

90  $\mu$  m

# ***FIS Introduction (Part 1)***

AKARI/FIS Data Reduction Workshop

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Prepared by Issei Yamamura (ISAS)

1 degree  
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# Scope of the presentation

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## (Part 1)

- FIS instrument overview
  - Hardware overview
  - AOT's
- FIS observation data
  - Data package
  - Data format

## (Part 2)

- Introduction to the data reduction toolkit
    - Installation & startup
    - Data browser
    - Running the toolkit
- demonstration



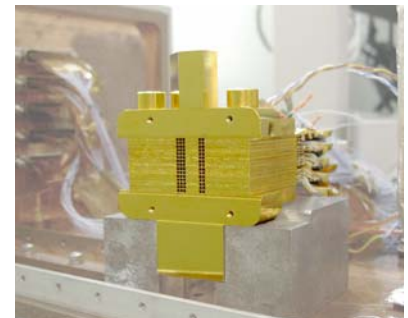
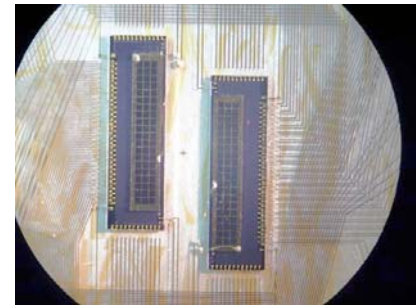
# FIS Photometric Mode

Band	N60	WIDE-S	WIDE-L	N160	
Wavelength	50–80	60–110	110–180	140–180	[ $\mu\text{m}$ ]
Central Wavelength	65	90	140	160	[ $\mu\text{m}$ ]
Detector	Monolithic Ge:Ga		Compact Stressed Ge:Ga		Ge:Ga chips supplied by NICT
Readout	Charge Trans-Impedance Amplifier (CTIA)				
Array format	20 x 2	20 x 3	15 x 3	15 x 2	Pixels
Pixel size (Physical size)	27 x 27 (0.5 x 0.5)	27 x 27 (0.5 x 0.5)	44 x 44 (0.9 x 0.9)	44 x 44 (0.9 x 0.9)	[arcsec <sup>2</sup> ] ([mm <sup>2</sup> ])



# FIS: Far-Infrared Surveyor

- Simultaneous observation in **four** FIR bands.
- Detectors:
  - Monolithic Ge:Ga array [SW: 50–110  $\mu\text{m}$ , 20x(3+2) pix)]\*
  - Stressed Ge:Ga array [LW: 110–180  $\mu\text{m}$  , 15x(3+2) pix]
- Spatial resolution of 30–75 arcsec.
- Fourier Transform Spectrometer.
  - Martin-Puplette type polarized interferometer.
  - 0.36  $\text{cm}^{-1}$  ( $R=450$  @ 60 $\mu\text{m}$ , 170 @ 180  $\mu\text{m}$ )

