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AN INTERSTELLAR EXPLORATION INITIATIVE FOR FUTURE FLIGHT

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Abstract

An example is presented of a Space Exploration Initiative (SEI) that would maintain the rapid rate of aerospace progress we accomplished in the past and culminate in journeys to the stars. Such an SEI would embody extremely long-term goals that challenge the human spirit, meet human needs and set forth our intention to embark upon a manned interstellar journey within 100 years after the first human exploration of another celestial body (the moon). Near term goals would be the same as current SEI ones (establishment of Space Station "Freedom", return to the moon, and manned exploration of Mars) because they are the next logical stepping stones to the stars. The paper shows prospects for the kinds of future technical breakthroughs which would maintain the rapid rate of aerospace progress of our past and how such breakthroughs might phase into SEI architectures during coming years. Finally, it is shown that an SEI that embodies an interstellar initiative would not significantly impact current spaceflight initiatives and plans. However, it would require that a greater fraction of space exploration funding be dedicated towards "far-out" research for future flight.

Introduction

In the past, we expanded beyond the boundaries of birth, then beyond countries and continents, and even beyond the limits of earth. In the future, we

plan to extend human presence into the solar system by establishing settlements on the moon and Mars. The next logical steps in space after human expansion throughout the solar system would be travel beyond the solar system to the stars. But although many interstellar flight studies have been performed, very few interstellar initiatives have been proposed. References 1, 2, 3 and 4 are some of the several documented ones this author knows.

Here, most interstellar studies have been of slower-than-light starships that embody foreseeable spaceflight technology and have longer mission times than the remaining lifetimes of those who would be called upon to sponsor their trips. Therefore, there has been little enthusiasm for sponsoring interstellar initiatives that involve such ships. But, discoveries of new sources of energy and new modes of vehicle impulsion could enable extremely swift starships that could share some of the results of their interstellar explorations with those who made possible their trips. Furthermore, the kinds of scientific and technological breakthroughs that would enable new energy sources and modes of impulsion could also help solve some of the severe environmental and economic problems we will be facing in the future on earth. Thus, this paper will examine an interstellar initiative that strives for the kinds of revolutionary breakthroughs that could take us to the stars and meet future human needs on earth as well.

* The views presented here are those of the author. They do not necessarily represent the views of McDonnell Douglas with respect to either Interstellar Exploration Initiatives or the SEI.

What if We Could Maintain the Aerospace Progress of Our Past

The modern history of flight began approximately 87 years ago with the Wright Brothers first successful controlled and powered flight above the sands of Kitty Hawk, North Carolina in 1903. Since then, there have been many significant advancements that have enabled enormous progress during the first 87 years of flight. Some of these, are shown in Figure 1.

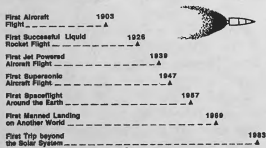


Figure 1. Major Breakthroughs and Milestones During the First Century of Flight

Past significant advancements are: the first rocket and airbreathing vehicle flights (1926) and (1939), first attainment of supersonic speed (1947), first spaceflight around the earth (1957), first manned landing upon the moon (1969) and first travel beyond the solar system (by the Pioneer 10 spacecraft in 1983).

It is not truly proper to view aerospace progress as a smooth continual improvement, since (as indicated in Figure 1) it is made in steps. Here, improvement occurs fairly quickly with introduction of a new capability, followed by a slower rate of progress as the new capability is perfected and refined. Nevertheless, we can look back on our first 87 years of powered flight and determine the average rate of improvement in speed and distance covering capability that we achieved.

The Wright Brothers' first powered flight above the earth was made at a speed of about 30 miles per hour over a distance of about 150 feet. Today, 87 years later, mankind's longest flight is still underway. For the Pioneer 10 spacecraft, traveling faster than 30 thousand miles per hour, is still transmitting data while more than 4 billion miles from earth. Thus, we have made more than a thousand-fold increase in flight speed during our first 87 years of flight, while increasing our distance covering capability by more than 200 billion times. Furthermore, Figures 2 and 3 show that if we could maintain our past average rate of progress during the next 87 years of flight, we will have reached the velocity of light and distant stars.

