EUROPEAN SOUTHERN OBSERVATORY

Organisation Européene pour des Recherches Astronomiques dans l'Hémisphère Austral
Europäische Organisation für astronomische Forschung in der südlichen Hemisphäre

ESO - European Southern Observatory
Karl-Schwarzschild Str. 2, D-85748 Garching bei München

Very Large Telescope

Paranal Science Operations

Infrared Array Detectors Tests and Monitoring Plan

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Prepared . . . L. Vanzi, C. Lidman . . .

Date Signature

Approved . . . A. Kaufer . . .

Date Signature

Released . . . O. Hainaut . . .

Date Signature

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Contents

1 Introduction

1.1 Scope of the Document

This document describes the requirements and specifications for the test procedures of the infrared detectors of the VLT, VLTI and La Silla scientific instruments. A number of detector's parameters, which are relevant for monitoring purposes are described, the test and monitoring procedures are defined in detail. This document shall serve as input for the establishment of a monitoring scheme for the infrared detectors of the scientific instruments in use at the Paranal/La Silla Observatory. It is meant as a guide for more detailed and instrument related requirements to be specified by the VLT, VLTI and La Silla instrument responsibles.

1.2 Abbreviations and Acronyms

In the document the following abbreviations and acronyms are used:

ADU	Analog Digital Units
BIB	Blocked Impurity Band
BLIP	Background LImited Performances
DIT	Detector Integration Time
DHA	Data Handling Administration
DMD	Data Management Division
IR	Infra-Red
IRACE	Infra-Red Array Control Electronics
MIR	Mid-Infra-Red
NIR	Near-Infra-Red
QC	Quality Control
RON	Read Out Noise
VLT	Very Large Telescope
VLTI	Very Large Telescope Interferometer

1.3 VLT IR Detectors

The IR detectors present in VLT/VLTI and LaSilla scientific instruments at the moment of writing this document are summarized in Tab. 1. All detectors are operated by the IRACE system with the exception of the NAOS Hawaii and MIDI Raytheon.

The detectors are operated in different read-out modes according to the observations to be performed and, depending on that, they have different characteristics, these characteristics are described in the documentation specific to each instrument and are summarized in the corresponding web pages. All IR detectors which are relevant to this document are photon detector arrays. Their photon detection process is based on the same principle as optical CCDs but employ materials other than silicon, as HgCdTe, InSb and Si:As. These materials are not suitable for the charge transfer, so that IR arrays are normally coupled to a silicon multiplexer for the charge read-out process. For more details on IR detectors see for instance http://www.eso.org/~gfinger/ .

Instrument	Detector	technology	operation range
ISAAC	Rockwell 1024 × 1024 Hawaii	HgCdTe	0.9-2.5 μm
	SBRC 1024 × 1024 Aladdin 2	InSb	1-5 μm
VISIR	2 × DRS 256 × 256 BIB	Si:As	5-25 μm
CONICA	SBRC 1024 × 1024 Aladdin 3	InSb	1-5 μm
NAOS	Rockwell 1024 × 1024 Hawaii	HgCdTe	0.9-2.5 μm
SPIFFI	Rockwell 2048 × 2048 Hawaii	HgCdTe	0.9-2.5 μm
MIDI	Raytheon 320 × 240 IBC	Si:As	5.0-25 μm
AMBER	Rockwell 1024 × 1024 Hawaii	HgCdTe	0.9-2.5 μm
SOFI	Rockwell 1024 × 1024 Hawaii	HgCdTe	0.9-2.5 μm
TIMMI2	Raytheon 320 × 240	Si:As	5.0-25 μm

Table 1: VLT/VLTI IR Detectors

1.4 Analysis and Results

The analysis of the data, aimed at measuring the detector parameters defined in the monitoring plan, is performed in two ways: through pipeline recipes and through scripts independent of the pipeline. The results generated by the pipeline are published in the QC webpage (http://www.eso.org/observing/dfo/quality/index.html) while all other results are posted in the science operation internal web pages specific to each instrument.

