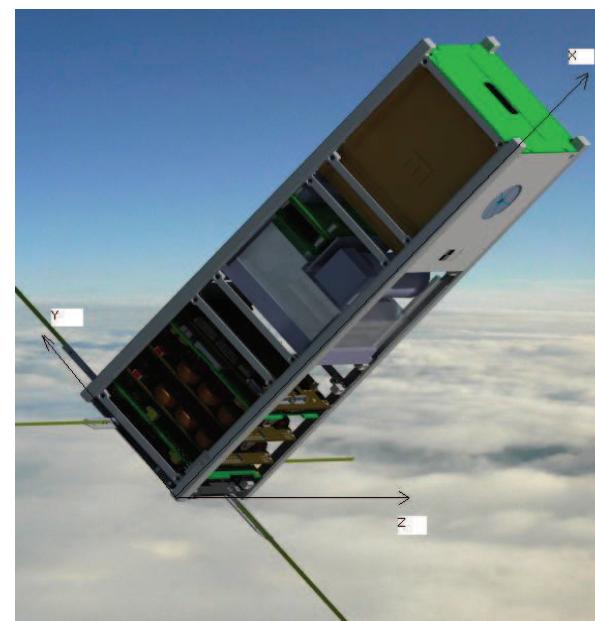
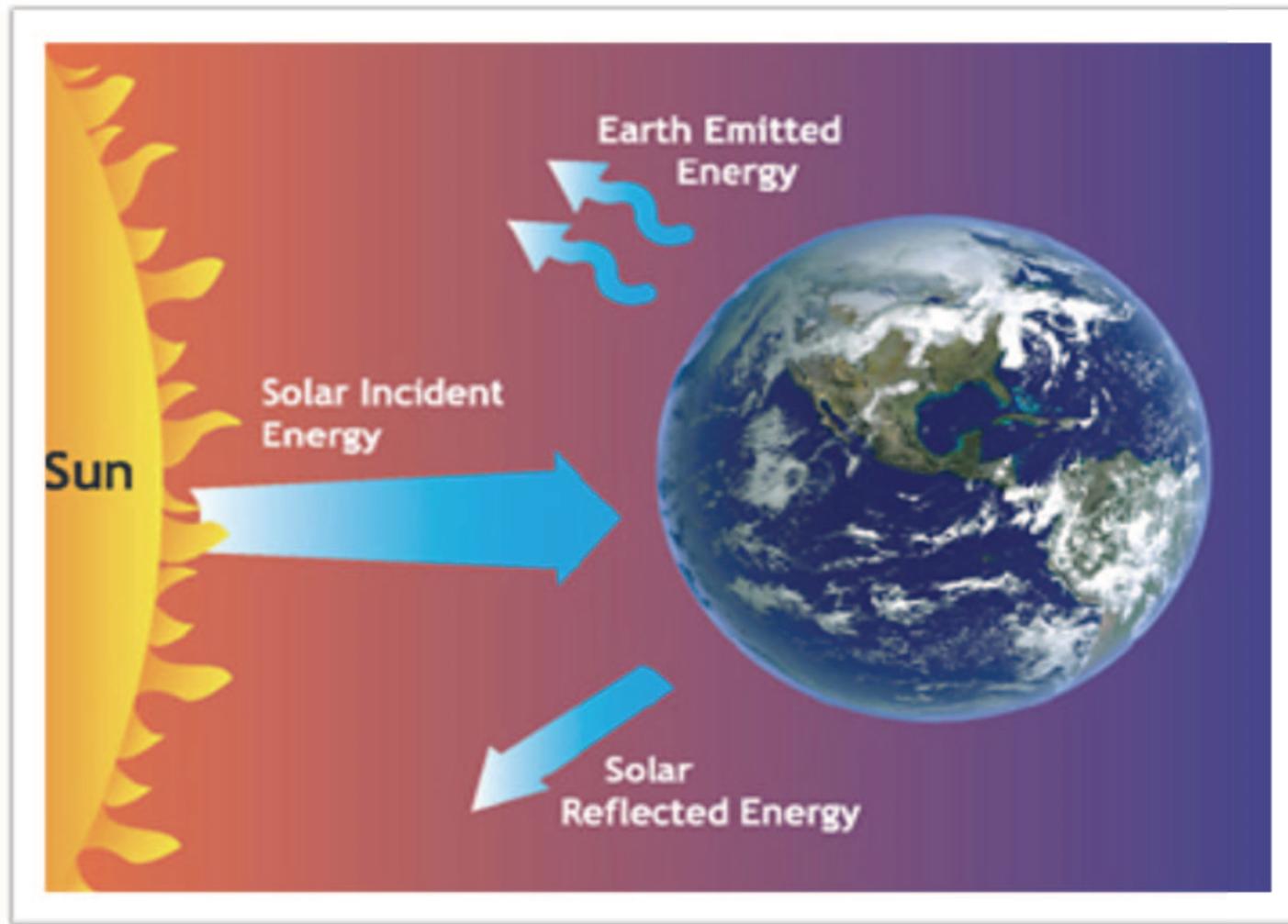


The RMIB space odyssey: new frontiers

S. Dewitte



EARTH RADIATION BUDGET



Measurement of Total Solar Irradiance from Space



RMIB TSI SPACE RECORD

PAST IN SPACE:

1983 SPACELAB 1 NASA ESA
1992 ATLAS-I NASA STS-45
1992 EURECA ESA STS-46: returned to ground
1993 ATLAS-II NASA STS-56
1994 ATLAS-III NASA STS-66
1997 HITCHHIKER NASA STS-85
1998 HITCHHIKER NASA STS-95
2003 FREESTAR NASA STS-107

NOW IN SPACE:

SOHO/VIRGO/DIARAD	ESA	December 1995	> ongoing (> 19 y)
ISS/SOVIM/DIARAD	ESA	February 2008	> 1 year
PICARD/SOVAP	CNES	June 2010	> terminated

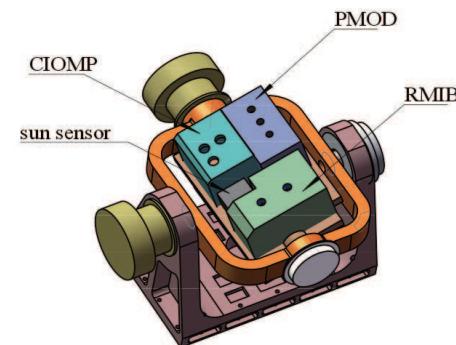
PLANNED:

