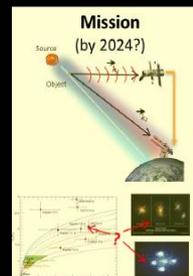
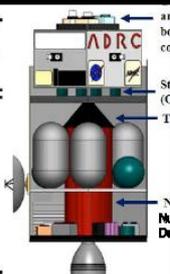
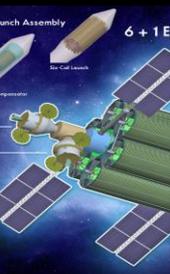
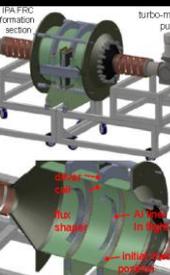
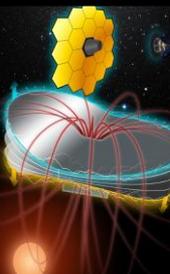




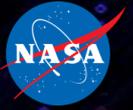
NASA INNOVATIVE ADVANCED CONCEPTS 2012 Advance Space Propulsion Workshop

Dr. Ron Turner
Senior Science Advisor
NASA Innovative Advanced Concepts
(Analytic Services Inc...ANSER)
Ron.turner@anser.org

November 28, 2012
Marriott Huntsville
Huntsville, AL



www.nasa.gov/niac



INTRODUCTION



www.nasa.gov/niac



What is *NIAC* ?

NASA Innovative Advanced Concepts

NASA Innovative Advanced Concepts

A program to support
early studies of
innovative, yet
credible, visionary
concepts
that could one day
“change the possible”
in aerospace.



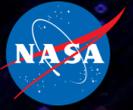
**Visionaries and geniuses share
common traits:**

**The ability to transcend life's experiences
and leap vast intellectual distances
to set a new course for others to follow.**

**Imagination and visualization are generally the first
step in learning, or creating, something radically new.**

**Genius is the ability to transcend experience
and "The Rules"**

***"You cannot depend on your eyes when your
imagination is out of focus" -- Mark Twain***



Who are we looking for?



www.nasa.gov/niac

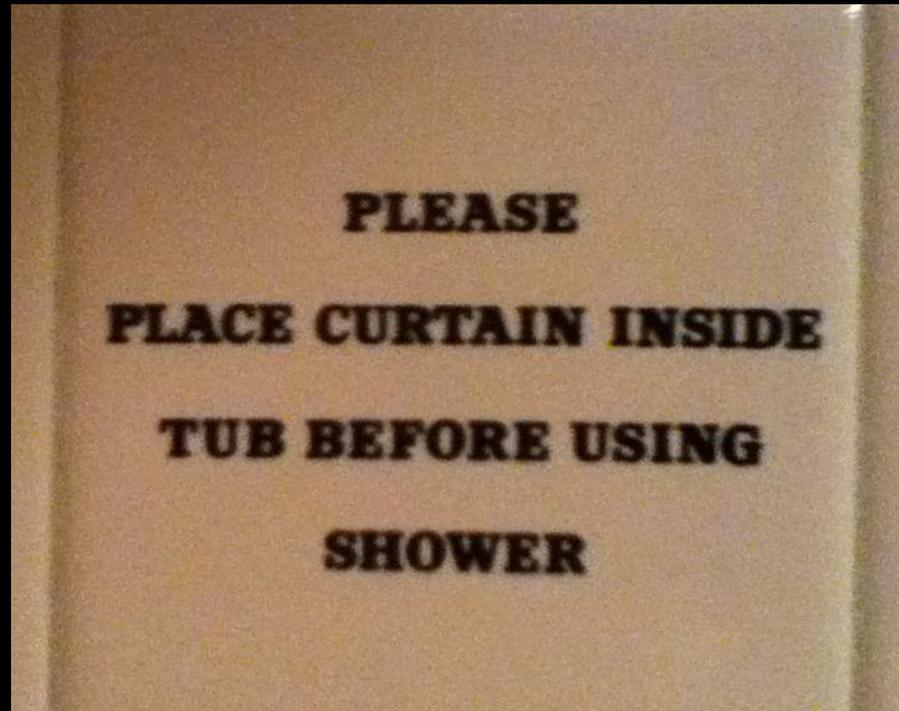
**BOAT ROCKERS, REBELS, RISK TAKERS, DEVIATORS
FROM THE NORM, INNOVATORS, CHAMPIONS,
REVOLUTIONARIES, MOVERS & SHAKERS,
INVENTORS, RABBLE ROUSERS, FLY IN THE FACERS,
REFORMERS, WAVE MAKERS, BOUNDARY PUSHERS &
OUT OF THE BOX THINKERS...**



Image: NASA, CW Leo

In other words...

