



ESO Test Plan for AO WFS CCD220

Mark Downing

European Southern Observatory ESO (<http://www.eso.org>)

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Talk Overview

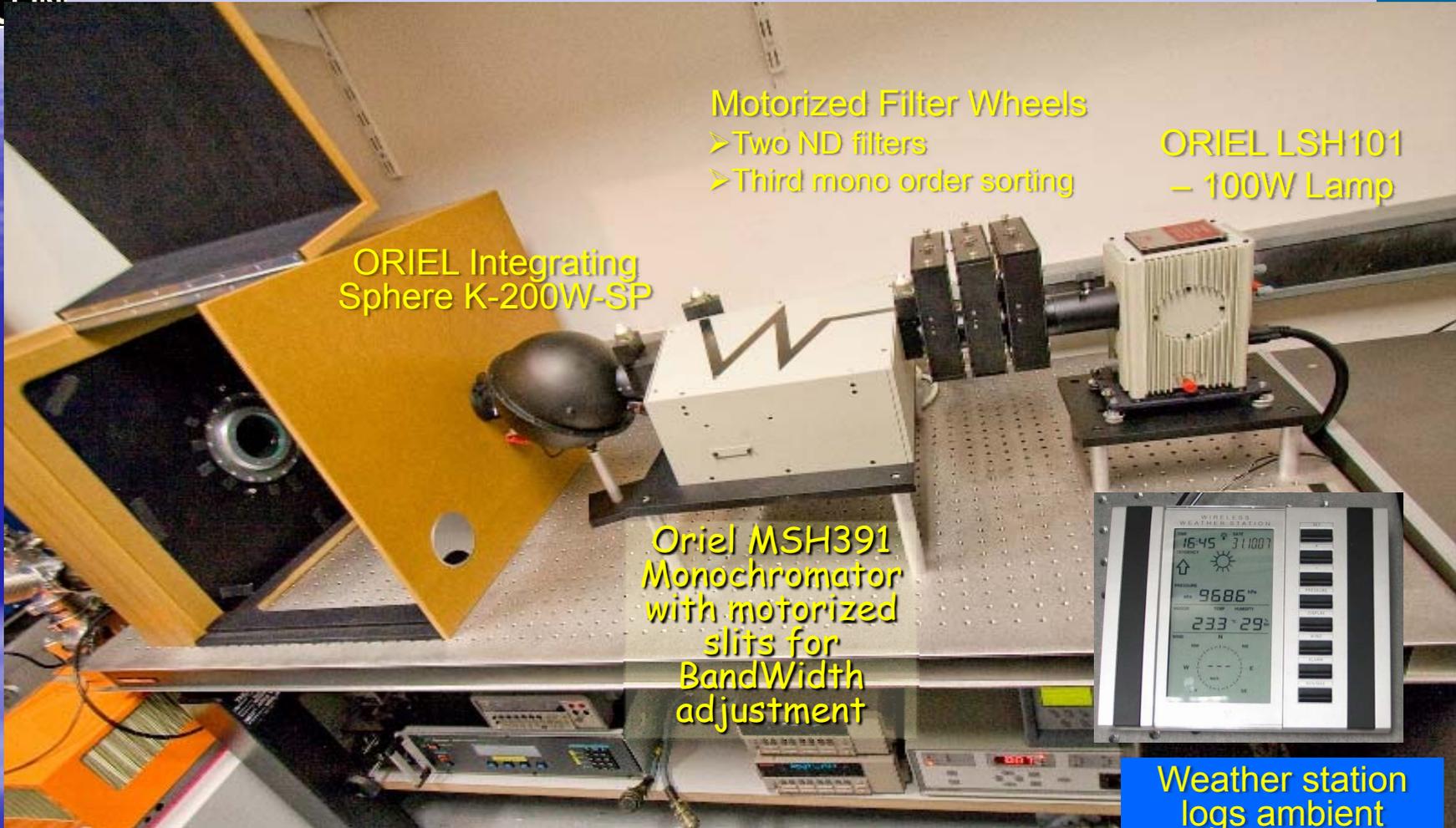


- Progress on AO Test Bench
- Test Plan
- Status and Schedule



Progress on AO Test Bench

Setup Well Advanced



Motorized Filter Wheels

- > Two ND filters
- > Third mono order sorting

ORIEL LSH101
– 100W Lamp

ORIEL Integrating
Sphere K-200W-SP

Oriel MSH391
Monochromator
with motorized
slits for
BandWidth
adjustment



Weather station
logs ambient
temperature/
humidity

Thanks to Sebastian Deiries and Eric Mueller



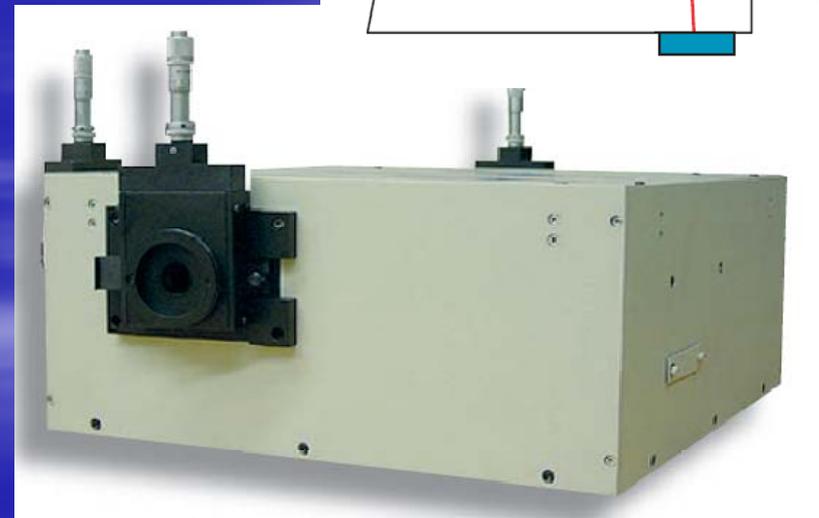
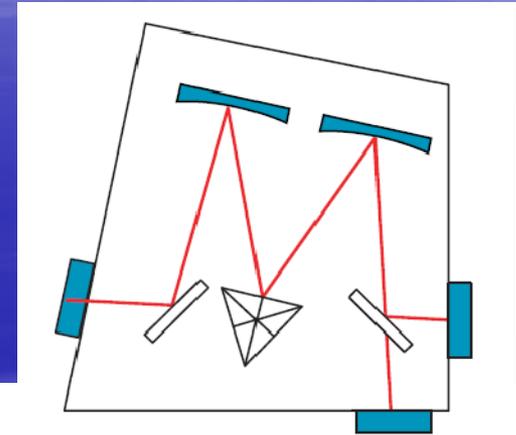
Bolt to Optical Table or mount on slide TBD.



Equipped with

- Grism (MSG321) 600l/mm, blaze 400nm, range 250-1300nm
- Micrometer driven slit unit (MSZ111) for Bandwidth control
- Order selecting filter wheel (MSZ121)

Specifications	
Focal length:	260 mm
Aperture ratio:	f/3.9
Optical design:	In-Plane Czerny-Turner
Optical port:	Side entrance and two side exits
Operating range:	185 nm - 22 μ m with interchangeable gratings
Resolution:	0,15 nm with 1200 l/mm grating at 546 nm, 10 μ m slits