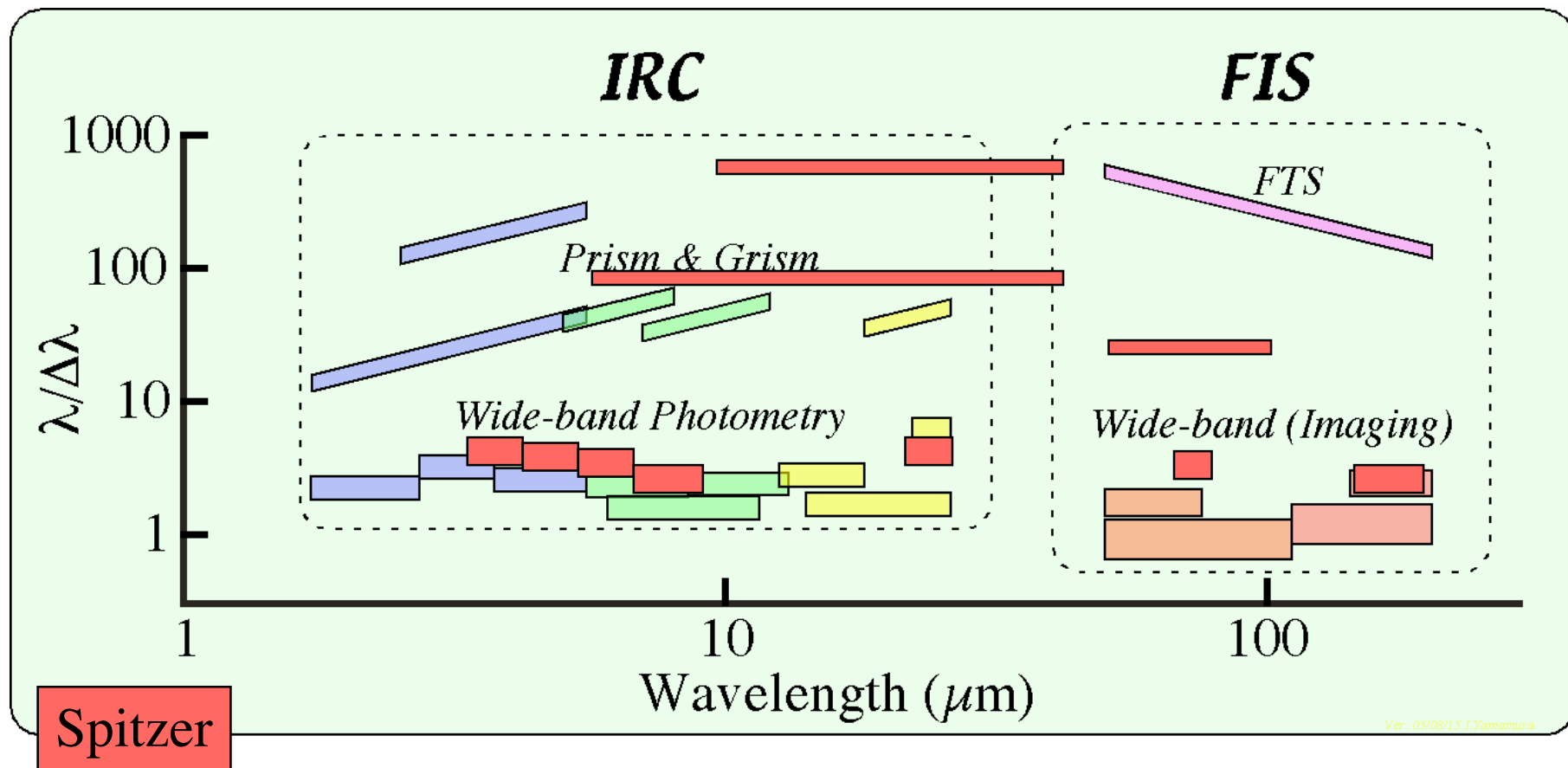


*\*The SW detector was manufactured by NICT*



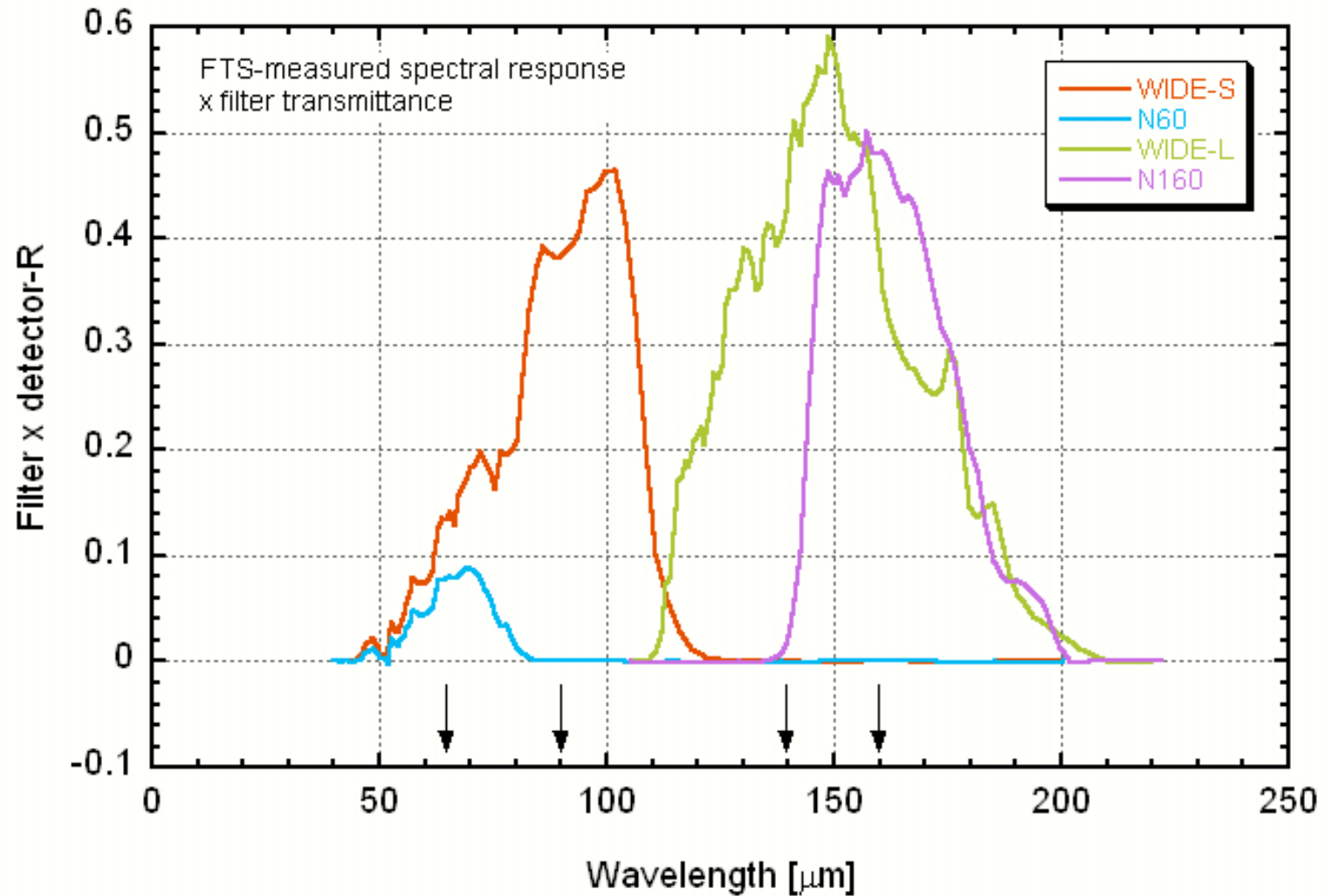
# Onboard Instruments

## Photometric & Spectroscopic Capabilities



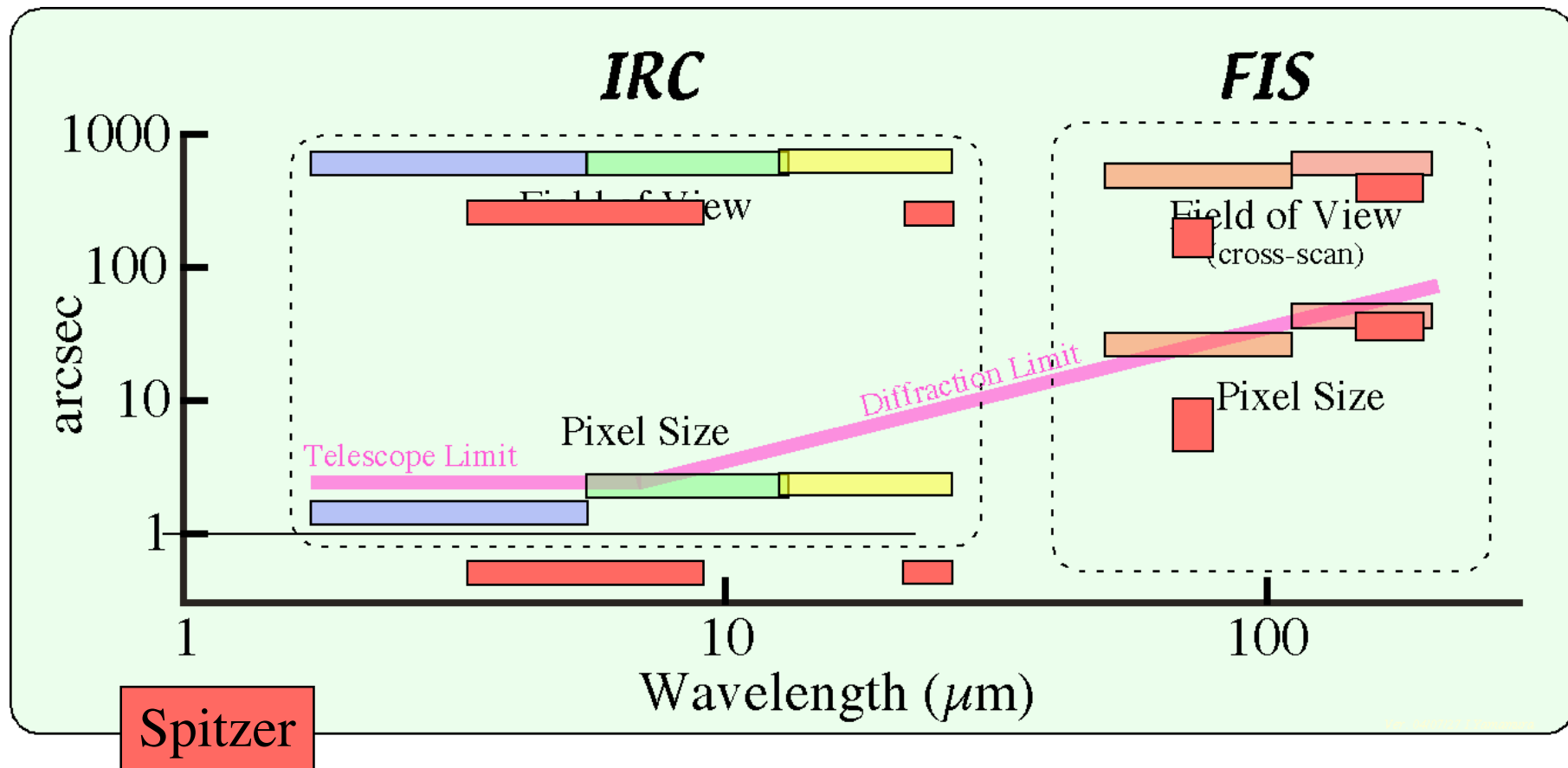