If this warning applies to you:



W E L C O M E T O...



www.nasa.gov/niac



NIAC OVERVIEW



www.nasa.gov/niac

Space Technology Programs



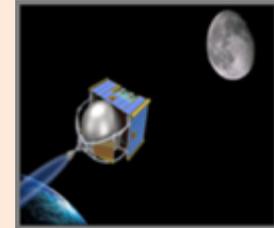
Transformative &
Crosscutting
Technology
Breakthroughs



**Game Changing
Development Program**



**Technology
Demonstration
Missions Program**



**Small Spacecraft
Technologies Program**

Pioneering Concepts/
Developing
Innovation
Community



**Space Technology
Research Grant Program**



**NASA Innovative
Advanced Concepts
(NIAC) Program**



**Center Innovation Fund
Program**

Creating Markets &
Growing Innovation
Economy



**Centennial Challenges
Prize Program**



**Small Business Innovation Research
& Small Business Technology
Transfer (SBIR/STTR) Program**



**Flight Opportunities
Program**

NIAC Program Personnel

- Program Executive: **Jay Falker***
- Program Manager: **Jason Derleth***
- Senior Science Advisor: **Ron Turner**
- Outreach Coordinator: **Kathy Reilly**
- Financial Analyst: **Anita Babb-Bascomb***



* NASA Civil Servants

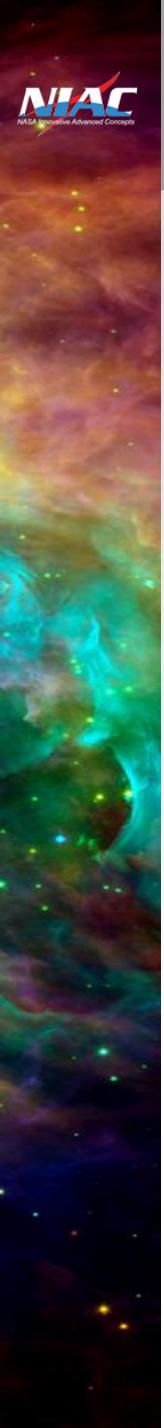
- NIAC External Council Chair: **Bob Cassanova**

Director of the original NIAC from 1998-2007



“Don’t let your preoccupation with reality stifle your imagination”





NIAC External Council Members



- **Dr. Penny Boston**
- **Dr. David Brin**
- **Dr. Robert Cassanova (Chair)**
- **Dr. John Cramer**
- **Dr. Frank Drake**
- **Dr. Frank Martin**
- **Dr. Mike Yarymovych**
- **Dr. Larry Young**

NIAC Scope, Awards, & Culture

- **NIAC supports early studies of visionary aerospace concepts. These must be...**
 - Aerospace *architecture, mission, or system* concepts (not focused tech.)
 - **Exciting**: offering a potential breakthrough or revolutionary improvement
 - **Unexplored**: novel, with basic feasibility and properties unclear
 - **Credible**: sound scientific/engineering basis and plausible implementation
- **NIAC awards support two phases of study:**
 - **Phase I**: up to \$100K, ~9 months, for concept definition and initial analysis in a mission context
 - **Phase II**: up to \$500K, 2 years, for further development of most promising Phase I concepts, comparative mission analysis, pathways forward
- **NIAC networking, outreach, and inspiration are also key:**
 - Fall Symposium: status presentations by the Phase II Fellows
 - Spring Symposium: mid-term presentations on the Phase I Studies
 - Conferences / Websites / Articles / Interviews / Radio Spots ...

What Opportunities does NIAC Offer?



