



# Space Life and Physical Sciences Research & Applications Division Overview and Status

## Committee on Biological and Physical Science in Space

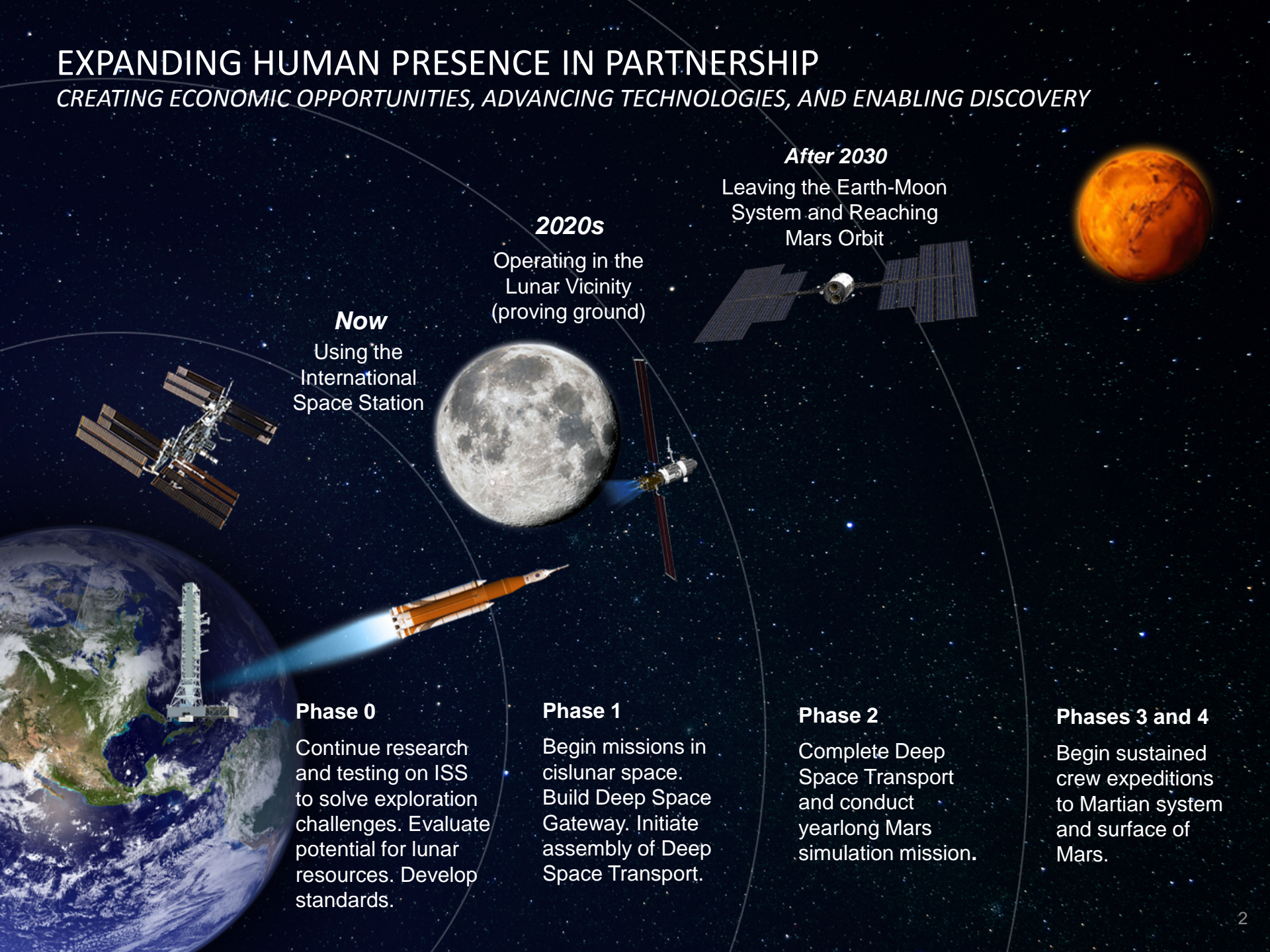
**1 November 2017**

Craig Kundrot, PhD

Director, Space Life and Physical Sciences Research & Applications  
Human Exploration & Operations Mission Directorate

