DARK ENERGY
SURVEY

DES CCD Characterization

Juan Estrada

- **Two examples of technical progress**
- **R&D projects for the next year**

January 25, 2006

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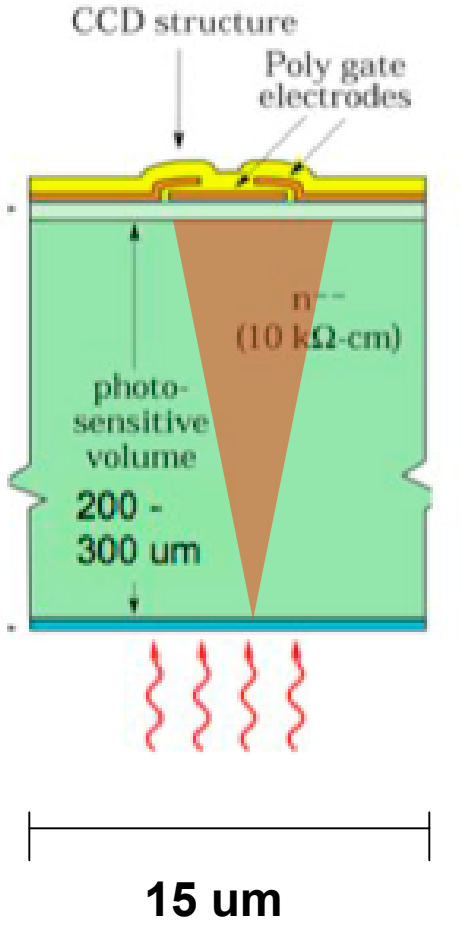
Diffusion



higher QE in the near infrared is achieved using 250 um thick CCDs (most instruments use <50 um).

Charge produced near the back surface (blue light) has to travel 250um before reaching the potential well where it is store. This gives chance of diffusion. With high E fields one can reduce diffusion.

For fully depleting the devices we apply 40V at the the back surface. We need to check that this 40V are enough.

Diffusion measurement with double slit diffraction

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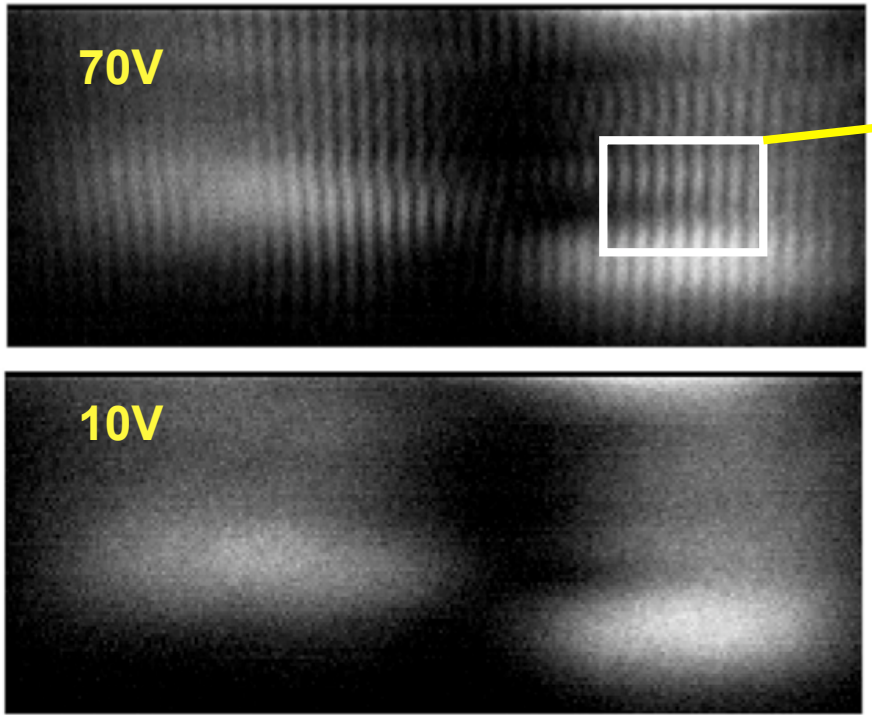
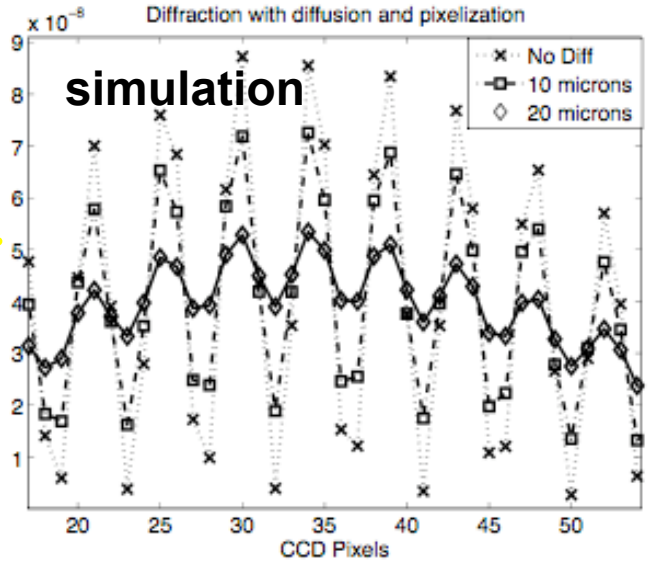
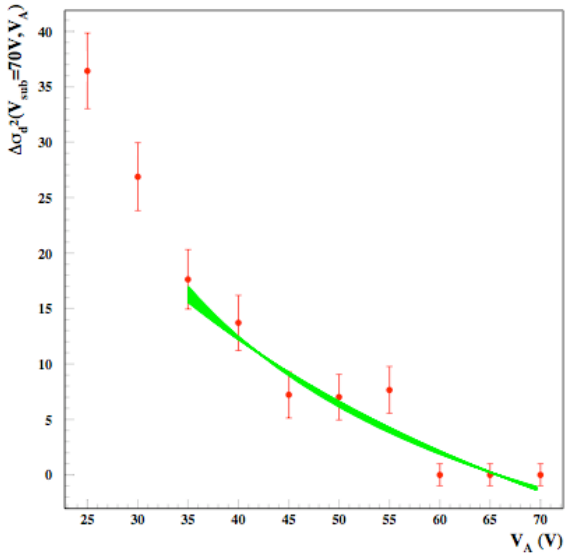
data



