

NASCAP SIMULATION OF PIX II EXPERIMENTS

James C. Roche
National Aeronautics and Space Administration
Lewis Research Center
Cleveland, Ohio 44135

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Myron J. Mandell
S-CUBED
San Diego, California 92121

The second Plasma Interaction Experiment (PIX II) consisted of a set of four short-circuited solar array modules mounted on the side of a Delta launch vehicle. The modules were independently biased over a range of positive and negative voltages relative to the Delta ground structure. The experiment was launched into low Earth orbit on 25 January 1983, and data were gathered for 18 hr on the currents collected by the modules from the space plasma. In this presentation the latest version of the NASCAP/LEO digital computer code was used to simulate the PIX II experiment. NASCAP is a finite-element code and previous versions have been restricted to a single fixed mesh size. As a consequence the resolution was dictated by the largest physical dimension to be modeled. The latest version of NASCAP/LEO can subdivide selected regions. This permitted the modeling of the overall Delta launch vehicle in the primary computational grid at a coarse resolution, with subdivided regions at finer resolution being used to pick up the details of the experiment module configuration. Langmuir probe data from the flight were used to estimate the space plasma density and temperature and the Delta ground potential relative to the space plasma. This information is needed for input to NASCAP. Because of the uncertainty or variability in the values of these parameters, it was necessary to explore a range around the nominal value in order to determine the variation in current collection. The flight data from PIX II were also compared with the results of the NASCAP simulation.

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OBJECT DEFINITION

GEOMETRY

- RECTANGLES ONLY
- MAIN GRID MESH: 0.25 m
- SUBDIVISION FACTOR: 9
- 1194 SURFACE CELLS
708 MAIN GRID
486 SUBDIVIDED GRID

SURFACE MATERIALS

- 751 INSULATING CELLS:
WHITE PAINT, CELL, AND KAPTON
 - 443 CONDUCTING CELLS:
BLACK PAINT, STAINLESS STEEL, THERMAL CONTROL
MATERIAL, AND SOLAR CELL INTERCONNECTS
 - PHYSICAL PROPERTIES DEFAULTED
- COMPUTER TIME: 2.5 min TOTAL

RUN PARAMETERS

STANDARD CONDITIONS

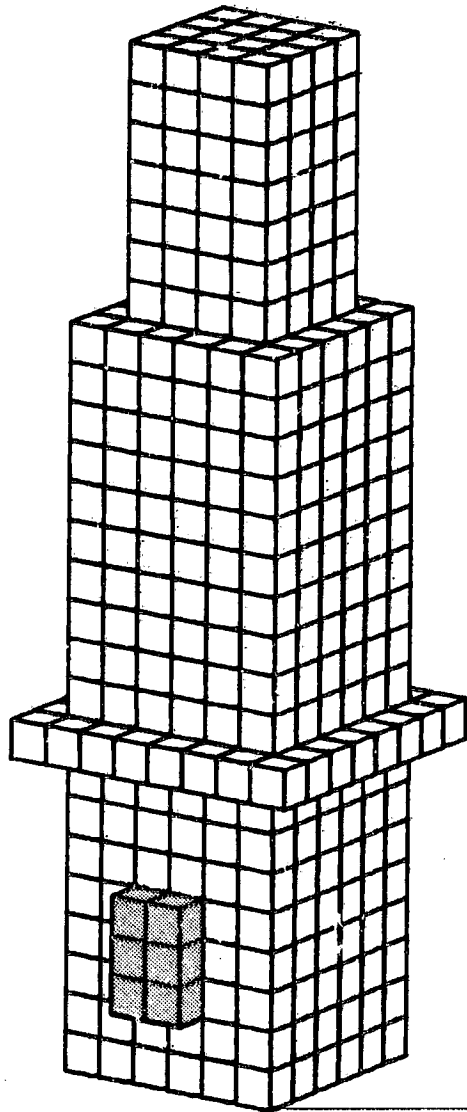
- TEMPERATURE: 0.15 eV
- DENSITY: 10^{10} IONS/m³ (14.3 amu)
- DEBYE LENGTH: 0.0288 m
- SPACECRAFT GROUND POTENTIAL: 0 V
- INITIAL POTENTIAL ON WHITE PAINT: -0.9 V
- ALL FOUR MODULES SAME BIAS: +30, +50, +100, +125,
+190, +255, +350, +500, +700, AND +1000 V

