ITER vs The Least Action Principle

Snubbing one of the fundamental principles of the Universe

- Rolf A. F. Witzsche

Scale model of ITER

Snubbing the principle of least action

One of the methods employed by the pioneer of modern science, Johannes Kepler, who changed the world of science in the early 17th Century, is a method he used in his book *New Astronomy* in which he begins with exploring the errors that have trapped astronomers for 17 centuries up to his time, into dead-end pursuit in the exploring the Universe, from Ptolemy to Copernicus. After his extensive refutation he presents how the Universe actually functions. With this method he set the stage for modern science, clearing away defective methods that had crippled science. In Kepler's case, the errors he exposed were based on false axiomatic assumption, typically derived from religious doctrines. In modern time cleverly crafted false axiomatic assumptions have been intentionally created by the masters of empire to achieve political objectives, such as driving science into the ground.

The policy for driving science into a dead-end pursuit, to disable its natural effectiveness, reflects the core policy of Paolo Sarpi, the reformer of the Venetian Empire back in the 16th Century. Sarpi had recognized that the nature of science is deadly to the objectives of empire, but is also a natural force of humanity that it cannot be prevented. Thus he developed a policy to allow science to some degree, but to hinder it by all possible means, thereby grinding it into the ground.

The policy of thus grinding society into the ground became later a core feature of the Fabian Society of the new empire in the north that had appropriately named itself, according to its core policy direction, after the Roman general Quintus Maxiums Fabius who gained his fame for his policy of not confronting a superior enemy, but grinding it into the ground by subversive means. Fabious had defeated the vastly superior forces of Hannibal that way. The famous author of the empire crowd, H. G. Wells, loved the Fabian's effort, except he thought it was not radical enough.

The devolution of culture and science is still a key element in the political word that continues to be controlled by the masters of empire. Over the years the attempts to throttle scientific progress have become evermore exotic as means to hinder the natural unfolding of science. One of these pursuits is found in the arena of nuclear-fusion-power research. Nuclear fusion is an empty promise of a utopia in a power-starved world that can be used as a trap to prevent mankind from exploring the real nature of the Universe and mankind's power to develop with it according to its principles.

One of the most basic principles that we see reflected everywhere in the physical universe is the Principle of Least Action. The physical universe (including the biological sphere and living processes) is organized in such a fashion that the least amount of action is required to produce a certain result. Unnatural research is of a type that defies this principle, resulting in an effective method to 'guide' mankind into tying itself into knots, which is the evident hallmark of nuclear-fusion-power research.

Nuclear-fusion power has no role to play in a Universe that its self-expanding, self-powering, and self-developing. The nuclear-fusion powered Sun is a dream-construct located in the perception of a self-consuming, winding down, entropic Universe. The real Universe is anti-entropic, and electrically self-powered. 99.999% of the mass of the Universe exists in the plasma state that is electrically charged, facilitating vast electric currents in response to electromagnetic principles. Tons of evidence exists that shows plainly that vast electric currents flowing in plasma interconnect all the galaxies in the Universe -- in an Electric Universe -- and within the galaxies, power the stars -- on the Electric Sun principle -- and also power the galaxies themselves.

It is not possible to acknowledge the Universe as being anti-entropic in nature, while recognizing every sun within it as a self-consuming nuclear-fusion furnace that is winding down its existence. This paradox does not exist in the Electric Universe -- the real Universe -- which thereby renders the pursuit of nuclear-fusion power, for which no requirement exists in the natural world, an unnatural pursuit, because nuclear-fusion simply doesn't power anything in the Universe. This is also the reason why nuclear fusion is failing, and the further reason why it is being promoted by the masters of empire as it exhibits all the hallmarks of a dead end pursuit where huge efforts can be consumed for unusable effects.

Indeed why would nuclear-fusion-power be needed anyway, if the Universe itself is Power?

Galaxy cluster ACO 334 - The European Space Agency - VIMOS image - 500 million light years distant

Click here to view the Capodimonte Deep Field
a view of 35,000 galaxies

The Universe exists by electric power that simply powers everything by an infinite array of principles, from an atom to the stars. All the galaxies in the Universe are electrically interconnected by thin, barely visible plasma filaments in which electric currents flow. The galaxies are strung out along these vast networks of filaments like beads on a thread; all being powered the electric currents flowing within them. Nothing appears to be self-powered in the Universe, except the Universe itself.

