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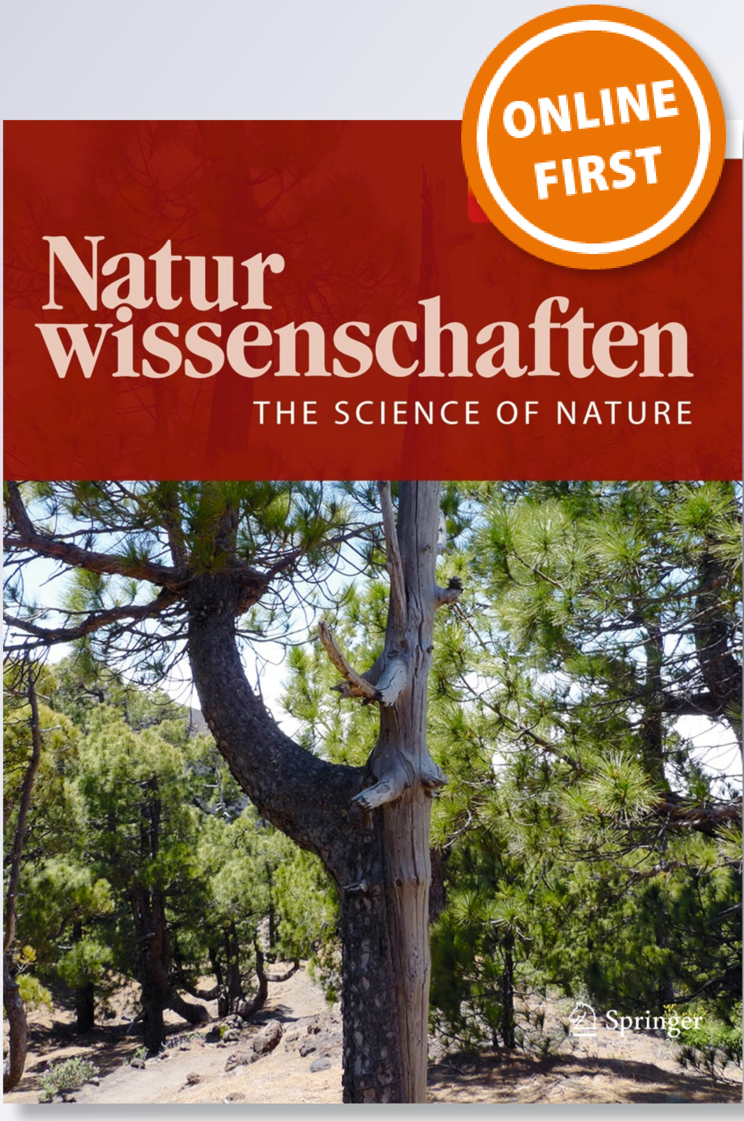

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COMMENTS & REPLIES

Nuclear phenomena in low-energy nuclear reaction research

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Abstract This is a comment on Storms (Naturwissenschaften 97:861–881, 2010) Status of Cold Fusion, Naturwissenschaften, 97:861–881. This comment provides the following corrections: other nuclear phenomena observed in low-energy nuclear reactions aside from helium-4 make significant contributions to the overall energy balance; and normal hydrogen, not just heavy hydrogen, produces excess heat.

Keywords LENRs · Low-energy nuclear reactions · Cold fusion · Energy balance

Knowledge of low-energy nuclear reaction research is expanding (Storms 2010). However, for continued progress, reviews of the field must include examples of all significant valid experimental research. Excluding significant data sets may lead to erroneous conclusions.

Storms' paper, although replete with excellent experimental evidence, contains two significant errors (Storms 2010). The first error is that Storms writes that, except for helium-4, all other nuclear phenomena in low-energy nuclear reactions (LENRs) are a "side issue." They are not.

Storms writes that "a search for the required nuclear product was rewarded with helium production being identified as the major reaction." His conclusion about helium-4 is not defensible because most experimentalists made no attempt to analyze for all possible products. Those who did found other energetic phenomena that could also explain the excess heat.

Storms' second error is that he gives examples in which researchers found no excess heat with normal hydrogen, but he omits other hydrogen experiments that did.

