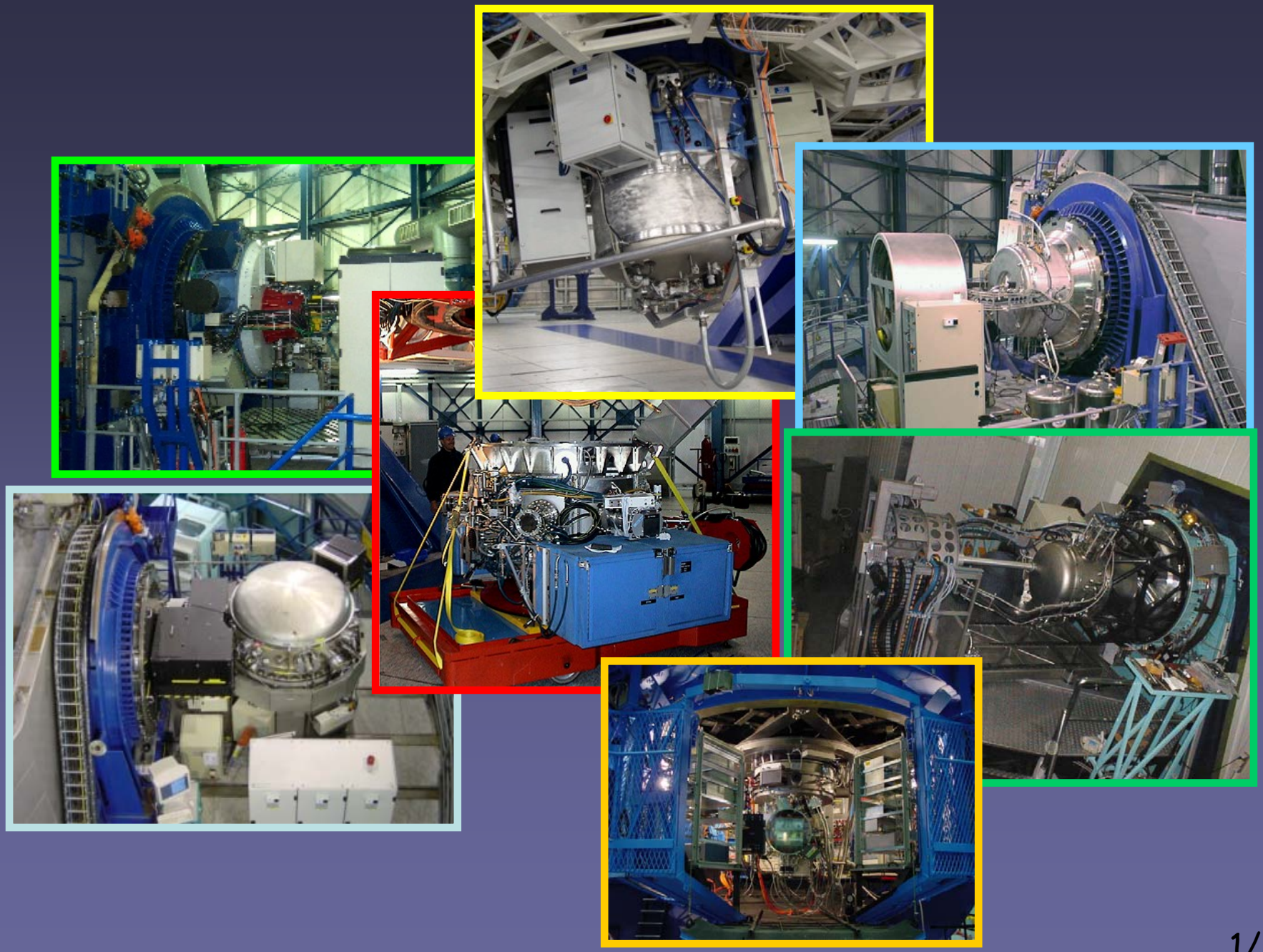
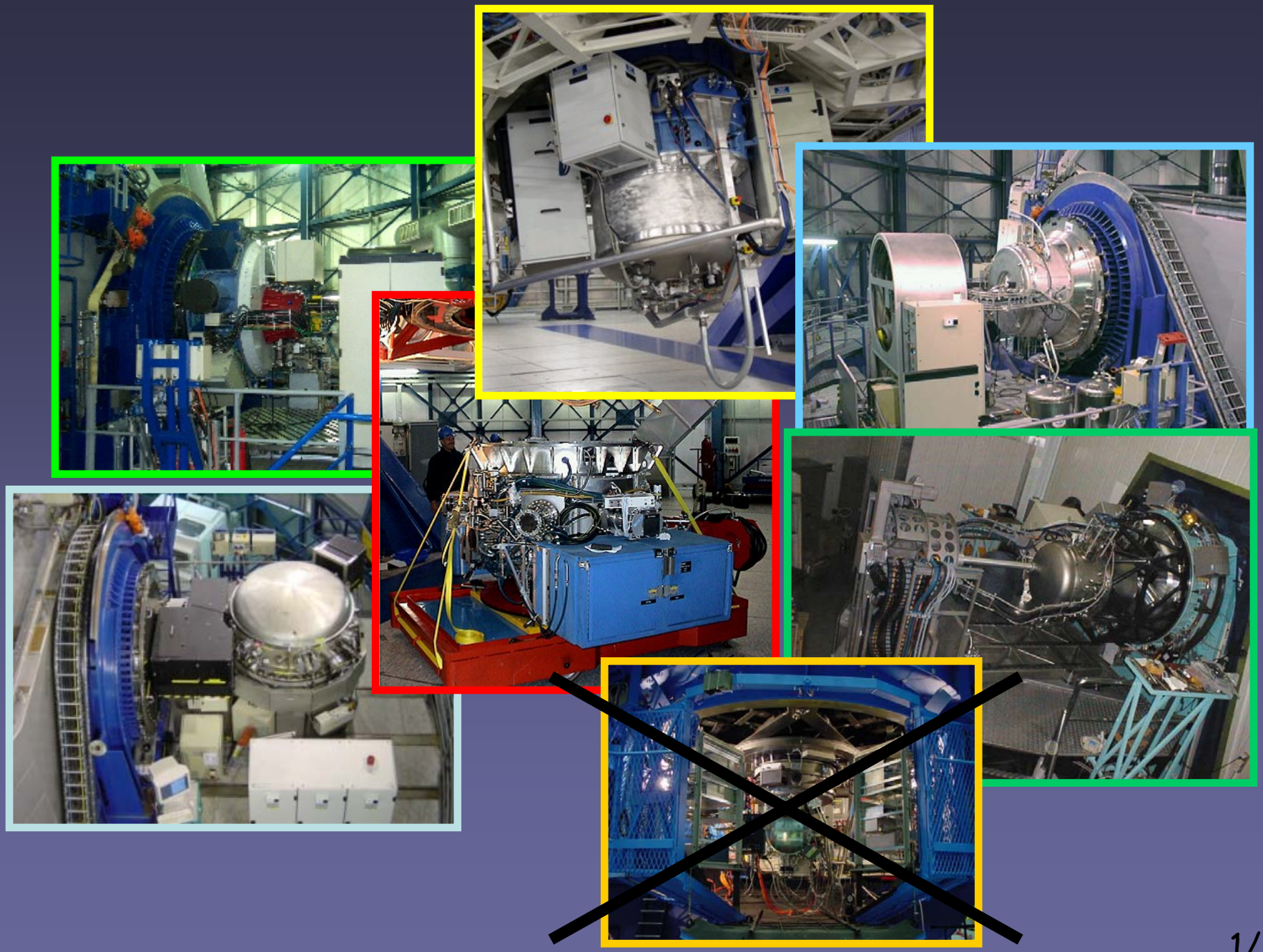
IR instruments - ISAAC

