SAFARI Technical Overview

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and
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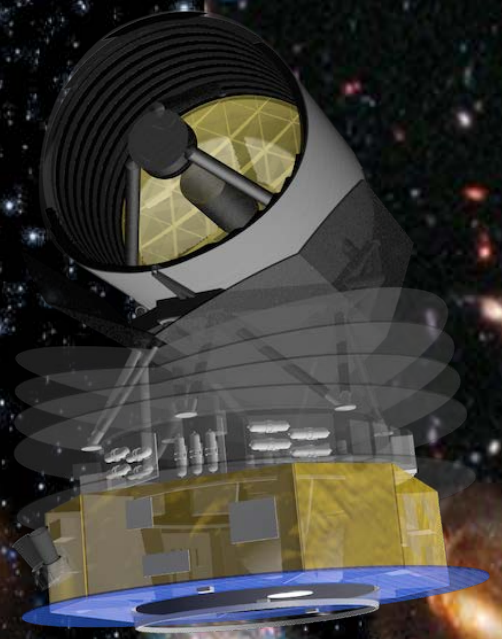
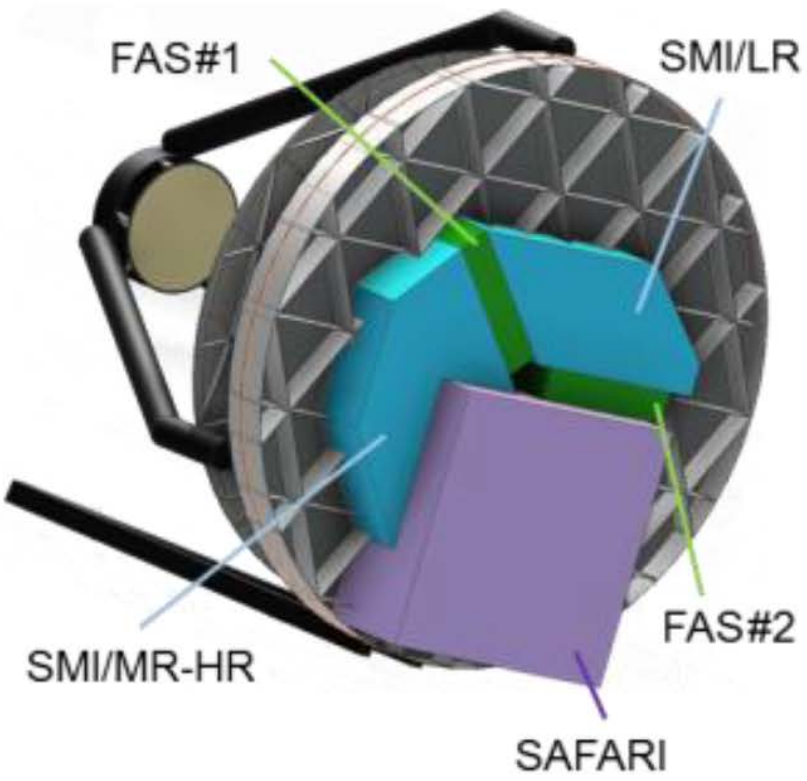
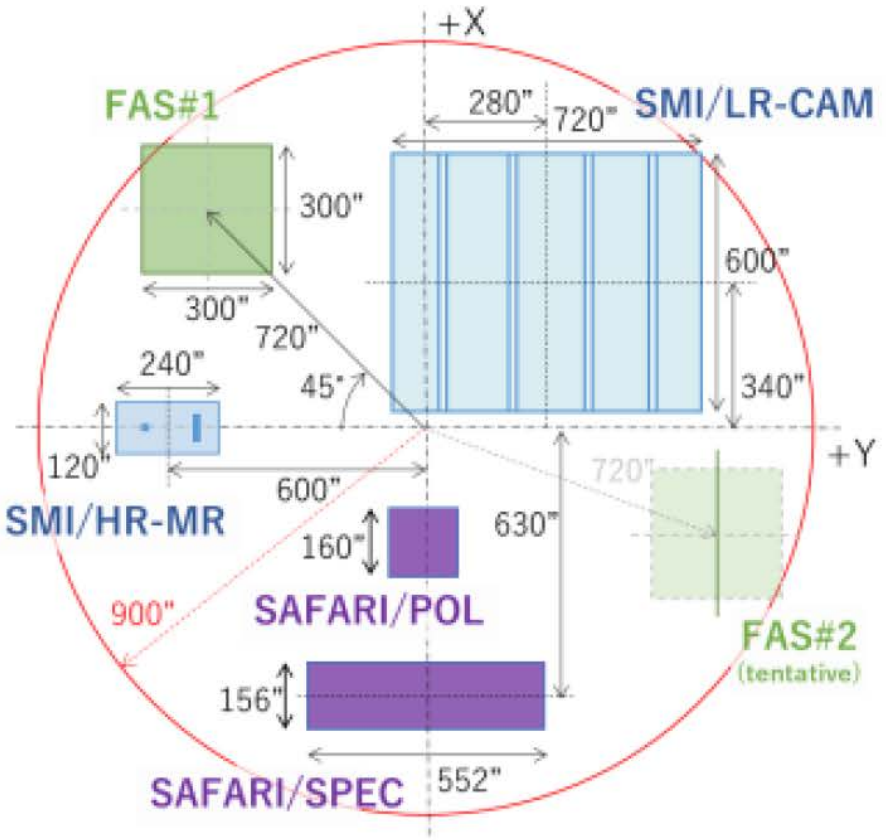


