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A collage of four images: a satellite in space, a flame, a space station, and an astronaut on a planet surface.

# Workshop on Research Needs in Fire Safety for the Human Exploration and Utilization of Space

*Hosted by*

**NASA John H. Glenn Research Center  
and the  
National Center for Microgravity Research in Fluids and Combustion**

***Sheraton Airport Hotel  
Cleveland, Ohio  
June 25 - 26, 2001***



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## Background



- **Last Spacecraft Fire Safety Workshop was held August 20-21, 1986**





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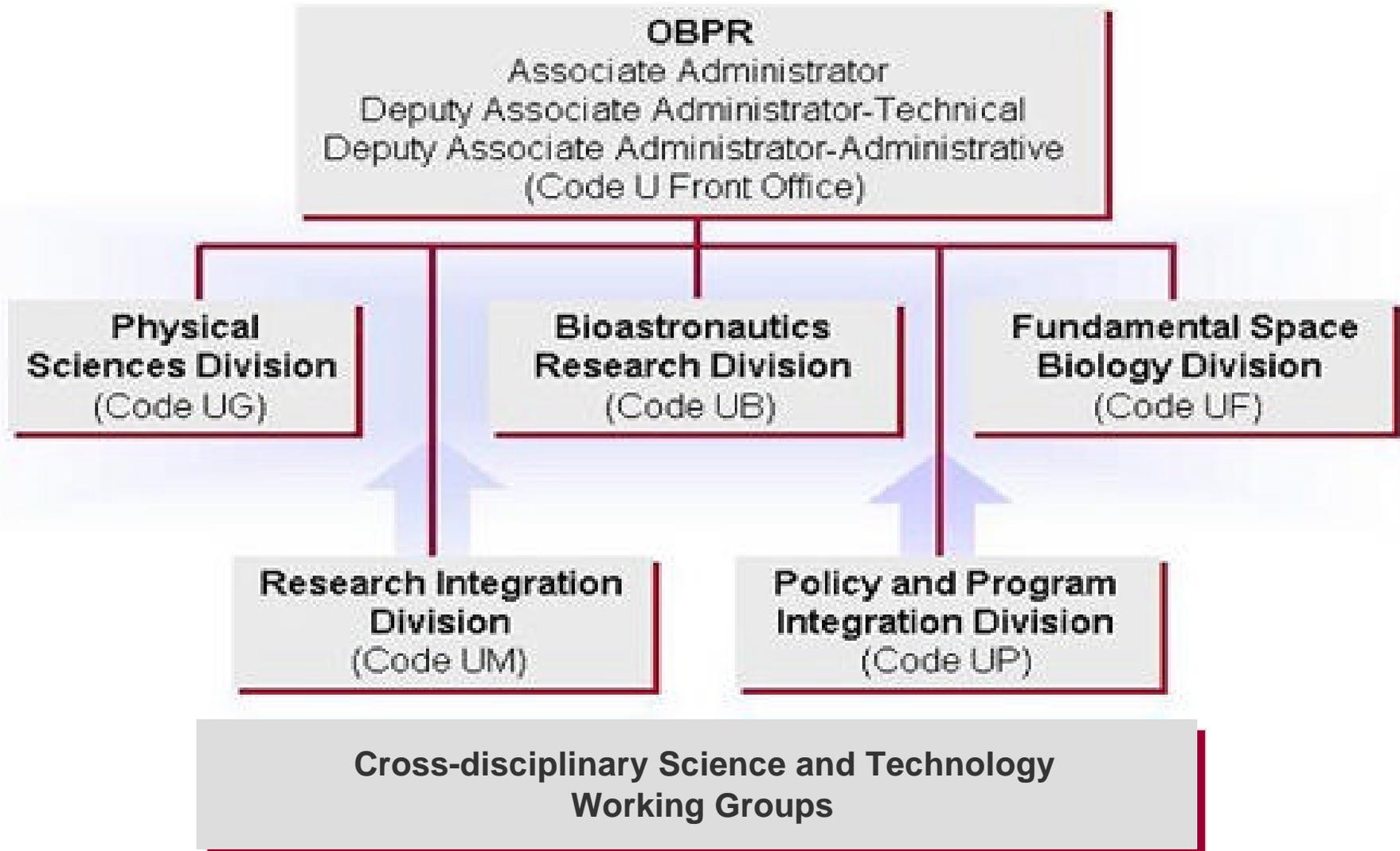