Dispersion ¹⁾ :	6.4 nm/mm for 600 l/mm grating at blaze wavelength
Accuracy (wavelength) ²⁾ :	$\pm 0,35$ nm
Repeatability ²⁾ :	$\pm 0,08$ nm
Drive step size ²⁾ :	0,1 nm
Focal plane size:	28 x 10 mm
Standard slit:	Width: 4 μ m – 3 mm, ± 10 μ m via micrometer control Height: 2-15 mm, selectable
Grating mount:	triple grating turret, gratings interchangeable
Grating size:	50 x 50 mm
PC Interface:	RS232C and GPIB
Size/Weight:	346 (L) x 362 (W) x 90 (H) / 9,5 kg



Supplier: LOT-Oriel

http://www.lotoriel.de/site/site_down/ms_msh301_deen.pdf

- Illumination
 - ⇒ Halogen Lamp (LSH101) 1000W with UV Quartz condenser (LSC115) ,
 - ⇒ NEWPORT 69931 40-300W Radiometric digital LAMP PWR Supply,
 - ⇒ http://www.lot-oriel.com/site/site_down/ls_halogen1000w_uken04.pdf
- QE measurement
 - ⇒ Absolute calibrated Hamamatsu S2387-1010R Silicon Photodiode
- Photodiode current measurement
 - ⇒ KEITHLEY 6514/E ELECTROMETER
 - ⇒ <http://www.keithley.de/products/locurrhiresist/electrometers/?mn=6514>



RS-5B LED Computer Programmable Light Source



- Contrary to “normal” CCD tests cannot vary exposure time to vary illumination level.
- Perform linearity measurements at fixed frame rate.
- RS-5B varies light intensity with 16 bit resolution and accuracy of 0.25% rms.
- Demo in evaluation.