FY3E/JOIM/DIARAD CMA 2018

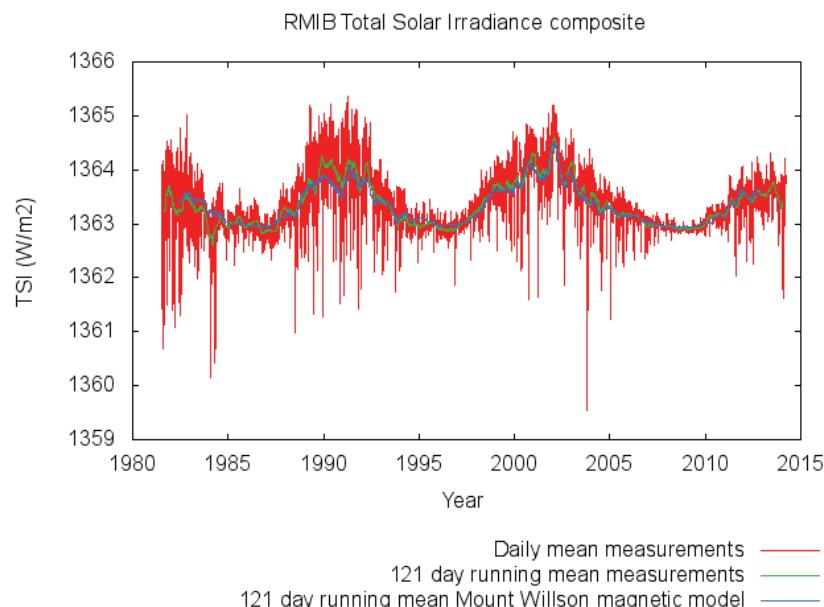
DIARAD/JOIM/FY3E

Flight opportunity

- ☒ FY3: Chinese operational meteorological polar satellites, comparable to Eumetsat EPS in Europe
- ☒ FY3E: 6-18 orbit: ideal for solar observation (similar to Picard orbit)
- ☒ Design lifetime: 8 years
- ☒ Support from CMA (China), comparable to Eumetsat in Europe, for flying DIARAD instrument



MAIN OBJECTIVE: ensuring continuity of monitoring of Total Solar Irradiance variability

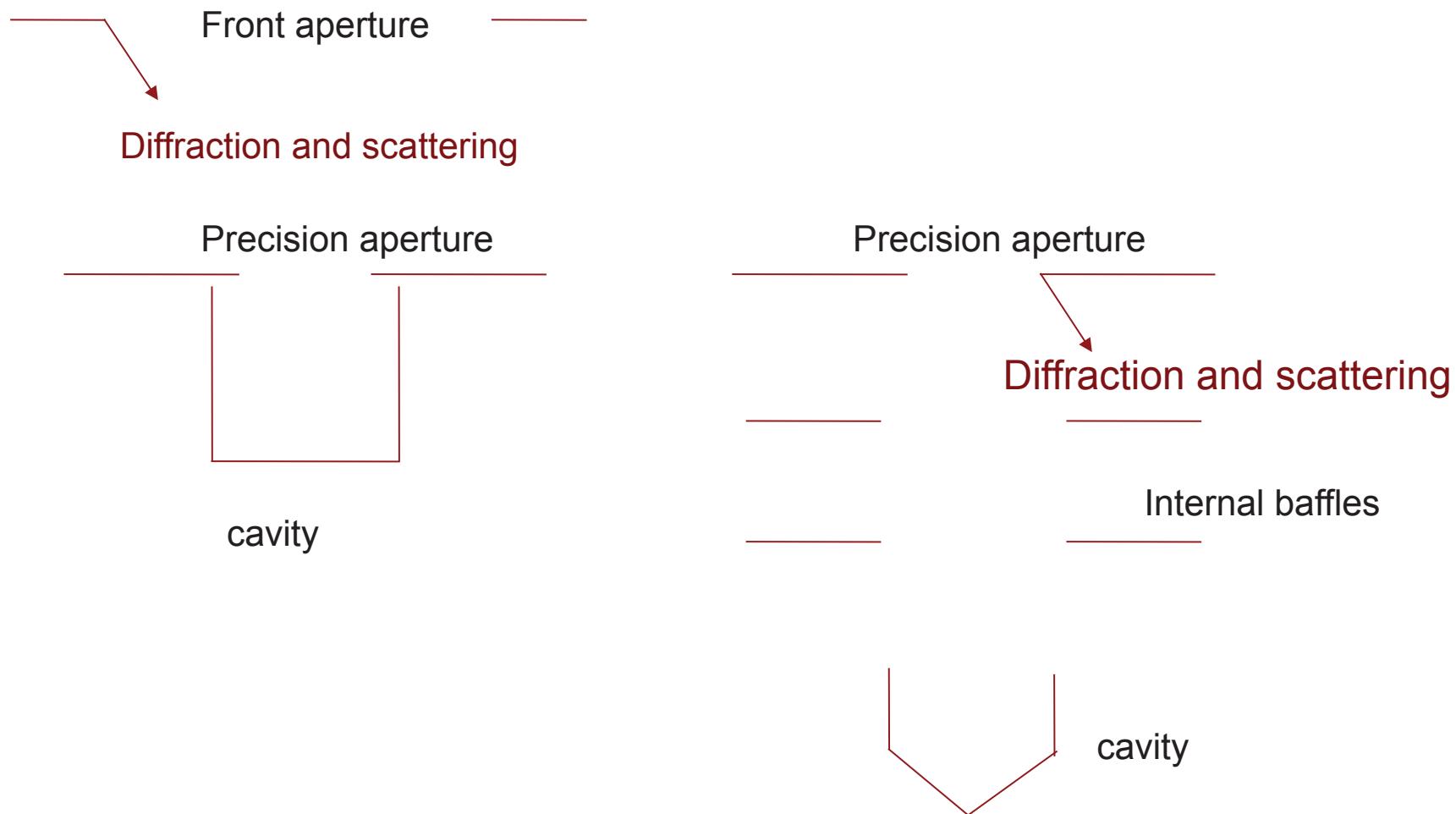


- Successor of DIARAD/VIRGO on SOHO; developed in collaboration with Verhaert - measuring for record time since 1996.
- RMIB TSI composite used in near real-time by NASA Ceres

SECOND OBJECTIVE: solve problem of absolute value of Solar Constant

- Old consensus value: 1365 W/m^2
- New TIM/SORCE value: 1361 W/m^2
- Revised RMIB value: 1363 W/m^2
- Link to **geometry** demonstrated in laboratory comparison @ LASP in 2013
 - > interesting to demonstrate this in flight