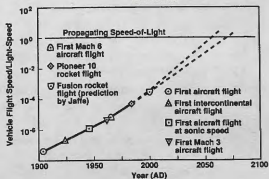


Figure 2. If We Could Maintain Our Past Rate of Improvement in Flight Speed, We Could Reach the Speed-of-Light by 2075

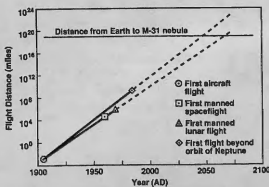


Figure 3. If We Could Maintain Our Past Rate of Improvement in Flight Distance, We Could Reach Other Galaxies by 2075

Such rapid achievement of such seemingly impossible things certainly appears preposterous at this time. For just as faster-than-sound travel and manned expeditions to the moon were not foreseen by any technical person in 1903, so things such as faster-than-light travel and intergalactic expeditions cannot be envisioned today.

The Possibility of Impossible Things

Robert Browning once said, "By far the greatest obstacle to the progress of science and to the undertaking of new tasks and provinces therein, is found in this—that men despair and think things impossible," and there has never been a lack of prestigious people to declare the impossibility of future things. In 1885, Lord Kelvin, President of the Royal Society, declared that "Heavier than air flying machines are impossible." Charles Duell, Director of the U.S. Patent Office in 1899 announced that, "Everything that can be invented has already been invented." While in 1923, Robert Millikan, winner of the Nobel Prize in Physics proclaimed that, "There is no likelihood man can ever tap the power of the atom."

Just as one must be cautious before accepting authoritative statements on impossibility of future things, so we must also be careful in attempting precise predictions of extraordinary things that might come to pass. Nevertheless, we can review our past flight advances and the progress they allowed and the kinds of future advances that might enable comparable progress for future flight.

As advancement from newtonian to quantum physics was needed for a better understanding of the underlying structure of material things, so Table 1 indicates that further advancement to a so-called "meta physics" may be needed to reveal the deeper essence of the vacuum of space and as quantum physics enabled new technologies such as solid-state electronics (that exploit electromagnetic phenomenon within material mass), so meta physics might enable new technologies that would exploit electromagnetic phenomenon within the vacuum of space.

Similarly, as revolutionary computational developments have already evolved a significant degree of artificial intelligence, so future advancements may enable an even deeper fusion of human intellect and thinking machines; and as past material developments have emphasized heat resistance and structural strength, so future advancements may emphasize hyperconductivity -- electrical properties and magnetic strength.

Some of the advancements and achievements that have enabled significant progress during the first 87 years of powered flight

New sciences: relativity theory and quantum physics

New technologies: solid state electronics and photonics, cybernetics, composite materials

New sources of power: solar energy and nuclear energy

New modes of propulsion: air breathing and rocket propulsion

Achievements: progression from subsonic to supersonic flight

Possible advancements and achievements that may enable comparable progress during the next 87 years of powered flight

New sciences: meta relativity and quantum meta physics

New technologies: vacuum electro-magnetics, psychocybernetics, hyperconductive materials

New sources of power: vacuum zero-point energies of space

New modes of propulsion: field propulsion, inertia-less drives

Achievements: progression from subsonic to superluminal flight

Table 1. Past and Future Possible Advancements During the History of Flight

Furthermore, just as new sources of power (solar and nuclear energy) were developed during the first 87 years of powered flight, so new sources (such as the "zero-point" electromagnetic energies of the vacuum of space) might be perfected during the second; and as advancement from propeller propulsion to jet propulsion revolutionized air transportation and enabled progression to supersonic (faster-than-sound) speed, so it is seen that advancement from jet propulsion to a new mode of impulsion (such as field propulsion) might be needed to revolutionize space transportation and eventually enable transition to superluminal (faster-than-light) state.

Possible Breakthroughs for Future Flight

This section will mention four of many possible future breakthroughs that could enable our future rate of aerospace progress to be comparable to that of our past. These breakthroughs are fusion propulsion, vacuum energy, field propulsion and

superluminal flight. However, these are only examples of many breakthrough possibilities for future flight. For example, "magnetic monopoles" (Reference 5) and "negative matter" (Reference 6) are other propulsion possibilities not forbidden by physical law that could revolutionize future spaceflight art.

