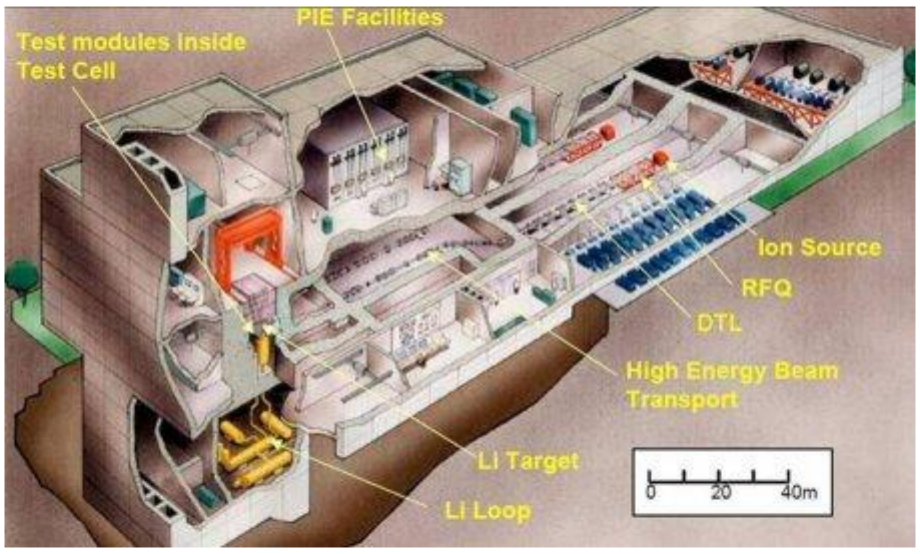
NUCLEAR FUSION destructive radiation



IFMIF(International Fusion Materials Irradiation Facility)

We aim for what is does not exist in the Universe while we ignore what does exist a New Ice Age ahead

The nuclear-fusion energy is destructive, not practical

A much bigger problem stands in the way of nuclear-fusion energy systems than merely forcing the confinement of the fuel for ignition, fire which immensely huge installations are required. The nuclear energy that is derived from the D-T fusions process is extremely damaging. The neutron energy of 14 MeV destroys everything around it.

The only fusion fuel that can be made to fuse reasonably well is a mixture of two heavy isotopes of hydrogen. One of the two is deuterium that has a neutron attached to its nucleus, and the other is tritium that has two neutrons attached. These isotopes are so heavily loaded that when they are banged together hard enough, one will break apart and a portion of it will fuse with the other to form a heaver atom, a helium atom, and the remaining portion, a neutron that doesn't fit into the new atom, will split off. In this process, the split off neutron becomes ejected at great speed that packs a wallop that is a hundred times greater than what is encountered in normal nuclear fission reactors. This wallop is so immense that a 'small' 10 MW test reactor, which achieved experimental fusion-burns for merely half a second in duration, became quickly so intensely radioactive that it had to be handled with remote control equipment for an entire year afterwards. Also the high-speed impact of the neutrons is so devastating to the internal structure of the metals of the reactors, that the integrity of the metals breaks down. The high-power impact dislodges the atoms within the lattice structure of the materials, by which the metals loose their structural strength, and this rather quickly.

In the fusion process the newly created helium atom also carries a rebounding energy (3.5 MeV) which the metals of the reactor vessel must also absorb, together with the radiated heat-flux of the 100 million degree plasma in the reactor. The materials do not presently exist that can carry the neutron stress and the heat load on a continuous basis for a commercially practical period.

A new research facility is being planned for this materials research to begin in the early 2020s, the

International Fusion Materials Irradiation Facility (IFMIF also see IFMIF-pdf).

Nobody knows at the moment if the fusion equipment materials challenge can be solved. The answer will be explored in the 30-year timeframe (2020-2050) with the operation of IFMIF, should it actually be constructed.

NUCLEAR FUSION Paradox
helium-3

The Moon

nuclear fusion is a no-win project

The paradox of the nuclear-fusion fuel

The damage to the metals in nuclear fusion reactors, - resulting from neutron radiation in nuclear-fusion experiments - is so great that suggestions have been made to use helium-3 as a fusion fuel, which exists abundantly on the moon.