VARIATIONS

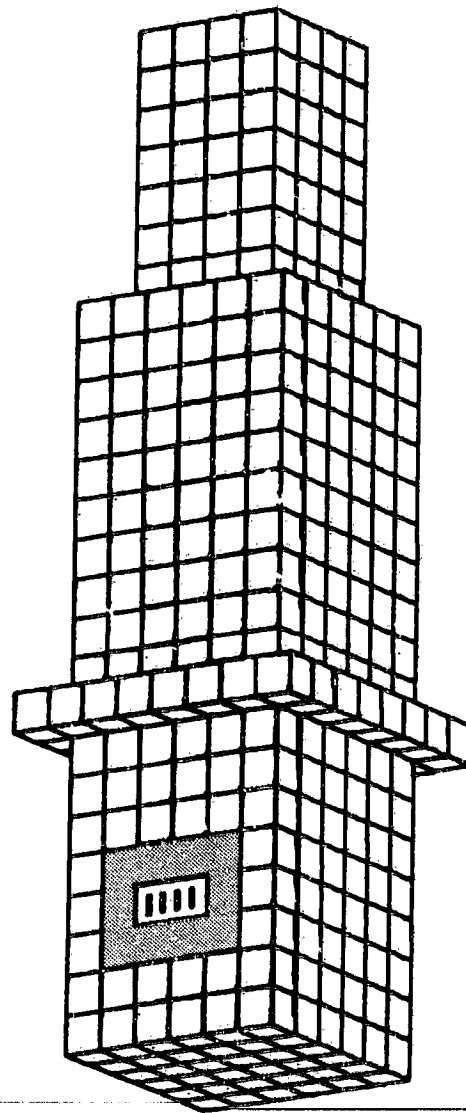
- TEMPERATURE: 0.10 eV (0.0235 m)
- DENSITY: 10^9 IONS/m³ (0.0910 m)
- SPACECRAFT GROUND POTENTIAL: -30 V

COMPUTER TIME: 26 min/RUN (AVERAGE)





DELTA ROCKET (ELECTRONICS BOX SIDE)