1.5 Responsibilities

The following responsibilities are defined:

- definition of the IR detectors Monitoring Plan: Paranal Instrument Scientist and Instrument Scientists
- preparation, implementation and maintenance of the IR detectors monitoring plan: Instruments Scientists with the help of Paranal Software Group
- execution of the monitoring plan: Science Operation Team
- development and maintenance of the pipeline recipes: DMD Garching and DHA Paranal
- analysis: DMD Garching and Science Operation Team
- monitoring of the results: Instrument Scientists

2 Detector Parameters

In this section we describe the main parameters that characterize the performances of IR detectors, stressing in particular those that can be subject to temporal variation and that, therefore must be regularly monitored to ensure the best performances of the instruments at any time.

2.1 Read Out Noise

IR instruments will perform better when operated in background limited conditions or BLIP, for this reason it is important to make sure that this condition is verified as much as possible during the observations. In order to operate a detector in BLIP, the RON must be known. The RON is the noise introduced by the read-out process, it receives contribution from two main sources: the analog to digital conversion and spurious electrons. The RON depends on the read-out mode employed and on the temperature and it is measured in electrons. Beside its intrinsic relevance monitoring the RON is important also because it can be a good indicator of different instrumental problems.

2.2 Dark Level

As in optical detectors the dark current is the signal detected in absence of illumination, it includes the instrument thermal background, stray light, spurious electrons generated inside the detector and the bias signal. Since 0 second integrations cannot be taken with IR detectors, the dark and the bias signal cannot be separated. It has been observed in some cases a dependency of the dark on the average signal, the Hawaii detector is an example of such a case. As for the RON a variation of the dark level is an indicator of instrumental problems.

2.3 Bad Pixels

Bad Pixels are those elements of the IR Array Detector that cannot be used for science because of a bad response or unpredictable behavior. They can be blind or have very low quantum efficiency (dead pixels), they can be all time saturated or close to saturation (hot pixels) or they can be significantly noisier than average (noisy pixels) as for instance those with highly variable dark level or quantum efficiency, see Fig 1. Finally they can be identified as bad pixels all those with other odd behaviors as for instance highly non linear pixels or pixels that produce electronic ghosts when saturated. This effect is particularly strong in the VISIR's DRS detectors. The number of bad pixels is not constant as they typically increase over the detector life time. In particular as result of thermal cycles the contacts between the photosensitive elements of the array and the multiplexer can deteriorate or be completely lost. For this reason it is important to monitor the number of bad pixels over time. Not intrinsically related to the detector performances are those pixels masked by dust particles that would randomly appear or disappear especially after an opening of the dewar.

2.4 Linearity

IR Array Detectors are intrinsically non linear. Within a limited dynamic range the effect of non linearity is small and the detectors can be used as they were virtually linear, outside this dynamic range a linearity correction must be applied. It has been observed in some cases a dependency of the linearity on the flux intensity, different illuminating fluxes can produce different responses even if the average number of counts generated is in the same range.

2.5 Conversion Factor

Conversion factor is the ratio between ADUs and electrons, its value is defined by the electronics.

2.6 Spatial Uniformity

The response of an Array Detector is not spatially uniform and shows pixel to pixel, low scale variations and larger scale structures. All are mostly corrected in the flat fielding process, however this is not always true and the correction is never perfect so that it is important to monitor the evolution of these structures with time to keep the science targets far from them.

2.7 Odd-Even Column Effect

The odd-even column effect is observed in the Rockwell Hawaii detector and it is an offset between the signal of the odd and even columns of the array. It depends on the flux and it can be as large as few %. Beside the flux, the effect also depends on the quadrant, on the read-out speed and on time. In particular the effect has shown random variations with time, in occasion of instrument interventions or detector warming up. For these reasons it is important to monitor the effect carefully.

2.8 N pixel correlated noise

Similar to the odd-even column effect but occurring on a N pixel base. A 8 pixel correlated noise is observed in the CONICA Aladdin detector.

2.9 Amplifier Glowing

It has been observed that the amplifiers of the multiplexer attached to the IR sensitive array are sources of glowing and generate a spurious signal, during the read-out process, with associated noise, see Fig. 1. This signal is detected by the array and can be a limit to the maximum useful DIT. The effect is most relevant in those read-out modes characterized by low RON.

