ESO Test Plan for AO WFS CCD220

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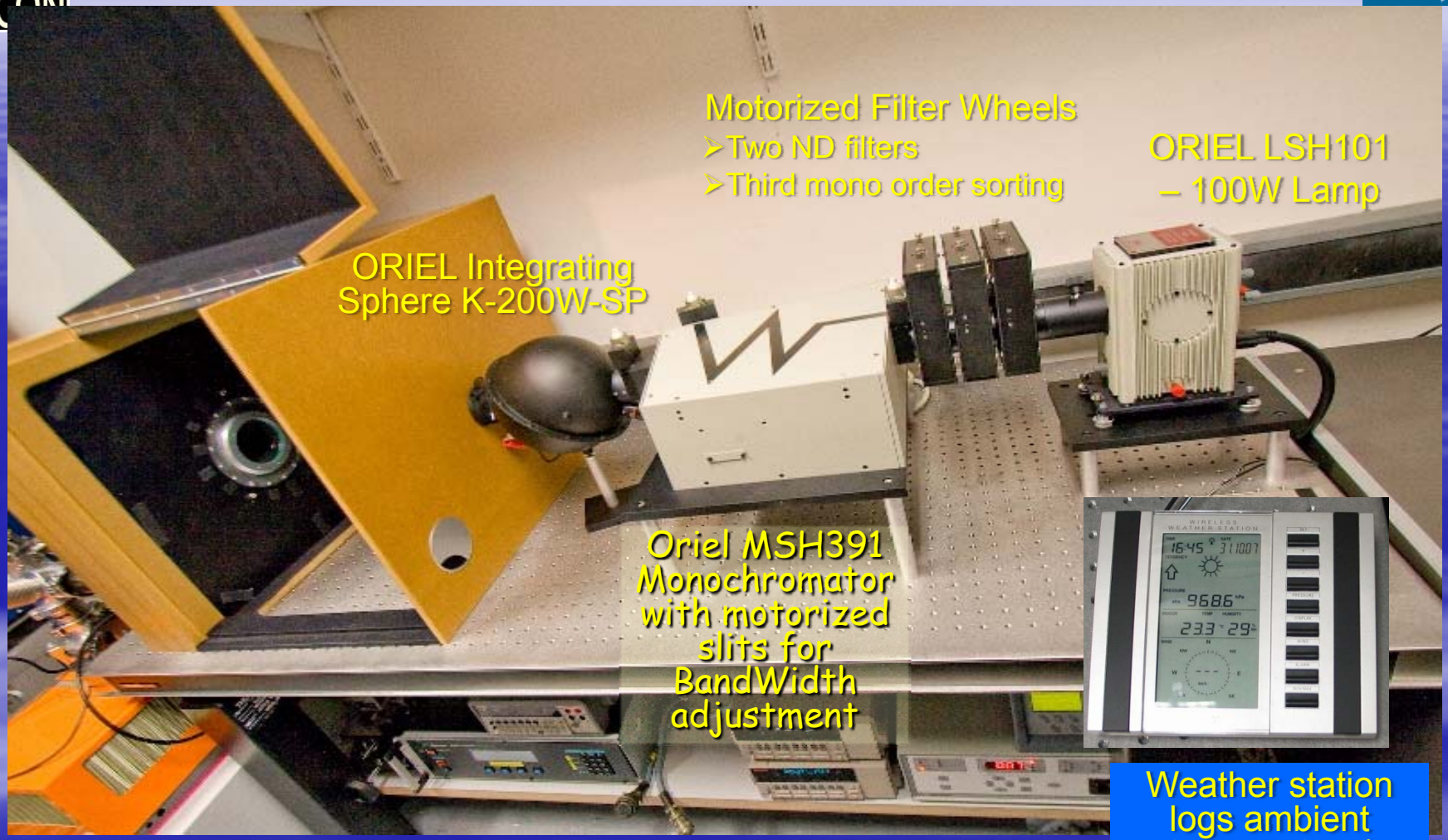
Talk Overview