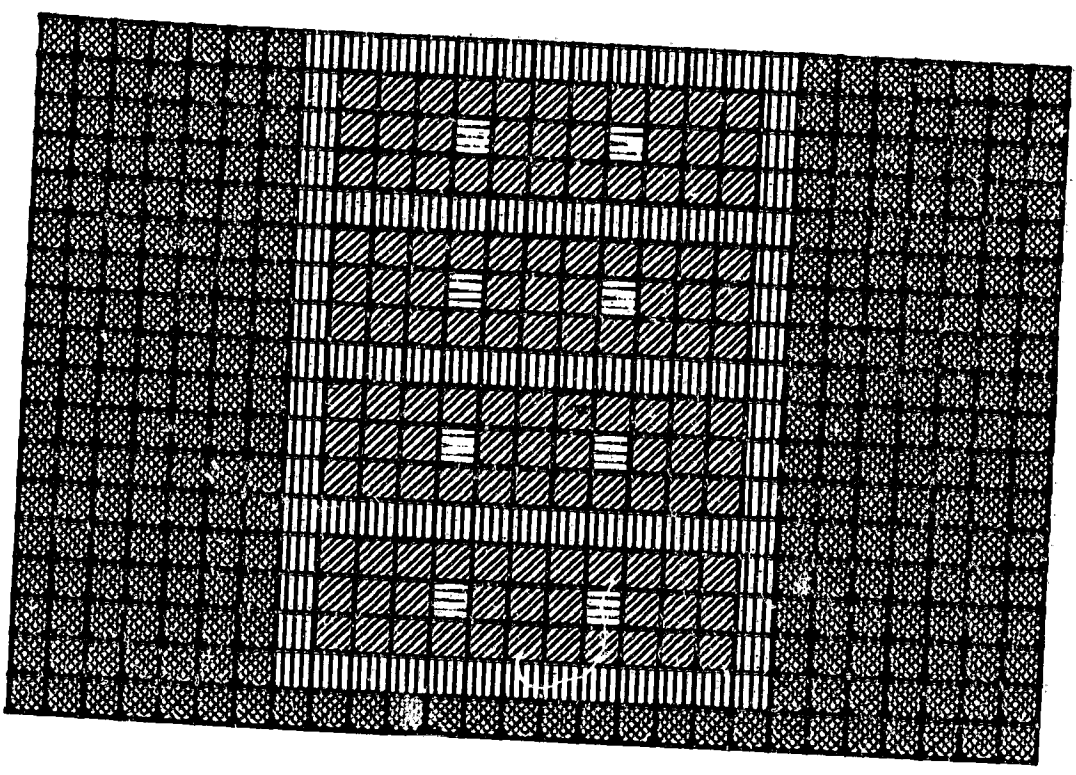


DELTA ROCKET (EXPERIMENT PLATE SIDE)