2.10 50 Hz pick-up noise

The pick-up of the 50 Hz frequency manifests in the form of strips crossing the detector, see Fig. 2. These strips are typically inclined with respect to the rows or to the columns. It depends on the read-out mode, in particular the spatial frequency of the stripes depends on the read-out speed, it changes with time and it is strongest for some values of the DIT.

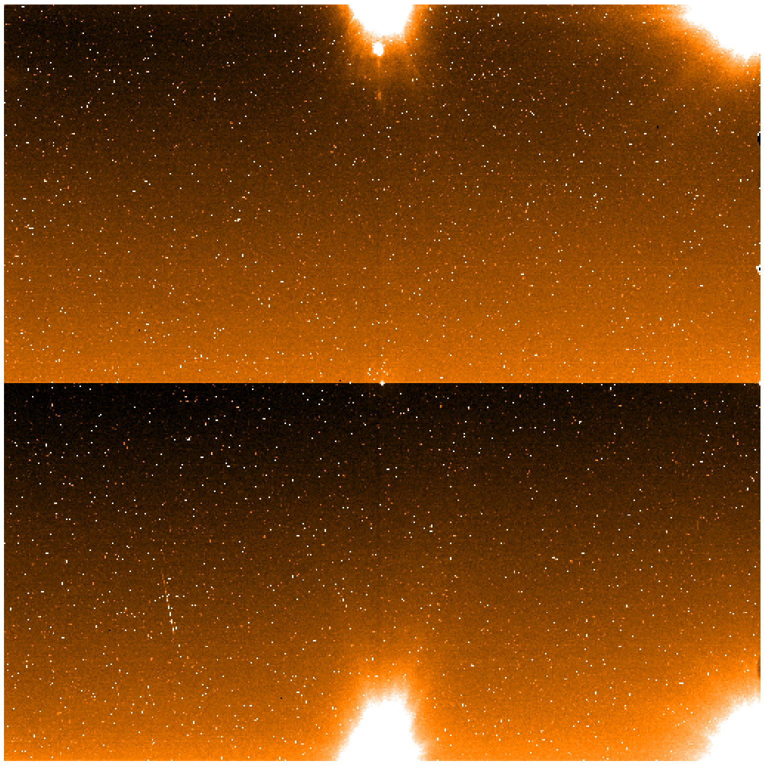

Figure 1: Multiplexer glowing and "hot" pixels in a dark frame of the Hawaii array.

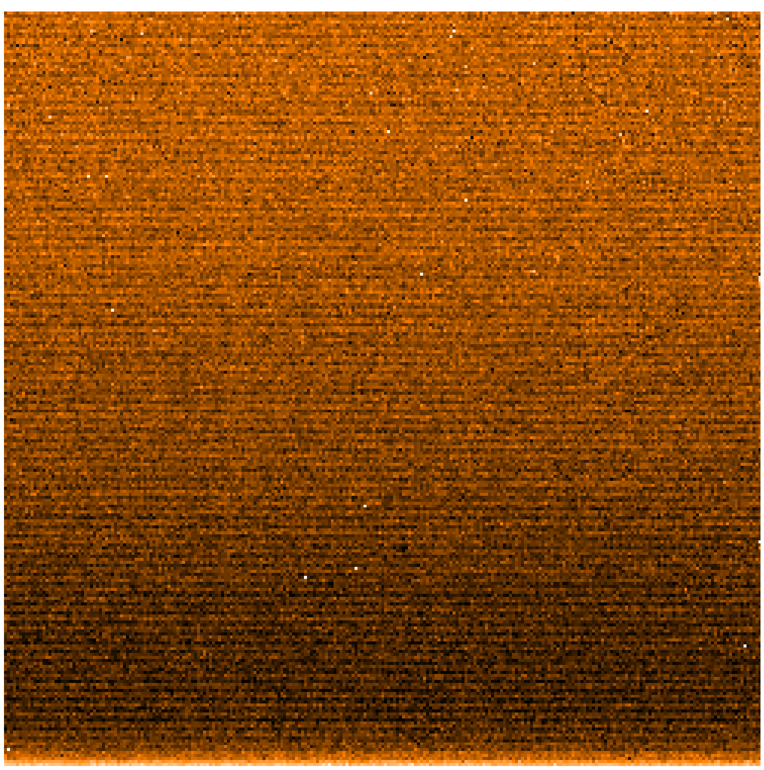

Figure 2: 50 Hz pick-up noise in one quadrant of the Hawaii array.

