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A Short Communication on Progress and Problems of ITER Fusion Project

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ABSTRACT
In recent years, it becomes clear that ITER project in France, as one of the largest experimental fusion reactors underway, is far away from achieving net energy production. In this review article, we presented a short communication this week with Robert Neil Boyd, a senior physicist who happens to have his own working design of fusion reactor in the past. We hope that this transcript of our communication with him (as per 15-17th Nov. 2021) may be found useful for younger scientists.

KEYWORDS

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INTRODUCTION

As we know, many people and scientists believe that fusion energy is our hope for clean source of energy in the future. But whether there is real ground for such a hope, or it is just another techno-fantasy, we shall find out. In recent years, it becomes clear that ITER project in France, as one of the largest experimental fusion reactors underway, is far away from achieving net energy production. According to W. Wayt Gibbs: "Major fusion projects such as ITER in France and NIF in the U.S. have consumed billions of dollars and are nowhere close to generating enough energy to even sustain their own operation

much less create commercial power. Smaller, simpler designs are now being explored, in some cases by private companies. Preliminary results have raised hopes that there might be more practical, less expensive paths to fusion power plants."[1] In this article, we presented a short communication this week with Robert Neil Boyd, PhD, a senior physicist who happens to have his own working design of fusion reactor in the past. He is now associated with Princeton Biotechnology Corp., New Jersey. We hope that this transcript of our communication with him (as per 15-17th Nov. 2021) may be found useful for younger scientists.

RECENT PROGRESS OF ITER PROJECT

As the story goes, for future power generation, fusion reactors have unique benefits. Unlike conventional nuclear reactors, fusion reactors cannot melt down and do not produce radioactive material that can be weaponized or that requires special disposal. Safety and environmental concerns with fusion reactors are minimal, and the deuterium and lithium required for fuel can be extracted from seawater. A fusion power plant can, in aspiration, be built at a competitive capital cost and have virtually no input cost beyond operating expenses.[2] For readers not quite familiar with the progress of ITER, allow us to quote W. Wayt Gibbs again: "Right now the pragmatists have people's attention because the academics have hit practical dead ends: enormous reactors that have clarified some fusion science but are not on track to pump electricity into the grid by midcentury. One example is the National Ignition Facility (NIF) at Lawrence Livermore National Laboratory. "NIF fires just a few hundred shots a year," Binderbauer says in his Austrian lilt. A power plant would have to fire tens of thousands of times a day. Two years ago Livermore pulled the plug on designing a prototype power plant. The second discouraging example is ITER, a 10-story-high machine under construction in France by a consortium of nations. It will rely on giant superconducting magnets to control a plasma burning at roughly 150 million degrees C for minutes at a time. Even if it succeeds, ITER will make no electricity."[1]

NEIL BOYD'S REMARK AND VC'S RESPONSE

Note: RNB stands for Robert Neil Boyd, and VC stands for one of these authors. RNB: "Similar and related events are seen in this Aureon-produced video: https://vimeo.com/453152469. The striations which arise from the plasma dis- charge are due to quantization of the electric field. Here is an example of a larger Natural version of the instrumented results of the Safire experiments, as observed in by astrophysical instruments, such as this Hubble telescope image of the "Cat's Eye" Nebula. The point of this is that if one looks closely at the full moon, which has been surrounded by a rainbow ring for more than 7 consecutive years, you can see similar circular radial behaviors of light as it arises from the surface of the moon. However, the electric field caused directly by solar and stellar radiation is not sufficiently large to cause such layered radiation sources.