Phase I Solicitation

Open to everyone (US)
Date: early Jan. 2013



Phase II Solicitation

Eligible upon Phase I completion
Date: late May 2013



NIAC Spring Symposium

Open to everyone
Date: March 2013

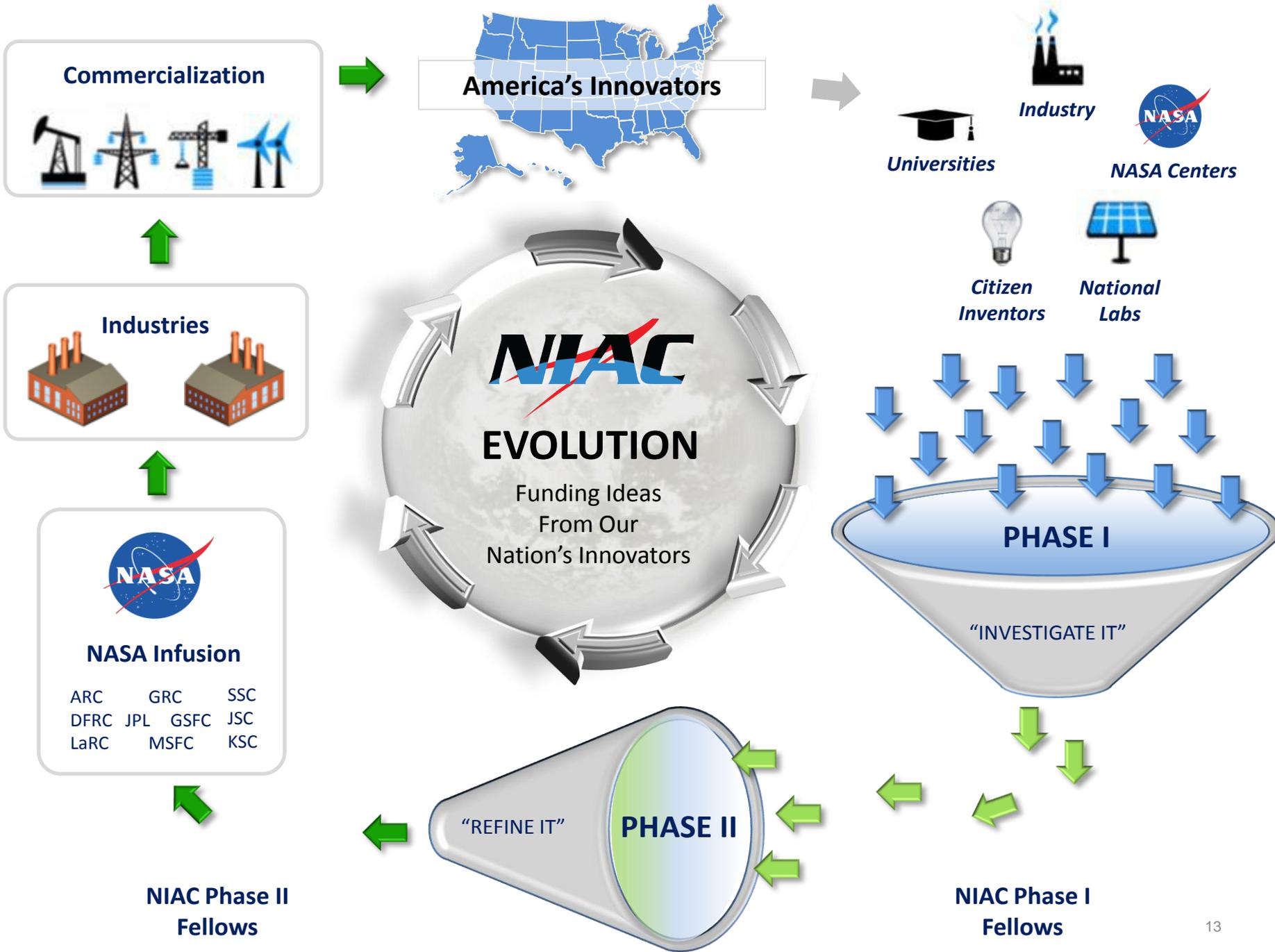


NIAC Fall Symposium

Open to everyone
Date: November 2013



Open access to presentations/studies at:
www.nasa.gov/niac



Outreach

We encourage communication and sharing

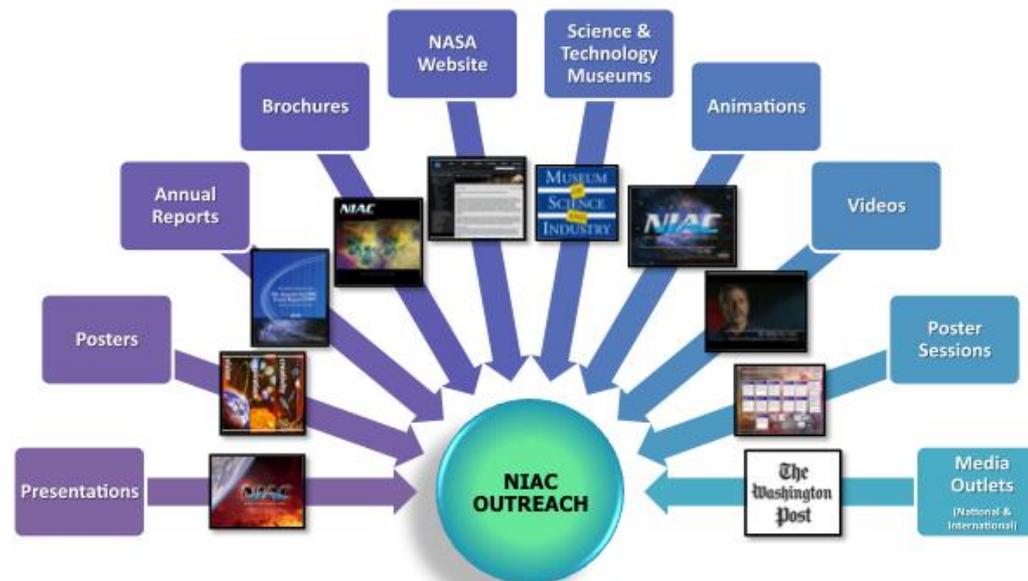
Between Fellows and with NASA, public, press, and other orgs

All Symposia presentations and Final Reports will be **public**

Posted in pdf format on the NIAC website

Sensitive information can be protected (e.g., separate appendix)

Chicago Museum of Science & Industry, NIAC Education & Public Outreach Initiative: “From Science Fiction to Science Fact” Lecture Series





NIAC In The News

Coverage In Hundreds of Media Outlets Since 1st Awards Announcement (08/08/11)



The collage includes logos for the following entities:

- MSNBC** (with NBC peacock)
- NewScientist**
- AAAS** (ADVANCING SCIENCE. SERVING SOCIETY)
- Next Big Future**
- SPACE.COM**
- UNIVERSE TODAY**
- Phoenix Online News**
- VOA** (VOICE OF AMERICA)
- INNOVATION NOW**
- EE Times**
- POPULAR SCIENCE** (THE FUTURE NOW)
- AIAA** (The World's Forum for Aerospace Leadership)
- dradio.de** (MACHINERY AND EQUIPMENT)
- MRO** (MAINTENANCE, REPAIR AND OPERATIONS)