In real terms nuclear-fusion-power is not needed on Earth either, since we have vastly more ready-made natural power resources at our feet than we can likely ever use. Uranium nuclear fission power, and thorium nuclear fission power, are examples of power systems that already serve us well, and will likely continue to serve us even after the next step of development enables us to tap into the galactic power resources. The already tested Liquid Fluoride Thorium Reactor (LFTR), for which the USA all by itself has 917,000 tons of fuel sitting unused on the ground, with more on the moon that will likely serve us as a convenient power source for eons to come, especially for space-flight applications, such as to power helium-3 fusion space propulsion systems that might give us the potential to get us to Mars in 3 days and to the Moon in the space of a coffee break.

It is not possible to gain a realistic perception of the collapsing political landscape of today, and the steps that are needed to meet mankind's challenges, without an understanding of the anti-entropic nature of the Universe, and civilization, and man. The artificial perception of entropy in nature, intentionally imposed on civilization, creates a platform on which the grandest is destined to fade away into dust, and one loses sight of the human power of creativity, productivity, and the spirit to stand tall and to develop. The natural Principle of Least Action is inherent in the 'larger' principle of the anti-entropy of the Universe - the self-developing nature of the Universe.

The current notion of Nuclear-Fusion Power is basically entropic‹

And it is failing. Its underlying notion of entropy is the reasons why it is failing, being built on the entropic assumption that every sun in the Universe is isolated from it and powered by nuclear fusion whereby it consumes itself. Since no real evidence exists that supports this assumption the nuclear-fusion-power concept is built on a false premise that after fifty years of research has brought us to the point of the gradual realization that commercial fusion power is an unattainable dream that runs contrary to the nature of the Universe itself. The realization has not reached the point yet that science has been hijacked and 'imprisoned' into a dead-end pursuit for the forced devolution of scientific development. However, immensely large ITER (International Thermonuclear Experimental Reactor) research project comes to light will all the hallmarks of imperial intention standing behind it that is evidently standing behind CERN. The same can also be said about the planned HiPER project (the proposed European High Power laser Energy Research facility that is modeled on the American National Ignition Facility that serves a similar dead-end process.)

In contrast with these, the scientific pursuit of natural processes offers us the freedom of the Universe, such as by developing nuclear-fission power that is building on natural processes that are producing much of the internal heat of the Earth, and by developing the technology for tapping into the galactic electric power-flow that powers our Sun, and so on.

With this said, let's look at ITER (International Thermonuclear Experimental Reactor,) and its characteristic to become the world's biggest dead-end game.

'Unauthorized' research: ITER

It has been admitted in recent years that magnetic confinement fusions is a dead-end game.

The rumor has been started that helium-3 nuclear fusion is ideal, for it doesn't create the condition that dooms any hope for practical nuclear fusion. The notion has been started in the sciences that helium-3 is the ideal fuel for nuclear-fusion power-reactors on Earth, because its fusion process results in kinetic energy invested into protons that can be utilized for direct electricity production, rather than producing power with fast neutrons (the standard process) that are destructive. Fast neutrons from fusion reactions are destructive to the equipment that produces them. The kinetic energy of the neutrons is typically 100 times greater in a fusion reactor than in a fission reactor. Their enormous intensity makes the surrounding metals of a reactor's structure radioactive in a process that rapidly weakens the metal's structural lattice. This so-far unresolved problem has created a barrier against the practical usefulness of nuclear fusion-power systems, should the fusion process itself become practical. This dead-end condition has been acknowledged, for which helium-3 was brought onto the scene. Except, helium-3 is extremely hard to fuse. A great natural barrier stands in the way. The barrier is so great that presently a million times more energy is needed to cause the fusion, than the fusion gives back.

The barrier against fusion is called the *Coulomb barrier (energy barrier).* For helium the barrier is such that it requires a dramatically greater energy input for helium-3 fusion to happen, than is encountered with the 'conventional' deuterium-tritium fusion, which is inherent in their different atomic makeup.