The helium-3 paradox

Helium-3 is a light isotope that has a neutron missing, instead of having an extra one as is the case with D-T fusion fuel. The missing neutron makes it a light isotope. When the light isotopes fuse into a normal helium atoms, the process splits off two protons that are electrically charged, which might be used for electricity production. The potential that this might be possible is hailed as the ideal solution for nuclear-fusion power as a means to get around the neutron damage to the metals in fusion reactors that results from normal D-T fusion.

Since no solution for the neutron-cased damage is currently in sight, helium-3 is hailed as a fusion fuel since it doesn't radiate neutrons. Unfortunately, helium-3, being a light isotope, doesn't fuse well. Only heavy isotopes fuse reasonably well. The dramatic difference is due to the nature of the fusion process.

Before two atoms are able to fuse, they have to be pushed close enough together so that their respective nuclei 'touch' each other, or nearly so, at which point the nuclear-force acts on them and snaps them together. For this to happen they have to bump into each other rather violently. This occures typically when they are heated up to extremely high temperatures in the range of several hundred million degrees. However, the closer the two nuclei come towards each other, the more they are repelled away from each other by the electric charge of their protons.

The fusing of atoms is inhibited by the repelling electric force of protons against each other, of the fusing nuclei. This repelling force is immensely powerful. It is one of the strongest forces in the Universe. In the case of deuterium and tritium that have each an extra neutral mass attached. The resulting greater total mass helps to overcome the repelling force. However, with helium-3 the opposite happens. The helium-3 atom has two protons that provide double the repelling force, while the isotope contains less mass with its neutron missing. This fundamental difference makes the helium-3 fusion much harder to achieve.

The only test reactor that has actually achieved helium-3 fusion, requires a million-times greater energy input than the fusion generates. This tells us that helium-3 is a very poor fusion fuel, which may also be the reason why the Sun has thrown so much of it away that it has become abundantly accumulated on the moon. For this reason, much interest was roused in the moon. The intense energy input requirement puts practical fusion power from helium-3 via magnetic confinement fusion far out of reach.

Nor is it likely that the NIF laser fusion facility, that has not yet achieved D-T fusion, will achieve the large needed increase in power input to overcome the much larger Coulomb barrier of helium-3. As I said earlier, the only reactor that has demonstrated helium-3 fusion (to my knowledge) is an electrostatic confinement reactor designed by Professor Kulcinski, a member of the NASA Advisory Council. This reactor requires a 1,000,000-fold greater energy input than the fusion gives back. Professor Kulcinski's design uses "an electrostatic field to contain the plasma, instead of an electromagnetic field. His current reactor contains spherical plasma roughly ten centimeters in diameter. It can produce a sustained fusion with 200 million reactions per second producing about a milliwatt of power while consuming about a kilowatt of power to run the reactor. The result would furnish nuclear power without radioactive nuclear waste or neutron caused radiation damage (see: A fascinating hour with Gerald Kulcinski), but it is far from being a practical option for a commercial power plant.

Aneutronic Fusion

The deuterium-tritium fuel, that is currently used as it presents the slightest resistance to fusion, comes with a lot of problems attached. As stated earlier, a number of different fusion-fuel combinations are possible, that should not have this problem. They would produce atoms with high kinetic energy instead that might be directly converted into electricity. These are called aneutronic fusion fuels. As has been proposed, such fusion fuels can be composed of light atomic nuclei like hydrogen, deuterium, tritium, helium, lithium, beryllium, boron, and their various isotopes. Some isotopes like hydrogen-1, helium-3, lithium-6, lithium-7 and boron-11 are of interest for aneutronic nuclear fusion (low neutron radiation hazards), for example:

$^{1}H + 2\ ^{6}Li \rightarrow\ ^{4}He + (^{3}He + ^{6}Li) \rightarrow 3\ ^{4}He + ^{1}H + 20.9\ MeV\ (153\ TJ/kg \approx 42\ GWh/kg)$

^{1}H + ^{7}Li → 2 ^{4}He + 17.2 MeV (204 TJ/kg ≈ 56 GWh/kg)

