Fusion and Directed-Energy For a Dynamic Approach

by Benjamin Deniston

Nov. 27—There is currently no defense of Earth from future asteroid and comet impacts.

The aim here is to provide an overview of a systemic defense capability, necessitating an increased capability encompassing the entire territory of the inner Solar System. While the basic nature of the challenge has been treated in some depth by our "Basement" Research Team,[1] Lyndon LaRouche has recently placed a new emphasis on the deeper systemic challenges involved, and the need to reexamine the specific role of Mars in mankind's future in the Solar System, as in his new writing, "Turnabout: The New Strategy for Space" (see article, p. 4).

The methodological approach needed to properly deal with large systems of asteroids is classified as "dynamic," strictly in the continuity of the scientific tradition of Nicholas of Cusa (1401-1464), Johannes Kepler (1571-1630), Gottfried Leibniz (1646-1716), Carl Gauss (1777-1855), and Bernhard Riemann (1826-1866).[2] This requires that the Solar System be understood from the standpoint of a single governing principle, or an interaction of a limited set of principles, not the additional accumulation of individual objects. While most asteroids reside in relatively stable orbits between Mars and Jupiter, there are millions of asteroids in the inner Solar System, "beneath" Mars' orbit, and many of these cross the Earth's orbit on a regular basis. Presently, we have identified and tracked only 10,000 out of the estimated population of millions.

How can this be addressed?

First, compare the difference between treating the system of asteroids as if it were a product of the cumulative addition of the actions and interactions of all the individual parts (the reductionist view), versus understanding the properties of the individual asteroid as derived from the governing nature of the Solar System as a unified process (a dynamic approach). Further insight is provided by examining the integration of the Solar System process within the unified process of our galactic system.

Second, recognize that for billions of years these have been the only governing principles ordering and determining the processes of the inner Solar System. *The subject here is the entry of a new principle of control: mankind.* The defense of advanced life in the Solar System, and, most importantly, human civilization, depends upon mankind exerting control over this entire region. This raises the prospect of not merely deflecting individual dangerous asteroids, but managing them as systems, perhaps even creating new, man-made asteroid belts to reorganize the inner Solar System into safe and productive real estate.

Accomplishing this involves scales of action that are many orders of magnitude beyond what civilization has become accustomed to while operating on the surface of Earth: distances in the tens and hundreds of millions of miles, interplanetary travel times of months and years, typical velocities measured in the tens of thousands of miles per hour, and collision energies covering the entire range from megatons well into the gigatons (and beyond), associated with asteroids ranging from the size of large buildings to huge mountains, traveling many times faster than the fastest speeding bullet.

What will enable mankind to have dominion on these scales?

Biologically, mankind might appear to be similar to other forms of mammalian life found on Earth. However, the prospect of mankind becoming a governing principle of the inner Solar System—entering a domain of action

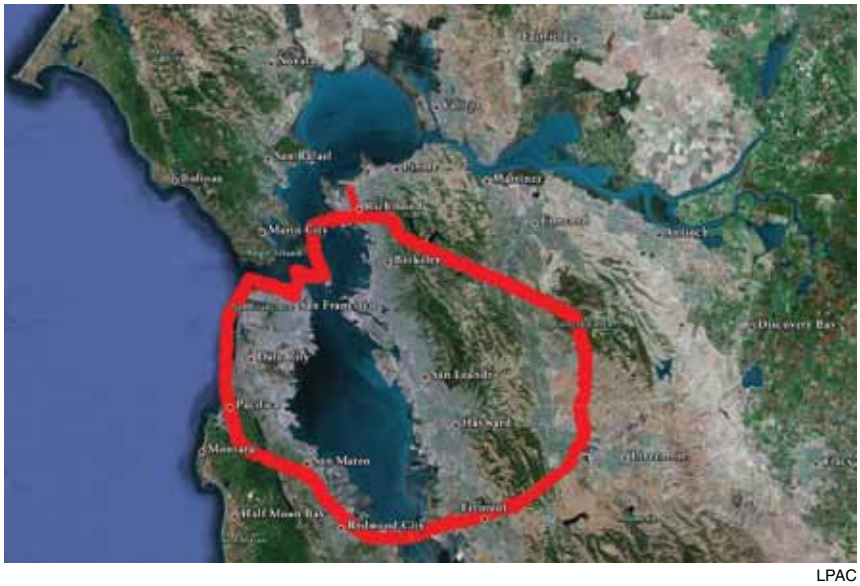
1. See the Fall/Winter 2012-2013 issue of *21st Century Science & Technology* magazine.

