

# **The NASA and LVX System Partnership for Development of Light Communication Technologies**

**IEEE International Conference on Wireless for  
Space and Extreme Environments 2015**

Jack Fox  
December 16, 2015



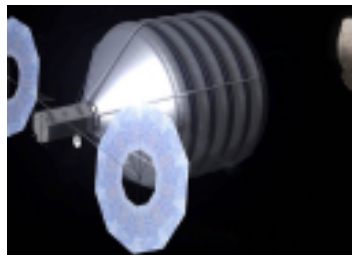
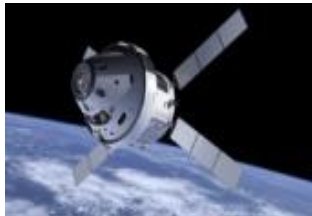
- **NASA Kennedy Space Center's Research and Technology**
- **LVX System**
- **NASA – LVX System Partnership: Space Act Agreement and First Collaborative Project**
- **NASA – LVX System License Agreement and How Others Can Participate**



# NASA KSC's Research and Technology

John F. Kennedy Space Center

- Swamp Works is a hands-on, lean development environment for innovation. Our theme is space resources. Our mission is to provide government and commercial space ventures with pioneering technologies that enable working and living on the surfaces of the moon, planets, and other bodies in our solar system.*





# NASA KSC's Research and Technology (cont'd)

— John F. Kennedy Space Center —

## *CRYOGENICS*

- Unique expertise providing energy-efficient solutions for storage, transfer, and use of cryogenics and cryogenic propellants on Earth and in space.
  - Thermal insulation systems
  - Integrated refrigeration systems
  - Design of propellant servicing systems
  - Novel materials and components
  - Low-temperature applications
  - Energy-efficient technologies for the energy-intensive endeavors of exploration
- Contact: James E. Fesmire - (321) 867-7557, [james.e.fesmire@nasa.gov](mailto:james.e.fesmire@nasa.gov)



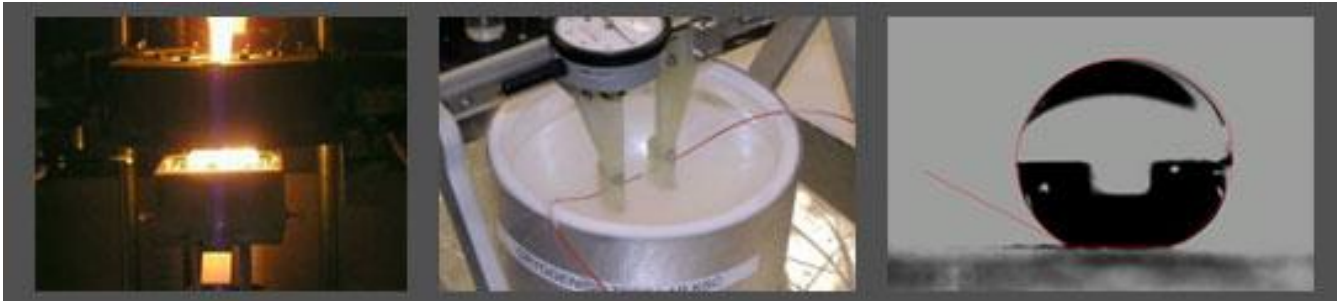


# NASA KSC's Research and Technology (cont'd)

John F. Kennedy Space Center

## *ADVANCED MATERIALS & SYSTEMS*

- Polymer science, materials chemistry, & novel composite systems for space applications.
  - Aerogel composites & smart thermal materials
  - Chemochromic gas sensing materials & systems
  - Damage detection, self-healing, & repair
  - Carbon nanotube & conductive polymers
  - Nanocomposites & polymer processing
  - Materials for flight technology demonstrations
- Contacts: Martha K. Williams, PhD - (321) 867-4554 , [martha.k.williams@nasa.gov](mailto:martha.k.williams@nasa.gov)  
Luke B. Roberson, PhD - (321) 867-1543, [luke.b.roberson@nasa.gov](mailto:luke.b.roberson@nasa.gov)