Source Geometry	100 mm diameter extended source. Projection beam, lambertian/super-lambertian option. Up to 10 spectral channels.
Spectral Output	Narrow or broadband configurations from 500 to 1550 nm. Custom spectrums/illuminants or CIE[x,y] gamuts by request.
Spectral Bandwidth	10-700 nm (<i>can be narrowed on request</i>).
Linear Brightness Adjustment	
Resolution	16 bits
Dynamic Adjustment Range	Depends on Spectrum (14 bits typical)
Signal to Noise ratio	96 dB
Non-linearity	
Radiometric	0.25% nominal (RMS of full scale)
Photometric	< 1.0% RMS of full scale
Colorimetric	< 1.0% RMS of full scale
CCT	< 1.0% RMS of full scale
Spectral	1% to 10% RMS of full scale (depends on spectrum)

- PC running XP
 - ⇒ GPIB Interface – National Instruments.
- LabView Version 8 for control
 - ⇒ Test Bench functions (shutter, filters, monochromator etc),
 - ⇒ Could do data taking and simple analysis.
- Data taking/image analysis
 - ⇒ FITS format
 - ⇒ Standard PRiSM scripts available,
 - ⇒ PRiSM needs control link to OCAM and NGC for setup, control of data taking and transfer of images.
 - ⇒ IDL scripts written by Simon Tulloch for specialized analysis.





GUI Interfaces

ESP300_standalone.vi Front Panel

ESP 300

File Edit View Project Operate Tools Window

Busy

GPIO Parameters

TermChar	Timeout	Delay	Port In
2	5000	100	14

Actual pos[mm] 0.0000 +

Increment [mm] 0.0001 -

Absolute pos[mm] 0.0000 goto

Settings

Actual pos[mm] 0.0000 +

Increment [mm] 0.0001 -

Absolute pos[mm] 0.0000 goto

Settings

Actual pos[mm] 0.0000 +

Increment [mm] 0.0001 -

Absolute pos[mm] 0.0000 goto

Settings

Check Pos. Abort motion

Define home Search for home

Exit

Error_log

read_fits_real_image_file3.1.vi Front Panel

File Edit View Project Operate Tools Window Help

Image Table Display image Display table

X 4296 Y 512

ITPIX = 16 / 2 byte twos-compl integers (16 bits)

AXIS = 2 / 2 axis (two dimensions)

AXIS1 = 4296 / # pixels/row

AXIS2 = 512 / # rows

ORIGIN = 'ESO ' / European Southern Observatory

DATE = '2007-10-26T15:09:35.689' / Date this file has been written

RVAL1 = 1.0 / Coordn first column (x-start)

RPIX1 = 1.0 / Always referenced to first pixel in x

DELTA1 = 1.0 / Increment along x (x-step)

TYPE1 = 'PIXEL ' / Units along x

RVAL2 = 1.0 / Coordn first row (y-start)

RPIX2 = 1.0 / Always referenced to first row (y)

DELTA2 = 1.0 / Increment along y (y-step)

TYPE2 = 'PIXEL ' / Units along y

SCALE = 1.0 / Real = File*BSCALE+BZERO

ZERO = 32768.0 / Real = File*BSCALE+BZERO

UD-OBS = 54399.631563 / Start of exposure

XPTIME = 2.0094 / Total integration time

XTEND = F / Extension may be present

COMMENT Temp.(CCD1) / 140.6K

COMMENT Temp.(CCD2) / 140.0K

Filter_wheel_standalone.vi Front Panel

File Edit View Project Operate Tools Window

GPIO Port 4

Filter Label

1	Cut on 305nm
2	Cut on 550nm
3	Cut on 1000nm
4	-
5	-
6	-

Change label

STOP

Error log

FIERA_standalone.vi

File Edit View Project Operate Tools Window Help

Press "Ctrl" + "H" for context help

STOP VI

Setup Indicators

Type Normal

Exposure time [s] 1

Readout mode 2 225kpx/rr/HG/512 2

Number of exposures 1

Delay [s] 0

Save file as default

display image

display table

Write comments to header

Start Fiera

Put Fiera ONLINE

Start exposure

Put Fiera in standby

Exit

Error log

Keithley_6514_standalone.vi Front Panel

File Edit View Project Operate Tools Window

Keithley 6514

GPIO Address 14

Measurements 5

Mean 1.3343nA standard deviation 0.9543pA

Error_log

PowerSupply_standalone.vi

File Edit View Project Operate Tools

Press "Ctrl" + "H" for context help.

