The development status of Second Generation Global Imager (SGLI), Infrared Scanning Radiometer (IRS)

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SPIE Asia-Pacific, Beijing

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GCOM project/JAXA

GCOM Global Change Observation Mission

JAXA 宇宙航空研究開発機構 Japan Aerospace Exploration Agency

Empowered by Innovation NEC

http://suzaku.eorc.jaxa.jp/GCOM_C/index_j.html

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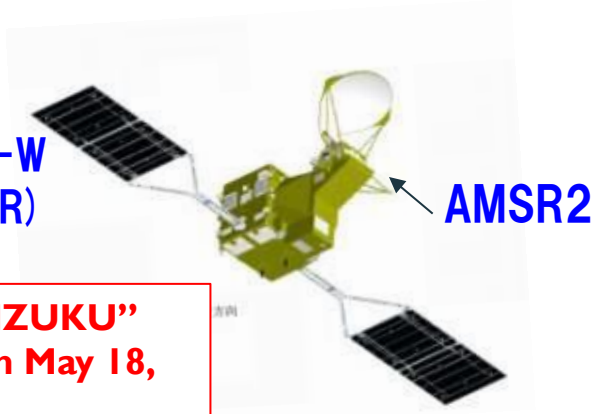
- ✓ GCOM mission and GCOM-C satellite
- ✓ Current Status
- ✓ The development status and key components performance of Infrared Scanning Radiometer (IRS)
- ✓ Conclusion

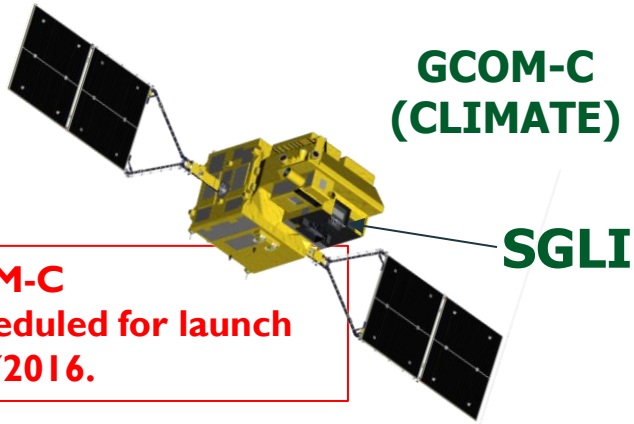
Global Change Observation Mission (GCOM)

- Global observation satellite system as JAXA's GEOSS contribution.
- 2 satellite series for 5 years, total 13 years observation.
  - ✓ **GCOM-W** Microwave radiometric observation for **WATER CYCLE** using AMSR2 (AMSR-E follow on)
  - ✓ **GCOM-C** Optical multi-channel observation for **RADIATION BUDGET** and **CARBON CYCLE** using SGLI (GLI follow on)



GCOM-W "SHIZUKU" was launched on May 18, 2012.

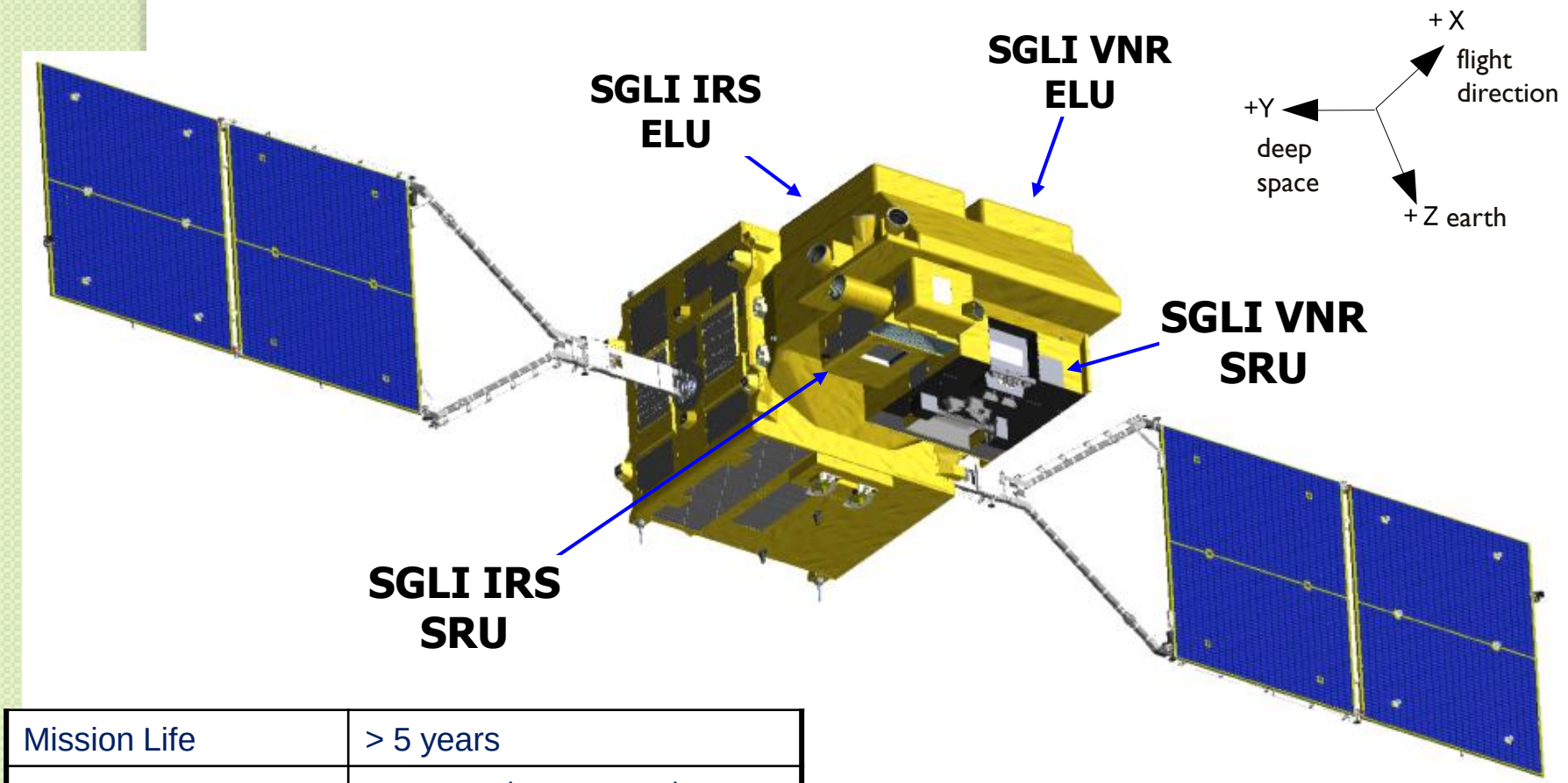
Sensor	Advanced Microwave Radiometer 2 (AMSR2) Passive Microwave Observation Water vapor, soil moisture etc