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

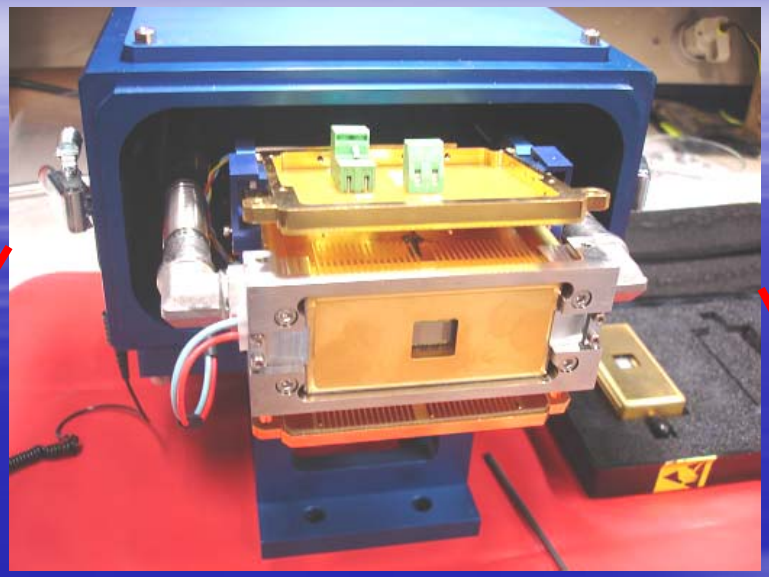
Progress on AO Test Bench

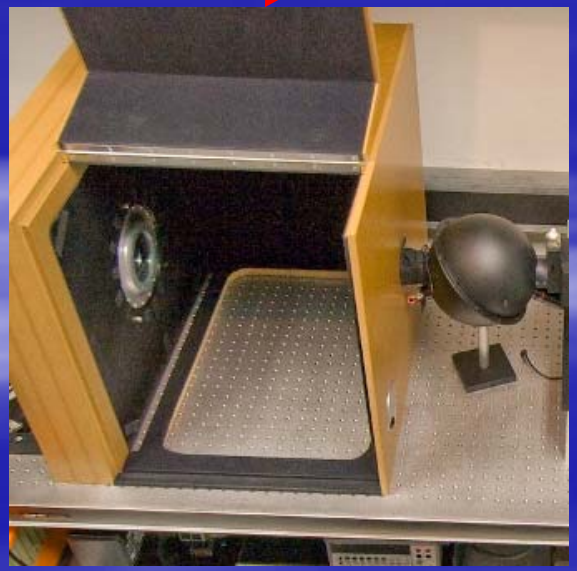
Setup Well Advanced



Thanks to Sebastian Deiries and Eric Mueller

Bolt to Optical Table or mount on slide TBD.





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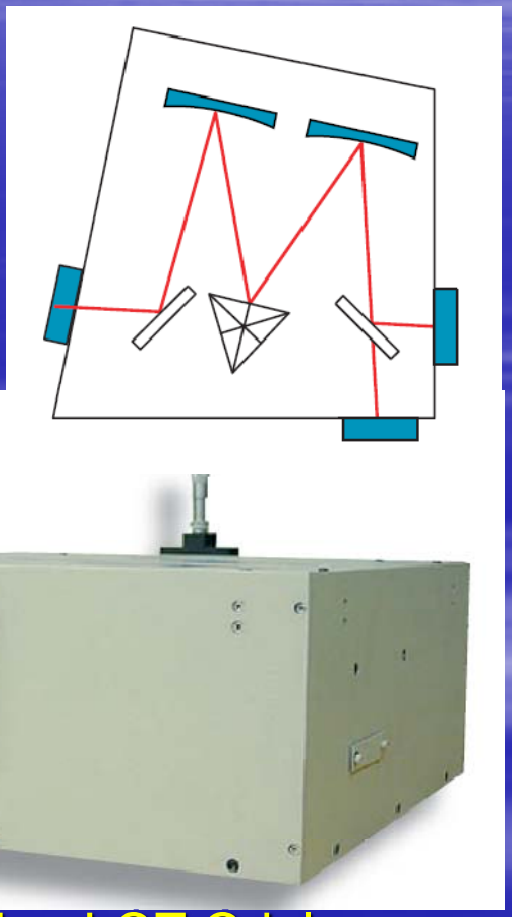
LOT-Oriel Monochromator (MSH391)

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 µm with interchangeable gratings
Resolution:	0,15 nm with 1200 l/mm grating at 546 nm, 10 µm slits
Dispersion[1]:	6.4 nm/mm for 600 l/mm grating at blaze wavelength
Accuracy (wavelength)[2]:	±0,35 nm
Repeatability[2]:	±0,08 nm
Drive step size[2]:	0,1 nm
Focal plane size:	28 x 10 mm
Standard slit:	Width: 4 µm – 3 mm, ±10 µm 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