simulation





Diffusion results

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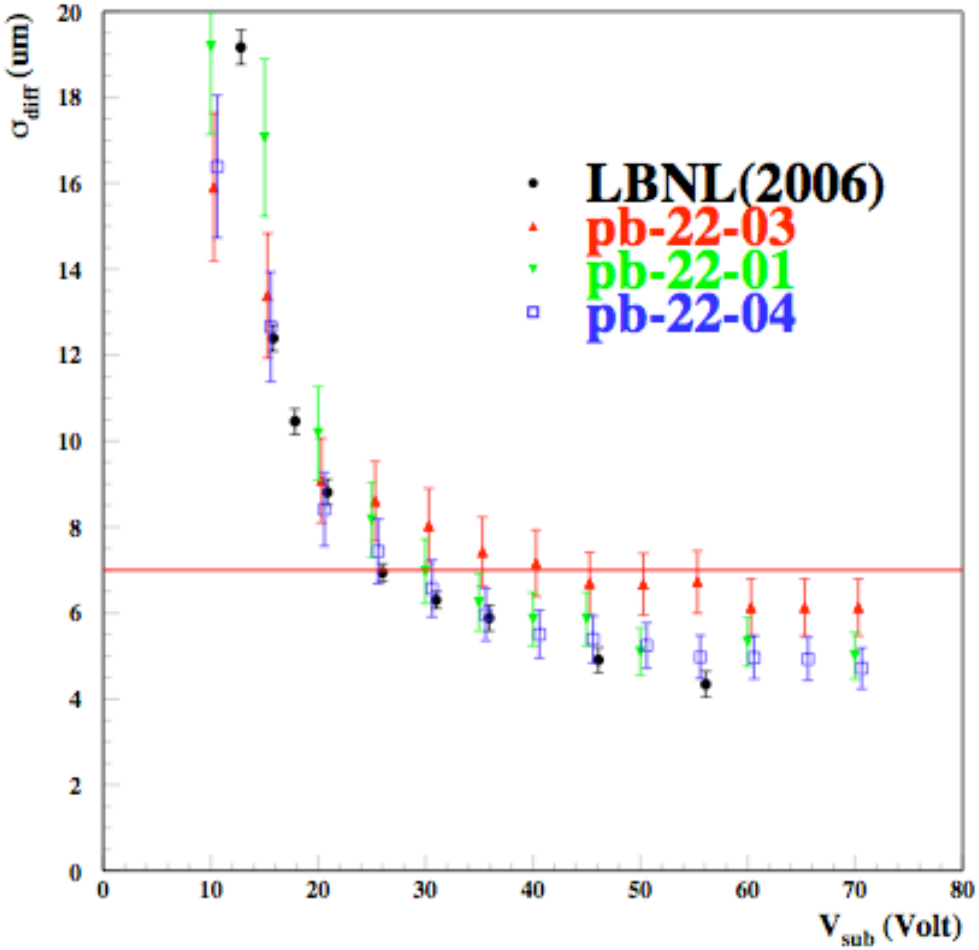

LBNL has done this measurement by focusing a small spot (~3um) on a pixel a moving it around.

The results obtained with our method are consistent with LBNL and among different devices. This technique will allow us to do the measurement in each CCD (simple setup and quick data collection).