- **Last Spacecraft Fire Safety Workshop was held August 20-21, 1986**
  - Challenger accident 8 months earlier
  - Space Station designs underway
- **107 people, 5 break-out forums**
  - Fire detection and ignition
  - Fire extinguishment
  - Human responses to combustion products and inert atmospheres
  - Spacecraft materials and configurations
  - Selection of spacecraft atmospheres
- **Objectives**
  - Review current knowledge in fire safety
  - Assess the needs relevant to spacecraft
- **Microgravity combustion research conducted since 1986 has impacted fire safety practices on STS and ISS**



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# Office of Biological and Physical Research





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## Bioastronautics Initiative - History



- In mid-1999, the Space and Life Sciences Directorate at Johnson Space Center was challenged to develop a new paradigm for NASA human life sciences
  - Space Medicine
  - Space Biomedical Research and Countermeasures
  - Advanced Human Support Technology
- A new thrust - **Bioastronautics** - was formulated with a budget augmentation request
- Objective:
  - Expanded extramural community participation through the National Space Biomedical Research Institute
  - Initiated the detailed planning and implementation of Bioastronautics
    - *An Integrated Approach to Ensure Healthy and Safe Human Space Travel*
    - *Assist in the Solution of Earth-based Problems*



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## Bioastronautics Initiative



- **Builds upon previous and ongoing work**
  - A significant amount of fundamental knowledge has been created through ground and flight research
  - Apply this knowledge base to applications and solutions which will provide safer human operations in space
- **Utilizes new research resources**
  - ISS research opportunities
  - Ground analogs
- **Leverages new and unique capabilities**
  - Scientific community to focus on NASA issues
  - Transfer knowledge to Earth based problems
  - Cooperate with other Federal Agencies
  - Develop new technologies
    - smart medical systems
    - biologically-inspired technologies
    - fire protection



