SpaceBuoy
A Pathfinder Nano-Satellite for a Space Weather Monitoring Network

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Overview

- Background of SSEL and SpaceBuoy
- Mission Statement
  - Mission Objectives
  - Science Instruments
  - Collaboration With Industry
SSEL Background

- Space Science Engineering Laboratory
  - Interdisciplinary Research Lab
    - ME, MET, I&ME, EE, CS, CpE and Physics
  - Older students mentor new students to pass on heritage information
  - Collaboration with industry
SpaceBuoy Background

- Maia heritage: NS-3 Competition
  - Structure
    - Center stack
  - Command and Data Handling
    - Data processing
  - Attitude Determination and Control System
    - Torque Coils

Maia EDU (heritage)
SpaceBuoy Mission Statement

**Mission Statement**

- The SpaceBuoy mission will collect data on several ionospheric plasma parameters essential to space weather forecasting from a nanosatellite platform (MS1), and will demonstrate that data can be made available to the forecasting community in 1.5 hours of being taken (MS2).
Mission Objectives

- Student education
- Contribute essential data to GAIM Model (Global Assimilation of Ionospheric Measurements) currently being used by Air Force Weather Agency (AFWA)
  - In-situ Ion Density (Ni)
  - Columnar Total Electron Content (TEC)
  - As a goal: Electron Temperature (Te)
Atmosphere Ion Density Profile
Mission Objectives

- Demonstrate feasibility of buoy-like operations concept
  - Pathfinder mission of fleet of ionospheric measurement platforms
  - Near real-time (1.5 hours) data delivery
  - Inexpensive (relative) and robust
- Three month minimum mission life, goal of 1 year.
CITRIS Receiver Total Electron Content

Langmuir Probe Array In-situ Ion Density

19 inches

18.5 inches
Langmuir Probe Array

- Consists of 2 Langmuir Probes mounted on opposite skins of the S/C

- Design based on heritage from AFRL-Hanscom (Space Weather Effects Section) Planar Langmuir

- Collector Plate Design
- Log Amp design and layout

- Being designed and built by MSU students

<table>
<thead>
<tr>
<th>Mode</th>
<th>Measurement(s)</th>
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<tbody>
<tr>
<td>1: Fixed Bias</td>
<td>Ion Density ($N_i$) Relative Electron Density ($N_e$)</td>
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<tr>
<td>2: Sweep Bias</td>
<td>Floating Potential Electron Temperature ($T_e$) Full I-V Characteristic</td>
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1.5” diameter collector head
Collaboration with Industry

- Planar Langmuir Probe instrument is based on flight heritage from AFRL Hanscom (PLP Instrument)

- Langmuir Probe Array
  - Ion Density (Ni)
    - Designs from PLP instrument will allow for more rapid fabrication and testing
    - Non-deployable instrument
    - Also allows for Electron Temp. Measurements
CITRIS Instrument

- Total Electron Content (TEC) measurements
  - DORIS mode: Slant (ground-to-satellite)
  - CERTO mode: Tomography (satellite-to-satellite)
- Line of sight TEC
  - Differential Phase measurement on several frequencies
  - CITRIS Instrument has been flown on 6 missions before (flight heritage)
- Antennas
  - Communication and CITRIS
- RF Interface Box
  - RF switch
    - Either CITRIS or Comm connected to the antennas, NOT both
    - Switch is controlled by CDH
Collaboration with Industry
Deliverable from NRL

- Modified CITRIS provided to MSU by Naval Research Laboratory
- CITRIS modifications
  - Antennas
    - NRL
      - Quadrafilar Helix Antenna
      - Crossed Dipole Antenna
    - SpaceBuoy
      - 2 patch Antennas
      - 8 monopole Antennas
  - RF Interface Box
    - Doubles as our Communication
Final Remarks

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More information see:
www.ssel.montana.edu