UK SPICA Meeting
RAS London 14 Dec. 2016

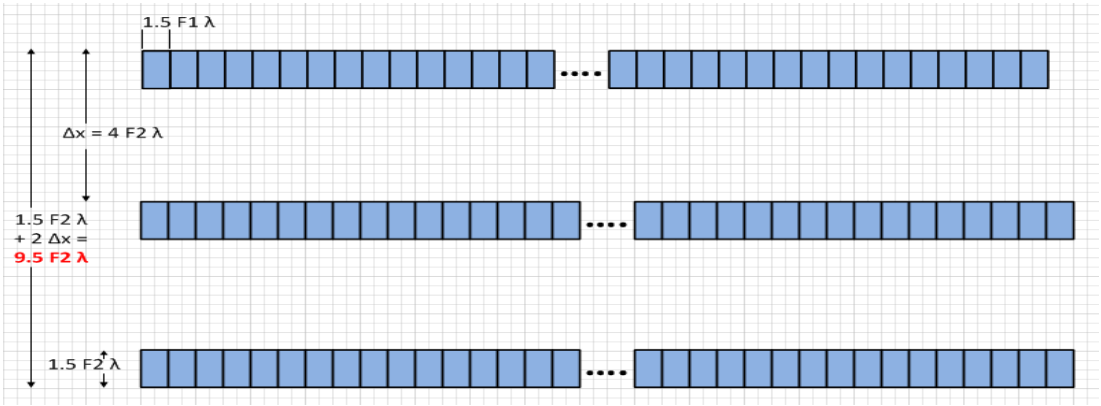
SPICA Focal Plane Layout

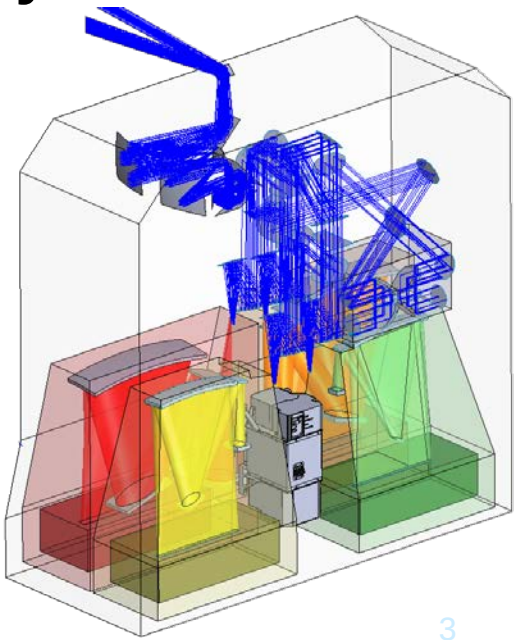




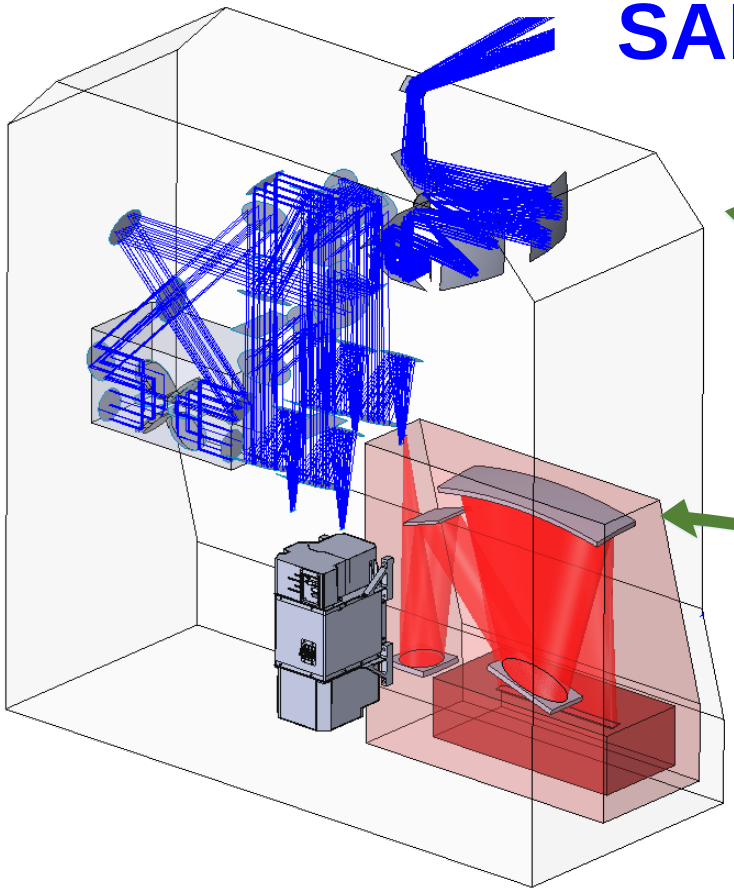
SAFARI Spectrometer

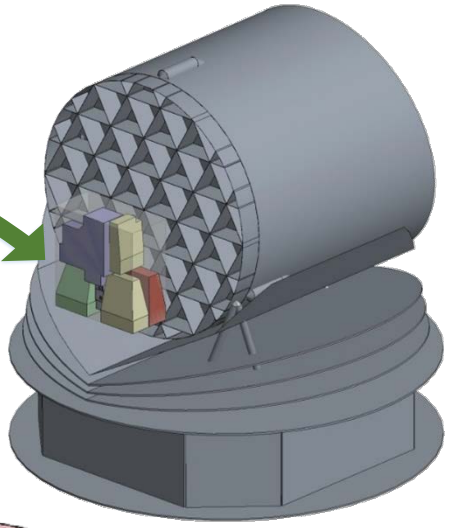
- High sensitivity grating spectrometer
- Basic *R* ~ 300 mode → 1hr; 5σ 5 - 7×10^{-20} W m^{-2}
  - Improves with better TES performance
- Martin-Puplett Interferometer for high-res mode
- 4 bands with instantaneous coverage: 35 - 230 μm
  - 34 – 56; 54 – 89; 87 – 143; 140 – 230 mm
- Limited imaging capability: 3 pixels on-sky