- Market Watch** (THE WALL STREET JOURNAL)
- facebook.**
- ALL TECH NEWS FINANCIAL**
- NATIONAL INSTITUTE OF AEROSPACE**
- The Washington Post**
- THE WHITE HOUSE WASHINGTON**
- VIRTUAL-STRATEGY MAGAZINE** (your leading source for virtualization news)
- SPACE DAILY** (your portal to space)
- INTERNATIONAL BUSINESS TIMES**
- YouTube**
- WIRED SCIENCE**
- SYS-CON MEDIA**
- issuu**
- PHYSORG.COM** (SCIENCE : PHYSICS : TECH : NANO : NEWS)
- Business Wire** (A Berkshire Hathaway Company)
- abc NEWS**
- DIGITAL JOURNAL**
- ALASKA NATIVE NEWS**
- Slashdot**
- USC** (UNIVERSITY OF SOUTHERN CALIFORNIA)
- ASTROBIOLOGY MAGAZINE**
- dt DIGITAL TRENDS**
- PITTSBURGH BUSINESS TIMES**
- space REF**
- Centauri Dreams**
- The Des Moines Register**
- smartplanet**
- fuse**
- SPACE POLICY ONLINE**
- BRADENTON HERALD** (Bradenton.com)
- PENN STATE**
- Environmental PROTECTION**
- YAHOO! NEWS**
- TXCHNOLOGIST** (SPONSORED BY GE)
- imag'nation|now** (Moving from what is to what if...)
- PORTAL TO THE UNIVERSE**
- USRA QUALITYDIGEST**
- U.S. Politics Today** (AN EIN NEWS SERVICE FOR POLITICAL PROFESSIONALS)
- ROCHESTER INSTITUTE OF TECHNOLOGY** (R-I-T 1829)
- sculpteo**
- Azrobotics.com** (The A to Z of Robotics)
- Orlando Sentinel**
- Iowa State University College of Engineering**
- SPACEFLIGHT NOW** (The leading source for online space news)
- CRAZYENGINEERS** (UNITING ENGINEERS ACROSS THE WORLD)