DIARAD & TIM type geometry

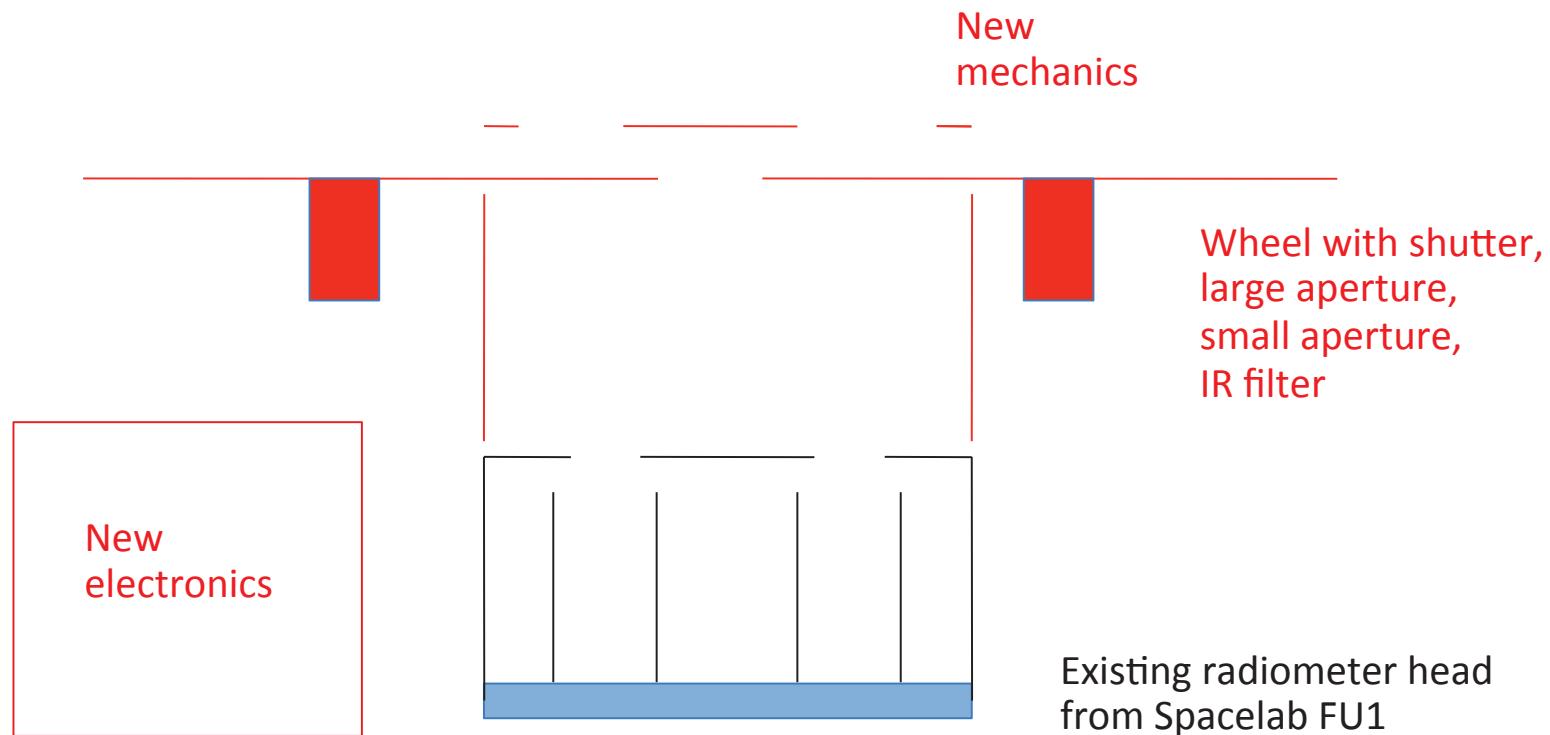


THIRD OBJECTIVE: solve problem of absolute level solar IR spectrum

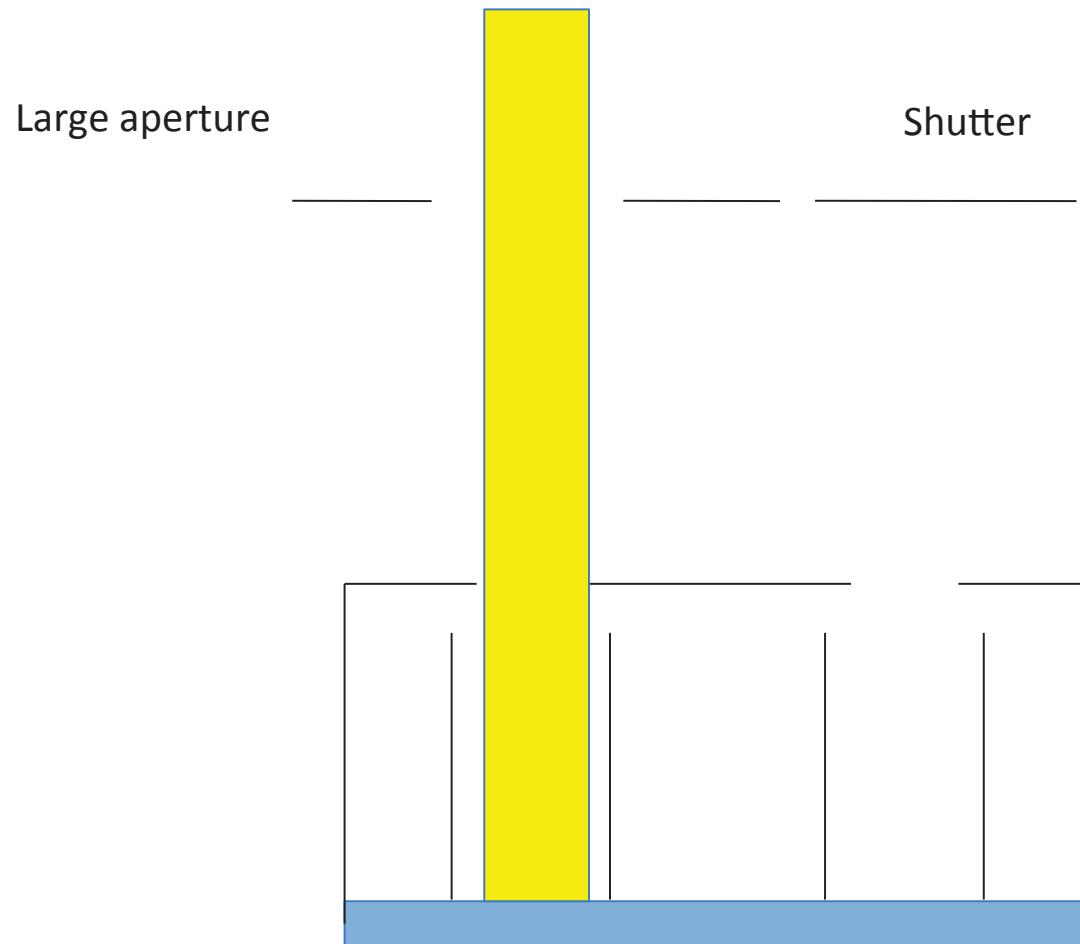
- Use cavity radiometer as absolute detector
- Make measurements with broadband IR filter in front of cavity
- Requires on-ground characterisation of IR filter spectral transmission