Readout noise/speed

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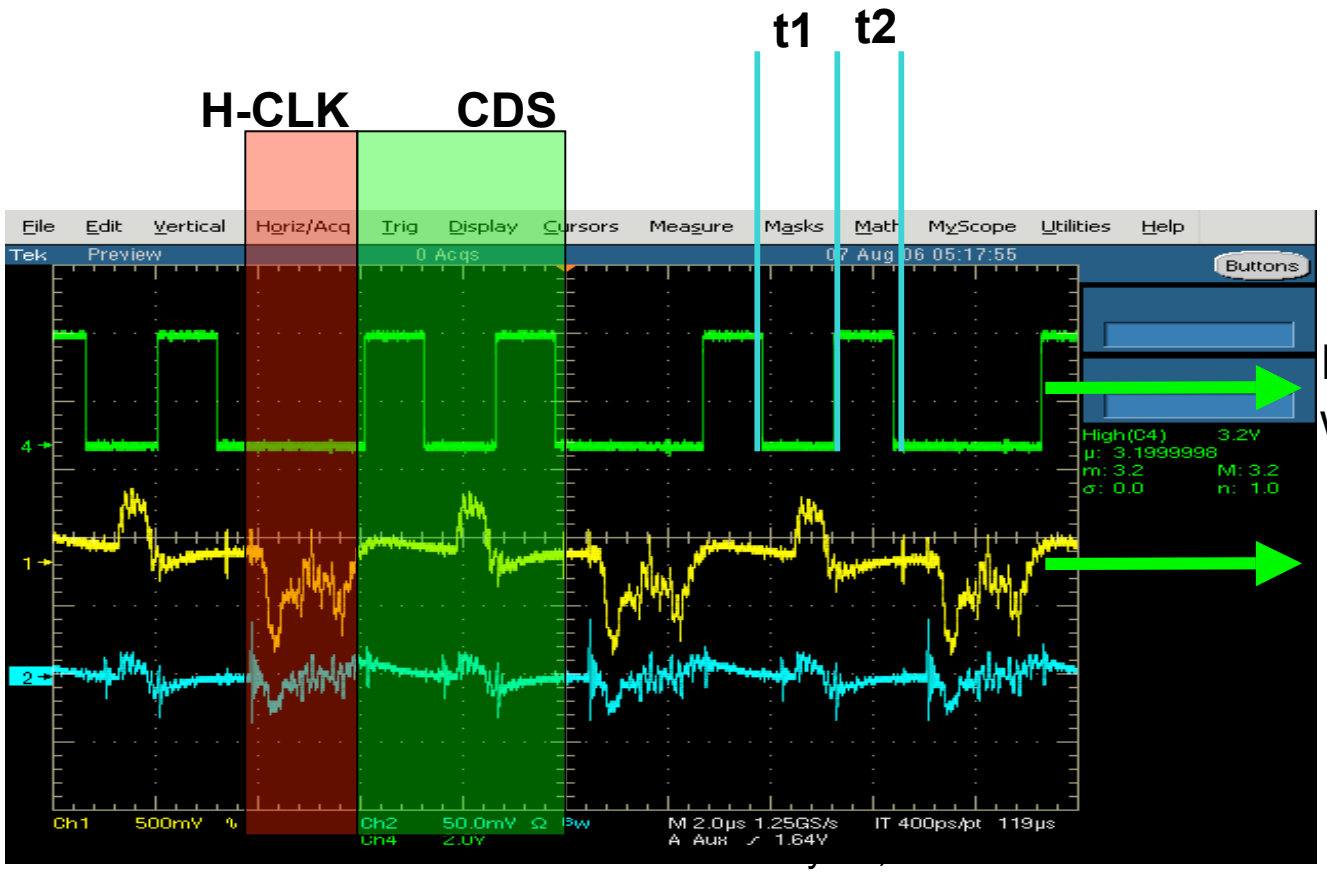
The upgraded telescope will move in ~17sec. Readout the CCD during that time in order to avoid extra dead time between exposures => 250 kpix/sec.



Current situation

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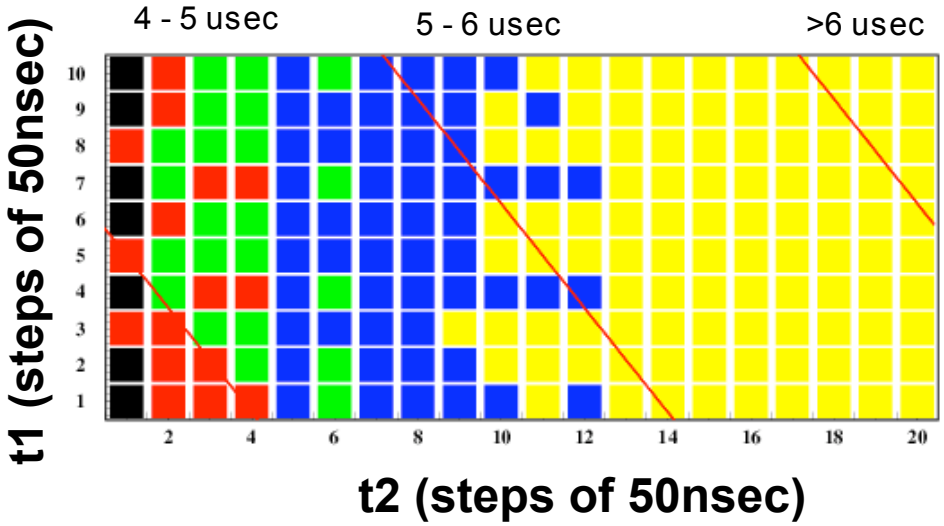
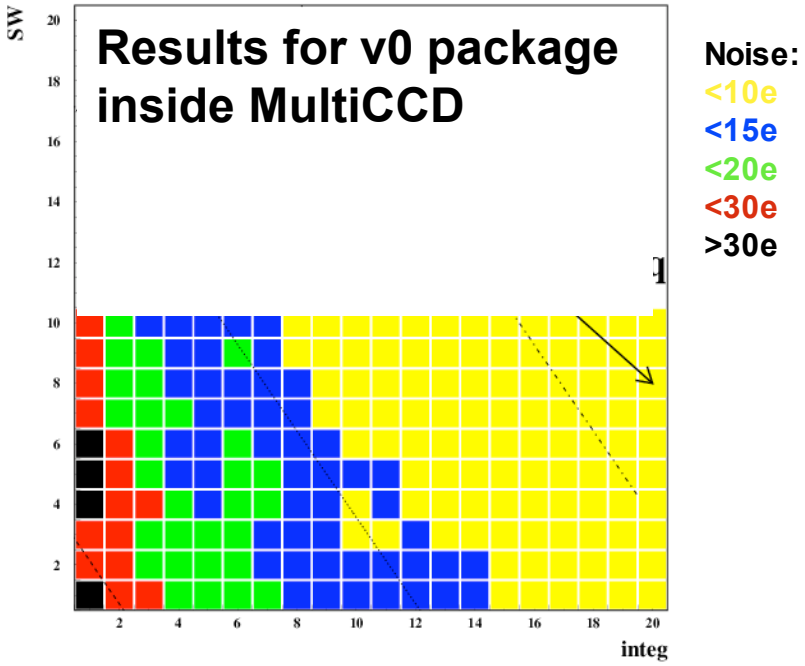
250 kpix/sec means 4usec/pix