# FIS RSRF





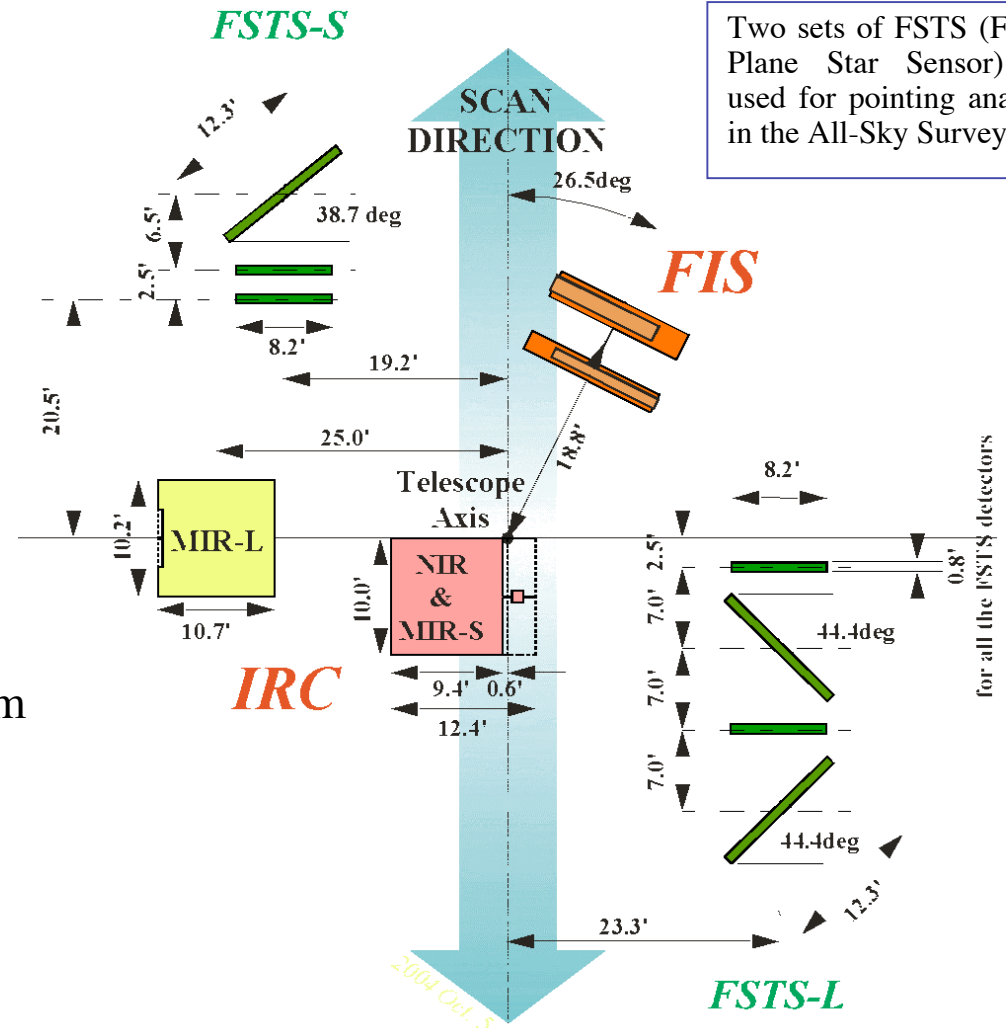
# Field of View and Pixel Size





# Field of View

- Three apertures
  - FIS (SW + LW)
  - IRC (NIR + MIR-S)
  - IRC (MIR-L)
  
- All instruments *can* be operated simultaneously.
  - Three apertures look at different areas of the sky.
  - FIS two channels share the same area of the sky by beam splitter.
  - IRC NIR and MIR-S share the same area of the sky by beam splitter.







