National Aeronautics and Space Administration

NASA Innovative Advanced Concepts (NIAC) & Center Innovation Fund (CIF)

John (Jay) Falker, PhD

NASA TECHNOLOGY DAYS 2012

Cleveland, Ohio

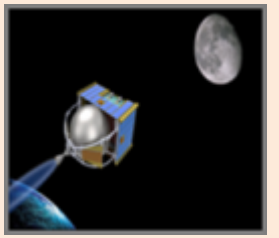
www.nasa.gov

Space Technology Programs

Transformative & Crosscutting Technology Breakthroughs

Game Changing Development Program

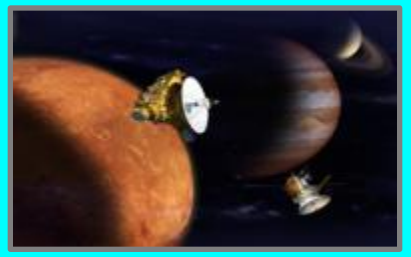
Technology Demonstration Missions Program



Small Spacecraft Technologies Program

Pioneering Concepts/ Developing Innovation Community

Space Technology Research Grant Program



NASA Innovative Advanced Concepts (NIAC) Program

Center Innovation Fund (CIF) Program

Creating Markets & Growing Innovation Economy

Centennial Challenges Prize Program

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

Flight Opportunities Program

Center Innovation Fund (CIF)

CIF Overview

Center Innovation Fund (CIF) Program Objective:

To stimulate and encourage creativity and innovation within the NASA Centers

CIF seed funds support…

- New technologies
- Innovative approaches
- Creative ideas

Leveraging NASA Center talent and capabilities, as well as external partnerships

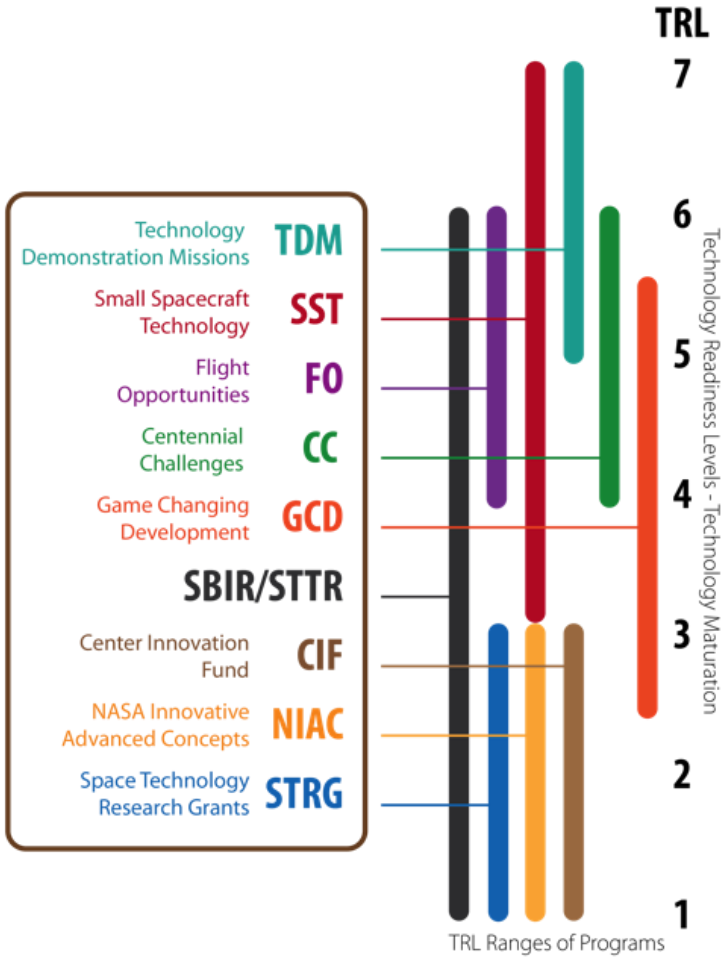
CIF Evaluation Criteria

CIF solicitation and selection processes are run by the NASA *Center Chief Technologists*

