Hall Propulsion Technology Development
NASA Glenn Research Center

50 kW Thruster Technology

EXPRESS Ground/Space Correlation

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"ST Day 2000: Reducing Risk for the Next Generations"

- **Technology goals and objectives**

  It is the goal of this activity to develop 50 kW class Hall thruster technology in support of cost and time critical mission applications such as orbit insertion.

- **Background**

  NASA MSFC is tasked to develop technologies that enable cost and travel time reduction of interorbital transportation. Therefore, a key challenge is development of moderate specific impulse (2000-3000s), high thrust-to-power electric propulsion. NASA GRC is responsible for development of a Hall propulsion system to meet these needs.

- **Current Status**

  First-phase, sub-scale Hall engine development completed. 10 kW engine designed, fabricated, and tested. Performance demonstrated >2400 s, >500 mN thrust over 1000 hrs of operation documented.

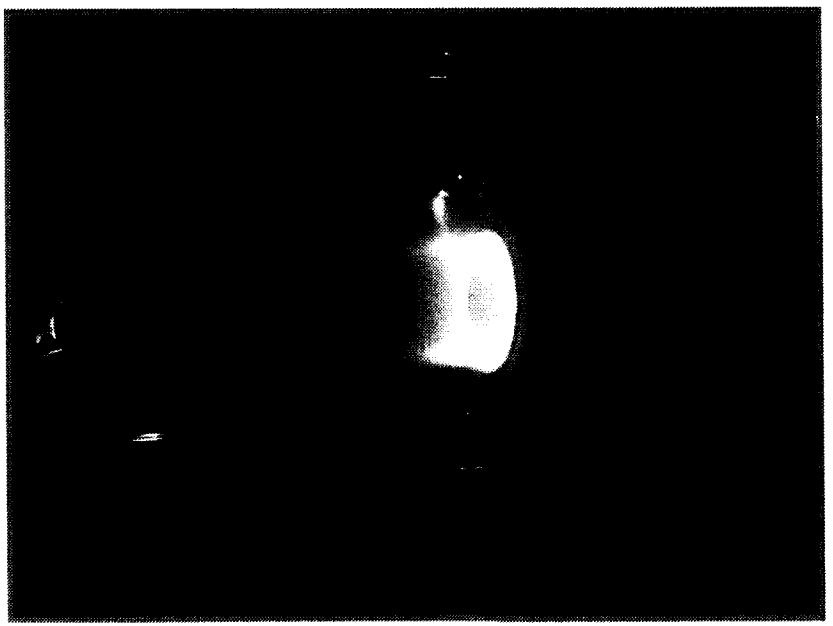
50 kW Thruster Technology

- **Major accomplishments (FY00):**

  The NASA T-220 10 kW Hall Effect Thruster demonstrated over 500 mN thrust at 2450 seconds specific impulse (Isp) and 59% total efficiency while demonstrating good erosion characteristics over 1000 hours of operation. This is the longest operation ever achieved on a high power Hall thruster (>5 kW). This test indicates the availability of 10 kW Hall thruster technology for future NASA, commercial, and military missions and confirms the technical approach for development of even higher power thrusters.

- **Near Term Plans (FY01):**

  Procure a 50 kW engine design and prepare diagnostics and test equipment.



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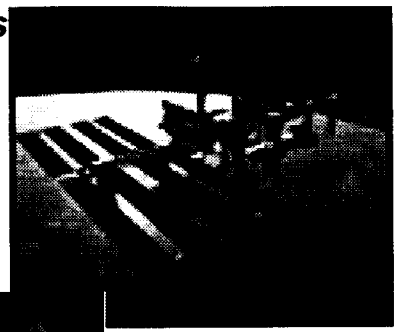
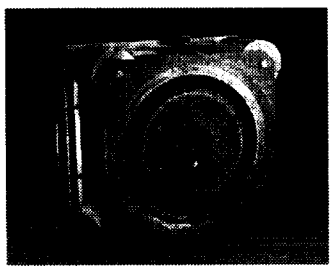
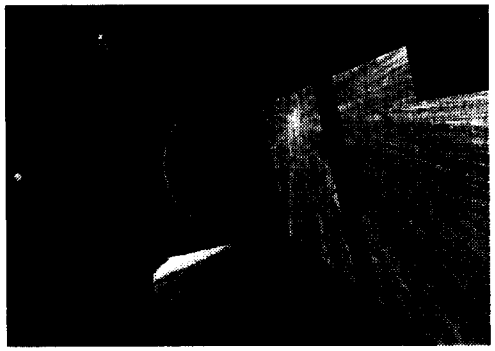
50 kW Thruster Technology

ISS Drag Makeup
Significantly reduces required refueling flights



Lunar/Mars Exploration
, Reduces Launch Vehicle Fleet





LEO to GEO space transportation ***Four Times the Payload of Chemical Systems In Four Weeks using next generation Power levels***

- **Need Power Levels ~ 50 kW & Isps ~ 2000 sec**

Space Solar Power
Reduces number of launch vehicles required by a factor of 5 ! Deliveries in few weeks to less than four months.