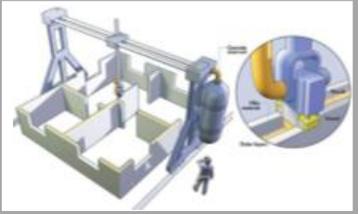


NIAC: Inspiring Economic Benefits for the Nation

Berok Khoshnevis



3-D Printing the Home of the Future
Emergency Construction for natural disasters, eradicate slums in developing countries



Kevin Duda



Improving Health With Spacesuit Technology
Medical rehabilitation and physical therapy for individuals affected by stroke, spinal cord injuries, brain injuries, and the elderly.



Greg Scott



Bacterial Batteries
Novel Energy Source: Bacterial Microbes to power up robots



John Mankins



Space-Based Solar Power
Power transmission to Earth for use during power outages, after natural disasters, to those in remote areas or by the military.



Babak Saif



Navigation
Gravitational waves on the atomic level could lead to technology for better steering of military submarines or aircraft



2012 NIAC Studies: Five Group Overview



Revolutionary Construction

SpiderFab
Orbiting Rainbows
ISRU Robotic Construction
E-M Deployment/Structures
OCCAMS
Printable Spacecraft

Human Systems

Water Walls
Solid State Air Purification
V2Suit
Magnetic Radiation Protection

Sensing/Imaging

HOMES
NIST in Space
Atom Interferometry
Ghost Imaging

Autonomous Exploration

Super Ball Bot
RAP
Regolith Biters
Venus Landsailing Rover
EUROPA
Cavehopping Planetary Tunnels
Extreme Environmt. Sample Return

Transportation/NEO Mitigation

NanoTHOR
Plasma Aerocapture & Entry System
SSEARS
MAGNETOUR
Bi-Directional Flying Wing
Fusion Driven Rocket
NEO Impact Threat Mitigation

*Blue denotes Phase II Studies

2012 Phase I Awards

Adrian Agogino

Super Ball Bot - Structures for Planetary Landing and Exploration
NASA ARC Moffett Field, CA 94035

Juan Arrieta

The Regolith Bitters: A Divide-And-Conquer Architecture for Sample-Return Missions
NASA JPL Pasadena, CA 91109-8001

Marc Cohen

Robotic Asteroid Prospector (RAP) Staged from L-1: Start of the Deep Space Economy
Marc M. Cohen, Architect Palo Alto, CA 94306-3852

Thomas Ditto

HOMES - Holographic Optical Method for Exoplanet Spectroscopy
3DeWitt LLC Ancramdale, NY 12503-0010

Michael Flynn

Water Walls: Highly Reliable and Massively Redundant Life Support Architecture
NASA ARC Moffett Field, CA 94035

Wayne Gellett

Solid State Air Purification System
eSionic Menlo Park, CA 94025-1438

Robert Hoyt

NanoTHOR: Low-Cost Launch of Nanosatellites to Deep Space
Tethers Unlimited, Inc. Bothell, WA 98011-8808

Robert Hoyt

SpiderFab: Process for On-Orbit Construction of Kilometer-Scale Apertures
Tethers Unlimited, Inc. Bothell, WA 98011-8808

David Kirtley

A Plasma Aerocapture and Entry System for Manned Missions and Planetary Deep Space Orbiters MSNW, LLC Redmond, WA 98052-3557

Geoffrey Landis

Venus Landsailing Rover
NASA GRC Cleveland, OH 44135-3127

Gregory Lantoine

MAGNETOUR: Surfing Planetary Systems on Electromagnetic and Multi-Body Gravity Fields
NASA JPL Pasadena, CA 91109-8001

Leigh McCue

Exploration of Under-Ice Regions with Ocean Profiling Agents (EUROPA)
Virginia Polytechnic Institute and State University Blacksburg, VA 24061-0001

Jeffrey Nosanov

Solar System Escape Architecture for Revolutionary Science (SSEARS)
NASA JPL Pasadena, CA 91109-8001