Port COM9

Display Set A/P

Mode Power mode change

Power 0 W

Voltage 0 V

Current 0.07 A

Lamp hours 0 Reset

Lamp on? Start lamp Stop lamp

Update every 30 sec

Error_log

Thanks to Sebastian Deiries and Eric Mueller



Test Plan

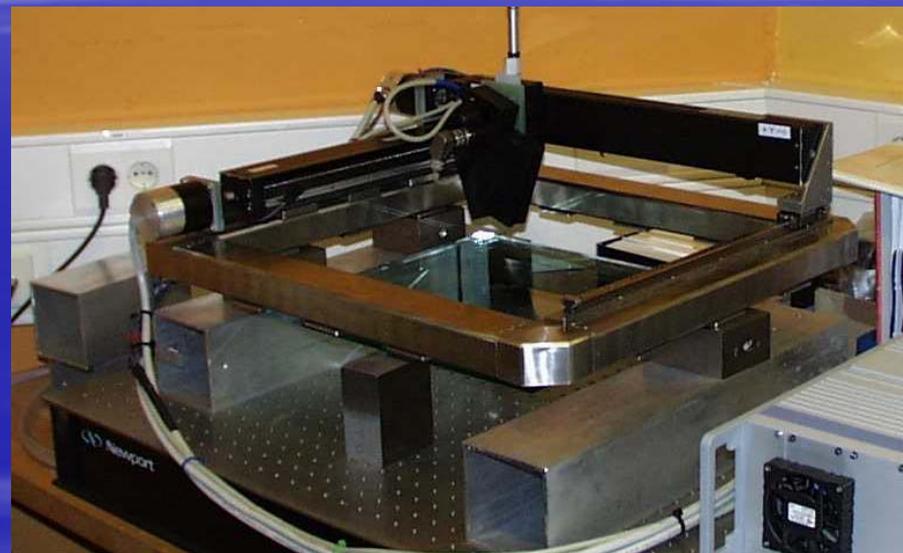


Test Plan Objectives



- Quick verification of critical performance parameters:
 - ⇒ noise, gain, cosmetics, dark current (CIC), linearity, QE, and CTE
- Obtain experience with Marseille controller and feedforward to NGC.
 - ⇒ Stability of gain with voltage and phase of HV clock.
 - ⇒ Stability of gain and bias with temperature and time.
 - ⇒ CTE with signal level
- Perform more complete test and optimization.

- Use existing metrology equipment
 - ⇒ Could be problems with differentiating between sapphire window and CCD surface if too close.
 - ⇒ Measurements of Front Face device in progress.
- Perform measurements at room and operating temperature.
 - ⇒ Flatness
 - ⇒ Optical Distance Between Silicon and Window
 - ⇒ Angle Between Silicon and Front of Window





Electro-optical Tests I



- **QE**
 - ⇒ Use standard established setup at ESO
 - ⇒ Calibrated diode comparison technique
- **Cosmetic Defects (gain = 1000)**
 - ⇒ Median filter stack of 10 biases and flats
 - ⇒ Bright defect - deviant pixel in bias $> 400\text{e/p/s}$ at 25Hz
 - ⇒ Dark defect - deviant pixel in flat $< 50\%$ mean unbiased signal at 1500Hz.
 - ⇒ Traps (TBD)