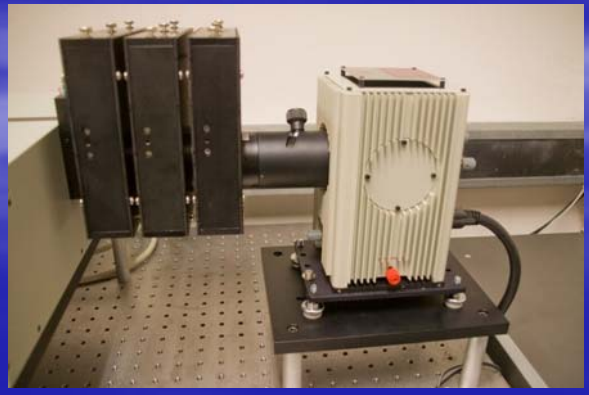


Supplier: LOT-Oriel

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

Illumination and Detection

- 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



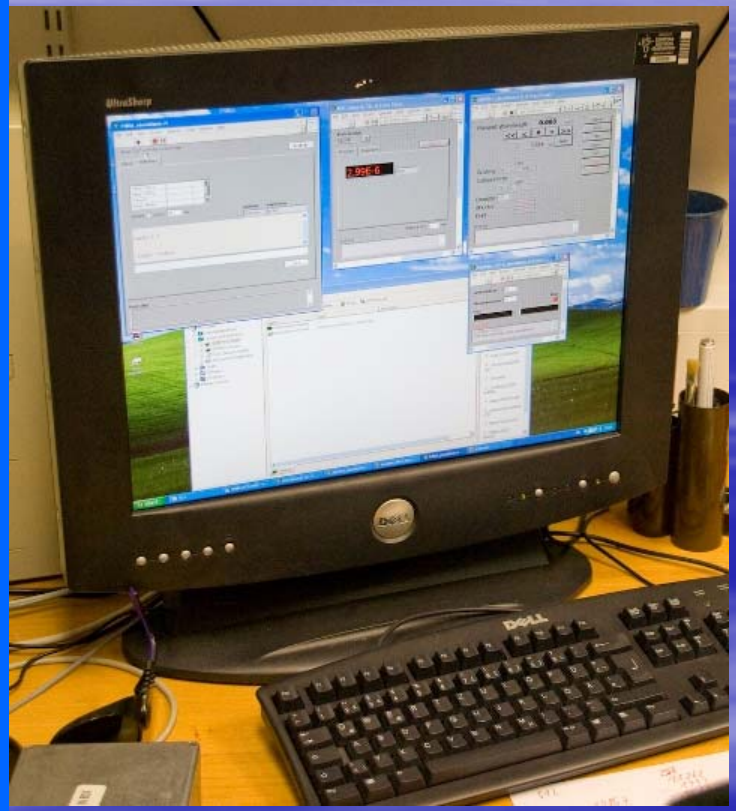
RS-5B LED Computer Programmable Light Source

- 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.