Joseph Predin

NIST in Space: Better Remote Sensors for Better Science ITT Space Systems, LLC
Fort Wayne, IN 46818-1165

Marco Quadrelli

Orbiting Rainbows: Optical Manipulation of Aerosols and the Beginnings of Future Space Construction NASA JPL Pasadena, CA 91109-8001

Babak Saif

Atom Interferometry for detection of Gravity Waves-a NASA GSFC Greenbelt, MD 20771-2400

Robert Winglee

Sample Return Systems for Extreme Environments
University of Washington, Seattle Seattle, WA 98195-1310

Gecheng Zha

Silent and Efficient Supersonic Bi-Directional Flying Wing
University of Miami Coral Gables, FL 3314

Kevin Duda

Variable Vector Countermeasure Suit (V2Suit) for Space Habitation and Exploration
Charles Stark Draper Laboratory Inc. Cambridge, MA 02139-3539

Behrokh Khoshnevis

ISRU-Based Robotic Construction Technologies for Lunar and Martian Infrastructures University of Southern California Los Angeles, CA 90089-0001

David Miller

High-Temperature Superconductors as Electromagnetic Deployment and Support Structures Massachusetts Institute of Technology Cambridge, MA 02139-4301

Joe Ritter

OCCAMS: Optically Controlled and Corrected Active Meta-material Space Structures Neoteric Physics, Inc. Kihei, HI 96753-9310

Kendra Short

Printable Spacecraft: Flexible Electronic Platforms for NASA Missions NASA JPL Pasadena, CA 91109-8001

John Slough

The Fusion Driven Rocket: Nuclear Propulsion through Direct Conversion of Fusion Energy MSNW LLC Redmond, WA 98052-3557

Dmitry Strelakov

Ghost Imaging of Space Objects NASA JPL Pasadena, CA 91109-8001

Shayne Westover

Radiation Protection and Architecture Utilizing High Temperature Superconducting Magnets NASA JSC Houston, TX 77058-3607

William Whittaker

Cavehopping Exploration of Planetary Skylights and Tunnels Astrobotic Technology, Inc. Pittsburgh, PA 15213-3524

Bong Wie

An Innovative Solution to NASA's NEO Impact Threat Mitigation Grand Challenge and Flight Validation Mission Architecture Development Iowa State University Ames, IA 50011-2207



DATES & DETAILS



www.nasa.gov/niac

Key 2013 Dates: Symposia & Site Visits

- Spring Symposium: **March 12-14, in Chicago, IL**
 - **Phase I presentations** on study progress
 - Phase II posters on study progress
 - We will discuss Phase II (this is before solicitation release) and answer questions
- Fall Symposium: early November, venue TBD
 - Agenda/emphasis likely much like here
- Phase II Site Visits: Sept-Oct 2013, venue TBD



Key 2013 Dates: Phase I Solicitation

- Two-Step Solicitation / Response: Jan - April
 - NASA Research Announcement (NRA) release early Jan
 - Step A White Papers due early Feb (1 month)
 - Step B invitations early March (1 month)
 - Step B Full Proposals due early April (1 month)

- Review Panels: April - June
 - Technical Review Panels complete by late May
 - Integration Panel complete by late June

- HQ Review & Announcements: July
 - Consultation for synergy/overlap with other NASA efforts
 - Official Source Selection by mid-late July
 - Announcement ASAP (all proposers receive notification)

- Goal: all awards received by mid-August
 - These will be for 9-month studies, up to \$100K

Intent of Phase I Study

The Phase I awards will be nine-month efforts to explore the overall feasibility and viability of visionary concepts. A Phase I *study* must:

- **Develop the concept** — the constituent technology/systems and operations should be identified, defined, or refined. Key properties should be investigated. Potential applications and paths for further advancement (of the overall concept and key elements) should be considered.
- **Assess the concept in an Aerospace or Aeronautics mission context** — determining feasibility and comparing properties/performance with those of current missions/concepts should be the main focus. (*This is more important than detailed analysis of the underlying phenomena or technology.*) Concepts that may support multiple missions should discuss the range, but must feature detailed analysis of at least one candidate mission application.

A final written technical report at the conclusion of the effort, ***suitable for public release***, to include:

- Detailed description of the concept and the benefits it offers
- One or more detailed example applications in a NASA mission context
- The approach used to evaluate the concept
- Technical details supporting the findings with regard to the concept's technical feasibility
- Technical challenges that remain to be addressed

Phase I Deliverables

Status Reports

Brief written status reports to NASA Headquarters by the 15th day of the second month after award, and bimonthly thereafter.