Fusion Propulsion

Thermonuclear fusion releases 50 million times more energy (in terms of calories per gram of mass) than chemical combustion of hydrogen fuel and has long been recognized as a possibility for earth's future energy and for propulsion for future flight. Here, most fusion research has been directed towards large systems to meet earth's enormous future energy needs and, unfortunately, achievement of fusion with such systems remains very difficult to achieve. Thus, nuclear fusion has generally been perceived as being too "far-out" for propulsive use as well. However, recent studies in the United States and the United Kingdom (References 7 and 8) indicate that small magnetic confinement fusion reactors, operated in a pulsed mode, may be developable for space propulsion much sooner than more massive and powerful machines, operated in a steady-state mode, can be developed for terrestrial energy use.

References such as (7) indicate that fusion propulsion systems could enable a 10- to 20-fold reduction in fuel consumption per pound of thrust and achieve speeds high enough to reduce Mars trip times from about 300 to 30 days. Furthermore, neutron flux and radioactivity from fusion reactions involving fuels such as deuterium and helium 3 may be mild enough such that ground testing associated with nuclear fusion propulsion would not cause environmental concerns as nuclear fission propulsion would do.

Vacuum Energy

Although the vacuum of space seems inert and "empty," quantum theory reveals that it is teeming with vigor and vitality over scales of time and

distance that are too short and small for the material senses to perceive. And over these submicroscopic scales some of the vacuum's vigor and vitality is manifested in stupendous "zero-point" electromagnetic energy pulsations whose ever-changing rhythm pervades the entire breadth, length, height and depth of cosmic space.

Furthermore, estimates of the zero-point energy density of the vacuum, given in References such as 9, 10 and 11, indicate that a single cubic foot of so-called "empty space" contains more than enough zero-point energy to meet earth's total energy needs for more than a million years. And, Reference 12 indicates that the enormous power achievable with such stupendous energy could rapidly accelerate starships to nearly the speed of light.

Although there is some foreign interest in vacuum energy research, there appears to be little current interest in such research in the United States. For just as distinguished scientists once rejected the idea of tapping the nuclear energies of the atom, so most scientists today doubt the feasibility of tapping the vacuum energies of space. Nevertheless, References such as 13 and 14 describe some of the ways that are being considered for extracting zero-point energy from the vacuum of space.

Field Propulsion

Field propulsion systems would develop force by the action of fields instead of by expulsion of mass, and certain types of these systems have already been investigated with generally negative results. Most of the investigated systems have been based upon the classical laws of electrostatics and electromagnetics, which allow force development by either electric or magnetic repulsion or by the inductive effect between electric and magnetic fields.

Unfortunately, the forces developed by such interactions are so small compared to the inert weights of the electrical and magnetic components needed to develop them, that the thrust-to-weight

ratios of field propulsion systems based upon our current electromagnetic knowledge and state of the art would be very inferior to those of rocket propulsion systems today.

Since effective field propulsion systems would require much more powerful interactions than those achievable with our current electromagnetic knowledge and hardware state of the art, it is conceivable that such interactions might have to involve a coupling with the enormous vigor contained within the vacuum's quantum dynamical state. In this respect, Reference 15 describes some possibilities for coupling with the space-time metric associated with mass, gravitation and the vacuum's dynamical state, while Reference 16 outlines ways of evolving and testing field theories that reveal how such couplings could occur.

Superluminal Flight

Superluminal ships would be vehicle systems that could leave one location and arrive at another before light could travel between the two locations in normal space. Thus, these ships would be somewhat analogous to supersonic aircraft that can change their location in the atmosphere faster than their sound can. Unfortunately, even hypothesizing superluminal ships is controversial since the overwhelming consensus of scientific opinion is the impossibility of faster-than-light flight. Nevertheless, only such ships could reach the further reaches of cosmic space and return to share the fruits of their expeditions with the people of earth. Therefore, it would appear worthwhile to examine some of the things that would have to happen in order that the "light-barrier" be overcome.

Surpassing light speed in space would be somewhat analogous to surpassing sound speed in air. For just as Einstein's Special Relativity predicts resistance to accelerated vehicle motion (its inertia) becomes infinite at the speed of light, so simplified (Prantl Glauert) theories of aerodynamics predict resistance to vehicle motion (its drag) becomes infinite at the speed of sound. But, in actuality, there is a change in the flow field about a vehicle as

its speed approaches sonic speed (which is not accounted for in the simplified aerodynamic theories) and this change prevents flight resistance from becoming infinite at the speed of sound. Thus, some analogous change in field state (which is not accounted for in Special Relativity) may have to prevent resistance to accelerated motion from becoming infinite at the speed of light.

