an energy flux density of around 40,000 watts per capita, and beyond, in the first generation of the 21st century, four times the current value of 10,000 watts. Again, this would not simply be more power for the same economy, but a fundamentally new economy.

However, this natural growth process was halted with the takeover of the anti-progress environmentalist movement, a shift, then, which sent the economy on the direct path into the attritional collapse being experienced, now—a collapse process accelerated by imposing policies which lowered the energy flux density of the economy.[15]

15. This was not some happenstance change, but resulted from the top-down strategic intention of the Anglo-Dutch Empire, whose leaders have been explicitly and openly operating on a policy intention of reducing the world population to less than one billion people. For example, see "Behind London's War Drive: A Policy To Kill Billions," by Nancy Spannaus, *EIR*, November 18, 2011.

As is clear in the second graph shown, nuclear fission power was never allowed to realize its full potential, and the energy flux density of the economy stagnated and began to collapse.

While the actual implementation of nuclear fission is seen in the red sliver, the role it needed to play is indicated in the gray wedge above, a projected value which keeps with the natural growth rates of a progressing human economy, and includes the beginnings of a fusion economy as well.

The 40-year gap between the needed growth rate and the present levels expresses the source of the current economic breakdown, and demonstrates the immediate need for a crash program to develop and implement the next stage, the fusion economy, to overcome decades of lost time by creating a new economy at a higher level than ever before.

Appendix 2: Our Future in and of the Stars: The High Energy-Density Physics Platform—Plasmas, Lasers, Antimatter, and Fusion

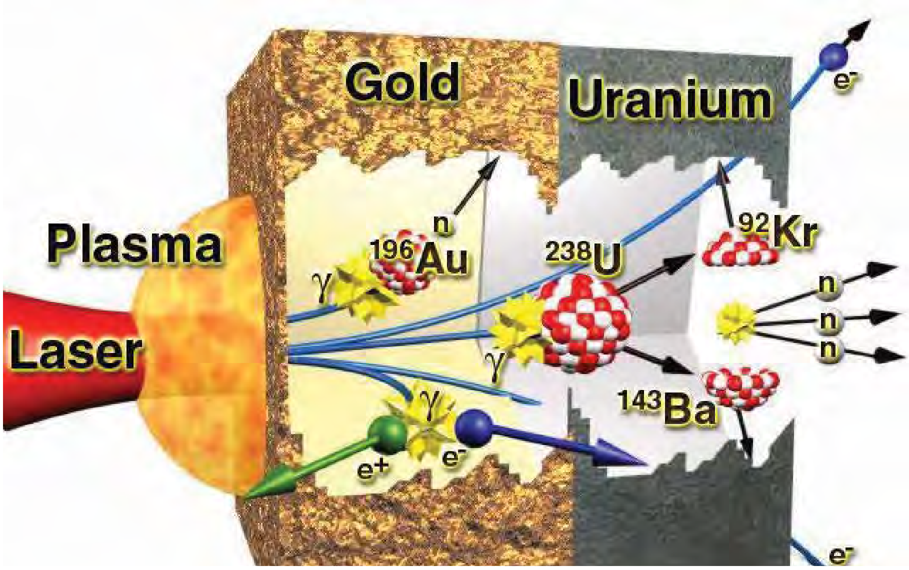
The next platform in the evolution of our human economy is the control of atomic processes like those found in our Sun, as this is to be applied to energy production, materials creation, and earthmoving, among other things. But this is not just for use here on Earth: the development of this power will be applied to conquering the entire domain of our Sun's influence, the Solar System, and will ultimately put us in range of our closest neighboring stars.

To achieve this will require the full exploitation of the dynamic relationships which currently exist between the fields of plasma, laser, antimatter, and fusion research, i.e., high-energy-density physics, where much of the work is already vectoring towards the next generation of space propulsion techniques. Only fusion propulsion can generate the 1-gravity equivalent acceleration, which is ideal for the human body, in that it both produces an Earth-like gravity environment, which mitigates some of the deleterious effects of microgravity, and reduces travel time, thus limiting exposure to harmful cosmic radiation. For example, at 1-G acceleration a trip to Mars could take as little as one week, achieving velocities of one-tenth the speed of light.