GCOM-C is scheduled for launch in JFY2016.

Sensor	Second Generation Global Imager (SGLI) Optical Observation 380nm – 12 micron Cloud, Aerosol, Vegetation, Chrolophl etc

Second generation Global Imager (SGLI) on GCOM-C satellite



Mission Life	> 5 years
Solar Paddle	> 4000w（End of Life）
Mass	about 2,000kg

SGLI Second Generation Global Imager
VNR Visible and Near Infrared Radiometer
IRS Infrared Scanning Radiometer
SRU Scanning Radiometer Unit
ELU Electronic Unit

Current Status

- Critical Design Review (CDR) of SGLI sensor and GCOM-C satellite was held in 2013.
  → The flight model (PFM) manufacturing was approved.
- The manufacturing of SGLI key flight parts, such as optics, filters, detectors or coolers, is almost finished and under the final inspection for the components assembly and tests.
- SRU sensor system integration and test is ongoing until early 2015. The sensor level pre-flight tests will be done in 2015.
- Satellite level test will start in 2015 and planned for launch in JFY 2016.

SGLI Performance

- The SGLI features are **250m (VNR-NP, SW3 & TIR) spatial resolution** and **polarization/along-track slant view** channels (VNR-PL), which will improve land, coastal, and aerosol observations.

Orbit	Sun-synchronous (descending local time: 10:30) Altitude 798km, Inclination 98.6deg
Mission Life	5 years (3 satellites; total 13 years)
Scan	Push-broom electric scan (VNR) Wisk-broom mechanical scan (IRS)
Scan width	1150km cross track (VNR: VN & P) 1400km cross track (IRS: SW & T)
Digitalization	12bit
Polarization	3 polarization angles for P
Along track direction	Nadir for VN, SW and T, +45 deg and -45 deg for P
On-board calibration	VN: Solar diffuser, LED, Lunar cal maneuvers, and dark current by masked pixels and nighttime obs. SW: Solar diffuser, LED, Lunar, and dark current by deep space window T: Black body and dark current by deep space window