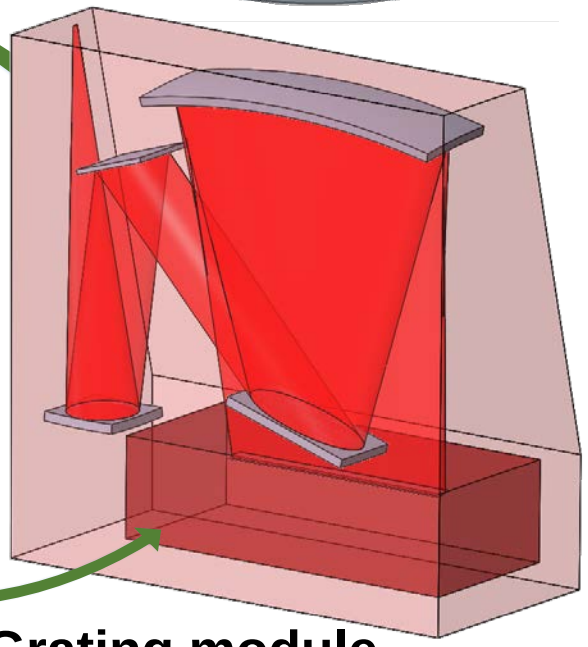


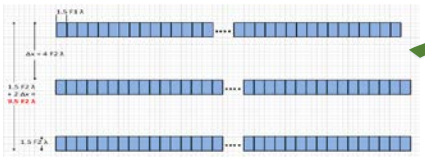


SAFARI Spectrometer

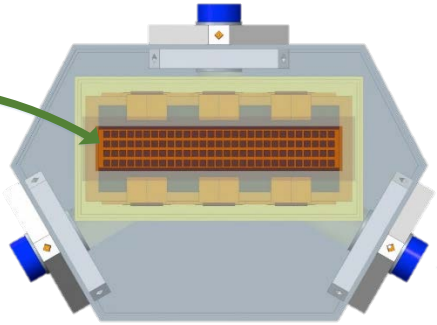








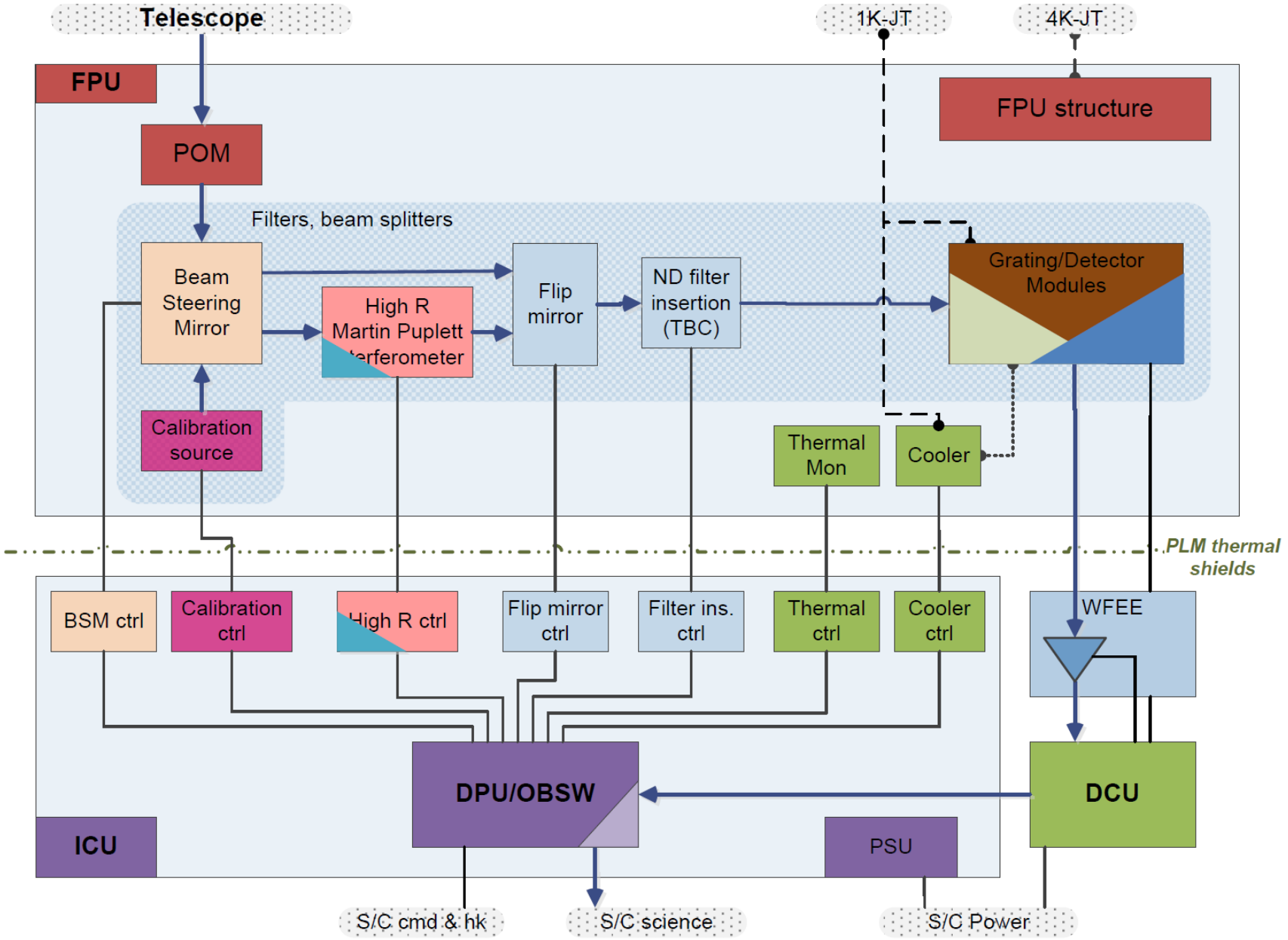
Detector arrays



Detector assembly

Grating module

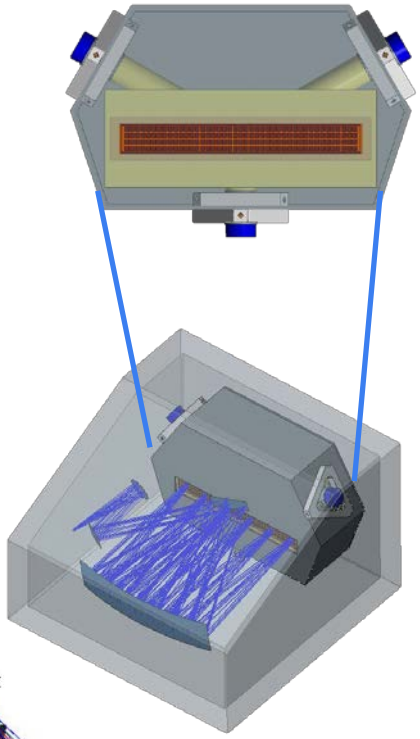
SAFARI Spectrometer Block Diagram

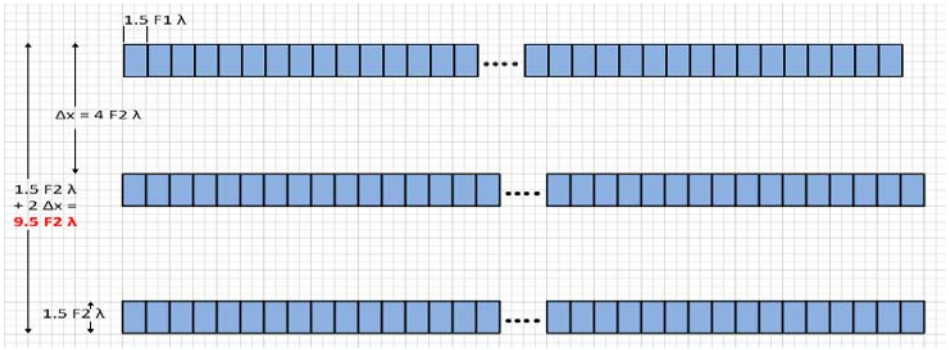


