# Scope of the NIAC Call for Proposals

## Introduction

The NIAC encourages potential proposers to focus their thoughts decades into the future and aggressively pursue concepts that will "leap-frog" the evolution of current aerospace systems. Rickenbacker observed that,

> *The very existence of aviation is proof that man, given the will, has the capability to accomplish deeds that seem impossible.*
>
> *Our progress in aviation and in space travel is limited only by the boundaries of human imagination.*

Science fact and fiction writers have often stimulated our imagination. One of the most prominent space scientists of our time was Carl Sagan.

> Carl Sagan , Pale Blue Dot: *…the continuing dance between science and science fiction, in which the science stimulates fiction, and the fiction stimulates a new generation of scientists, a process benefiting both genres.*

While the NIAC seeks concepts which stretch the imagination, these concepts should be based on sound scientific principles. **Now is your time to dream and stretch your imagination**. The **"Dreams"** supported through the NIAC funding can be the framework for future NASA missions and programs. Advanced concept proposals should be aimed well beyond the evolution technical challenges that occupy current programs and set new, **revolutionary** directions in aeronautics and space. We are seeking advanced concepts, ***specifically systems and architecture*s**, that are indeed "Grand" and revolutionary, and which ***will expand our vision of future possibilities***.

Just as was noted by Eddie Rickenbacker, at one time, human flight seemed impossible. And, as observed by Arthur C. Clarke, some **"**impossibilities**"** of today, could be the **"**possible worlds**"** of the future.

> Clarke's Second Law: *The only way of discovering the limits of the possible is to venture a little way past them into the impossible.*

These "possible worlds" are the ones that we seek in this NIAC Call for Proposals.

> Freeman Dyson, Imagined Worlds: *If we are looking for new direction in science, we must look for scientific revolutions. When no scientific revolution is under way, science continues to move ahead along old directions. It is impossible to predict scientific revolutions, but it may sometimes be possible to imagine a revolution before it happens.*

## <u>Grand Challenges in Aeronautics and Space</u>

The proposer should become familiar with the information supplied in the NASA webpages (http://www.nasa.gov/) which provides valuable insight into the NASA mission, current activities and future directions. The NASA Strategic Plan provides valuable background information about the visions of future aeronautics and space programs and should be considered as a starting point for the development of revolutionary concepts being sought by the NIAC. **The general thrust of the NIAC advanced concepts is to develop revolutionary ideas which have a potential for leaping well past the current plans and can enable and expand the vision of NASA's long-range strategic plans.** These proposed advanced concepts <u>must</u> be focused 10-40 years into the future.

To assist potential proposers in the development of advanced concepts, the NIAC has developed a list of challenges in science and engineering which, while not exclusive, are meant to give some guidance for visionary and revolutionary concept development. **These challenges in aeronautics and space listed below are examples of focus areas for proposals and are not meant to be comprehensive.** While the grouping of the challenges approximately corresponds to the NASA Enterprises, proposers are encouraged to conceive of synergistic concepts which address the challenges of more than one Enterprise or focus area. **Proposals are also encouraged in other areas which are not specifically listed, but are still within the NASA mission areas.** The NASA Enterprise areas are described in the NASA webpages.

### Space Science

Solve the mysteries of the universe

- →Expand our knowledge of the universe from the Big-Bang to the present including, the first 300K years and the formation of galaxies; the interaction of stars galaxies and interstellar matter and exotic structures and phenomenon such as black holes, quasars, pulsars and mysterious ultra high energy particles.
- →Devise techniques to test the physical theories and reveal new phenomenon throughout the Universe including gravitational and relativistic phenomenon, such as testing the variation of gravity with time and validating the general theory of relativity.
- →Identify, characterize and quantify the invisible mass in the universe

Explore the solar system

- →Develop an understanding of sun-earth interactions as they related to critical Earth processes
- →Define and optimize techniques, including space mission components, for detecting and characterizing near-Earth (or Earth approaching) asteroids and comets.
- →Conduct comprehensive exploration of the entire solar system (including beyond the planets) through remote sensing, in-situ measurements and sample return.