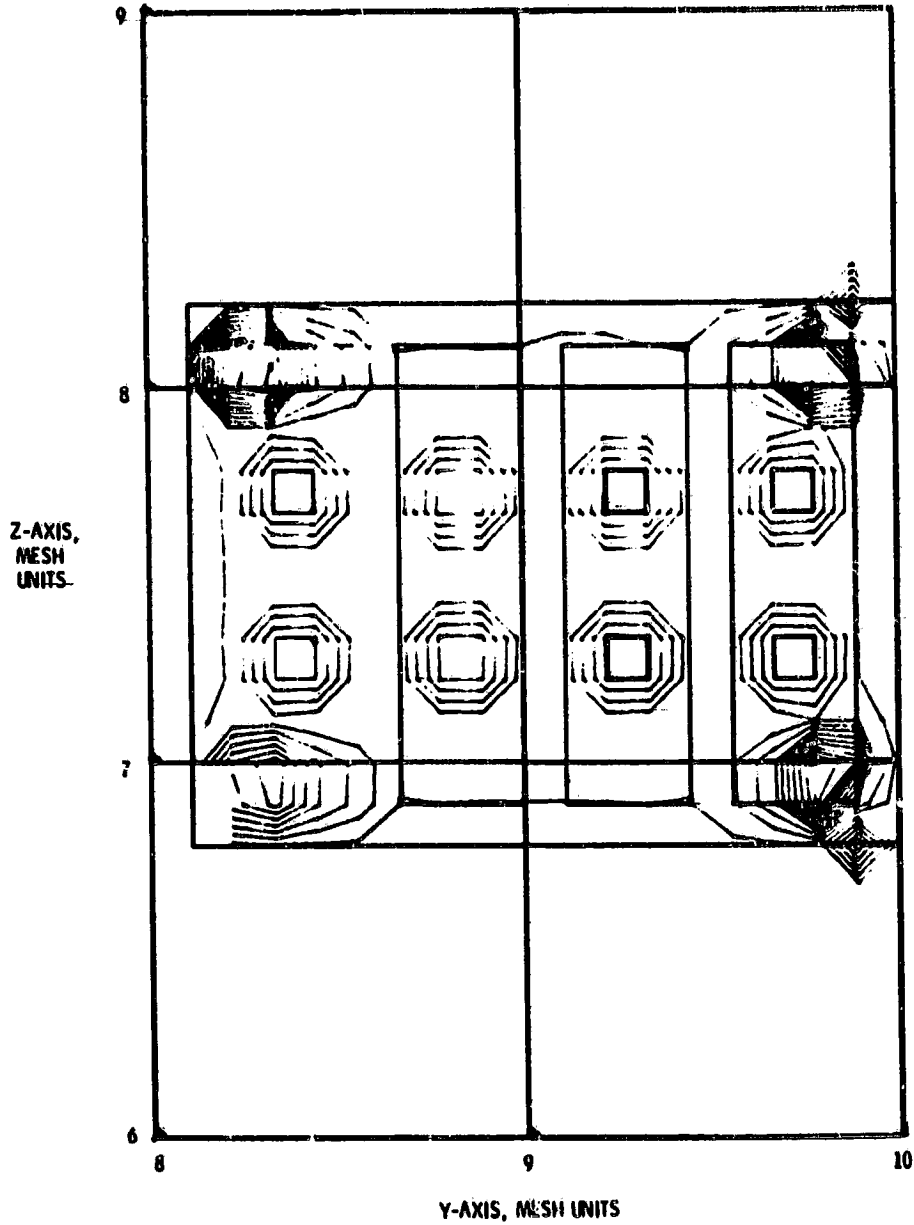
PIX II EXPERIMENT PLATE

-  KAPTON
-  SOLAR CELL INTERCONNECT
-  SOLAR CELL
-  BLACK PAINT



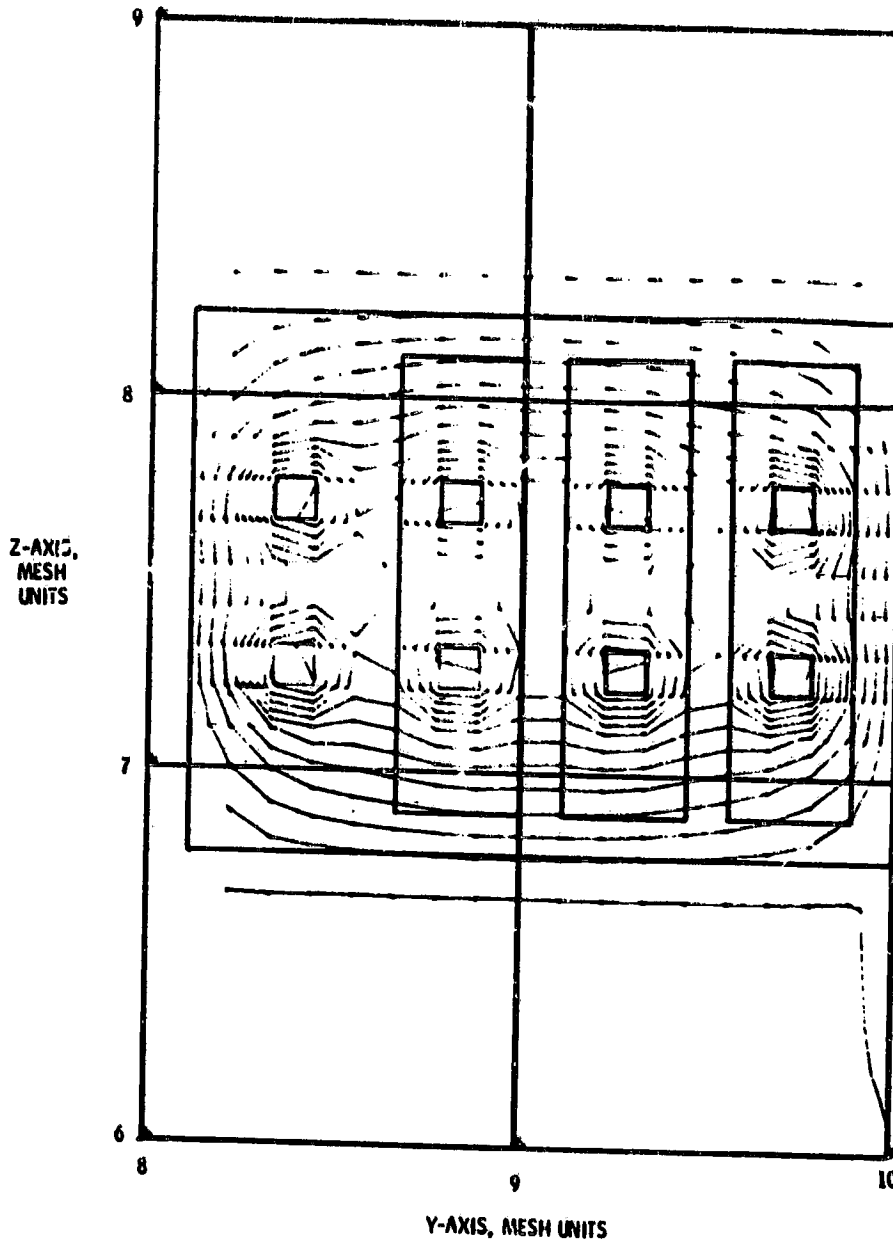
POTENTIAL CONTOURS AT X=6 FOR BIAS OF +30 V

CONTOUR LEVELS, -11.7 TO 20.5 V WITH POTENTIAL INCREMENTS OF 2 V —



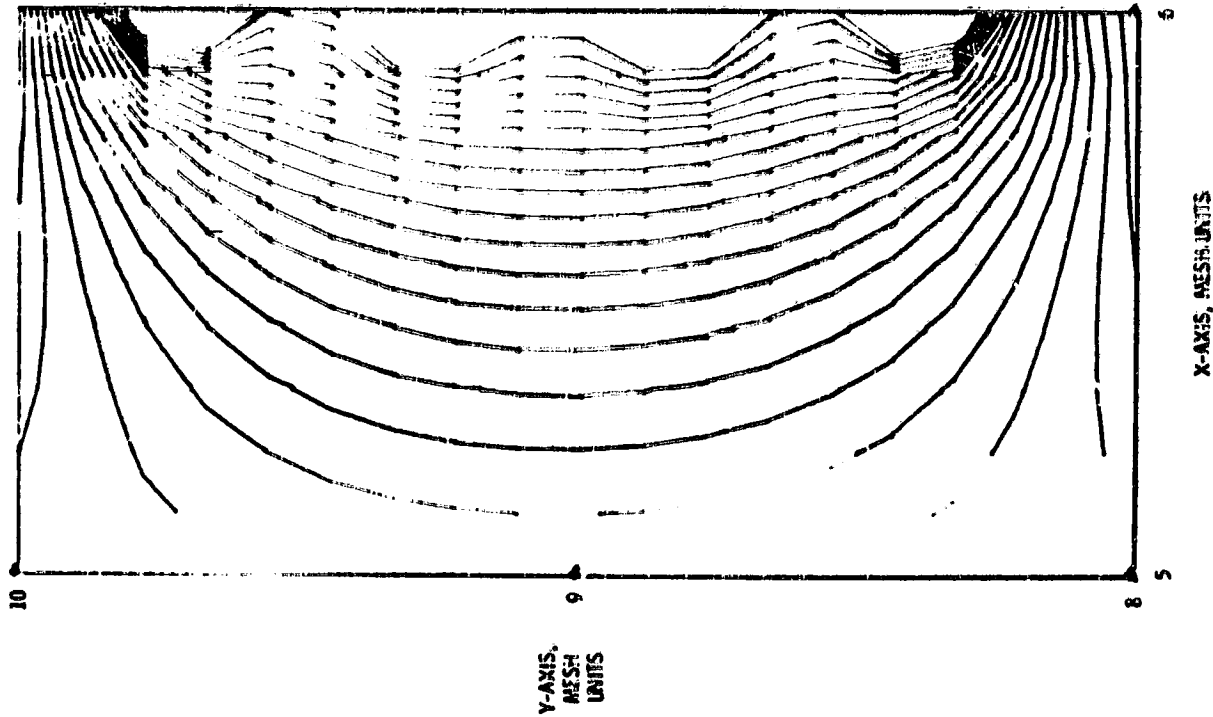
POTENTIAL CONTOURS AT $X = 6$ FOR BIAS OF +1000 V

