NASA Innovative Advanced Concepts

Space Technology Mission Directorate
NASA Headquarters, Washington, DC

Jason Derleth, *NIAC Program Executive*
Michael LaPointe *NIAC Program Manager*
Ronald Turner, *Senior Science Advisor*
Katherine Reilly, *Strategic Partnerships Manager*
John Nelson, *Senior Technology Consultant*

Presentation to the Space Resources Roundtable
Golden, CO
June 12-14

NIAC
NASA Innovative Advanced Concepts

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.

Space Technology Pipeline

Early Stage

- NASA Innovative Advanced Concepts
- Space Tech Research Grants
- Center Innovation Fund

Commercial Partnerships

- SBIR /STTR
- Flight Opportunities
- Centennial Challenges
- Regional Economic Development

TECHNOLOGY PIPELINE

NIAC is Unique!

- Yes, we give out funds to pursue innovative concepts, but we are also a "Fellowship" encouraging sharing and interactions
- The Public loves NIAC, and the Press seeks out our Fellows to report on their concepts and their enthusiasm
- NIAC sponsors unique opportunities for our Fellows to interact with the public, including a series of "Science Fiction to Science Fact" sessions at Museums across the country
- Each Fellow's full Final Report is posted on the web for all to see, as well as the presentations they gave on their progress, given at an Annual Public Symposium

NIAC is more than a research grant opportunity

NIAC in the News

Coverage in Hundreds of Media Outlets

The Washington Post

June 12, 2014

"If you thought Elon Musk was the only person coming up with innovative ideas for the exploration of outer space, you'd be wrong….

…Ultimately, that's the beauty of the NASA Innovative Advanced Concepts program – it lets people dream big, commits only a relatively small amount of seed money up-front before the next round of funding, and is ***capable of generating a 10X or 100X return on the initial investment. That's just the way it works in Silicon Valley****…"*

NIAC Program Personnel

A “Renaissance Team” with diverse, multidisciplinary backgrounds

Jason Derleth
Program Executive

Michael LaPointe
Program Manager

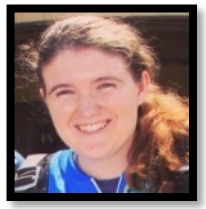
Ron Turner
Senior Science Advisor

Kathy Reilly
Strategic Partnerships Manager

John Nelson
Senior Technical Consultant

Barbara Mader
NIAC Budget Analyst

Tara Halt
Program Analyst



NIAC External Council

Senior Scientific Advisory Team

Dr. Louis Friedman
NEC Chair
Co-Founder, The Planetary Society, author

Dr. Amy Kronenberg
Biophysicist, Lawrence Berkeley National Laboratory

Dr. David Brin
Scientist, speaker, author, futurist

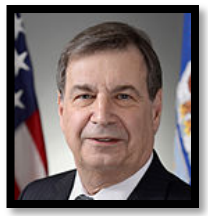
Dr. Laurence Young
Apollo Prof. of Astronautics & HST, MIT

Dr. John Cramer
Prof. of Physics, Univ. of Washington, and author

Ms. Ariel Waldman
Founder of SpaceHack.org & Science Hack Day

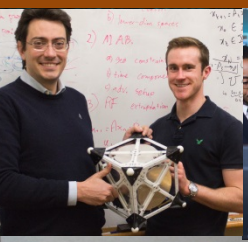
Dr. Frank Drake
Astronomer, Astrophysicist, father of SETI

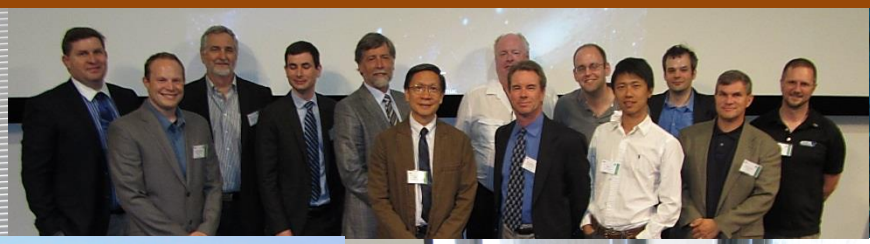
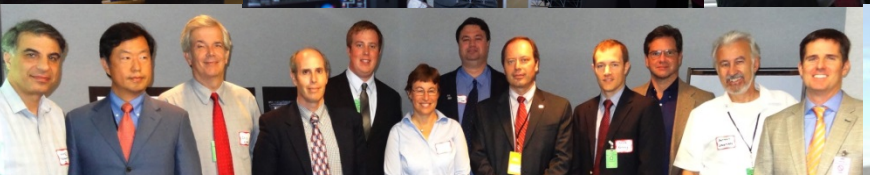
Dr. Gregory Zacharias
Chief Scientist, US Air Force