# EXPANDING HUMAN PRESENCE IN PARTNERSHIP

*CREATING ECONOMIC OPPORTUNITIES, ADVANCING TECHNOLOGIES, AND ENABLING DISCOVERY*



**Now**  
Using the  
International  
Space Station

**2020s**  
Operating in the  
Lunar Vicinity  
(proving ground)

**After 2030**  
Leaving the Earth-Moon  
System and Reaching  
Mars Orbit

**Phase 0**  
Continue research  
and testing on ISS  
to solve exploration  
challenges. Evaluate  
potential for lunar  
resources. Develop  
standards.

**Phase 1**  
Begin missions in  
cislunar space.  
Build Deep Space  
Gateway. Initiate  
assembly of Deep  
Space Transport.

**Phase 2**  
Complete Deep  
Space Transport  
and conduct  
yearlong Mars  
simulation mission.

**Phases 3 and 4**  
Begin sustained  
crew expeditions  
to Martian system  
and surface of  
Mars.



## The White House

Office of the Press Secretary

For Immediate Release

September 02, 2017

# President Donald J. Trump Announces Intent to Nominate Personnel to Key Administration Posts

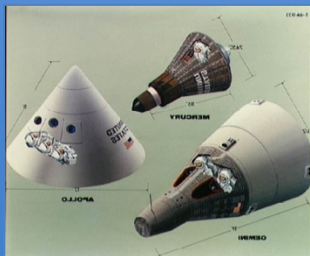
President Donald J. Trump today announced his intent to nominate the following individuals to key positions in his Administration:

## **James Bridenstine of Oklahoma to be Administrator of the National Aeronautics and Space**

**Administration.** Mr. Bridenstine was elected in 2012 to represent Oklahoma's First Congressional District. He serves on the House Armed Services Committee and the Science, Space and Technology Committee. Mr. Bridenstine began his Naval aviation career flying the E-2C Hawkeye off the USS Abraham Lincoln aircraft carrier. It was there that he flew combat missions in Iraq and Afghanistan. While on active duty, he transitioned to the F-18 Hornet and flew as an "aggressor" at the Naval Strike and Air Warfare Center. After leaving active duty, Mr. Bridenstine returned to Tulsa, Oklahoma to be the Executive Director of the Tulsa Air and Space Museum & Planetarium and flew counter-drug missions in Central and South America in the Navy Reserve. He holds a triple major from Rice University and an M.B.A. from Cornell University. Mr. Bridenstine is currently a member of the 137th Special Operations Wing of the Oklahoma Air National Guard.



