MAJIS IR Focal Plane Array

Caracterization Plan at IAS

On behalf of IAS BIRD team

Rationale

- Detectors are **performance-critical**
- **TIS only provides very limited knowledge** for some key parameters
- Scatter of performance between FPA providers and within the same batch of an FPA: **need to fully check each component**
- Previous experience for planetary science: **bad surprises**! Loss of focal plane or degraded performance hampering science
- Sub-system calibration of FPA to **gain knowledge prior to integrated calibration** (*see talk by P. Guiot*)

The BIRD benches at IAS

3 configurations are implemented or foreseen

1. Dark bench : no optical stimuli or limited to a heated screen (black body emission)

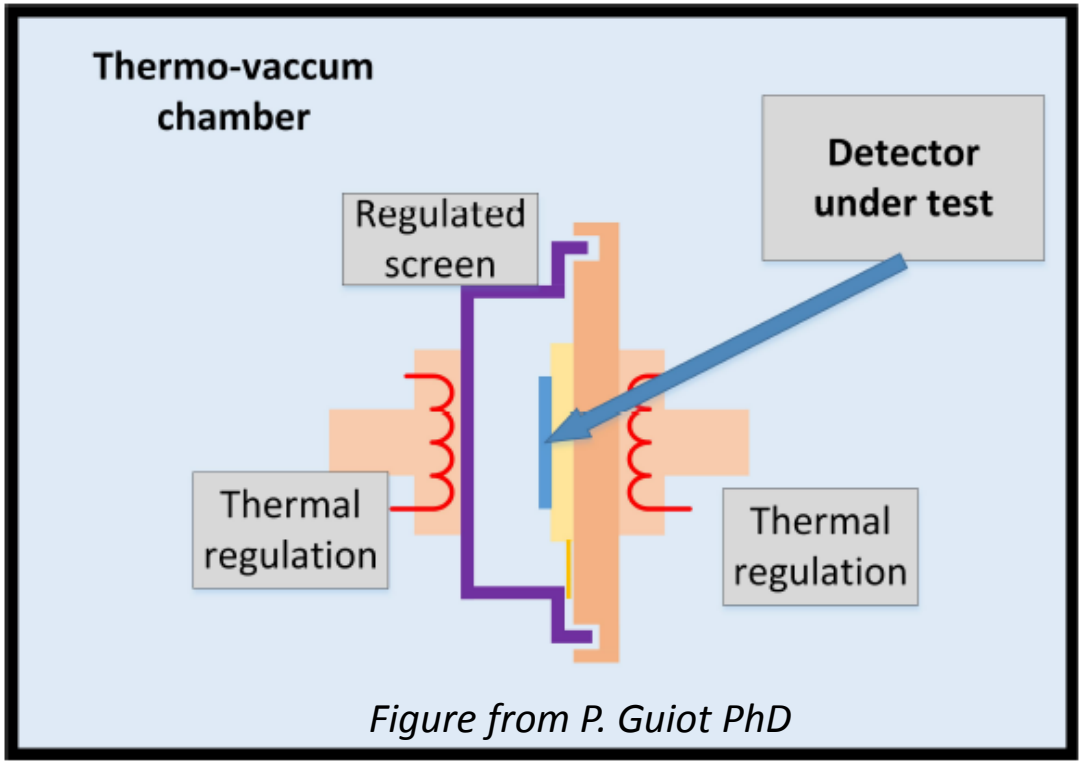

Figure from P. Guiot PhD

Can measure everything that does not require mono-chromatic light or a resolved source:

- → No QE
- → No PRNU with λ
- → No crosstalk
- → No fine sampling of remanence
- → No gain

- → Bias & reference
- → Dark & DSNU
- → RON + FPE noise
- → Linearity & well depth
- → Operability