Achieved thanks to the installation of the **source follower close to the package** (reviewers recommendation + Hypersuprime input). Readout time reduced from 6.2 usec (standard) to 4.8 usec.
Two v1 packages readout for MultiCCD next week.

Persistence problem

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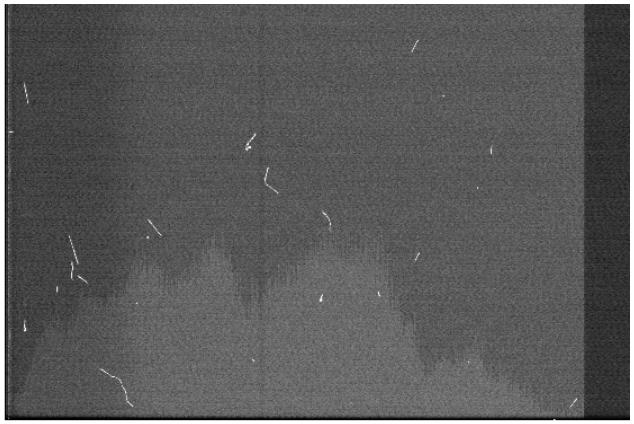
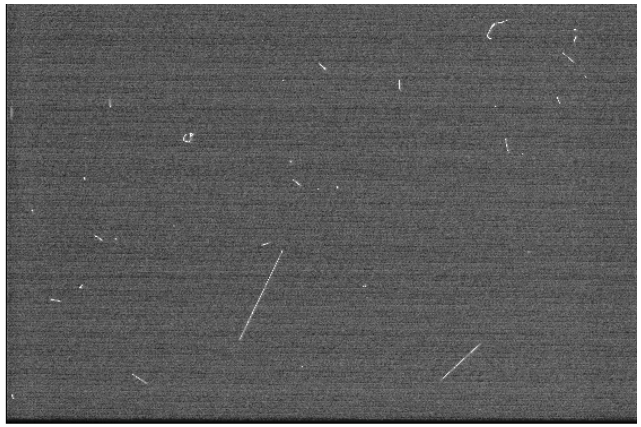
After saturation charge is trapped in the back surface. Thin CCDs get rid of this charge by running in inversion (making opposite sign charge available), we can not do this because of the 40V in the substrate.



400 sec dark after a completely saturated exposure (note shadows).

