

Superconducting Submillimeter-Wave  
Limb-Emission Sounder on board JEM  
(JEM/SMILES)

Research Announcement

Japan Aerospace Exploration Agency

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## 1. Introduction

Superconducting Submillimeter-Wave Limb-Emission Sounder (SMILES) was designed to be aboard the Japanese Experiment Module (JEM) on the International Space Station (ISS) as a collaboration project of Japan Aerospace Exploration Agency (JAXA) and National Institute of Information and Communications Technology (NICT). Mission Objectives are: i) Space demonstration of super-conductive mixer and 4-K mechanical cooler for the submillimeter limb-emission sounding, and ii) global observations of atmospheric minor constituents in the stratosphere ( $O_3$ , HCl, ClO,  $HO_2$ , HOCl, BrO,  $O_3$  isotopes,  $HNO_3$ ,  $CH_3CN$ , etc), contributing to the atmospheric sciences. It is scheduled to launch in September 2009 by the H-II Transfer Vehicle (HTV).

This Research Announcement (hereinafter referred to as the “RA”) invites researchers who are interested in calibration, validation, algorithm development, data application, and scientific use of the SMILES data, on top of the basic researches and developments to be performed by JAXA and NICT, in order to make the SMILES mission more effective. All research teams whose proposals are selected in this RA will be granted a priority in data distribution. Applicants to this RA are encouraged to read the contents of this document carefully. Selection of the proposals will be performed by the Committee organized under the JEM/SMILES project run by the ISS Science Project Office of JAXA. The office handling tasks related to this RA (RA Office) is also set in the ISS Science Project Office. General information on the SMILES mission can be found in the following.

<http://smiles.tksc.jaxa.jp/>

Related documents including the Mission Plan can be found down below the above top page.

<http://smiles.tksc.jaxa.jp/document/indexe.shtml>

## 2. Definition of the JEM/SMILES Research Announcement (RA)

### 2.1. General Description

The purpose of this RA is to provide an opportunity for researchers who are interested in using the SMILES data for calibration, validation, data processing algorithms, and atmospheric sciences with a goal to make more use of the outcomes from the project. The research topics selected by the Committee and adopted by JAXA will be granted a preferential data distribution. The proposer should keep in mind, however, that neither JAXA nor NICT is a funding body for the scientific community. This RA seeks to accomplish JEM/SMILES’s goal and to expand new utilization of JEM/SMILES data.

## 2.2. Qualification requirements

JEM/SMILES RA is basically open to all individual researchers in educational organizations, research institutes, and governmental bodies. However, there is restriction for those who live in non-MTCR (Missile Technology Control Regime) countries. For this time, their RAs will not be accepted. Those who live in MTCR countries and are willing to use the SMILES data for non-profit purposes are entitled to participate in the RA. Investigators involved in carrying out the research themes selected in the RA are called “RA Investigators”. A team of RA Investigators working on a research theme will be led by one principal investigator (hereafter referred to as “PI”) who will represent the team. The PI is expected to act as a contact person with JAXA in carrying out the selected research theme, such as communication, data transfer, and submission of necessary documents. In principle, the research organization to which PI belongs shall also agree with the participation.

## 2.3. Basic Policies

The RA will be conducted on the basis of the following policies:

- 1) JAXA will establish a committee (hereafter referred to as “the Committee”) to select the research proposals and to follow their results. Research proposals submitted in response to the RA will be evaluated by the Committee, and they will be selected by JAXA based on the evaluation results by the Committee.
- 2) The research period shall be the operational period of JEM/SMILES and its ground system (3 years after the launch, in principle). Any long-term research extending beyond the operational period will be subject to interim reporting to JAXA.
- 3) This RA will be the first opportunity. Additional RA opportunities to follow will be determined based on the status of responses to the first invitation.
- 4) The PI of a research team can make multiple research proposals on different themes during the mission period.
- 5) The PI may not submit observation requests which are specific to the research theme.
- 6) The PI may submit requests for distribution of SMILES data free of charge to the extent designated by the Committee per research theme.
- 7) Applications for this RA and research plans shall be submitted by e-mail or conventional mail if the size of the submission materials is large (see Section 6 in detail).
- 8) After the selection the official agreement between JAXA and the research organization to which PI belongs will be concluded.