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50 kW Thruster Applications

- **Technology goals and objectives**

  Compare measurements of critical plasma parameters from on-orbit with ground test data. Develop fundamental understanding of the differences enabling extrapolation to other thrusters/geometries for integration assessments.

- **Background/Approach**
  - **Several different types of sensors integrated on two Russian Geo-Comsats (Express-A #2 & EXPRESS-A #3) utilizing 1.5 kW SPT-100 Hall thrusters.**
  - **Ground tests validating sensors and duplicating space measurements to be taken at NASA GRC**
  - **Additional GRC ground tests with alternate thrusters/geometries**

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- **Sensors integrated on to Express-A, #2 and launched**
  - Data being collected
  - Data transfer and correlation with thruster operation being addressed
- **Sensors integrated on to Express-A, #3 and launched**
  - Data being collected
  - Data requirements also being addresses
- **GRC ground testing**
  - Planning stages - test details being discussed
  - S/C representative sensors being procured

Current Status

- **Major accomplishments (FY00):**

  Successful launch of sensor packages on EXPRESS-A #2, and EXPRESS-A #3

- **Near Term Plans (FY01):**

  Procure a duplicate set of EXPRESS-A #2, and EXPRESS-A #3 sensors. Plan ground test program.

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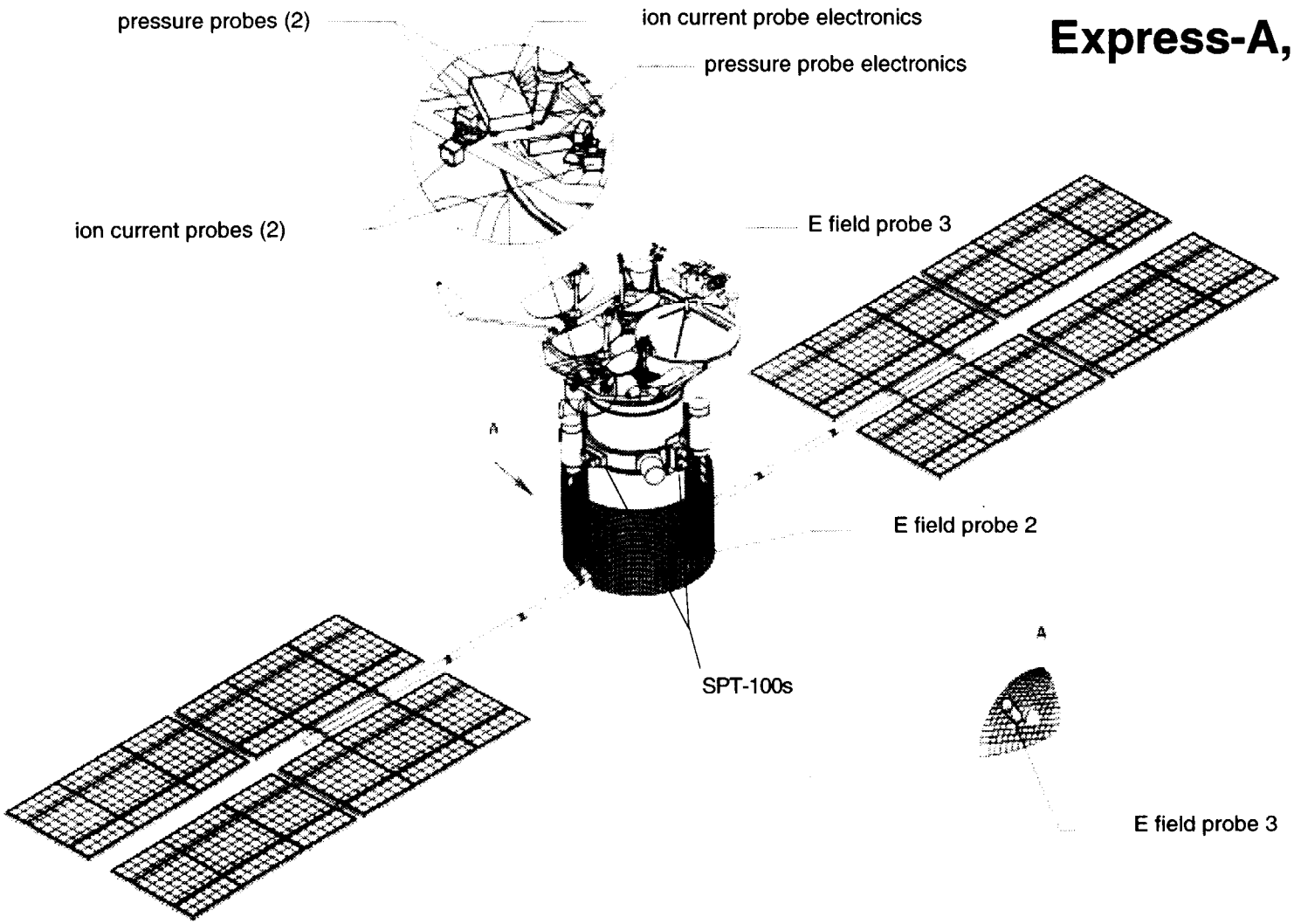
- **Sensor Types**
  - **Pressure: Measure local density to understand how plume expands Simple measurement, previously conducted**
    - Measurement in back flow region very difficult on ground
    - Maybe important for assessing corona phenomena for payload
  - **Electric Field Strength: Measure how the plasma modifies E-field at S/C surface**
    - Less simple measurement , previously conducted
    - Gives insight into how the spacecraft couples to the ambient space plasma
    - Maybe important for assessing corona phenomena for payload

