DEPFET Mini-matrix Setup

C. Oswald, J. Scheirich

Charles University in Prague
Institute of Particle and Nuclear Physics

6th International Workshop on DEPFET Detectors and Applications

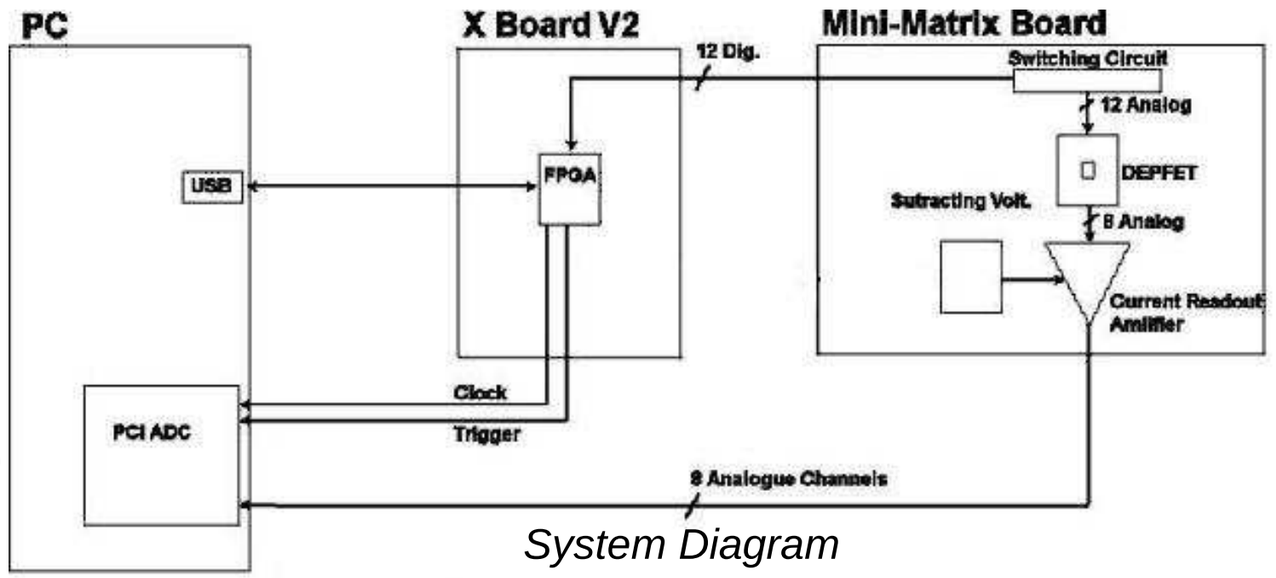
7-9 February 2011 LVR-Landes Museum Bonn

Outline

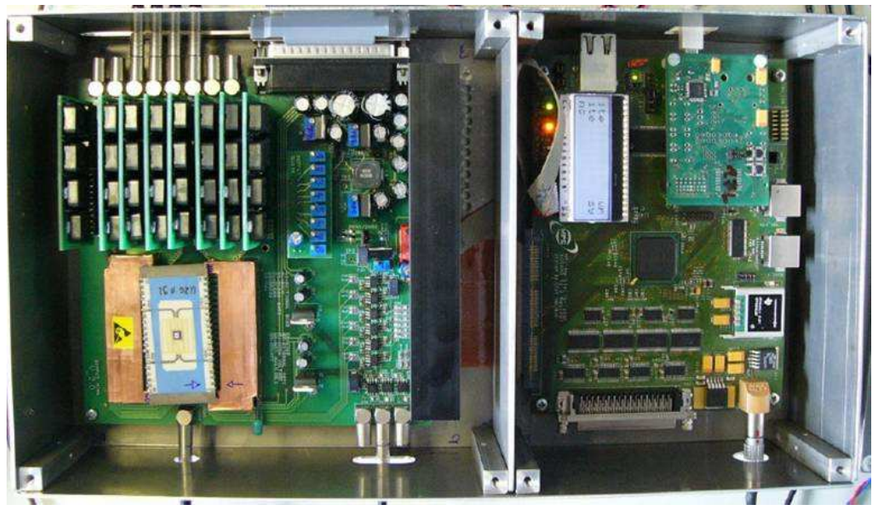
- Introduction
- System Upgrade
- Overview of Software
- Source Spectra
- Noise Performance
- Summary & Plans