# FIS Detectors

WIDE-S: 3x20

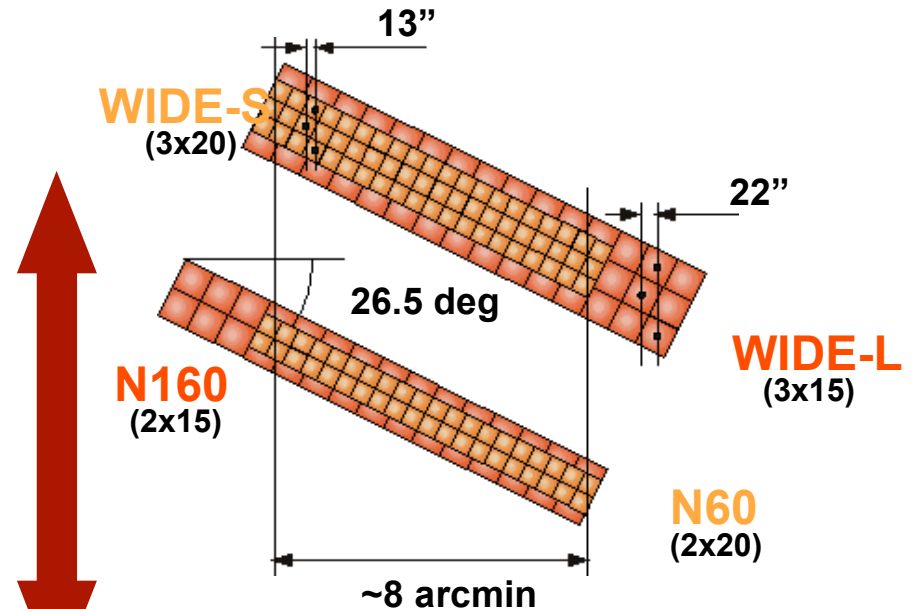
N60: 2x20

N160: 2x15

WIDE-L: 3x15

Overlap each other

Scan Direction



- 44.2" x 44.2" / pixel
- 26.8" x 26.8" / pixel

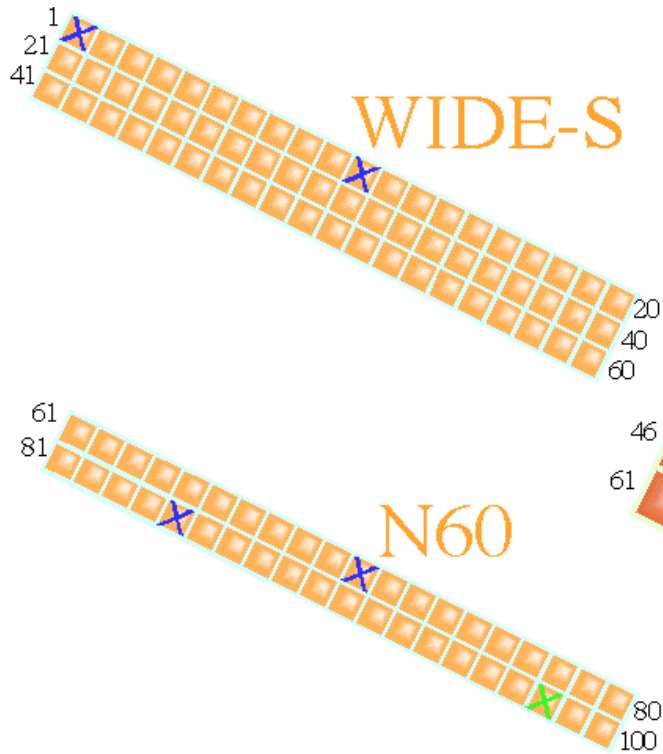
FoV of the FIS

Scan direction ~ along the constant Ecliptic longitude

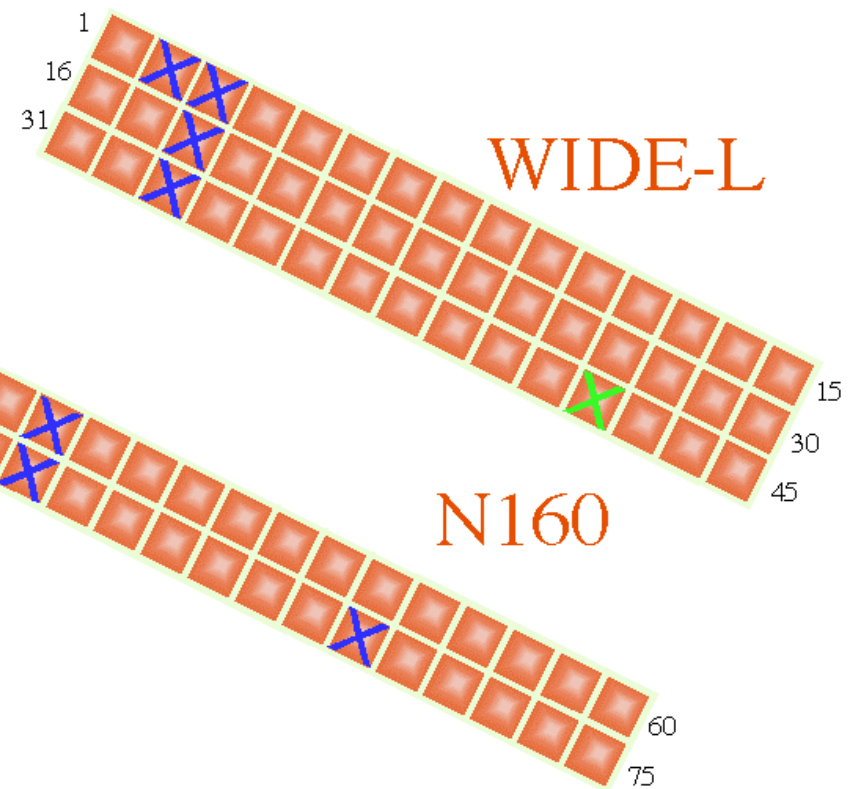


# Dead pixels

Scan direction



SW: 1, 11, 71, 84 (98)



LW: 2, 3, 18, 33, (42), 48, 63



# FIS AOT (Astronomical Observation Template)

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- FIS01: Photometry/Mapping of small areas 

- FIS02: Mapping of wider areas 

- FIS03: FTS spectroscopy

- Very complicated: contact to the FTS team!!!