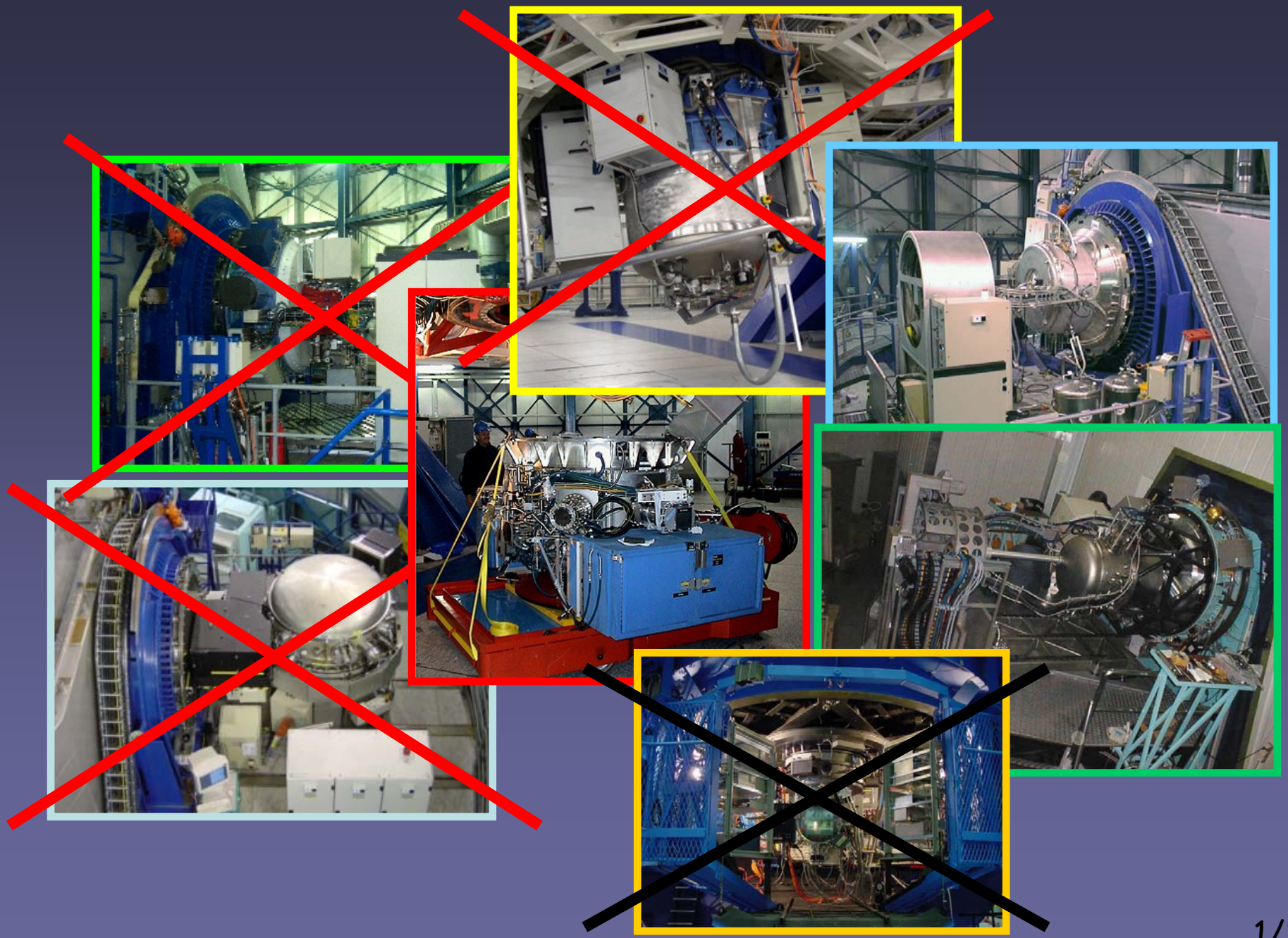
Instrument Overview Talk

The 2007 ESO Instrument Calibration Workshop
Garching, January 23-26, 2007

E. Mason







calibrations for science

calibration for the instrument characterization

calibration for monitoring

~~technical calibrations~~

	ISAAC	SofI	Conica	Sinfoni	VISIR
science calibration	• darks • spec. flats & arcs • tw/sky flats • phot std (Persson et al. 1998) • telluric star (B or G type, Hipparcos/2MASS) • night flat/arc	• darks • dome flats (IMG, SPC, IPOL) • arcs • phot std • telluric (selected sample)	• darks •tw/sky flats • flats (IPOL, IMG, SPC) • arcs • phot std • telluirc • night flat/arc (FP night arcs: mandatory)	• darks • flats • arcs • standard (pho & telluric at a time)	• phot std for IMG (Cohen et al. 1999) • telluirc std for SPC (Cohen et al. 1999)
instrument characterization	• linearity • star trace • illumination correction • filed distortion	• linearity • star trace	• linearity • gain	• [fiber frames]	–
monitoring	• dark (LW, SW, all read-out modes), ZP, telluric-of-the-month, lamp efficiency • slit image • grating check • flat check	– [grating check]	• dark, ZP, lamp efficiency • slit image	• dark, lamp efficiency, off lamp check • grating check • resolution	• darks (IMG and SPC) • [flats (IMG on both detectors)] • [sensitivity & conversion factor (ZP)]

ISAAC

science calibration

- darks
- spec. flats & arcs
- tw/sky flats
- phot std (Persson et al. 1998)
- telluric star (B or G type, Hipparcos/2MASS)
- night flat/arc

instrument characterization

- linearity
- star trace
- illumination correction
- filed distortion

monitoring

- dark (LW, SW, all read-out modes), ZP, telluric-of-the-month, lamp efficiency
- slit image
- grating check
- flat check

VISIR

science calibration

- phot std for IMG (Cohen et al. 1999)
- telluirc std for SPC (Cohen et al. 1999)

instrument characterization

-

monitoring

- darks (IMG and SPC)
- [flats (IMG on both detectors)]
- [sensitivity & conversion factor (ZP)]

the calibration plan depend on:

- instrument history (ISAAC is in operation since 1999, VISIR since 2004)
- instrument specific problems
- instrument usage/type of observations (e.g. ISAAC IPOL)

no darks, no flats, no arcs to the VISIR user …

- darks monitor the status of the instrument and the detectors.
- darks subtraction is critical when scaling frames to an average background.