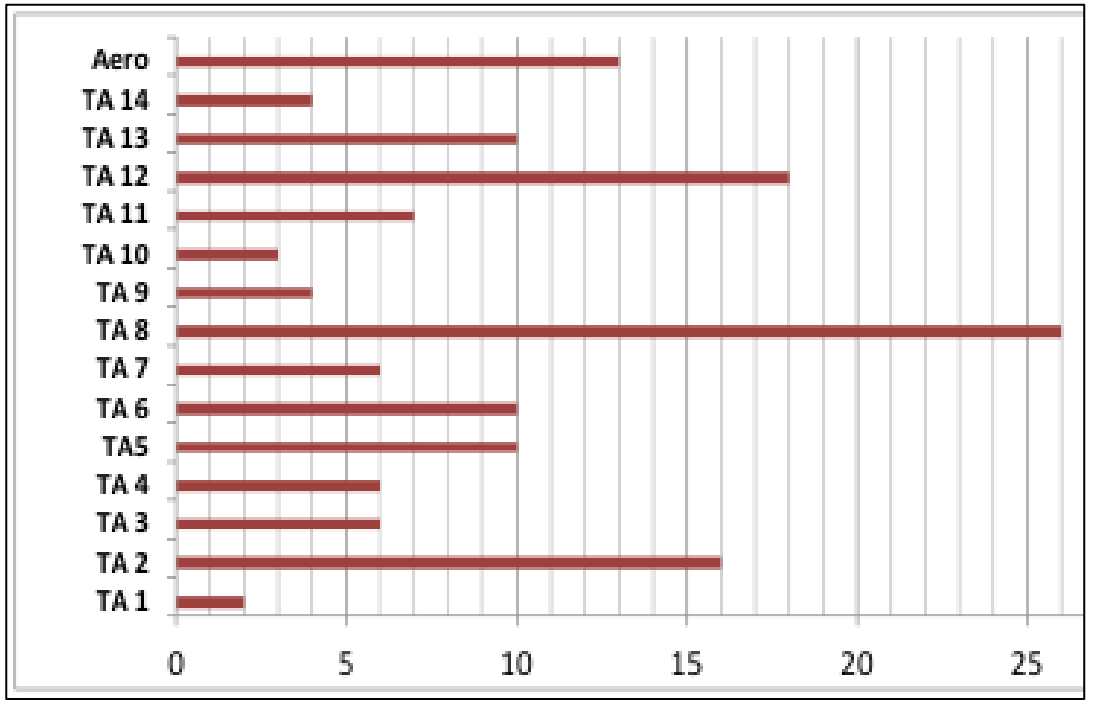
NASA Headquarters participates, and reviews annual progress, but does not direct individual CIF efforts