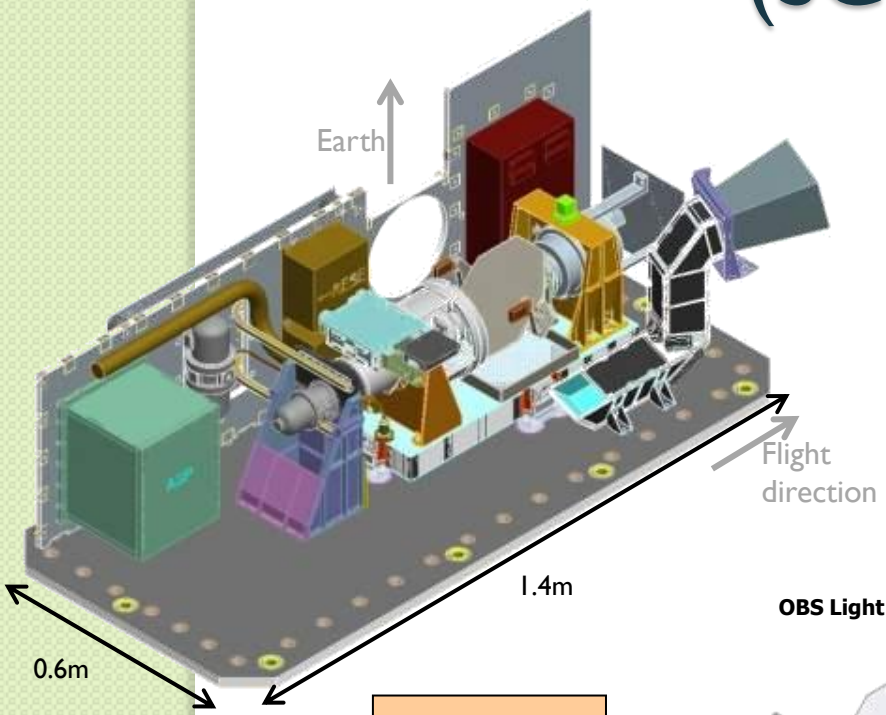
Multi-angle obs. for 674nm and 869nm

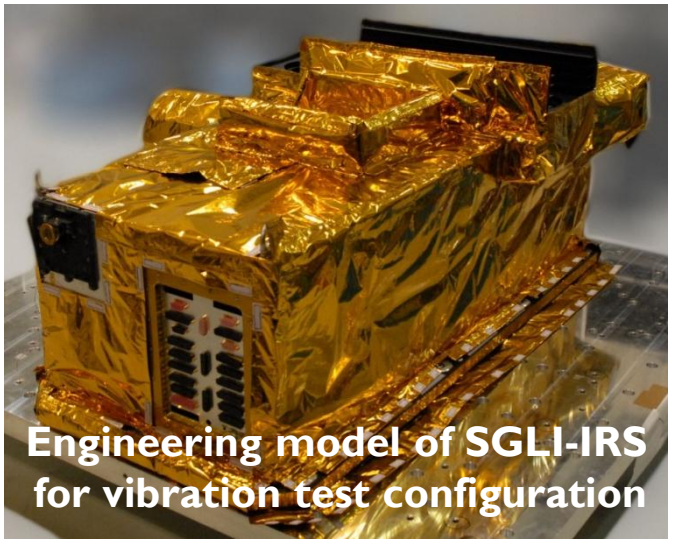
250m over the Land or coastal area, and 1km over offshore

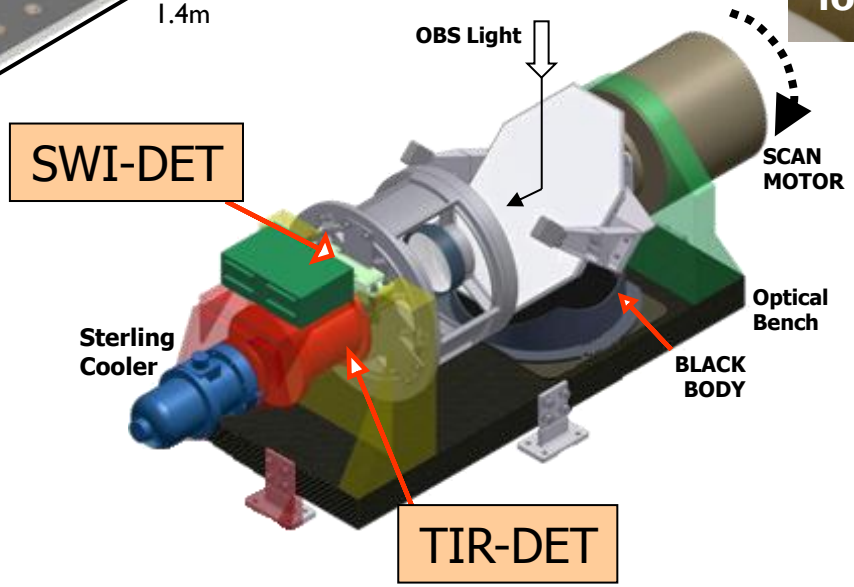
SGLI channels						
CH	λ NP, PL, SWI: nm T: μm	Δλ	L_{std} NP, PL, SWI: $W/m^2/sr/\mu m$ T: Kelvin	L_{max}	NP,PL,SWI: SNR at Lstd T: NEΔT	IFOV m
VN1	380	10	60	210	250	**250**
VN2	412	10	75	250	400	**250**
VN3	443	10	64	400	300	**250**
VN4	490	10	53	120	400	**250**
VN5	530	20	41	350	250	**250**
VN6	565	20	33	90	400	**250**
VN7	*673.5*	*20*	23	62	400	**250**
VN8	*673.5*	20	25	210	250	**250**
VN9	763	12	40	350	1200	**250**/1000
VN10	*868.5*	20	8	30	400	**250**
VN11	*868.5*	20	30	300	200	**250**
PL1	*673.5*	20	25	250	250	1000
PL2	*868.5*	20	30	300	250	1000
SW1	1050	20	57	248	500	1000
SW2	1380	20	8	103	150	1000
SW3	1630	200	3	50	57	**250**
SW4	2210	50	1.9	20	211	1000
T1	10.8	0.7	300	340	0.2	**250**/1000
T2	12.0	0.7	300	340	0.2	**250**/1000

TIR : 500m resolution is also used.