- AOT parameters for FIS01/FIS02

- Reset interval: 0.5 / 1.0 / 2.0 sec

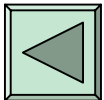
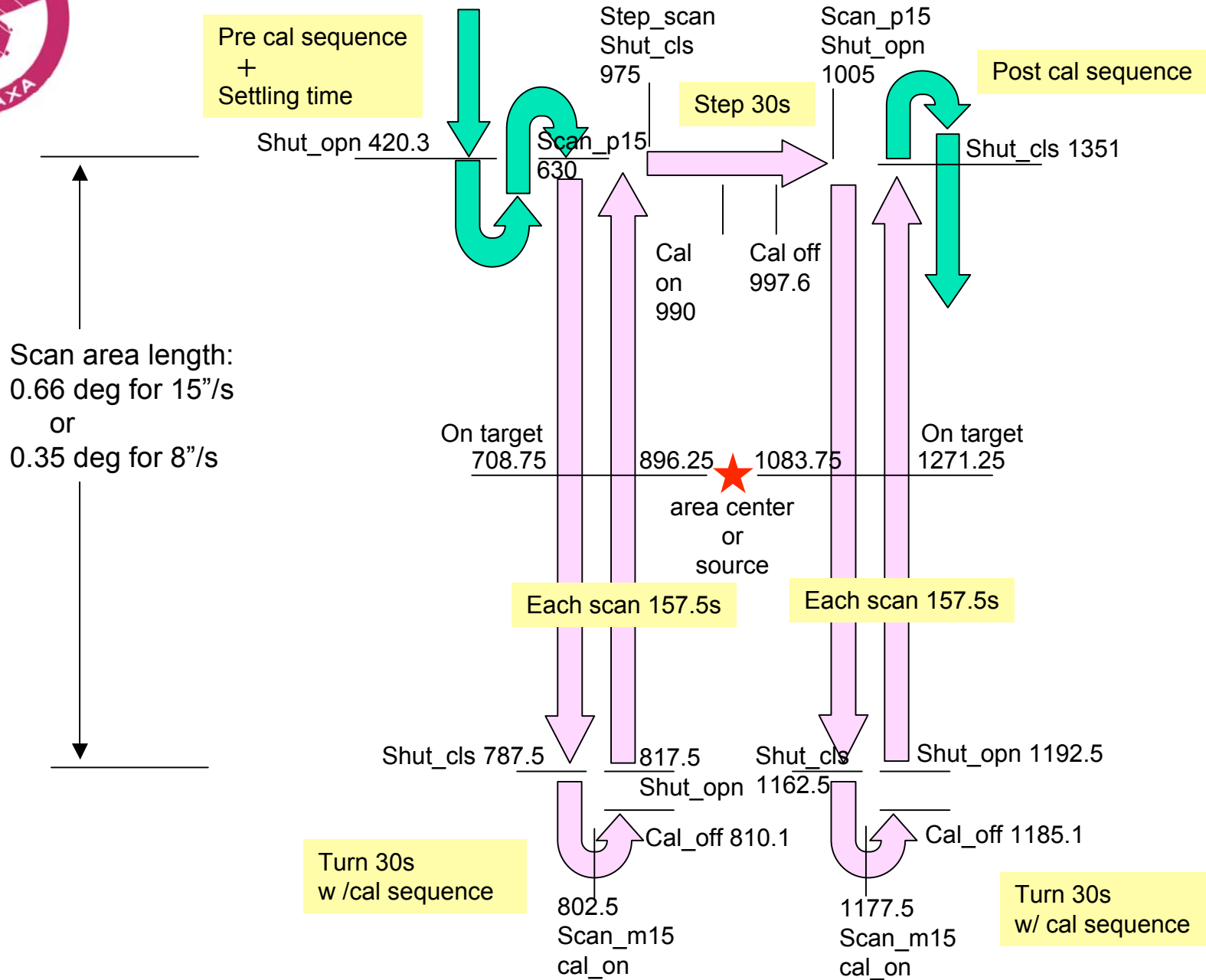
- Scan speed: 8 / 15 arcsec/sec (FIS01)

- 15 / 30 arcsec/sec (FIS02)

- Step scan: 70 / 240 arcsec (only FIS01)