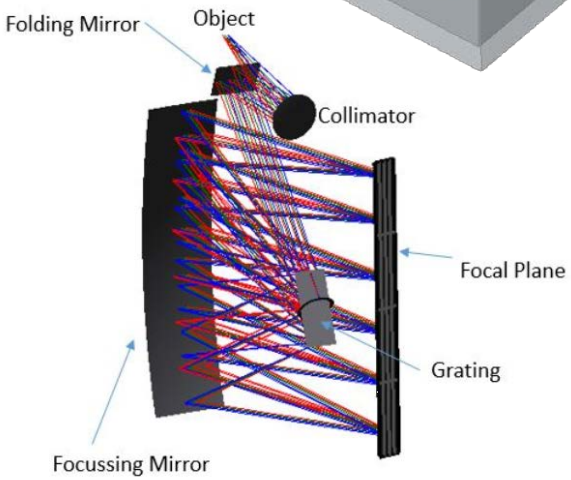
Detectors-Grating Modules

- **Linear TES arrays with FDM readout**
  - **1.5 Fλ separation in spectral direction**
  - **Three on-sky pixels**

- **Integrated FPA/Grating unit**
  - **Grating optics at 1.7 K**
  - **Shielding integrated in structure**
    - **Builds on SAFARI/FTS development**
  - **Detector modules suspended inside at 50mk**