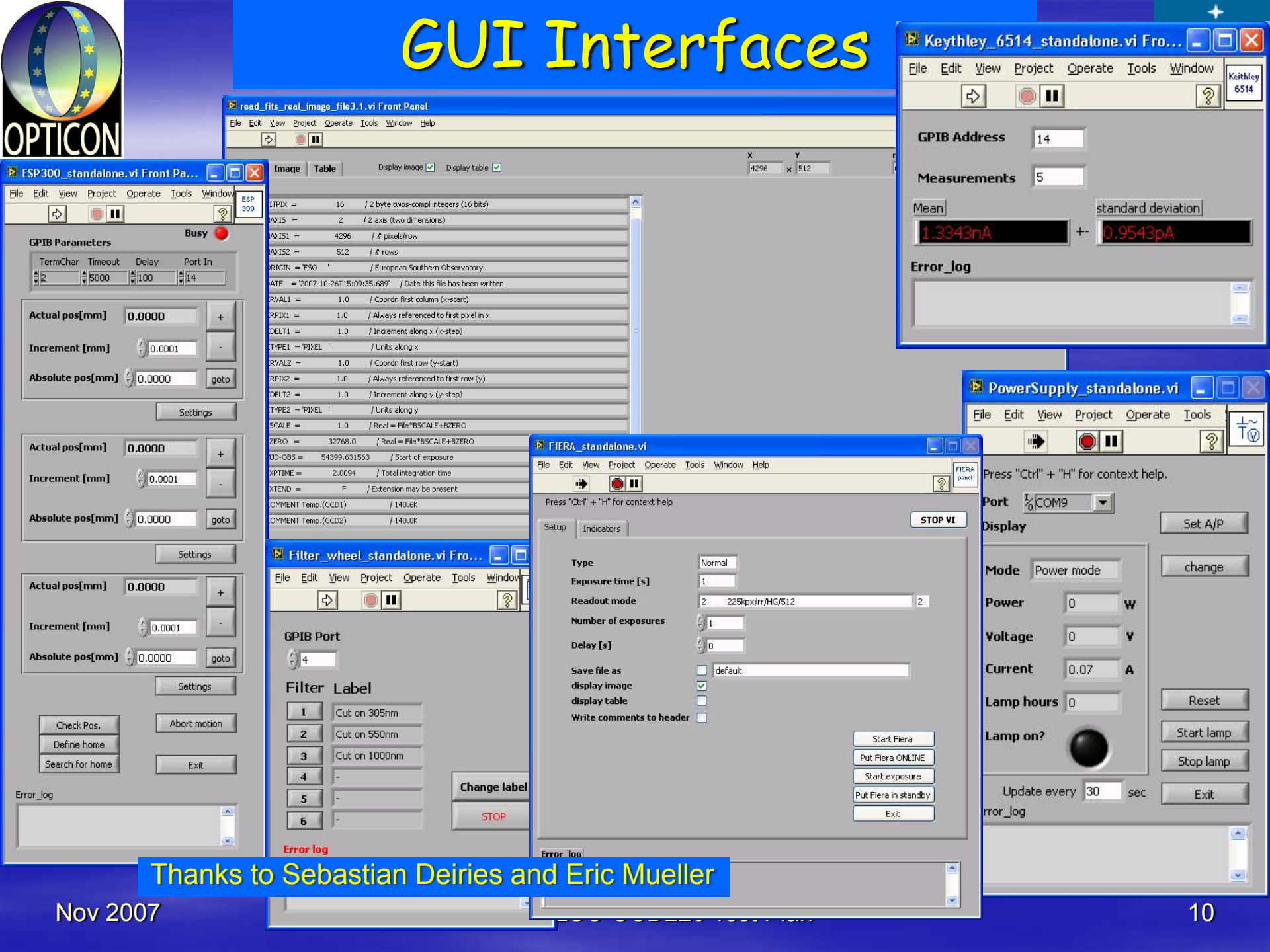
Source Geometry	100 mm diameter extended source. Projection beam, lambertian/super-lamber option. Up to 10 spectral channels.
Spectral Output	Narrow or broadband configurations from [illegible] Custom spectrums/illuminants or CIE[x,y] gamuts by request.
Spectral Bandwidth	10-700 nm *(can be narrowed on request)*.
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)

Computer and Software

- 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



Thanks to Sebastian Deiries and Eric Mueller

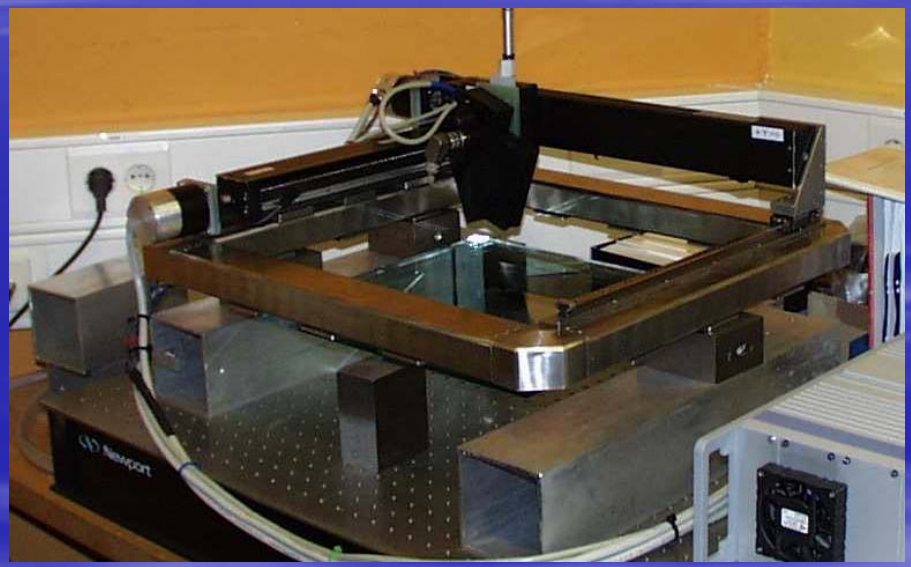
Test Plan

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.