Electro-optical Tests II

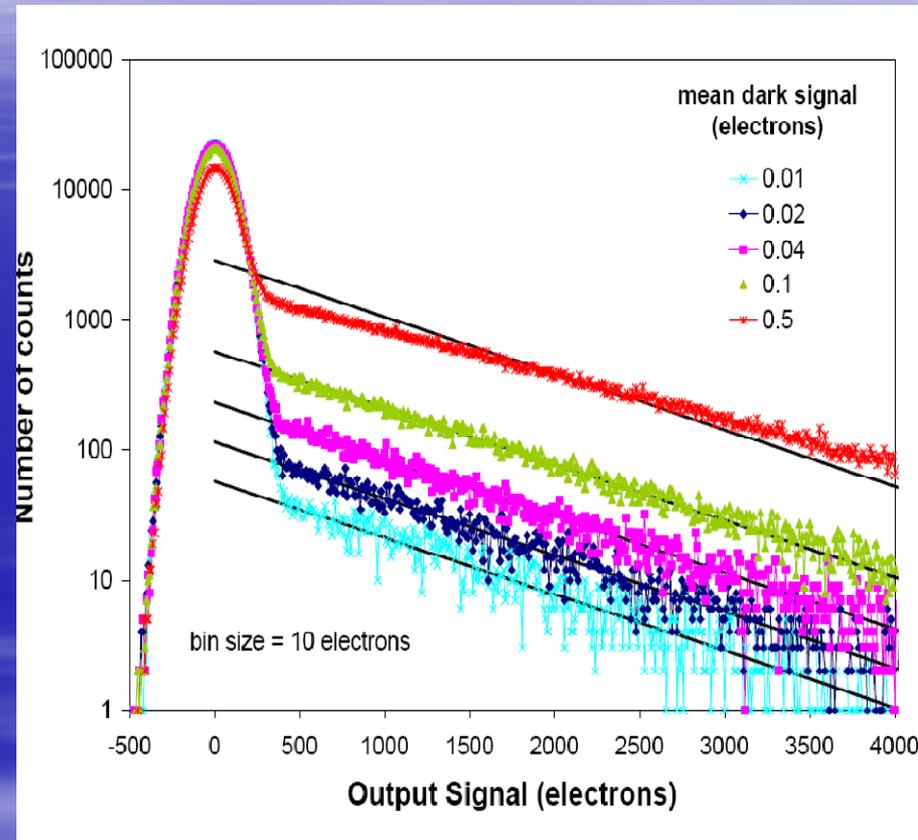


System Gain (1500fps) e/ADU

- At x1 gain - use photon transfer curve.
- At 1000x - use histogram technique - plot histogram of 100 biases and slope of line of dark current part = gain.
- Use e2v technique of measuring IRD to determine input flux and measuring output in ADU. Measure at two levels and gain = $\Delta\text{IRD}/\Delta\text{ADU}$. Can be used at x1 and x1000.

Noise (gain ~ 1000, 1500fps and 25fps)

- Same technique as e2v
 - ⇒ Plot histogram of 100 biases.
 - ⇒ Fit gaussian curve to part dominated by amplifier noise and calculate 1 std.
 - ⇒ Divide by gain=1000



Estimating Ultra Low Levels of Dark Signal Using an L3Vision Device

Mark Robbins e2v technologies



Electro-optical Tests III



Dark Current

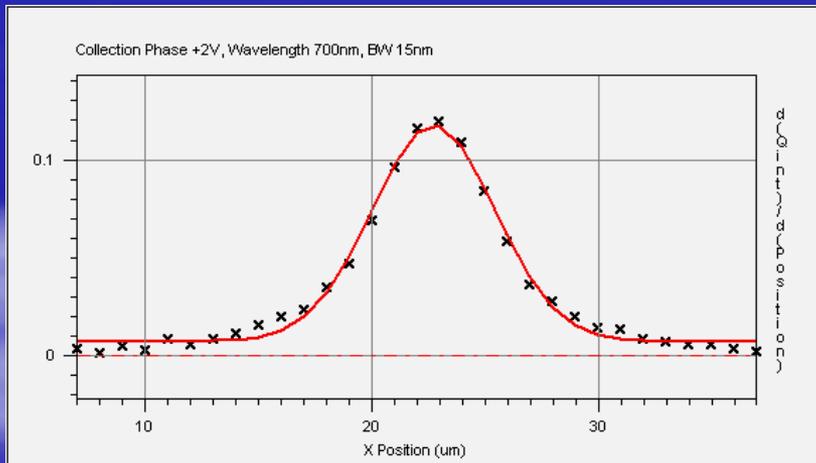
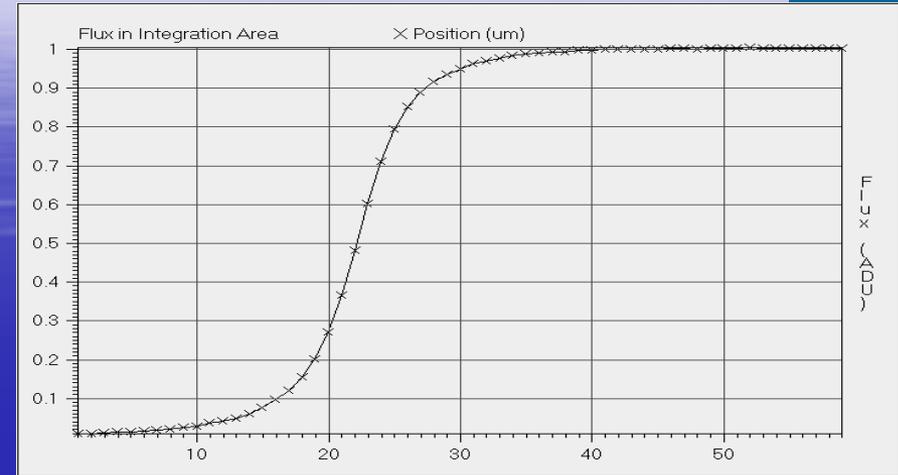
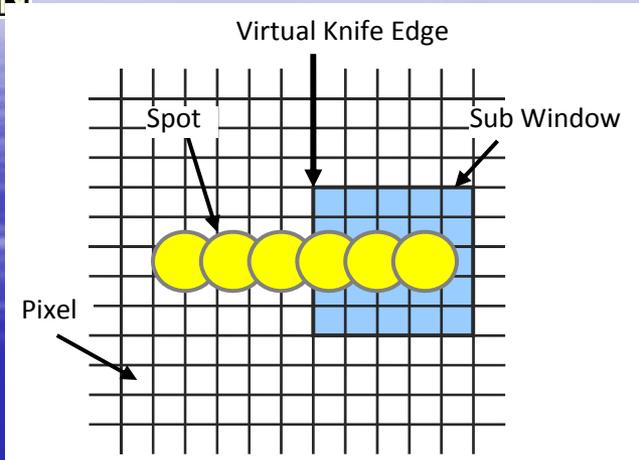
- Measure at 1500fps and 25fps; x1000 gain
- Extract from same data as noise (100 biases)
- Use e2v technique of fraction of pixels per frame above thresholds of 500e and 1000e.