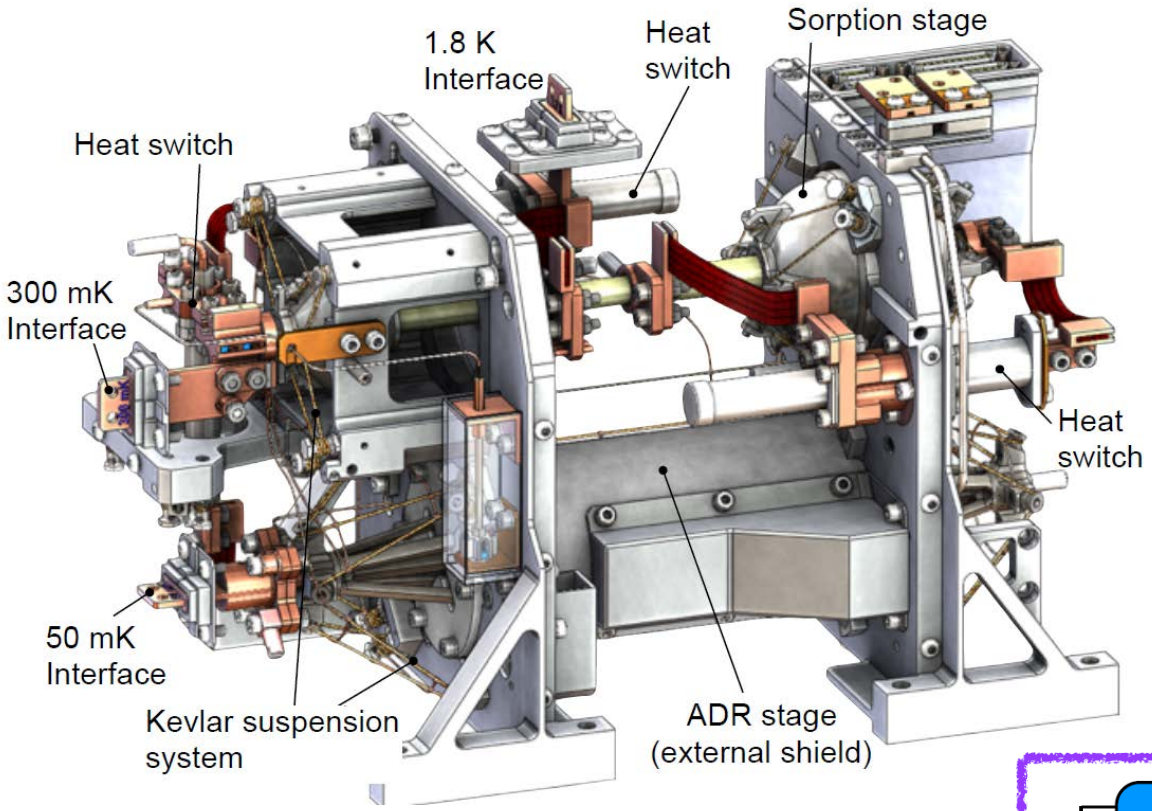


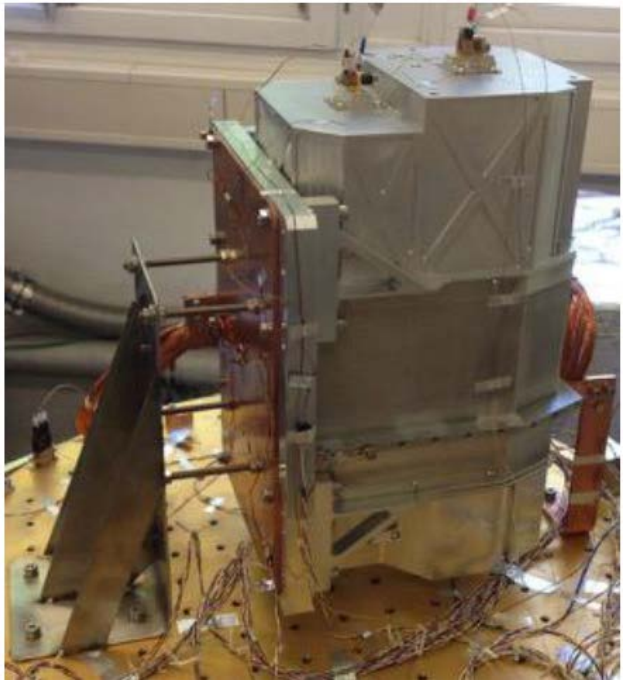
SAFARI Spectrometer Bands and Sensitivities

	SW	MW	LW	VLW
Band center / μm	45	72	115	185
Wavelength range / μm	34-56	54-89	87-143	140-230
Band center beam FWHM	4.5”	7.2”	12”	19”
Number of pixels	3x294	3x294	3x294	3x294
Point source spectroscopy (5σ-1hr)				
SAFARI/LR - low resolution R~300				
Limiting flux / $x10^{-20}$ Wm^{-2}	7.2	6.6	6.6	8.2
Limiting flux density / mJy	0.31	0.45	0.72	1.44
SAFARI/HR - high resolution R~1500-11000				
Limiting flux / $x10^{-20}$ Wm^{-2}	13	13	13	15