[Note: to synchronize reporting, despite variable start dates, please provide your updates in: December 2012, February 2013, etc.]

Final Technical Report

A final written technical report by the conclusion of the effort, suitable for public release, detailing the concept and what it offers to NASA, the approach used to evaluate the concept, and the findings with regard to the concept's technical feasibility.

NIAC Symposium Participation

NIAC Fellow (i.e., Principal Investigator) attendance at two program meetings. The first will be to present an overview poster of the concept at a three-day NIAC Fall Symposium and the second will be to present status and preliminary findings at a three-day NIAC Spring Symposium.

NOTE: In addition to the formal deliverables, NIAC encourages you to publish in technical journals, present at technical conferences, and engage the public (and press) for outreach. Please remember to **include NASA/NIAC attribution**, and keep Kathy Reilly informed.

Key 2013 Dates: Phase II Solicitation

- One-Step Solicitation / Response: May - July
 - NASA Research Announcement (NRA) release late May
 - Full Proposals due early July (6 weeks)*
 - * Only eligible if Phase I Final Report is received

- Review Process: July - August
 - Technical Reviews complete by early Aug
 - Integration Panel complete by mid Aug

- HQ Review & Announcements: July
 - Consultation for synergy/overlap with other NASA efforts
 - Official Source Selection by late Aug
 - Announcement ASAP (all proposers receive notification)

- Goal: all awards received by mid-September
 - These will be for 2-year studies, up to \$500K

Intent of Phase II Study

To study major viability issues associated with cost, performance, development time, and key technologies. Aim to provide NASA a sound basis to consider the concept for further development and a future mission. Toward that end, a Phase II study should...

- **Continue to develop the concept from Phase I** — refinements or advances identified during Phase I are expected to be incorporated, but the Phase II must be a continuation of the Phase I study.
- **Continue to assess the concept in a mission context** — the main focus should be determining viability and comparing properties/performance with those of current missions/concepts. Concepts that may support multiple missions should discuss the range, but must feature detailed analysis for at least one candidate mission.
- **Assess the programmatic benefits and cost versus performance of the proposed concept** — explore the relationships between the concept features (technology, complexity, etc.) and the projected benefits, cost, risk, and performance.
- **Develop paths forward** — identify the key enabling technologies/systems and propose steps for research, development, and demonstration

Phase II Deliverables

Status Reports

Brief written status reports (no more than a few pages) to NASA Headquarters by the 15th day of the second month after award, and bimonthly thereafter.

Site Visit Review

Presentation at a one-day Site Visit Review to provide a thorough overview of technical and programmatic progress. This meeting will be hosted by the PI and supported as appropriate by key team members. The NASA review team will consist of NIAC program management, in addition to invited technical experts. The site visit shall be planned for approximately one year after award, but scheduling will be subject to the availability of the appropriate NASA review team. Travel costs of the NASA review team are not to be covered by the contract.

Final Technical Report

A final written technical report within thirty days of the conclusion of the effort, suitable for public release, detailing the concept and what it offers to NASA, the approach used to evaluate the concept, and the findings with regard to the concept's technical feasibility.

Annual Key Enabling Technologies Report

A written summary of identified key enabling technologies and prepare a pathway for development of a technology roadmap. Delivered to NASA Headquarters annually beginning one year after award.

NIAC Symposium Participation

NIAC Fellow (i.e., Principal Investigator) shall attend up to two program meetings per year. The first will be to present an overview of the concept at a three-day NIAC Fall Symposium and the second will be to present progress via posters at a three-day NIAC Spring Symposium.