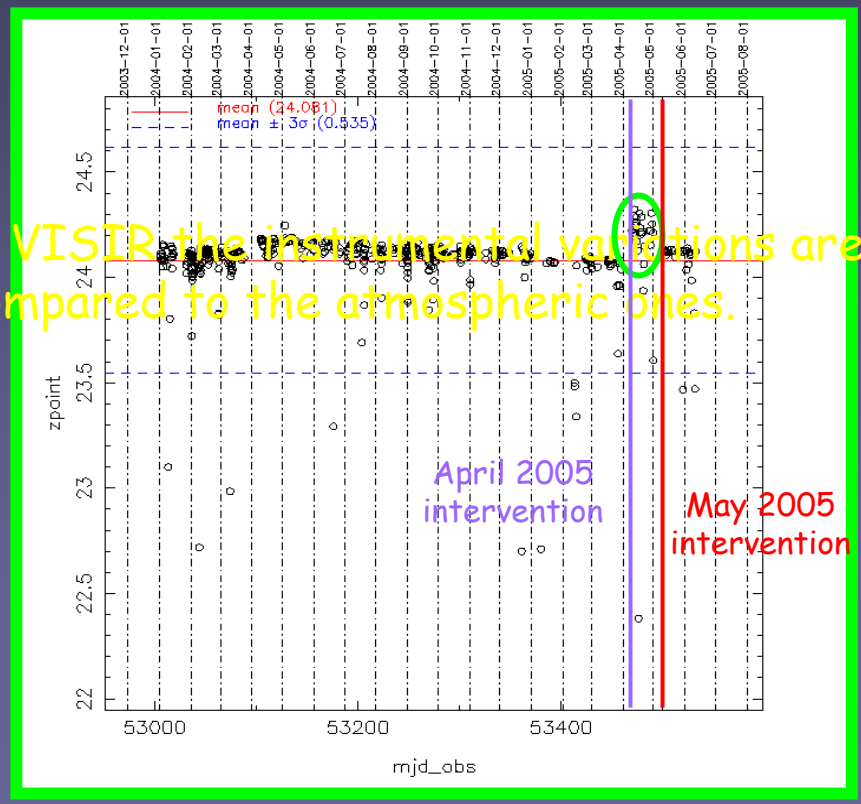
→ ISAAC and NaCo delivers darks to the users

→ VISIR: nod and chopping automatically remove the dark level
same with flats

- day time arcs for: → short exposure (NIR)
  → cross check (NIR)
  → MIR always dominated by sky emissions

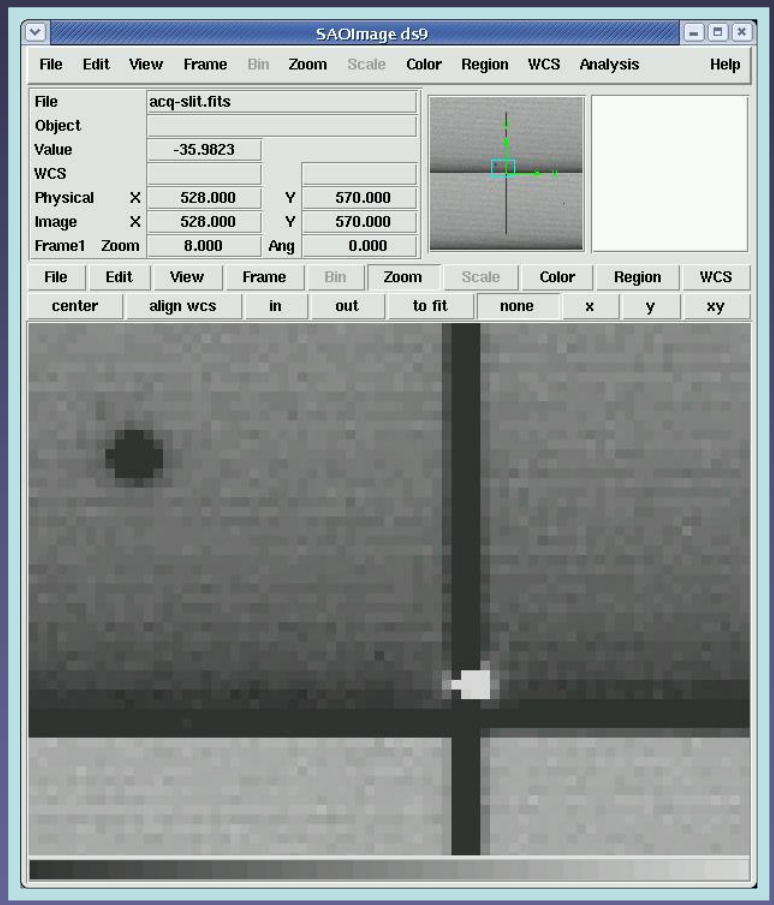
ZP for monitoring ?

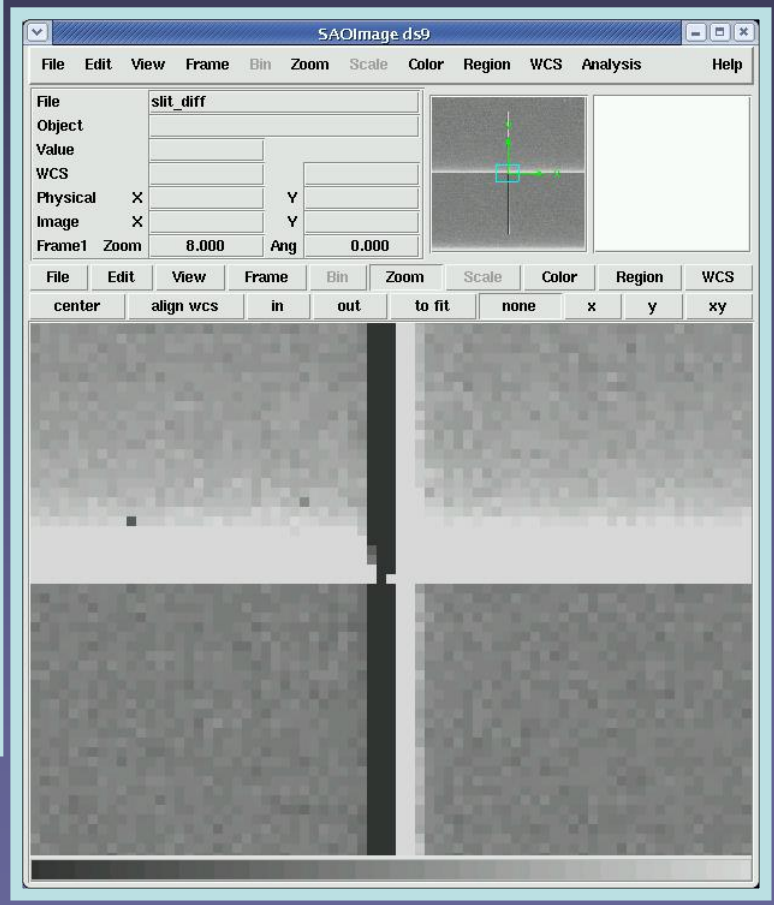
ZPs to: → classify the night & the OBs
→ check the instrument status at the beginning of the night (e.g. AO, alignment, in NaCo)
→ monitor the instrument status (NIR)