Limiting flux density / mJy	18	17	17	19
Mapping spectroscopy (5σ-1hr)				
SAFARI/LR - low resolution R~300				
Limiting flux / $x10^{-20}$ Wm^{-2}	84	49	30	23
Limiting flux density / mJy	3.6	3.3	3.3	4.1
SAFARI/HR - high resolution R~1500-11000				
Limiting flux / $x10^{-20}$ Wm^{-2}	189	113	73	51
Limiting flux density / mJy	253	151	97	67
Photometric mapping (5σ-1hr)				
Limiting flux density / μJy	209	192	194	239
Confusion limit / μJy (5σ)	15	200	2000	10000

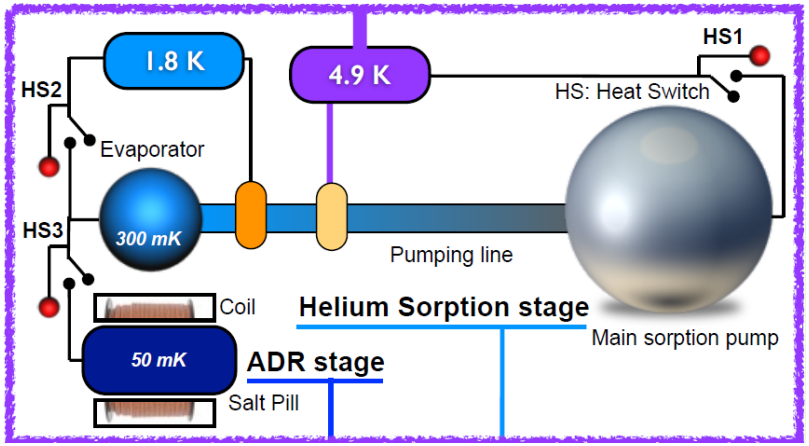
Envisaged saturation limits for SW, MW and LW bands: ~30, 50, 90 Jy