2. For pedagogical presentations of a selection of the original works and discoveries of this tradition, see http://science.larouchepac.com.

which has, up to this time, been reserved to the Sun—demonstrates an entirely different capability unique to mankind. As will be seen below, this could be described as an ability for the willful self-evolution of the human species, measured by increases in energy-flux density. The next self-evolutionary stage, the same stage that enables mankind to become a governing principle of the inner Solar System, is the systemic control and utilization of thermonuclear fusion as the primary power source for mankind.

Over the past year, LaRouche has emphasized that such considerations, including the potential demonstrated by NASA's Curiosity mission, force the need for reconsideration of the role of Mars. The important issue is not to send people there per se, but to develop Mars as mankind's critical expandable outpost in the mission to develop our power as a controlling force in the inner Solar System for the defense of Earth and the progress of mankind.[3]

FIGURE 1
The Tunguska Event Transposed to California



LPAC

A representation of the area of destruction from a small asteroid impact over Siberia in 1908, compared with the size of the Bay Area in California.

The Goal

The focus here is a systemic view of the dynamics of action in the inner Solar System: space and time access to all relevant regions, and the ability to influence and control those regions.

This differs from the general framework of discussion dominating planetary defense and space exploration today, where the accepted level of discussion has fallen to a sadly practical level. In this author's experience, the existing boundaries of mankind's access to the Solar System are usually accepted "as is," and efforts are focused on making individual missions work within that far-too-limited framework.

While, to the uninformed, it may appear that mankind can get by with this, it would only take one single comet coming out of the black depths of space to end such delusions. Since no one would live to learn the lesson from such an event, we should take the real-life *possibility* of such a scenario as the lesson, and respond accordingly.

Since mankind presently has no defense from asteroids, let alone the larger challenge of long-period comets, what is needed is a systemic approach to mankind's access to and power for action within the Solar System as a whole. What are the critical determining factors therein, and what can be done to act upon, and expand those bounding factors?

Today, high-powered directed-energy systems, thermonuclear fusion, and associated technologies stand out as the critical factors.

It must be emphasized that these capabilities have been long delayed. Since the 1970s, the general path to fusion has been clear, but its development has been suppressed. In the 1980s, LaRouche's program for the Strategic Defense Initiative (SDI), with strategic roles played by Dr. Edward Teller and President Ronald Reagan, could have ended the threat of nuclear weapons through the development of advanced directed-energy technologies, but the directed-energy aspect of the SDI was shut down. As LaRouche presents in his article preceding this one, a full understanding of the present conditions and challenges facing mankind requires an understanding of the effects of the oligarchical system, both historically, and the continuing effects today. This is necessary to understand the source of the zero-growth

3. The creepy activities of some pushing a degenerate and unworkable vision for manned missions to Mars should be investigated with the proper suspicion. See "Operation Buzzkill: The Empire Targets Mars," *EIR*, June 28, 2013.