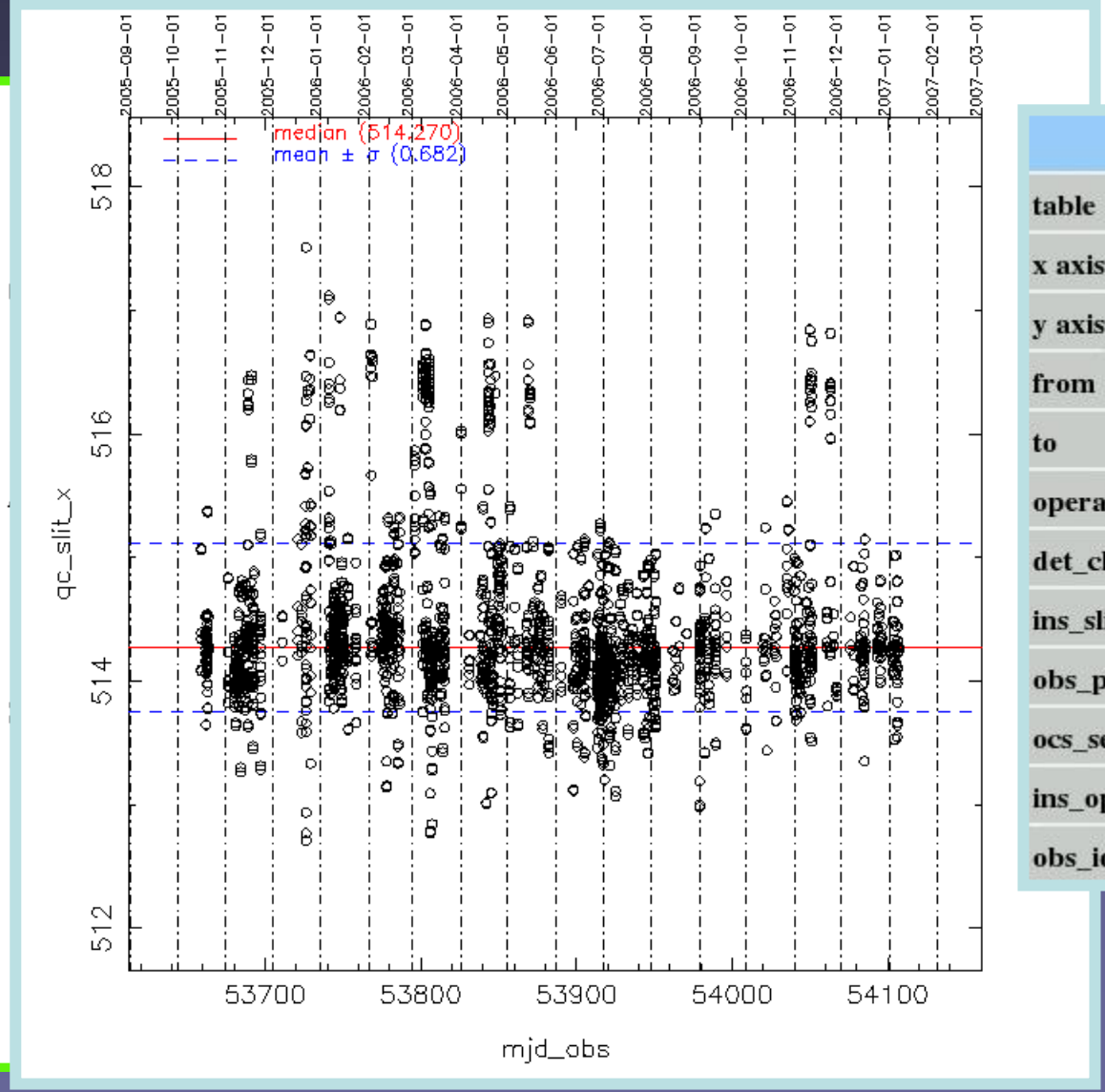
→ in VISIR the instrumental variations are minimal compared to the atmospheric ones.

monitoring: ISAAC objectives & slit image





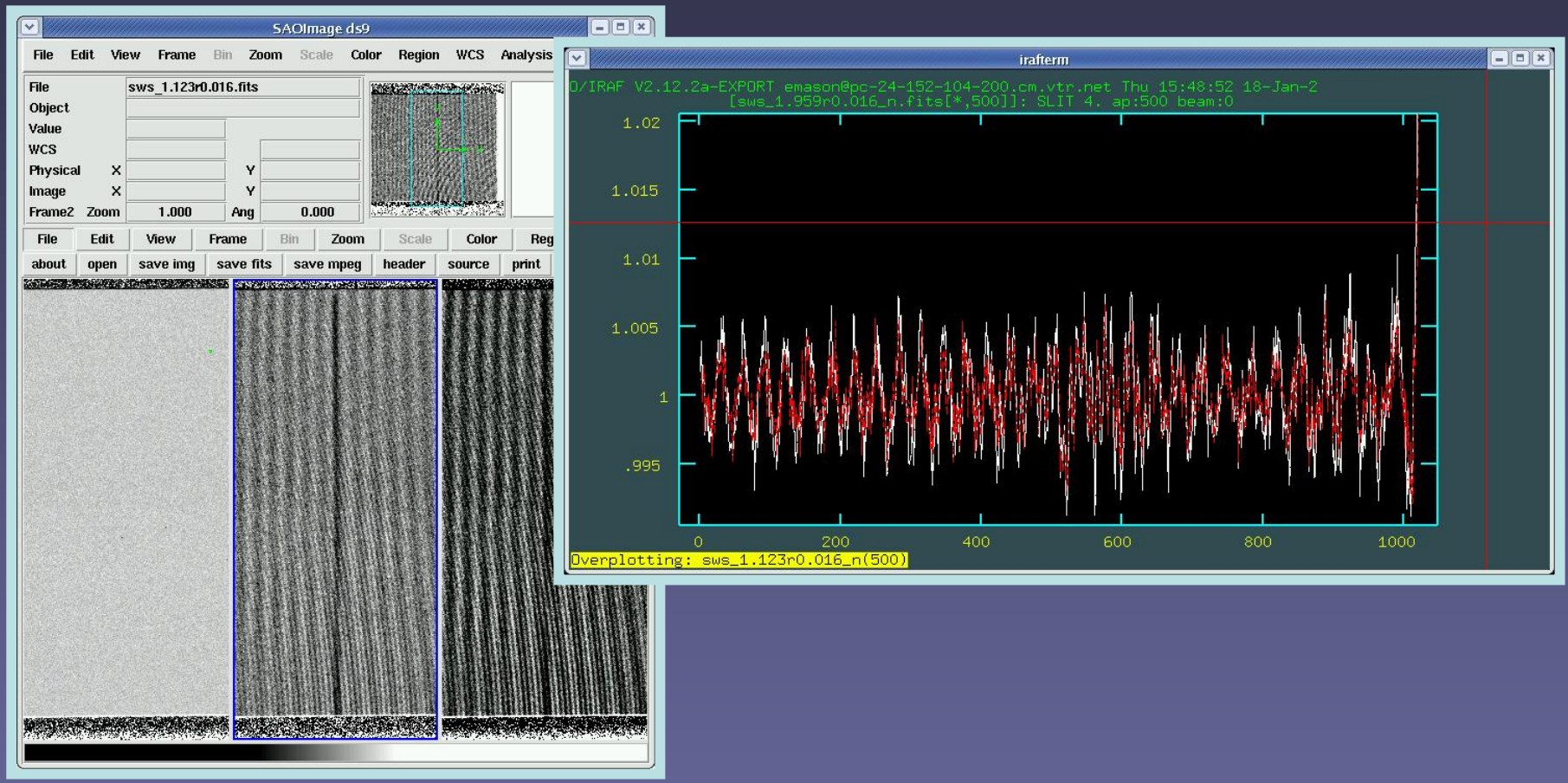
ISAAC objective (continue):