In addition to the space travel benefits of thermonuclear processes, the fields of high energy-density physics are furthering our understanding of processes occurring in stars and other cosmic phenomena, such as supernovas, widening our scope of understanding about the universe. This is opening up a renewed and necessary collaboration between astronomical, quantum, laser, and plasma physicists, where insights in one field quickly feed into the investigations of another. The physics of the lab and the physics of the stars are becoming more coherent.

Petawatt lasers, which operate on the order of 10^{15} watts of power, equal to 1,000 times the power of the entire U.S. electrical grid—a feat achieved by compressing mere hundreds of joules of energy (enough to light a 100-watt bulb for a few seconds) into pulses of trillionths of a second duration (femtoseconds)—are opening up vast new potentials for humanity. These lasers have thus far been directed towards the production of such things as: deuterium-deuterium fusion neutrons, the transmutation of gold into platinum, and the creation of anti-electrons (positrons), among other effects.

One such device is being operated by a group at the University of Michigan, where researchers have created what is being called the first table-top antimatter gun. The group has been aiming a petawatt laser at hydrogen gas, which in turn fires a stream of high-energy electrons at a thin metal foil, thereby producing quadrillions of antimatter particles (positrons). They have yet to develop



Lawrence Livermore National Laboratory

Interaction of the petawatt laser pulse with the gold and uranium target material. The laser forms a plasma plume at the target surface, in which electrons (e-) are produced with very high energies. Some of these electrons make gamma-rays (g) in the target, which in turn can knock neutrons out of the gold nuclei. Those neutrons cause uranium nuclei to fission. Some gamma-rays are converted into matter-antimatter electron-positron pairs (green e+).

the ability to trap and hold the antimatter, but that will be the next step they aim for.[1]

The other petawatt laser currently operating in the U.S. is at the University of Texas, where researchers have directed their efforts towards using the high-powered pulse for the creation of fusion reactions by blasting a plasma of hydrogen. Thus far they have been successful in generating neutrons from the fusion of deuterium-deuterium, and hope to increase the yield by adding a collapsing magnetic field around the plasma, further increasing the density.[2] This is a technique similar to that being developed by a group led by John Slough at the University of Washington. Slough proposes using a collapsing magnetic field around a plasma to rapidly contract a metal casing upon fusion fuel, triggering fusion, and then being ejected along with the fusion products for space propulsion.[3]

Continuing with the theme of antimatter's role in this new high energy-density paradigm, and the dynamic that exists between these different paths of pursuit, antimatter has the potential to be used as a trigger for fusion reactions. One application being explored is the antimatter triggered fusion propulsion system for rockets. To this end, a study was recently put out by a joint group from Pennsylvania State University and NASA Johnson Space Center which demonstrates the feasibility of two different models for antimatter-catalyzed propulsion, based on existing production rates of antimatter and methods for its application, as this would be applied for deep space exploration.[4]

Various proposals are being floated for antimatter triggered fusion propulsion systems, but they will all necessitate significantly more physical and intellectual investment to achieve the breakthroughs required.

The designs for rockets run all the way from antimatter triggered fusion propulsion, up to pure antimatter fuel propulsion. As things currently stand, the main road-block to making these systems a feasible reality are the limits in antimatter production and containment of the fuel, along with some engineering challenges. All of these are really a matter of proper rates of investment, as opposed to theoretical challenges. In addition, laser cooling techniques may be the key to efficiently generating Bose-Einstein condensates of anti-hydrogen, which are orders of magnitude more dense than simple anti-hydrogen gas or liquid. These condensates would make antimatter storage a real possibility for deep space flight, since (charged) anti-protons cannot themselves be packed densely, and (neutral) anti-hydrogen is difficult to contain otherwise. The proposed system would achieve velocities of just over half the speed of light and get within the range of our nearest star beyond the Sun in about 18 years.[5]

Another option for the use of antimatter triggered explosions is their use as shaped charges for large scale earth-moving and tunnel boring purposes, along with other applications as proposed in operation Plowshare,

1. Center for Ultrafast Optical Science, Michigan Engineering, http://www.engin.umich.edu/research/cuos/ResearchGroups/HFS/Experimentalfacilities/HERCULESPetawattLaser.html; Bob Yrka, "Physicists Create Table Top Anti-matter Gun," June 25, 2013, http://phys.org/news/2013-06-physicists-tabletop-antimatter-gun.html.