- 9) The titles and PIs (and their organization) of the research themes selected for the RA will be disclosed on the Websites run by the RA Office.
- 10) In general, the outcomes of this RA must be disclosed to the public in the form of papers published on academic journals and other media and at the same time be reported at the related meetings.
- 11) Neither JAXA nor NICT provides any financial assistance to the PIs, in principle, under the RA scheme.

#### 2.4. Implementing Organization

JAXA will organize an office in charge of the RA within the JEM/SMILES project. The RA Office will carry out the following tasks:

- 1) Prepares the RA procedures and releases them to the public.
- 2) Carries out the administrative work as the secretariat of the Committee.
- 3) Accepts proposals submitted in response to the RA and requests the Committee for due evaluation for selecting research themes.
- 4) Notifies the selection results to all PIs who submitted research proposals.
- 5) Receives the outputs of the research from the PIs.
- 6) Organizes the research result report meetings.

See Chapter 9 for the contact address for the RA Office.

### 3. Overview of JEM/SMILES

Detailed information on the SMILES mission can be found in the Mission Plan as follows.

[http://smiles.tksc.jaxa.jp/document/SMILES\\_MP\\_ver2.11.pdf](http://smiles.tksc.jaxa.jp/document/SMILES_MP_ver2.11.pdf)

Additional information in relation to the current status after the mission plan is also found in the following.

[http://smiles.tksc.jaxa.jp/document/current\\_status/](http://smiles.tksc.jaxa.jp/document/current_status/)

In the following subsections brief descriptions will be given.

#### 3.1. Orbit and Attitude of ISS

The ISS will be a nearly circular orbit at a nominal altitude of approximately 400 km with an inclination of 51.6 degrees to the equator, and will usually maintain a torque equilibrium attitude

(TEA) during the microgravity mode of its operation. It is predicted that the ISS altitude will vary between 350 km and 460 km. In order to keep this altitude range, the ISS will be periodically reboosted approximately every 10 to 45 days by using onboard thrusters.

### 3.2. Overview of JEM

The JEM consists of manned Pressurized Module (PM), Experiment Logistic Module-Pressurized Section (ELM-PS), and Exposed Facility (EF). The JEM-EF, an unpressurized pallet structure exposed to the space environments, will be located just outside of the JEM-PM placed at the ram-port side of the ISS. The SMILES payload will be attached to the ram side of the JEM-EF at the location EFU #3.

### 3.3. Instrumentation of SMILES

The SMILES payload instrument consists of a number of sections: The Submillimeter Antenna (ANT), Submillimeter Receiver (SRX), Intermediate Frequency Amplification Section (IFA), and Radio Spectrometer (AOS) comprise the main part of the payload. The Star Tracker (STT) has a function of detection and calibration of the SMILES payload attitude. The SMILES is equipped with a heterodyne superconductor-insulator-superconductor (SIS) receiver to be operated in the 625/650-GHz band as a limb-emission sounding radiometer. The SMILES has a mechanically scanning elliptical offset-Cassegrain antenna with diameters of 40 cm × 20 cm to achieve an altitude resolution of about 3.5 - 4.1 km at the tangential altitude ranging from upper troposphere (10 km) to lower mesosphere (60 km) from the orbit of the ISS. The atmospheric limb emission collected by the ANT is directed to the SRX, where the received submillimeter-wave signal is combined with a reference signal (637.32 GHz) from a submillimeter-wave local oscillator (SLO), and is directed to SIS mixers through quasi-optics consisting of focusing mirrors, wire-grids, and a sideband separator. Two SIS mixers, one of which for upper sideband (USB: 649.12 GHz - 650.32 GHz) and the other for lower sideband (LSB: 624.32 GHz - 626.32 GHz), are operated for simultaneously down-converting both sidebands into the intermediate frequency (IF) band ranging between 11 GHz and 13 GHz. The IF signals are further down-converted and amplified in the IFA, and then analyzed by two acousto-optical spectrometers in the AOS.