Principal design instrument

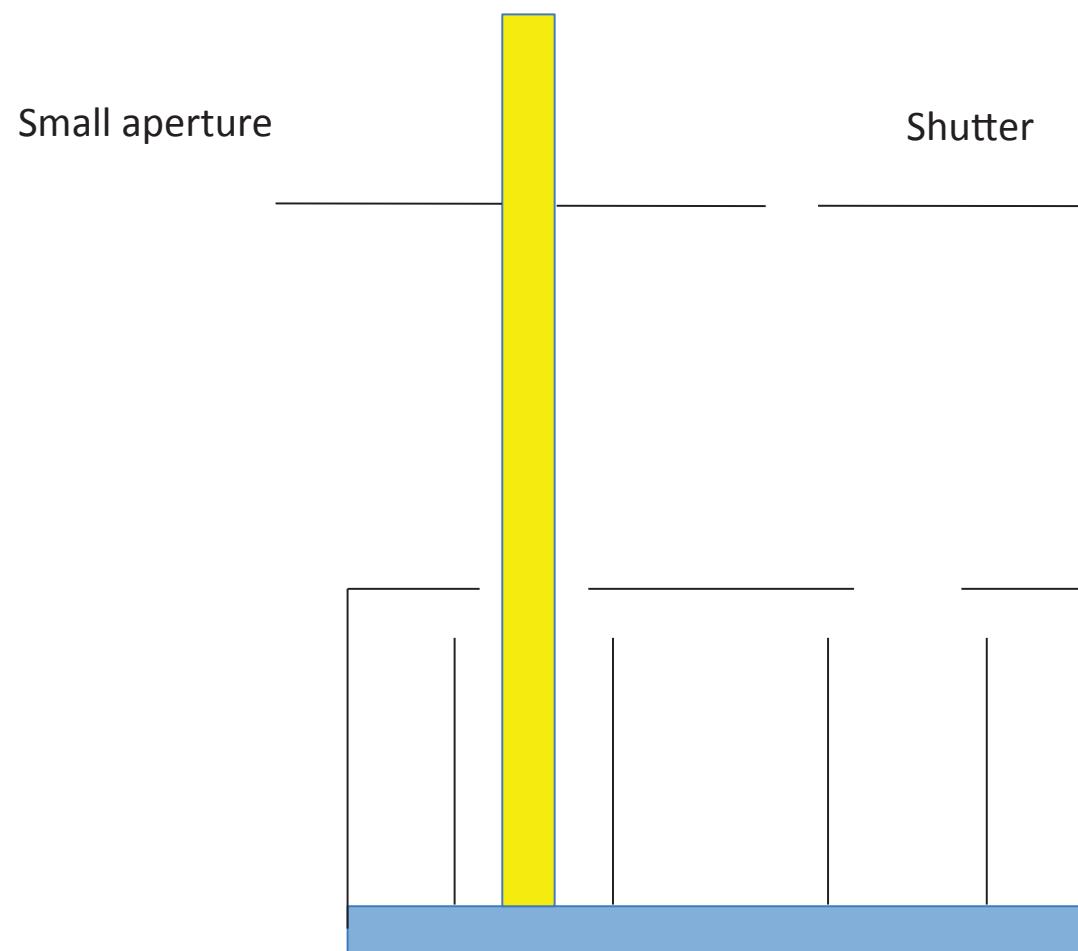
Red: to be developed



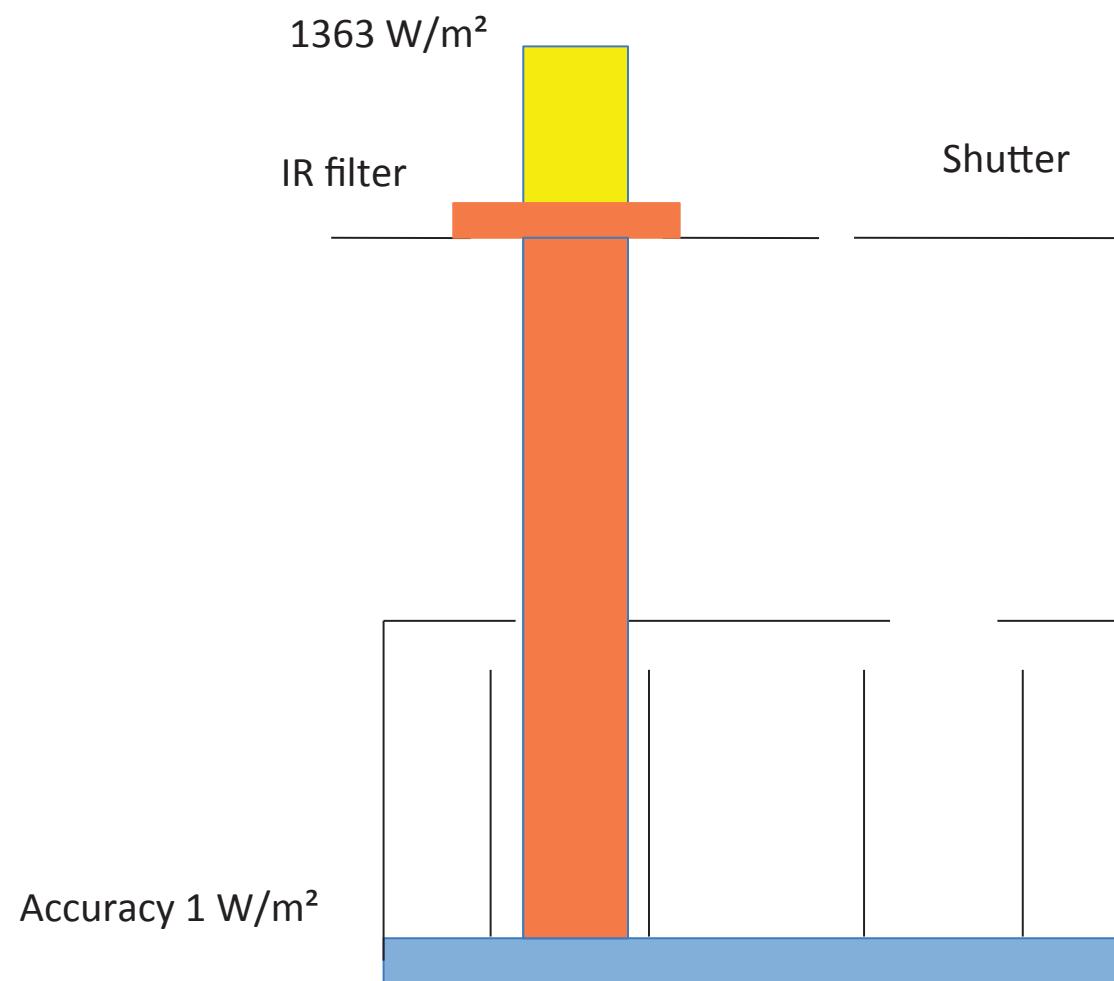
Classical geometry TSI mode



TIM geometry TSI mode

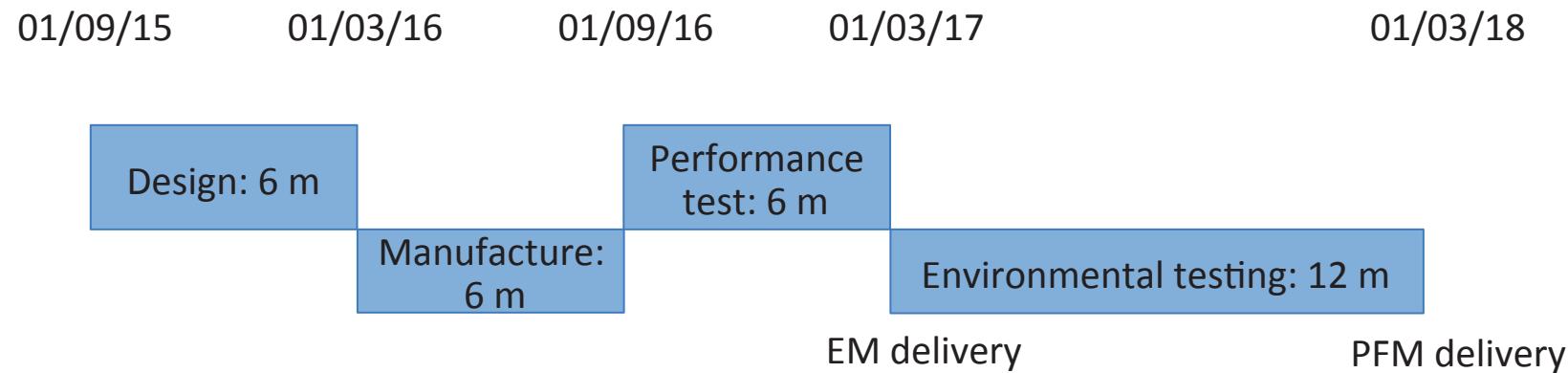


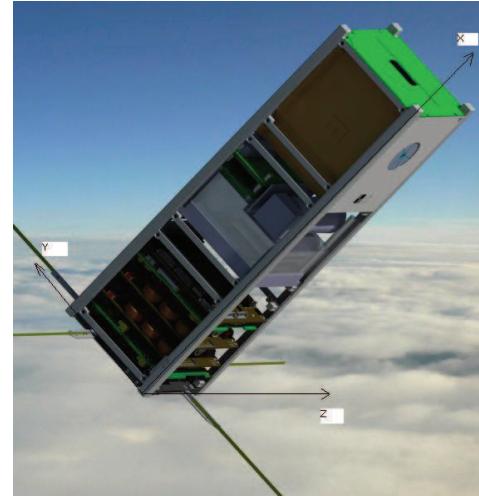
IR Solar Irradiance mode