In spite of this rarely-mentioned barrier helium-3 is being hailed as the ideal fusion fuel, because its fusion produces only produces protons or kinetically energized atoms whose motion energy, when the atoms are ionized, can be converted directly into electricity. The direct conversion offers a three times greater efficiency (90% vs 30% over steam powered conventional electricity generation). However, helium-3 fusion doesn't exist naturally on Earth, but it does exist on the moon. Suddenly the fusion effort is dependent on mining the moon.

Currently the fusion fuel is a D-T mixture - consisting of deuterium (hydrogen-2) and tritium (hydrogen-3). Both are 'heavy' isotopes of hydrogen that have atomic structures that are supercharged with an extra neutron, or two. The extra neutrons make these atoms 'heavy' without the equivalent electric repulsion that heavy atom normally has. This characteristic makes them 'easier' to fuse. Helium does not have this advantage, and helium-3 that is missing a neutron has an added disadvantage.

The reason that helium-3 is even considered under these circumstance, indicates that the resulting neutron damage that is caused by the fusion process is so great that anything justifies the search for a different fuel. For example, after a single series of D-T fusion tests at the currently largest experiment, the Joint European Torus (JET) facility that is able to produce a 'whopping' 10 megawatts of fusion power, sustained for half a second, has caused the vacuum vessel to become so intensely radioactive that remote handling became needed for an entire year following the tests.

The neutron-caused damage is one of the factors that makes D-T fusion impractical, for which helium-3 is now hailed, because it doesn't cause this damage. However, since Helium-3 does not fuse well, a compromise options is being considered for which only deuterium would be used as fusion fuel. If D-D fusion would cause less neutron damage, because of its lower neutron energy (2.45 MeV versus 14.1 MeV). However, for this fusion to be possible the energy confinement would have to be 30 times better, while the power produced would be 68 times less. This inherent inefficiency makes the D-D fuel impractical too.

Another alternative fuel to helium-3, which would likewise produce no neutrons, which would be the cleanest of them all, would be a mixture of normal hydrogen and boron. However, for this fuel to fuse, the energy confinement would have to be 500 times better than what is required for the D-T reaction, and the power density would be 2500 times lower than for D-T. This even greater inefficiency makes the fuel even more impractical.

Considering that the only helium-3 test reactor that is operating on the planet today requires a million times more energy input than the fusion gives back, and that the helium-3 fusion is nevertheless hailed because of its zero neutron damage, gives an indication of how great a problem the neutron damage is creating. Apart from this problem the D-T fusion's own inefficiency in fusing creates an even large barrier.

While the thermal break-even point has been crossed with D-T fusion for short periods, in the most leading edge magnetic-confinement fusion systems, a three-fold gain in continuous operation is required for any practical system just to reach the practical break-even point. This 3-fold larger fusion power is necessary due to the inefficiency in the thermal to electricity conversion. And then, there is another problem to consider.

In magnetic confinement systems, the big problem currently isn't located in causing the D-T fusion to happen. The problem is to get enough of it to happen, and to contain the reaction in a steady state as it happens without the fusion process 'blowing itself out.' The greater the fusion- power-level is, the more difficult it becomes to contain the plasma in which the fusion takes place. And since the D-T fusion creates helium, the fuel mixture becomes diluted with it, preventing continuous operation. In order to combat these two problems, the machines are made bigger. In bigger machines the plasma confinement becomes less critical as the reaction chamber becomes lager in volume. However, for the larger machines, an even greater containment power is required. This puts the effort into a vicious circle as if the Universe had natural laws established against the fusion-power process from succeeding. We are literally fighting against the Universe, and this fight is fast getting gigantic in scope, and we aren't winning.

In considering the ever-increasing barriers that are continually thrown up against our best technological capabilities, the practical realization of nuclear fusion as an energy source may never be attained. But then, we don't really need it.

Now let’s look at the scale of the efforts involved to overcome the problems associated with D-T fusion.

The ITER - The world's leading edge experiment for magnetically confined nuclear fusion (currently under construction).