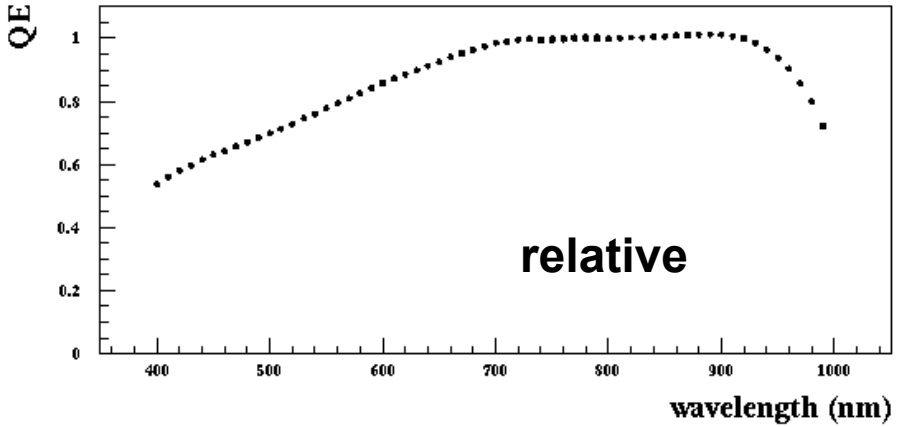


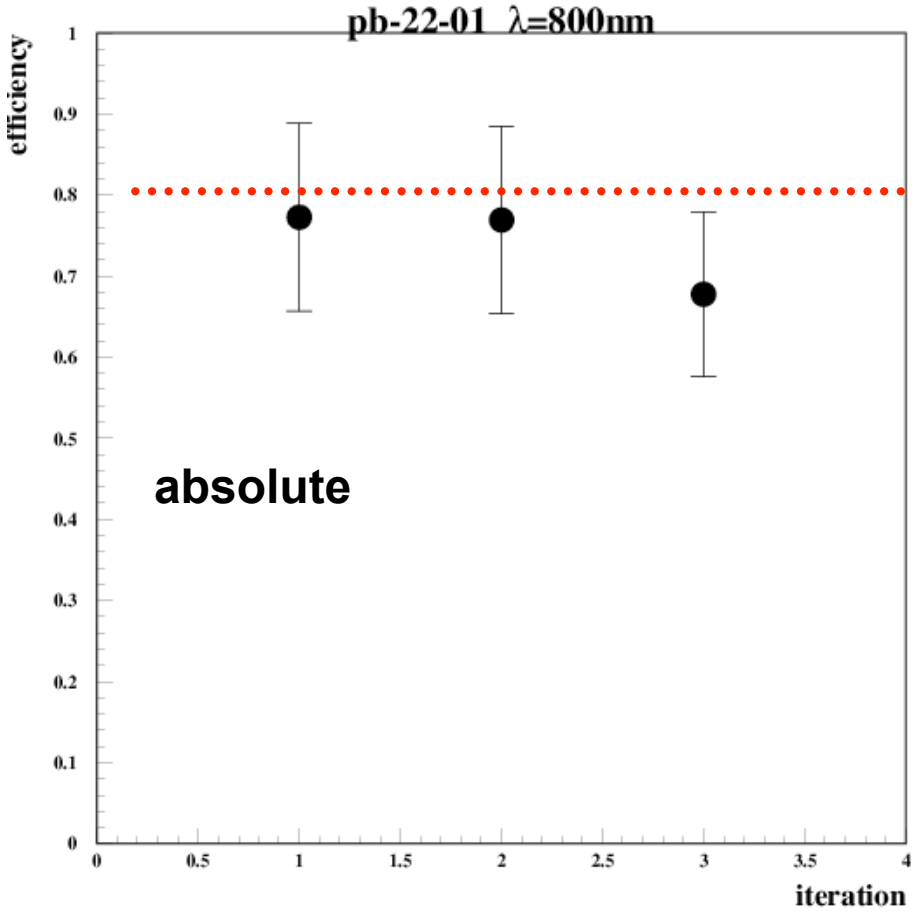
400 sec dark

Erase now done at 1sec.

19.2 sec readout + 1 sec ERASE = 20.2 sec between exposures

QE





Relative QE is under control.

Absolute QE has 15% uncertainty. We are building some parts to make our mechanical assembly more stable.

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R&D projects for 2007

- Reduce readout+ERASE time to the 17sec specification
- Absolute QE to 5% in several detectors
- Performance of CCDs in multiCCD focal plane (crosstalk, noise, temperature stability)
- Faster readout for guiding detectors, possible crosstalk with science CCDs. Binning?
- Diffusion measurement region by region
- Flatness of a v1 packages
- Determine the yield on Lot 2A -2B (key to establish test strategy for production).
- Determine CCD yield in Lots 2C-2D

5 cubes: 2 for new CCD, 1 FEE + special tests, 1 QE, 1 flatness

The addition of Donna Kubik to the team is very important for this program.

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Conclusion

- Significant technical progress understanding the performance of individual CCDs.
- R&D projects on individual CCD performance will continue during next year.
- Starting MultiCCD operation in prototype camera.
- Huge amount of work remaining to understand the performance of the multiCCD system.

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BACKUP SLIDES

Diffusion cosmic rays

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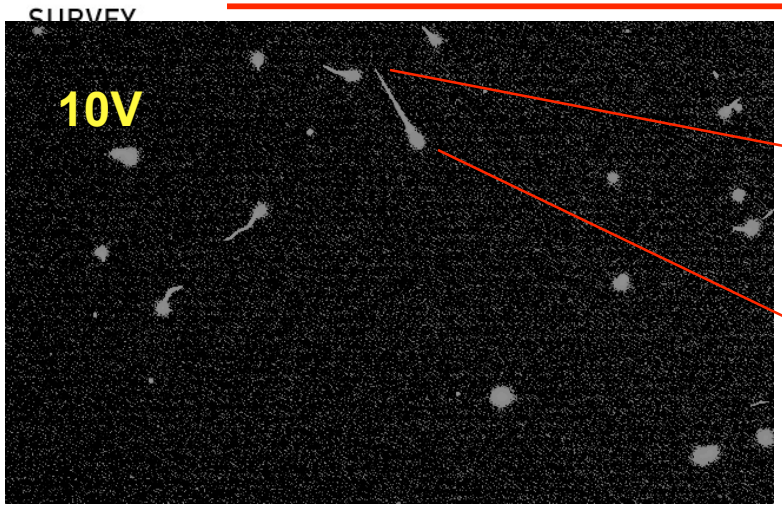
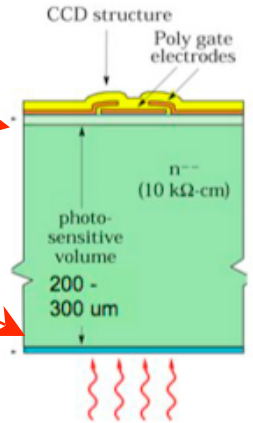
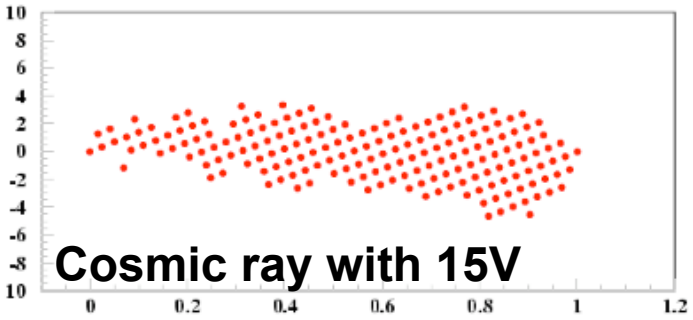