In this respect, Reference 17 shows solutions to the Einstein General Relativity equations that allow faster-than-light travel through tunnels formed by warping space and held open with special fields; and Reference 18 suggests that warping space by means of highly charged, highly excited nuclei might be possible with conceivable advancements of our technical art. Furthermore, Reference 19 shows faster-than-light solutions to the Einstein Special Relativity equations in realms that are "above" the spacetime realm of existence of our material world. Therefore, just as aircraft that exceed takeoff speed climb above the length and breadth of earth, so spacecraft that could exceed light speed would climb "above" the length and breadth of space and time.

It follows that faster-than-light solutions to either Special or General Relativity require a Cosmos of deeper dimensionality than the 4 dimensions of normal 3-D space and 1-D time, with this deeper dimensionality needed to give starships "room" for rapid transits to distant stars.

Phasing Technical Breakthroughs into Our Next Steps in Space

We have no choice but to use existing spaceflight art in our next steps in space. However, future plans should provide for exploitation of technical breakthroughs such as fusion and field propulsion when and if they occur. As an example, Figure 4 shows that only chemical rocket propulsion (and perhaps certain near-term nuclear fission systems) would be available for Mars trips during the next several decades. However, fusion rocket propulsion breakthroughs would enable a 10-fold reduction in trip time for Mars expeditions at a somewhat later

date. Then, field propulsion breakthroughs at a still later time could enable much lower space transport costs (by enabling the complete reusability and simpler operations of a single propulsive stage) and a further significant reduction in Mars transit time.

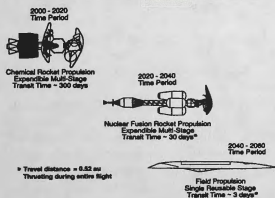


Figure 4. Typical Mars Transportation Possibilities

Possible steps in the perfection of a new mode of impulsion (such as field propulsion) are shown in Figure 5.

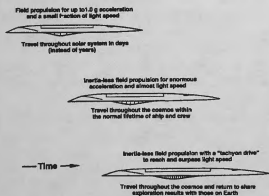


Figure 5. Evolution of Field Propulsion

Here, if first generation systems could achieve flight accelerations (and decelerations) in the 0.1 to 1.0 g range, it is seen that they could reach the outermost planets of our solar system in less than 90 days. Second generation systems which could null inertia within the ship, could rapidly accelerate

to nearly light speed and reach even distant stars in short time intervals—as measured on-board the ship. Trips at nearly light speed to the nearest stars could also be fairly short in earth years—with transmitted data being received about 10 years after ship departures from earth. However, data could not be received quickly from long interstellar journeys because thousands of earth years would elapse during such trips. However, if final perfection of field propulsion systems could enable light speed to be achieved and surpassed, round trips to distant stars might be accomplished within the lifetimes of the crew and the earthlings waiting the outcomes of their trips.

A Typical Schedule for Future Flight

Since one cannot forecast or legislate the exact times technical breakthroughs will be made, it is obviously impossible to lay out precise program schedules and milestones for the next 100 years of flight. Nevertheless, we can lay out a sample schedule of future flight advancements if we assume they could unfold with about the same average rapidity as flight advancements of the past. Figure 6 shows such a schedule of advancements for future flight.

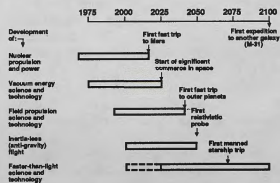


Figure 6. An Ambitious Schedule for Astronautical Progress During the Next Century of Flight

Just as Figure 1 shows significant milestones that have been associated with the first century of flight, so Figure 6 shows comparable milestones that might be associated with the next century of flight. Here, it is seen that fusion propulsion could enable the first rapid transits to Mars, while the reduced travel times and costs made possible by field propulsion could enable the start of true space commerce by about 2025, and fast trips to the outer planets before 2050. It is also seen that achievement of inertia-less flight could enable the enormous acceleration and speed needed for relativistic interstellar probe missions by about 2050, and that faster-than-light science and technology could enable the first manned round-trip journeys to distant stars by about 2075. Finally, further perfection of faster-than-light flight would enable embarkation on expeditions to other galaxies just before the next century ends.