^{3}He + ^{3}He → ^{4}He + 2 ^{1}H + 12.9 MeV (205 TJ/kg ≈ 57 GWh/kg)

^{1}H + ^{11}B → 3 ^{4}He + 8.7 MeV (66 TJ/kg ≈ 18 GWh/kg)

"Boron and helium-3 are special aneutronic fuels, because their primary reaction produces less than 0.1% of the total energy as fast neutrons, meaning that a minimum of radiation shielding is required, and the kinetic energy from fusion products is directly convertible into electricity with a high efficiency, more than 95%... Boron is available in the Earth's crust and helium-3 is available in the lunar regolith, both are relatively plentiful if compared to tritium."
(see: http://www.crossfirefusor.com/nuclear-fusion-reactor/overview.html)

The Hydrogen Boron fusion (p-^{11}B)

Boron is a 'heavy' atom (5 protons and 6 neutron). The optimum temperature for hydrogen to fuse with it, is nearly ten times higher than that for the pure hydrogen reactions. For this, the energy confinement must be 500 times better than that required for the D-T reaction, and the power density will be 2500 times lower than for D-T. Since the confinement properties of conventional approaches to fusion, such as the tokamak and laser fusion are marginal, a new method must be developed for aneutronic fusion, based on radically different confinement concepts, such as the Polywell and the Dense plasma focus.

It has been reported recently that "A Simple, Local, Affordable Hot Fusion Approach" is possible with advanced developments in plasma focusing that utilizes the magnetic field produced by electric currents flowing in plasma to pinch the cross section of the plasma, thereby increasing its energy concentration without the need of external magnets. It is believed that with sufficient funding a highly efficient 5MW power-generating system can be constructed. The boron/hydrogen mixture begins to fuse at temperatures above 1-billion degrees (ideally at 6-times that). The 1-billion degree temperature in plasma has been attained, but the boron/hydrogen fusion has so far not been realized for the lack of the funding for the experimental equipment. However, the D-D fusion has been achieved with the plasma focus devise, for testing purposes, which requires a 30-times greater energy confinement than D-T fusion, which to my knowledge the tokamak and laser devises are not capable of, but which the plasma focus device has the potential to far supercede.

See: http://pesn.com/2011/02/01/9501755_Simple_Local_Affordable_Hot_Fusion_Approach/ - On December 21, 2010, Eric J. Lerner, inventor and founder of The Focus Fusion Society held an in-house seminar about the breakthrough that has been achieved in producing atomic fusion with the plasma focus technology (the zenith of achievement thus far). A recording of the highly informative seminar (appropriately named "solstice") has been posted to YouTube in five parts: Video 1 - Video 2 -Video 3 - Video 4 -Video 5

The hydrogen-boron fusion, however, has this drawback that it requires a 500-times greater energy confinement than D-T fusion. The actual hydrogen-boron fusion has not been demonstrated to date. However, the general experience in plasma physics has been that the applications of the principles involved can be scaled up, in some cases almost without limits. The resulting potential makes the hydrogen-boron fusion the only practical option for attainable fusion-power production (fusion-induced nuclear fission power) that we have on the horizon today.

The fusing of 1H with 11B (boron has 5 protons and 6 neutrons) results in the forming of a carbon atom 12C, which in turn fissions into three helium atoms 4He. The energy that is produced in the process is derived from the atomic fissioning that happens as the result. Natural boron is about 20% 10B and 80% 11B. The nuclear industry separates the 10B, which is ideal for radiation shielding for its neutron absorbing capacity, whereby it becomes 11B. In the nuclear industry 11B is considered "depleted" boron, a 'heavy' isotope which makes it a prime candidate as a fuel for aneutronic fusion. When struck by a proton with energy of about

500 keV, it produces three alpha particles (helium nuclei) and 8.7 MeV of energy. The alpha particles from 11B fusion can be turned directly into electric power, and all radiation stops as soon as the reactor is turned off.

