Objective

Study feasibility of actively controlling spacecraft potential by charged particle emission

Approach

Conduct experiments using:

- ATS-5 electron emitter
- ATS-6 plasma emitter
- UCSD particle instruments

Analyze particle data to obtain:

- Spacecraft potentials with and without particle emission in various environments
- Differences in the effectiveness of electron and plasma emission

Figure 2. Objective of investigation
Figure 1. Schedule for Spacecraft Charging Investigation

- DEFINE ENVIRONMENT
- DEVELOP GROUND SIMULATION TECHNIQUES & FACILITIES
- DEVELOP SPACECRAFT ANALYTICAL MODEL
- DEVELOP MATERIALS
- EVALUATE ACTIVE CONTROL TECHNIQUES
- FLIGHT DATA
  - ATS-5 AND 6 ADDITIONAL DATA
  - SCATHA
- ADDITIONAL FLIGHT EXPERIMENT
- DESIGN CRITERIA AND TEST REQUIREMENTS

△ REPORT

CONTINUOUS INPUTS FROM ALL OF ABOVE

MISSION

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Figure 3. ATS-5: Detectors and Ion Engines

- UCSD Plasma Viewing Cone
- Magnetometer (Boom in Z-axis)
- Solar Pressure Balance Ring
- Solar Panels
- Thermal Control
- Experiment Equipment Bay
- Ion Engine Experiment (Second Ion Engine on Opposite Side Not Shown)
- UCSD Auroral Particles Experiment
- Solar Panel
- UCSD Plasma Viewing Cone

Length = 72.5 in.
Diameter = 57.6 in.
Figure 4. ATS-6: Detectors and Ion Engines
Figure 5. ATS-5: Thruster

- VAPORIZER HEATER (350°C)
- SPLIT SEGMENTED ELECTRODES
- ACCELERATE & VECTOR CESIUM ION BEAM
- - 2000 VOLTS POTENTIAL
- ELECTRONS INJECTED INTO CESIUM ION BEAM
- NEUTRALIZER HEATER (1750°C)
- HIGH VELOCITY NEUTRAL CESIUM PLASMA
- DECELERATING ELECTRODE GROUND POTENTIAL
- POROUS TUNGSTEN BUTTON CESIUM IONS ARE GENERATED AT SURFACE + 3000 VOLTS POTENTIAL
- POROUS NICKEL WICK (FEEDS LIQUID CESIUM)
- ZERO-G CESIUM FEED SYSTEM & RESERVOIR
- IONIZER HEATER (1100°C)
- CESIUM VAPOR FEED TUBE
- BI METAL THERMAL VALVE
FIGURE 6. ATS-6: THRUSTER
Figure 7. ATS-5 and ATS-6: Comparison of Passive Spacecraft Potentials
Figure 8. ATS-5: Potential During Eclipse/Neutralizer Operation 9/20/74
Figure 9. ATS-5: Effect of Electron Emitter on Spacecraft Potentials
Spectrogram 1. ATS-6: Eclipse with Injection of Hot Plasma; 10/2/75
Spectrogram 2. ATS-5: Neutralized Operation in Eclipse; 9/20/74
Spectrogram 3. ATS-6: Ion Engine Operation; 7/18/74
Spectrogram 5. ATS-6: Neutralizer Operation in Daylight; 8/20/76
Spectrogram 6. ATS-6: Neutralizer Operation in Daylight; 11/14/76
Spectrogram 7. ATS-6: Neutralizer Operation in Eclipse; 10/14/76
Spectrogram 8. ATS-6: Neutralizer Operation in Eclipse; 9/3/76