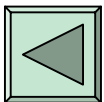
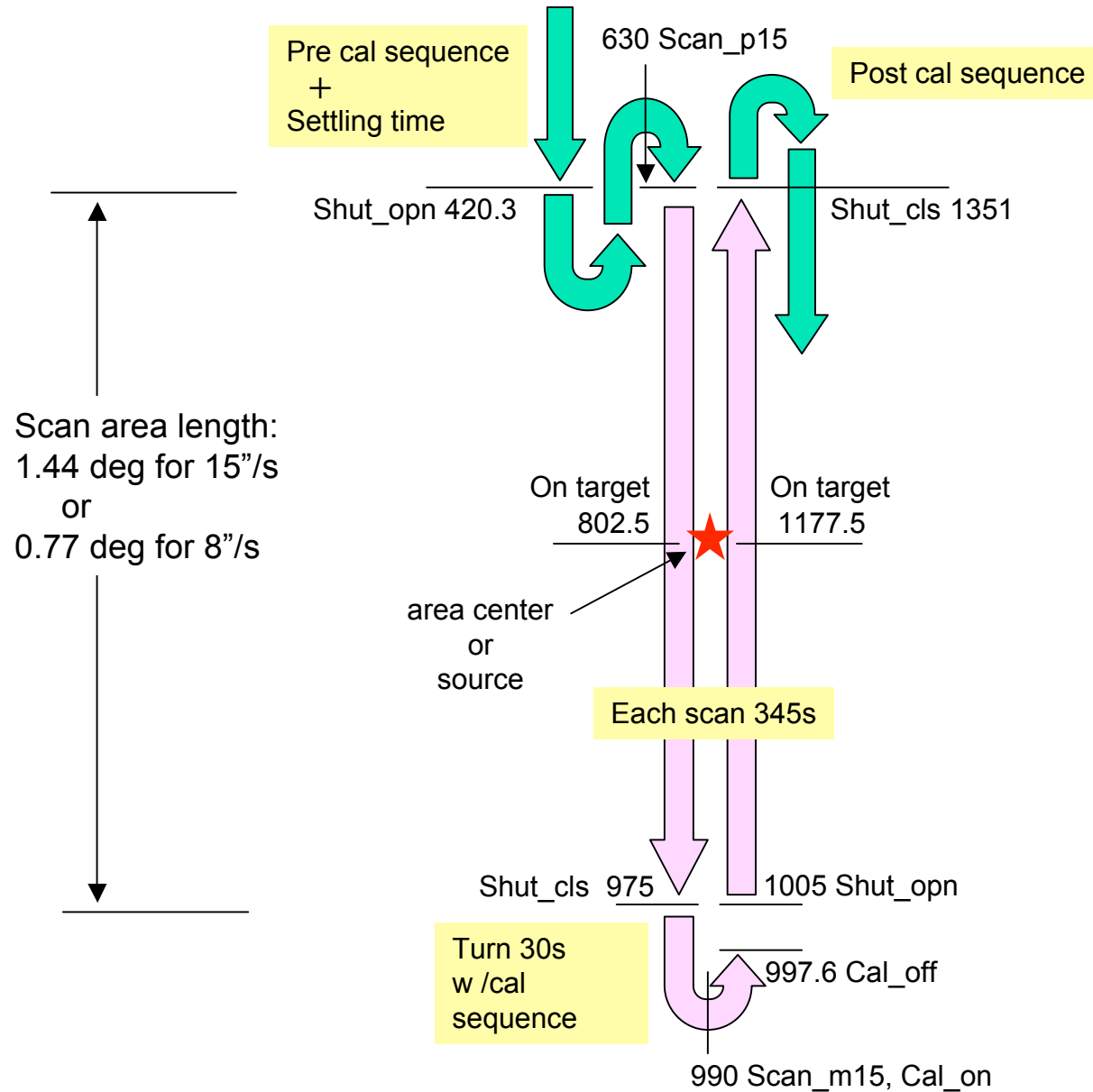


# Observation Sequence (FIS01)





# Observation Sequence (FIS02)





# Flight performance

	N60	WIDE-S	WIDE-L	N160
All-Sky Survey [mJy]	2400 (500)	550 (100)	1400 (100)	6300 (300)
Slow-Scan* [mJy]	130 (45)	26 (9)	67 (6)	330 (12)

- 5-sigma noise level per scan
- Slow-Scan is for the scan speed of 8 arcsec/sec and reset interval of 2.0 sec.
- Main causes of the degradation:
  - Detector bias lowered (LW)
  - Detector temperature was too low (SW).
  - Glitches cause unstable signal level.



# The data package

- A data package consist with;

- Two TSD FITS files (SW and LW)
- Two jpeg images as example results.
- Version of the example processing

AKARI\_FIS\_5110085\_001/

FIS\_LW\_20070705213613\_1770.fits.gz

FIS\_SW\_20070705213613\_1770.fits.gz

Start time of the observation

FIS\_LW\_20070705213613\_1770\_img.jpg

FIS\_SW\_20070705213613\_1770\_img.jpg

VERSION

Length of file [sec]

- Contents of the TSD file

- **Detector signals**, Position info., Statuses of satellite & instruments, flags, etc.



# Time Series Data (TSD)

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- The FIS detectors are continuously sampled with  $\sim 25$  and  $\sim 17$  Hz for SW & LW, respectively, while the telescope scans the sky.
- The FIS data is in the **dedicated format** called ‘TSD’, a table FITS format. (*not image FITS*)
- Interface to the TSD FITS files and data browser are distributed in the software package.