Three Stages of Reaction to Revolutionary Ideas

- 1 – It's completely impossible
- 2 – It's possible, but it's not worth doing
- 3 – I said it was a good idea all along

Arthur C. Clarke



The Future Possibilities Depend on You



**NIAC is the most open-ended
and far-reaching of NASA's
technology programs**

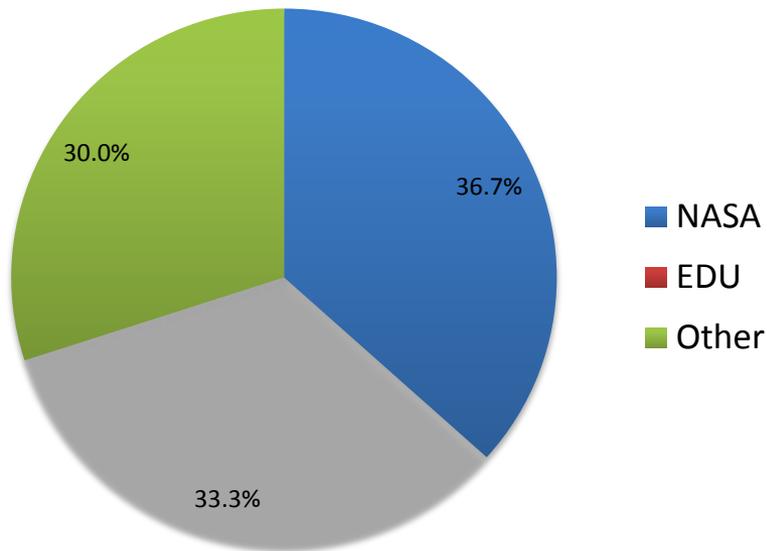
Stretch your imagination...change the possible!

Dr. Jay Falker

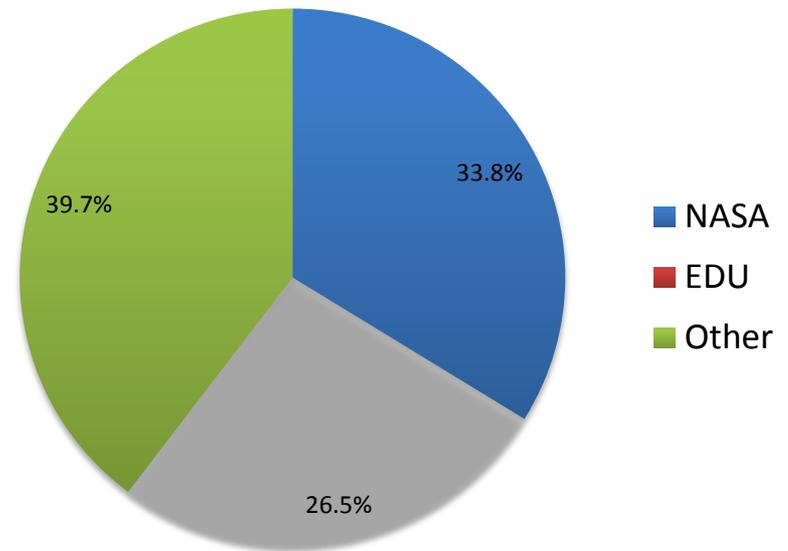
BACKUP MATERIAL

Dollar Distribution 2011 - 2012

NIAC \$ DISTRIBUTION 2011

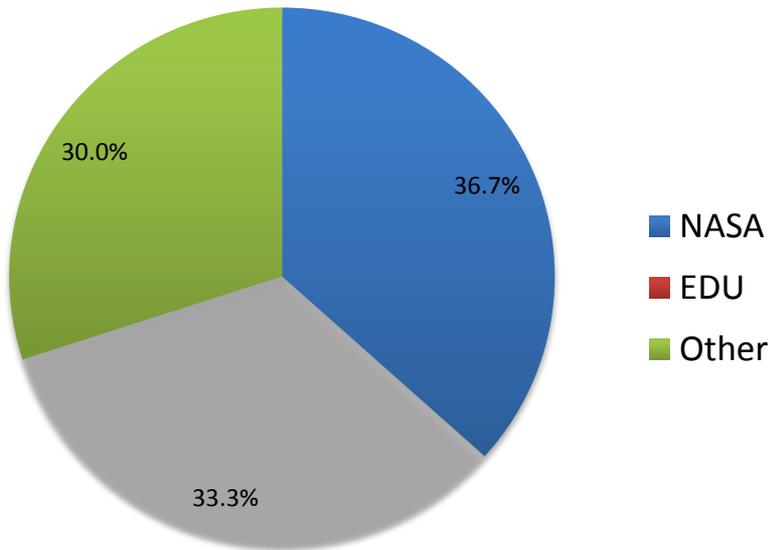


NIAC \$ DISTRIBUTION 2012



Study distribution 2011 - 2012

NIAC STUDIES 2011



NIAC STUDIES 2012