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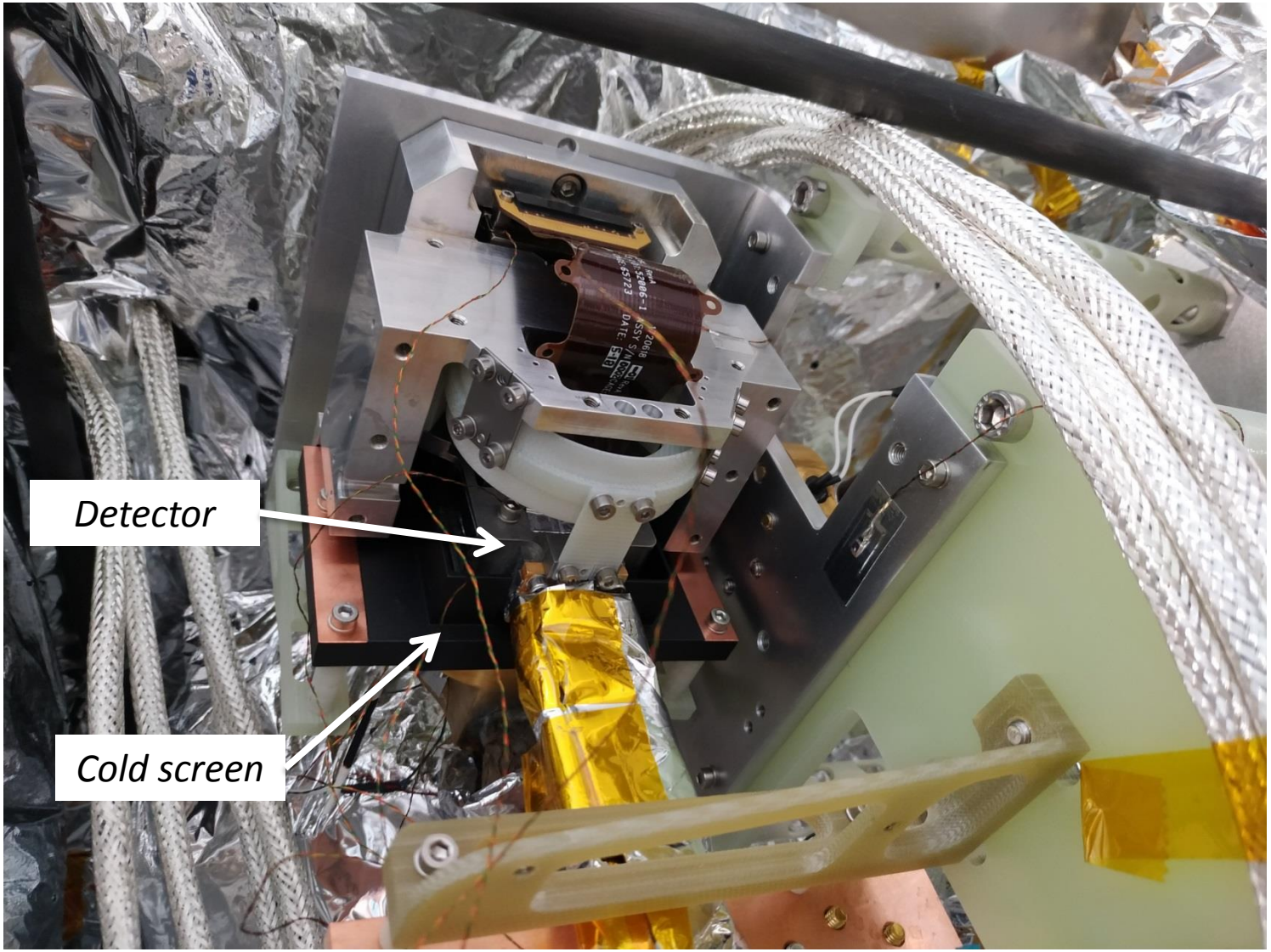


The BIRD benches at IAS

3 configurations are implemented or foreseen

2.a. Optical bench: calibrated spectral radiance, diffusive, divergent beam, monochromatic