2.11 Image Persistence

IR detectors are very often affected by memory effects. A bright source illuminating the detector generates a ghost that remains even after the source is not imaged anymore. Such a ghost disappears only after the detector has been read-out several times.

2.12 Crosstalk and Electronic Ghosts

When a section of the detector is illuminated by a strong source, ghosts can be mirrored in other regions of the array as result of electronic cross talk. In the Hawaii detector for instance a stripe appears extending horizontally along the rows corresponding to the bright source and on the corresponding rows of the adjacent quadrants. This particular effect is known as *inter-quadrant crosstalk* and it is different from the effect described in Section 2.3 for the VISIR's arrays, since it is common to all pixels of the array and not only to a few specific ones. Further details can be found at:

http://www.eso.org/~gfinger/hawaii_1Kx1K/crosstalk_rock/crosstalk.html

2.13 Microphonic noise

Phonon or acoustic noise is typically produced by mechanical vibrations as those generated by Closed Cycle Cooler systems. It produces a series of horizontal or vertical strips that moves on the detector from one integration to the other.

2.14 Temperature Stabilization

Despite the fact that the detectors are stabilized in temperature by an active control they can show some times instability mostly related to the level of illumination. As the illumination level increases, it also increases the current through the chip and the power dissipated. The operation points of the current sources and amplifiers are shifted and there is a temperature variation. If the temperature control is not fast enough the change of temperature can produce a significant variation of the response of the detector. This variation may take some time before stabilizing.

3 Monitoring Plan

Not all parameters described are relevant for the different detectors operated at the VLT and La Silla. In addition they typically show variations on different time scales. So that a specific plan must be set to monitor the critical parameters of each detector with the suitable frequency. In Tab. 2 the monitoring plan is summarized indicating which parameters are most relevant for each detector and their corresponding monitoring frequency. The details of the tests to be executed are described in the next Section. The NAOS IR Wave Front Sensor detector is a special case, it is not aimed at producing scientific data frames but to acquire data for the AO correction of CONICA and it does not share the operation mode with the other Hawaii detectors, in particular it is not operated by the IRACE system. For these reasons its requirements are different. The monitoring plan for the NAOS Hawaii is summarized in Tab. 3.

Detector	test	frequency
Hawaii	ron	daily
	dark	daily
	odd-even	daily
	stability	daily
	50 Hz	monthly
	linearity	biyearly
	transf. func.	biyearly
	bad pix	yearly
Aladdin	ron	daily
	dark	daily
	stability	daily
	8-pix	monthly
	linearity	monthly
	phonon	biyearly
	transf. func.	biyearly
	bad pix	yearly
BIB/IBC	stability	daily
	linearity	monthly
	transf. func.	biyearly
	bad pix	biyearly
	temperature	yearly

Table 2: IR detectors monitoring plan

Detector	test	frequency
NAOS Hawaii	ron	daily
	dark	daily
	cosmetics	yearly

Table 3: Naos detector monitoring plan

Priorities to implement the IR detector monitoring plan in the quality control daily health check are defined in Tab. 4.

Priority	test	instrument
1	dark	ISAAC-SW, ISAAC LW, CONICA, NAOS, SINFONI, AMBER, SOFI
1	ron	ISAAC-SW, ISAAC LW, CONICA, NAOS, SINFONI, AMBER, SOFI
2	bad-pix	All
2	odd-even	ISAAC-SW, SINFONI, AMBER, SOFI
2	pick-up	ISAAC-SW, SINFONI, AMBER, SOFI
3	linearity	All (NAOS excluded)
3	gain	ISAAC-SW, ISAAC LW, CONICA, SINFONI, AMBER, SOFI

Table 4: Priorities for the implementation of the IR detector monitoring plan. 1=Immediate. 2=Medium term, 6 months. 3=Long term, 1 year.

4 Individual Test Procedures

In this section the details of each individual test are described including data acquisition procedure, analysis, output results and frequency.