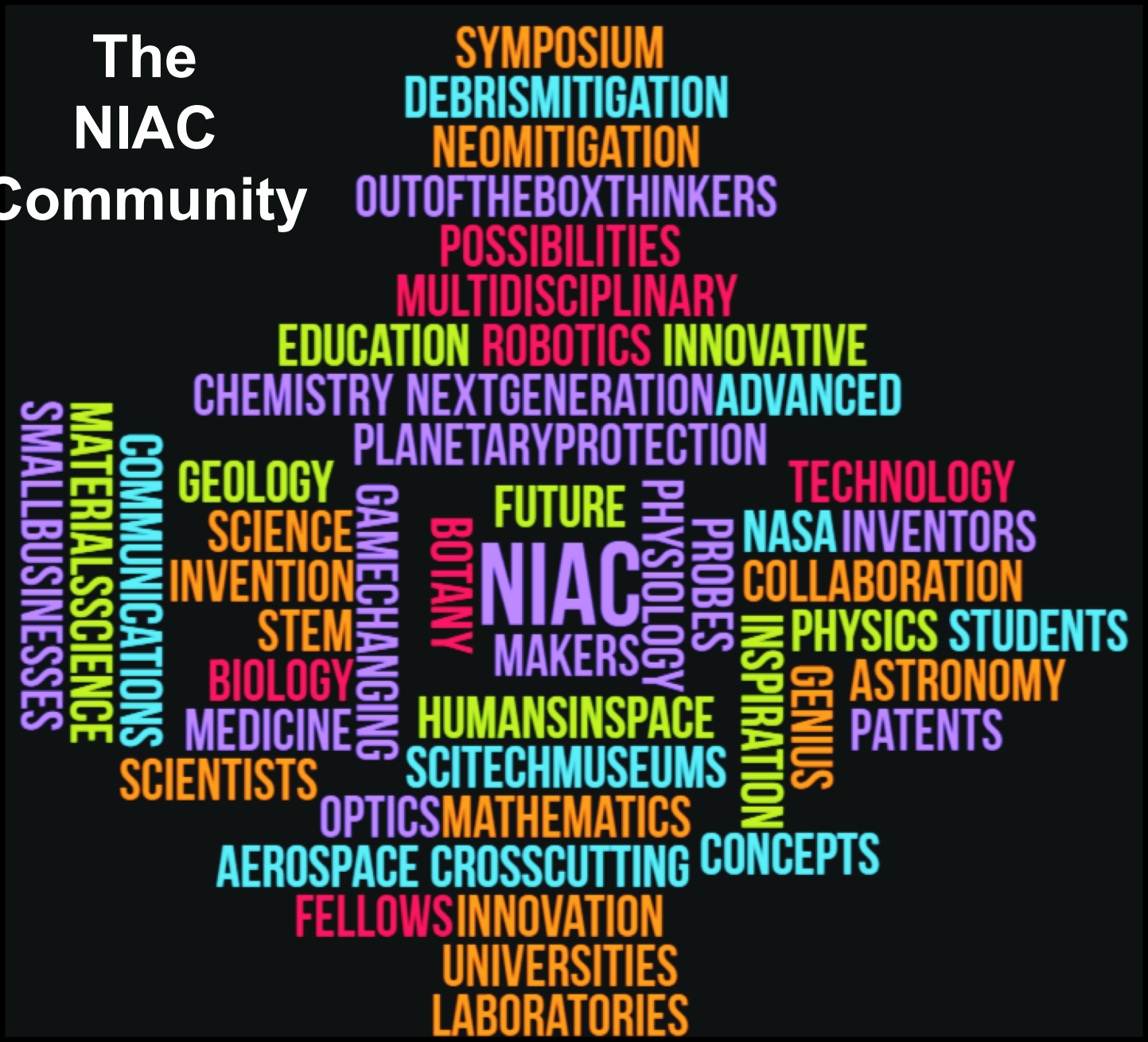
T NIAC COMMUNITY

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...