Two Perspectives on CIF

Technology Readiness Level (TRL) Scope of CIF Program



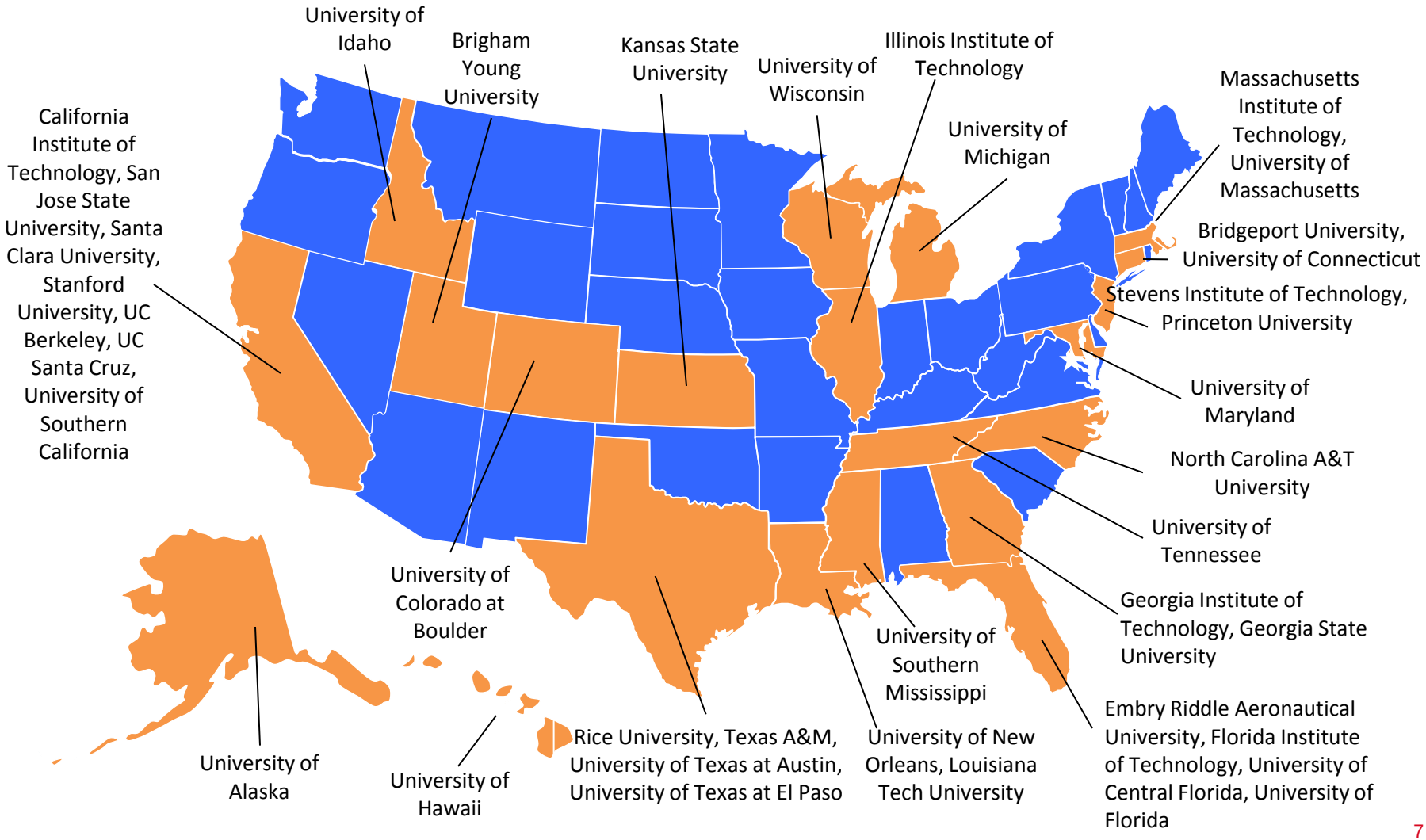
Distribution of 2012 CIF Projects by NASA Technology Area (TA)



TA.1. Launch Propulsion
TA.2. In-Space Propulsion
TA.3. Space Power/Storage
TA.4. Robotics
TA.5. Comm./Navigation
TA.6. Human Health
TA.7. Human Expl. Dest.
TA.8. Sci. Instr./Sensors
TA.9. Entry, Descent, Landing
TA.10. Nanotechnology
TA.11. Modeling/Simulation
TA.12. Materials Structures
TA.13. Ground/Launch
TA.14. Thermal

CIF 2012 University Partners

Exploring new concepts to expand aerospace possibilities



CIF Example (MSFC)

Electrically-Controlled Extinguishable Solid Propellant

Project Summary:

Electrically-controlled extinguishable solid propellant (ESP) thrusters are inert unless ignited with an electric potential of appropriate magnitude. Once electrically ignited, burning rates can be increased by up to 20x (throttled) using electrical power and then switched off (extinguished) by removing the electrical power.