Schedule

- Flight model delivery: 2018
- Engineering model for interface tests: 2017



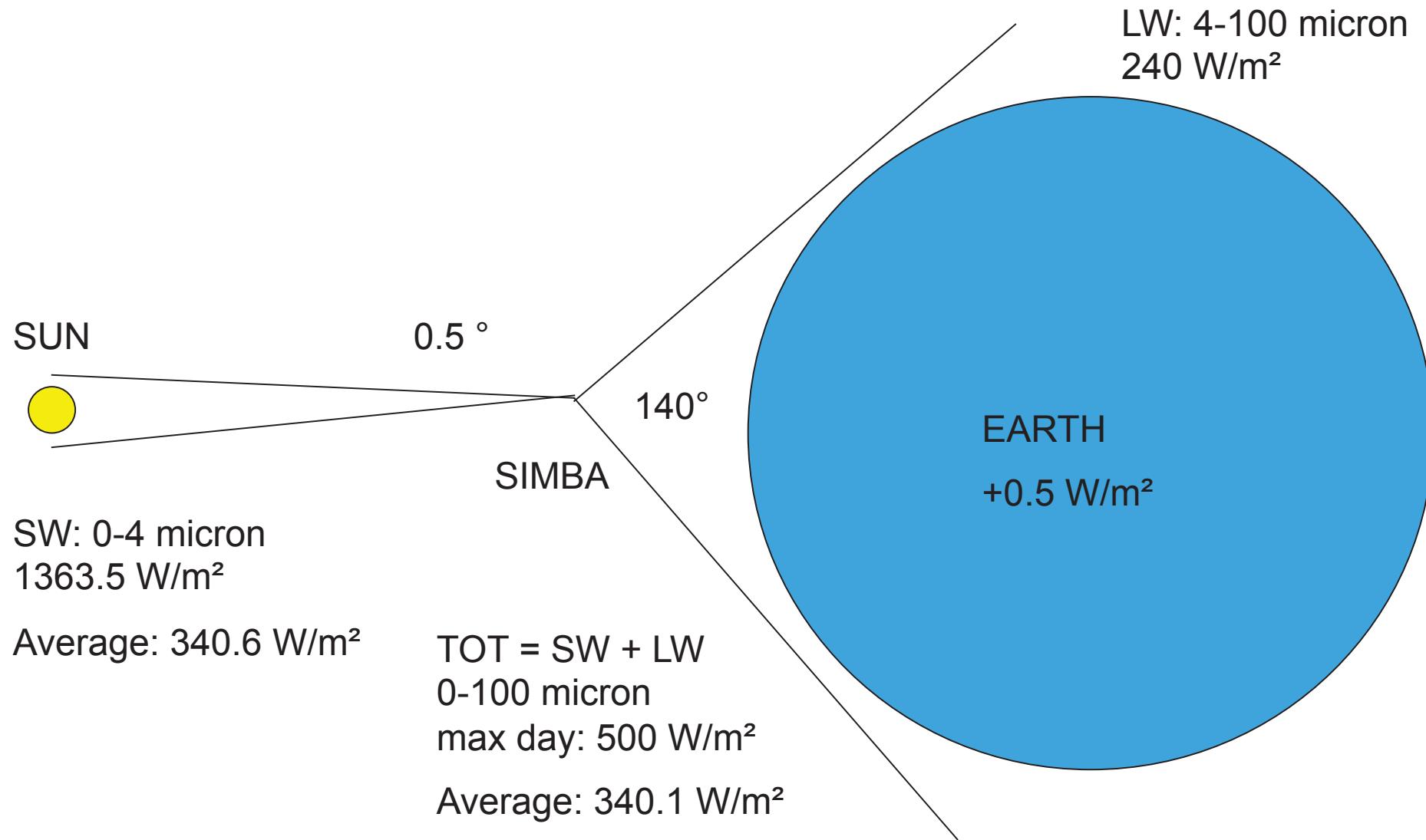


SIMBA: the Sun-earth IMBALance radiometer

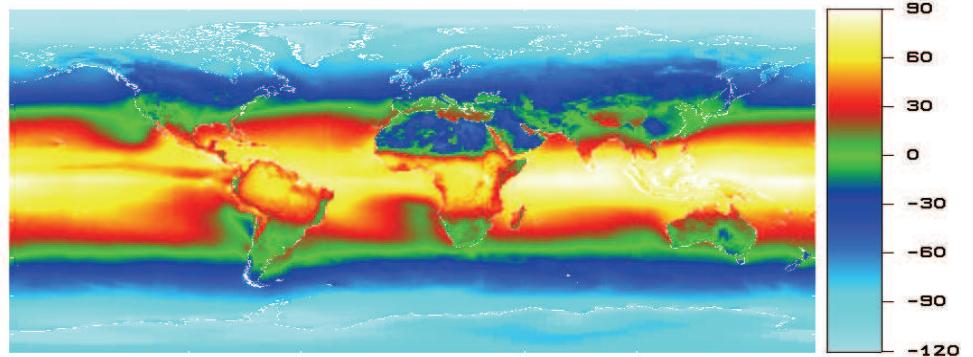
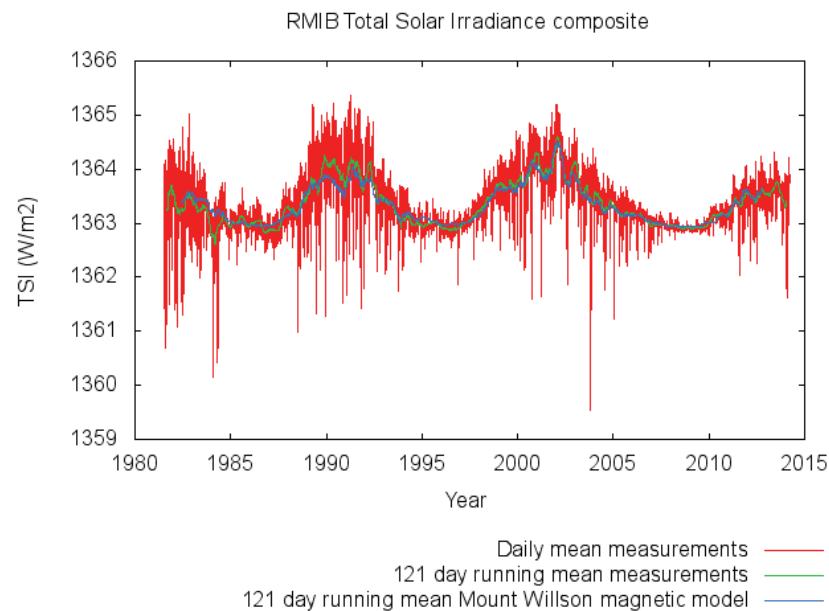
PI: Dr.ir. Steven Dewitte – RMIB