### 3.4. Ground data processing system

The SMILES ground data processing system consists of Experiment Operations System (EOS) and Data Processing Systems (DPS). The EOS is a facility to receive telemetries and send commands. The DPS is divided into two main facilities, which are a data processing system for Level 0 and Level 1b (DPS-L0/L1) and that for Level 2 (DPS-L2). Definition of each level is as follows.

Level 0: Reconstructed, unprocessed mission data at binary packets

Level 1b: Calibrated instrument radiances and related data

Level 2: Derived geophysical variables at the same resolution and location as the Level 1b source data

Downlinked raw data from the SMILES will be received by the DPS-L0/L1 at User Operation Area (UOA) on Tsukuba Space Center (TKSC).

The DPS-L0/L1 processes the raw data consisting of house-keeping (HK) data and mission data to Level 1b data in near-real-time. The Level 1b data are periodically transferred via a non-network media to a data server connected to the Internet.

The DPS-L2 automatically receives the Level 1b data from the data server through the Internet and processes the Level 1b data into the Level 2 data. The task of the DPS-L2 is to produce the vertical profiles of target species and to distribute the Level 2 data to users by a web server. The DPS-L2 consists of three major functions, that is a system operation function, a data analysis function, and a data processing function.

## 4. JEM/SMILES Data

### 4.1. Basic Policy

Each PI is entitled to obtain the SMILES data necessary for his/her respective research theme, free of charge, from JAXA on the condition that he or she agrees to the following provisions:

- 1) The use of the data for any other purpose than his/her research theme is prohibited.
- 2) Redistribution of the data to any third party is prohibited.
- 3) The data obtained within this RA can only be distributed among the PI and RA Investigators.
- 4) Any publication of the outcomes obtained through the use of the data must refer to the data source properly.

In addition to the above item 4, it is recommended to write such a sentence in the acknowledgement as “JEM/SMILES mission is a joint project of Japan Aerospace Exploration Agency (JAXA) and National Institute of Information and Communications Technology (NICT).”

The data to be distributed will be subject to the operational status of the JEM/SMILES and the physical restrictions of the sensors. JAXA and NICT shall not be liable for any missing data, degradation of data quality, delay in data delivery, or any other situation in which the data cannot be provided, as a result of problems in relation to the spacecraft or the ground facilities.

The ownership of the original data acquired with JEM/SMILES belongs to JAXA and NICT. The “original data” here means the Level 0, Level 1b and Level 2 products prepared by JAXA. Such data should be distinguished from the data obtained by RA Investigators as an outcome from their research activities.

Basically, Level 1b data product will be closed within the JEM/SMILES project, but may be used under this RA. If he/she is interested in exploring Level 1b data, prepare for the proposal in response to this RA.

Level 2 data product contains the species which are classified as the standard products such as O<sub>3</sub>, HCl, ClO, HO<sub>2</sub>, HOCl, O<sub>3</sub> isotopes (<sup>18</sup>OOO, <sup>17</sup>OOO and O<sup>17</sup>OO), BrO, HNO<sub>3</sub>, and CH<sub>3</sub>CN. The research products provided by JAXA and NICT are not defined herein this announcement. However, during the RA research term, RA investigators can coordinate with JAXA through the RA Office about distribution of the research product.

#### 4.2. Data Format and Distribution Media

Level 2 products will be provided in the EOS-HDF (EOS Hierarchical Data Format) format, which is commonly used for distributing earth-observation data. SMILES data will be distributed online via the Internet, in general. However, other media such as CD-ROM or DVD may be used in case that the network environment is not readily established for RA researches. In this case, actual costs (for media and shipping) should be paid by the researches.

### 5. Rights and Obligations of the Principal Investigator (PI)

#### 5.1. Rights

The PI shall be responsible for communicating with JAXA through the RA Office when applying for the RA and also researching on the research theme, if adopted. The PI shall be entitled to the following rights, if it is appropriate for the research theme:

- 1) Requesting a delivery of the standard products, free of charge, before the release to the public.
- 2) Requesting a delivery of the research products free of charge.