Innovation summary:

ESP is a revolutionary new capability for solid propellant systems, with the potential to replace multi-mode liquid propulsion systems

NASA/Government Application:

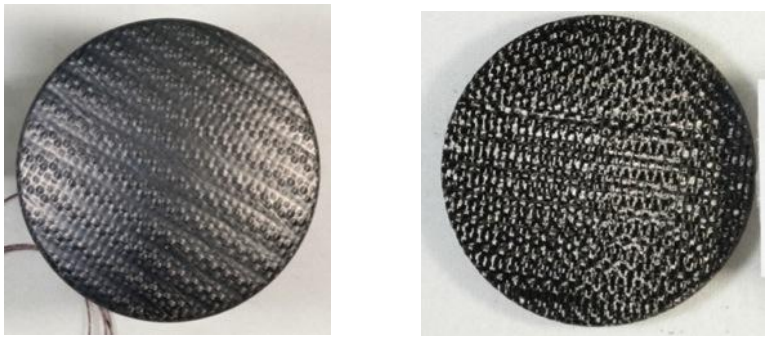
Multiple applications for NASA and other agencies

CIF Example (ARC)

3-D Woven Thermal Protection System

Project Summary:

3-D WTPS utilizes mature weaving technologies to manufacture preforms. Varying the material composition by controlling placement of fibers, and optionally infusing with resins, yields ablative TPS to meet a wide range of entry conditions.



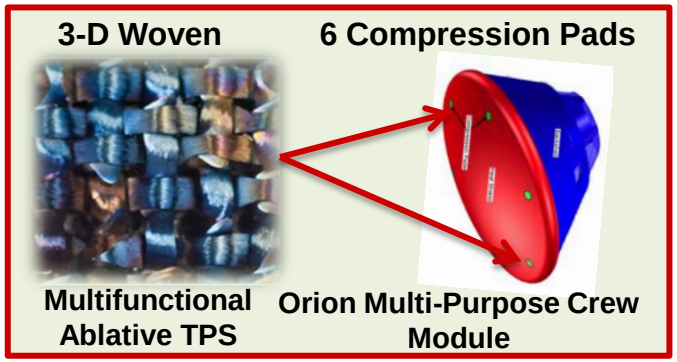
Resin infused, pre & post arc jet tested coupons, left and right, respectively. Condition: 0.625 atm & ~700 W/cm^2.

Innovation summary:

A game changing approach to manufacturing thermal protection systems that use precisely engineered 3-D weaving techniques

NASA/Government Application:

Woven TPS could enable robotic missions that encounter extreme entry environments (e.g., Venus, Saturn, high-speed sample return), and human missions from beyond the Moon



3-D Woven TPS is being evaluated for a possible Lunar Flight test in 2017.

CIF Contact Information

- Jay Falker (Program Executive) jfalker@nasa.gov
- David Hash david.b.hash@nasa.gov
- Minoo Dastoor minoo.n.dastoor@nasa.gov

The NASA Center Chief Technologists
www.nasa.gov/offices/oct/about_us/cct_page.html

CIF Website http://www.nasa.gov/offices/oct/stp/innovation_fund/index.html

NASA Innovative Advanced Concepts (NIAC)

What is NIAC ?