Infrared Scanning Radiometer (SGLI-IRS)



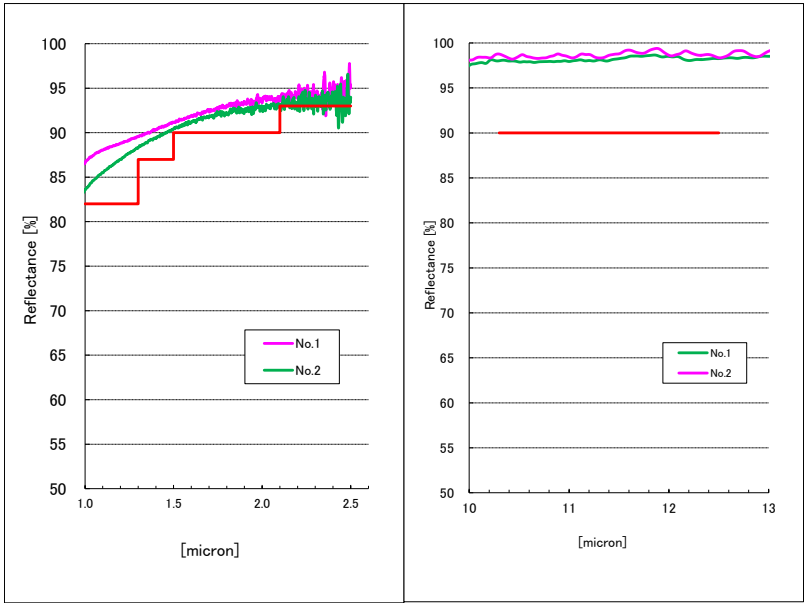

Engineering model of SGLI-IRS for vibration test configuration

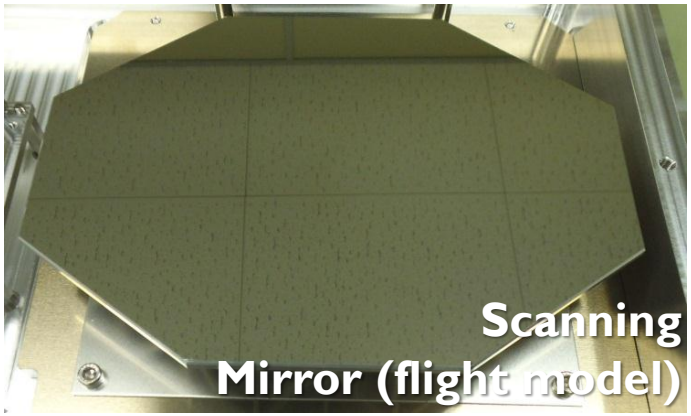


Weight: 193kg
Power: 400W

IRS scanning mirror

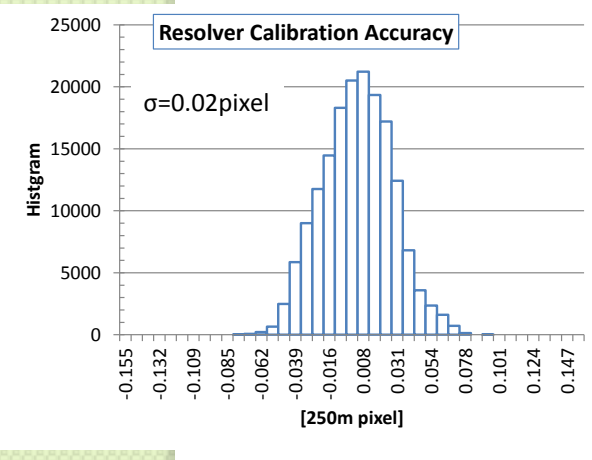
- 45deg tilting folding octagonal mirror.
- Mirror is coated aluminum with above 84% reflectance and polarization ratio is less than 1.4% including the telescope and SWI-BPF effects.
- The effect of mechanical stress to the mirror flatness is also considered with the light weight requirement (1.1kg).