+ QE
+ PRNU with λ
+ crosstalk
+ remanence
+ gain

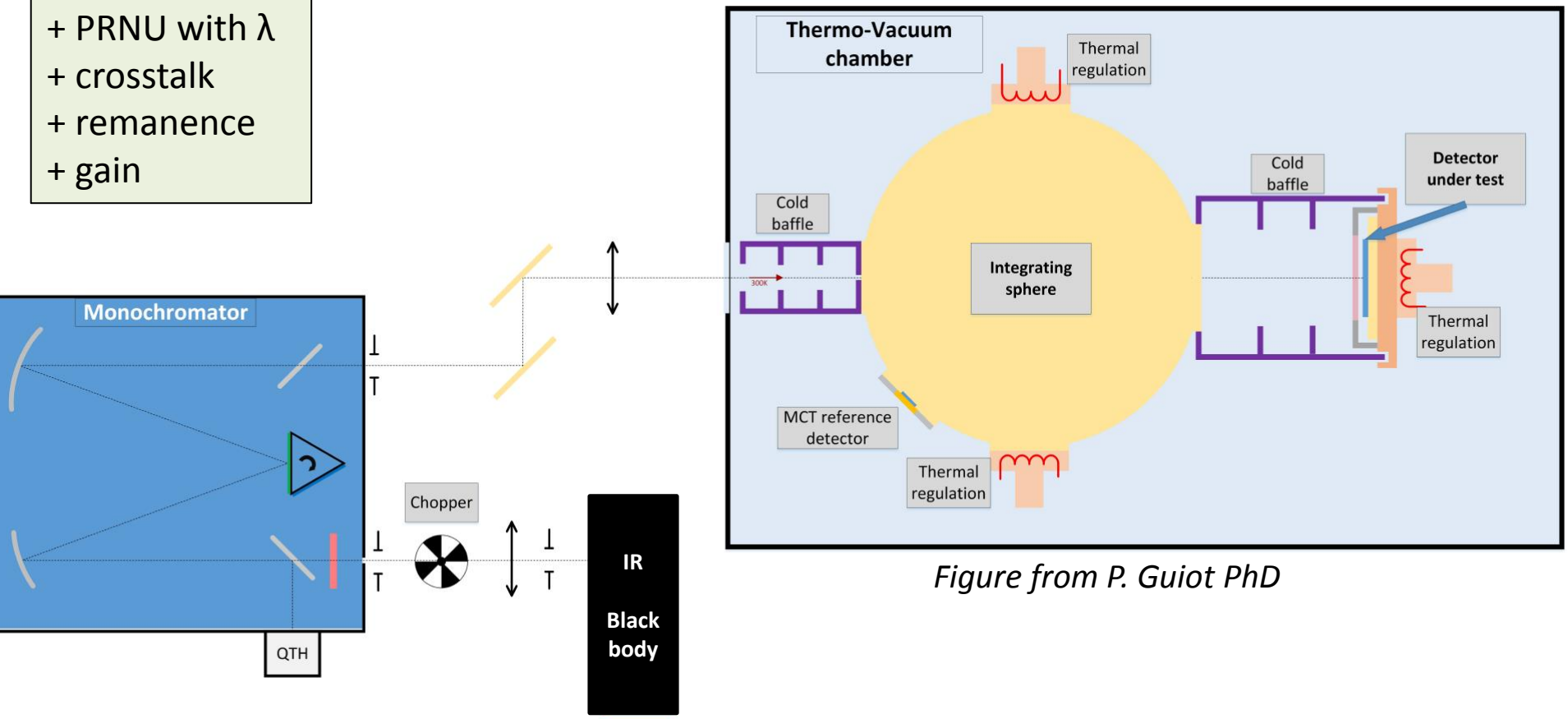


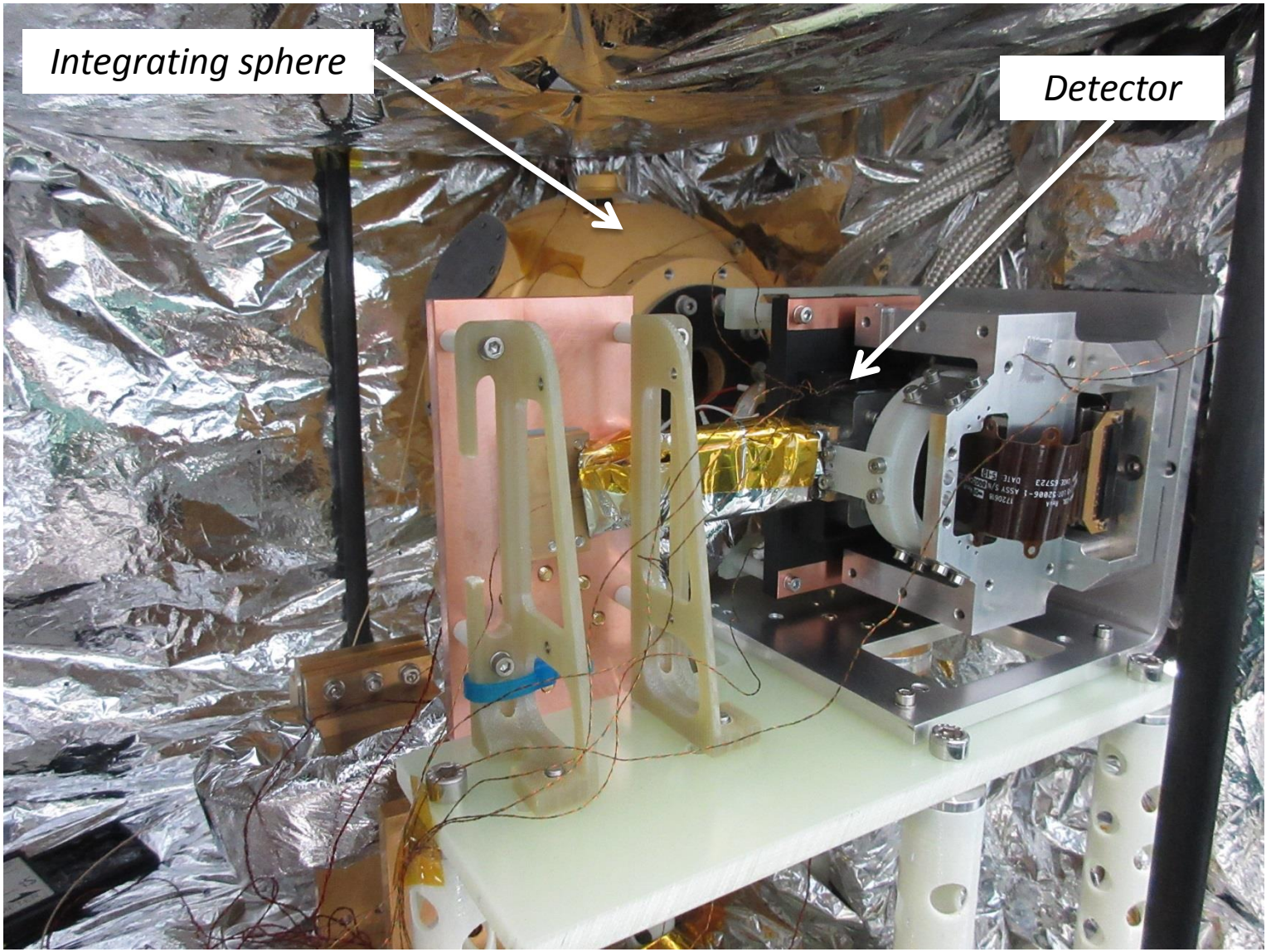
Figure from P. Guiot PhD

2.b. Optical bench on complete FPU: calibrated spectral radiance, diffusive, convergent beam, monochromatic with the filter in filter holder

The BIRD benches at IAS

3 configurations are implemented or foreseen

2.a. Optical bench: calibrated spectral radiance, diffusive, divergent beam, monochromatic



Bench status

Bench configuration	Status
1 « Dark »	Measured a SOFRADIR test detector, a H1RG reject grade + EM Minimal straylight observed, OK for measurement → **Ready for measurements in November** → ***See dedicated Talk by Paolo***
2a « Optical bench, without filter »	Measured a SOFRADIR test detector Photometry issue: new calibration of radiance exiting the integrating sphere **planned this month**
2b « With filter »	Design architecture finalized To be mounted and tested ≥ November 2019