The NIAC Community



NIAC: Funding Innovation across the Nation

Universities

National Labs

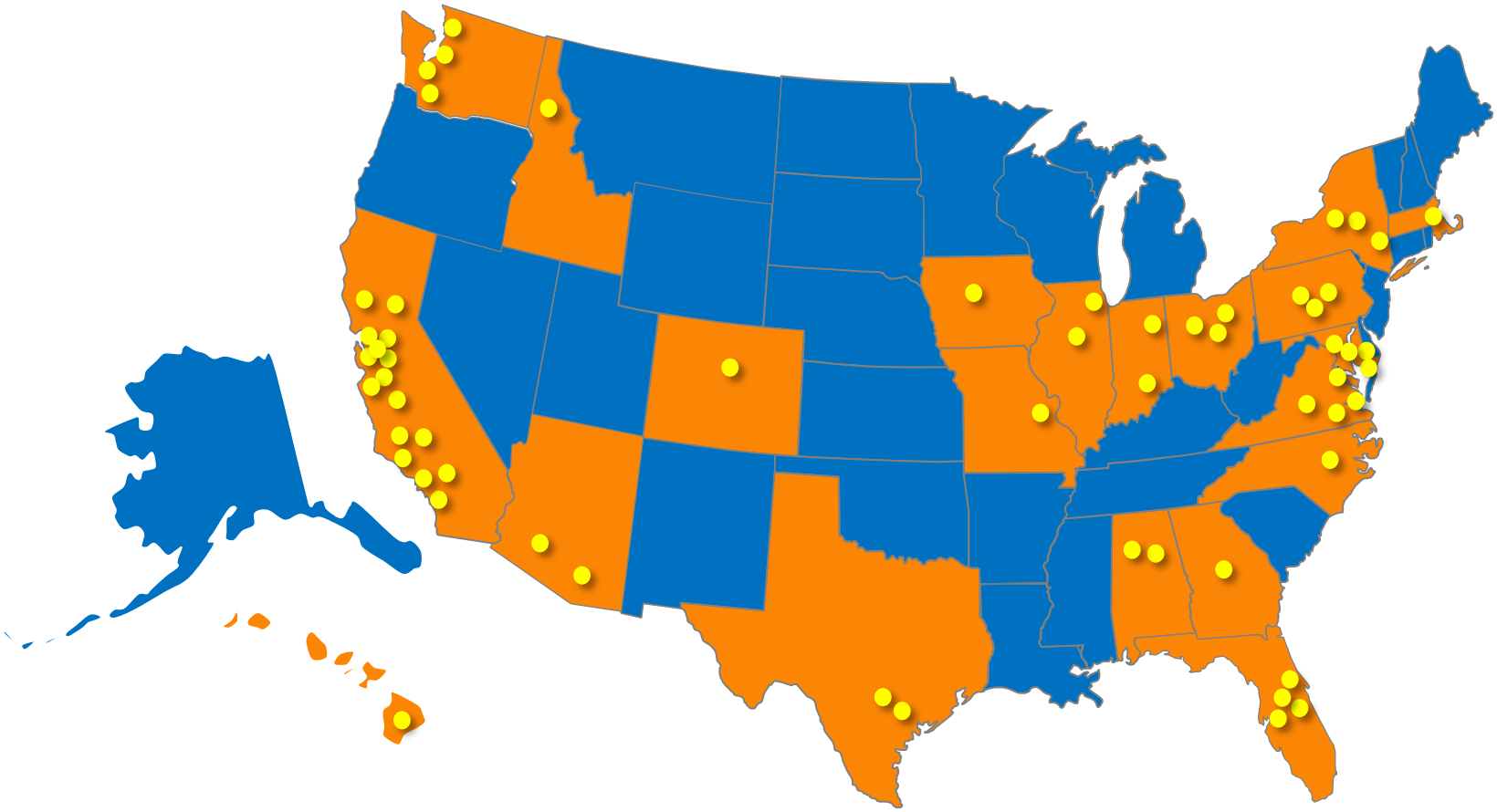
Industry

Small Businesses

NASA Researchers

Individuals & Garage Inventors

Funding Innovation across the Nation



Locations of NIAC Fellows through 2017 selection

NIAC Awards: Ph I and Ph II

Phase I and Phase II Research

PHASE I Research

Call opens: Summer

- Up to **$125K**
- ~ **9 MONTHS** for concept definition and initial analysis in a mission context