4.1 Dark Level and Read Out Noise Test

Purpose. The purpose of this test is to measure the mean dark level of the detector and the RON for a particular read-out mode.

Data Acquisition. A set of darks with suitable DIT is acquired daily in different read-out modes as part of the calibration plan. Beside few basic modes and DITs included by default in the daily calibrations, the details of the sequence acquired depend on the observations executed during the previous night. A sequence of darks can also be acquired independently of the daily calibrations using a specific OB.

Analysis. A master dark is created by the pipeline and the mean dark level is measured. A master dark is the average of 3 or more dark frames obtained with an identical setup and it is routinely generated by the pipeline. For daily monitoring the RON can be simply measured as the RMS, on defined areas, of the difference of two dark frames divided by the root square of 2. The RON must be measured independently for each quadrant or port. For a more accurate analysis a detector transfer curve must be obtained, see Section 4.5.

Output. The mean dark level in electrons per DIT and the RON in electrons. Plots with the evolution of the two parameters with time are available in the QC web-page.

Frequency. The dark signal is monitored daily for all detectors, the RON is monitored daily for the Hawaii and Aladdin detectors.

4.2 Stability Test

Purpose The purpose of the test is to give a quick flavor of the stability of the detector. The stability is then more accurately quantified by monitoring specific detector parameters, as ron, dark, linearity, bad pixels etc.

Data Acquisition Darks and Flats as part of the calibration plan.

Analysis Darks and Flats are divided by reference frames that are updated on a monthly base. The frames are inspected and possible changes are quantified.

Output On screen, evaluated in real time.

Frequency Daily

4.3 Bad Pixel Test

Purpose. The purpose of the test is to asses the cosmetic quality of the detector in terms of pixels with bad response (bad pixels), including hot, dead and noisy pixels. Pixels with different types of misbehavior are considered as particular cases of the specific detectors and are not treated here.

Data Acquisition Darks and flat frames obtained as part of the regular calibration plan.

Analysis. The hot pixels are identified as those exceeding by more than 5 σ the mean level of a master dark. A master dark is the average of 3 or more dark frames obtained in the same read-out mode and with the same DIT and it is routinely generated by the pipeline. Are also identified as hot pixels those exceeding by more than 5 σ the mean level of a master flat. A master flat is a gain map obtained through a linear fit, pixel by pixel of the single pixel value versus the median value of the frame, over a sequence of flat frames with different illuminations.

The dead pixels are identified as those below more than 5 σ the mean level of a master flat.

Finally the noisy pixels are identified as those deviating by more than $\pm$ 5 σ from the mean level of the σ map of a sequence of darks and a sequence of flats. A σ map is obtained as the σ, pixel by pixel, of the average combination of a number of frames.

The combination of hot, dead and noisy pixels gives the global number of bad pixels. The test is repeated for different read-out modes and DITs.

Ouput. Number of bad pixels and bad pixel mask. The fraction of bad pixels as function of time is posted in the QC Web page.

Frequency Yearly, after instrument intervention and warm-up of the detector.

4.4 Linearity Test

Purpose The purpose of the test is to evaluate the response of the detector in terms of linearity, define the linear dynamic range if possible, and define a linearity correction.

Data Acquisition A sequence of internal flats is acquired with fixed illumination and different DITs in such a way that the entire dynamic range of the detector is covered. The stability of the test source must be checked during the acquisition, for this reason frames acquired with a reference DIT are periodically taken during the sequence of exposures. A typical sequence of DITs could be, for instance: *0.5*, 1, 1.5, 2, 2.5, 3, *0.5*, 3.5, 4, 4.5, 5, 5.5, *0.5*, 6, 6.5, 7, 7.5, 8, *0.5*, 8.5, 9, 9.5, 10, 10.5 *0.5* sec. A sequence of darks is taken with the same DITs. For those detectors that show a dependency of the linearity on the flux two sequences of measurements are taken with high and low illumination respectively.

Analysis. Darks with the corresponding DITs are subtracted from the Flats. The stability of the lamp is checked using the frames taken with the reference DIT. The stability of the lamp must be within 1%. A plot of the average counts on selected areas versus DIT is produced. A fit of the counts versus DIT is produced pixel by pixel in those cases where the linearity significantly changes from one pixel to the other. A polynomium of order 3 is used. The test is repeated for different read-out modes and DITs. The pixels that show high non linearity are included in the number of bad pixels.

