

January 18, 2011

## Report on Japanese- and Korean-led instruments of SPICA

This report describes the purpose, procedure, and result of the review for the Japanese- and Korean-led instruments of SPICA.

### 1. Review Process

The review committee for the Japanese- and Korean-led instruments of SPICA, which consists of SPICA pre-project team and SPICA Task Force from GOPIRA, released the call for proposals of the SPICA instruments on 14th Dec. 2009 (1\*). The first instrument proposals were delivered in the end of April 2010. After interviewing the instrument teams on 12th July, the review panel (\*3) examined the feasibility of the instruments in July-Sep. The most important criterion for the FPI screening is to identify the essential instruments or functions requisite for achieving the goals in line with the scientific major objectives of SPICA in MDR, e.g., “the drama of galaxy formation” and “the recipe for planetary systems”. Maturity of the conceptual design study must be addressed. The technical feasibility and the consistency with the stringent limit of the system resources are also the points to judge the design.

The interim report of the review result was given to the Japanese and Korean communities on 2nd Sep (\*2). Then the instrument teams revised the proposal in accordance with the recommendations of the panel. In the course of revising, three original MIR instruments were merged into a single instrument. The SCI team was asked to clarify its outstanding uniqueness or advantages compared to other instruments onboard JWST.

The second instrument proposals have been delivered on 30th Sep. These instruments are:

MCS (Mid-infrared Camera and Spectrograph) (PI. H. Kataza)

SCI (SPICA Coronagraph Instrument) (PI. K. Enya)

FPC-S(Focal Plane Camera – Science) (PI. Dae-Hee Lee)

### 2. Expected FPIs and Options

In the process of selecting the expected FPIs and their options, we should keep our attention to the advantageous coverage in long wavelengths with unprecedented

sensitivity thanks to the cold telescope SPICA with a large aperture. The focal plane instruments must make full and best use of the advantage. After the launch of JWST, which will give answers to many unsolved problems in astronomy, SPICA is a unique space observatory which will shed light on the dusty universe. As such, a higher priority is given in longer wavelengths as a matter of principle.

Because of the life time limit for SPICA, as more functions are available, less telescope time will be allocated to each function and eventually consumed for many miscellaneous targets, which would not always fully utilize the unique capabilities of SPICA. It should be also noted that the larger field of view or longer slits of SPICA instruments than those of JWST are regarded as minor advantages over JWST in its wavelength coverage

## **MCS**

The MCS is the main instrument of SPICA and should be given the highest priority. The main functions in the proposal are:

WFC-S (Wide Field Camera in Short wavelengths)

WFC-L (Wide field Camera in Long wavelengths)

LRS-S (Low Resolution Spectrograph in Short wavelengths)

LRS-L (Low Resolution Spectrograph in Long Wavelengths)

MR-S (Medium Resolution Spectrograph in Short wavelengths)

MRS-L (Medium Resolution Spectrograph in Long Wavelengths)

HRS-S (High Resolution Spectrograph in Short wavelengths)

HRS-L (High Resolution Spectrograph in Long Wavelengths)

The current MCS has too many functions and too complicated design for any space instruments. It is mandatory to reduce the complexity. The feasibility is concerned also in view of the human resources which would be allocated to the development of each function. As in the interim report, WFC-L and WFC-S are the functions indispensable for the success of SPICA. Although the wavelength coverage of WFC-S has an overlap with that of JWST, it has a much wider FOV.

A spectrograph in long wavelengths is also essential for SPICA. From the scientific merits and to avoid the redundancy of functions, only one of LRS and MRS is recommended to be installed. Although it is difficult to select one of MRS-L and LRS-L because the choice strongly depends on what science objectives in MRD are preferred, the committee recommends MRS-L as a mandatory function on the whole.

Other functions are judged to be the options in the priority order of LRS-L, MRS-S. Although HRS-L and HRS-S are expected to be very prospective from its uniqueness with strong scientific feasibility as noted in the interim report, the main concern would be the team structure, which is well not defined yet. Technical risks to achieve high dispersion are also concerned.

In summary, the mandatory functions should be WFC-L, WFC-S, MRS-L.

The options are reckoned in the priority order of LRS-L, MRS-S, HRS-L, LRS-S, HRS-S.

The “option” does not mean that any functions are adopted if the resources are available. The review panel strongly recommends a minimum number of functions so that those with highest priority are more powerful and productive. In addition, the panel encourages the team to look into a possibility to extend wavelength coverage of MCS as long as to  $\sim 50 \mu\text{m}$ , and to have a discussion with a SAFARI team on which instrument of SAFARI or MCS with extended wavelength coverage, will cover the pioneering wavelength range of 40 to 50  $\mu\text{m}$ .

## **SCI**

SCI does not demand as a cold telescope as SPICA. Therefore its unique capability for extra-solar planet science from the space is a key point of the verification. However, the concept design as well as the specifications of SCI is not well defined yet in this final stage of reviewing. The instrument is discussed based on the baseline design. If the base line of SCI is the contrast of  $10^{-4}$  at best, SCI does not deserve to be onboard in spite of its unique spectroscopic capability because the scientific merits of SCI with  $10^{-4}$  are not well clarified yet. The technical propositions to achieve much higher contrast, e.g.,  $10^{-5}$ ~ $10^{-6}$  without DM are immature yet, or the way to prove the maturity is not clearly described. The instrument team should find out scientific superiorities over JWST with feasible technology. Otherwise SCI would be hardly given a higher priority than MCS and its options. It is another concern that the scientific team is not well organized.

## **FPC-S**

FPC-S is a Korean-led instrument and it should be discussed within a framework of the international collaboration. Nevertheless, the committee highly recommends FPC-S

to be onboard SPICA from the prospective view of international collaboration between Japan and Korea, provided that the instrument does not demand any extra burden or cost to the telescope and other instruments. Parallel or coordinated observations with other instruments, including those after the life time of cryocooler, will reinforce scientific achievements made by the main instruments.

In conclusion, it is recommended to implement FPC-S under the conditions that it well keeps the FPC-G functions, including redundancy, and that additional resources are as small as in the current proposal. If the image quality is found in due course to be not as good as expected for the current science objectives, the specifications and scientific goals should be reviewed.

#### Review Committee

Takashi Ichikawa (Chair)  
SPICA Task Force  
SPICA Pre-project Team

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[http://www.ioa.s.u-tokyo.ac.jp/gopira/stf/Announcement\\_SPICA\\_FPI.pdf](http://www.ioa.s.u-tokyo.ac.jp/gopira/stf/Announcement_SPICA_FPI.pdf) (in Japanese)

(\*2)

[http://www.ioa.s.u-tokyo.ac.jp/gopira/stf/STF\\_SPICA\\_FPI\\_review\\_result.pdf](http://www.ioa.s.u-tokyo.ac.jp/gopira/stf/STF_SPICA_FPI_review_result.pdf) (in Japanese)

(\*3) Review Panel members

Chair: Takashi Ichikawa (Tohoku Univ.)

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