50-mK Cooler



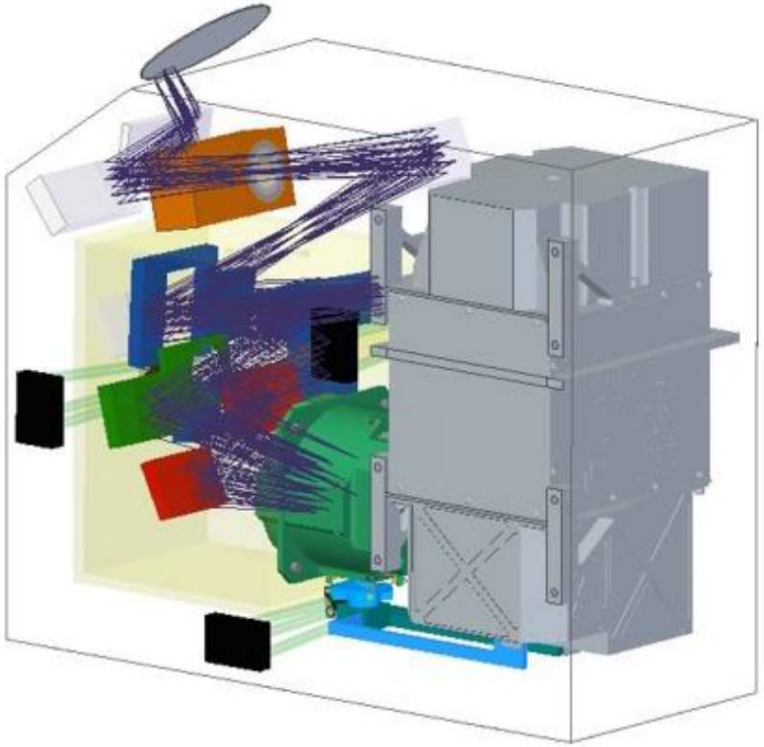


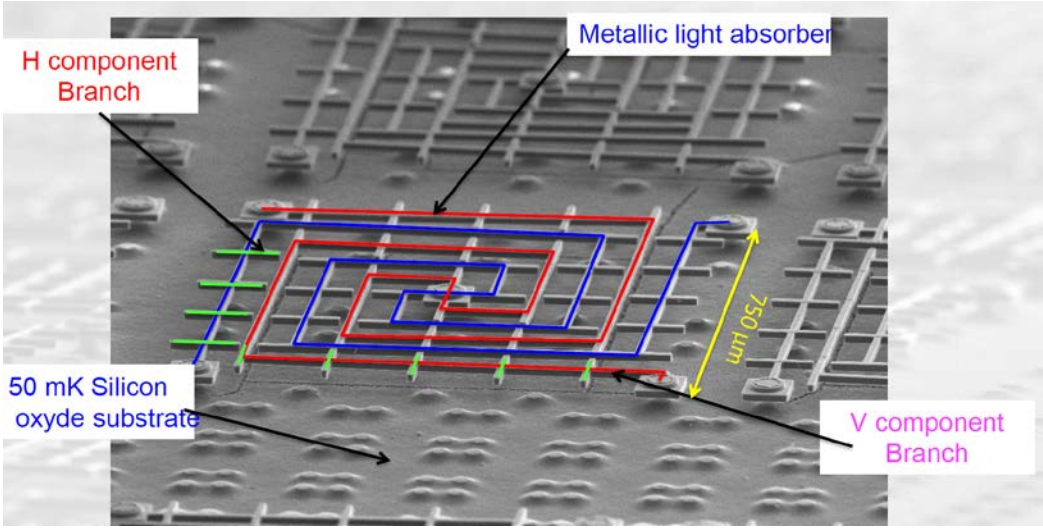
Cooler autonomy	38.5 h
Full cycle duration	48 h
Duty cycle	80 %