Introduction

- Mini-matrix Setup
  - System for measurement of the DEPFET mini-matrices
  - 48 pixels active
  - 8 drain channels
    - Readout in parallel
  - 6 gate channels
    - Addressing the double-rows
  - Slow readout
  - Low noise



System Diagram



Mini-matrix Setup

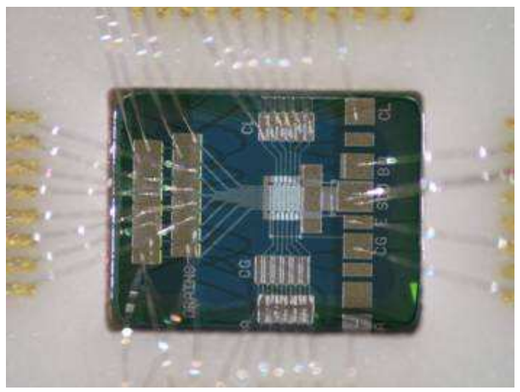
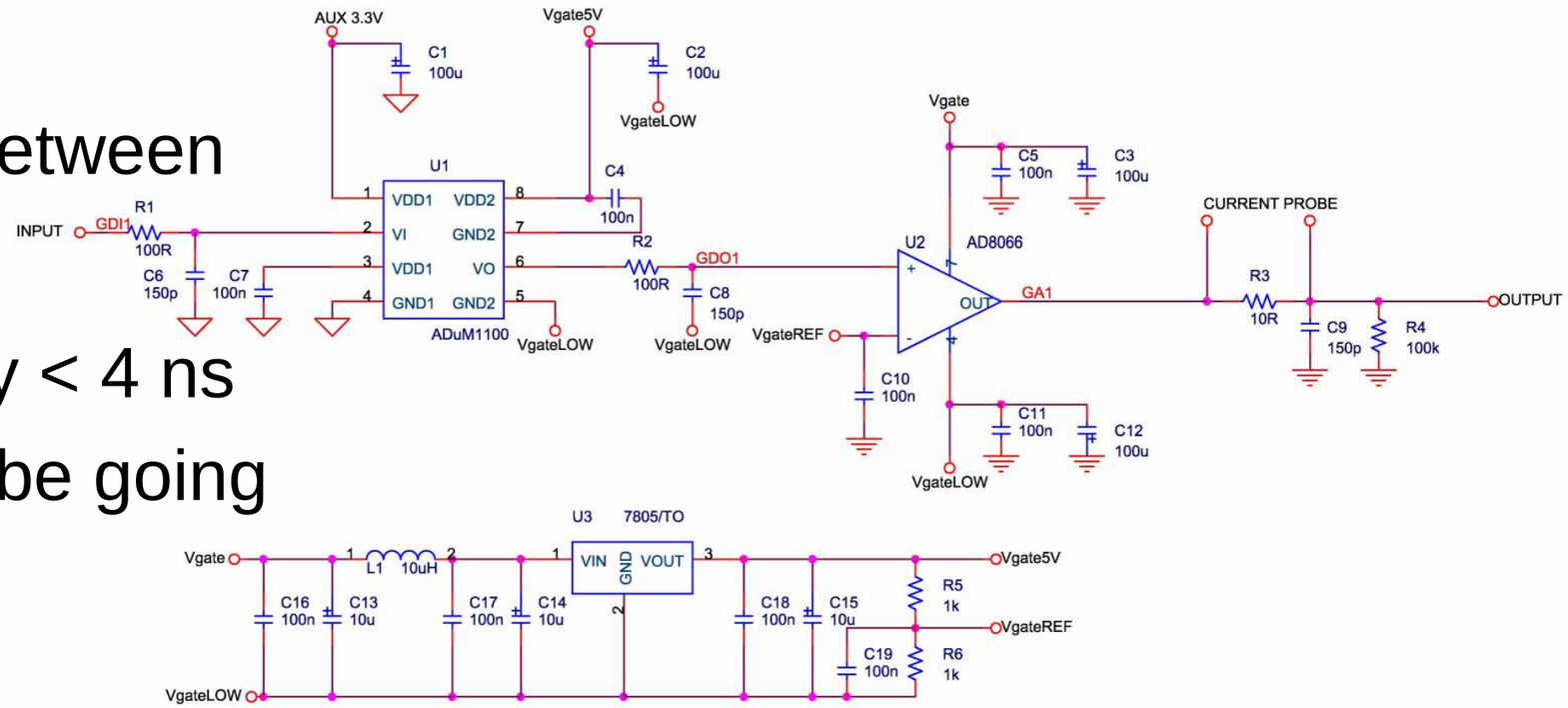