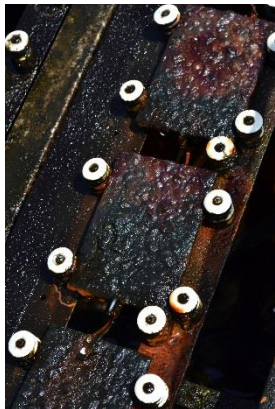


# NASA KSC's Research and Technology (cont'd)

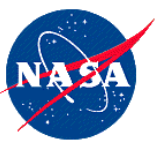
— John F. Kennedy Space Center

## *CORROSION TECHNOLOGY*

- Technical innovations and engineering services in all areas of corrosion for NASA and external customers.
  - Investigation of materials performance and degradation in different environments
  - Mechanical, physical, and environmental testing
  - Applied research
  - Development of new corrosion detection and control technologies
  - Consulting and testing services
- Contact: Luz M. Calle, PhD - (321) 867-3278, [luz.m.calle@nasa.gov](mailto:luz.m.calle@nasa.gov)







# NASA KSC's Research and Technology (cont'd)

John F. Kennedy Space Center

## *APPLIED PHYSICS*

- Development of instrumentation and tools to answer vehicle processing and ground support equipment questions.
  - Nondestructive evaluation of flight hardware and ground support equipment
  - Leak detection and visualization
  - Sensor development
  - Electromagnetic radiation
  - Ultrasonics
- Contact: Robert C. Youngquist, PhD - (321) 867-1829, [robert.c.youngquist@nasa.gov](mailto:robert.c.youngquist@nasa.gov)



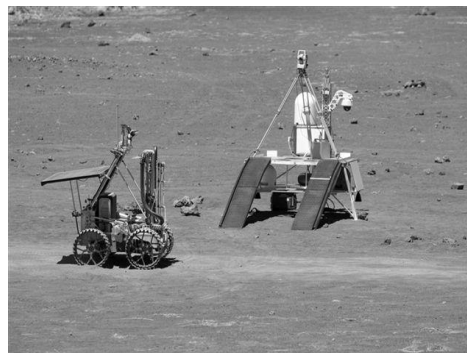
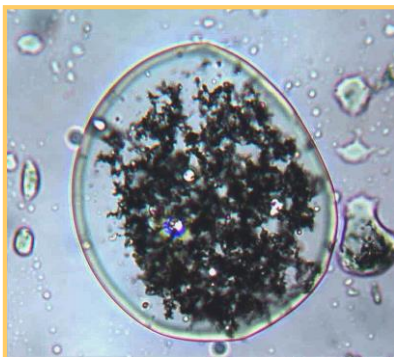


# NASA KSC's Research and Technology (cont'd)

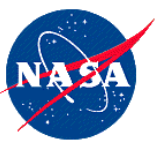
— John F. Kennedy Space Center

## *APPLIED CHEMISTRY*

- Research and development for a range of chemistry applications to solve NASA's unique needs.
  - Green propellant compatibility & leak detection
  - Solvent-free precision cleaning
  - Oxygen recovery from spacecraft CO<sub>2</sub>
  - Analytical chemistry for process development
  - Catalyst and other chemical synthesis
  - Environmental remediation technology development
  - In situ resource utilization technology development
- Contact: Jacqueline W. Quinn, PhD - (321) 867-8410, [jacqueline.w.quinn@nasa.gov](mailto:jacqueline.w.quinn@nasa.gov)







# NASA KSC's Research and Technology (cont'd)

— John F. Kennedy Space Center

## *GRANULAR MECHANICS & REGOLITH OPERATIONS*

- Development of technologies for working with regolith (surface materials) on other bodies in space, and the study of its basic physics and geology.
  - Excavation technologies
  - Pneumatic transport of regolith
  - Magnetic handling of regolith
  - Dust-tolerant mechanisms
  - Construction using regolith
  - Rocket exhaust plume effects
- Contact: Robert P. Mueller - (321) 867-2557, [rob.mueller@nasa.gov](mailto:rob.mueller@nasa.gov)