Can an SEI Help Meet Future Critical Human Needs?

The most obstinate obstacle facing advocates of space exploration is the general perception that such exploration, having no real relevance to the practical issues of daily life is something to be embarked upon only after critical human needs are met. By contrast, this section will contend that the most critical environmental, economic and social problems facing earth in coming years can be overcome only by the kinds of scientific and technological advancements that are needed for significant exploration of space.

In Table 2, critical human needs are somewhat arbitrarily categorized into: bare essentials—energy, resources, and environmental quality for a reasonably healthy life; minimal needs—opportunity for a useful and a productive life; and higher needs—aspirations and inspirations for a richer and more satisfying life; and Table 2 shows that the kinds of technical breakthroughs needed for real space exploration can also help meet such human needs.

Critical Human Needs	How Needs Can Be Met by New Science and Technology for Space Travel and Daily Life
Bare Essentials: Enough energy and resources and environment for increasing numbers of people on earth	Breakthroughs in science and technology to enable new sources of "clean" energy for Earth, and new modes of spaceship propulsion for obtaining ample resources and revenues from space with acceptably low travel time and cost
Minimal Needs: Greater opportunity for increasing numbers of people for a useful and productive life	Creation of new careers and occupations in manufacturing and service industries - made possible by breakthroughs in "clean" energy development and low cost travel to space
Higher Needs: Higher aspirations for a much richer and satisfying life	Motivation of people to greater achievement and understanding by participating in the adventure of discovery and exploration and the challenge of difficult things

Table 2. Kinds of Technical Breakthroughs That Would Revitalize Flight Would Meet Future Human Needs as Well

Bare Essentials

Although ever increasing amounts of energy will be needed for the ever increasing populations of earth, continued burning of fossil fuels and continued fission of nuclear fuels will eventually cause unacceptable pollution and deterioration in quality of life. Furthermore, significant amounts of material from other bodies within our solar system may also be needed to prevent eventual depletion of the soils, forests, and mineral resources of earth.

In this respect, energy obtained from nuclear fusion of nuclear fuels such as deuterium and helium 3 would result in much less radioactivity and pollution of earth than energy obtained from combustion of current fossil and nuclear fission fuels; and it has been mentioned that such energy would also enable much more propulsive power than the chemical rocket propulsion systems we have today. Solar energy beamed from orbiting satellites on the moon has also been proposed as a source of purely non-polluting power for earth. However, development of space based solar energy would require breakthroughs in propulsion technology (to enable economic transport of many heavy solar energy components to geostationary orbits or to the moon).

An almost unlimited energy source would be the energies contained within the vacuum of space itself. For the vacuum contains more than enough "zero-point" electromagnetic energy to meet all conceivable energy needs throughout the entire future of earth. If such a stupendous energy source could someday be tapped, it could not only meet future terrestrial energy needs, but also become the basis of an entirely new mode of space vehicle propulsion (such as field propulsion) which could enable economical acquisition of extraterrestrial materials to preserve critical resources of earth.

Minimal Needs

Once bare essentials for life are met, the next level of need is purposeful activity that gives one a sense of worth. This, of course, is the need for new jobs, occupations, and careers to enable earth's ever-increasing numbers of individuals to live a useful and productive life. The history of air transportation is an example of how scientific discovery and technological advancement can help meet such human needs.

Here, aviation progressed steadily after the Wright Brothers' first powered flight. But, it did not really "takeoff" until a new science "quantum physics" enabled the solid-state devices used in today's avionics and micro-computers, and until a new technology "jet propulsion" enabled economical flight over long distances at high speed. This resulted in an air travel revolution which began approximately 60 years after the Wright Brothers' first flight. This air travel revolution spawned a vast and still growing infrastructure of hotels, resorts, and tourist-travel industries that have provided expansive new experiences and productive careers for millions of people on earth.

Similarly, spaceflight has progressed steadily since Sputnik became the first space vehicle to achieve orbit in 1957. For within a period of only 35 years, a vast satellite communications network has been established in space that provides telephone and television service almost everywhere on earth. Nevertheless, space travel has not yet been

revolutionized like air travel has because it still has a very high cost. Here, current costs to place a person in low earth orbit are roughly a million dollars per trip, while a cost of more than a billion dollars per person may be required to make the first expeditions to Mars. Space transportation costs would have to be reduced more than a 100-fold for things such as space tourism, and longer space missions would require greater reductions still.