Linearity (x1000 and x200 gain)

- Fixed frame rate and vary illumination level using RS-5B light source.

CTE (x1000 gain)

- Calculated by standard technique of measurement of deferred charge in overscans.
- Measure over a range (10ke-100ke) of output levels.



$$Q(x) = a - \frac{(a-b)}{\pi\sigma/k} \int_{-\infty}^x 1/\cosh\left(\frac{x'-c}{\sigma/k}\right) dx' \quad k = 1.368 \quad (1a)$$

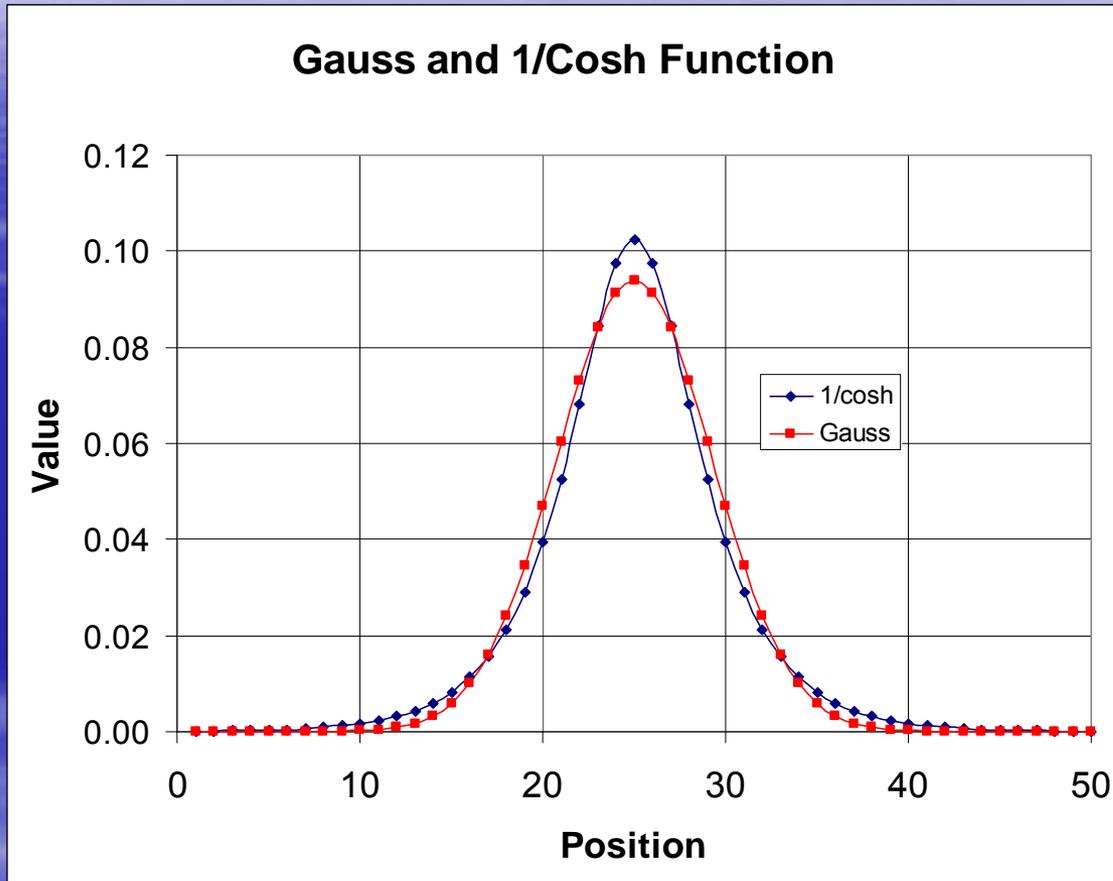
$$Q(x) = a - \frac{(a-b)}{\sqrt{2\pi}\sigma} \int_{-\infty}^x \exp\left(\frac{-(x'-c)^2}{2\sigma^2}\right) dx' \quad (1b)$$