The leading edge experiment in magnetic confinement fusion, the International Thermonuclear Experimental Reactor, (ITER) is designed to be a giant magnetic-confinement fusion reactor, which, when completed in the 2020s, it will be standing 120 feet tall - a quarter the height the Great Pyramid of Egypt - and weigh 23,000 tons - three times the weight of the steel in the Eiffel tower.

To date, only a scale model has been been built, see below, or an artist's rendering.

see: http://en.wikipedia.org/wiki/ITER

The giant facility is designed to produce approximately 500 MW of fusion power when it is completed and is tweaked to its maximum in 30 years time. It is expected that it will eventually be able to sustained its fusion burn for up to 1,000 seconds (16 minutes) with a hoped-for 5-10 fold energy gain (a 3-fold gain is required to break even if the thermal-to-electricity conversion is included). If the experiment is successful in 30 years time (10 years for the construction, and 20 years for the refinement) this gigantic effort will demonstrate that 150 MW of electricity can be produced for short periods with a facility that will be the largest technological construct of all times, stand a quarter as tall as the great pyramid. Can this be called a success? It really can't, can it?

If it takes a gargantuan infrastructure to produce 150 MW of useful power, or the equivalent of 15% of what of a commercial (1000 MW) nuclear fission reactor power plant produces in uninterrupted power (which fusion has not yet been able to duplicate) then it is unlikely that any practical machine built on the magnetic confinement principle can be scaled up for a commercial output of 1000 MW. Such a machine would likely have to be several times larger than the great pyramid in Egypt.

In addition another critical factor is now being recognized that is slowly being considered, which include the structural damage. For ITER no concern is raised that the 14 MeV neutrons that are produced by the fusion reactions, will severely damage the materials from which the reactor is built. Research is now planned for a future time to determine how, and/or if, reactor walls can be designed that last long enough to make a commercial power plant economically viable in the presence of the resulting intense neutron bombardment and very high operating temperatures. The structural damage in the metals is primarily caused by high energy neutrons knocking atoms out of their normal position in the crystal lattice of the metals. A new research facility is being planned for this materials research task, which is planned to begin operation in the early 2020s, presently called, the *International Fusion Materials Irradiation Facility (* IFMIF).

Apart from neutron flux density, and its intensity, other damaging factors must be considered for which no solutions are in sight. In a fusion reactor extremely high temperatures (typically 100 times greater than that in a nuclear fission reactor) resulting from the high-power environment, is posing a huge problem for designing materials that can maintain their structural integrity for long enough periods and under extremely large thermal loads, such as occur in a fusion reactor (up to 10 MW/m^2 acting on the materials facing the plasma). The material must be able to withstand the extreme thermal flux without melting at the surface prior to reaching the coolant, and this for very long operating periods in the order of years rather than seconds.

The actual research activity, for solving the materials problem, is not expected to even begin operation until far into the future.. When completed, the IFMIF (expected to be a 40-year long research project) will operate two parallel accelerators, each about 50 m long, producing beams of deuterium nuclei. These, on contact with a lithium target, become converted into high-energy neutrons that are used to irradiate materials specimens and to test components. Results from this research won't be available for the first-generation of the ITER reactor, but it is hoped that it will provide important contributions for the construction of commercial fusion reactors after the ITER project has run its course. Such construction, if it becomes feasible at all, won't happen until the 2050-2080 timeframe.For details of the IFMIF, see: http://en.wikipedia.org/wiki/IFMIF
- http://accelconf.web.cern.ch/AccelConf/e98/PAPERS/FRX03A.PDF
- http://www.frascati.enea.it/ifmif/

To date, it is not possible to predict if any, much less all of the many problems inherent in magnetic confinement fusion will ultimately be solved, or even can be solved.

The final question: Would fusion power be worth the effort should it ever become possible?

