



DARK ENERGY  
SURVEY

# WBS1.2.3 CCD Reports and Data Analysis

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Julia Campa  
IEEC Barcelona



# Current Status of Data Analysis

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Two steps for an initial CCD Test ([FNAL-1](#)):

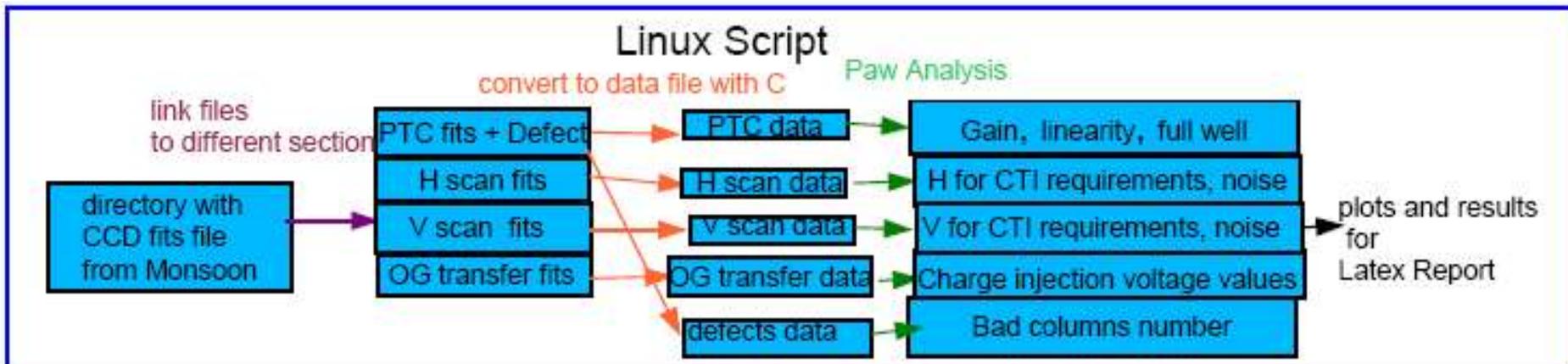
- The data are archived in the FNAL DES cluster to be analysed after an automated data taking is done for a device at FNAL
- Analysis of data CCD test and report:
  - non-FNAL collaborators (Barcelona) make the analysis via Kerberos or Crypto card
  - 470 FITS of 600 (22GB) are used for the automated analysis and the reports. The rest are used for Time Scan studies



# Analysis procedure

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- A Linux script selects the FITS files from the tested device name directory and distribute them to be analysed in different sections
- Run the programs to read the FITS files in a selected pixel area per section
  - A C program with **CFITSIO** library *converts FITS file into a text file with the ADU value of the pixels*
- Data analysis with **PAW** programs
- Reports with **Latex** using plots and values generated with Paw
- 3 sizes of CCD in the automated analysis require the same programs with parameters different like over scan area, row and columns number.





# Analysis procedure

- Every image has a log file to identify it (test date, cube number, CCD ID, exposure time, temperature, etc)
- Always the data taking test is made in the same order to automate the analysis
  - Fits files used for data analysis:

Sections	FITS file number required
I.Photo Transfer Curve(Gain)+Linearity +Full Well	156
II.Horizontal Clock Scan	80
III.Vertical Clock Scan	80
IV.Output Gate transfer curve	154
V.Defective Columns	1 (flat from section 1)
<b>TOTAL</b>	<b>470</b>



# Reports Overview

- In the first page there is an overview with the ID CCD and analysis results table

**CCD ID:**

<b>Device ID</b>	109001-3-1
<b>Package ID</b>	pb-24-02
<b>Lot</b>	1 A
<b>Package</b>	Picture Frame
<b>Type</b>	Back Illuminated
<b>Size</b>	2048X4096
<b>Thickness</b>	250 microns
<b>Operator</b>	Juan Estrada
<b>Analysis</b>	Julia Campa

**Analysis Results:**

	<b>Right Amplifier (RH)</b>	<b>Left Amplifier (LH)</b>
<b>Gain (ADU/e)</b>	1.41	1.41
<b>Full Well (e)</b>	>130000	>130000
<b>Non Linearity &lt;1%</b>	Yes	Yes
<b>Min. Horizontal Clock for CTI requirements H+ (1,2,3) (V)</b>	6.5	8.5
<b>Max. Horizontal Clock for CTI requirements H- (1,2,3) (V)</b>	-4	-4
<b>Minimum Output Gate (V) for Vref = -12 V to prevent charge injection</b>	3	3
<b>RMS</b>	10	10

<b>Min. Vertical Clock for CTI requirements V+(1,2,3)(V)</b>	7
<b>Max. Vertical Clock for CTI requirements V- (1,2,3) (V)</b>	-3
<b>Dark Current (e/hr/pixel)</b>	
<b>Light Bulbs number</b>	2
<b>Bad columns number</b>	16



# Reports Overview

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- There are five sections in the CCD Reports:
  - *I Photo Transfer Curve* : 6 plots  
PTC Plot, Mean as function of exp time and linearity for U and L amplifier
  - (II) *X-Ray Exposure* to obtain the Gain in some cases: 1plot  
Distribution of charge
  - *II H Clock Scan* : 12 plots  
*II.A/II.B H+/H-* for U and L amplifier :transition to over scan plot ,CTI and noise for H+/H- values
  - *III V Clock Scan*: 6 plots  
*III.A V+ / III.B V-* : transition to over scan (serial) ,CTI and noise for V+ /V- values
  - *IV OG Transfer*: 2 plots  
Mean as a function of  $V_{og}$  for different values of  $V_{ref}$  for U and L amplifier
  - *V Defects*: 2 plots  
Deviation from local average (  $5 \sigma$  deviation ) to detect bad columns  
10 column average as function of column for the complete CCD



# Reports Overview

- In the future will include more sections with [FNAL-2](#) test:
  - QE studies
    - › QE versus temperature
    - › QE versus wavelength
  - Dark counts versus temperature



# Individual CCD Test

Required time for one full individual CCD test :

## FNAL-1:

- CCD taking data test at FNAL : 1 overnight
- CCD data analysis and report at Barcelona : half day (run programs + evaluate the results)

## FNAL-2:

- if device pass FNAL-1 then : 3 days per detailed study  
(QE measurement, temperature studies, flatness, cooling maintained )

**Total time:** 4 days

- During 2007 the data will be analysed at Barcelona (one non-Fnal Collaborator)
- During **Production** 5 CCDs per week should be tested to select 70 devices in ~18 month
- Two non-Fnal collaborators (CTIO and Barcelona) will analyse the test data to keep the 5 CCD/week rate