NASA

Lyndon LaRouche has emphasized that the potential demonstrated by NASA's Curiosity mission, force the need for a reconsideration of the role of Mars: that we develop Mars as an outpost for man's control of the inner Solar System for the defense of Earth and the progress of mankind.

policy of the United States and Europe over the past four decades, which has ensured that there has been no major systemic development in our space capabilities since the efforts of President Kennedy.[4]

Since much of this falls beyond the scope of this writing, and is treated by LaRouche in the cited work, the focus here will be on the critical determining role of energy-flux density in a systemic approach to planetary defense. Here, energy-flux density considerations arise in three domains:

One, in the ability to change the trajectory of a massive object moving at a high relative velocity, such as an incoming asteroid or comet.

Two, in what is generally referred to as orbital dynamics: the considerations involved in being able to deploy a spacecraft to the target at the desired location in space and time.

Three, in the application to interplanetary infrastructure, expanding the capabilities of the first two considerations.

Higher levels of energy-flux density applied in these domains increase mankind's systemic capabilities in the inner Solar System, including planetary defense. Controlled-fusion systems and advanced directed-energy systems will serve as the critical drivers for advancement in these domains.[5]

Directed-Energy and Speed of Light Action

For example, advanced directed-energy systems would revolutionize the interorbital travel requirements of planetary defense missions. To grasp the gravity of this fact, examine the distinct areas of energy requirements for asteroid deflection missions. This can be divided into three categories:

Deflection: The energy needed to move an asteroid, changing its course to ensure it does not collide with the Earth (or destroy it if there is not enough warning time to deflect it). This can be done by various methods.

Travel: The energy needed to send a spacecraft (the deflection mission) to the target. Because this is in the domain of interorbital travel, it can be defined as the energy needed to place the spacecraft on a "transfer orbit," which will depart from the Earth's orbit at just the right time to intersect the target at an ideal location in its orbit.

Rendezvous: The energy needed to rendezvous with the target. Because the relative speeds in interorbital space travel are so high, a significant amount of energy will be needed to match the speed of the target (i.e., leaving the transfer orbit, and matching the target's orbit) in order to allow a rendezvous at a safe speed.

Certain asteroid-deflection proposals require all three of these categories. For example, the gravity tractor design would depend upon sending a spacecraft

4. This is not a casual choice of words, but, as will be seen below, a precise scientific assessment. While the space program has seen the benefits of technological innovation and development within the existing framework (as the Curiosity mission demonstrates), the actual systemic framework has actually stagnated or declined since the culmination of Kennedy's space program. For an overview of what the United States (and the world) lost with the assassination of JFK, see Michael Kirsch, "50 Years Behind, the President from the Future." See also, "What His Assassins Killed: John F. Kennedy's Program for a Nuclear America," *EIR,* Oct. 18, 2013.

5. Some, perhaps many, experts in the domain of planetary defense might argue that nuclear power, or fusion, is not needed to defend Earth from the threat of an asteroid impact. In certain limited scenarios, that argument can be made. However, here we have departed from limited situations. The issue is fundamentally and systemically expanding the scope of what is possible for all scenarios. This is a dynamic approach, not a mechanistic one. The focus here is expanding the dynamic of mankind, not finding clever ways to try to do things at a lower dynamic imposed by a zero-growth paradigm.

from Earth onto a transfer orbit, then to expend more energy to match the orbital speed of the target to make a safe rendezvous, and then to begin to alter the target's orbit by using the craft's thrusters to maintain a certain distance from the asteroid, allowing the gravity of the spacecraft to very slowly pull on the asteroid and alter its trajectory. Presently this has a very limited potential usefulness. However, the development of nuclear propulsion systems could allow for a more massive spacecraft to be deployed and expand the potential of this option.

JPL

The gravity tractor (shown here in an artist's concept) is one possible technology for altering the trajectory of an asteroid headed toward Earth.