CONTOUR LEVELS, -0.9 TO 819 V WITH POTENTIAL INCREMENTS OF 90 V



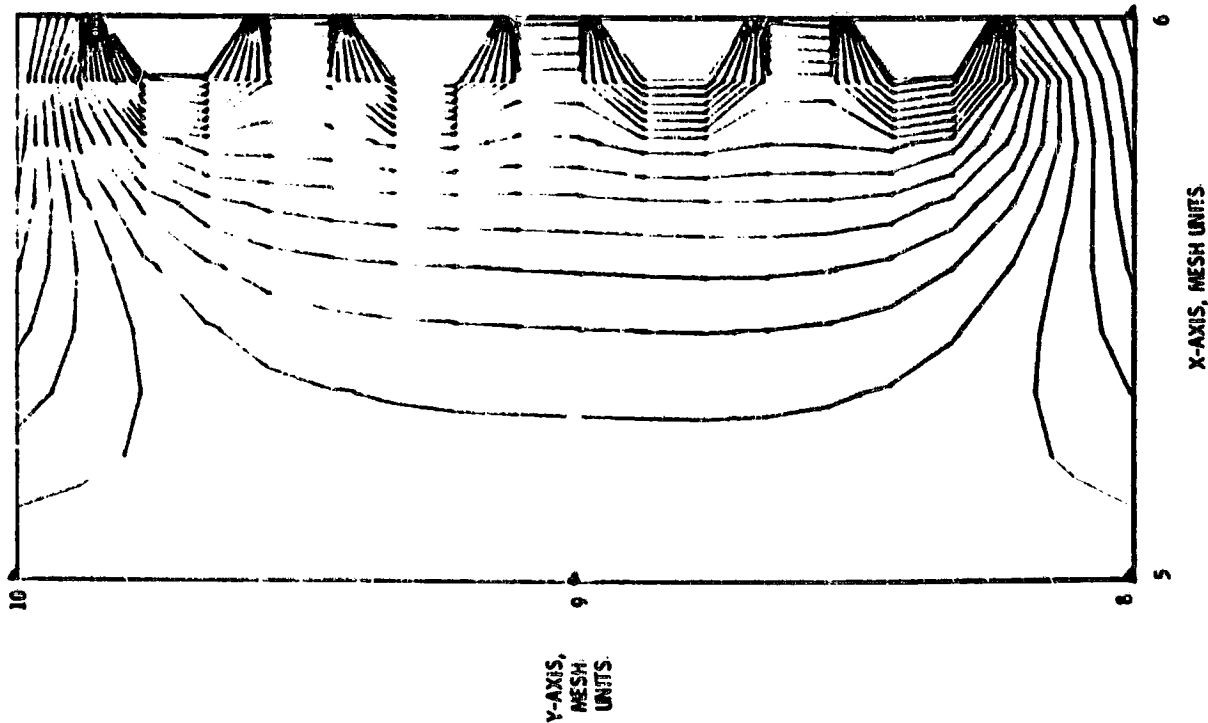
POTENTIAL CONTOURS AT $Z = 7.28$ FOR BIAS OF $+1000$ V

CONTOUR LEVELS, 0 TO 362 V WITH POTENTIAL INCREMENTS OF 20 V



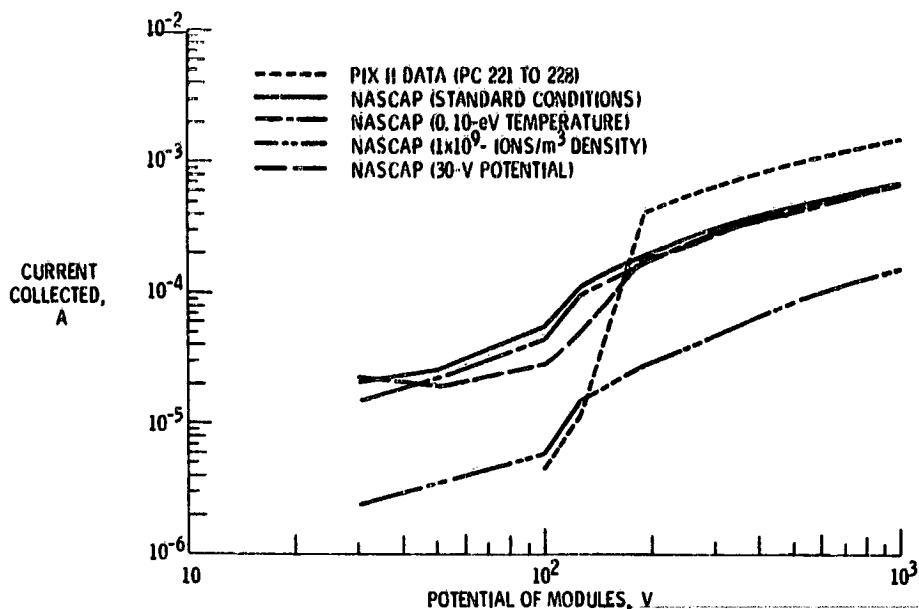
POTENTIAL CONTOURS AT $Z = 7.28$ FOR BIAS OF $+30$ V

CONTOUR LEVELS, -0.165 TO 2.98 V WITH POTENTIAL INCREMENTS OF 0.2 V

