Appendix M

Thermal design and analysis of the FMOS IR Camera

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Thermal Design and Analysis of the FMOS IR Camera





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Requirements (1)

Parameter	Spectrograph	Camera	Detector
Life	10 years	10 years	
Absolute temperature	190 К-200 К	<77 K	Controllable within range 70 K <t<77 K to accuracy of 0.1K</t<77
Temperature stability	1 K/5mins	1K/min	0.1 K/hr
Temperature drift over life	+/-2.5K	N/A	2К
Temperature gradient	N/A stability: stable to 1K/5mins	200 K – 77K (TBC) stability: N/A	0.1 K stability: stable to 0.01 K/min
Maximum cooling rate for lenses	10 K/hr	10 K/hr	N/A
Maximum cold-warm- cold cycle time	48 hrs	<1week	<1week

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Thermal Design / ESARAD Geometric Model





ESARAD Geometric Model (Cross-Section)



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RAL AIT (2)

Testing of the Camera without Spectrograph in room temperature at RAL

LN2 pre-cooling

GN2 + heater warm-up

Detector overheating from feedback sensor error

Strap/sensor attachment

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Cryogenic Testing - RAL Results

Steady State

Part	Requirement / K	Lab (Room Temperature) Actual / K	Cooldown with LN2 = 24 hrs (without predicted 60 hrs)
Front Window	200	284.9	
Lens 1 Centre	190	(Estimate) 180	Warmup with GN2 = 65 hrs
Lens 1 Mount		150	
Filter Centre	<148	117.7	
Filter Mount	-	84.4	
Lens 6	< 87	76.1	
Detector	70-77	70.0	
Copper Block	70-77	70.0	
Coldhead 1 st stage	-	45.2	
Coldhead 2 nd stage	-	37.4	

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Oxford University - In Spectrograph



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