclear projectiles then what kind of projectiles are emitted? Can they be alpha particles and protons, as suggested by SPAWAR researchers (4)?

Taking the nuclear origin of copious pits for granted, I convinced myself that SPAWAR-type pits could not possibly be due to alpha particles, or to less massive projectiles, such as protons. That conclusion, based on my own experimental data, was reported in (3). In the paper to be published (2) I show that SPAWAR's experimental data, reported in (1), lead to the same conclusion. Additional observations can be seen in (9).

The paper (2) also refers to experimental results reported by several CMNS researchers. In an experiment conducted by Tanzella et al. (5), the CR-39 detector was surrounded by a six-micron mylar film. This was done to eliminate direct contact between the CR-39 detector and the cathode (or the electrolyte). The film was sufficiently thin to allow alpha particles (with energies higher than 1.5 MeV) to be transmitted. No copious pits were observed in this experiment. I consider this to be a direct proof that SPAWAR-type pits are not due to alpha particles with energies higher than about 1.5 MeV.

The most interesting result of (5), however, was the presence of another kind of pits, on both sides of the CR-39 detector surrounded by the thin mylar film. These pits were not as abundant as SPAWAR-type pits (only about 100 per square centimeter versus millions per square centimeter) and they were considerably smaller than copious pits in SPAWAR-type experiments. A subsequent investigation (by Lipson et al.) showed that sizes of pits, on the mylar-protected CR-39 chip, are about the same as sizes of pits due to protons with energies between 2 MeV and 3 MeV. In my opinion, proton-like pits offer a more convincing evidence of a nuclear process due to electrolysis than much more abundant SPAWAR-type pits, near the cathode.

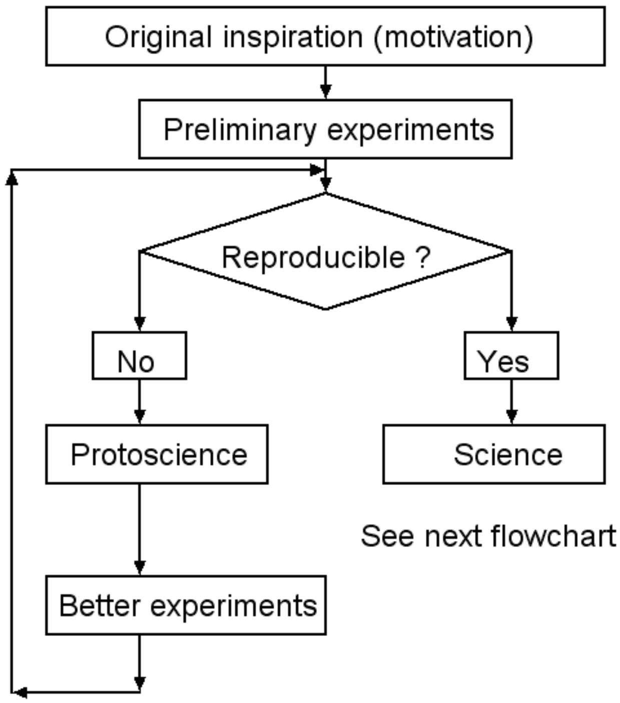
General observations and suggestions

1) Problem of reproducibility: science versus protoscience

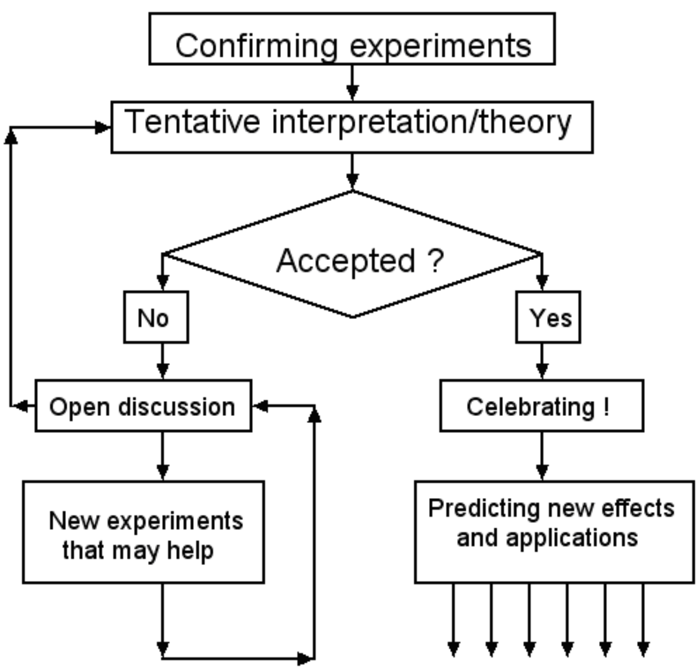
Use of scientific methodology of validation, in a given field, is not sufficient to make a field scientific. At least some demonstrations of new phenomena must be reproducible on demand. Without this a field should be characterized as protoscientific. The expected evolution of a protoscience into science is schematically represented in Flowchart 1, below.

2) Struggle for recognition

A field in which scientific methodology of validation is used, and in which some new phenomena are reproducible on demand, is scientific. The expected evolution of a new scientific field, toward general acceptance, is schematically represented in Flowchart 2.