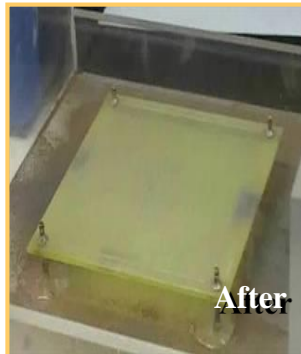
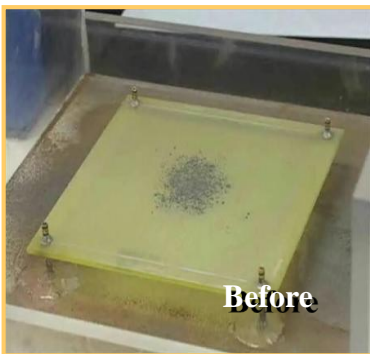


# NASA KSC's Research and Technology (cont'd)

John F. Kennedy Space Center

## *ELECTROSTATICS & SURFACE PHYSICS*

- Investigation of electrostatics and surface physics problems with applications for spaceflight and planetary exploration.
  - Electrostatic analyses
  - Detection, mitigation, and prevention of electrostatic charge generation on spaceflight hardware and ground support equipment
  - Dust mitigation for solar panels, in situ fluid and power connections, and spacesuit materials
- Contact: Carlos I. Calle, PhD - (321) 867-3274, [carlos.i.calle@nasa.gov](mailto:carlos.i.calle@nasa.gov)



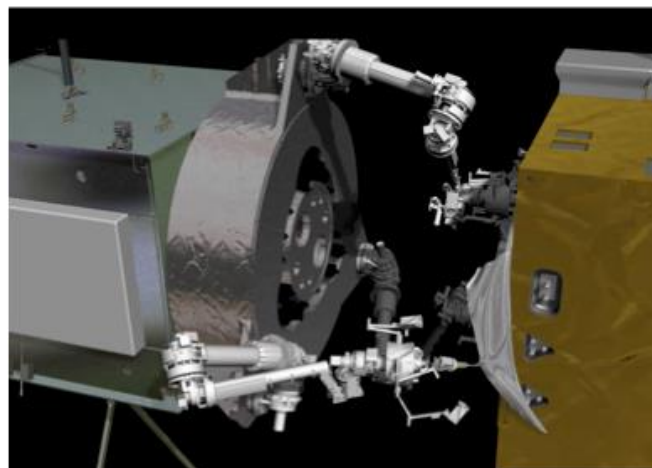


# NASA KSC's Research and Technology (cont'd)

John F. Kennedy Space Center

## *IN-SPACE ROBOTIC SERVICING*

- KSC supports the GSFC Satellite Servicing project office in design, development, and testing of satellite propellant servicing technologies
  - Engineering development unit testing using hypergolic propellants
  - Xenon on-orbit propellant transfer systems
  - Integrated bus/spacecraft concepts/trades
- Contact: Gary Snyder - (321) 867-4276, [gary.n.snyder@nasa.gov](mailto:gary.n.snyder@nasa.gov)



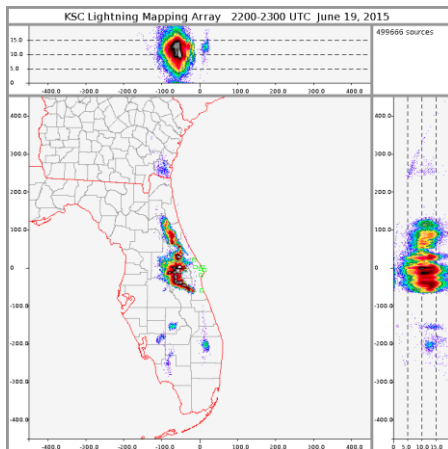


# NASA KSC's Research and Technology (cont'd)

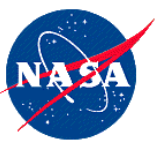
John F. Kennedy Space Center

## *WEATHER INSTRUMENTATION FOR LAUNCH ENVIRONMENTS*

- Research and development of weather instrumentation to measure lightning and other large scale electrical discharges
  - Lightning mapping arrays for 3-D lightning detection in partnership with New Mexico Tech, Florida Tech, NASA MSFC and NASA Wallops Flight Facility
  - Development of sensors for electric field detection
  - High-speed cameras on the Vehicle Assembly Building for Sprite detection in partnership with Duke University
- Contact: Jennifer Wilson- (321) 867-0824, [jennifer.g.wilson@nasa.gov](mailto:jennifer.g.wilson@nasa.gov)