Apply Fit
 (1a) for under depleted,
 (1b) for over depletion

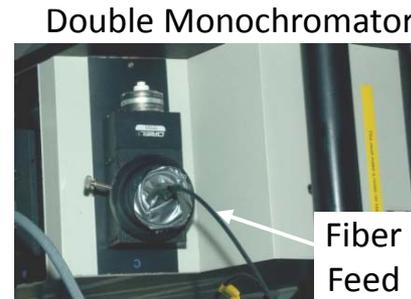
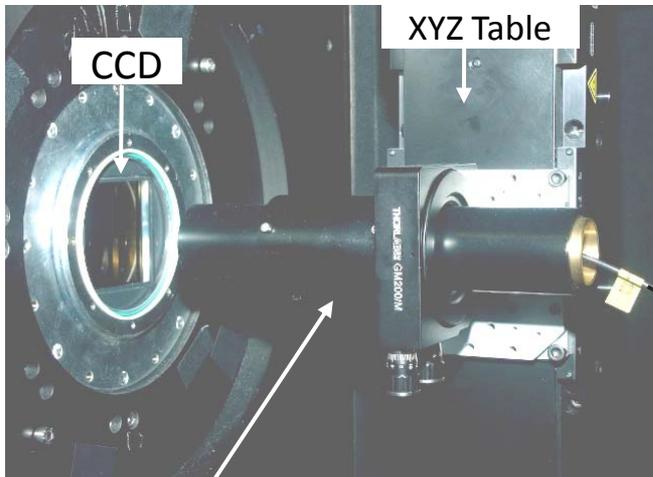
Measurement of Lateral Charge Diffusion in Thick, Fully Depleted, Back-illuminated CCDs, Armin Karcher.
http://snap.lbl.gov/ccdweb/LBNL_55685.pdf



Gauss and 1/Cosh Fit



PSF Setup



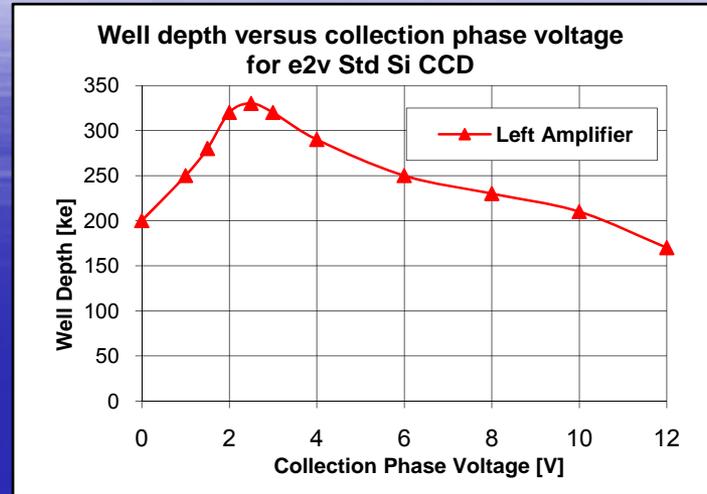
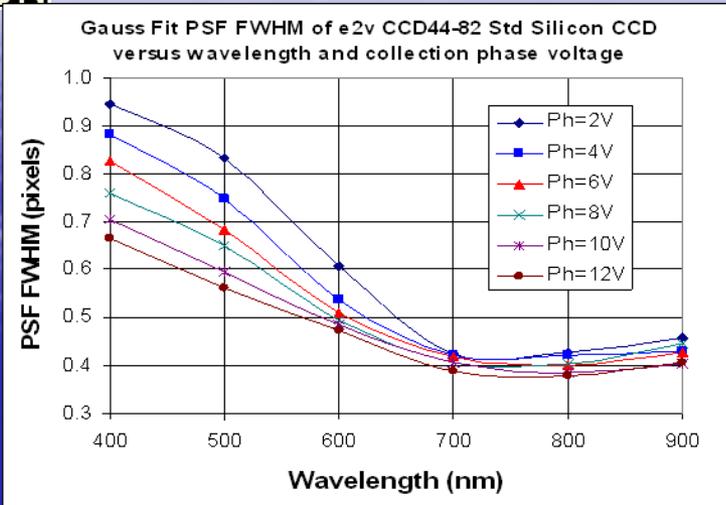
Optical
Fiber