Some of the released energy is also emitted in the form of x-ray energy, which too, can be directly converted into electricity with a potential efficiency of 90% (without first converting it into heat-energy). Once an efficient fusion system becomes practical, to be built in mass production, it would take theoretically 5.37 pounds of boron to power a 5MW generator for a year (or roughly 1,000 pounds per gigawatt plant) at 100% efficiency, not counting energy inputs and energy losses in the form of heat.

As a reader pointed out, the p-11B reaction produces 18 GWh/Kg as per the table above. As the result a 5 MW plant (X 24 X 365) producing 43.8 GWh per year, would consume 43.8/18 = 2.43 Kg of Boron. That's the theoretical minimum. In practice the heat loss is large, posing a significant challenge to the cooling system design. The high heat loss is unavoidable for a device operating above the billion degree temperature range. At the present time it is unknown how great an energy gain (output over input) can be achieved at a repetition rate of a 1000 ignitions per second. The actual energy to electricity conversion efficiency is expected to be 70% because of the direct electric conversion, which is far more efficient than the conventional steam generator process, and is in addition tens of times less expensive in generating equipment cost.

Also it is presently unknown what percentage of the fuel burn-up can be achieved, and to what degree the efficiency is reduced as the fuel mixture becomes diluted with the fusion product. The fuel requirements therefore remain an open question.

I have seen an estimate as high as 1.5 tons of boron/year for a 5 Mw reactor, which has justifiably been termed "ridiculously high," for which I can no longer locate the quote, which likely was erroneous and may have been removed for that reason. The previously stated 1.5 ton estimate should therefore be disregarded.

A more reasonable worst-case estimate might be in the range of 50 Kg/yr for a 5 Mw reactor or (10 tons per gigawatt). It has been pointed out that the current world electric energy needs might be supplied with just 10% of the current world production of Boron.

The question now arises whether boron is available for the long term or is in limited supply and is declining. If the answer is that it is limited, then the hydrogen-boron fusion generator would have a relatively short lifespan as a global energy source and would therefore became impractical, considering that a dozen years have already been wasted by delayed development for the lack of research funding. So, what are our prospects on the supply side? Is the supply inherently limited?

Boron is a relatively rare element in the Earth's crust, representing only 0.001%. The worldwide commercial borate mineral deposits are estimated at 170 million tones, for a 34-years supply at the current world production of boron minerals of app. 5 million tons per year. The worldwide maximum reserve base is slightly larger, at app. 400 million tons, containing about 10 million tons of boron. The supply is definitely not unlimited. Turkey and the United States are the world's largest producers of boron. Turkey has almost 72% of the world's boron reserves. Boron does not appear on Earth in elemental form but is found combined in borax, boric acid, colemanite, kernite, ulexite and borates.

Countering the notion of potential fuel-supply shortages, a reader has pointed out that "Boron is really cheap and plentiful. It's even in the ocean. You can't divide known reserves by consumption and say it will run out. It is so cheap that nobody is even looking for it. People said lithium was in short supply but now they are finding it everywhere. People don't prospect for cheap desert dirt like they do for oil. The 10% of production was just to illustrate how ridiculously little fuel is needed. Obviously no one technology will produce all of the world's energy."

Boron fusion, if it became possible as a practical system, would be ideal for special application, such as to provide electricity at remote locations, for towns and industries that lay outside the range of national electricity grids. Also large-scale power production is feasible. Only 200 boron reactors would be needed per

GW, or 71,400 reactors, to match the currently produced nuclear power worldwide, which is under attack to be shut down for political reasons. Boron reactors could be mass produced relatively inexpensively in automated production facilities for universal mass application, including for large mobile applications such as for powering trains and ships. The practicality of the boron fusion power device would therefore not be limited for the lack of application or achievable power density. Its practicality would likely be determined by the fuel-supply side. While potential long-term limits are disputable, the field appears wide open in the short run.

At present, the p-11B fusion power option is the most promising of all the fusion-power options. Only supply limitations could makes the hydrogen-boron fusion, if it becomes realized, of questionable practicality. However, if the potential supply limits did materialize, the p-11B fusion might yet pave the way to other options for fusion-induced fission power.