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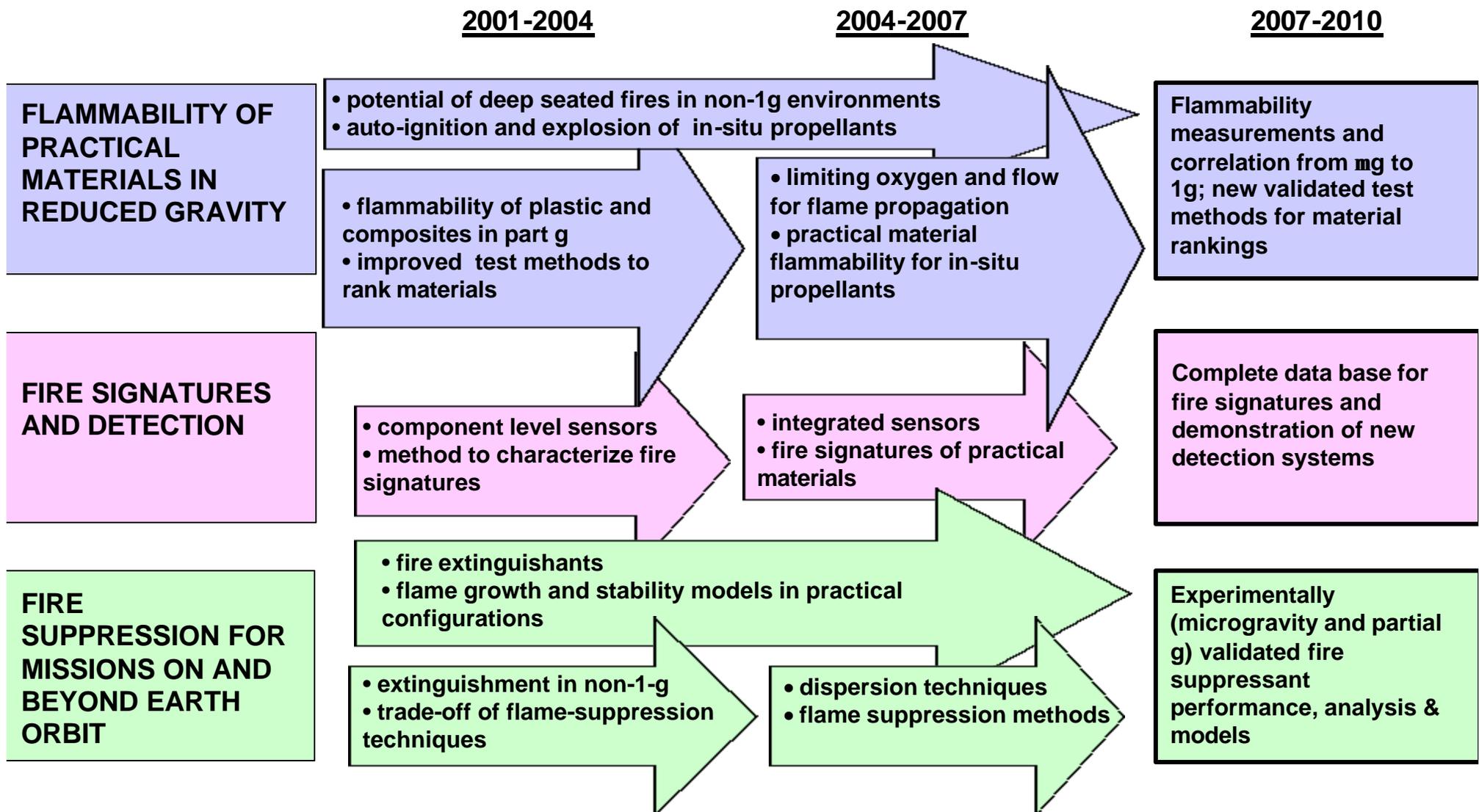
## NASA Bioastronautics Initiative – Combustion Science



- **Substantially improve spacecraft fire safety within six years**
  - \$1M per year for four years (initial funding level)
  - Grant-based through NRAs and directed research
- **Fire safety practices and procedures**
  - ISS and Shuttle operations
  - Prolonged human-crew missions in Earth orbit and beyond
  - Lunar and/or Martian habitats
    - In-situ resource utilization
    - Propellant manufacture and storage



# Fire Safety On and Beyond Orbit





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## Workshop Objectives



- Identify research needed for fire safety of STS, ISS and their payloads
- Identify fire safety concerns for prolonged human-crew missions in Earth orbit and beyond
- Anticipate research for future Lunar/Martian habitats

### Approach

- Plenary session to overview current operations and issues in fire protection in space
- Working groups to review current research and identify needs in the areas of
  - Fire prevention and material flammability
  - Smoke and fire detection
  - Fire and post-fire response



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## Plenary Speakers



- **Dennis Griffin**
  - Group Leader, Chemistry Group  
Materials, Processes, and Manufacturing Department  
NASA Marshall Space Flight Center
- **Michael D. Pedley**
  - ISS Materials and Processes Manager  
NASA Johnson Space Center
- **Alana A. Whitaker**
  - ISS Environmental Control and Life Support Systems  
Fire Detection and Suppression Department  
NASA Johnson Space Center
- **Dale E. Lueck**
  - Systems engineering and Analysis Branch  
Spaceport Engineering and Technology  
NASA Kennedy Space Center