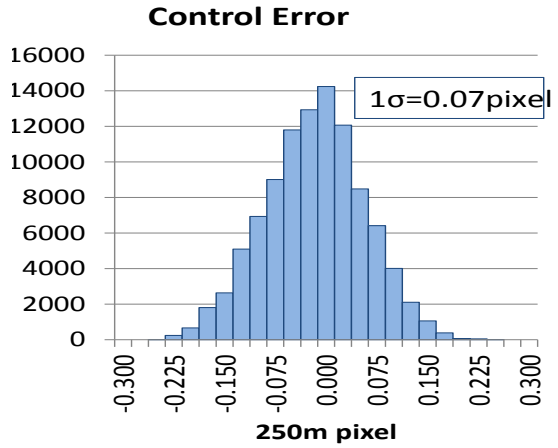


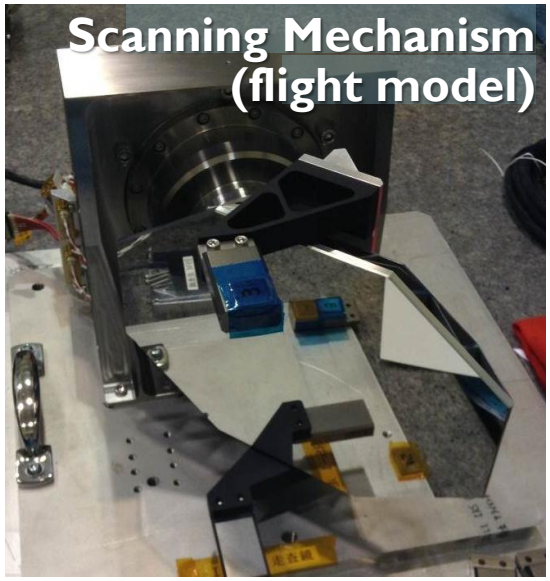


IRS scanning mechanism

- Geometric accuracy req. is 0.5 pixel of 250m.
- High rotation stability and measurement accuracy.
- AC servo motor with slot less type to avoid the torque disturbance.
- The low surface pressure bearing with the high reliability lubrication.

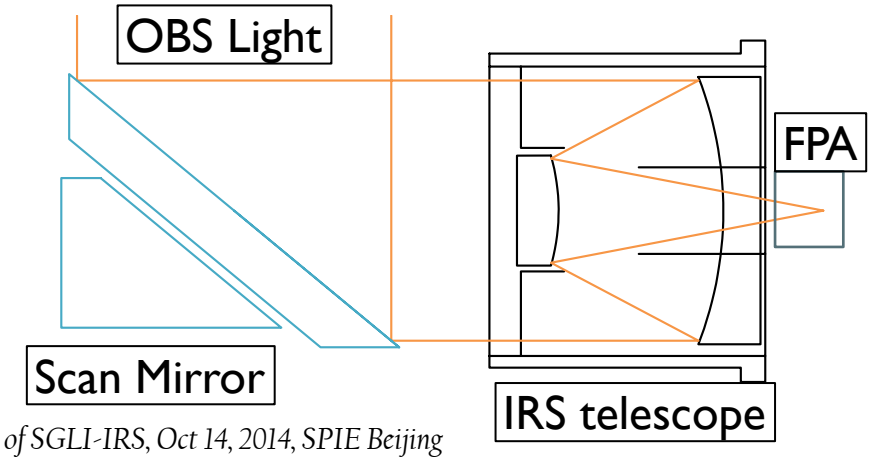


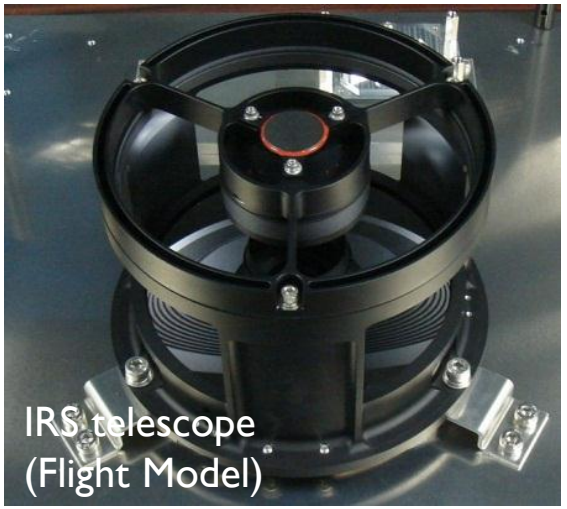




IRS telescope

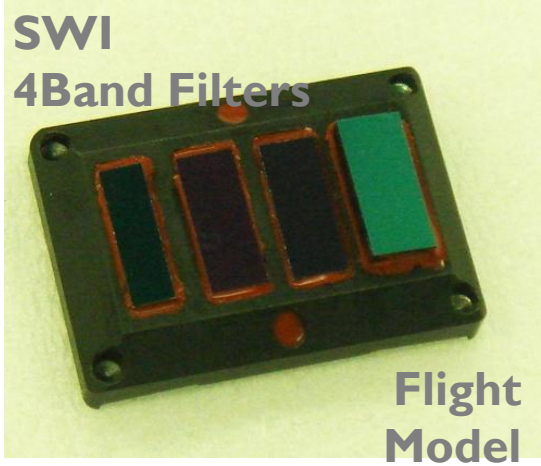
- Ritchey-chretien type coated aluminum telescope. (F/2.64, f=448mm, 170mm aperture)
- The several optical shields optimized to prevent the undesired stray light path.
- Thermally controlled within narrow room temperature range for 5 years operation
- The minimum depth of focus is tested with MTF 60% requirement.