NASA Innovative Advanced Concepts

NASA Innovative Advanced Concepts

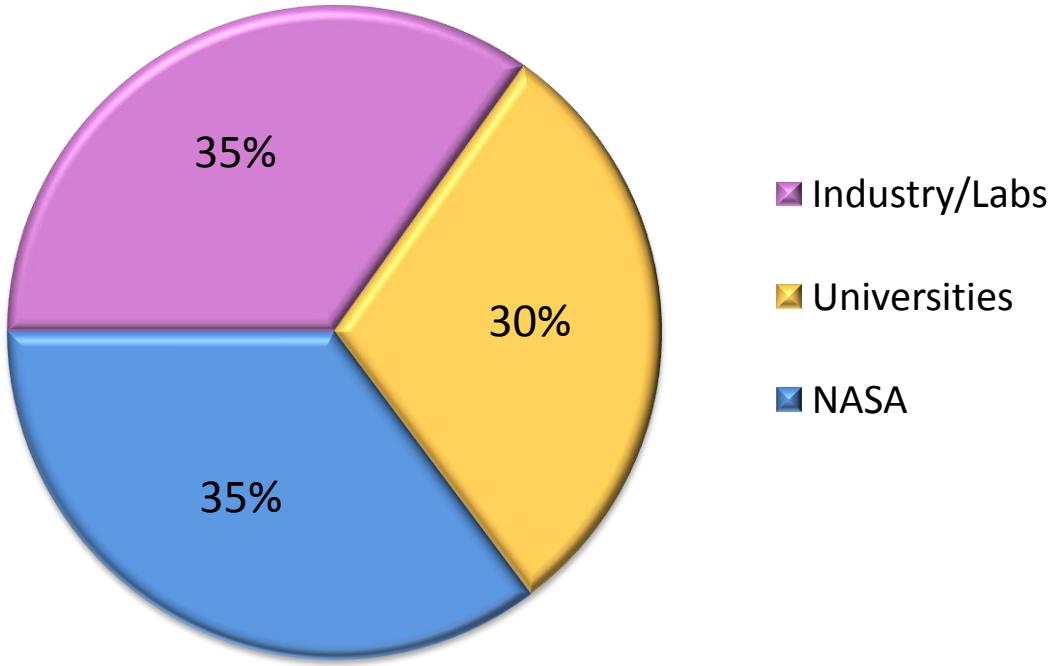
A program to support early studies of innovative, yet credible, visionary concepts that could one day "change the possible" in aerospace.

NIAC Program Details

- NIAC supports early studies of visionary aerospace concepts
  - 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 2 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 & Spring Symposium: presentations by the NIAC Fellows
  - Conferences / Websites / Articles / Interviews / Radio Spots …

NIAC Award Distribution

Fraction of NIAC Award Funding
by Organization Type of Lead Proposer
(2011-2012)



NIAC in the News

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

NIAC is #1! (At least briefly)

#1 Most Popular Article on TIME.com (08/14/12)

2012 NIAC Studies: 5 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

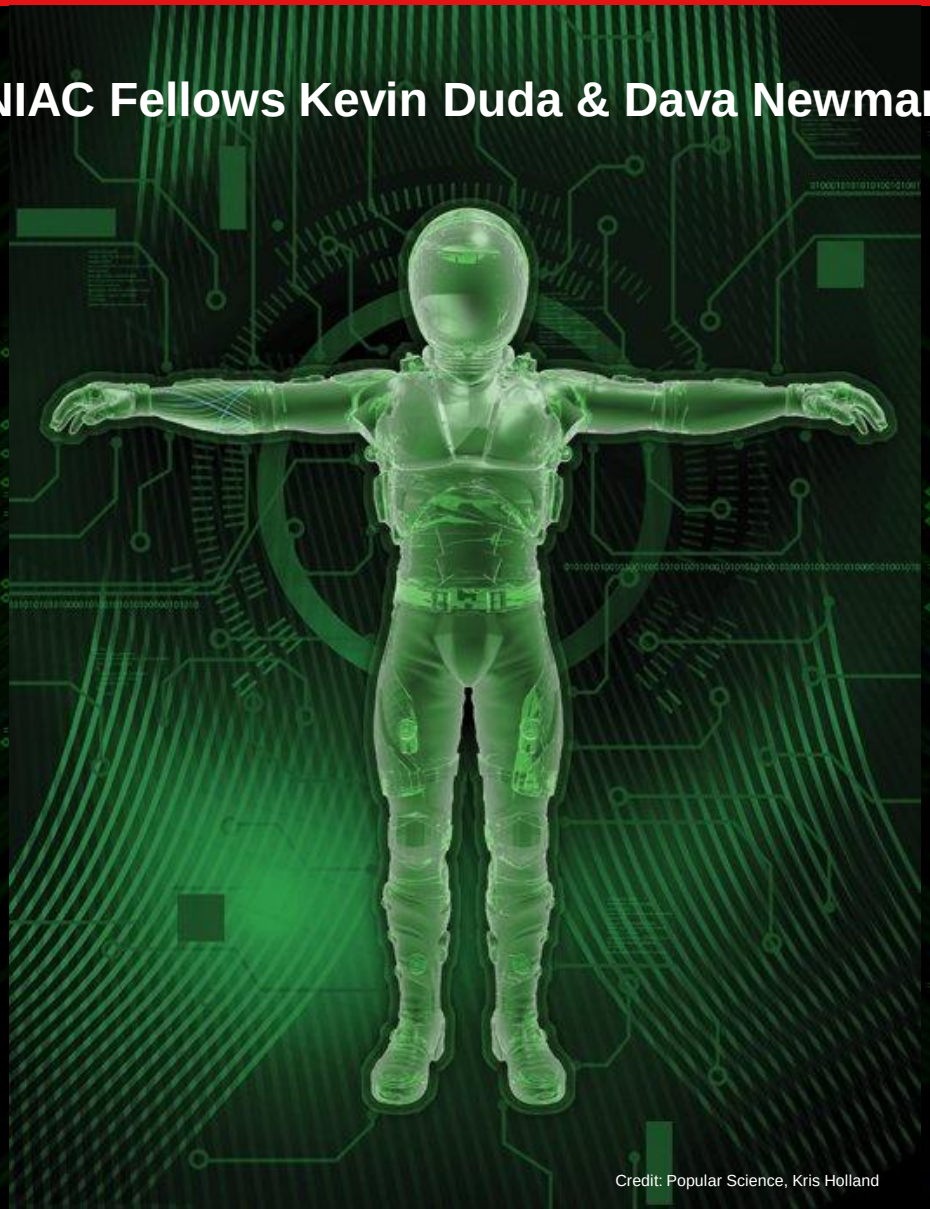
NIAC Example: V2Suit (Draper)