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## Working Groups



- **Fire Prevention and Material Flammability (O'Hare Room)**
  - James T'ien, Case Western Reserve University
  - Dennis Griffin, NASA Marshall Space Flight Center
- **Smoke and Fire Detection (Dulles Room)**
  - David L. Urban, NASA Glenn Research Center
  - Thomas Cleary, National Institute of Standards and Technology
- **Fire and Post-Fire Response (Hartsfield Room)**
  - Robert Friedman, NASA Glenn Research Center
  - J. Michael Bennett, Wright-Patterson Air Force Base
- **Sessions will begin with introductions and short presentations of current research**
  - Begin discussions of mission-driven fire protection systems within these areas
  - Recognize current knowledge and identify unknowns
  - Define research needed to fill gaps
  - Prioritize by short and long term, if applicable



# Schedule



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## Monday, June 25

Event	7:00 AM	8:00 AM	8:30 AM	9:00 AM	9:30 AM	10:00 AM	10:15 AM	10:45 AM
<b>Plenary</b> (Grand Ballroom)	Registration/ Continental Breakfast (Grand Ballroom)	<b>Welcome</b> Ruff, Ostrach	<b>Materials Testing and Certification</b> Griffin NASA MSFC	<b>Spacecraft Fire Safety: A Human Space Flight Program Perspective</b> Pedley NASA JSC	<b>ISS Fire Protection and the ECLSS System</b> Whitaker NASA JSC	Break (Grand Ballroom)	<b>In-Situ Propellant Manufacture and Storage</b> Lueck NASA KSC	<b>Charge to Working Groups</b> Ruff
<b>Fire Prevention and Material Flammability</b> (O'Hare Room)	11:00 AM <b>Moderators:</b> <b>T'ien, Griffin</b> Presentations: Torero, Fernandez-Pello Olson	Lunch (Lambert Room)	1:30 PM <b>Working Session</b>	3:30 PM <b>Break (Grand Ballroom)</b>	4:00 PM <b>Working Session</b>	6:00 PM <b>Cash Bar (Lambert Room)</b>	6:30 PM <b>Dinner (Lambert Room)</b>	
<b>Smoke and Fire Detection</b> (Dulles Room)	<b>Moderators:</b> <b>Urban, Cleary</b> Presentations: Urban, Hunter, Young		Working Session		Working Session			
<b>Fire and Post-Fire Response</b> (Hartsfield Room)	<b>Moderators:</b> <b>Friedman, Bennett</b> Presentations: Ross, Takahashi, Abbud-Madrid		Working Session		Working Session			



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# Schedule



## Tuesday, June 26

Event	7:00 AM	8:00 AM	9:00 AM	9:45 AM	10:30 AM	10:45 AM	11:30 AM	11:45 AM
<b>Plenary</b> (Grand Ballroom)	Continental Breakfast (Grand Ballroom)		Fire Prevention and Materials Summary	Smoke and Fire Detection Summary	Break ( Grand Ballroom)	Fire and Post-Fire Summary	<b>Closing</b> Ruff	Lunch/Completion of Written Summaries (Working Group Leaders) (Lounge)
<b>Fire Prevention and Material Flammability</b> (O'Hare Room)		Working Session Wrap-up						
<b>Smoke and Fire Detection</b> (Dulles Room)		Working Session Wrap-up						
<b>Fire and Post-Fire Response</b> (Hartsfield Room)		Working Session Wrap-up						



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## Summary Presentations



### General Topic

- **Current level of understanding**
- **Desired improvement or level of knowledge required**
  - If possible,
  - Near-term
  - Long-term
- **Recommendations for research within this topic**
- **Other Considerations**
  - Enabling technologies
  - Impact on current procedures or future designs
  - Technology transfer/technology teaming opportunities
  - Who is the User?
    - Desired format



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# Written Report



- **Introduction**
  - Conduct of the group
  - Decision/discussion process
  
- **Current Technology Issues**
  - Issue 1
    - Knowns and unknowns
  - Issue 2
  
- **Research Areas**
  - Major Areas
    - Near-term
    - Mid-term
  - Enabling technologies
  - Technology teaming possibilities
  - Format of information desired by user