X- Y- Z- Motors and
Encoders

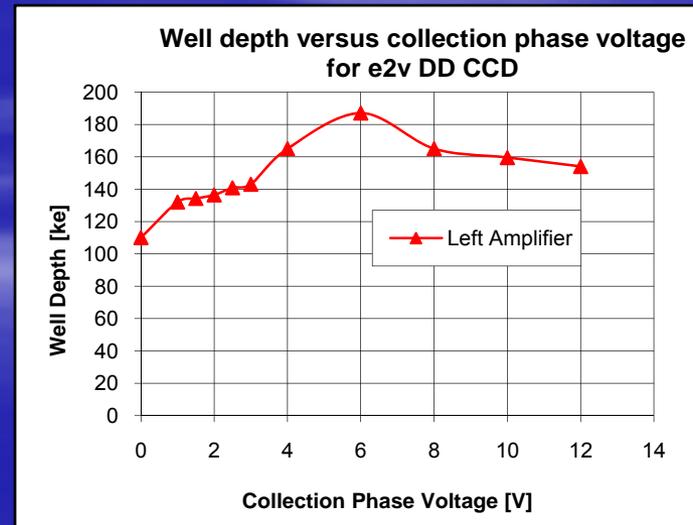
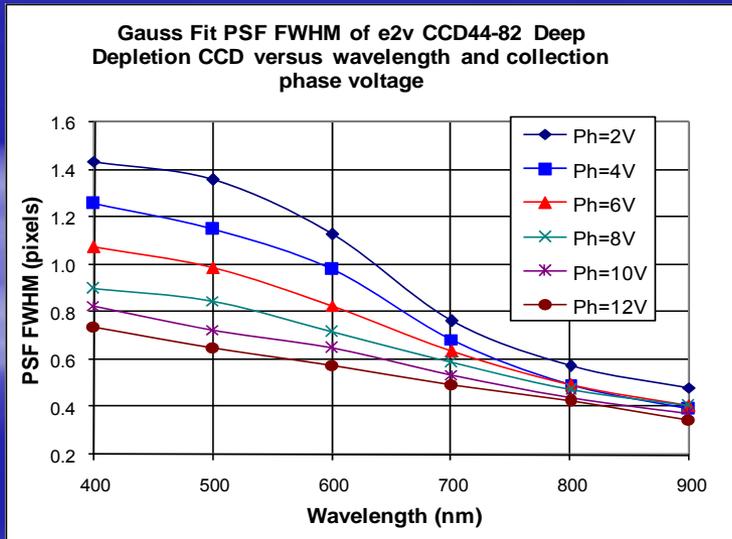




Some PSF Results



Std Si
CCD44-82



Deep
Depletion
CCD44-82



Test Plan Document Started



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EUROPEAN SOUTHERN OBSERVATORY

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

CCD220/219 Test Plan

VLT-TRE-ESO-14690-XXXX

Issue: 0.1

1 Nov 2007

Prepared By:		
Name(s)	Organization	Date / Signature
Mark Downing	ESO	
Approved By:		
Name (s)	Organization	Date / Signature
R. Arsenault	ESO	
Released By:		
Name (s)	Organization	Date / Signature
N. Hubin	ESO	
D Baade	ESO	



Status and Schedule



- Most hardware mounted and in place.
 - ⇒ RS-5B digitally programmable light source to be ordered soon.
 - ⇒ Mount for Marseille camera still pending. Either on optical slide bench or bolted direct to optical table.
- Labview GUIs working to control individual units.
- System integration with FIERA and NGC is in progress.
- Next phases to be completed in coming months:
 - ⇒ Complete system integration
 - ⇒ Cyril Cavadore to modify PRISM to talk to LabView for full current script support (data taking and analysis).
 - ⇒ Cyril Cavadore to modify PRISM to support Ocam ESO.
 - ⇒ Do complete calibration of Test Bench
 - ⇒ To complete preparations need Ocam ESO to test interfaces
- Experience with testing AO WFS gained in testing pnCCD (see talk tomorrow about results)
- Test plan document started.



END
Thanks!