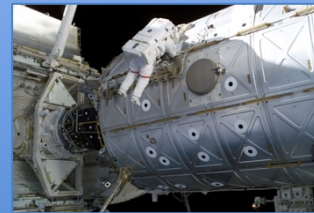
## Mercury – Gemini – Apollo – Skylab



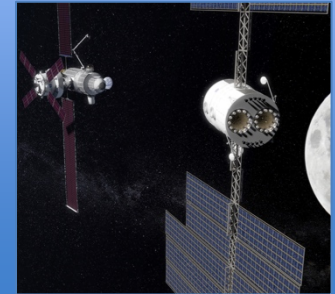
## Space Shuttle



## International Space Station



## Post-ISS BLEO



## Post-ISS LEO

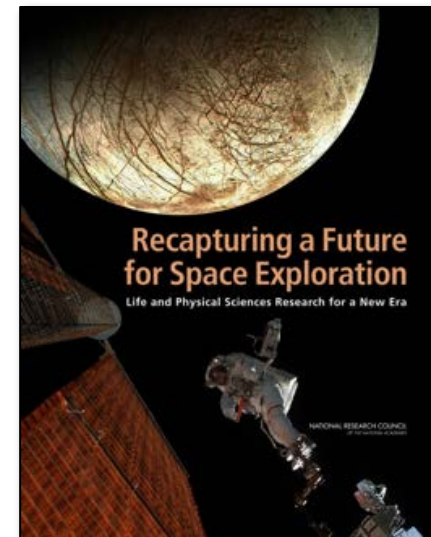
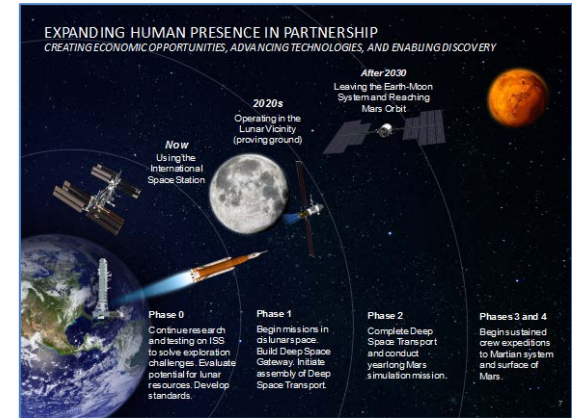


- Vision

- We lead the space life and physical sciences research community to enable space exploration and benefit life on Earth

- Mission

- **Enable exploration** to expand the frontiers of knowledge, capability, and opportunity in space
- **Pioneer scientific discovery** in and beyond Low Earth Orbit to drive advances in science, technology, and space exploration to enhance knowledge, education, innovation, and economic vitality



- Many variables change in spaceflight
  - Gravity
  - Radiation
  - Atmosphere
  - Biome
  - Psychological environment
  
- These variables provide
  - Unique probes of biological and physical systems
  - Challenges to human spaceflight exploration
  
- These variables can be manipulated in many settings
  - Levitators, drop towers, parabolic flight, sounding rockets, particle accelerators, environmental chambers, isolation chambers
  - LEO, BLEO, lunar surface, Mars surface



# Unusual and Unique Facilities



Drop Tower



Low G Parabolic Flight



Balloon Flight



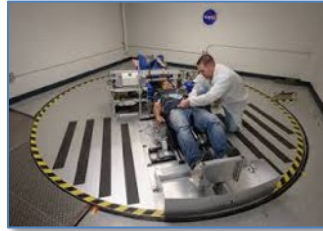
Sounding Rocket



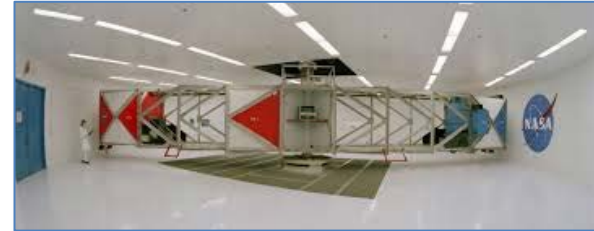
Space Station



Animal Centrifuge



Short Arm Human Centrifuge



Long Arm Human Centrifuge



NASA Isolation Chamber



NSF Polar Station



Russian Isolation Chamber



NASA Space Radiation Lab



Neutral Buoyancy Facility

\*



GeneLab

\* Also Through Center for the Advancement of Science in Space (CASIS)



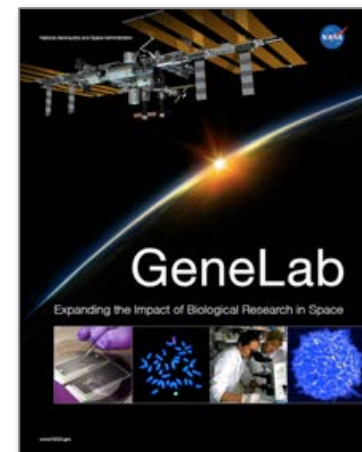
- Open Science

- Maximize community participation in the formulation of investigations where feasible
  - Co-Principal Investigator Teams
  - Science Definition Teams
  - Topical Teams
- Disseminate and reuse data, tools, and samples post-project
  - GeneLab
  - Physical Science Informatics
  - Life Sciences Data Archive