Since the power that is derived from the hydrogen-boron fusion is not directly the result of the fusion process, but results from the fissioning of the larger atom in the process of the fusion, the same result might be achievable with other types of 'reversed' fusion. When boron is upgraded to carbon 12C in the fusion reactor, the electron of the hydrogen does not have the needed energy to fit itself into the 12C valence shell, whereby the 12C doesn't happen and the 11B fissions instead, so that the fusion product ends up as three lesser atoms of 4He (helium). This type of process happens in all cases where fusion power is produced - where the energy is derived from the fusion-induced fission.

The theory of the fusion-powered sun is based on a concept that is observed in molecular chemistry where the binding energy is less in proportion for larger molecular structures than it is for smaller ones. In this case lamented energy is released by combing a number of elements into a larger structure, as in the case of a burning candle where oxygen and carbon are combined. On combing, their energy fields overlap. The excess is released as energy powering the flame. This principle doesn't apply to fusing atomic nuclei. A large investment in energy is required to break through the repelling Coulomb barrier to build a larger nucleus. The invested energy is the latent energy that is released when an atom breaks apart in the attempted fusion. (A kind of reversed fusion.) The fusion-sun theory is disputed on this basis, as nuclear fusion is typically an energy consuming process, from which nuclear fission power is derived. Instead of the sun being a fusion furnace, it is electrically powered externally, in a plasma-electric reaction. In this reaction atoms are built. When we manage to reverse the atomic building, we get some of the energy back that built it. That is why we need heavy isotopes to fission for fusion power. Atoms slightly larger than 11B might yet be fissionable in a highly developed plasma focus device by means of a destabilizing effects.

'Reversed fusion'

For example: If 12C carbon could have one of its electrons stripped off from its outer shell, the resulting instability would likely cause it to fission in plasma focus reactor. If such an option became possible a vastly greater resource base would become available for it. The world's coal reserves are estimated at app 850 billion tones, with plenty other sources available as well. Carbon 12 is fourth on the cosmic abundance table, behind only hydrogen, helium, and oxygen.

More abundant than carbon as a resource, would be oxygen. The mass of the Earth is approximately 5.98×10^{24} kg. It is composed mostly of iron (32.1%), oxygen (30.1%), silicon (15.1%), magnesium (13.9%), sulfur (2.9%), nickel (1.8%), calcium (1.5%), and aluminium (1.4%); with the remaining 1.2% consisting of trace amounts of other elements. Due to mass segregation, the core region is believed to be primarily composed of iron (88.8%), which makes oxygen the most abundant element in the surface. 80% of the oceans, by mass, is oxygen (see: abundance of elements). If oxygen (16O) can be stripped of electrons and be fissioned in a plasma-focus devise (similar to the fissioning of boron), then we would have the potential for infinite energy production.

However, why would we bother to produce laboriously what the Universe offers us for free in the form of plasma-electric currents in space surrounding the Earth?

If nuclear-fusion energy production is ever to be realized, the hydrogen-boron fusion offers a potential path into a new direction beyond fusion. It is not certain at the present time if the hydrogen-boron fusion process can actually be made to work, and much less so if a commercial operation is achievable as an interim short term measure. Great challenges stand in the way before this goal can be realized, not the lest of which is the challenge to transport the produced energy out of the small space of the reactor that is determined by the nature of the plasma focus process. While thorium fission may be more practical, the real practical value of the boron fusion may be found in its 'suggesting' that carbon or oxygen fission might be possible, which would open up a whole new world on the infinite-energy stage until galactic-electric energy can be efficiently tapped into to supply mankind's needs.

Another challenge greater than fusion

Whatever process offers mankind unlimited energy resources will be blocked by the imperial powers that have vested interest to protect, including the existence of empire itself. While the the hydrogen boron fusion process itself is small enough to be financed privately, those efforts typically get shut down for as long as the masters of empire rule the world who reap enormous 'profits' from high energy prices when supplies are limited.

In the world past the end of empire when truth in science rules once more the plasma focus devise might become an option for 'harvesting' unlimited energy resources by fissioning the atoms of the most abundant elements, if the barriers can be overcome. If it came to that, such a breakthrough would make thorium nuclear power obsolete. However, it too, would likely fall by the wayside when the science and the technology of tapping into the galactic electric energy grid becomes realized, that would make energy production on Earth an obsolete pursuit.