Explore beyond the solar system

- →Discover, image and characterize planets around other stars and identify which, if any, may be most Earthlike.
- →Observe Wolszczan planets directly and develop systems for future exploration

Search for life beyond Earth

- →Understand the relationships and develop models to classify the relationships between life and planetary evolution

Eliminate the barriers of extreme distance and long duration space flight

- →Increase the distance to which we can travel, our ability to observe where we cannot travel and the quality of the work we can do there
- →Develop mechanical, electrical or biological self-diagnostic and repair systems for long duration space flight
- →Develop high efficiency, high performance detectors and instruments for the entire electromagnetic spectrum

**Earth Science**

Develop revolutionary cost-effective means to enable entirely new investigations to expand our understanding of the Earth system beyond current capability.

- →Provide knowledge of component climate processes in a framework that allows assessments and forecasting of changes in the global earth system, including short-term severe (e.g., tornadoes, hurricanes and earthquakes) and long term (e.g., El Nino).
- →Develop measurement and analytical techniques to create a comprehensive model of the Earth's biosphere with special emphasis on the ocean-atmosphere and earth-atmosphere interfaces.
- →Develop micro-instrumentation for comprehensive distributed *in situ* measurements
- →Develop new techniques to manage the explosive growth of Earth science and applications data and provide timely analysis.

**Human Exploration and Development of Space**

Enable human exploration and development of our solar system

- →Develop systems for the generation and distribution of energy anywhere in the solar system
- →Develop mechanical, electrical or biological self-diagnostic and repair systems for long duration space flight.

Transport humans comfortably between desirable habitats throughout the solar system

- →Provide reliable, safe, short transit times, low radiation exposure, low accelerations, artificial gravity, low cost, adequate amenities)
- →Use knowledge from advanced genetics and biotechnology to optimize the selection and performance of human crews in prolonged missions

→Develop compact, non-invasive methods, compatible with the space environment to assess/monitor/amplify physiological and biological processes and cognitive motor functions.

Enable human settlements beyond Earth

→Emphasize the use of *in situ* resources for self-sufficiency including habitats, infrastructure and consumables.

→Develop techniques and facilities to enable long term human activities in space vehicles and on planetary bases.

→Develop self-reliant (e.g., self-diagnostic and repair ) systems including mechanical, electrical or biological systems for humans in long duration space flight and in planetary habitats.

→Develop biological systems which assist in the support of planetary human habitats

Use the space environment to enhance life on Earth

→Identify how unique aspects of the space environment can be used to provide knowledge about disease, improve health and extend life on Earth.

→Use unique environments (e.g., variable gravity, microgravity and space radiation) throughout the solar system to develop a comprehensive understanding of the basic physical, chemical and biological/medical processes and human physiology.

**Aeronautics and Space Transportation**

Expand our use of aviation

→Develop advances in air travel safety, affordability and environmental compatibility that would open up aviation to all people either as pilots or passengers

→Reduce portal to portal, multi-modal, aviation transportation time on a global basis by a factor of three

Explore innovative aviation system enablers

→Mitigate the constraints of flight transportation systems related to cost, emissions and noise (sonic booms, jet noise and rotor noise)

→Provide broadband information/data (communication, navigation, weather, and situation awareness) to all participants in the global aviation system to dramatically improve safety

→Develop air vehicles with unlimited flight duration for uses such as: observation and detection of earth/atmosphere/solar relationships; information relay and/or collection; solar energy collection and relay

Revolutionize our access to space

→Devise a space transportation system where transportation and operation costs are a small fraction of the total mission costs

→Develop advances in space transportation to allow science, research, commerce, and exploration platforms to deliver payloads on rendezvous missions to the outer planets within a ten-year mission time frame and to go beyond our solar system to interstellar distances in a fifty-year horizon.

→Develop space propulsion systems capable of continuous thrust to achieve very high speed.

→Identify and develop non-propulsion means for space travel such as highly economical concepts that do not rely on an on-board propulsion system.