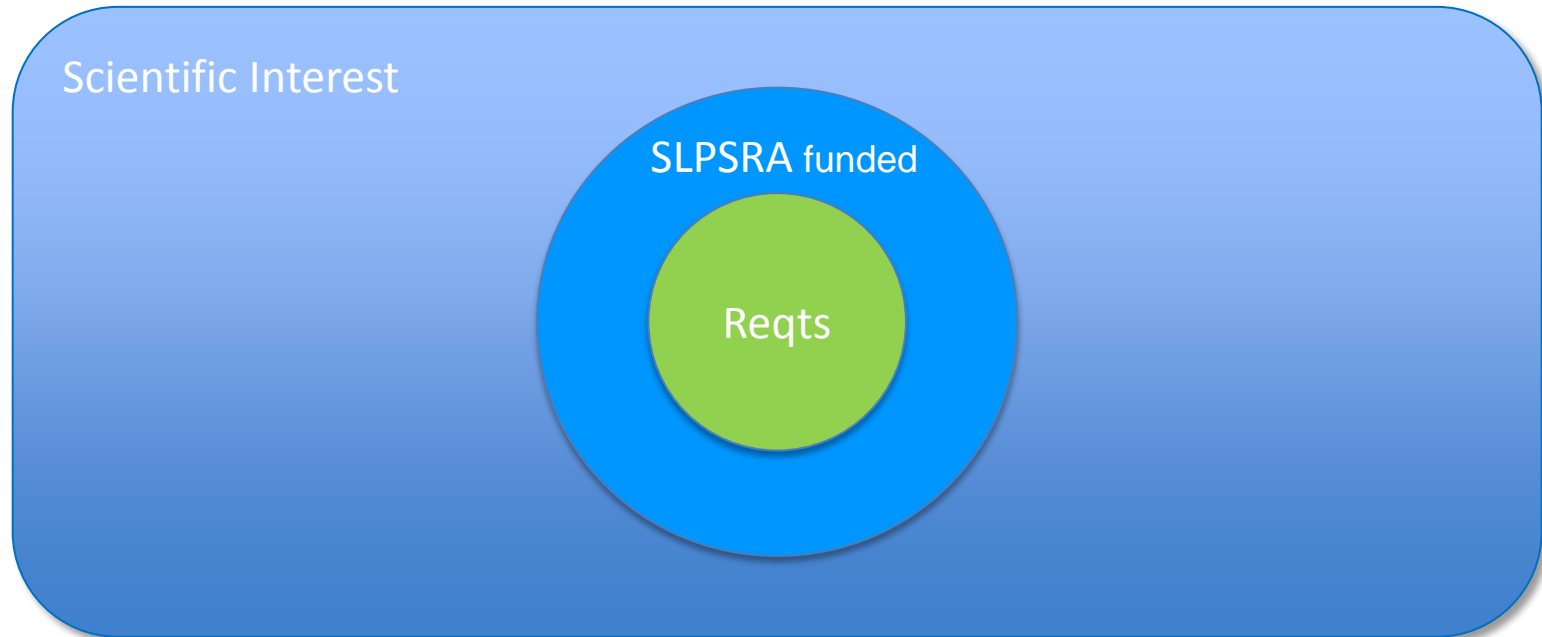
- Partnerships

- **Generate demand for enabling exploration (pull)**
- Identify adopters for pioneering scientific discovery
- Leverage resources
- Access new experimental platforms
- Strengthen technical foundation





- Technology PUSH
  - Provider identifies need
  - Provider PUSHES the idea of the need to the recipient
  - If the recipient is convinced, provider develops and delivers the product to the recipient
- Market PULL
  - Recipient identifies need
  - Recipient PULLS the product from the provider
    - Provider develops and delivers the product to the recipient