This is a comment on Storms E (2010) Status of Cold Fusion. *Naturwissenschaften* 97:861–881.

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The significance of which nuclear phenomena occur in LENRs, and at what rates bears directly on and either supports or refutes proposed theoretical explanations. The purpose of this comment is not to engage in a discussion of theory; however, for readers who are unfamiliar with the topic, there are two dominant schools of thought in LENR theory: one based on neutron capture concepts (Widom and Larsen 2006) and another based on proton (or deuteron) fusion concepts (Schwinger 1990).

Stanley Pons performed a palladium–deuterium experiment and observed 101 W of excess heat for 30 days, giving 294 MJ of excess energy (Roulette et al. 1996). Thomas Passell and researchers at the University of Texas used neutron activation analysis to study a cathode from a similar Pons' experiment and measured a depletion of Pd-108 (Bush and Lagowski 1999).

They showed how, by the most conservative estimate of nuclear binding energy released by the isotopic shift, Pons' experiment produced an amount of heat in good agreement with the excess heat Pons measured in that set of experiments.

Passell performed a similar analysis on a sample from a palladium–deuterium experiment by Yoshiaki Arata and Yue-Chang Zhang (Passell 2003). The analysis showed an increase of 6.6 to 14.4 times the Zn-64 isotope over the virgin palladium.

Passell estimated that the nuclear binding energy released by the production of the excess Zn-64 would be 20 MJ, which is in approximate agreement with the 30 to 40 MJ of excess heat that Arata and Zhang measured in similar experiments. Arata analyzed for helium-4 but not for isotopic shifts.

Passell worked with the University of Missouri to perform prompt gamma activation analysis on a cathode that produced 0.5 MJ of excess heat in a palladium–deuterium experiment performed by Michael McKubre. The analysis showed an 18 % reduction of boron-10 in the post-electrolysis cathode compared to its concentration in the virgin material.

Passell wrote that the "18 % depletion in B-10 corresponds almost exactly to the number of reactions of B-10 via the d, alpha reaction to Be-8 needed to explain the 0.56 megajoules of excess heat observed." The author considered possible alternative explanations for the anomalous isotopic reduction and conjectured a selective chemical leaching effect; however,

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the author did not test this hypothesis (Passell 1996). McKubre analyzed for helium-4 but not for isotopic shifts.

Qiao et al. observed helium-4 in a palladium–deuterium gas-loading experiment. But they also performed a palladium–hydrogen gas-loading experiment and analyzed for and found anomalous zinc and terbium, as well as energetic charged particles. They estimated the energy of the charged particles in the megaelectron-volt range (Qiao et al. 1998). This is one example of energetic nuclear phenomena in light hydrogen LENR experiments.

In another example, Lipson et al. analyzed for and found alpha particles ranging from 11.0 to 16.0 MeV and protons near 1.7 MeV in a light water experiment (Lipson et al. 2002).

On April 12, 1989, at the Dallas American Chemical Society meeting, Pons reluctantly reported his observation of excess heat in a light water experiment to the press (Pons 1989). This is historically significant because it was the first, though informal, disclosure of light water excess heat. Although data are not available for the Pons light water experiment, many other researchers have also published excess heat results in normal hydrogen experiments. One example is the Piantelli group. That group also proved that palladium is not required; nickel also produces excess heat (Focardi et al. 1998).

Storms makes a pervasive representation in his paper that light hydrogen does not produce excess heat in LENRs. As shown in the examples provided here, Storms' representation is contradicted by experimental facts. Mengoli et al. also performed a useful survey of excess heat results in light water (Mengoli et al. 1998).

At the end of his paper, Storms did provide a single, vague sentence, but no data and no references, to suggest the possibility that ordinary hydrogen may produce excess heat in LENRs. This does not sufficiently inform the reader of the significance of normal hydrogen as a reactant in LENRs and its potential bearing on theory.

The data cited by Storms to support his conclusions argue in favor of the D+D→4He+24 MeV(heat) hypothesis; by contrast, the data omitted in Storms' paper, as shown above, disprove it.

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