Bold and exciting single stage to orbit vehicle developments such as the National Aerospace Plane (NASP) may eventually enable 100-fold reduction in earth-to-orbit travel costs and References such as 20 indicate that this could revolutionize space transportation within close proximity to earth. However, foreseeable advances in space rocketry and space sailing cannot provide the enormous cost reductions needed for longer trips. Therefore, entirely new modes of propulsion will be required for space travel cost reductions that would permit true space commercialization and, therefore, new economic opportunities and meaningful careers (like air travel did) for millions of people on earth.

Higher Needs

Serious problems facing the United States include increased illiteracy, crime, unethical behavior and, to growing numbers of people, a general dissatisfaction with merely material things. Such lowering of the human spirit can only be reversed by endeavors that lift it above the ordinary and mundane, and beyond mere maintenance of material life. In this respect, spaceflight has lifted the human spirit, fired the imagination and provided more human drama than any other technical activity of today. Here, youth interest in science and engineering directly followed U.S. dedication to the exploration of space, with growth of scientific and technical graduates closely matching growth of space funding during the 1960 Apollo program decade. Then, decrease in graduates closely followed diminished space activity in later years. It follows that a bold and long-term spaceflight program should, more than any other technical endeavor, motivate youth to greater achievement

by participating in the adventure of discovery and exploration, and the challenge of difficult things.

In summary, a bold and long term space program, that strives for the kinds of breakthroughs that will meet human needs, may be the best way of: preserving the kind of environment we want, providing many of the future jobs we need, and imparting the inspiration and aspirations that we all should have.

Setting Goals for Future Flight

Space goals have been a very important part of the exploration of space. Those that have been bold, visionary, and well articulated have stirred the human spirit and enabled enormous advancement of our spaceflight art. Here, John Kennedy set forth the first major space goal for the United States when he called for landing a man on the moon before the end of the 1960 decade. This goal was bold and ambitious, and it was reached with a magnificent effort which yielded advancements that have improved many aspects of life on earth. Its accomplishment was even more remarkable because it occurred while the U.S. was fighting the Vietnam war. For although this war severely drained fiscal resources, about 4 percent of the U.S. National Budget was being spent on space exploration when funding for the Apollo Program peaked. No other space goal was effectively articulated after Apollo for almost 30 years, and the U.S. space program has languished, with public enthusiasm waning to such an extent that the U.S. now spends less than one percent of the National budget on space.

Because the U.S. space program has lacked a long-term vision of what should be accomplished, it is very encouraging that President George Bush has taken the important step of elucidating specific goals for our next steps in space. However, setting space goals is difficult because leaders, who must proclaim them, look to technologists for what they should be; and technologists, not wanting to be irresponsible, tend to recommend endeavors that are safely within their expected technical reach.

Such prudence minimizes program risk, but it precludes the need to strive for the kinds of revolutionary advancements that gave America aerospace leadership in the past and created whole new industries and careers to meet human needs.

It has been concluded that a space exploration initiative that meets future human needs must entail a much more rapid rate of technical advancement that has been envisioned to date. Here, new technologies, new sources of energy and new modes of propulsion are needed for: ample sources of clean energy and resources from space, new industries and careers and raised hopes and aspirations of youth. Furthermore, the required rate of technical advancement to do this would be no more than which we have already accomplished in the past.

It is, therefore, proposed that we set an ambitious and extremely long-term space exploration goal that will meet human needs and challenge the human spirit for as long as the next 100 years. Furthermore, it is suggested that the long-term goal be far beyond our present technical reach and require about the same rate of aerospace advancement we accomplished in the past. Less ambitious "intermediate" goals (which include Space Station Freedom, Return to the Moon, and Expeditions to Mars) are also proposed as necessary stepping stones to the long-term one.

Table 3 presents a sample set of space exploration goals that include an initiative for interstellar flight. It emphasizes long-term activities that will help meet future human needs, and it includes our next desired steps in space. Finally, it also cites our long-term spaceflight intention — landing on a planet in another solar system within 100 earth years after the first manned landing on another celestial body (the moon).

