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Small Spacecraft

EXPANDING CAPABILITIES ENABLING SCIENCE & EXPLORATION

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Disclaimer

The NASA SBIR/STTR subtopic workshop was held for informational purposes only and was an opportunity for the small businesses community to explore and share ideas related to the general technical topic areas.

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Small Spacecraft Sub Topics Overview

“Small” for this discussion is defined as less than 180-kg (400-lbs)

Small can also mean Affordable, Agile, Transformative

“Spacecraft”: chipsats, nanosats, cubesats, smallsats, 1U, 3U, 6U, 27U 64U, etc.

Z8.01 Small Spacecraft Propulsion Systems

Z8.02 Small Spacecraft Communications Systems

Z8.03 Small Spacecraft Power and Thermal Control

Z8.04 Small Spacecraft Structures, Mechanisms, and Manufacturing

Z8.05 Small Spacecraft Avionics and Control

Small Spacecraft: Enabling Science

Small Spacecraft's exponential capabilities will allow NASA Scientists and Engineers to cost effectively address the Decadal Survey mission needs and expand the knowledge base of Earth, our solar system, and deep space.

Earth Sciences Observations – land surface, biosphere, Earth interior, atmosphere, and oceans

Planetary Science Decadal Survey Priorities – Galactic origins, Life Detection, Planetary Processes

Planetary Reconnaissance – Exploration, Strategic knowledge gaps, pre landing missions,

Space Biology – Radiation Effects, Gravitational Effects, Human exploration, synthetic biology

Technology Transfer – sensors, Instruments, power generation, medical, materials

Small Spacecraft platforms are a cost effective tool for NASA's primary mission.

Small Spacecraft: Propulsion Systems

Z8.01 Small Spacecraft Propulsion Systems

- Small delta-V: attitude and control, pointing angles
- Large delta-V: Single axis maneuvers, orbit raising, orbit capture
- Volume & Mass Efficient
- Thrust to Power Ratios
- Reliability & Performance

Wide range of technology: No bias to any certain technology

Considerations for LEO and Deep Space Operations

Small Spacecraft: Communications

Z8.02 Small Spacecraft Communications Systems

- Few operational constraints on mission objective
- Reduce mass, power, and volume requirements
- SmallSat to ground and SmallSat to SmallSat

  - High-gain Antennas,
  - Transceivers,
  - Network Protocols,
  - Optical Communications

Compatible with current NASA space communications infrastructure

<u>Considerations for LEO and Deep Space Operations</u>

Small Spacecraft: Power & Thermal Control

Z8.03 Small Spacecraft Power and Thermal Control

- Reliability for long deep space missions
- Efficiency of Power Generation
- Energy Management Systems – Integrated Systems
- Heat Rejection in Small Spacecraft
- Deployable – solar array and radiator systems

<u>Considerations for LEO and Deep Space Operations</u>

Small Spacecraft: Structures, Mech. & Manufacturing

Z8.04 Small Spacecraft Structures, Mechanisms, and Manufacturing

- Structural Efficiency
- Novel Materials
- Innovative Manufacturing
- Integrated Chassis (structure + power + internal comm)
- Mechanisms & Deployable
- Robotic Manufacturing

Considerations for LEO and Deep Space Operations

Small Spacecraft: Avionics & Control (GN&C)

Z8.05 Small Spacecraft Avionics and Control (GN&C)

- Reliability
- Efficiency (power & mass)
- Precision Integrated Attitude Detection and Control Systems (ADCS)
- Flexible Integration and Operations
- Modularity and/or Reconfigurable Flight Software
- Single Spacecraft and SWARM Operations Capabilities
- Deep Space Radiation Tolerant Designs

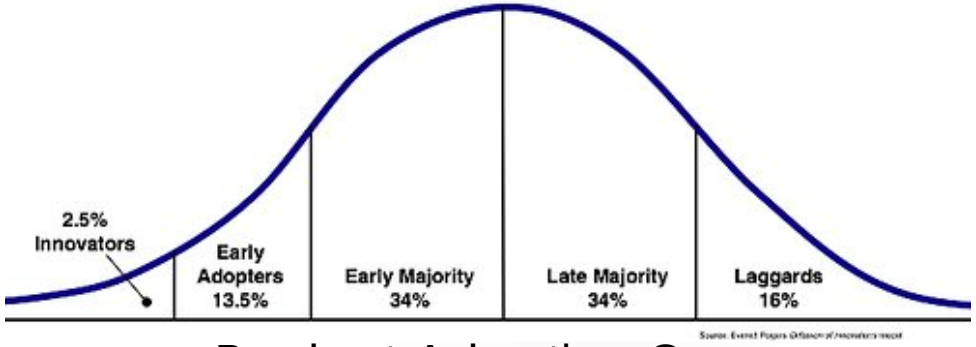
Considerations for LEO and Deep Space Operations