Metrology

- 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 > 400e/p/s at 25Hz
  - ⇨ Dark defect - deviant pixel in flat < 50% mean unbiased signal at 1500Hz.
  - ⇨ Traps (TBD)

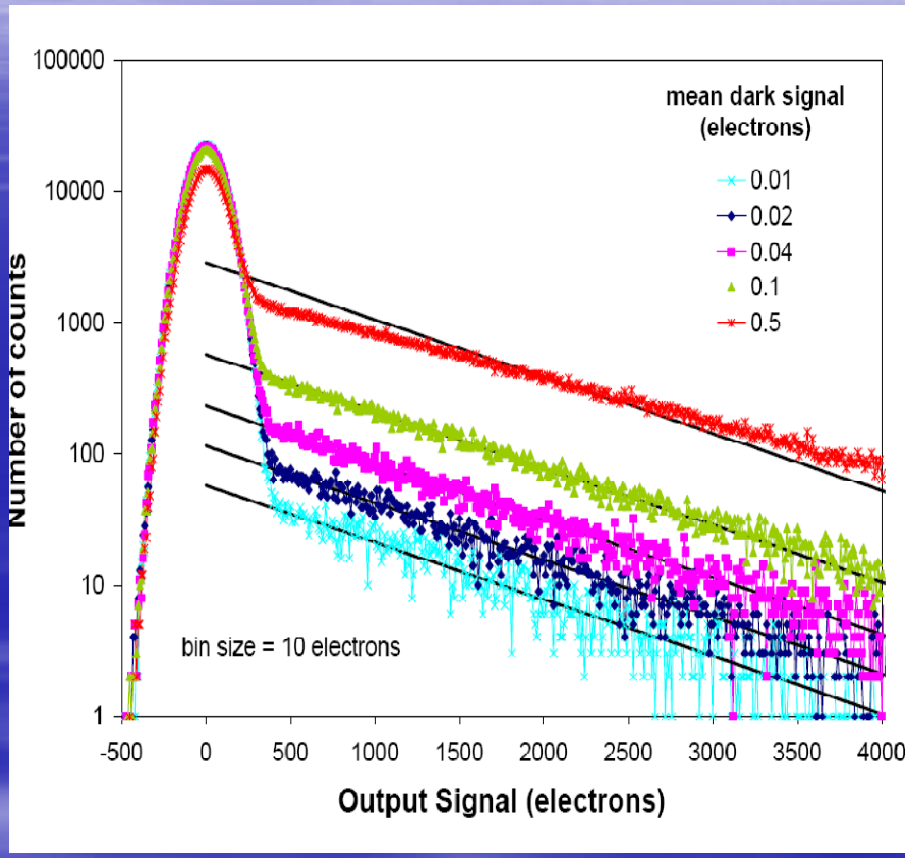
Electro-optical Tests II

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 = ΔIRD/ΔADU. 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.

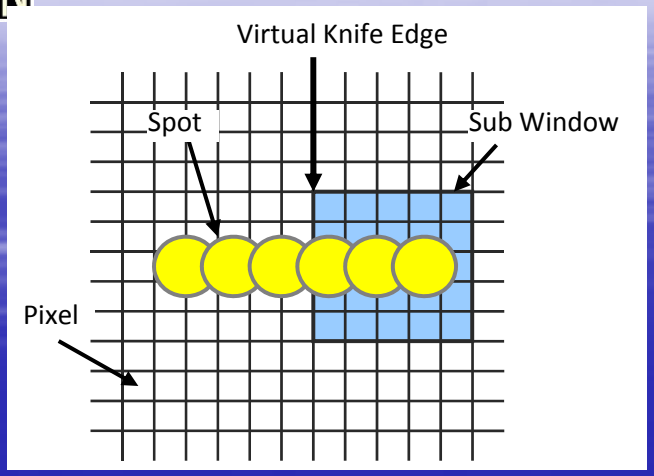
Linearity (x1000 and x200 gain)