Thus the greatest barrier to limitless energy on Earth is the barrier of small-minded thinking in society, which is often intentionally imposed. On the small-minded platform the Sun is deemed to be a fusion furnace, regardless of all evidence to the contrary, just as the world is deemed to be gripped with manmade global warming for which no evidence exists either. These are real barriers that mankind is facing. And so, the words of German poet Friedrich Schiller (1759-1805) continue to apply that the great moments in history find all too often a small people.

NUCLEAR FUSION POWER

dead-end science

political games of universal dead-end science

The political barrier

The political barrier is formidable as the physical evidence is increasingly obscured by the constant barrage of lies that are spewed out on the subject of the fusion-powered Sun, from the centers of empire. The whole world has been made to believe in the mythology of the fusion-powered Sun. But why is this the case? The reason is that the masters of empire who aim to control the whole world want to keep society impotent. An impotent people are easier to exploit. Thus, they aim to render society impotent. One way to do this is by promoting a world-view that is built on entropy. The masters created the Big Bang Cosmology for this. By this theory the Universe is deemed to have been born in a bang and began expanding outward from the point of its explosion. From this point on it become immediately self-consuming, by which the Universe is therefore doomed to end. And so the saying goes that all good things are, by the very nature of the Universe, doomed to end, whereby poverty, impotence, and decay can be recognized in society's 'managed' thinking as something normal and natural. The model of the fusion-powered Sun was built on this grand fairy tale of universal entropy. Our solar system is thereby described as a closed system that exist isolated by itself in royal isolation from the rest of the galaxy, with its own sun at the center of it as its life-giving power source. And for a source for its power, nuclear fusion was imagined. All of this makes a nice-sounding fairy tale alright, which the imperial science masters tell mankind over and over to put it asleep with, like children are put to sleep with bedtime stories that are typically fairy tales.

And that's what the fusion Sun story is. It's one of these stories. It has put society asleep indeed. Modern society is sleep walking, and is falling off the cliff, again and again, while trying endlessly to make fusion energy a productive system. And as society fails, the masters cheer. They want us to fail. They want to tie us into knots. They do not want to see us developing ourselves. They want to force mankind into the fate of entropy and accept the notion of natural diminishment. That's what nuclear-fusion power appears to be really is all about. It causes society to waste its talents by tying it to a dead-end game. More in the subject of evading reality and blocking the truth, below:

Experiencing the Truth

The political games that are designed to force mankind's research into dead-end pursuits, are only a part of the problem. The fusion-power game within those games, has so far been a powerful blocking factor that blinds society to the available resources at hand. The fusion-power dead end game has become a giant that blocks the free-flowing development of mankind. We've been saying to one-another, 'hold everything until fusion-power is ready,' because then we will have endless energy for unlimited development. And so we tie ourselves into knots over something that will never become practical, while the practical options that are actually more powerful and efficient, are left by untouched by the wayside.

Thus the masters of empire laugh at us, as we lock ourselves in to a box and squirm, researching nuclear-fusion power, laboring endlessly to achieve the impossible while we ignore the riches we have at hand, such as thorium nuclear power, and beyond that, electric power drawn from space that is the active energy source that powers the Universe, the Sun, and which also surrounds our planet orbiting the Sun.

Nuclear-fusion power, a dead-end pursuit

Six strikes against nuclear-fusion power

Nuclear-fusion experiments - NIF, ITER

The nuclear-fusion energy is destructive

The paradox of the nuclear-fusion fuel

The paradox of nuclear-fusion power

MSR/LFTR Liquid Fluoride Thorium Reactor

Also see:

2011 - NAWAPA

2011 - Industrial Revolution

2011 - Free Electric Energy

2011 - Nuclear Fusion Power Delusion

2011 - Ice Age anew and Renaissance

2011 - Universal Love

2011 - Empire Religion

2011 - Empire Wars

2011 - Christian Science

2011 - New Science

more on empire, universe, energy, NASA, science, NAWAPA, music, world
with LPAC videos on the Nation, Science, Economics, and Empire

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