2. The Texas Petawatt Laser, The Center for High Energy Density Science, http://texaspetawatt.ph.utexas.edu/overview.php.

3. See: John Slough, "Developing Fusion Rockets to Go to Mars," *21st Century Science & Technology*, Fall-Winter, 2012-2013.

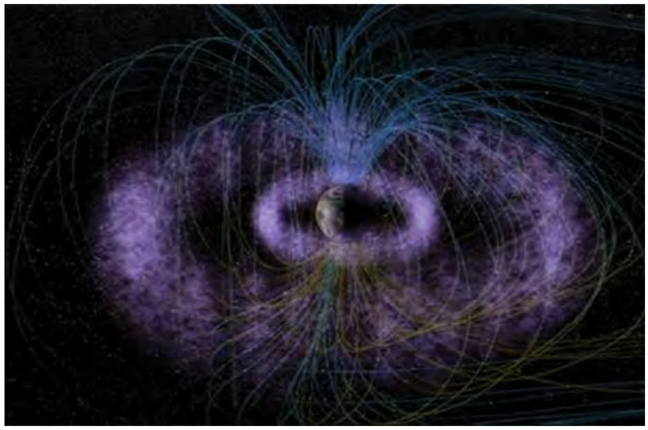
4. Schmidt, G. R., et al., "Anti-matter Production For Near Term Propulsion Applications," http://www.engr.psu.edu/antimatter/papers/nasa_anti.pdf.

5. Turyshev, Slava G., et al., "Controlled Anti-hydrogen Propulsion For Nasa's Future In Very Deep Space," October 21, 2004, http://arxiv.org/pdf/astro-ph/0410511v1.pdf.

for example. Anti-matter fusion explosions do not produce the radioactive fall-out associated with the PNEs of earlier designs.[6]

Regarding plasmas, the fourth state of matter, around which much of this new scientific paradigm revolves, in addition to those being developed in the tokamak fusion reactors and plasma torches discussed above, there is the potential for the controlled use of plasmas in fusion propulsion systems and petawatt lasers. One design for a propulsion system being developed by a group at the University of Alabama in Huntsville, utilizes the plasma pinch approach to create the densities for fusion reactions. The plasmas themselves are generated by electric pulses equivalent to 20% of world power output, which then go through a process of magnetic self-compression (the pinch), towards densities of action capable of igniting fusion reactions.[7]

The importance of the plasma state cannot be overemphasized, as it is a key aspect of all these interacting lines of development, for it seems to always accompany processes moving towards fusion. More to the point, the majority of observable phenomena in the universe seem to exist as some form of plasma, and as such, are better understood in terms of electromagnetic fluid dynamics, with its various non-linear qualities. This means changing our emphasis away from simple mechanics and thermodynamics, and towards the kind of non-linear evolutionary dynamics found in living processes, for example. This means broadening the scope of what we mean by astrobiology. This can already be seen clearly in the immediate Earth domain where lightning (a plasma) has been found to generate antimatter, and NASA has just discovered that the Van Allen (plasma) Belts that surround the globe, bear a functional resemblance to particle accelerators. Both processes are the product of life's effects and its interaction with cosmic processes.



NASA

The Van Allen Belts. NASA studies have shown a particle accelerator effect acting within the belts.

6. Gsponer, André, et al., "Anti-matter Induced Fusion and Thermo-Nuclear Explosions," February 2, 2008, http://arxiv.org/pdf/physics/0507125.pdf.

7. "UAHuntsville student seeking 'Holy Grail' of rocket propulsion system", http://www.uah.edu/news/research/3855-alpharetta-graduate-seeking-holy-grail-of-rocket-propulsion-system#.UiYc3TYkJ8E.