Output Plot of the average counts on selected areas versus DIT, linear dynamic range, coefficient frames, linearity correction.

Frequency Depends on detectors, typically biyearly for SW detectors (Hawaii), monthly for LW detectors (Aladdin, Raythen etc.).

4.5 Transfer Function Test

Purpose. The purpose of the test is to generate the detector transfer function, measure the conversion factor and the read out noise accurately.

Data Acquisition A series of internal flats with average counts spanning the linear dynamic range of the detector is acquired. Different count levels can be obtained both varying the intensity of the test source or the DIT. At least two frames must be obtained for each level of counts. The stability of the test source must be checked.

Analysis The mean and σ frames are calculated for those frames obtained at the same count level and a linear regression of σ^2 versus mean signal is produced over the sequence of flats. The σ^2 must be normalized to the number of frames used to derive it. Each quadrant or port is analyzed independently, the mean and σ can be calculated over the entire quadrant or on selected subsections. The slope of the linear regression gives the inverse of the conversion factor in electrons per ADU while the intercept gives the square of the RON in ADUs according to the relation:

$$\sigma^2(ADU) = \frac{1}{G} \times I(ADU) + \frac{1}{G^2 \times RON(e^-)^2}$$

where G is the conversion factor in electrons per ADU. The conversion gain given by this tecnique must be corrected for a factor that takes into account the coupling of adiacent pixel's capacitance. This is described in:
http://www.eso.org/~gfinger/taormina_gert_finger_conversion_corrected_29_july_05.pdf

Output. RON and G. The RON must be consistent with the values derived on the daily monitoring described in Section 4.1. Evolution of G with time.

Frequency. Biyearly for all detectors.

4.6 Uniformity test

Purpose The purpose of the test is to monitor the spatial uniformity of the detectors, the possible appearance of large scale structures and features intrinsic to the detector or even produced by dust grains that could possibly escape the bad pixel monitoring because not contrasted enough as to be detected in a σ clipping process.

Data acquisition A series of sky or internal flats with two levels of illumination, low and high.

Analysis The flats are compared with reference flats. Flats with high counts are divided by flats with low counts, the result is compared with a reference division.

Output On screen. Description of the detector's features in the suitable documentation.

Frequency Monthly.

4.7 Odd-Even Test

Purpose. The purpose of the test is to quantify the odd-even column noise.

Data Acquisition. The test is executed using flatfield frames. Sky or Internal Screen Flats are regularly acquired depending on the needs as part of the calibration plan.

Analysis. The analysis is based on the comparison of the signal averaged over the even and odd columns of the array, respectively. The analysis must be independent for each quadrant or port. The average ratio odd/even is compared with the average signal in counts, its evolution in time is monitored.

Output. Ratio of the average odd/even as function of the average signal (see Fig. 3) and as function of time are posted in the QC Web Page.

Frequency. The odd-even effect monitoring is subject to the availability of suitable flats but is normally performed on a daily basis for the Hawaii detectors.

4.8 Glowing Test

Purpose. The purpose of the test is to monitor the glowing of the multiplexer in those cases where the effect is relevant.

Data Acquisition A sequence of darks in the suitable modes, typically those with the lowest RON, are taken with suitable DIT and read-out mode.

Analysis The glowing signal is measured on the darks on selected areas of the array.

Output Average intensity of the glowing on selected areas as function of time.

Frequency Rarely.

4.9 50 Hz Test

Purpose Evaluate the 50 Hz pickup noise.