NIAC Fellows Kevin Duda & Dava Newman

ARTIFICIAL GRAVITY

PROLONGED EXPOSURE TO LOW GRAVITY CAUSES BONE LOSS AND MUSCLE ATROPHY, WHICH ASTRONAUTS FEND OFF BY EXERCISING 2.5 HOURS EACH DAY.

DEVICES DEVELOPED BY KEVIN DUDA AT DRAPER LABORATORY COULD BUILD FITNESS INTO SPACE SUITS. GYROSCOPES ATTACHED TO THE ARMS AND LEGS COULD PROVIDE RESISTANCE SIMILAR TO THE FORCE OF GRAVITY ON EARTH.



Credit: Popular Science, Kris Holland

NIAC Phase II Fellow Kevin Duda, Draper Laboratory

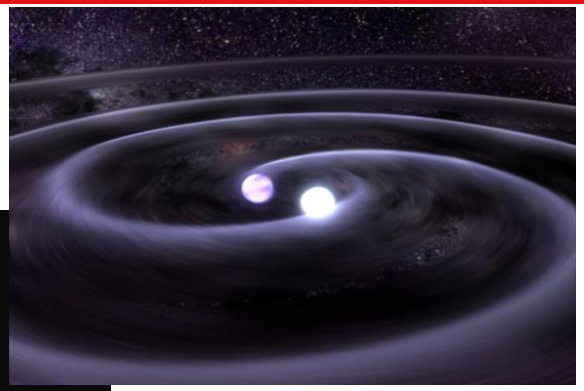
Variable Vector Countermeasure Suit (V2Suit) for Space Habitation and Exploration

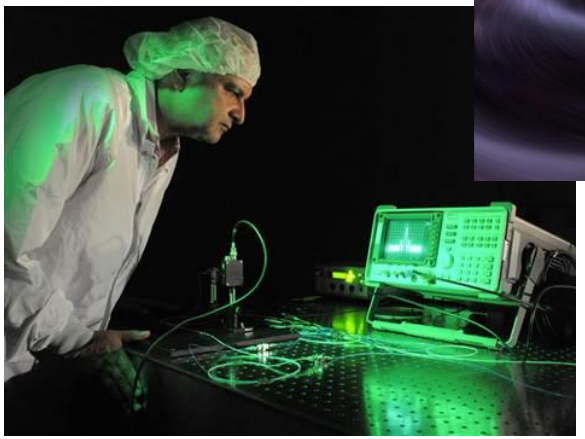
NIAC Phase II Fellow Dava Newman, MIT

Astronaut BioSuit System for Exploration Class Missions

NIAC & CIF Example (GFSC)