Note that the number of such requests will be determined in consideration of the conformity to the research purpose.

#### 5.2. Interim reporting

The PI shall report on the progress of his/her research in the way designated by JAXA at



JEM/SMILES workshops as well as interim report meetings. In addition, if the Committee deems the research purpose or data application of the RA Investigators as deviant from the initial research plan as a result of the examination of the progress reported, JAXA may terminate the agreement.

### 5.3. Final reporting

All PIs are required to submit the final reports to JAXA through the RA Office, generally in one year from the last interim report meeting. The reports shall be prepared in English. Moreover, the PIs are encouraged to present their research results in whole or in part at conferences, symposiums, and workshops relevant to the SMILES project.

## 6. Preparation and Submission of Research Proposals

### 6.1. Notes to the preparation of research proposals

The documents to be submitted in response to the RA must be prepared in accordance with the following procedures. Those proposals that are prepared in disregard of these conditions may be excluded from the succeeding evaluation process. In addition, the submitted documents will not be returned to the proposers for any reason.

- 1) Prepare a research proposal in accordance with the procedure for submission defined in this Chapter and the “Contents of Research Proposals and Application Forms” provided as Appendix A. The application forms in Appendix A will be used accordingly.
- 2) Submit your research proposal in the WORD or PDF format, in the way that it is ready for printing in A4 or letter size, together with necessary references via e-mail to the SMILES RA Office’s e-mail address described in Chapter 9. If the size of the submission materials exceeds 10 MB, prepare those on electric media, such as CD-R, and send it to the RA Office by conventional mail.
- 3) Letters on the documents should all be typed in 10- to 12-point size.
- 4) The research proposal and accompanying reference documents must all be prepared in English.
- 5) The research proposal must be compiled in the most simplified way, focusing on the minimally necessary contents. The total volume of the proposal, excluding appendices, must be 4 pages or less. See Appendix A for further specific rules.
- 6) Submission deadline is set on July 24, 2009. The document must arrive at the RA office by the deadline even if the document is sent by conventional mail.

## 7. Selection of Research Proposals

### 7.1. Evaluation and Selection Procedure

The research proposals submitted in response to the RA will be evaluated by the Committee. JAXA will make a final decision on the selection of research themes, based on the evaluation results of the Committee. The applicants may be requested to modify or rectify the contents of the proposed research plan, in the course of the selection by the Committee, with a view to enriching the expected scientific results from the proposed research. In addition, the Committee may solicit advice of the SMILES Science Team in the process of evaluation. All applicants will be notified of the selection results by August 28, 2009.

### 7.2. Evaluation Criteria

The submitted research proposals will be examined and selected based on the following evaluation criteria.

- 1) The contents of the proposed research conform to the purpose of the RA.
- 2) The methods and approaches adopted in the proposed research are appropriate and the underlying concept is original and/or innovative.
- 3) The RA Investigators, including the PI, are qualified in terms of research capability, experience, facility/equipment, and skills necessary for accomplishing the purpose of the proposed research.
- 4) The proposed research is consistent and relevant with the purpose of the SMILES mission.
- 5) The purpose of the proposed research can be accomplished within the research period.

### 7.3. Cancellation and Postponement of RA

The JAXA reserves the right to cancel the RA and joint research projects based on the RA by notifying in writing, and shall not be liable for any delay in the RA schedule or cancellation of the RA program itself or to those who did not receive any notice regarding such delay or cancellation.

## 8. Schedule

Release of RA	May 29, 2009
Deadline for submission of proposals	July 24, 2009
Notification of the selection results	August 28, 2009
The 1 <sup>st</sup> PI meeting	Scheduled around the beginning of 2010
Launch of JEM/SMILES	September, 2009

## 9. Point of Contact

Takuki SANO (Mr.)

JEM/SMILES RA Office

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*[Notice: Telephone and facimile number are subject to change with relocation of RA office in this summer. An e-mail contact is appreciated.]*

Appendix:           Contents of Research Proposal and Application Form