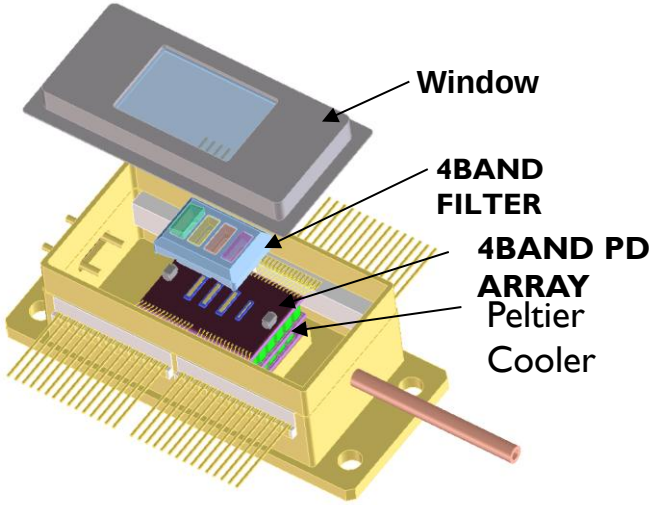




SWI focal plane assembly (SWI-DET)

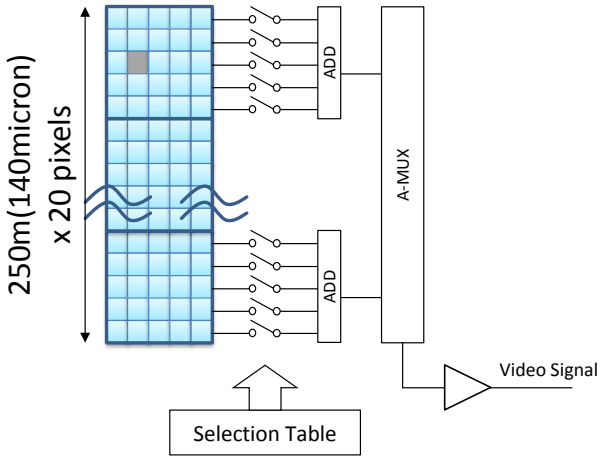
- InGaAs type SWI PD array with 4band BPF.
- The detector array is cooled at -30deg using peltier electronic cooler with PI control circuit in order to reduce the dark signal of 2.2micron channel.
- TIA circuit designed for low noise readout.
- AR coated window and filled with Xeon gas.

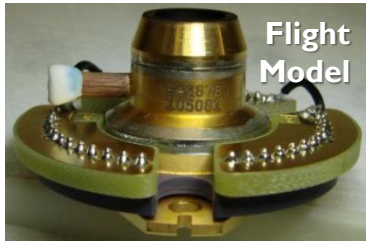




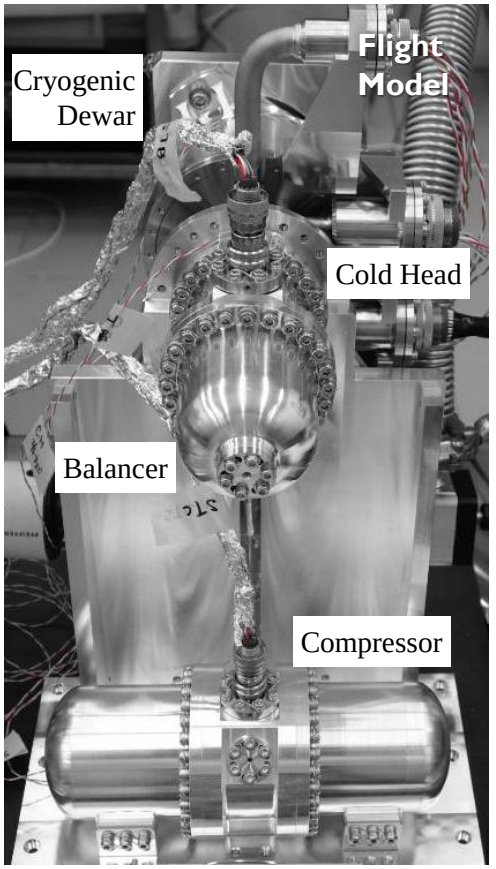
TIR focal plane assembly (TIR-DET)

- PV type MCT detector with cold BPF in the LWIRD filled with Neon gas.
- Cooler assembly with cryogenic dewar for the 55+/-0.1K with PI controlled heater.
- 140micron (250m) big pixel output using 28micron small pixel summation.
- Commandable selection table for poor performance sub-pixel deselection.



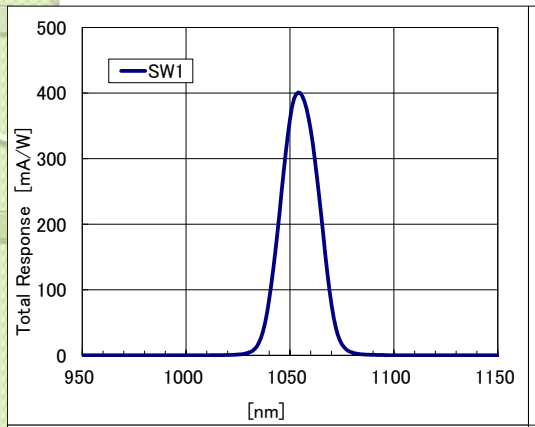


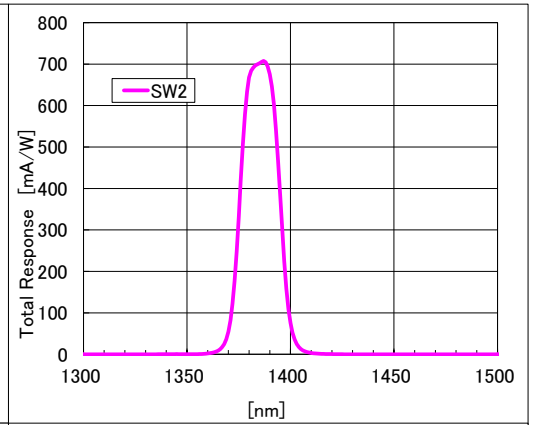
Long Wave Infrared Detector (LWIRD)