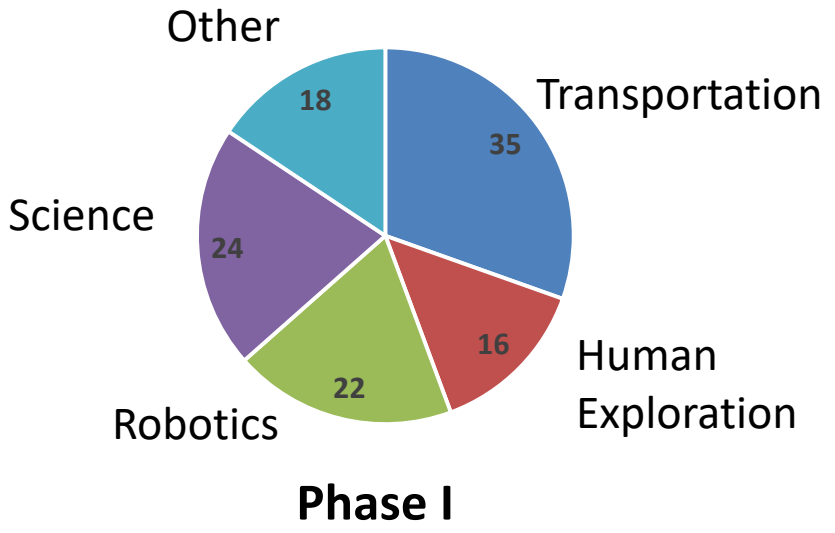
PHASE II Research

Call opens: Spring

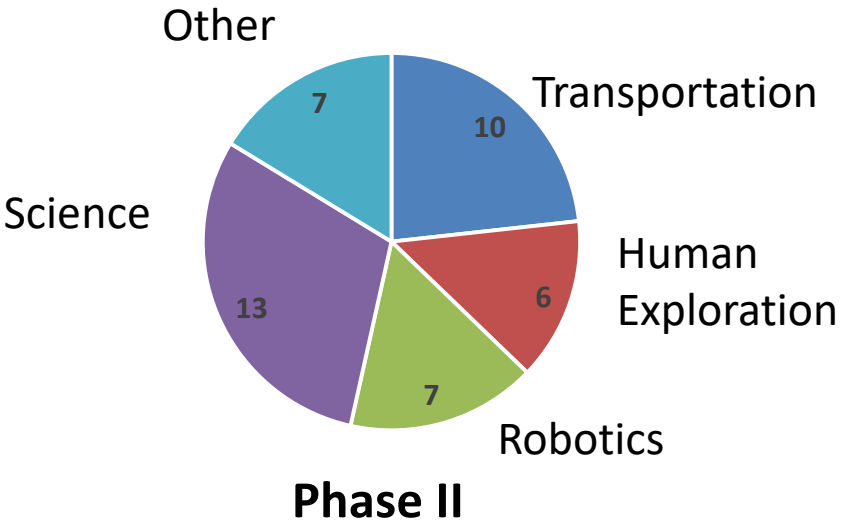
- Up to **$500K**
- ~**2 YEARS** for further development of most promising Phase I concepts, comparative mission analysis, pathways forward, spin off technologies

Distribution by Technical Discipline

(approximate…most NIAC concepts are inherently multidiscipline)