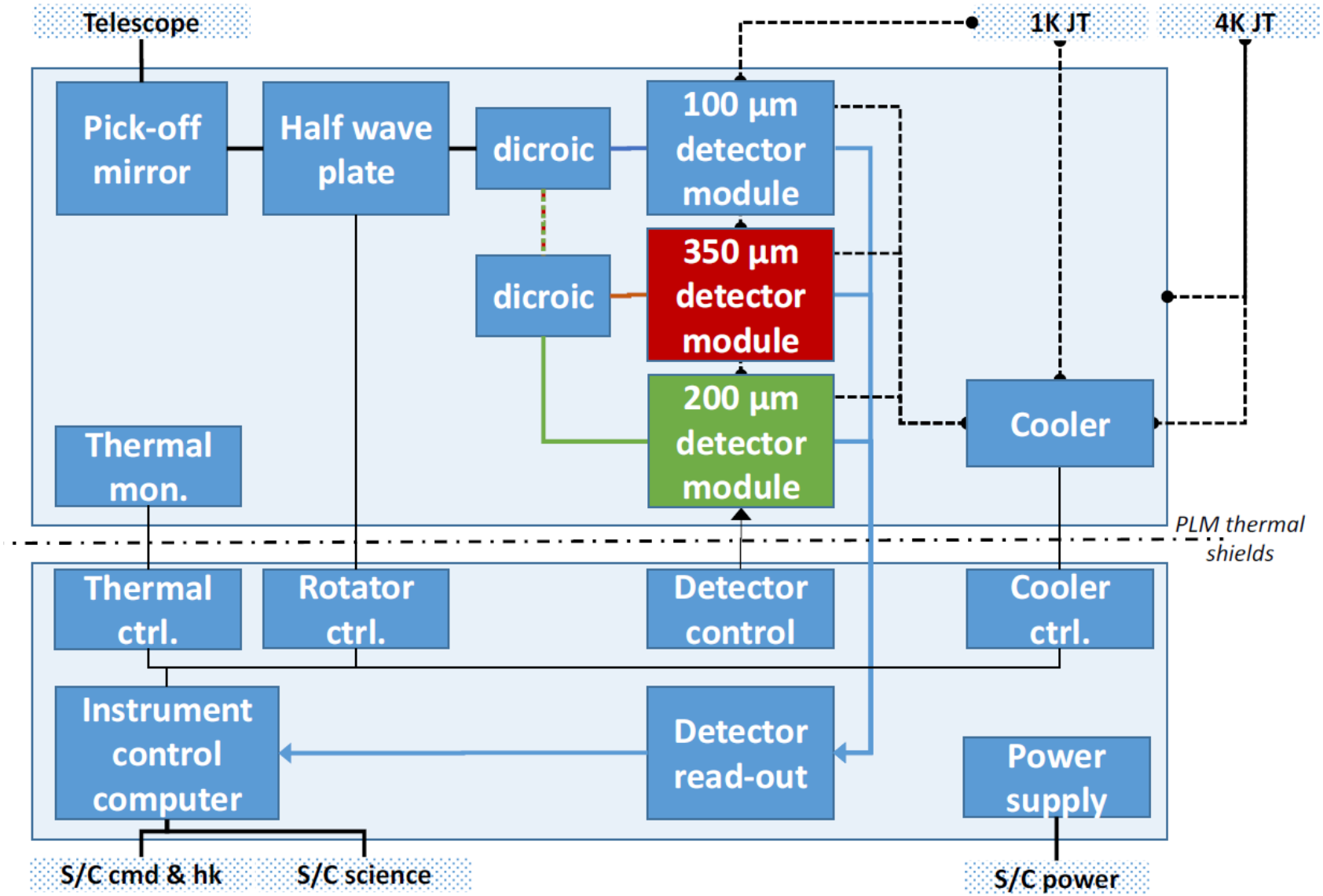
SAFARI-Pol

- **Imager/polarimeter**
- **Polarisation sensitive bolometers**
  - **3 bands: 110, 220, 350 μm**
- **Bolometers/readout similar *Herschel* PACS**





SAFARI-Pol Block Diagram



SAFARI-Pol Specifications and Observing Modes

	100 µm	200 µm	350 µm
Band	75–125 µm	150–250 µm	280–420 µm
Array size	32x32 x2 pol	16x16 x2 pol	8x8 x2 pol
Pixel size	5” x 5”	10” x 10”	20” x 20”
Band centre FWHM	9”	18”	32”
Point source sensitivity (1h-5σ-FoV)			
Unpolarised / µJy	21	42	85
Polarised stokes Q, U / µJy	30	60	120
Point source sensitivity (10h, 5σ, 1 deg^2)			
Unpolarised / mJy	0.16	0.32	0.65
Polarised stokes Q, U / mJy	0.23	0.46	0.92
Surface brightness sensitivity (10h, 5σ, 1 deg^2) / MJy/sr	0.09	0.045	0.025
To Stokes Q,U at 5% (10h, 5σ, 1 deg^2) / MJy/sr	2.5	1.25	0.7

- **Photometric mode**
  - **Orthogonal scan map with fixed WP position**
- **Polarimetric mode**
  - **Repeated with one or more different fixed WP orientations**