- Cost-benefit considerations may warrant providing more than PULL requirements
  - Larger domain of applicability
    - E.g., more comprehensive model
  - Higher quality of product
    - E.g., engineered cultivar exceeds best available terrestrial cultivar

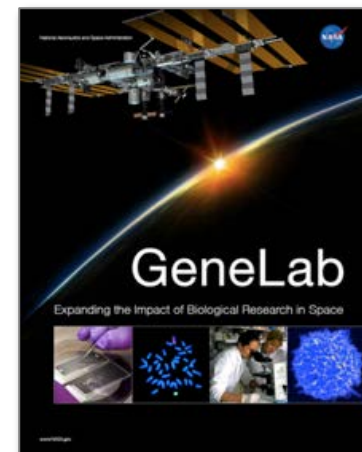
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Subject: Letter of Intent between the National Aeronautics and Space Administration and the Biomedical Advanced Research and Development Authority (BARDA)



Craig Kundrot  
 Craig Kundrot, Ph.D.  
 Director, Space Life and Physical Sciences Research & Applications Division  
 National Aeronautics and Space Administration

7/27/17  
 Date

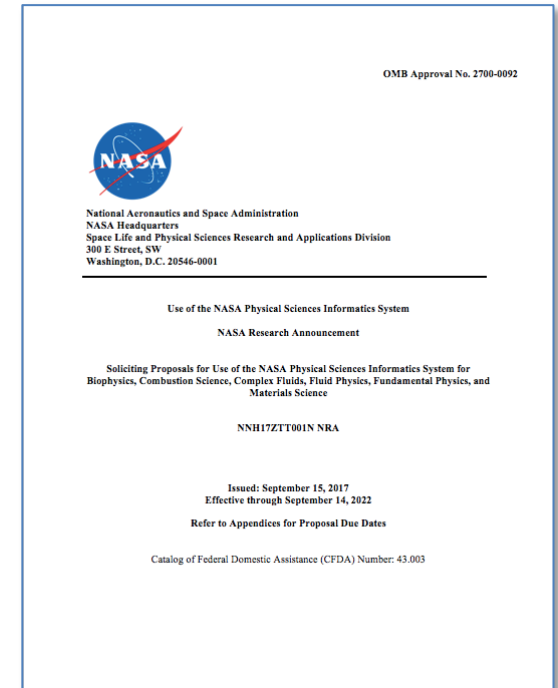
Rick Bright  
 Rick A. Bright, Ph.D.  
 Director, Biomedical Advanced Research and Development Authority  
 Deputy Assistant Secretary for Preparedness and Response  
 Office of the Assistant Secretary for Preparedness and Response  
 United States Department of Health and Human Services

07/28/2017  
 Date

- PK-4: Dusty Plasma
- Overall science objectives
  - Study of microparticles in an ionized gas to understand the fundamental behavior of plasmas.
  - Study of non-Gaussian statistics of particle motion, diffusion, viscosity, etc.
- NASA/NSF joint solicitation
  - Selected 6 investigations
    - 2 NASA funded
    - 4 co-funded
  - Data will be available to ALL of the PK-4 science team members
- ESA/ROSCOSMOS Mission



- Biological Sciences
  - Re-establishing annual NRA cadence
    - Flight and Ground
    - Traditional PI and Teams
    - Enabling Exploration and Pioneering Scientific Discovery
    - Alone and with other organizations
  
- Physical Sciences
  - Annual solicitation for Physical Sciences Informatics (PSI)
  - Complete currently selected investigations
  - Fundamental Physics
    - BECCAL partnership with DLR



- Space Biology

- NNH16ZTT001N-MoBE “Research Opportunities for Post-Doctoral Fellowships in Space Biology to Study the Microbiome of the ISS as a Built Environment: Using ISS as a Microbiological Observatory” Appendix B to ROSBio-2016 (NNH16ZTT001N NRA)
  - Released 9/16/16, Proposals Due 11/30/16. Selections 4/17
    - 3 awards by NASA
    - 2 awards by Alfred P. Sloan Foundation