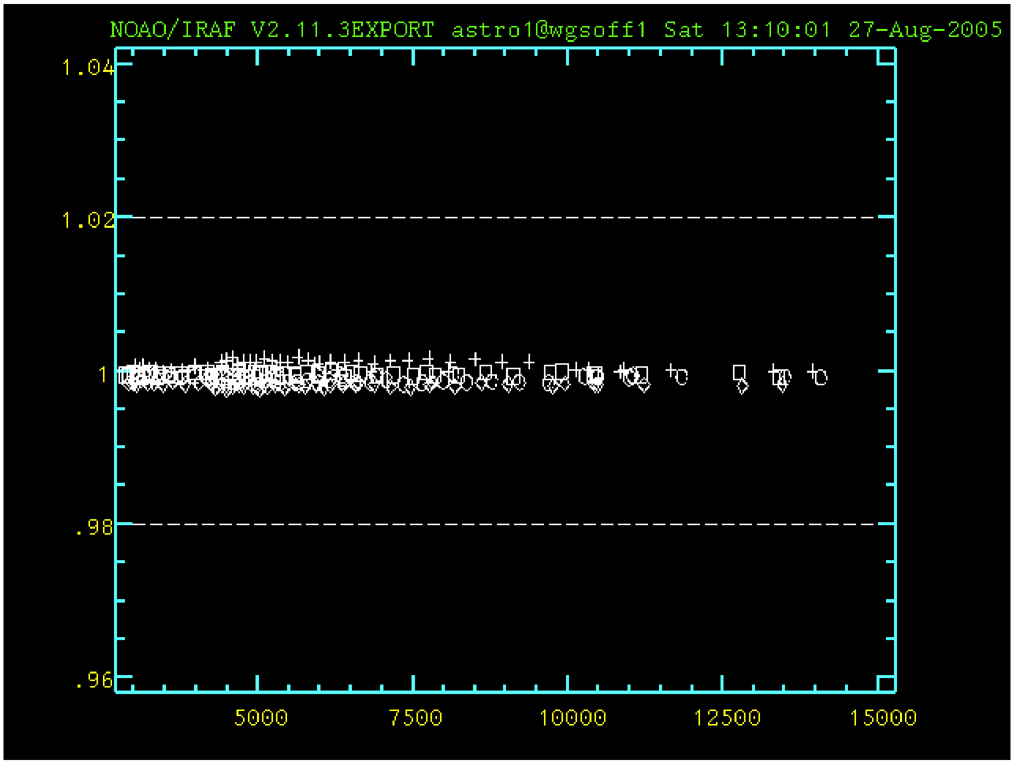

Figure 3: Odd-Even effect measured for the four quadrant of the Hawaii array as function of the average signal.

Data Acquisition A sequence of dark frames with NDIT=1.

Analysis The dark frames are visually inspected first to determine the orientation of the 50 Hz strips if present and to approximately evaluate their spatial frequency. Each image is sliced in the direction perpendicular to the strips in subsections few tens pixels wide. These subsections are block averaged to $1 \times N$ images, where N is the dimension of the array in the direction perpendicular to the 50 Hz stripes. Since the 50 Hz stripes are typically slightly tilted with respect to the rows or columns it is important that the slices are not too wide not to smooth away the effect to be measured. A Fourier power spectrum is obtained for each 1D image, the power spectra are average combined in a single one. The analysis must be performed independently on each quadrant or port.

Output. Frequency and intensity of the pickup noise in the spatial frequencies domain. The analysis could also evidence other type of periodic structures in the array.

Frequency. Yearly.

4.10 Crosstalk Test

Purpose Evidence and evaluate the presence of cross talk effects and electronic ghosts.

Data Acquisition Observe a bright star jittering on the array.

Analysis The data are reduced by the pipeline. The reduced image is visually inspected, the intensity of possible ghosts is measured and compared to the intensity of the star.

Output The images affected by the ghosts, description of the effect, ratio of the ghosts to the source.

Frequency Yearly.

4.11 Phonon test

Purpose Evaluate the phonon noise.

Data Acquisition A sequence of dark frames with NDIT=1.

Analysis The dark frames are visually inspected to detect the presence of phonon noise and to determine its orientation. Differently from other sources of noise, mechanical vibrations produce groups of stripes that change position from one frame to the other and that, therefore can be easily identified. Each image is collapsed in the direction perpendicular to the stripes, the resulting line is plotted and searched for picks of noise exceeding a threshold.

Output Intensity of the noise.

Frequency Yearly.

4.12 Temperature Stabilization Test

Purpose Evaluate the effect of the illumination on the detector temperature and on its response.

