Energy, Sustainability and Society

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Reply to "Analysis of some of the statements of L. Holmlid about T + D fusion, D + D fusion and ultra-dense hydrogen" by Mikhail L. Shmatov

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This is a short response specifically to the points of importance related with my original publication in ESS [1].

Most comments are of no interest to the content of my publication in ESS [1]. The comments by Hansen and Engelen referred to by Shmatov have recently been fully answered once more [2].

My statement that there is no option for tritium breeding in ICF was based on what is possible in reality, not about what has been discussed in the literature. The production of 1 kWh by fusion in the world's largest laser NIF using GWhs to run is not a practical solution to energy production and cannot breed any tritium. The neutron flux is too low. To produce 1 kWh by fusion where the cost of just the fuel capsule is many orders of magnitude higher than the value of the energy produced, as at NIF, cannot be considered to be a great step forward. It is an enormous waste of energy, time and money to attempt this line of research, which should have been abandoned a long time ago with no working prototype after decades of development. In contrast, within two years my company was able to produce much more energy than that by annihilation, at a competitive cost.

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My comments on the risks of accidents with fusion reactors were probably not important, I agree with that. Such reactors will never exist, so we do not have to worry about the risks. On the other hand, there appears to exist a large number of scientific studies on these points. Why? Since energy will not be produced, the main problem may be damage to the reactor structure stemming from faulty operation and resulting in leaks and large tritium emissions.

My discussion about picomols of fuel was not entirely correct. Due to the low efficiency of fusion it should be nanomols instead. In comparison, annihilation is 1000 times more efficient [1].

Finally, Shmatov starts a scientific discussion about the annihilation reactions. His discussion is wrong in many respects and it certainly does not prove that we do not observe baryon annihilation in ultra-dense hydrogen. I summarize my answers thus:

1. We have so far identified five different modes of baryon annihilation (to be published). The results cited by Shmatov are not resolved but study ill-defined averages of several annihilation modes.
2. We do not show ill-defined averages as Shmatov cites for the annihilation processes, but rather exact values for one process which is the annihilation process observed using H(0) ($s = 2$) [3].
3. It is impossible to create 5 pions the way Shmatov cites, since they are always created in pairs (one normal matter + one antimatter), so the numbers cited

by Shmatov are directly seen to be ill-defined averages.
4. We are working to understand further annihilation modes which create neutral pions. They are more difficult for us to identify with a very small budget (we cannot afford large expensive scintillators).
5. What averages Shmatov cites cannot be known due to the ill-defined state of solid hydrogen in his references (ill-defined molecular form, why not use atomic Rydberg Matter or even H(0) as we do).
6. CERN and other authors need to identify and separate the contributions from several annihilation channels like we have done, then the comparison which Shmatov fails to do correctly can be done.
7. Please see references [3, 4] to realize that we observe and identify kaons and pions and thus also muons. The mesons can only be a result of baryon annihilation.
8. In his discussion about the origin of our reported neutrons, Shmatov accepts that we have baryon annihilation, otherwise there would be no neutral pions formed to produce the neutrons.

Conclusions

The so-called analysis of my publication in ESS [1] presented by Shmatov is not an analysis, but rather two personal summaries of tritium breeding and the risk of accidents in future fusion reactors. No analysis of the facts leading to the title of my paper "Muon-catalyzed fusion and annihilation energy generation will supersede non-sustainable T+D nuclear fusion" was ever attempted by him. Thus, T +D fusion is non-sustainable, that is clear, no objections were presented.

The only science presented by Shmatov was annihilation results which were presented as THE correct results. Several different annihilation channels exist so the results cited by him are just random averages over some not identified channels and are thus useless.

The alleged analysis of my publication does not bring us one step further to a sustainable nuclear energy technology. In the meantime, the research performed by my company has long since reached break-even in baryon annihilation energy generation and is now at the stage of net-energy production by annihilation.

How many years will it take for non-sustainable T+D fusion to reach comparable results? Will humanity still exist? We need to focus on the best nuclear energy methods like muon-catalyzed fusion and baryon annihilation to survive.

This is what my publication in ESS [1] is about.

The high cost of tritium fuel means that non-sustainable T+D fusion can never provide the cheap energy that we need.

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LH performed all task for this manuscript

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Declarations

Competing interests
The author declares competing interests, since he owns part of a company which develops annihilation energy generation. This method is sustainable and uses ordinary hydrogen as fuel. It creates no waste or radiation risks.

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