- Physical Sciences

- NNH17ZTT001N Appendix C: Use of the NASA Physical Sciences Informatics System
  - Released 9/15/16. Proposals Due: 12/15/16. Selections: 6/8/17
- RFP EW-2692-945461: Bose-Einstein-Condensate Cold Atom Laboratory Science Definition Team
  - Released 5/23/17. Proposals Due: 6/26/17. Selections: 7/31/17



- Space Biology NRA NNH16ZTT001N
  - Appendix C: “Solicitation of Proposals for Possible Inclusion in a Russian Bion-M2 Mission.”
    - Released 7/14/17. Pre-proposals due: 09/21/17. Selections: TBD.
  - Appendix D: “Solicitation of Proposals to Conduct Research Using Microgravity Simulation Devices.”
    - Released 8/16/17. Proposals Due: 10/16/17. Selections 4/30/18.
  - Appendix E: “Solicitation of Proposals to Conduct Research In Parabolic and Suborbital Flights.”
    - Released 8/16/17. Proposals Due: 10/16/17. Selections 4/30/18.
  - Appendix F: “Solicitation of Proposals to Conduct Research on Antarctic Balloon Flights.”
    - Released 8/16/17. Proposals Due: 10/16/17. Selections 4/30/18.
  
- Physical Science
  - NNH17ZTT001N NRA Appendix D: Use of the NASA Physical Sciences Informatics System
    - Released: 9/15/17. Proposals Due: 12/15/17. Selections 6/30/18.

- Space Biology NRA NNH16ZTT001N
  - Appendix G: “Solicitation of Proposals for Flight and Ground Space Biology Research.” (Planned Release Date: 11/3/17).
  - Appendix H: “Space Biology Ames Life Science Data Archive Biospecimen Sharing.” (Planned Release Date: TBD).
  - “Space Biology Research Pathfinder for Beyond Low Earth Orbit Space Biology Investigations”. (Planned Release Date: 2018)
  - “NASA Life Science Data Archive Biospecimen Sharing” (Planned Release Date: 2018)
  - Joint with HRP
    - Topic 6 of NNJ16ZSA001N-SRHHC (Appendix E of HRP HERO): Combined Effects of Simulated Weightlessness and Space Radiation on Cardiovascular Structure and Function. (Released: 03/22/17; Proposal Due: 7/31/17).
    - Biological, Physiological, and Behavioral Functions of Mice during Partial (0 – 1) G-Exposures Provided by Centrifugation on the International Space Station. (Planned release date: 10/17).
- Physical Science
  - NNH17ZTT001N NRA Appendix E: Use of the NASA Physical Sciences Informatics System
    - Release: 9/14/18. Proposals due: 12/17/18. Selections: 6/30/19.

- Opportunities
  - Refinement of exploration plans?
  - Abundant crew time on ISS (for a season)
    - Technology demonstrations: e.g., Real Time Protein Crystal Growth
  - Excellent environment for partnerships with other government agencies
  
- Challenges
  - Refinement of exploration plans?
  - Funding investigations through delays



- Funding investigations through delays
  - Possible approach in future:
    - Fund flight definition (2-3 years) at high level
    - Select for flight decision
    - Fund waiting period at maintenance level for travel, telecons (no students, post-docs, techs)
    - Fund flight period at high level starting at
      - Launch – N?
      - Hardware checkout – N?
      - Flight queue has N investigations in front?
    - Questions
      - How tolerable is the waiting discontinuity?
      - How much lead time is needed before flight (N)?
  - What about current investigations?

- NASA has announced more detailed plans for exploration
  - NASA awaits a new administrator
- SLPSRA continues to implement Decadal Survey content to
  - Enable exploration
  - Pioneer scientific discovery
- SLPSRA promotes Open Science and partnerships
- SLPSRA continues to solicit for research
  - Enabling Exploration and Pioneering Scientific Discovery
  - Traditional and Open Science
  - Alone and with other sponsors
  - Ground and flight