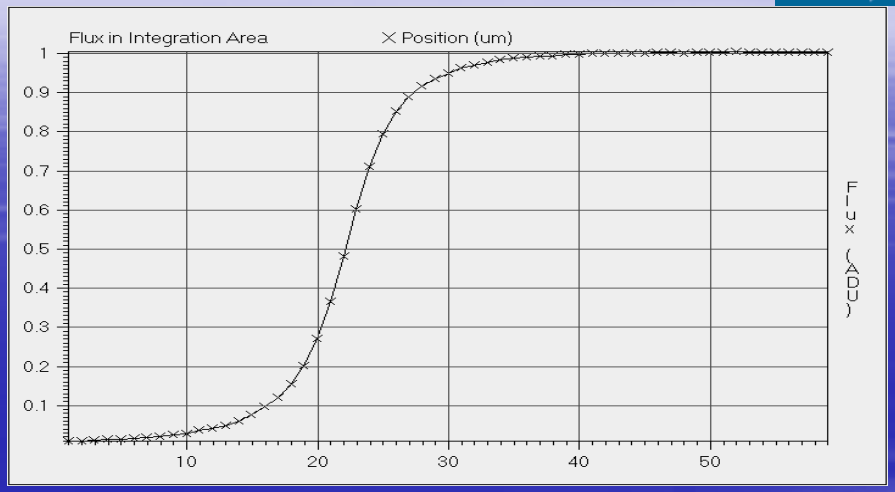
- Fixed frame rate and vary illumination level using RS-5B light source.

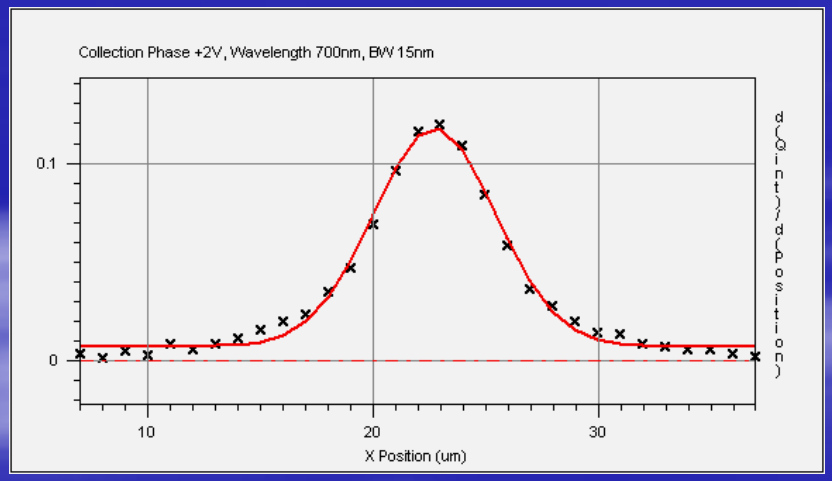
CTE (x1000 gain)

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

PSF Measurement







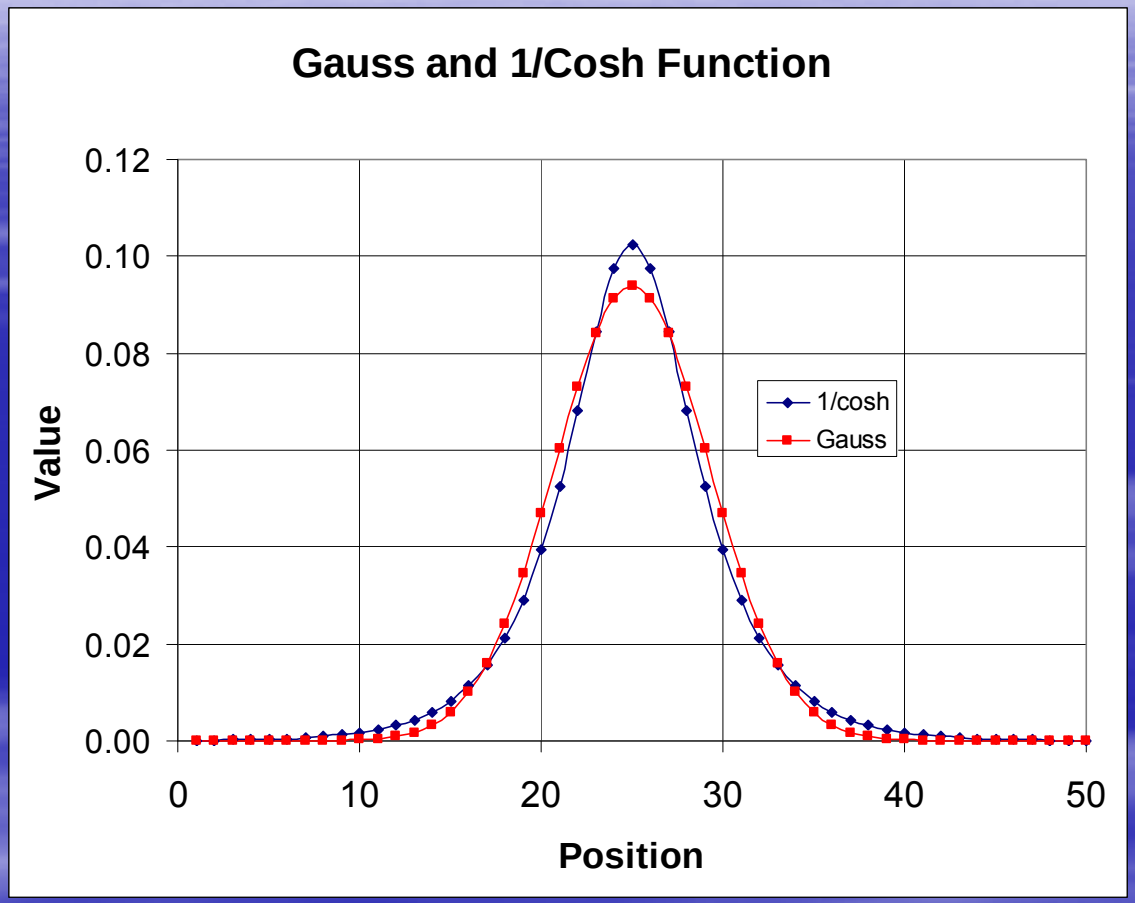
$$Q(x) = a - \frac{(a-b)}{\pi\sigma/k}\int_{-\infty}^{x} 1/\cosh\left(\frac{x'-c}{\sigma/k}\right)dx' \qquad k = 1.368 \qquad (1a)$$