Photo of a Mini-matrix

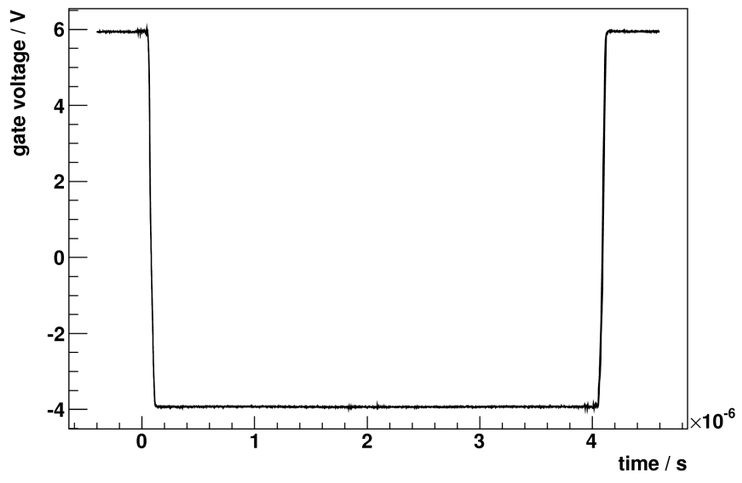
System Upgrade - Switcher

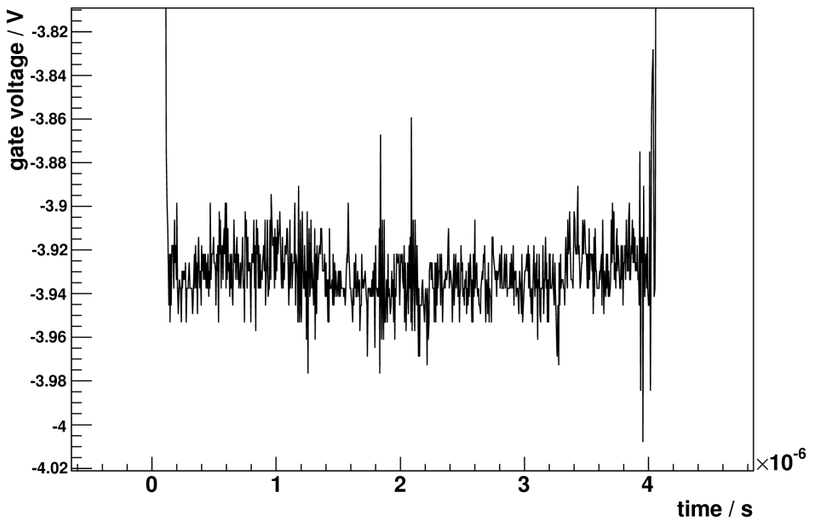
- Smooth signal
- Amplitude difference between channels < 3 mV
- Repetition time stability < 4 ns
- Gate/Clear current probe going to be implemented