Phase I

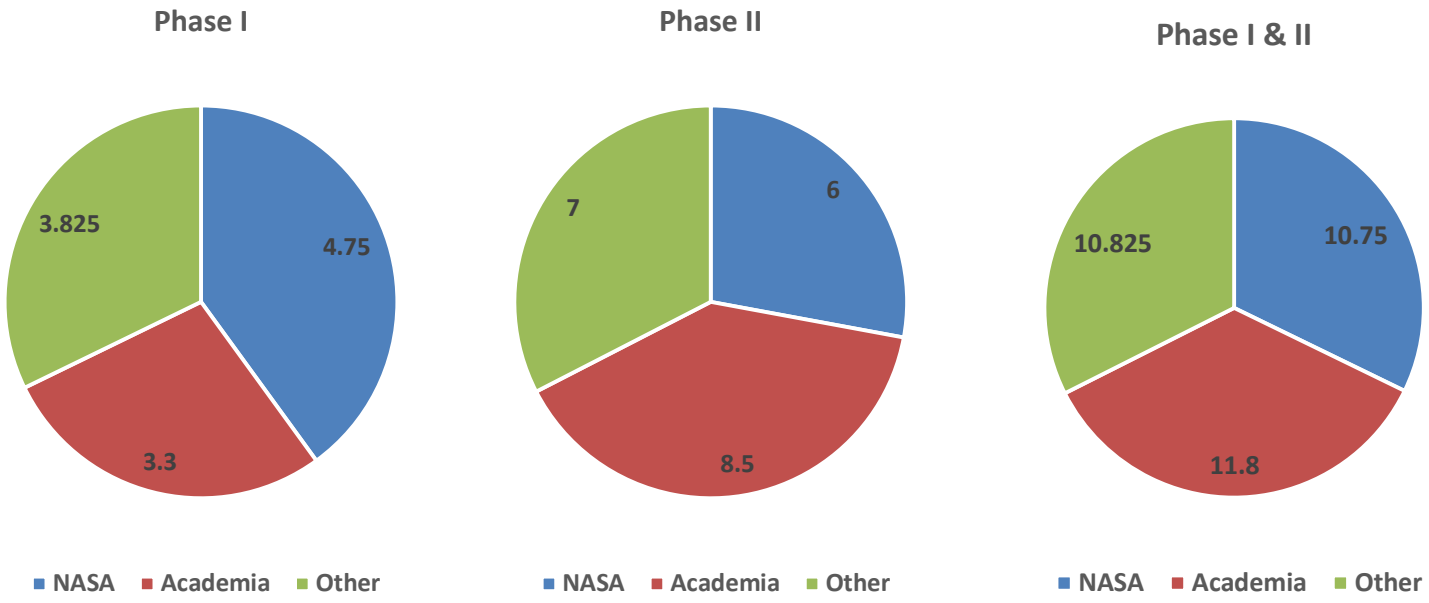


Phase II

- **Transportation**
  - **Earth to Orbit**
  - **In Space**
  - **Entry/Descent/Landing**
  - **Infrastructure**
  - **Aeronautics**
- **Human Exploration**
  - **Environment Control**
  - **Radiation Mitigation**
  - **Habitats**
  - **Infrastructure**
- **Robotics**
  - **Mobility**
  - **Sample Collection**
- **Science**
  - **Astronomy and Astrophysics**
  - **Planetary**
  - **Heliophysics**
  - **Earth Science**
- **Other**
  - **Navigation**
  - **Power**
  - **Communications**
  - **Structures,**
  - **Asteroid/Orbital Debris Mitigation or Exploitation**

Total Dollars Awarded ($M) By Phase and Organization Type

- Dollars are assigned to the Fellow's Organization
- All Phase I are assumed to be $100K until FY17, then $125K
- All Phase II are assumed to be $500K

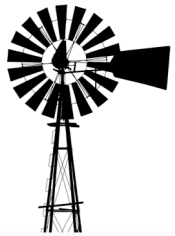


NASA (Includes JPL) / Academia / Other (Includes Industry and Not For Profit)

NIAC and ISRU

- Since 2011, NIAC has funded 183 studies
  - 131 Phase I and 52 Phase II
- Twenty-five studies funded to date have been directly related to space resource utilization
  - 19 Phase I and 6 Phase II

Propellant



Power

Life Support

Habitats

NIAC-funded ISRU studies cover a wide range of technologies and applications, including use of in situ resources for fuel, habitats, and life support