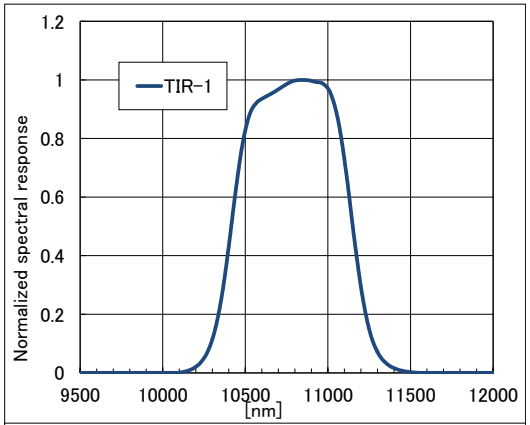


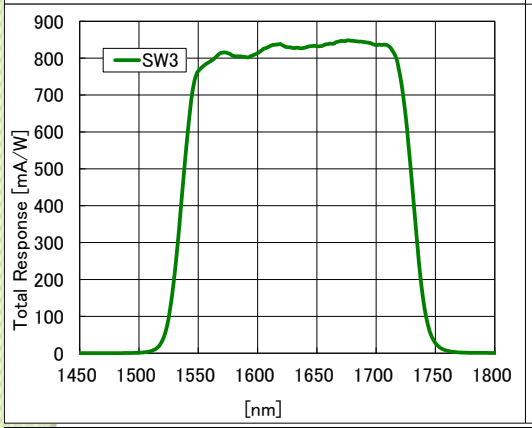
Cooler Assembly

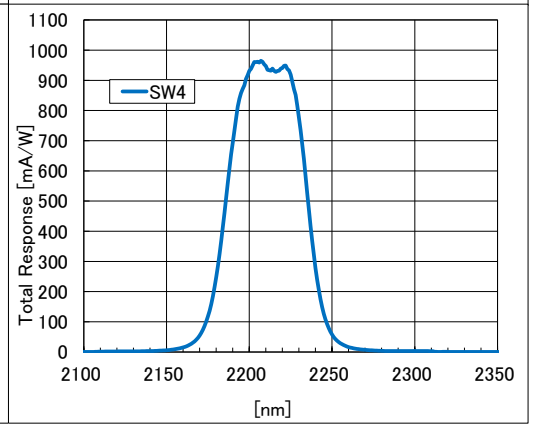
IRS spectral performance

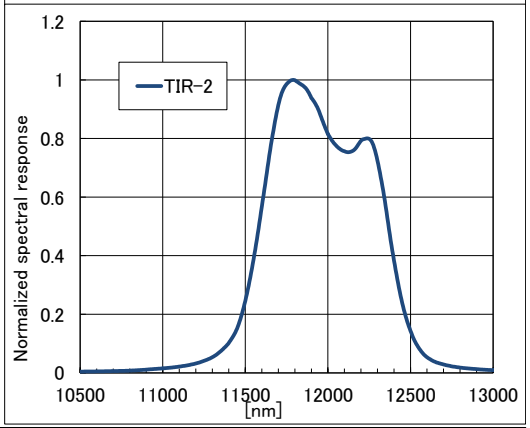










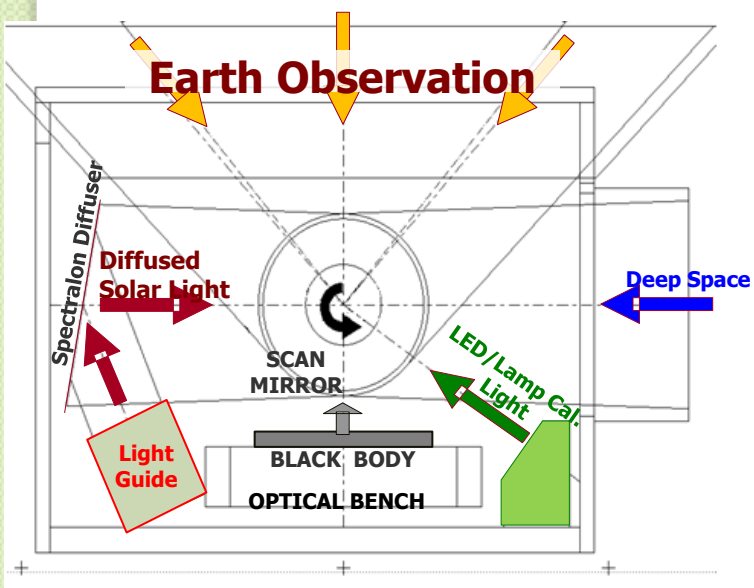


	FWHM Spectral Reponse [nm]							Weighted Spectal Response			
	Center Wavelength	Peak Wavelength	Lower Half Response		Upper Half Response		band width	Center Wavelength	Half Responce		band width
			Wavelength	10-80% width	Wavelength	10-80% width			Lower Wavelength	Heigher Wavelength	
SW1	1054.9	1054.0	1044.4	11.1	1065.5	11.2	21.1	1054.9	1043.9	1065.7	21.7
SW2	1385.3	1387.0	1375.3	7.2	1395.4	7.6	20.1	1385.4	1375.0	1395.6	20.6
SW3	1633.7	1667.0	1536.2	19.4	1731.2	19.5	195.0	1634.5	1539.2	1730.2	191.0
SW4	2210.6	2207.0	2185.4	18.2	2235.8	16.7	50.4	2210.7	2184.8	2236.5	51.7
T1	10782.7	10840.0	10415.0	197.9	11150.4	195.8	735.3	10786.1	10420.0	11157.1	737.1
T2	11974.8	11790.0	11582.0	264.6	12367.5	289.0	785.5	11956.7	11559.1	12327.9	768.8

SGLI-N-TD-14119_0930_SGLI SWI 総合波長特性[第4版].xlsx
SGLI-N-TD-14238_0909_SGLI TIR 総合波長特性[第2版].xlsx

Black Body

- Black body is used for thermal channels calibration on-orbit with cold space response.
- The sensor background signal is canceled in two points calibration techniques. The emissivity of black body is better than 98%.



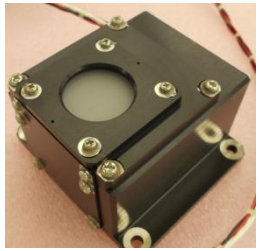