Partners: RMIB, KUL, ISIS, U Stellenbosch,
Latmos, VUB, ROB, VKI, Belspo, ESA

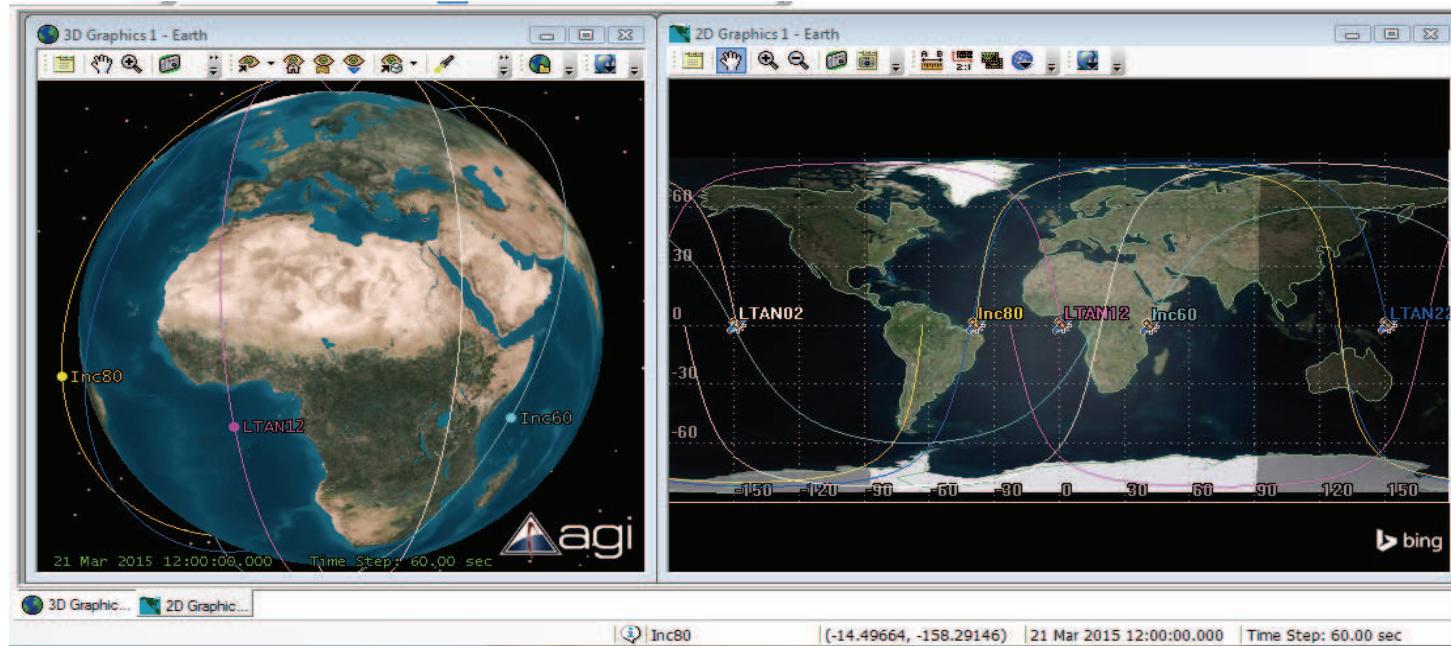
Sun – Earth measurement



Incoming solar / Net earth radiation

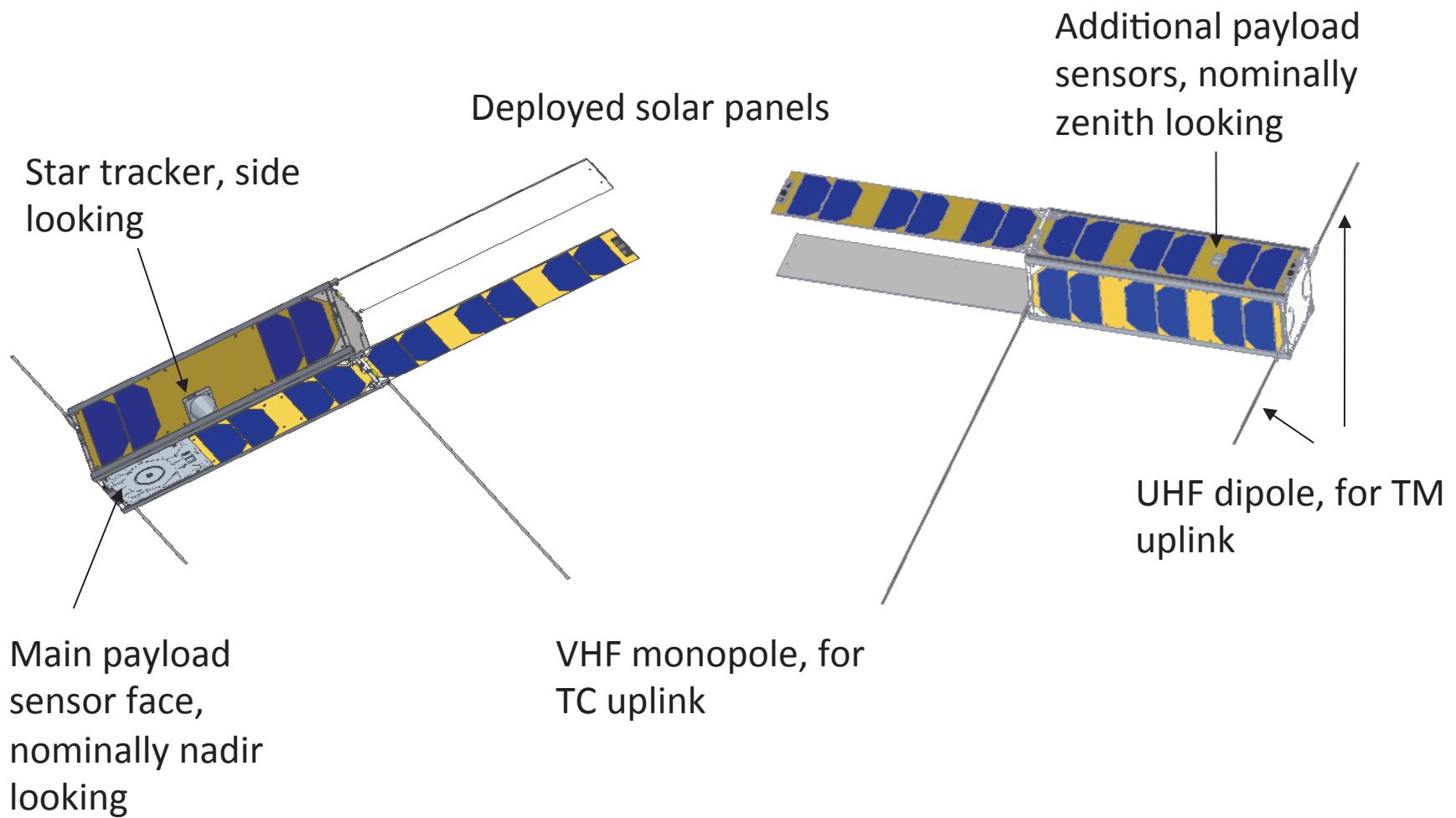


Low Earth Novel Advanced Radiation Diurnal Observation (LEONARDO concept)



Long term goal:
constellation of Simba-like satellites for
measuring the diurnal cycle of the earth
leaving radiation.