# NASA KSC's Research and Technology (cont'd)

— John F. Kennedy Space Center

## *UNMANNED AERIAL VEHICLE (UAV) APPLICATIONS*

- Development of Fixed-Wing UAV's for airborne instrumentation
  - Development of airborne electrical field sensors for electrical field measurement in thick clouds
  - Manufacture and assembly of UAV platforms using carbon fiber and other composite materials
  - Development of control and tracking systems for UAV operations in active range environments
- Contact: Robert G. Brown- (321) 861-7988, [robert.g.brown@nasa.gov](mailto:robert.g.brown@nasa.gov)





# NASA KSC's Research and Technology (cont'd)

John F. Kennedy Space Center

## *LIFE SCIENCE AND PLANT RESEARCH AND TECHNOLOGY*

- NRA driven life science research responding to NRC Decadal Report
  - PI support, and flight prep, monitoring, and control environment areas
- Development of flight hardware to support PI questions and bioregenerative technologies, responsive to exploration roadmap
  - Veggie (on orbit)
  - Advanced Plant Habitat (APH) (in dev., readiness date Aug 2016)
- Contact: Deborah Hahn - (321) 867-6183, [deborah.j.hahn@nasa.gov](mailto:deborah.j.hahn@nasa.gov)



Biology being place in MELFI



Arabidopsis in  
Petrie dish prepped  
for flight



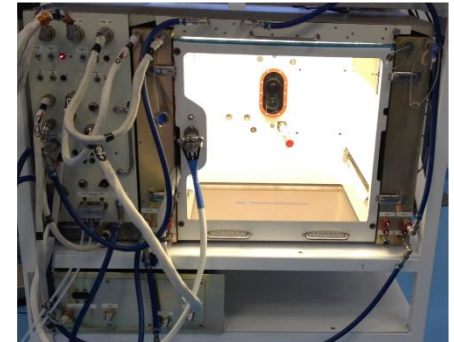
Plants on ISS



Kennedy  
Fixation Tube



Veggie on ISS



APH Engineering Development Unit



- LVX is an acronym for Light Visually X-Transceiving
- LVX System provides lighting and data communication as a unit of a “Data Lumen hour” or “DLh” that is equal to one million lumen hours
- LVX System’s founder and CEO, John Pederson, is the inventor of two-way broadband Visible Light Communication (VLC)
- There are 51 LVX companies to offer this new service of light, one to serve each state and the District of Columbia
- There are also 4 common supporting companies
  - LVX Western, the manufacturer of the LVX lighting apparatus
  - LVX Lab, to research and develop the technology and designs
  - LVX License, to finance infrastructural growth and license LVX for government and vendor participation
  - LVX System, the holding company, located at Kennedy Space Center, FL

- **On July 30, 2015 Kennedy Space Center Director, Bob Cabana, and LVX Board Chairman and CEO, John Pederson, signed a 5 year fully reimbursable Space Act Agreement for collaboration on research and development of new applications for Visible Light Communication**



- The first collaborative project is to develop a simulated deep space habitat, outfit with Visual Light Communication capabilities, integrate cameras, microphones, and speakers



Dr. Eirik Holbert  
with lighting fixture



Habitat mock-up previously  
developed at KSC and now at  
MSFC. New habitat will be similar.



# **NASA – LVX System License Agreement and How Others Can Participate**



— John F. Kennedy Space Center —

- **On August 6, 2015 NASA and LVX sign agreement for irrevocable, non-exclusive, royalty free license**
- **Applicable to incoming LVX IP, incoming NASA IP, and resultant collaborative IP**
- **NASA may grant sublicenses to any other U.S. Government agency, sub-agency, or department of the U.S. Government; with LVX approval**
- **LVX may grant licenses to any state government agency, sub-agency, department, or entity**
- **LVX may grant licenses to any private entity, individual, and/or third party in private sector**



# **NASA – LVX System License Agreement and How Others Can Participate (cont'd)**



— John F. Kennedy Space Center —

- **NASA research and technology work limited to aerospace and aeronautics applications**
- **NASA work must be performed at KSC**
- **Additional partners must be approved by LVX**



# Thank you!



- **Contacts:**

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<http://www.lvxsystem.com>