x_c distribution

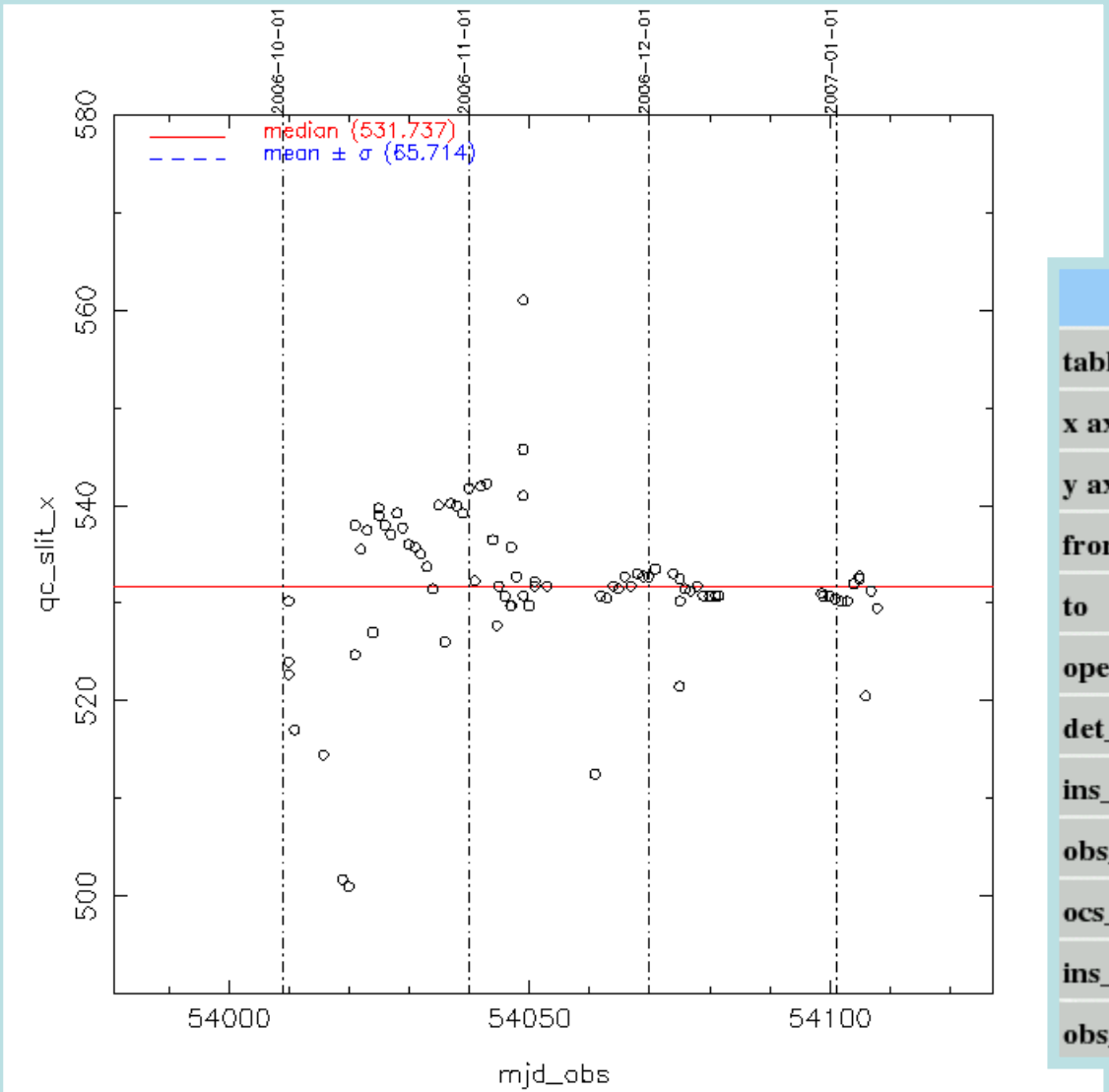
Summary Information	
table	isaac_slit
x axis	mjd_obs
y axis	qc_slit_x
from	2005-10-15 (mjd=53658)
to	2007-01-15 (mjd=54115)
operat_type	ALIGN
det_chip_name	ESO-Hawaii
ins_slit	any
obs_prog_id	any
ocs_select_arm	SW
ins_opti_name	S2
obs_id	any