...By the way, "*free electricity*" was discovered and proved, long ago, by Faraday during one of his experiments regarding electric and magnetic field behaviors. Faraday's result got stopped and it was never published in any of the journals of those days. But Faraday still recorded it and kept it among his personal effects, for posterity." VC:"Thank you. Thanks also for the story of Michael Faraday." RNB: "Plasmas exhibit "double layers" which form *Birkeland currents*, plasma "cells" and multiple boundary layers, due to charge separation, exactly as we can see in the Aureon video. This happens when all the electrons go to one side of the given volume, while the positive charges (typically protons) are separated away from the electrons at another wall in the given volume, usually because protons and positively charged atomic nuclei are much more massive than electrons, so they have a lot more inertia and resistance to moving, and tend not to move very much or very fast. The force developed between the positive and the negative portions are measurably huge, and

eventually the positive and negative charges will meet and neutralize, if nothing about the existing configuration changes. Eventually the plus charges will start moving slowly towards the negatively charge volume. Or the electrons will flash over to where the positive charges are. Many energetic events can happen, associated with that kind of behavior. The Aureon results demonstrate some of the above discussion. I started my research in plasma physics back in 1966 and continued until the late 1990s. I designed the third energy-gaining thermonuclear fusion reactor in history. It was built and tested by DoE and I was notified of the success of the design back in 1989. They did an in-house video interview with me, but very few have any awareness of it aside from me. Bogdan Maglich designed and tested the second energy-gaining fusion reactor. I corresponded personally with Maglich for a while. He was really frustrated because nobody would fund him to build a power plant using his fusion reactor design, which had been publicly proven. Philo Farnsworth, who designed most of the components of the old tube-style television, made the first energy-gaining fusion reactor, based on a "multipactor tube", a very unusual tube he had developed during his TV researches. In 1965 his "Fusor Mark IV" was producing 50 giga-neutrons per second, due to huge numbers of fusion reactions occurring in a fusion confinement volume the size of a grapefruit. The 4th demonstrated fusion reactor was designed and constructed by a group of college kids in someone's basement. They got a patent of the device. The patent was sold to Chrysler-Daimler and never heard from again. I was in touch with them for a while too. I guess they got some good income from selling their patent, but they stopped talking to me soon after the patent issued. So where are any of these functional fusion reactors?" VC: "Thank you for your story, and also Maglich and Farnsworth's designs for real fusion reactor. I am skeptical on ITER project. I heard that only a Japanese team wrote honestly that the real purpose of ITER project is to improve gain function, not to obtain net energy production."

OTHER POTENTIAL CREATIVE ENERGY BREAKTHROUGH - TOWARD HYDROGEN AGE

Allow us to make a quick note about the potential for breakthrough energy towards a hydrogen-based economy (cf. Capra, 2009), as follows: There are indeed some leaders of technology companies, such as Elon Musk, who are skeptical of the fuel cell, and call it: "*fool sell.* " It may be that fuel cell technology is not economical in today's context, but let us briefly mention that since the 1980s-1990s, efficient water electrolysis technology has been discovered by Dr. Andrija Puharich, and what's interesting is that a few months after his electrolysis patent was accepted by the US patent office, he seems to have inspired Stanley Meyer's experiments on his known *water-fueled car design* (and a more efficient electrolysis process).

Recently, there are various debates in online channels on Indonesian version of the alternative fuel research for the motorbikes, which has become one of the hot topics, from the findings of H. Aryanto Misel from Lemahabang, Cirebon (Indonesia), which he calls Nikuba (according to him from the Javanese expression, "*niku banyu*"; trans. it's water). There has been controversy over these findings, and this is quite reasonable, considering that the electrolysis method has long been known in the field of chemistry.

What is interesting is that standard textbooks state that the electrolysis process is not efficient, because it takes a lot of energy to separate H_2O into H-H-O. In addition, among mechanical engineers, one other issue is corrosion that must be prevented. Maybe that's why the Nikuba electrolysis design, practically designed by Aryanto, Misel uses stainless steel. In addition, to achieve an efficient electrolysis process, it seems that he did not use the usual catalysts such as NaCl etc., but he used a special homemade catalyst. This is an interesting innovation, compared to the available information regarding the findings of the electrolysis process by Dr Andrija Puharich, around the 80s, which opens up the possibility of efficient

processes, including: (a) ordinary electrolysis, (b) pulsed electrolysis, (c) gated-pulsed electrolysis with a type of source wave called a waveform. The fourth innovative breakthrough made by Stan Meyer is to add a fourth alternative method to achieve an efficient electrolysis process, namely: (d) resonance electrolysis. From discussions among others in cyberspace, there is information that perhaps what is meant by resonance here is not the resonant frequency of water molecules, which are on the order of MHz, but ordinary electric resonance in the range of 280 Hz or about 495 Hz.