# TSD Format

TSD Branch	Time	Status (boolean)	Telemetry (analog)	Detector Data (analog)	Flags (boolean)	Quality	Counter
Non-Editable				Editable			
FIS_OBS							
FIS_HK							
IRC_HK							
HK_2							

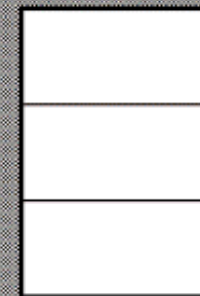
## Flat table:

All information is regridded to the detector sampling timing.

## Unique format:

Raw data are kept in the file.

Reduced results are recorded in the dedicated area.





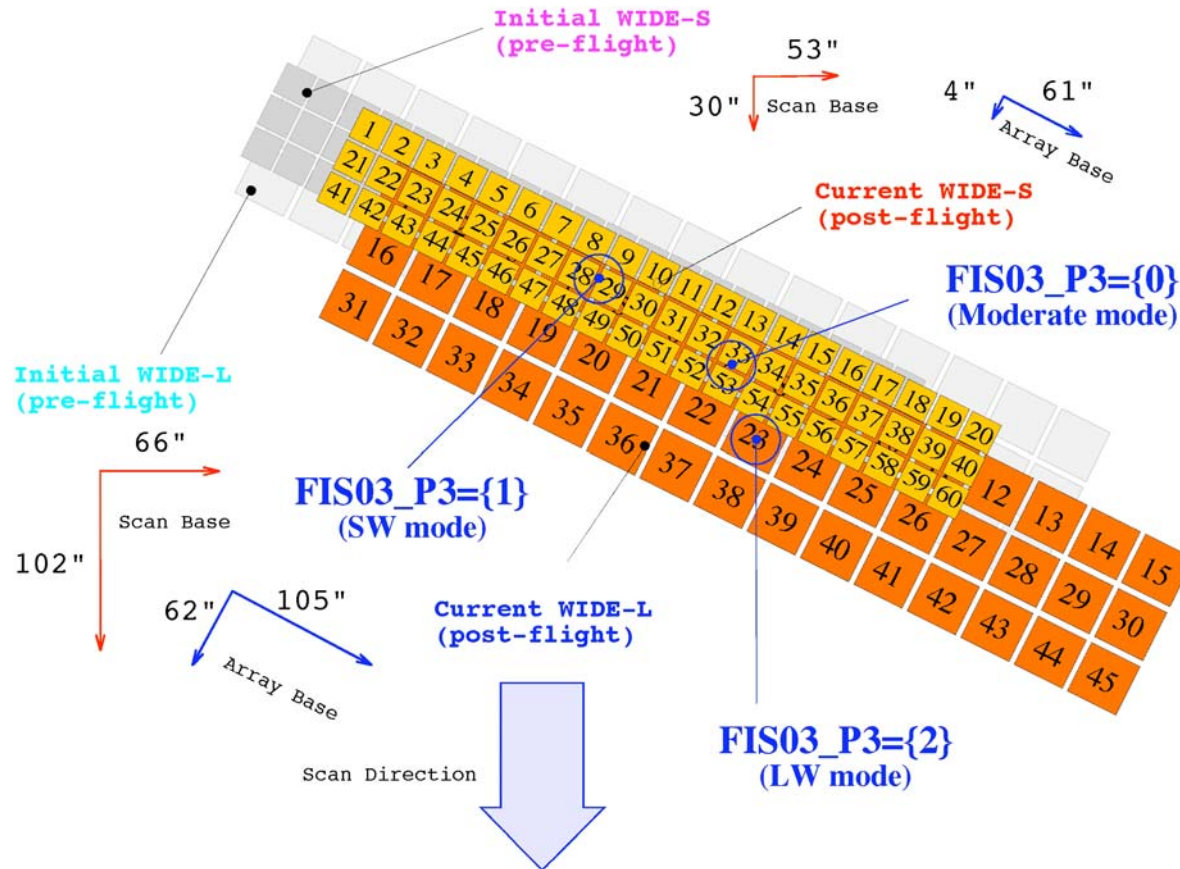
# Attitude determination

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- Two levels
  - Onboard determination by the AOCU (Attitude and Orbit Control Unit).
  - Ground-base attitude determination system (G-ADS)
- G-ADS supposed to be more reliable.
- Focal-plane pointing reconstruction is only made for the All-Sky Survey data.
- Current status:
  - G-ADS data delivered for all observation periods.
  - Current data (DR1) only have the latest G-ADS processing results after mid-December 2006. Older version for August to mid-December, 2006
  - DR2 will have the latest G-ADS information.
  - G-ADS has about 60 arcsec offset from the 'true' position.



# Detector Alignment (FTS)



- Corresponding information not yet available for the Slow-Scan mode.



# Data Release

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- Current version is “Data Release 1” (DR1).
  
- Data Release 2 (DR2) will be released in October.
  - Slight change in data format (position info.; should not affect to the slow-scan processing)
  - Processed with the latest pipeline.