Small Spacecraft: Small Business

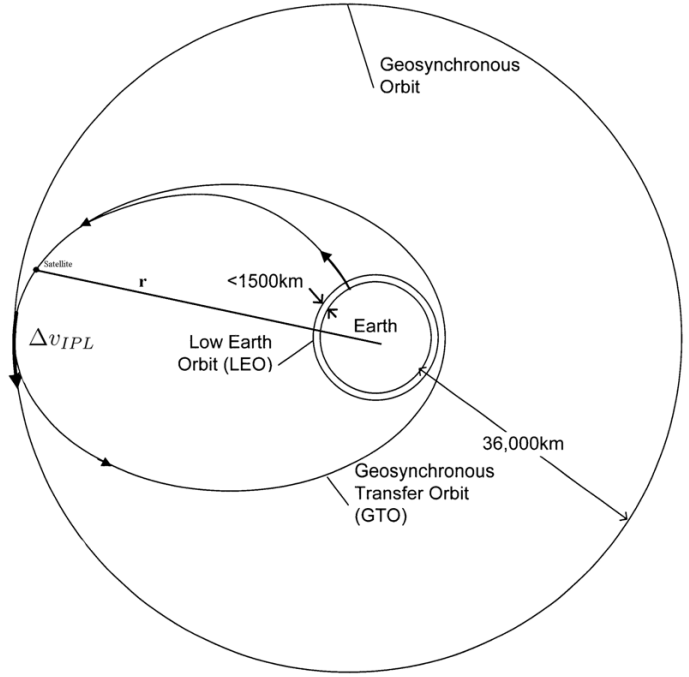
Small Business and Industry

- Small Spacecraft Innovation Stage
- Small Business' are Agile, Innovative, and Efficient
- Major Small Spacecraft Technology Gaps
  - LEO Capability Gaps
  - GTO Major Gaps (radiation)
  - Lunar, Planetary, & Deep Space

NASA depends on industry partners mission execution



Product Adoption Curve

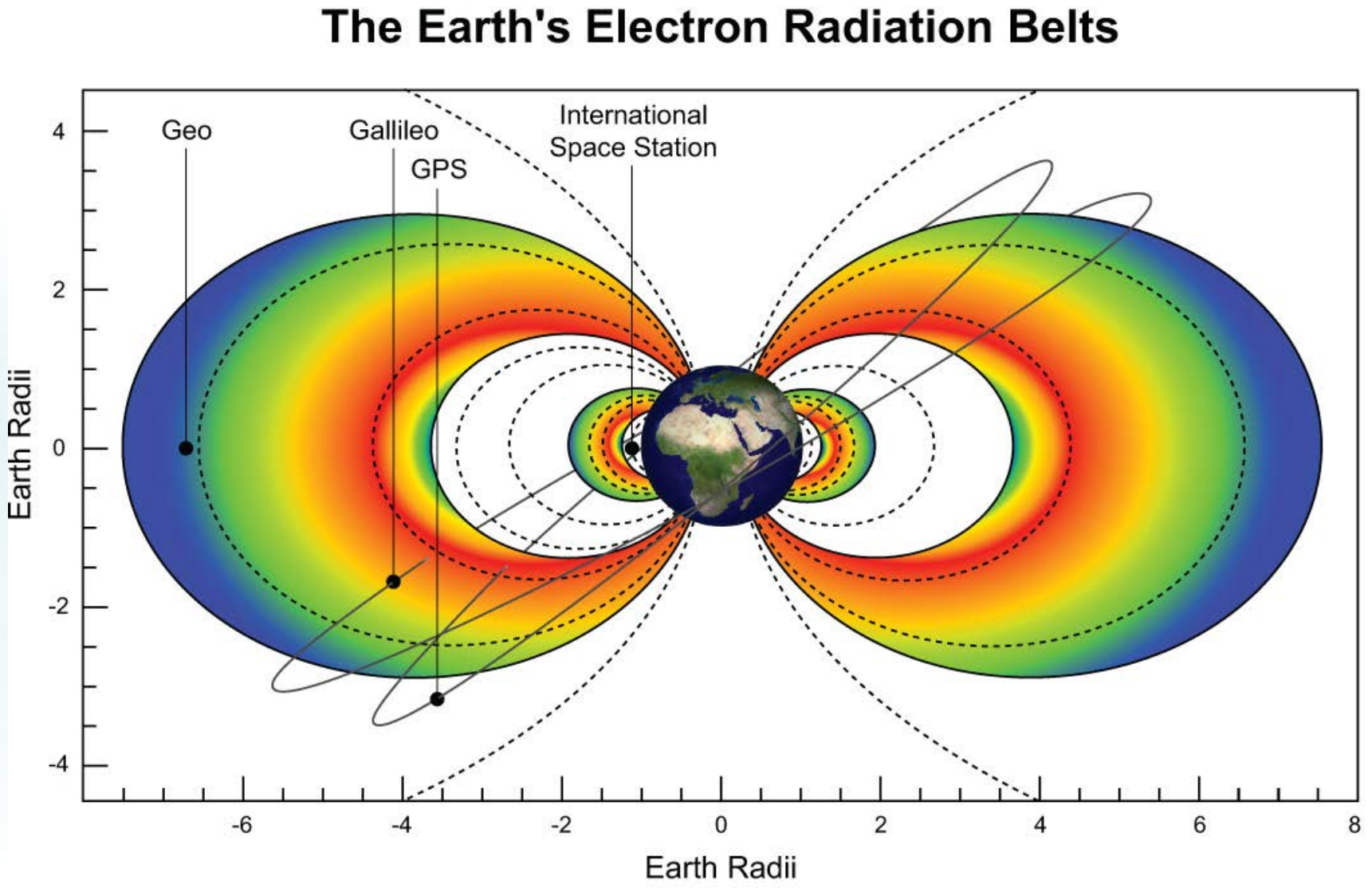


Small Spacecraft: Resources

NASA / TP-2015-216648/REV1
NASA Small Spacecraft Technology State of the Art Report
Mission Design Division, NASA Ames Research Center, Moffett Field CA
http://www.nasa.gov/sites/default/files/atoms/files/small_spacecraft_technology_state_of_the_art_2015_tagged.pdf

Space Radiation Effects on Electronics
Radiation Physics Office, NASA Goddard Space Flight Center
http://radhome.gsfc.nasa.gov/radhome/background.htm

Small Spacecraft: Space Environment



Van Allen Belt