Per ton, the current nuclear fusion fuel, a deuterium/tritium combination, contains 5 times the energy per kilogram than uranium 235 (481 TJ of energy per kilogram for D-T, versus 82 TJ of energy for uranium) This is not a huge difference. The small advantage in the fuel is more than used up by the inherent inefficiency of the fusion power process in which the fusion 'explosion' blows the fuel apart before all of it is used up. At NIF the fuel capsule typically contains 0.238 mg of fuel for an expected energy yield of 20 MJ, which will likely be achieved. This, however, adds up to only 17% of the energy contained in the fuel, as a result of the ignition process. At this rate of low efficiency the fusion fuel output is roughly equal to the fission fuel output in a thorium fueled nuclear fission reactor. At this rate, a ton of either fuel is required of (D-T fuel for fusion, or thorium for fission) to power a 1 GW reactor for a year. The difference is that of the thorium fission fuel, two million tons are readily available in known deposits, while the D-T fusion fuel does not exist at all in any useful quantities, and requires expensive and cumbersome processes for it to be produced.

The D-T fuel is made up of two parts. The deuterium (D) portion of the fuel is heavy hydrogen. It exists plentifully on the Earth. It is found in large quantities in seawater. However, it is highly diluted. In the oceans, 'heavy hydrogen' (D) amounts to a mere 0.015 percent of the hydrogen of the water molecules. Deuterium is 'heavy' hydrogen, because it has a neutron attached to its nucleus. The presence of 'heavy' hydrogen produces 'heavy' water. At current technologies 340,000 tons of seawater are required for the extraction of a single ton of heavy water, from which the deuterium can be extracted. Since the hydrogen (deuterium) component of 'heavy' water makes up only 20% of the weight of heavy water, five tons of heavy water is required to produce a ton of deuterium. (In the D-T fusion fuel, 40% is deuterium). In other words, it takes the processing of 680,000 tons of water (and desalination if seawater is used) to produce the deuterium for a single ton of fusion fuel. The fuel production on this scale adds up to a rather expensive and energy intensive process, considering that 1 ton of D-T fuel is required to power a 1 GW reactor for one year.

Between 1979 and 1997 Canada had operated the world's largest heavy water plant, the Bruce Plant, located at Douglas Point in Bruce County on Lake Huron, where it had access to the waters of the Great Lakes. The heavy water plant was a part of an integrated complex of 8 CANDU nuclear reactors that supplied the plant's process heat and electrical power. The giant heavy water plant had produced 700 tons of heavy water per year, (containing 140 tons of deuterium, enough for 350 tons of D-T fuel, or half the amount needed to power the USA for a year with nuclear fusion reactors). The Bruce heavy water plant was shut down in 1997 because of environmental concerns, since it utilized the Girdler process that involves large amounts of hydrogen sulfide. After the shutdown the plant was gradually dismantled and the site cleared. Atomic Energy of Canada Limited (AECL) is currently researching other more efficient and environmentally benign processes for creating heavy water. The production of heavy water is essential for the future of the CANDU reactors since heavy water represents about 20% of the capital cost of a CANDU reactor. The case of Canada is mentioned here as an indicator of the high production cost of the D-T fusion-reactor fuel. It may well be less expensive to import the fusion fuel from the moon, should helium-3 fusion, and indeed nuclear fusion power in general, ever become commercially feasible.
(see: http://en.wikipedia.org/wiki/Heavy_water)
Heavy waters is currently used in CANDU reactors for its excellent efficiency in moderating the neutron propagation without absorbing the neutrons themselves. (See table)

The other component of the fusion fuel is tritium. It is extremely rare on Earth. It takes a million tons of seawater to extract a single ton of tritium from it. Tritium can also be produced in nuclear reactors by irradiating lithium with neutrons. This too, is a slow process. Since 1996 only a quarter ton of tritium has been produced. The production has been largely shut down under the nuclear weapons control treaty. Tritium (T) is an even 'heavier' isotope of hydrogen, which is also slightly radioactive and has a half-life of only 12 years. Tritium is currently the key element in the D-T fusion fuel. Its nucleus contains one proton and two attached neutrons. (Normally, hydrogen contains no neutrons.)

Unfortunately the D-T fuel is rather costly to produce. To help the production process of the tritium for the fuel, it is envisioned that commercial fusion reactors will be designed in a manner that some of their fusion-derived neutrons will strike lithium, which thereby breeds tritium, in order that the tritium can subsequently be extracted to produce more fuel. This adds another level of complexity to the fusion reactor design and operation.

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