Certain other proposed methods for asteroid deflection only require the first two categories of energy requirements, removing the need for a rendezvous. These include "kinetic impact," which basically involves running a spacecraft directly into the asteroid at high speed, to move it off course with a little push; or a nuclear explosive device, which can be detonated just above the surface of the asteroid before impacting it (also providing a push to change the asteroid's trajectory). Neither of these need the extra energy and fuel requirements of a rendezvous maneuver. Again, both would benefit from nuclear propulsion systems, allowing them to carry more mass to the target, to get there sooner, and to have more opportunities for launch windows.

A third class of asteroid-deflection method could discard the second two categories of energy requirements altogether, requiring only the first. These are long-distance directed-energy systems using lasers. As the name implies, these do not require moving the system that generates the energy to the target, but allows the energy source to remain at a fixed base of operations, from which the energy is directed across a vast distance to the target. Because the distances involved are so great, the directed energy must have a very high degree of concentration and coherence, properties associated with high levels of energy-flux density.

An intense laser beam applied to the surface of an asteroid can vaporize any known planetary surface, creating a jet of material which provides a thrust in the opposite direction.[6] This can be used not only to deflect incoming asteroids, but potentially to precisely manipulate and modulate their orbits, and raises the prospect for creating new, more desired orbits for these rebel bodies.

This not only applies to defense, but also to scientific investigations and mining opportunities. Directed-energy methods for such "orbital management" can make many asteroids easier and cheaper to access, for study, mining, or both. Access will then further improve through the development of high energy-flux density propulsion systems, such as fusion, enabling quick and easy trips to the new orbits of these bodies with the necessary industrial or scientific equipment, as well as returning material as needed.

This returns us to the more interesting question of the systemic dynamic effects. What does this do for mankind's access to and power within the inner Solar System as a whole?

The Dynamic Implications

New estimates of small asteroid impacts over the past century published in *Nature*[7] indicate that we could be facing many millions of asteroids in the inner region of the Solar System, three to ten times higher than previous estimates.

Some of these will pose threats to the Earth.

Some will provide critical scientific information about the dynamics of gravitation in a multi-million-

6. One such proposal is the DE-STAR system designed by U.C. Santa Barbara physicist Philip M. Lubin and California Polytechnic State University San Luis Obispo researcher Gary B. Hughes. See the interview with Professor Lubin in the Summer 2013 issue of *21st Century Science & Technology,* or at www.YouTube.com/watch?v=3zAq23BDd3c.

7. P.G. Brown et al., "A 500-kiloton airburst over Chelyabinsk and an enhanced hazard from small impactors," *Nature,* published online, Nov. 6, 2013.

body system, about the formation of our Solar System, and about the historical travels of our Solar System through the galaxy.

Some are rich in industrial and precious metals, providing critical resources for the industrial development of the inner Solar System. Given the immense energy cost to move mass from the Earth's surface into orbit, we will have to look to new ways of developing the resources available in asteroids, including "additive manufacturing" (e.g., 3-D printers) and other forms of production in space.

With everything stated up to this point being the perhaps not so simple facts of the matter, we now turn to this author's own conclusions respecting these facts.

The required goal is not simply stopping one asteroid, but the capability to move and manage tens, even hundreds, and perhaps, eventually, thousands of asteroid orbits.

This can be done with two expandable directed-energy stations, one at Mars, another at Earth with a range of one astronomical unit, or beyond. These will be expanding multi-function stations, including advanced telescopic observation systems in the optimal infrared wavelengths, precise interaction between the two stations enabling stereoscopic views of the Solar System and beyond, LIDAR-type beaming systems for more precise orbital determination of asteroids, directed-energy surface vaporization for spectral analysis of the material of the targeted asteroid, and high-powered surface vaporization for orbital alterations of a target body.