NIAC and ISRU: Phase I

Phase I		
FY 2018	Rothschild, Lynn	Myco-architecture off planet: growing surface structures at destination
FY 2017	Arkin, Adam	A Synthetic Biology Architecture to Detoxify and Enrich Mars Soil for Agriculture
FY 2017	Lewis, John	Massively Expanded NEA Accessibility via Microwave-Sintered Aerobrakes
FY 2017	McMahon, Jay	Dismantling Rubble Pile Asteroids with AoES (Area-of-Effect Soft-bots)
FY 2016	Bayandor, Javid	Light Weight Multifunctional Planetary Probe for Extreme Environment Exploration and Locomotion
FY 2016	Bugga, Ratnakumar	Venus Interior Probe Using In-situ Power and Propulsion (VIP-INSPR)
FY 2016	Dunn, Jason	Reconstituting Asteroids into Mechanical Automata
FY 2016	Janson, Siegfried	Brane Craft
FY 2016	Mueller, Robert	Mars Molniya Orbit Atmospheric Resource Mining
FY 2016	VanWoerkom, Michael	NIMPH: Nano Icy Moons Propellant Harvester
FY 2015	Lewis, John	In-Space Manufacture of Storable Propellants
FY 2015	Oleson, Steven	Triton Hopper: Exploring Neptune's Captured Kuiper Belt Object
FY 2013	Rothschild, Lynn	Biomaterials out of thin air: in situ, on-demand printing of advanced biocomposites
FY 2012	Arrieta, Juan	The Regolith Biters: A Divide-And-Conquer Architecture for Sample-Return Missions
FY 2012	Cohen, Marc	Robotic Asteroid Prospector (RAP) Staged from L-1: Start of the Deep Space Economy
FY 2012	Quadrelli, Marco	Orbiting Rainbows: Optical Manipulation of Aerosols and the Beginnings of Future Space Construction
FY 2011	Hogue, Michael	Regolith Derived Heat Shield for a Planetary Body Entry and Descent System with In-Situ Fabrication
FY 2011	Khoshnevis, Behrokh	Contour Crafting Simulation Plan for Lunar Settlement Infrastructure Build-Up
FY 2011	Sibille, Laurent	In-Space Propulsion Engine Architecture based on Sublimation of Planetary Resources: from exploration robots to NEO mitigation

NIAC and ISRU: Phase II

Phase II		
FY 2018	McMahon, Jay	Dismantling Rubble Pile Asteroids with AoES (Area-of-Effect Soft-bots)
FY 2018	Oleson, Steven	Triton Hopper: Exploring Neptune's Captured Kuiper Belt Object
FY 2018	VanWoerkom, Michael	NIMPH: Nano Icy Moons Propellant Harvester
FY 2017	Sercel, Joel	Optical Mining of Asteroids, Moons, and Planets to Enable Sustainable Human Exploration and Space Industrialization
FY 2014	Quadrelli, Marco	Orbiting Rainbows Phase II
FY 2012	Khoshnevis, Behrokh	ISRU-Based Robotic Construction Technologies for Lunar and Martian Infrastructures

Great! What do I have to do to Win one of these Studies?

It's EASY! Just follow these simple steps:

Think up an Innovative Concept that will change the way NASA does business

Watch for the Release of the NIAC call for Proposals

Expect the Release to be ~ August

Pay attention to the Proposal Preparation Instructions

Put your concept into an Aerospace Architecture, Mission or System context

Tell us WHY it is:
Exciting
Unexplored
Credible

What's the process?

The NIAC Phase I Process: A two-step call

STEP A

3-page whitepaper describing your technology development concept in a Mission Context

We review the Step A Proposals and **invite the best proposals to STEP B**

changing the possible

STEP B

8-page proposal detailing your concept and describing the work you would do

The Step B proposals are reviewed by an expert panel, ranked, and presented to the Source Selection Official at NASA HQ, who makes the final selection of projects

Selected Studies are awarded **$125K for a 9-month Study**, and also earn the Principal Investigator the title, "NIAC Fellow"

4.2.3.2 Step A Elimination Criteria (from the NIAC call for proposals)

"This solicitation explicitly does NOT solicit proposals for any of the eliminating criteria in the list below. Step A proposals that substantially exhibit any of the elimination criteria will be out-of-scope and will NOT be invited for a Step B proposal. Also, NIAC proposals should not request resources for writing Phase II proposals or other opportunities."