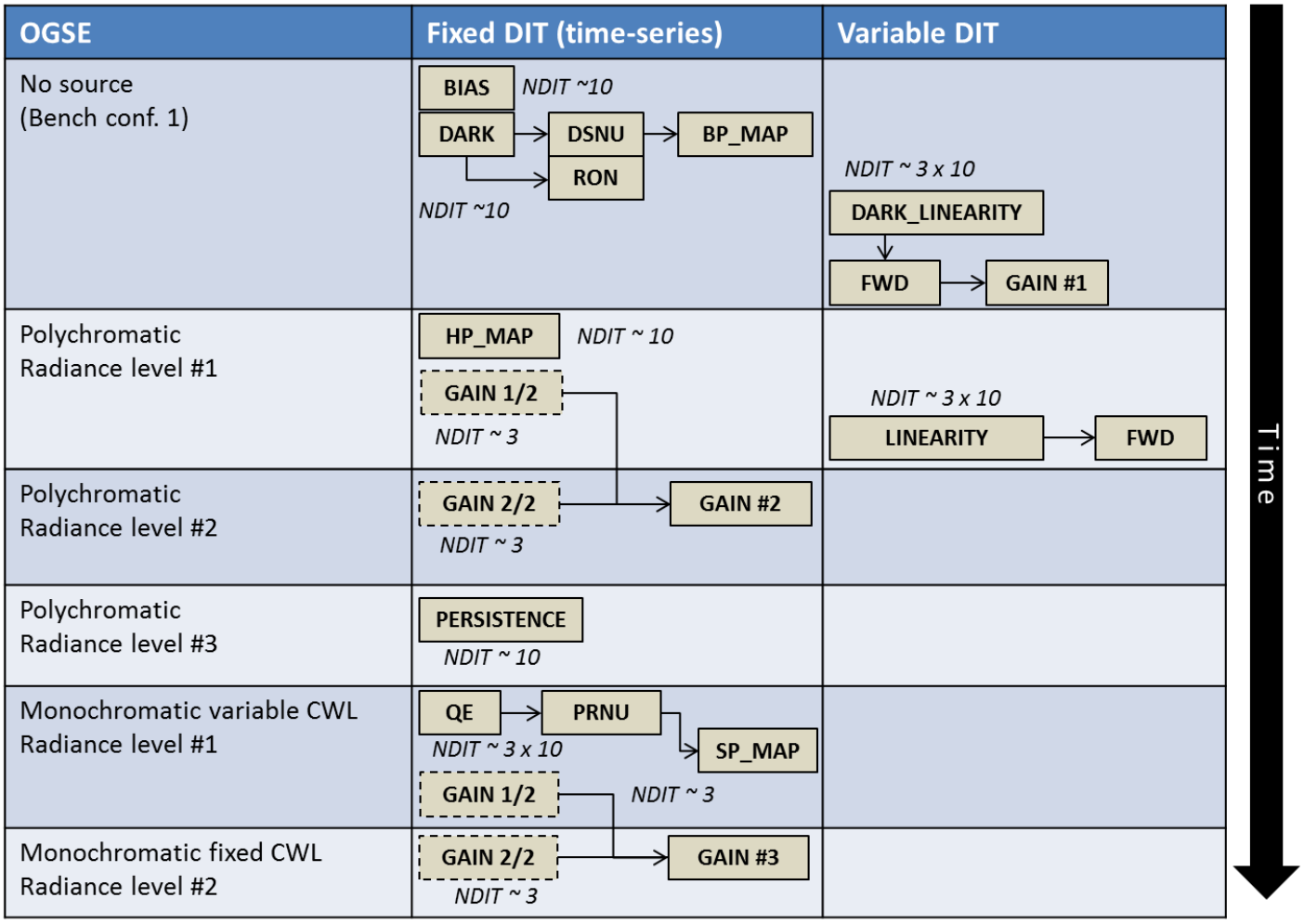
Measurement delivrables

Measurement type	Short description	Deliverable	FPA temperature range	Bench configuration	Readout mode/Microcode version
Bias	Bias of reference pixels + active pixels Bias drift with time	2D map in DN 2D map in DN/min	≤80 - 110K	1, 2a*, 2b*	100 KHz-1MHz Read-reset, CDS
Quantum Efficiency	Cut-on and cut-off Mean QE spectrum PRNU	Map of $\lambda_{cut\text{-}on}$, $\lambda_{cut\text{-}off}$ %, average over detector 2D detector flat, relative	≤80 - 110K	2a	100 KHz CDS
Dark current	Mean or median value Dark signal non-uniformity (DSNU)	e^-/sec mean 2D dark stddev map	≤80 - 110K	1, 2a*, 2b*	100 KHz-1MHz CDS
Noise	Total noise, including : -Read out noise (ROIC noise) -1/f and assimilated electronic noise -PE noise (including ADC noise)	e^- RMS map and mean	≤80 - 110K	1, 2a*, 2b*	100 KHz-1MHz Read-reset, CDS
Gain	Full gain (trans-impedance and ADC)	Mean and 2D Map in Phot.-e^-/DN	≤80 - 110K	2a	100 kHz-1MHz CDS
Pixel operability	Mapping of non-operative pixels: - Bad "Dead" pixels (BP) - "Hot" pixels (HP), time fluctuating - Spurious pixels (SP) that are N/C with QE and linearity specifications	2D Boolean maps	≤80 - 110K	1, 2a*	100 KHz-1MHz Read-reset, CDS
Well depth & saturation	Full Well Depth Digital (ADC) saturation (< FWD)	2D map, in e- DN, average over detector	N/A	1, (2a)	100 KHz Read-reset
Persistence	Under fluence, for each readout / FPE mode	2D map of % of fluence	N/A	2a	1 MHz Read-reset, CDS
Linearity	As a function of dark As a function of flux	2D map of % from linear slope fit	>90K ≤80-110K	1 1,2a	100 KHz CDS
Power consumption and dissipation	Based on heat load and power output	mW	≤80-110K	1 and 2	100 kHz-1MHz N/A
Straylight from filter assembly	Structured parasitic light	2D map in e-	TBD	2b	100 KHz CDS
Filter optical performance and spectral	Out of band blocking Band center mapping Obscuration bonding	10^{-x} attenuation (OD) / pix λ_{CWL} (µm) per	TBD	2b	100 KHz CDS

Measurement flow

Philosophy:
Blocks of sequences that minimize overheads

T_{FPA} = [80 – 110] K



Goal: Optimizing the measurement flow to limit test campaign to a few days.
A trade-off is being made on the resolution of the measurements: number of FPA Temperatures, QE points in λ, detector modes, etc. VERSUS time allocation