- **Sensor Types (continued)**
  - **Ion Current: Measure the flux density of the plume ions**
    - Simple measurement, not previously conducted
    - Easily compared with ground tests data and analytic predictions
    - Flux of ions needed for estimating thermal/momentum transfer to other parts of S/C
  - **Ion Current & Energy: Measure the flux density and energy of the plume ions**
    - Difficult measurement, not previously conducted
    - Provides desired information for determination of integration impacts
    - Flux and energy ions needed for determining thermal/momentum transfer and erosion of S/C



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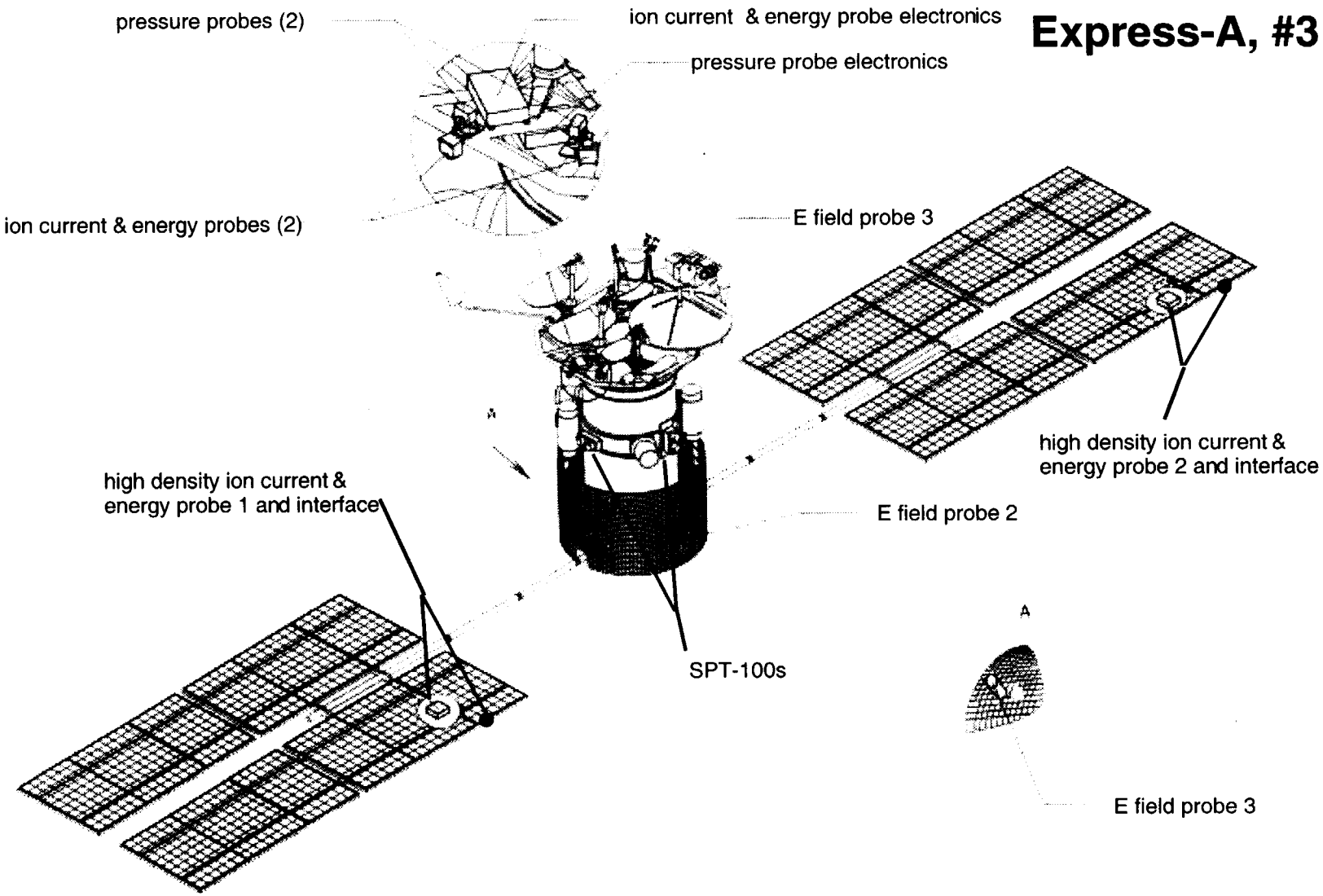

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