Latest Simba satellite design



Payload / Pointing

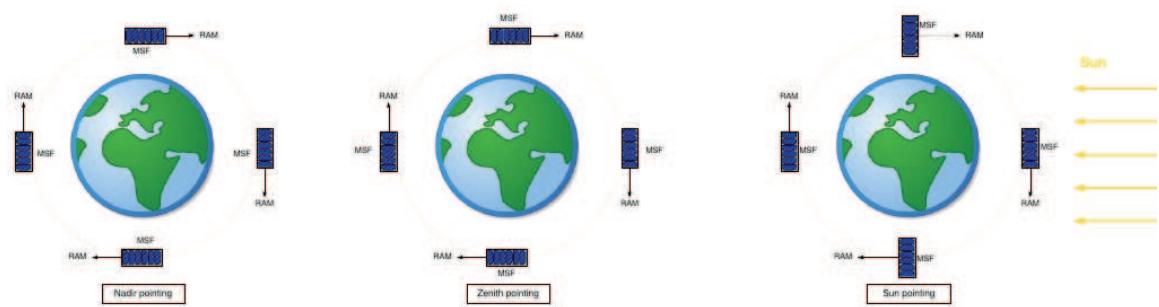
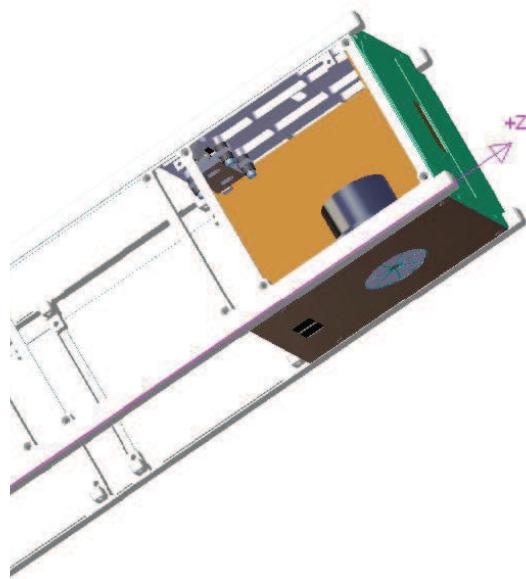
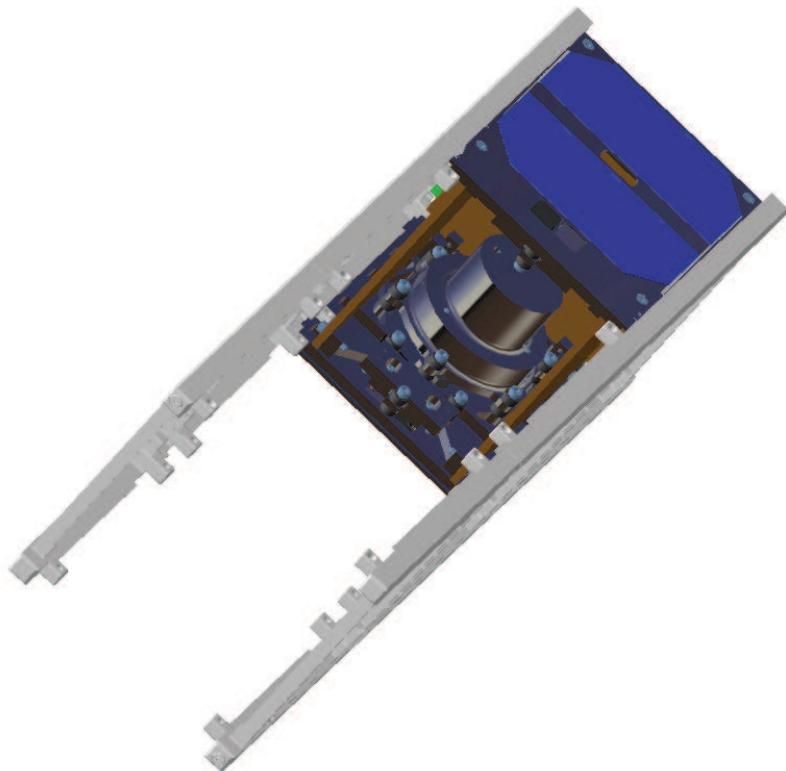


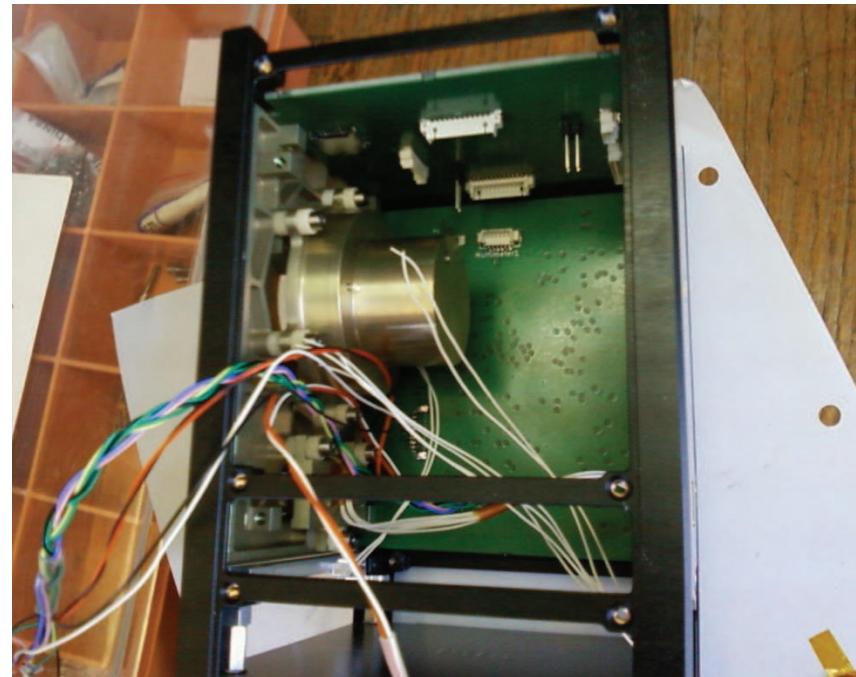
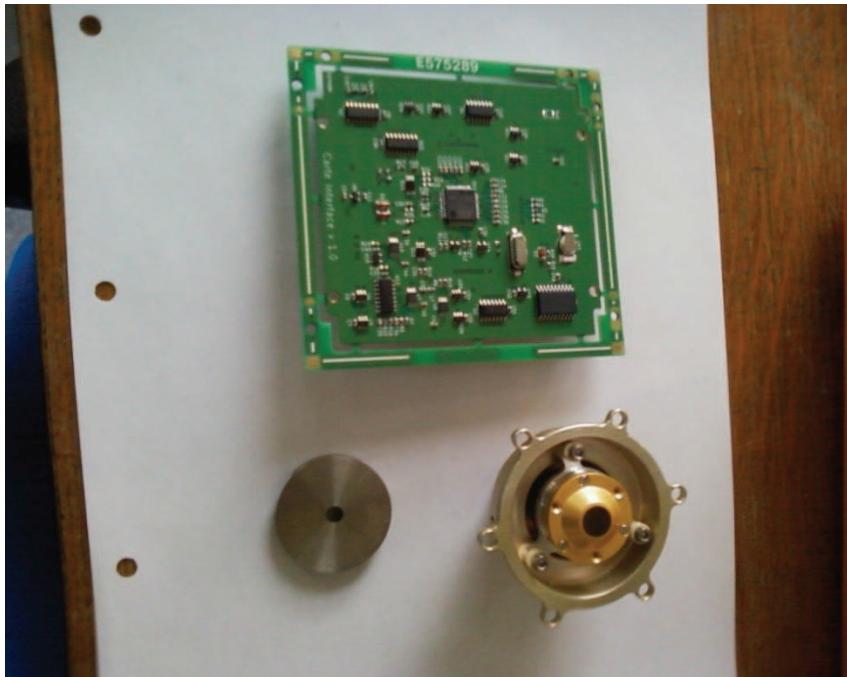
Figure 2-2: SIMBA pointing modes