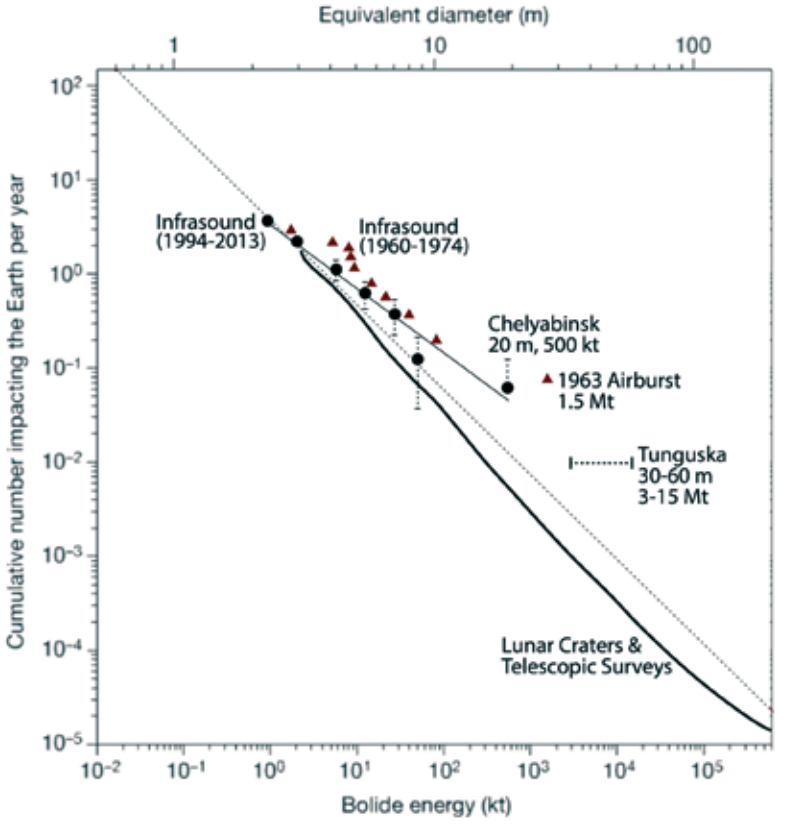
In addition to Earth orbit (or perhaps the Moon), Mars is the second critical location for the development of a growing and developing complex of systems. Mars provides a stable gravitational anchor for orbital systems; the body of Mars itself can be intensively studied with high-powered scientific equipment installed at the Mars complex, and the resources of the surrounding asteroids, and perhaps Mars itself, can begin to be developed for eventual on-site construction and development of additions and expansions of the Mars system. A high-powered communications trunk-line (with the necessary relay stations) will connect the expanding Mars complex with the Earth system, enabling stereoscopic views with significant parallax and interplanetary interferometry for new views of the universe.

The cross-coordination of such a Mars-Earth pair of complexes enables us to transcend a mechanistic view of dealing with a single asteroid here or there, and into serious consideration of the modulation and management of the territory of the inner Solar System through the control over tens, and then hundreds, of asteroid orbits, reaching into the thousands over the course of future generations.

Perhaps such systems can be used to start populating and filling new stable orbital belts that man creates, as well-regulated and controlled orbital freeways of the inner Solar System. These can have two main classifications:

Safety zones can be created, first with respect to the dynamic vicinity of the Earth's orbit, and eventually for Mars. Certain zones will be cleared of asteroids based on chosen criteria for how close certain objects will be allowed to get, based on their size. For example, large asteroids should not be allowed

FIGURE 2
Impact Frequency



A 500-kiloton airburst over Chelyabinsk and an enhanced hazard from small impactors (adapted from P.G. Brown, et al., Nature online, Nov. 6, 2013).

to pass between the Earth and our geostationary satellites, as will occur in 2029 with the 325-meter asteroid Apophis (unless we intervene).

Accessible zones will be orbits which are relatively easily accessible from the Earth system (i.e., low delta-V), but not so close as to be dangerous. If needed, we can practice with the Mars system first (so as not to endanger Earth), but once the capability is sufficiently demonstrated, we can bring asteroids into the Earth access zone for two purposes: scientific research and mining. Since there are many types of asteroids, we will want a variety within easy access, both for study and to develop their resource potential. If the scientific and industrial zones need to be separated, then probably the scientific zone will be more distant (but close enough for near-real-time communications and live control over humanoid robotic apparatuses at the asteroid) because the industrial zone will require moving more total mass to and from the asteroids.