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

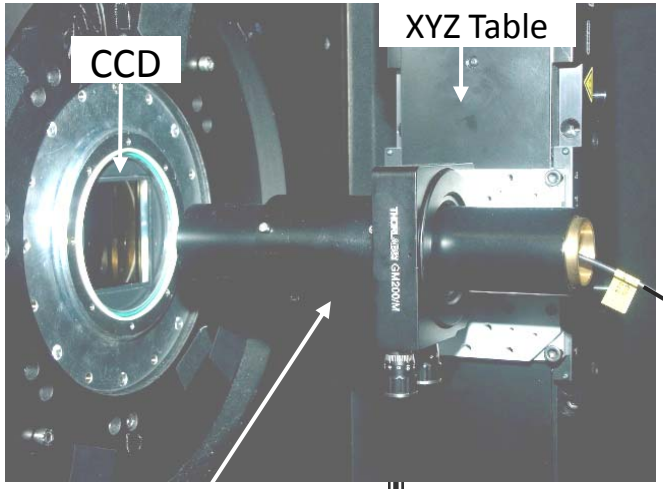
Apply Fit
(1a) for under depleted,
(1b) for over depletion

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

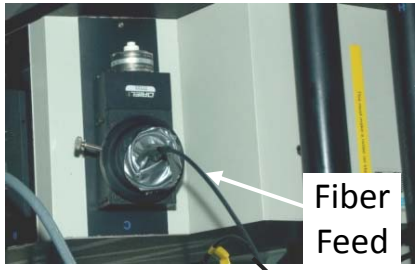


PSF Setup



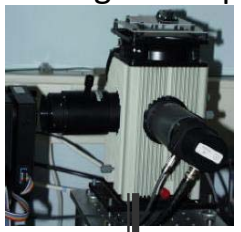
Spot Projector

Double Monochromator



Optical
Fiber

Halogen Lamp

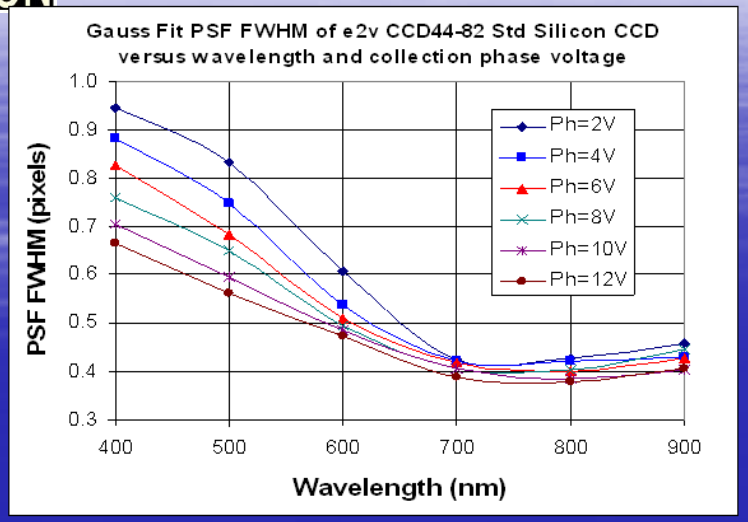


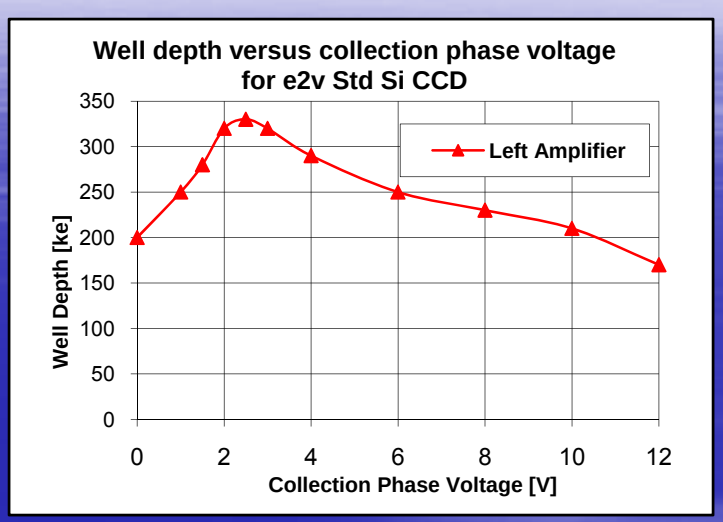
X- Y- Z- Motors and
Encoders

Newport ESP300 Motor Drive.

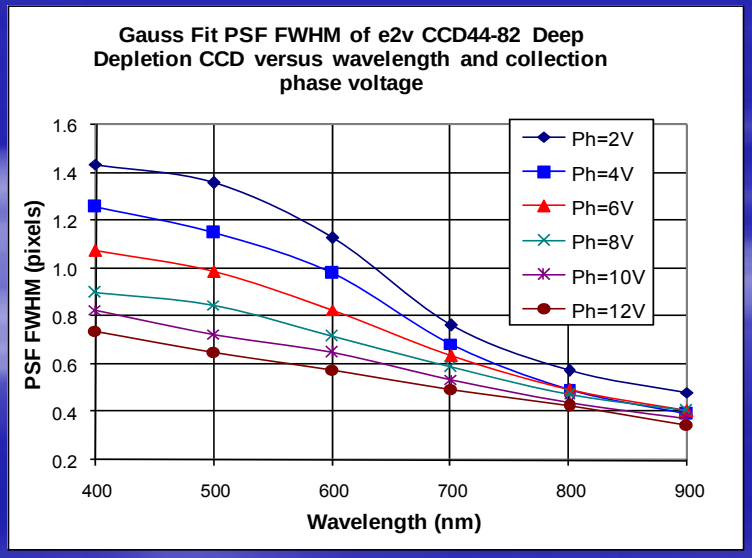