Atom Interferometry for Detection of Gravity Waves

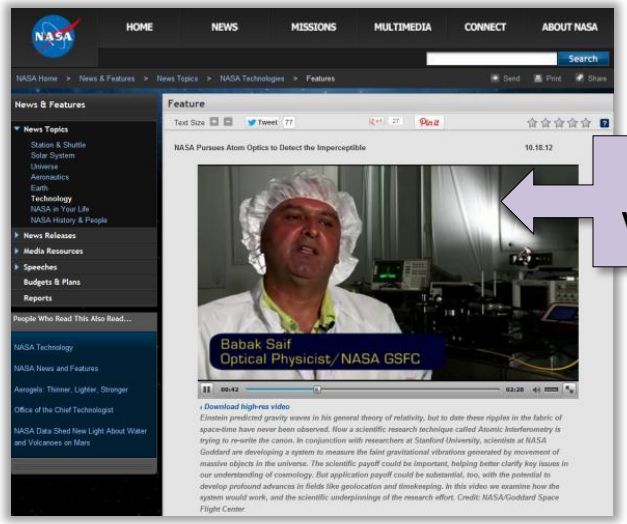




Example of NIAC / CIF Synergy

"NASA Pursues Atom Optics to Detect the Imperceptible"

NIAC 2012 Phase I Fellow
Babak Saif, GSFC



Spin Off Potential:

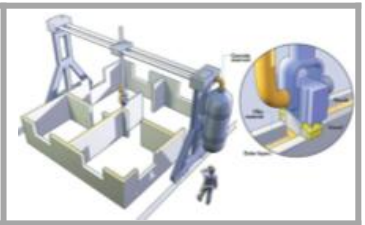
Hunting gravitational waves on the atomic level could lead to technology for better steering of military submarines or aircraft

http://www.nasa.gov/topics/technology/features/atom-optics.html

NIAC: Inspiring Economic and Wider Benefits for the Nation

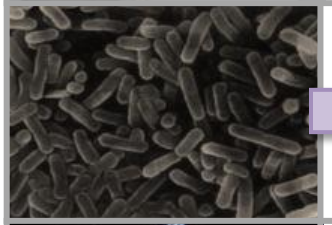
3-D Printing the Home of the Future

Emergency Construction for natural disasters, eradicate slums in developing countries



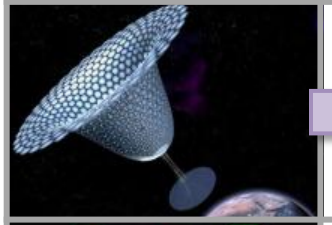
Improving Health With Spacesuit Technology

Medical rehabilitation and physical therapy for individuals affected by stroke, spinal cord injuries, brain injuries, and the elderly.



Bacterial Batteries

Novel Energy Source: Bacterial Microbes to power up robots



Space-Based Solar Power

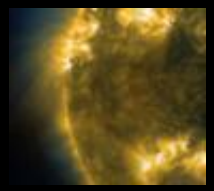
Power transmission to Earth for use during power outages, after natural disasters, to those in remote areas or by the military.

Navigation

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

What Opportunities does NIAC Offer?

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



Phase II Solicitation
Open after Phase I complete
Date: late May 2013

NIAC Spring Symposium
Open to everyone
Location: Chicago, IL
Date: March 12-14, 2013

NIAC Fall Symposium
Open to everyone
Location: TBD
Date: November 2013

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

NIAC Contact Information

- Please visit us at the NIAC booth

  9:30am – 3:00pm Wed

- Or Contact…
  - Jay Falker, Program Executive
  - Jason Derleth, Program Manager
  - Kathy Reilly, Outreach Coordinator
  - hq-niac@mail.nasa.gov
  - http://www.nasa.gov/niac

Conclusion

The Future Possibilities Depend on You

NIAC & CIF are among the most open-ended and far-reaching of NASA's technology programs

Stretch your imagination…
Change the possible!