Charge produced by cosmic rays will also diffuse.

front **back**



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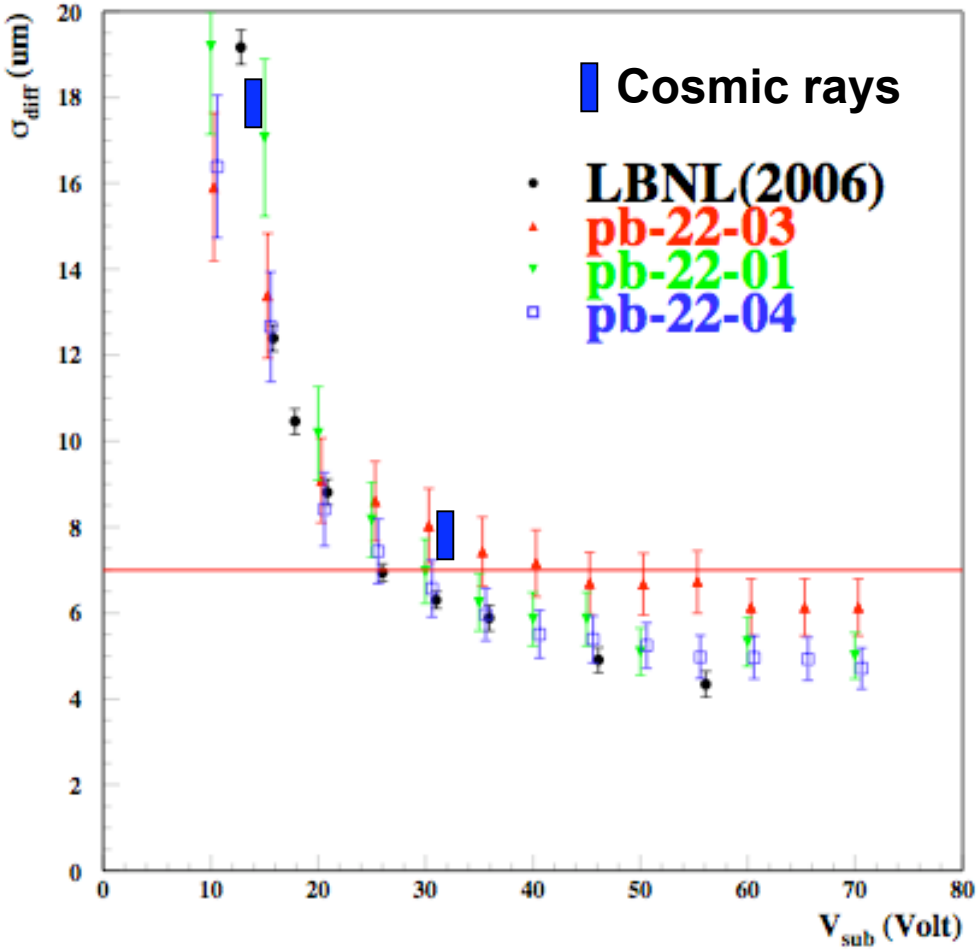
Diffusion



We are staring to do the measurements with cosmic rays. Potentially very powerful because will allow to monitor the performance of the CCDs while installed.