performing slit alignment we also minimize the fringing



however, fringing can be removed only with a specific observing strategy

monitoring: ISAAC grating



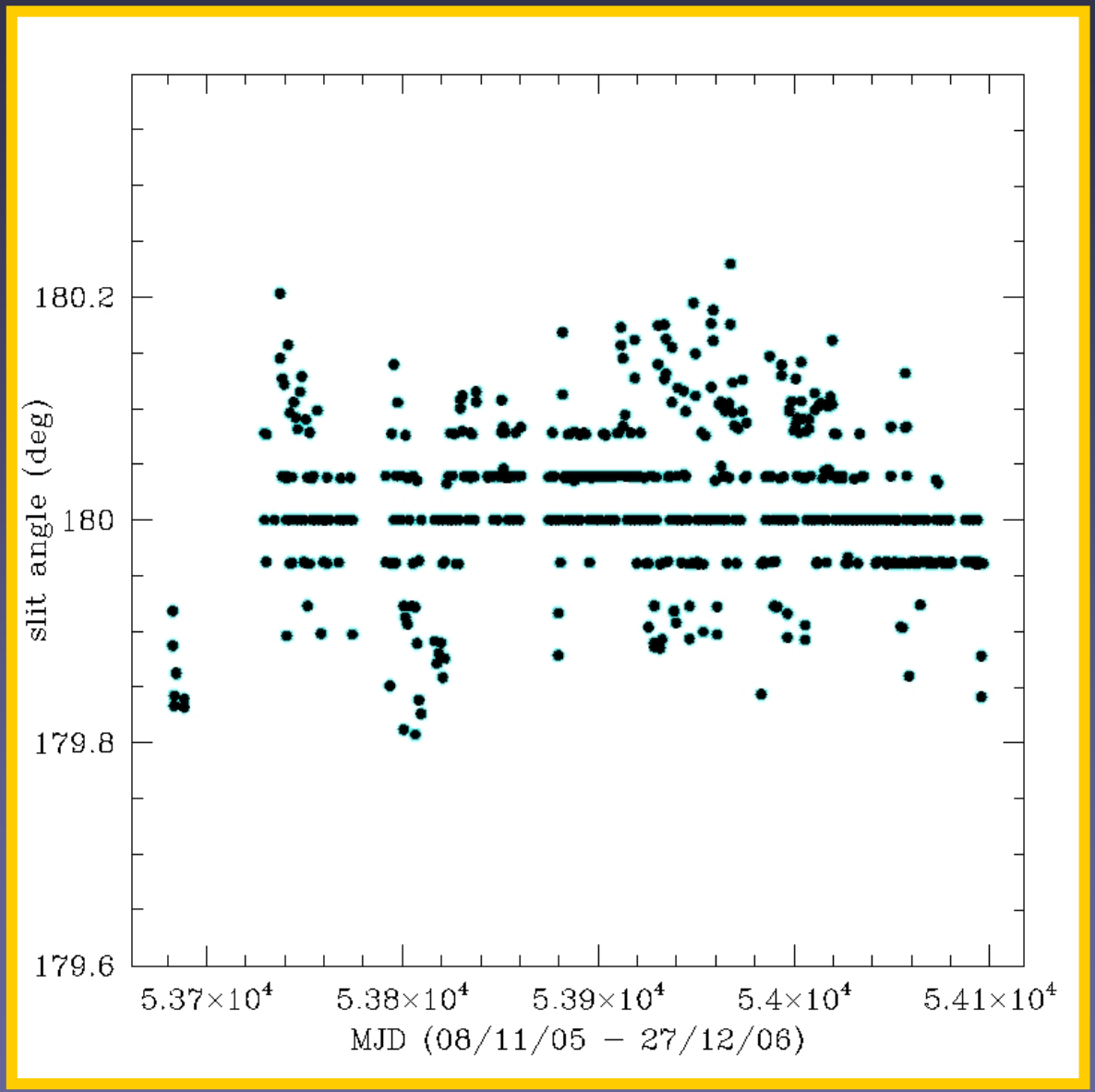
for large grating offsets:
- arcs are "useless"
- poor telluric correction
- poor flat fielding → fringing

Summary Information	
table	isaac_slit
x axis	mjd_obs
y axis	qc_slit_x
from	2006-09-15 (mjd=53993)
to	2007-01-15 (mjd=54115)
operat_type	GratingCentralLine
det_chip_name	ESO-Hawaii
ins_slit	any
obs_prog_id	any
ocs_select_arm	SW
ins_opti_name	S2
obs_id	any

NaCo slit angle:

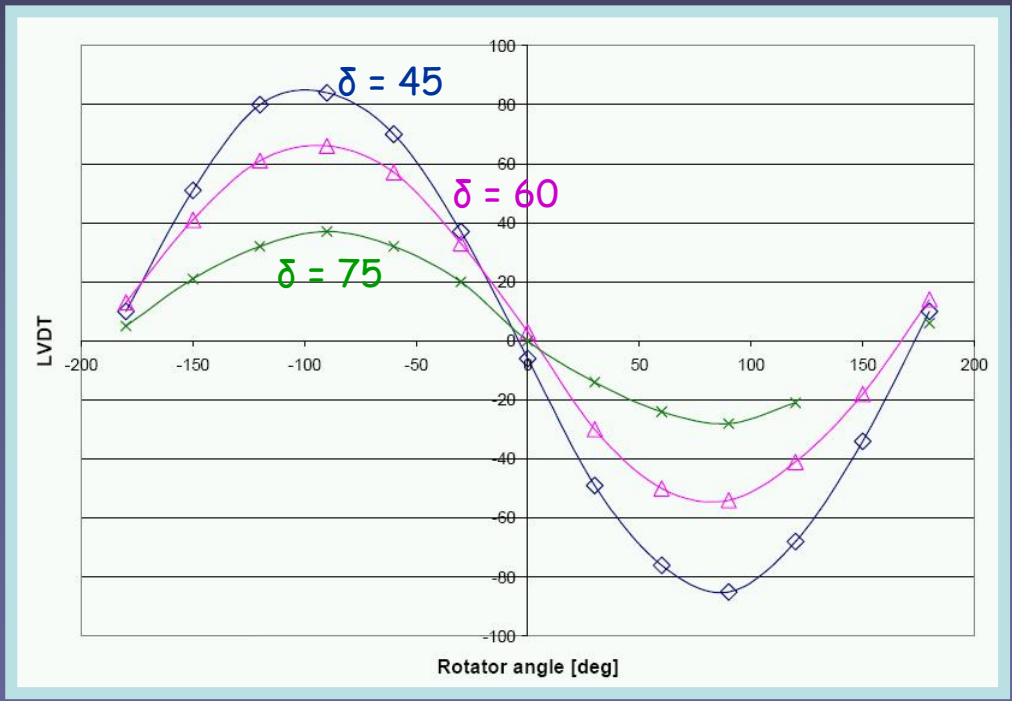
- tolerance 0.1 deg
- always check for uniform slit illumination

- a clear procedure to realign the slit angle is under "construction"



VISIR scanner

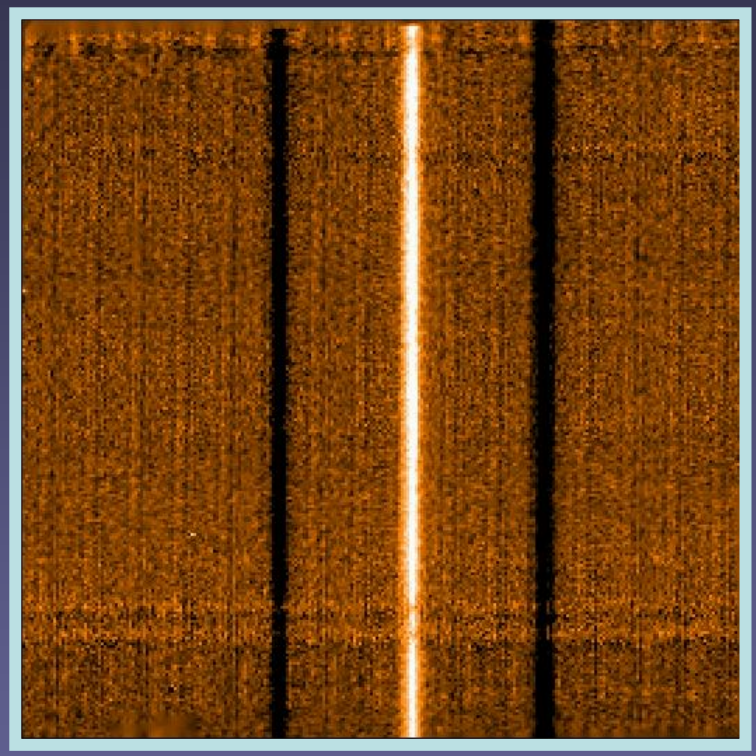
HR arm in the spectroscopic arm makes use of a scanner, a controller for the fine positioning of the grating.
Flexures measured during observations (telescope tracking and nodding) show a drift of 0.25pix/min and:

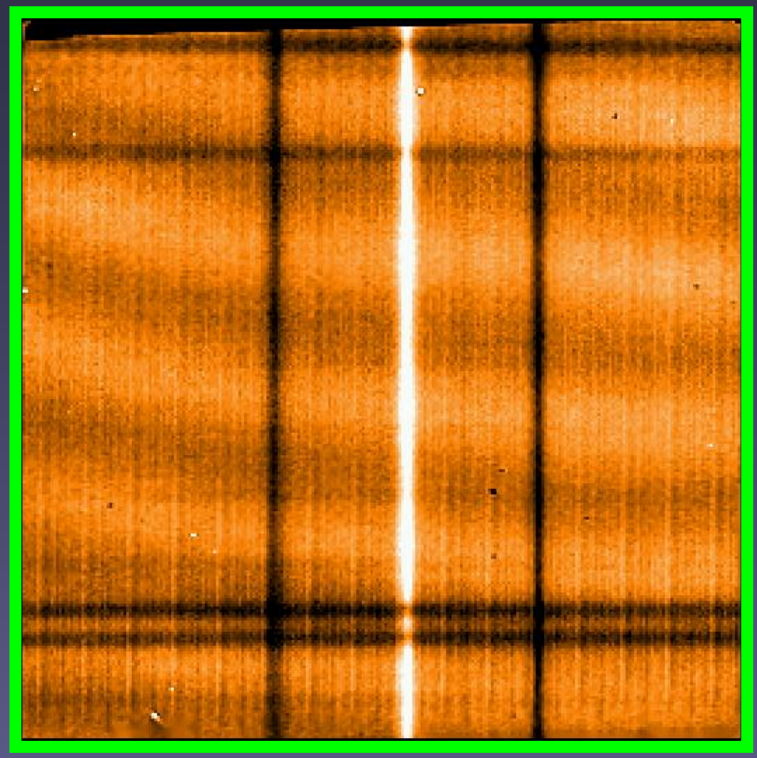


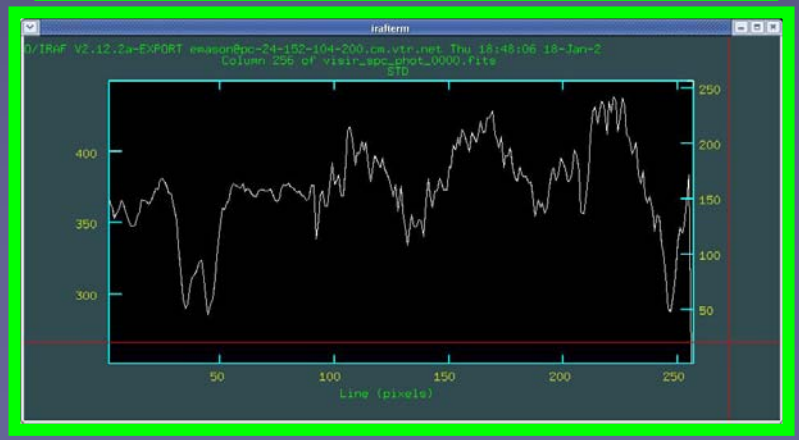
20
10
0
-10
-20
pixels

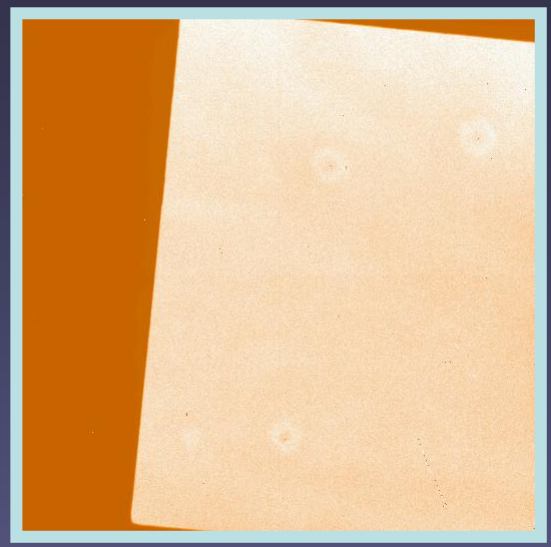
- diminished spectral resolution
- fringing

VISIR detector fringing:







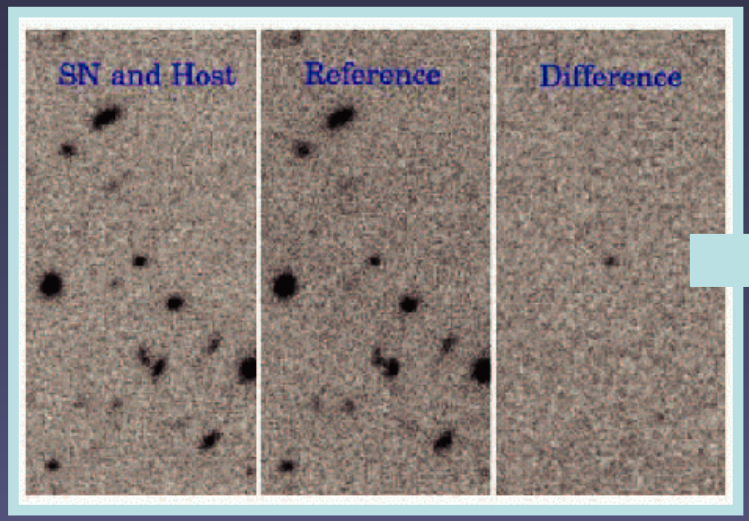


SofI dome flats

Hawaii → dark level depend on the total illumination
→ dark difference ~ 20-30 ct
→ 4 flats (2 pairs "fully exposed – partly exposed") delivered to the user: master flat = normalized ($high_{corrected}$ – $low_{corrected}$)

ISAAC does not have the same capability …

ISAAC standard calibration and good seeing:



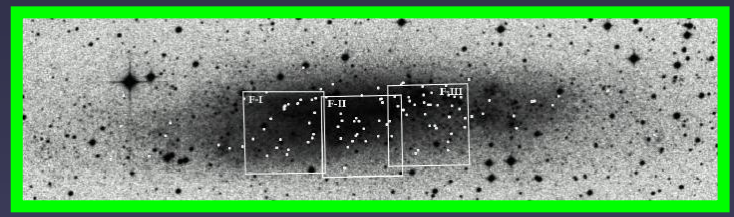
- 10+10 hr integration
- IQ=0.4"

→ S/N ~ 12
→ J=23.6
→ z=1.12

IQ=0.3 → z~1.5
HAWK-I AO wide field instrument
NACO needs a bright GS for AO corrections …

[Lidman, Messanger 118, 2004 – the SN cosmology project]

ISAAC non standard calibrations:



- 6 photometric standards (UKIRT system)
- broad color range bracketing target color
- various airmass

→ 0.03 mag accuracy with no more than 1hr telescope time for stds

→ ZPs stable to 2%

- no illum correction, no need 1% accuracy ←→ not possible
- ISAAC-UKIRT: matching K filter and very small J-K color term

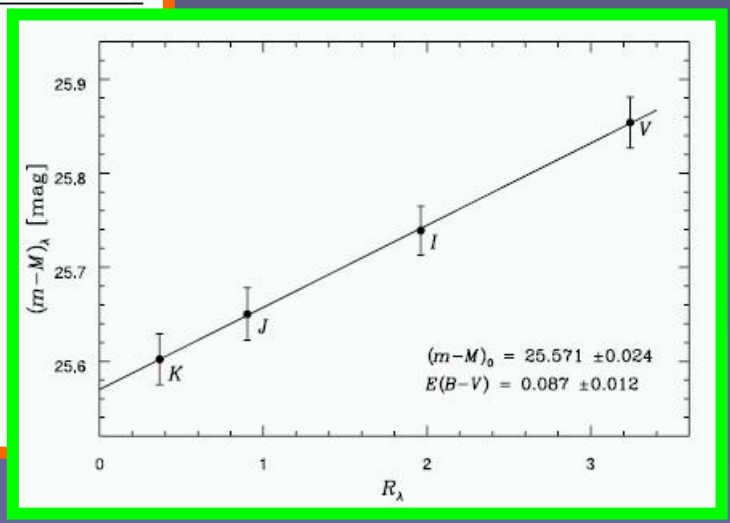
[ARAUCARIA project, Pietrzynski 2007, priv. comm.]

Soszynski et al., ApJ 648, 2006

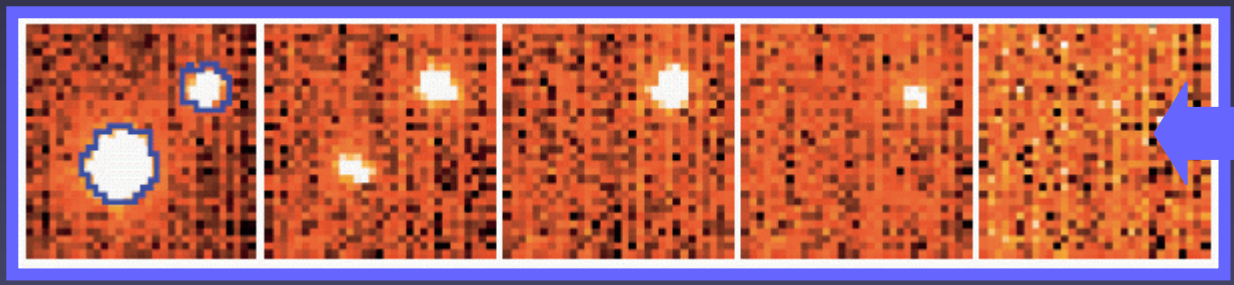
TABLE 2

INTENSITY MEAN J AND K MAGNITUDES FOR 77 CEPHEIDS IN NGC 3109

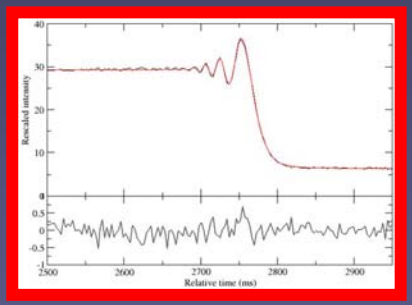
ID	P	$\langle J \rangle$	$\sigma_{\langle J \rangle}$	$\langle K \rangle$	$\sigma_{\langle K \rangle}$	Remarks
cep001	31.4793	18.864	0.033	18.413	0.028	
cep002	31.270	18.825	0.039	18.242	0.030	
cep003	29.110	19.077	0.038	18.544	0.034	
cep004	27.389	18.950	0.033	18.502	0.030	
cep005	26.8274	19.068	0.037	18.551	0.040	
cep007	20.388	19.795	0.035	19.252	0.039	
cep009	19.5759	19.328	0.035	18.861	0.031	
cep011	17.2293	19.767	0.036	19.261	0.039	
cep012	14.750	19.812	0.045	19.265	0.049	
cep014	14.062	19.650	0.048	19.282	0.039	
cep015	14.030	19.949	0.040	19.375	0.040	
cep016	13.9047	19.648	0.039	19.229	0.038	
cep017	13.6250	19.890	0.039	19.418	0.040	
cep018	13.364	20.189	0.063	19.675	0.051	



ISAAC and NO calibration – NO ISAAC NO Calibration – just Aladdin + IRACE and a big telescope

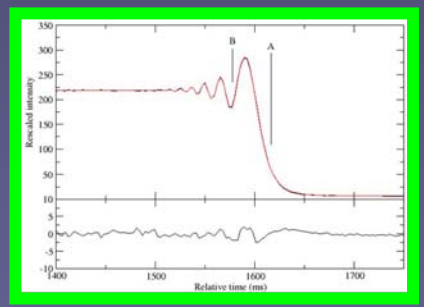


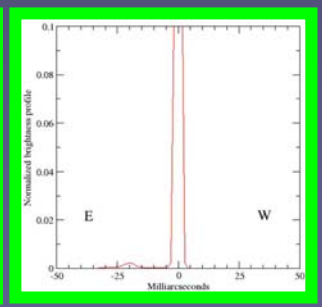
Richichi et al, Messanger 126, 2006



diameters

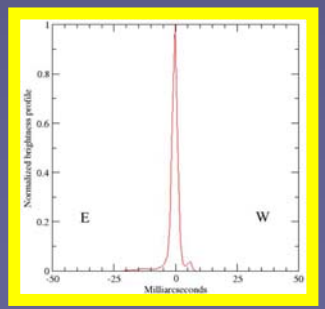
- K=6.67 mag, Φ=3.67±0.56 mas, S/N=96.3





binaries

- sep=19.72±1.25 mas, ΔK=4.89±0.15, S/N=253.81



extended emissions

[courtesy Fors, 2006]

→ limit magnitude K=12.2 mag
→ limit resolution Φ=0.5-1.0 mas