Data Acquisition A sequence of internal flats is acquired with short DIT. The test source is initially OFF and it is switched ON during the acquisition sequence, the acquisition of frames continues for a suitable time, typically a few minutes. The test is repeated for different illumination levels.

Analysis The average counts on selected areas are plotted as function of time.

Output Temperature stabilization time of the detector.

Frequency Yearly.

1 Appendix: OBs, Recipes and Scripts

In this Appendix we summarize the templates used for data acquisition and the pipeline recipes or scripts used for data reduction. In addition to be executed in ”stand-alone” mode when required, many of the templates listed are called by the OB CALOB.YYYY-MM-DD which is run daily to perform the daily calibrations.

Instrument	Test	template	script	product
ISAAC SW	dark	ISAACSW_img_cal_Dark	isaacp_dark-avg (p)	master dark, QC Web
		ISAACSW_spec_cal_Dark	" "	master dark, QC Web
	int. flats	ISAACSW_img_tec_LampFlat		master flat
	tw. flats	ISAACSW_img_cal_TwFlats	isaacp_twflat (p)	master flat, QC Web
	ron		isaacp_dark-ron (p)	QC Web
	odd-even	ISAACSW_img_cal_TwFlats	isaac_twflat_oe (p)	QC Web
			ampl.cl (i)	wgoff1
	linearity	SW_lin_DCR	isaacp_dtlin (p)	lin. plot
		ISAACLW_img_tec_Linearity		coeff. frames
	bad-pix	use darks and flats		
ISAAC LW	dark	ISAACLW_all_cal_Dark		master dark, QC Web
	flat	ISAACLW_img_cal_TwFlats		master flat, QC Web
	linearity	LW_lin_LWI3_DCHB, DCHLB		coeff. frames, QC Web
		LW_lin_LWI4_UCHB		
	bad-pix	use darks and flats		
CONICA	dark	NACO_all_cal_Darks	conicap_dark (p)	QC Web
	int. flat	NACO_img_cal_LampFlat	conicap_lampflat (p)	master flat
	tw. flat	NACO_img_cal_TwFlats	conicap_twflat (p)	master flat
	ron			QC Web
	linearity	NACO_img_cal_Linearity	conicap_detlin (p)	coeff. frames, QC Web
	bad-pix	use darks and flat		QC Web
SINFONI	dark	SINFONI_ifu_cal_Dark	si_rec_mdark (p)	master dark, QC Web
	flats	SINFONI_ifu_cal_mflat	si_rec_mflat (p)	master flat, QC Web
	ron			QC Web
	linearity	SINFONI_ifu_cal_Detlin	si_rec_detlin (p)	coeff. frames, QC Web
	bad-pix	use darks and flats		QC Web
VISIR IMG	flat	VISIR_img_cal_ExtSrcFlats	visir_img_ff (p)	master flat
	linearity			coeff. frames, QC Web
	bad-pix	VISIR_img_tec_BadPixels	visir_img_ff (p)	QC Web
VISIR SPC	flat	VISIR_spc_cal_ExtSrcFlats	visir_spc_ff (p)	master flat
	linearity			
	bad-pix	VISIR_spc_tec_BadPixels	visir_spc_ff (p)	QC Web
MIDI	flats			master flat
	ron	MIDI_autotest_tec_detron		
	linearity	MIDI_autotest_tec_detlin		
AMBER	linearity	AMBER_gen_tec_nonLinearMap		
	bad-pix	AMBER_gen_tec_badPixelMap		
SOFI	dark	SOFI_img_cal_Dark		
	flat	SOFI_img_cal_SpecialDomeFlat	special_flat.cl (i)	master flat
	ron	SOFI_det_tec_Ron	SOFI_Ron.prg (m)	ron by quadrant
	conv. f.	SOFI_det_tec_Gain	SOFI_Gain.prg (m)	conv. factor
	linearity	SOFI_img_tec_Linearity	SOFI_Linearity.prg (m)	coeff. frames, lin. plot
	bad-pix	SOFI_img_tec_BadPixels	bad_pix.cl (m)	bad pixel mask
TIMMI				
NAOS				

Table 5: Templates, recipes and scripts available to perform the tests. p indicates scripts that are part of the pipeline, i and m iraf and midas scripts respectively that are not part of the