ERASE

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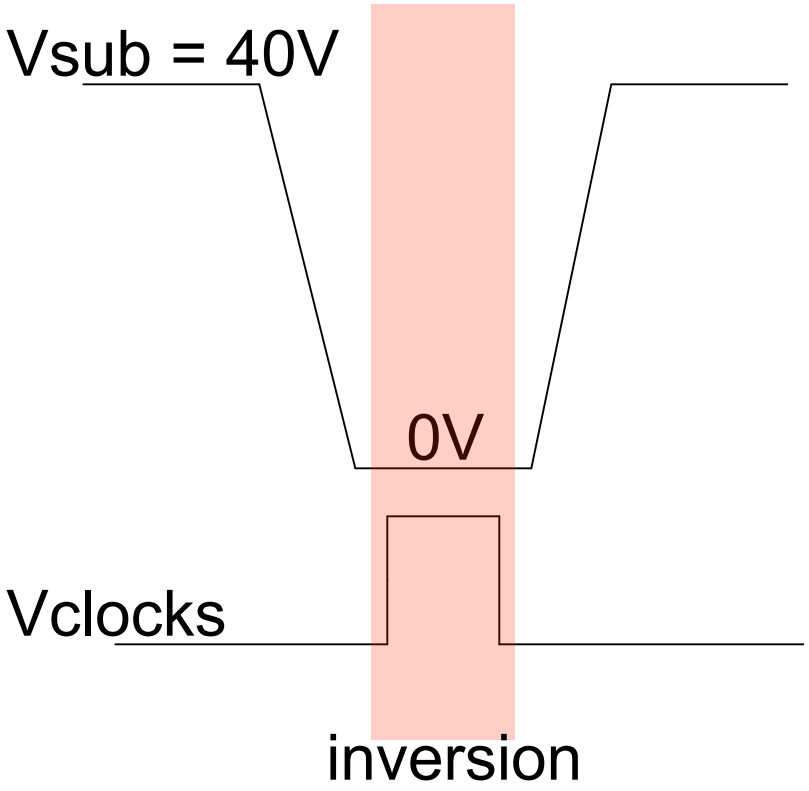
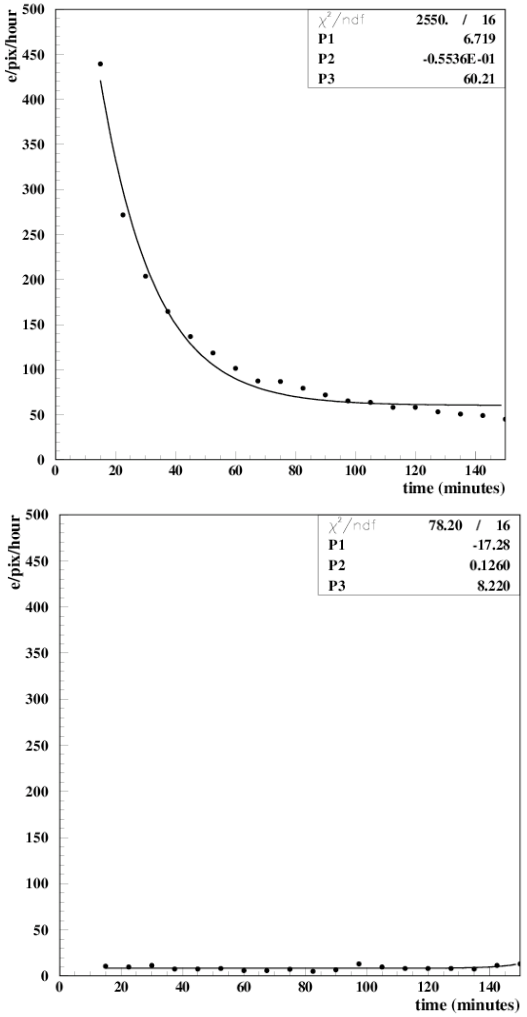
Ramp Vsub down to 0V, bring all the vertical clocks to 8V. Then reverse the process.





We are now able to do the ERASE in 1 sec.

19.2 sec reaout

1 sec ERASE

Very close to the 17 second allowed between exposures.

X-ray (pf-24-24)

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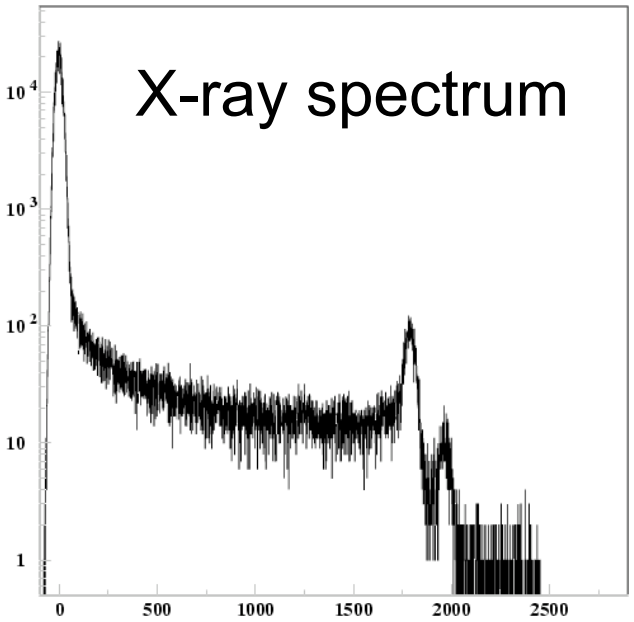
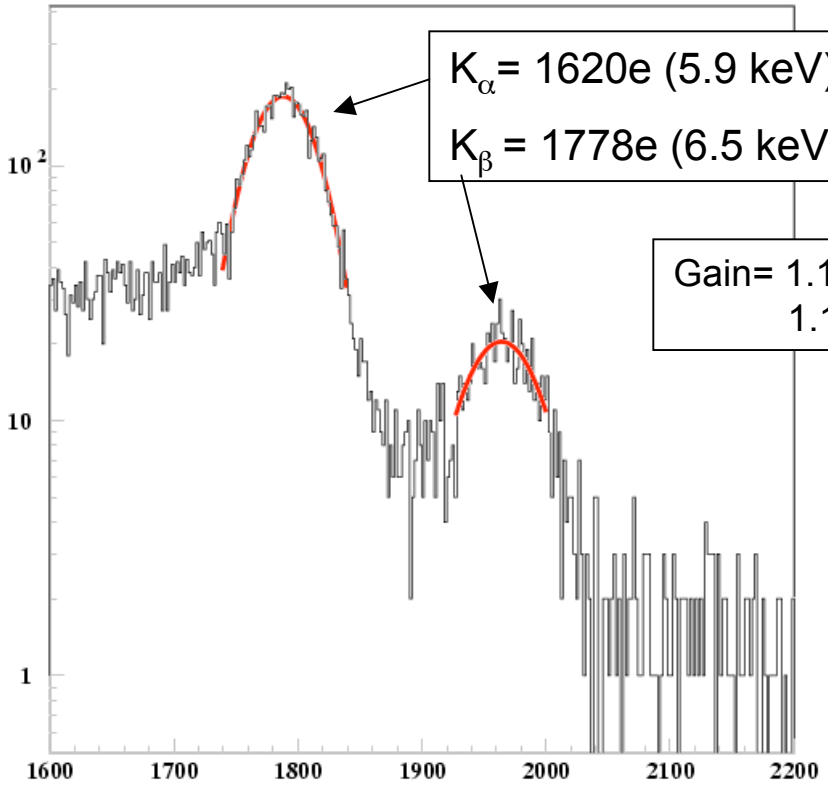
Fe55 gain determination