Flowchart 1



Flowchart 2

The evolution of protoscience into science (Flowchart 1) can be very slow because experiments are not reproducible and because researchers are not guided by a reliable theory.

Theories based on ad hoc assumptions are not reliable. Success depends on sheer luck in accidentally identifying necessary preconditions for reproducibility, and on available resources.

But the path from reproducibility of a new effect to general acceptance (the second flowchart above) is likely to be much faster. Starting with a reproducible experiment one can quickly learn how different parameters influence the effect. Some parameters will have only negligible effect on the outcome while others will have dramatic influence. Success will no longer depend on chance; it will become a matter of skill in systematic investigations.

3) Coordinated research versus working in isolation

It is unfortunate that, except for The Galileo Project, initiated by Steve Krivit (7), CMNS researchers work in isolation from each other. This is understandable; each researcher does what matches his/her expertise and limited resources. This kind of work has been going on for 19 years. It produced remarkable protoscience, in the subfields listed below:

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1) Excess heat, sometimes orders of magnitude larger than what can be attributed to known chemical reactions.

2) Excess heat correlated with production of 4He (generated at a rate close to 23 MeV per atom of produced helium).

3) Chemically-induced changes in isotopic composition of elements. Note that the term “chemically” is very broad; it covers all atomic and molecular processes, including diffusion of gasses through solids.

4) Production of new elements, either stable or radioactive, in amounts high above what can be attributed to omnipresent impurities.

5) Chemically-induced changes in the rate of radioactive decay.

6) Production of high energy photons, for example, gamma rays, during chemical processes.

7) Emission of energetic nuclear particles

But the task of turning protoscience into accepted science is still waiting for us. How to approach this difficult task and how to proceed more effectively? In my opinion, well-focused cooperative investigations, as in The Galileo Project, are likely to be more productive, in the next two or three years, than uncoordinated efforts of many individuals. Who should select the one or two most promising effects on which to focus? Who should coordinate these investigations? And who should cover the costs (probably not more than three to five million dollars)?

I think that the task of selecting one or two effects, on which to focus, belongs to us; our CMNS discussion list, run so well by Haiko, seems to be an ideal platform to debate various proposals. A decision is likely to emerge after about three months of intensive debating. But the two other tasks, coordination and providing financial support, belong to our governments. Acting as a group, we should approach government organizations, such as NSF, National Academy of Science, or DOE, and ask for coordination and support. That is the declared mission of such organizations. National laboratories best equipped for the selected projects should be selected, to minimize additional costs. That is the only way to get a clear yes-or-no answer about the new kind of nuclear activity.

How to convince governments that a relatively modest amount of additional money is worth investing to solve the puzzle? By being organized and acting as a group rather than as independent individuals. This kind of action was already tried, about five years ago, and it produced a result; the second DOE investigation of CMNS would not have taken place without such initiative. Unfortunately, that investigation turned out to be a failure. The reason is obvious; the DOE decisions were based on voting, rather than on experimental data. Scientific decisions should be based on available data, obtained by the most qualified scientists in the most suitable laboratories. Voting is not part of scientific methodology.

4) Which experiments would I recommend?

If only one experiment were to be selected, my choice would be from the second subfield (see the above table), preferably the protocol of Mike McKubre et al. Several independent, highly qualified, investigators reported production of helium during electrolysis. Each of them reported that results were reasonably reproducible in consecutive experiments. If two experiments were to be selected then the second experiment would be from the last field, preferably the protocol described in (5). But at least one more replication of the Tanzella-type experiment would be needed; a single experiment is not enough to make the decision. Production of helium and production of protons are undeniable nuclear signatures. No matter which experiments will be selected, for coordinated investigations, the purpose should be the same, to demonstrate a nuclear activity resulting from a chemical process.

Will we be able to act in unison and accomplish the first task quickly? Will at least one team of scientists emerge, ready to cooperate with mainstream scientists in a national lab? Will they obtain the necessary support from in at least one country? All this remains to be seen. In the final analysis, the outcome will depend on our willingness to fight for a clear yes-or-no answer.

5) On positive and negative contributions

It is difficult to present a negative CMNS report at a formal gathering of CMNS researchers. Most attendees want and expect positive results and convincing interpretations. Reporting something negative is likely to produce discomfort and personal friction. What fraction of CMNS researchers prefer to report nothing rather than reporting negative results? Reporting negative results is just as important as reporting positive results. We all know this. But how does this influence what we actually say, and not say, in public? Friendship and other considerations ("that is bad for CMNS reputation") might play a role, in practice. That would introduce bias.

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7. Editors: Jed Rothwell and Peter Mobberley; Copyright © 2008; The International Society for Condensed Matter Nuclear Science. Printed by Instant Publisher
8. S. Krivit “2007 Galileo Project Report” at http://www.newenergytimes.com/tgp/2007TGP/2007TGP-Report.htm
9. Ludwik Kowalski, http://csam.montclair.edu/kowalski/357.html This webpage offers a link to a SPAWAR paper that was published after the conference. The paper is a rebuttal of arguments presented in (2).