

CubeSat-based Science Missions for Space Weather and Atmospheric Research: A new NSF Program

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Cube-sat based science missions: A new NSF Program

- ➔ **Space weather and atmospheric research and education**
- ➔ **Launching 2-3 P-PODs per year**
 - × First Launch Dec. 2009
- ➔ **~3 new science missions per year**
 - × Max \$900k / mission
 - × Selection based on potential science return
 - × Training and student participation **MANDATORY**
- ➔ **Solicitation for proposals just out**
 - × Deadline May 28, 2008



Proposals Overview

▶ Regular research grants

- × 3-5 years

- × ~\$300k - \$900k Total Cost

▶ Complete missions

- × Satellite design

- × Construction

- × Testing

- × Operations

- × Data distribution and analysis



Launch and Mission Support

➡ **Launch arranged and paid by NSF**

- × Dod Space Test Program; 1st manifested launch
- × Future potential opportunities: DoD, NASA, Commercial

➡ **Commissioning program at NASA WFF**

- × P-POD, integration, testing, documentation
- × Technical POC for satellite developer and launch provider
- × Frequency licensing and ground station support
- × Other technical and management support



First Launch Dec 2009

Manifested Launches

<i>Primary Mission</i>	<i>Launch Vehicle</i>	<i>Slots</i>	<i>Launch Date</i>	<i>Orbit</i>
STP-S26	Minnotaur IV	1 P-POD	Dec 2009	LEO: 650km; 72 deg.

Special Requirements/ Restrictions:

- Only a 3U-cubesat will be accepted as payload for this launch.
- Time-line for design and delivery is quite tight.
Preliminary target delivery schedule is as follows:
 - October 2008: Updated Payload System to Launch Vehicle Interface Control Document (ICD); Updated Materials List (MSPSP); Updated Ground Operations Plan
 - February 2009: P-POD Engineering Design Unit for bench testing
 - February 2009: Final ICD, MSPS, and Ground Ops Plan

Review and Selection

- ➡ **Proposal deadline May 28, 2008**
- ➡ **Panel review July 8-9, 2008**
 - × Written reviews & panel discussion
 - × Aerospace engineers & space physicists
- ➡ **First mission selected by Late July**
 - × Award ~Sep 2008
 - × Potential selection of additional future missions ~Oct 2008
- ➡ **Next deadline Feb 2009**



From the Solicitation: Special Review Criteria

➡ **Science goals**

Proposals will be evaluated according to their relevance to current space weather research goals or to key outstanding science questions within other areas of atmospheric sciences.

➡ **Student training**

Proposals will be evaluated according to the student training opportunities they offer and to the degree of student involvement in the various aspects of the proposed missions.

➡ **Technical feasibility**

Proposals will be evaluated according to their degree of technological readiness or heritage, or the degree to which they make use of emerging technologies. Proposals will also be evaluated according to their compliance with CubeSat and P-POD standards.

➡ **Management plan**

Proposals will be evaluated according to the soundness of their plans for management, scheduling, and risk reduction during the satellite development and operations phases of the mission, respectively.

From the Solicitation: Special Award Conditions

➡ **Launch Specific Requirements**

Once a suitable launch opportunity for the selected science mission has been identified and manifested by NSF, Principal Investigators will be responsible for satisfying the environmental testing requirements at the satellite level, including the provision of specific documentation, appropriate for that particular launch vehicle.

➡ **Schedule**

As soon as a launch date has been set, a schedule for completion, testing, and delivery of the payload within the given time-frame must be submitted by the Principal Investigators and approved by a cognizant NSF Program Officer.

➡ **Project Status Updates**

During the design, building, and testing phase of the mission it is expected that awardees will have regular dialogue and/or status reviews with cognizant NSF Program Officers to ensure satisfactory progress and the timely completion of the payload.

➡ **Deliverables**

Principal Investigators will ensure the on-time delivery of their payload along with any required documentation for P-POD integration and testing prior to launch.

➡ **Problem Resolution**

Principal Investigators will participate in the timely resolution of any problems encountered during P-POD integration and testing.

Technical Issues & Requirements

- ➡ **Mass**
 - × Strict adherence to 3kg not necessary?
- ➡ **Communication**
 - × UHF and S-band options
- ➡ **NEPA and Space Policy Compliance**
 - × End-of-life plan (turn-off)
 - × Orbital lifetime < 25y
 - × Re-entry casualty analysis
- ➡ **Launch Safety deliverables**
 - × MSPS
 - × Ground Operations Plan
- ➡ **Schedule for Dec. 2009 launch**
 - × Satellite delivery to WFF ~ Late July 2009



Developing a NSF Satellite Program Supporting Space Weather & Atmospheric Research

➡ **The goal: A continual program of \$5-10M /year**

- × Small scientific satellite missions
- × Advance space weather and atmospheric research and education
- × Develop, build, launch, operate, and analyze data

➡ **Action Items**

- × Secure a series of regular, low-cost launches
- × Establish partnerships with other government agencies and private industry
- × Construct a 5 to 10 year program with annual proposal competitions

➡ **First Step: CubeSat Program**