Lamp Power Supply
/ Light Intensity Controller

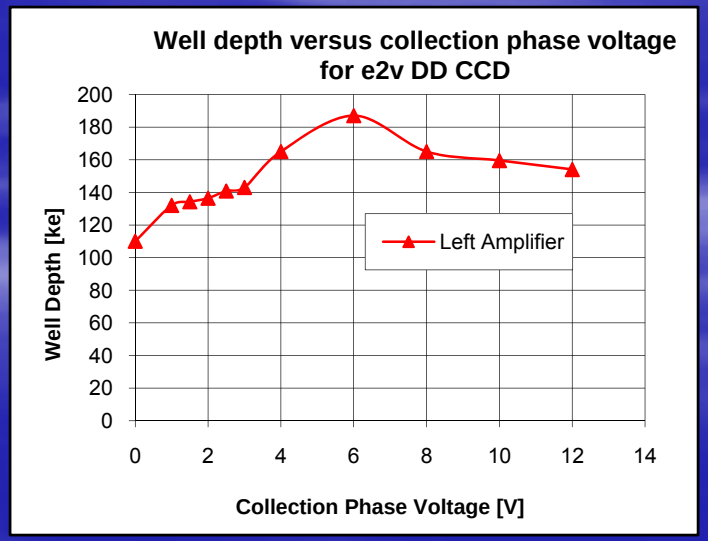
Some PSF Results





Std Si CCD44-82





Deep Depletion CCD44-82

Test Plan Document Started

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2 APPENDIX: COMPLIANCE MATRIX

2.1 PERFORMANCE REQUIREMENTS

VLT PROGRAMME

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	
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Released By: Name (s)	**Organization**	**Date / Signature**
N. Hubin D Baade	ESO 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!