Admittedly, the interstellar goal and timetable of Table 3 seems absurd today and, indeed, it might ultimately be proved unattainable by any possible mode of flight. But, we won't know this for sure for a very long time. In the meantime, "a man's grasp

□ Creation of new sources of clean energy, new modes of propulsion, and new means of exploiting the resources of space:

- To ensure adequate energy and resources for satisfactory quality of life on Earth for the next 100 years
- To create new industries, careers, and opportunities for the future generations of people in the United States
- To return to the moon to stay and land people on Mars by 2019 (50 years after the first manned landing on the moon)
- To explore the entire solar system and land people on a planet in another solar system by 2069 (100 years after the first manned landing on another celestial body – the moon)

Table 3. Example of SEI Goals That Include an Initiative for Interstellar Flight

should always exceed his reach” (Reference 21); so let’s “reach” the highest that we can in furthering the progress of flight.

Funding “Far-Out” Research for Future Flight

It, of course, would be folly to direct the bulk of aerospace resources on “far-out” research since this would cause current spaceflight momentum to be lost. But, today virtually nothing is spent on aerospace developments that would enable truly advanced things. Therefore, it is recommended that some fraction of our total space budget (somewhere in the 1 to 3 percent range) be allocated every year to advanced research for future flight.

Funding support for such activity should enormously stimulate technical interest in overcoming the flight barriers that would constrain us within an infinitesimal part of the vastness of space. It should also encourage activity by proposing organizations that would add to the far-out research accomplished with budgeted funds. Thus, a major problem may be selection of the best proposals from the many good ones that will be received. In this respect, proposals for far-out research could be solicited by NASA, DoD and DoE Small Business Innovation Research (SBIR) announcements and Broad Area Announcements (BAAs) and evaluated by qualified reviewers as is done today.

One obstacle to implementation of far-out research would be resistance from those who would prefer comfortable continuance of familiar things. For even if only 1 to 3 percent of conventional developments would have to make way for more radical work, this would require an uncomfortable transition into the uncertainty of bolder and more unorthodox things. Another obstacle would be continual pressure to take funding from long-term “far-out” research endeavors, and use it to keep larger near-term projects “on-track”. This has happened continually during the history of our space program, wherein smaller unmanned planetary exploration programs have been cutback, stretched and sometimes cancelled in order to provide more funding for larger and more visible manned space programs when they overrun.

Admittedly, scientific breakthroughs cannot always be expedited by mere increase in funding like many aerospace projects can. Furthermore, many breakthroughs seem to come more through serendipity rather than by formal planning and decrees. Nevertheless, there appears to be hardly any current momentum whatsoever in searching out and developing ideas and concepts that might lead to extraordinary things such as zero-point energy for earth and field propulsion for flight. And, significant support for breakthrough science and technology should surely improve the climate for serendipitous breakthroughs coming to pass.

Conclusions and Recommendations

Proposed goals for space exploration only consider our next steps in space, not our long-term vision and ultimate objective—journeys to the stars. Proposed goals are also technically conservative in that they do not demand the kinds of bold breakthroughs needed for significant human expansion beyond the limits of earth for meeting critical future human needs.

In this respect, maintaining the average rate of aerospace progress we accomplished during the first 87 years of flight would enable attainment of light speed and distant stars before the next 87

years of flight have passed. Such progress would include energy and propulsion breakthroughs gained by delving deeper into the mystery of so-called "matter, time and space"—the same kinds of breakthroughs in knowledge and technology that are needed to help solve the critical future problems facing the people of earth.

And, although space goals should emphasize our next steps in space, they include our intention to ultimately embark upon interstellar journeys to the further reaches of space.

Thus, although near-term plans for space exploration must mainly build on the spaceflight art we possess today, a small fraction of total spaceflight funding should be directed towards more "far-out" research for future flight.

It, of course, is conceivable that our future flight progress will be stopped by insurmountable barriers that cannot be overcome; that we will never discover new sources of energy or new modes of propulsion or ever surpass the speed of light; and that we will, therefore, be forever limited to an infinitesimally small portion of the vastness of cosmic space. But, since there is not yet overwhelming evidence that such limits do exist, it seems too soon to give up in our battle to overcome all barriers to flight. Therefore, until we know for sure that the distant stars are impossible to attain, let's have our future goals and plans for space exploration reflect our intention to strive for the ultimate in spaceflight attainment - interstellar flight.

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