DARK ENERGY SURVEY

WBS1.2.3 CCD Reports and Data Analysis

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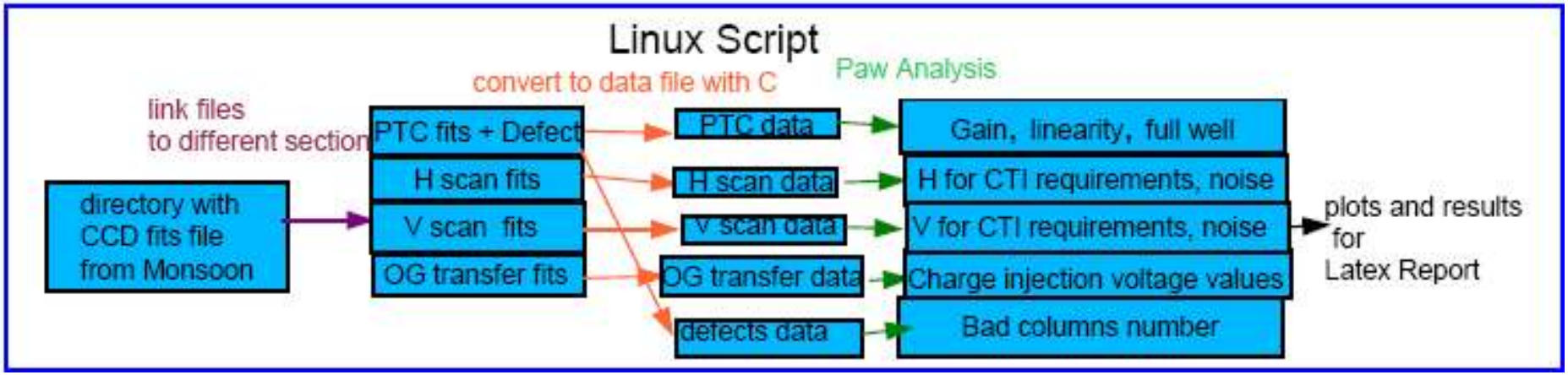
Current Status of Data Analysis

- Two steps for an initial CCD Test (FNAL-1):
  - After an automated data taking is done for a device at FNAL the data are archived in the FNAL DES cluster to be analysed
- 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

- 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 areas, 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)
TOTAL	470

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Reports Overview

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

CCD ID:

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

Analysis Results:

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

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

Reports Overview

- 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 H+ / II.B H- :transition to serial over scan ,CTI and noise for H+/H- values for U and L amplifier
  - III *V Clock Scan*: 6 plots
    III.A V+ / III.B V- : transition to parallel over scan ,CTI and noise for V+ /V- values
  - IV OG Transfer: 2 plots
    Mean as a function of Vog for different values of Vref for U and L amplifier
  - V *Defects:* 2 plots
    Deviation from local average (5 σ deviation) to detect bad columns
    10 column average as function of column for the complete CCD

Reports Overview

- With FNAL-2 test will include more sections:
  - 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:

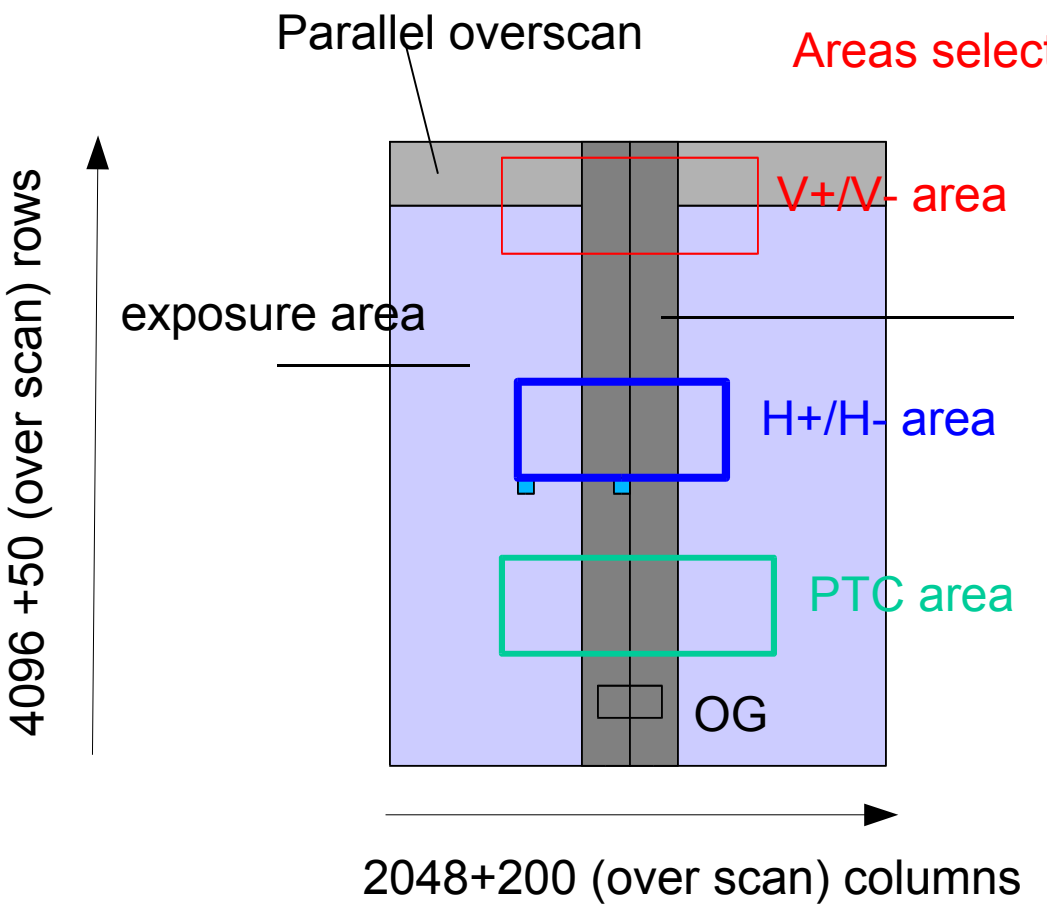
- if device pass FNAL-1 then : 3 or 4 days per detailed study

  (QE measurement, temperature studies, flatness, cooling maintained)

Total time: 4 or 5 days

- Manpower:
- Nowadays Barcelona is analysing the data test (one person)
- During 2007 one or two non-FNAL Collaborator of Barcelona will analyse the test data
- During Production test (2008/2009) two non- Fnal collaborators (CTIO and Barcelona) will analyse the test data

Pixels area selected (back slides)



•For bad columns the complete CCD is selected.