Partnership Opportunity Document

For

Candidate Mission for the NASA Explorer Program

September 14, 2009

NASA Goddard Space Flight Center

1.0 Introduction/Scope

The proposal opportunity is a NASA Announcement of Opportunity (AO) for Small Explorers (SMEX) or Medium Explorers (MIDEX), currently anticipated within the next 6 to 18 months. The Goddard Space Flight Center is developing a mission concept to be proposed for this AO. This partnership opportunity is being issued to select a teaming partner(s) to develop the mechanical cryo-cooler design for the mission.

The proposed mission is currently in pre-Phase A. The mission will be proposed in response to the next Explorer AO. The cost cap for this AO is not yet known. The previous Small Explorers AO, issued in September 2007, had a cost cap of $105M excluding a NASA-provided launch vehicle. The following schedule should be used as a basis for responses to this opportunity:

Partnership Opportunity Document released	September 2009
Responses due	Oct 16, 2009
Partner Selection announced	November 2009 (target)
GSFC/Partner internal design review	January 2010 (target)
Proposal in response to Explorer AO	Mid-to-late 2010 (target)
Phase A mission concept study	Typically 6 months duration
Flight	2015 (target)

There will be no exchange of funds between the teaming partners for the AO proposal cycle. If the proposed mission is selected for a Phase A Concept Study, limited funding will be available according to the budget developed during proposal preparation. If the proposed mission is selected for flight, partner(s) will be funded according to the budget developed during AO proposal phase.

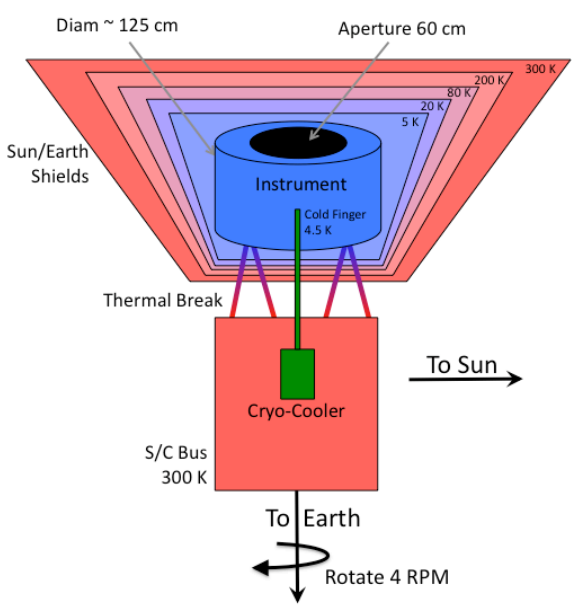

Fig 1: Schematic of the proposed mission.

2.0 Proposed Mission

The proposed mission consists of a single cryogenic instrument maintained at 2.7 K using a combination of active and passive cooling with no expendable cryogens. Figure 1 shows a schematic design. The observatory orbits the Earth in a 1200 km polar sun-synchronous orbit aligned with the day/night terminator so that the spacecraft is always illuminated by the Sun. The instrument views the sky through a 60 cm aperture oriented toward the zenith and approximately 90° from the sun line. A series of deployable shields surround the instrument to prevent direct illumination of the instrument or aperture by either the Sun or the Earth. A thermal break isolates the cryogenic instrument from the spacecraft. The entire observatory spins at 4 RPM as noted in Fig 1.

A mechanical cryo-cooler, mounted on the spacecraft side of the thermal break, provides cooling power for the instrument and several of the inner Sun/Earth shields. Table 1 lists performance requirements for the mechanical cryo-cooler.

Table 1: Cryo-Cooler Performance Requirements

Cooling Performance	40 mW at 4.5 K
Cooling Performance	50 mW at 18 K (typical)
Input power	Less than 350 W (with compressor at 285K)
Mass	Less than 50 kg (goal)
Vibration	Less than 0.2 N below 500 Hz
Lifetime	1 year minimum, 3 year goal

The mechanical cryo-cooler shall meet the following requirements:

Cooling performance: The mechanical cryo-cooler will be mounted on the spacecraft on the room-temperature side of the thermal break. A cold finger extends through the thermal break into the instrument area to provide cooling to the instrument. The cold finger must provide at least 40 mW cooling to the instrument at a temperature of 4.5 K or colder. Passively-cooled Sun-Earth shields are arranged as shown in Fig 1. Additional cooling to at least one of the inner sun-Earth shields is also required. This additional cooling is used to intercept parasitic heat in the support structure, so the cooling points are localized. The temperature value of 18K for conductive cooling of the supports is for illustration only; the actual temperatures and conductive cooling will depend on the cryo-cooler design and capabilities and should be included as part of the response to this offer. Note that all cooling requirements include design margin; offerors should not include margin above and beyond the values shown in Table 1. In addition to the cooling at 4.5K and 18K shown in Table 1, there will be a large, localized cooling load of about 2W at 75K. While not shown in the table above, the offeror should discuss options for handling this cooling using either a cryo-cooler stage or a radiator.