Step A Elimination Criteria

1. Not an aerospace architecture
2. Proposed concept is unclear or not adequately articulated
3. No mission context
4. Previously explored
5. Incremental
6. Not technically credible
7. Not programmatically credible
8. The proposal is too narrowly focused on technology or subsystems development of smaller scope
9. The proposal is too narrowly focused on science experiments
10. The proposal is too narrowly focused on the development of tools or processes

Top Three Reasons for Out of Scope
(for the past four years of NIAC calls)

Out of Scope Criteria	Percentage in FY18
Narrowly focused technology	31.3
Unclear mission context	20.2
Incremental	19.0

More about “Unclear Mission Context”

- NIAC does not fund technology development
- Instead, NIAC gives you a chance to show why your “cool idea” matters to NASA
- Your innovation must be expressed in a relevant implementation
  - So NASA can compare “apples to oranges” across a wide range of innovation

More about "Unclear Mission Context"
(examples, not exhaustive)

- Propulsion:
  - Total system mass (including payload)
  - Where would it matter?
  - What are alternatives?
- New instrument:
  - How would it fit in a spacecraft/lander/rover?
  - What are its mass/power/communications needs?
- New Life Support System:
  - How would it be integrated into a habitat or crew vehicle?
  - What are its mass/power/thermal needs (e.g.: Equivalent System Mass)?

Additional Common Pitfalls of ISRU proposals to NIAC

- Is it new?
  - Just because it hasn't been done yet is not sufficient; what is different?
- What is the benefit, and how does it compare to alternatives?
  - Not just to State of the Art, but to well-studied competitive approaches
- Is there a core "special sauce"?
  - A good system study is not enough

Before the NRA is released, the NIAC Program Office can advise you on whether the idea is in scope

NIAC is different, and so is your FINAL REPORT

- The final report is not a bureaucratic box to be checked, but rather is the primary outcome of the study
- It is also a part of your legacy as a Fellow of NIAC
  - The final report should be written in a way that provides a record of the concept for future reference
- And oh, by the way, it is a requirement if you wish to bid on a Phase II

What Do We Expect in the Phase I Final Report?

- **A final written technical report is due 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**

The final report is a way to share your excitement about your concept. It is also a part of your legacy as a Fellow of NIAC

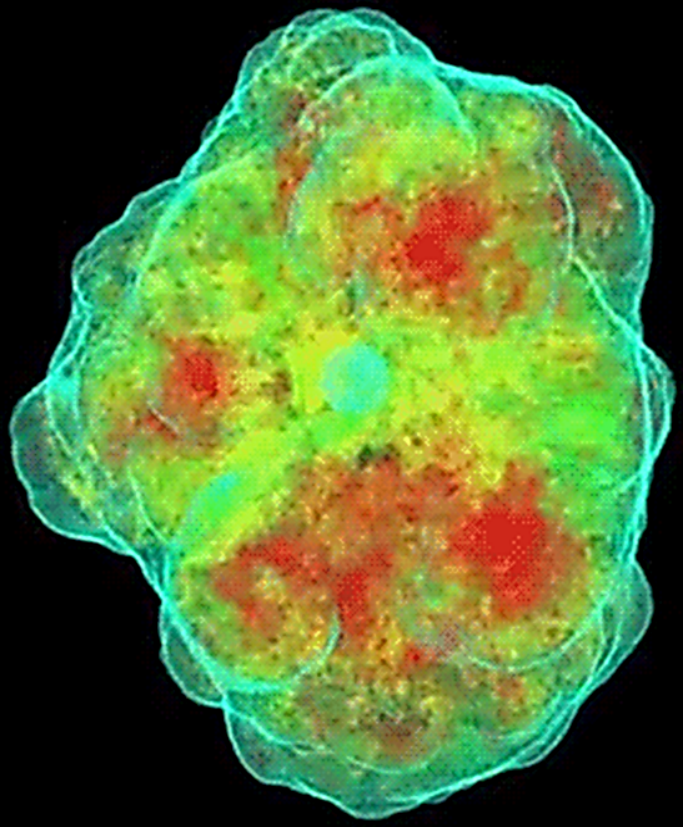

NASA's Dream Shop
Changing the Possible...
Credit: P. Rubin, A. Longman
©2011 Peter Rubin and Anthony Longman

The Future Possibilities Depend on YOU

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

This exciting program is open to *anyone* in the US

(international researchers may team, but no exchange of funds)



QUESTIONS?