Travel to and from these accessible zones, and the transport of scientific or industrial equipment to and from them, will be enabled by advanced fission- and fusion-propulsion systems.

Because directed-energy systems discard the energetically expensive requirements of space travel, they carry the inherent potential to be the most effective and efficient way to do the bulk of the work in mankind's perhaps gradual, but actual reshaping of the inner Solar System.

Today, mankind hopes to be lucky enough to dodge individual asteroids. Tomorrow, we have the prospect of creating our own highways of asteroid belts, designed to service our needs for science, development, and defense.

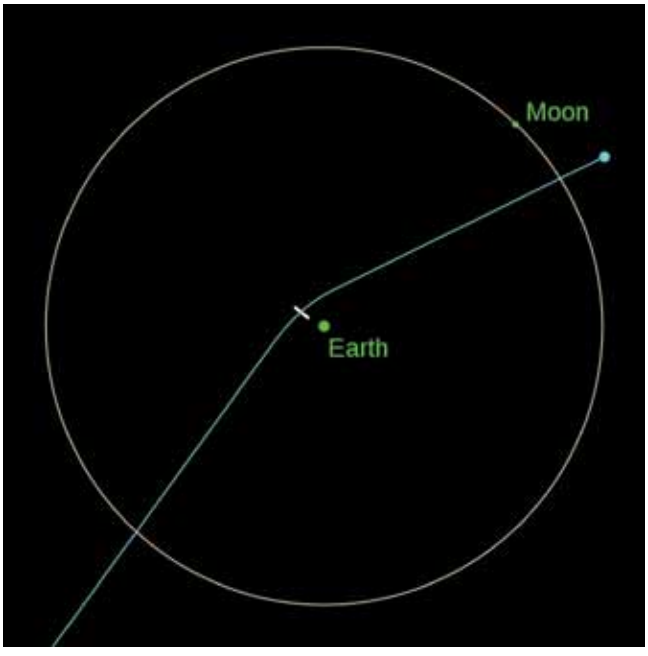
Man as Principle

Lyndon LaRouche writes in his above-cited paper:

"Speaking generally, 'combat' against 'errant' asteroids had not been, heretofore, the customary general policy of mankind's daily awareness. Nonetheless, the proper development of the effects of management of our duties in Solar space, is now a properly leading concern for our awareness; the leading question now, is 'when?'…

"'What this intention presumes,' is that, whereas, planets such as Mars and Earth, will be the 'homesteads' of this interior region of the Solar System set aside for our defenses, the asteroids will serve as the mines and other fields of harvest. The perspective for that system, is already indicated by aid of the means of the methods of thermonuclear fusion, and subsequently, more potent means. In short: mankind must learn to manage this, his present Solar homestead, and that productively."

FIGURE 3
Path of Asteroid Apophis



NASA

The path of asteroid Apophis on April 13, 2029. The white bar shows the range of uncertainty in Apophis's position as it passes the Earth.

Competent policy is not crafting practical projects which fit within the existing limitations, but pursuing programs which fundamentally change the outer bounding conditions which limit and define mankind's power and potential for effective action. For the advance of mankind, this is what truly matters.

This challenge of mankind's dynamic management of the inner Solar System takes us into a regime where stars and the galaxy have reigned supreme for billions of years, unchallenged in their dominion. The immediate future sees the entry of a new force: mankind. Perhaps still seemingly weak and small by his biological appearance to the sense-perceptual views predominating in society today, this fallacious view is to be forever cast aside, as the true nature of mankind is demonstrated to be found not in his biology, but in the ever-expanding creative powers of mind. With this, mankind enters the realm of the stars, and, eventually, beyond.

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