Input power: The cryo-cooler should use less than 350W power, assuming that the warmest compressor is maintained at 285K. Note that the 350W is the total power required to operate the cryo-cooler, including electronics, dissipation, and any inefficiency. Although it may be possible to reduce the electrical power by running the compressor at colder temperature, such an approach is not desirable unless a sufficient track record of operation under "cold compressor" conditions can be established.

Mass: A total mass of 50 kg or less is desirable (including electronics). Although lower mass is better, mass is not expected to be a limiting resource for this mission.

Vibration: The instrument includes components sensitive to mechanical vibration, particularly at frequencies below 500 Hz. Operation of the cryo-cooler should result in vibrations less than 0.2 N at frequencies below 500 Hz. Offeror should discuss the expected vibration as well as any mitigation strategies.

Lifetime: The minimum mission duration is one year in orbit. The goal is to achieve 3 years of cryogenic observations.

Note: Explorer missions are typically modified Class-D. Offerors should assume that only single-string reliability is required for the mechanical cryo-cooler.

3.0 Statement of Work

During the proposal preparation period, the offeror will participate as part of the mission proposal team. The offeror shall provide a statement of work that the offeror is proposing to provide.

4.0 Offer Format and Instructions

The response to this partnership opportunity is limited to 15 pages in not less than 12-point font. Excluded from the page count are the cover letter, title pages, table of contents and page for the acronyms list. Offerors may attach additional appendices that further describe their capabilities, although GSFC is under no obligation to include the contents of such appendices in the evaluation of the offer package.

Your written offer package shall include the following:

- The technical approach for the mechanical cryo-cooler. The technical description at a minimum must respond to all requirements listed in Table 1 and should additionally discuss options to handle the additional 2W heat load at 75K.
- The approach for supporting the cryogenic design, GSFC/partner design review, AO proposal, and the mission concept Phase A study, including the level of support that the offeror plans to make available for each activity. This should include support to define the temperature and cooling power required for conductive cooling of the inner sun/Earth shields.
- Technical maturity of the proposed cooler and the ability to meet the mission schedule as defined in this document. An initial Technology Readiness Level (TRL) of 5 or higher is preferred. The offer package should include discussion showing the planned schedule for which the cryo-cooler will achieve TRL 6 or higher.
- Demonstration of previous contributions to cryogenic space telescopes and instrumentation. The offeror should summarize the offeror's relevant experience and past performance in two pages or less.
- Statement of work defining participation in the AO proposal.
- Estimated cost for the cryo-cooler from initial selection (Phase A) through launch. GSFC recognizes that the design and associated cost estimate may be at a preliminary stage. Include a brief discussion of the uncertainty in the cost estimate.

The entire offer package, including any cover letter, title pages, and other supporting material, shall be formatted as a Portable Document Format (PDF) file delivered to the E-mail address below.

5.0 Evaluation Factors and Criteria

The evaluation team will use the following factors in selection and award. The government will evaluate the offer packages based on the following factors:

a. **Technical Approach (40%).** Offerors will be evaluated on their current state of the art capabilities in cryo-cooler development and expertise. This includes demonstrated understanding of the technical requirements described in Section 2.0, and proposed approach to meet these requirements, as addressed in your response to section 4.0 of this partnership opportunity document.

b. **Cost (30%)**. Offerors will be evaluated on their overall cost.

c. **Relevant Experience and Past Performance (30%)**. Special emphasis will be given to previous experience in developing elements similar to the cryo-cooler requirements described in this document. A low level of technical risk is desirable.

6.0 Points of Contact: Questions about this POD should be directed to **Julie Crooke (Phone: 301-286-7255, Email: Julie.A.Crooke@nasa.gov).**

7.0 Final Due Date of POD Response: The response of the POD is due 5 pm EDT on October 16, 2009. The electronic PDF document shall be sent to **Julie Crooke (Email: Julie.A.Crooke@nasa.gov)**

It is the responsibility of potential respondents to monitor the NASA Acquisition Internet Service (NAIS), GSFC Procurement site

http://code210.gsfc.nasa.gov/podhome.htm

for information concerning this POD.