National Aeronautics and Space Administration
George C. Marshall Space Flight Center
Materials and Processes Laboratory
Engineering Physics Division

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JUNE 1998

ENVIRONMENT MONITORING PACKAGE (EMP)

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EMP REQUIREMENT DEFINITION

- ENVIRONMENT MONITORING REQUIREMENTS
  - » SPACE STATION REQUIREMENTS DEFINED IN REQUIREMENTS DOCUMENTS
    - SSP 30420, SSP 30426 AND SSP 41000
  - » PAYLOAD USER REQUIREMENTS
    - OBTAINED INPUTS THROUGH ISS PAYLOADS OFFICE
  - » TECHNOLOGY DEVELOPMENT
    - INPUTS FROM NASA SPACE ENVIRONMENTS AND EFFECTS WORKING GROUP CHAIRS
- HARDWARE REQUIREMENTS DERIVED FROM ENVIRONMENT MONITORING REQUIREMENTS

- **ENVIRONMENT OVERVIEW**
  - » **NATURAL ENVIRONMENT**
    - **ATOMIC OXYGEN, SOLAR UV, RADIATION, ETC...**
  - » **INDUCED MOLECULAR ENVIRONMENT**
    - **OUTGASSING PRODUCTS**
    - **VENTS AND LEAKAGE**
    - **RAM BUILDUP OF DENSITY**
    - **MOLECULAR COLUMN DENSITY**
    - **CONTAMINATION DEPOSITION**
  - » **PLASMA ENVIRONMENT**
    - **STRUCTURE POTENTIAL**
    - **MAXIMUM PLASMA DENSITY**
  - » **PARTICULATE ENVIRONMENT**
    - **PARTICLES FROM STATION**
    - **MICROMETEORIOD/SPACE DEBRIS**
  - » **ELECTROMAGNETIC ENVIRONMENT**

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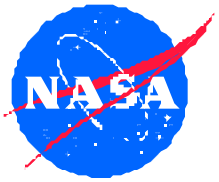

BASELINE EMP INSTRUMENTATION

- ION/NEUTRAL MASS SPECTROMETER (INTO RAM AND ALONG PERPENDICULAR AXIS LOOKING TOWARD MODULES)
- THERMOELECTRIC QUARTZ CRYSTAL MICROBALANCES
- COLD CATHODE PRESSURE GAUGES
- LANGMUIR PROBE/FLOATING POTENTIAL PROBE
- ION DRIFT PROBE (8-HEADS)

OTHER ENVIRONMENTS INSTRUMENTATION ON ISS

- RADIATION MONITORS PART OF ISS PROGRAM
- ACCELEROMETERS ON TRUSS AND IN MODULES
- SPACE ENVIRONMENT MONITOR ON JEM
- TEF INSTRUMENTATION
- RUSSIAN INSTRUMENTATION

EMP INSTRUMENTATION REQUIREMENTS

- **MASS SPECTROMETER; 4-300 AMU AND DELTA M/M = 0.007 AT 150**
  - » **SENSITIVITY LEVEL 10^{-14}**
- **TQCM WITH TEMP RANGE -60 C TO 27 C; RAM, WAKE, OTHER**
  - » **15 MHZ AND 50 MHZ OR HIGHER FREQUENCY CRYSTALS**
- **AMBIENT PRESSURE 10^{-10} TO 10^{-3} TORR; RAM, WAKE, OTHER**
- **PLASMA ENVIRONMENT; ELECTRON TEMPERATURE, DENSITY AND PLASMA POTENTIAL (-50 TO +50 VOLTS)**
- **FLOATING POTENTIAL PROBE (V-BODY PROBE); -160 TO 50 VOLTS**
- **ION ENERGY DISTRIBUTION; 0 TO 160 eV**
- **ELECTROMAGNETIC FIELDS, IONIZING RADIATION, SPACE DEBRIS, MICROGRAVITY; NO EXPECTED EMP REQUIREMENTS**

OPERATION OF EMP

- **EMP WILL BE LAUNCHED ABOARD THE SPACE SHUTTLE ON UF-5 IN MID-2002**
  - » **A SIGNIFICANT AMOUNT OF ISS IS ASSEMBLED BUT MAJOR ELEMENTS REMAIN TO BE DELIVERED**
  - » **EMP WILL BE ABLE TO ASSESS THE ENVIRONMENT OF ISS AT UF-5 AND WILL CHARACTERIZE ENVIRONMENT CHANGES DUE TO ARRIVAL OF NEW HARDWARE**
  - » **EMP WILL BE PLACED AT FIXED LOCATIONS ON STATION AS WELL AS REMOTELY MANIPULATED BY SPECIAL PURPOSE DEXTROUS MANIPULATOR (SPDM) AND SPACE STATION REMOTE MANIPULATOR SYSTEM (SSRMS)**
  - » **INITIAL EMP FIXED LOCATION IS ON S3 ATTACHED PAYLOAD LOCATION**
- **OPERATION OF EMP FROM SPDM ON END OF SSRMS WILL PROVIDE THE CAPABILITY TO POINT EMP, TO REACH WITHIN AN ENVELOPE AROUND ISS AND PROVIDE SPATIAL MAPPING OF ENVIRONMENT AROUND ISS**

CONCLUSIONS

- **IT IS RECOGNIZED THAT MONITORING OF THE ISS ENVIRONMENT IS VERY IMPORTANT TO SUCCESSFUL OPERATION OF EXTERNAL PAYLOADS**
- **THE EXTERNAL ISS ENVIRONMENT WILL BE VERY COMPLEX**
- **COORDINATION BETWEEN ALL PARTIES CONDUCTING ENVIRONMENTAL MONITORING WILL PROVIDE OPTIMUM BENEFIT FROM ALL DATA**
- **THE DATA THAT THE EMP WILL PROVIDE COUPLED WITH THAT PROVIDED BY ISS AND OTHER SOURCES WILL COVER ENVIRONMENTS IDENTIFIED BY THE SSUAS**