2 points calibration for TIR and SWI

LED-Halogen light assembly

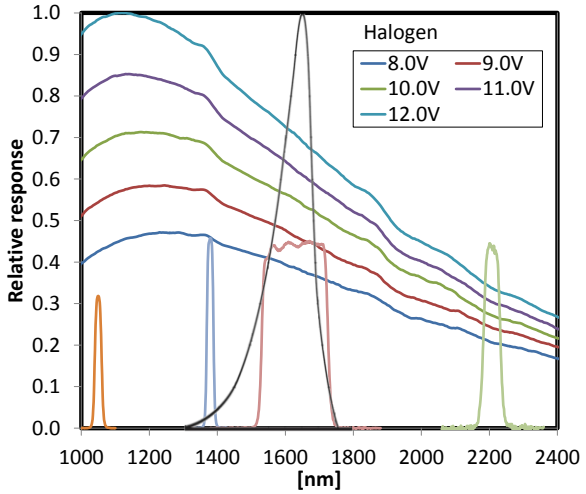
- LED-Halogen light assembly is used to monitor the sensor output between pre-flight calibration and on-orbit.
- Relative spectral shape is only checked with halogen lamp output. The absolute response comparison is by 1.6micron LED output in SW3 channel.
- SWI calibration activity is planned for every 8 days on orbit. Calibration maneuver such as lunar calibration and solar beta angle dependency check is also planned on orbit for the reliable calibration.

SWI LED assembly

SWI LED PD assembly

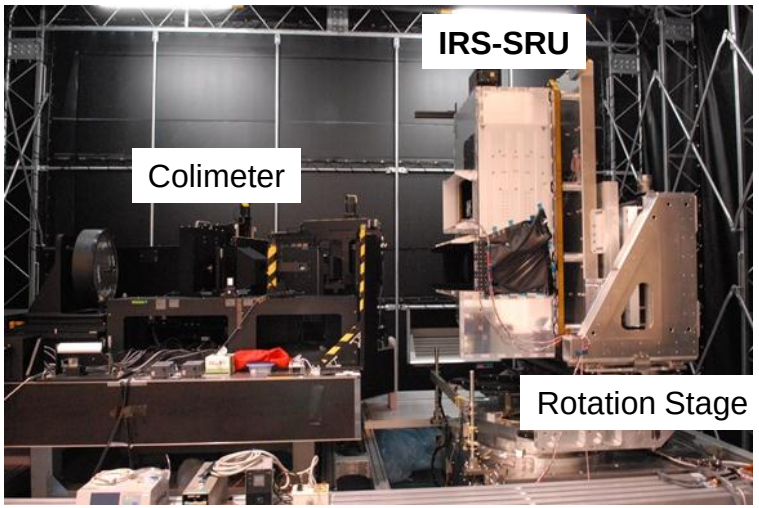


SWI Halogen assembly



IRS integration and tests

- IRS flight model sensor integration activity is ongoing.
- All components and panels are thermally baked before integration under thermal vacuum conditions to prevent outgas effects to IRS optical system.
- Optical bench with key optical components is located in the middle of SRU baseplate.
- Integration activity is planned in 2014 autumn period, and Preflight Test (PFT) including optical performance check starts at the end of 2014.



Summary

- ✓ SGLI flight model manufacturing is ongoing.
- ✓ Key IRS flight component test results are presented.
- ✓ Sensor integration & test will be started within this year.
- ✓ Target launch of GCOM-C is JFY2016.