Another interesting piece of information is that Stan Meyer triggered the resonance using a *bifilar coil source*, which can be traced back to Nikola Tesla's inventions. H. Aryanto's findings can be considered as the fifth innovation for an efficient electrolysis process because it uses a catalyst, so we can call it in more scientific terms: "catalytic-aided electrolysis generator." Of course it will be interesting, if the research can be continued further by developing alternative combinations between the catalytic method coupled with the bifilar coil / resonance: who knows maybe we will achieve a dramatic increase in efficiency, above 100% of the performance of current water electrolysis machines. Thus presumably the process of scientific discovery can continue. What is interesting is not only the concept of resonance which has long been known in physics, but also bifilar coil. Besides bifilar coil, there is also a so-called *Rodin coil*, which may be rarely known (cf. Boyd & Smarandache, 2022) [12]. Rodin coil has the potential not only to have a good effect on health (Schumann resonance), but can also be engineered to create a magnetic levitation machine. These things would be interesting if there are researchers who are interested in conducting experiments on aerial vehicles for the future.

Summarizing, in addition to developing a transportation ecosystem based on electrical energy (EV) as many countries begin to develop, it may also be time for us to prepare for the next stage of transformation: i.e. towards hydrogen energy age; cf. Capra, 2009 [13]. It is worth to mention here, that around two decades ago, Prof Pm. Kanarev from Kuban State University has proved that hydrogen economy era has come, especially with his finding of nuclear water electrolysis (Kanarev & Mizuno, 2001; Mizuno, 2001) [9,8].

DISCUSSIONS

As we pointed above, the Japanese ITER team is the only participating group to clearly and transparently state the power capability of ITER: "Will ITER make more energy than it consumes? . . . ITER is about equivalent to a zero (net) power reactor, when the plasma is burning."[4] Other than that, the problem is more accute, not only that Tokamak-based fusion includes complicated MHD problems which are highly nonlinear; cf. ref. [7], but also confusion in messages to public. As S. Krivit wrote: "Members of your fusion science community promoted ITER with language that made it appear to laypersons as designed for Q- engineering=10, rather than Q-fusion=10. They did this for three decades. Nobody said a word."[6] At this point, some readers may ask:"So, what are our choices for future energy?" We can cite T. Linden here, that there are: "relatively small and compact devices compared to tokamaks decreases the costs and building time of the reactors and this has allowed some private companies to enter the field, like EMC2, General Fusion, Helion Energy, Lockheed Martin and LPP Fusion."[3] Alternatively, one may also consider Prof. Ph. M. Kanarev's method of water electrolysis reactor.[10-11]

Last but not least, we can also argue that actually fusion process can happen even from classical electromagnetic considerations, see our paper at JCMNS, 2017 [8]. In other words, we may expect that fusion process can happen at relatively low temperature, such as from biological transmutation (see J. Biberian's papers in JCMNS).

CONCLUDING REMARKS

In this paper, we began by citing from W.

Wayt Gibbs, that actually our hope for plentiful energy based on fusion, is not based on actual progress of present experimental reactors. But as Linden, Gibbs, and Kanarev wrote, there are actually more hope on the so-called *'fusion underground*," or small fusion ex periments carried out by independent scientists. [1] We recall comment by a senior scientist at Russia, that there is a different culture of science between Russia and USA scientists; is that scientist in Russia is allowed to do small experiments at any type of inquiry that they like in their basement or houses more or less freely. Such a culture seems quite lacking, but it seems CF report by Pons-Fleischmann around 80s began to inspire other physicists, to do small basement-scale experiments at their own. Then such a small-scale experiment can be scaled up later on. All in all, for the time being, renewable energy sources (such as: WWS, geothermal, biofuels, etc.) may be expected to meet the world energy demands, at least partially, until that energy abundance days come. See for instance Mark Z. Jacobson's book [16]. Also ref. [15]. And in latter part, we discuss other potential energy breakthroughts, especially if we consider seriously going toward hydrogen age, cf. Pm. Kanarev (2001, 2002), F. Capra (2009).

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