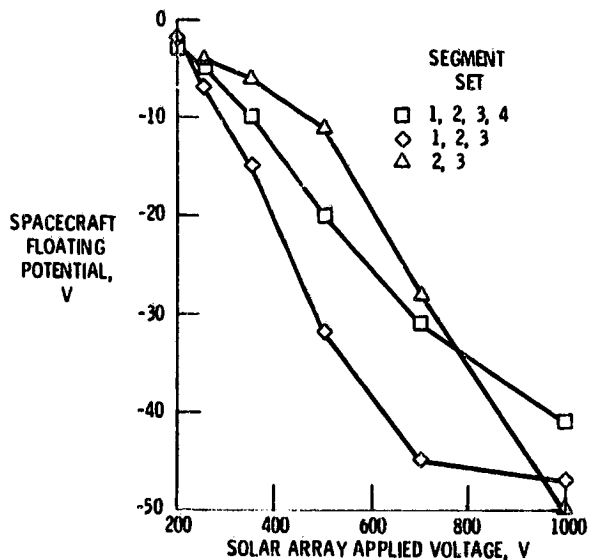


COMPARISON OF NASCAP WITH PIX II DATA

ALL SOLAR ARRAY MODULES HAVE SAME POTENTIAL



PIX-II FLOATING POTENTIAL



SUMMARY OF RESULTS

LEO MODEL CONSTRUCTED

- 10-INCH RESOLUTION ON VEHICLE
- 1.1-INCH RESOLUTION ON EXPERIMENT

POSITIVE BIAS MODELED

- TEMPERATURE
- DENSITY
- SPACECRAFT POTENTIAL

RESULTS

- SLOPE GOOD ABOVE 200 V
- CURRENT ENHANCEMENT TOO SMALL
- UNKNOWN DENSITY AND SPACECRAFT POTENTIAL COMPLICATE INTERPRETATION

FUTURE WORK

- REFINE DENSITY AND SPACECRAFT POTENTIAL
- RAM/WAKE
- GRADIENT MODE

LEO ENHANCEMENTS

- SELF-CONSISTENT DETERMINATION OF CONDUCTOR POTENTIAL
- BETTER GEOMETRY
- RAM/WAKE DENSITY MODEL

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