Horizontal CTE

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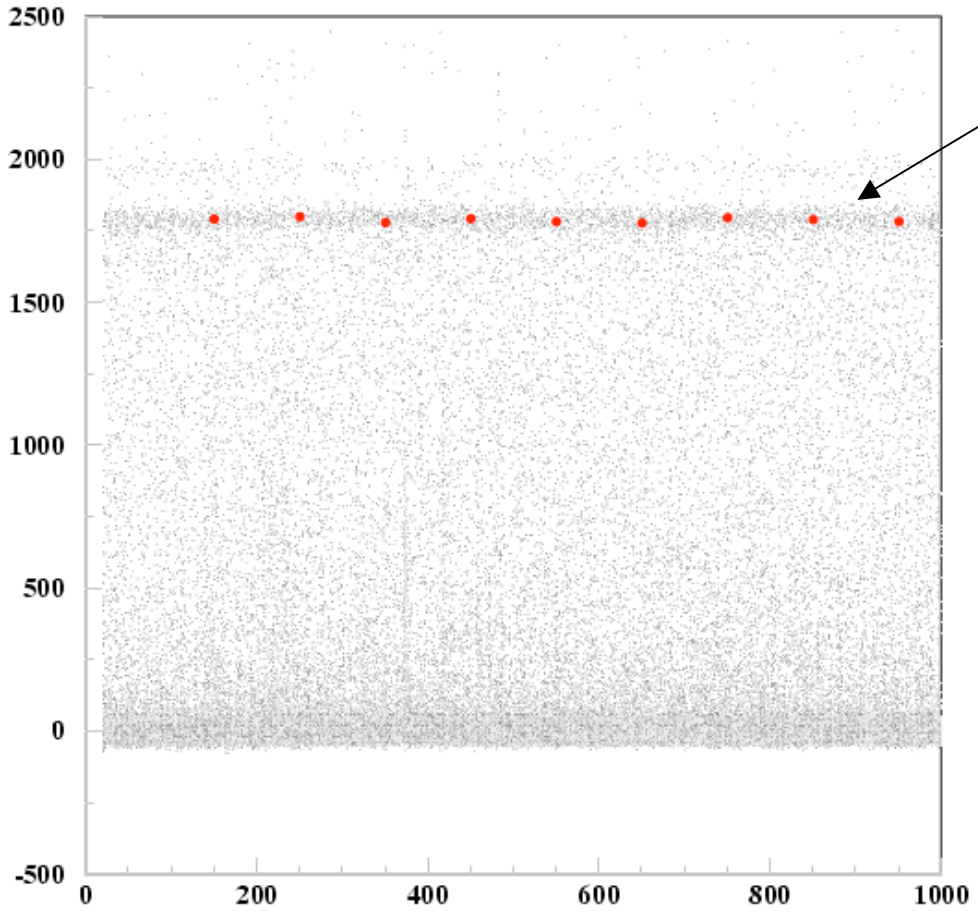


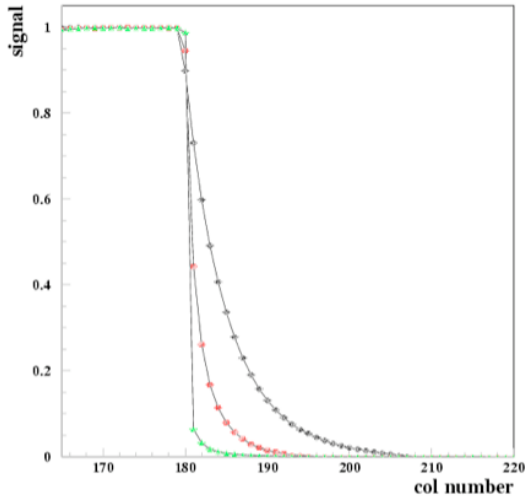
K_α

inefficiency :

pf-24-25: 3.9E-6

pf-24-24: 3.3E-6

Results agree with extended pixel method.



column