Soft X-ray Spectrometer (SXS) for the NeXT Mission



NeXT/SXS Team

Scientific objectives of SXS

• The primary goal of the NeXT mission is to understand the non-thermal Universe. SXS will determine the velocity of the hot plasma where particle acceleration occurs, with accuracy better than 500km/s.

•High resolution spectroscopy using an X-ray microcalorimeter has the highest priority in the X-ray astronomy community in the world. SXS will respond to it and recover the science that Suzaku left.

Overview of SXS sensor, cryogenic system, and electronics

Suzaku XRS is the only flight-qualified X-ray microcalorimeter at present, and SXS will make maximal use of that detector technology. As a cryogenic system, liquid helium and two-stage Stirling cooler will be used instead of liquid helium and solid neon like XRS, to reduce risks during ground operations.

SXS baseline design

	SXS baseline	Suzaku XRS
SXS detector		
pixel size	815 µm	625 μm
array format	6 x 6	6 x 6
operating temp.	50 mK	60 mK
energy resolution	~ 6 eV	6 - 7 eV
efficiency @ 0.6keV	15 %	15 %
efficiency @ 7keV	70 %	70 %
cryogenics	2ST+LHe(JT)+ADR	ST+SNe+LHe+ADR
SXT-S (XRT for SXS)		
Outer diameter	45 cm	40 cm
Focal length	9 m	4.5 m
SXT-S + SXS		
Effective area (S) @6.7keV	340 cm ²	140 cm ²
Grasp (SΩ) @ 6.7keV	0.42 cm ² deg ²	0.27 cm ² deg ²
pixel / whole array	0.31' / 1.9'	0.48' /2.9'

liquid helium (1.3K)

Suzaku XRS used two cryogens, i.e., liquid helium and solid neon, which made the system complex. To reduce possible risks during ground operations, SXS will use liquid helium as a cryogen, and replaces solid neon with a cryocooler.

cryocooler (20K/100K)

SXS will adopt two sets of two-stage Stirling-cycle coolers. The same type of cryocooler was developed for Akari (Astro-F), and is operating in orbit now. An option of Joule-Thomson cooler is under investigation, which could extend the lifetime of liquid helium.

Two-stage ADR (50mK)

Sensor

In the baseline design, SXS will use a backup sensor of XRS (pixel size: 815um, array format: 6x6). By operating the detector at 50mK, an energy resolution comparable to the XRS will be achieved.

SXS performance in comparison with other missions



energy resolution vs grasp



Schematic diagram of SXS cryogenic system



Sensor performance of Suzaku XRS



Sensor assembly of Suzaku XRS (left) and 6x6 microcalorimeter array (right)

Mn Ka₂

Mn Ka