Payload unit



- Responsability: RMIB
- Nadir Cavity Radiometer
- Nadir and zenith black and white Flat Spectral Sensors
- Heritage from 30 y TSI measurements and 10 y ERB measurements

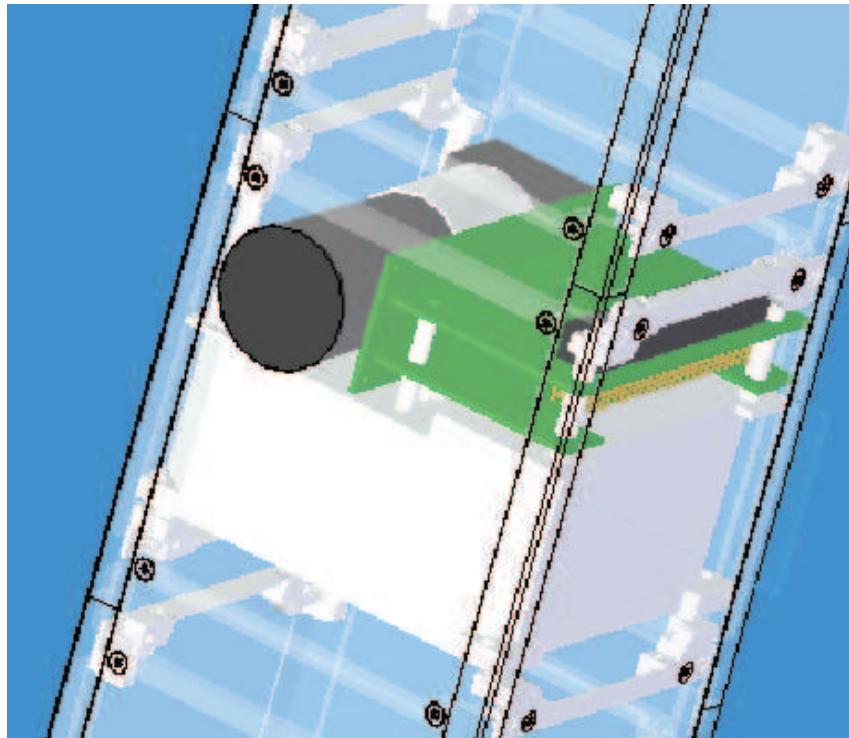
Payload flight representative model



ADCS options

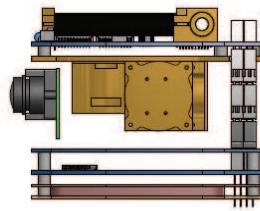
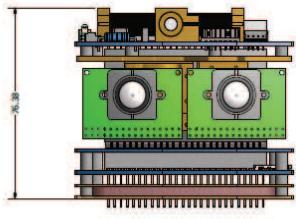
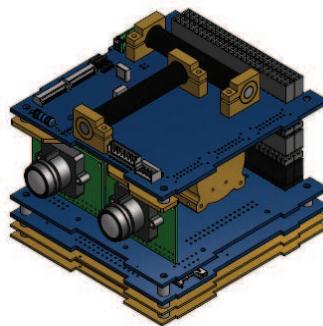
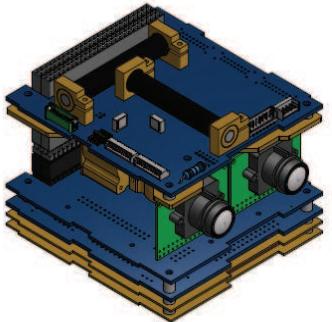
- Option 1: Katholieke Universiteit Leuven (KUL)
 - New Belgian development
 - Uses star tracker as main attitude sensor
- Option 2: University Stellenbosch
- Flight proven
- Uses CMOS Earth and Sun Cameras as main attitude sensors

ADCS unit: Option 1



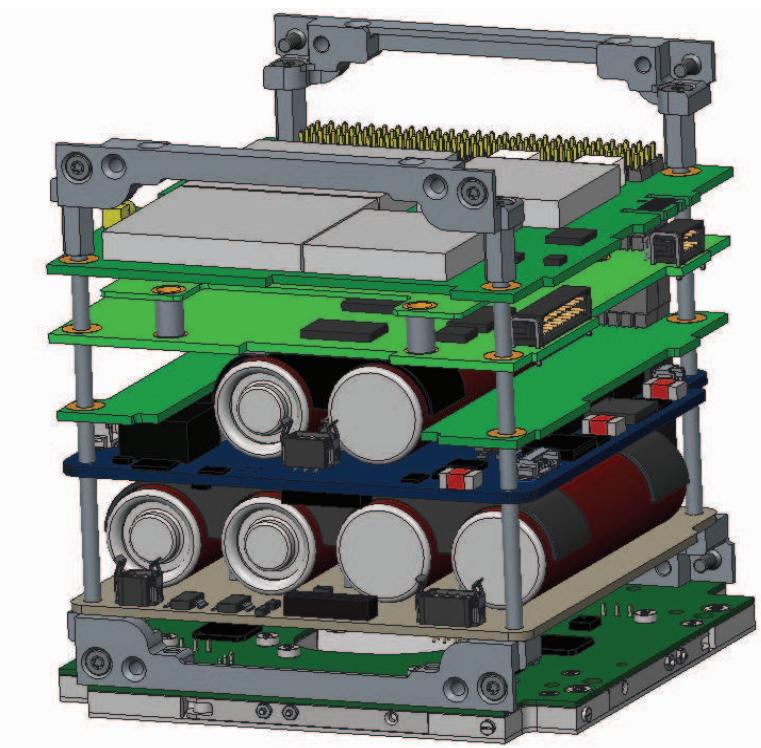
- Responsability: KUL
- Actuators: 3 reaction wheels + MTQs
- Main sensor: star tracker
- Auxiliary sensors: fotodiodes, magnetometer
- New development

ADCS unit: Option 2



- Responsibility:
University of Stellenbosch
- Actuators: 3 reaction wheels
and MTQs
- Main sensors: Earth and Sun
CMOS camera
- Auxiliary sensors: fotodiodes,
magnetometer
- Flight heritage from QB50 ADCS
on 2 QB50 precursor satellites
since 2013 & from DeOrbitSail,
launched 10/7/2015

System unit



- Responsibility: ISIS
- OBC
- Battery + EPS
- UHF/VHF communication
- Flight heritage from Triton-1 & 2 QB50 precursor satellites

Project schedule/planning

- Initial system studies performed by RMIB.
- Project passed ESA PDR in October 2014.
- System design by ISIS.
- ESA CDR foreseen February 2016, goals:
 - Payload + ADCS ready for integration
 - Decision on ADCS
 - Freeze satellite design + start building satellite

CONCLUSIONS

- ★ Simba is an innovative concept for measuring the incoming solar and outgoing earth radiation with a **single instrument**
- ★ Simba-1 is an In Orbit Demonstration 3U cubesat with target launch in April 2018.
- ★ Our LT goal is to have a **Simba constellation** measuring the earth radiation imbalance.