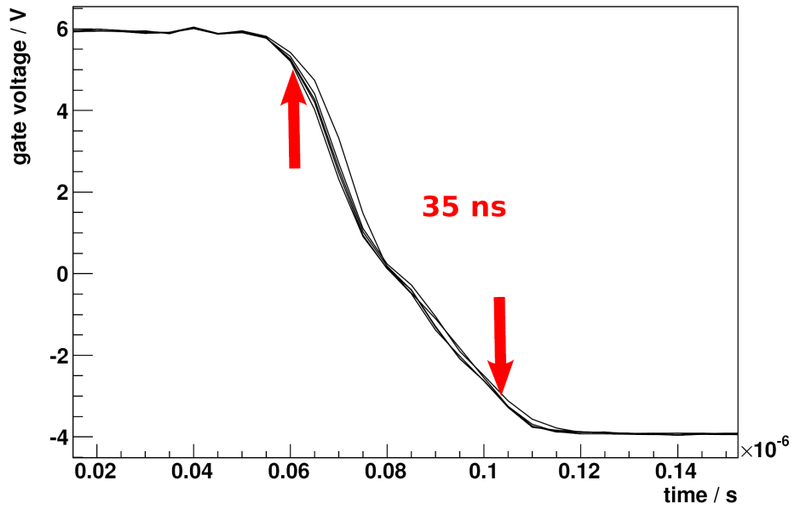
One Switcher Channel

Gate signals



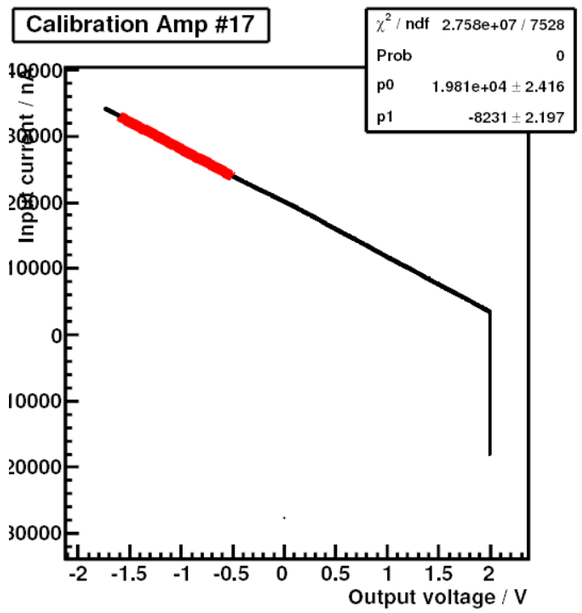


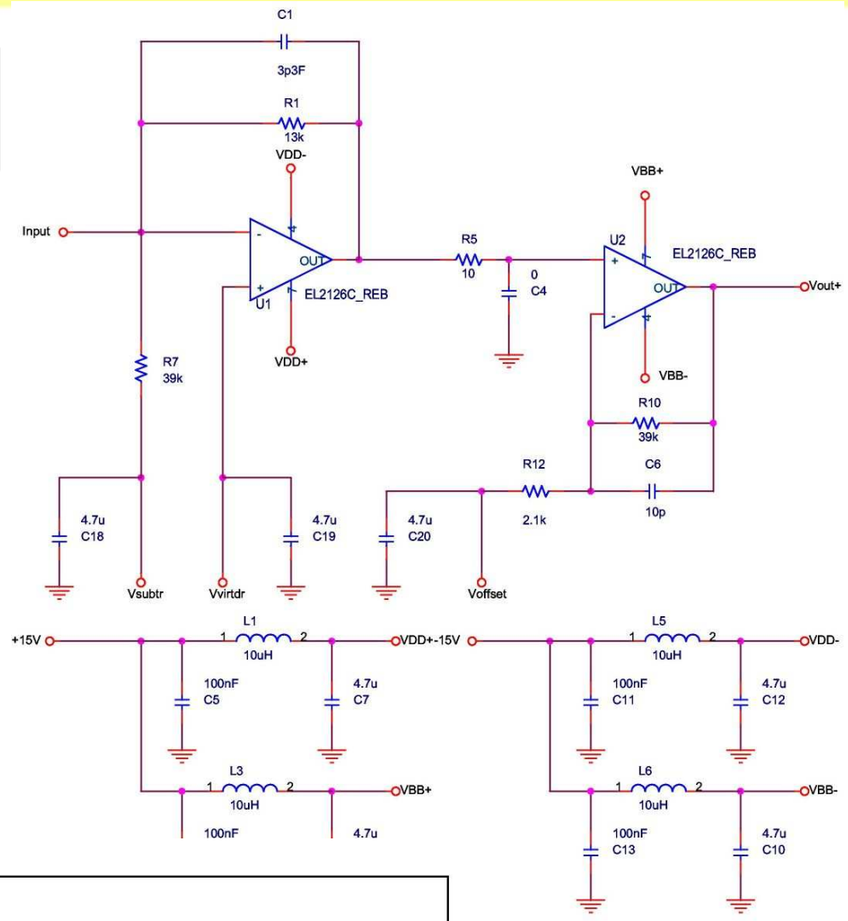
Edge of gate



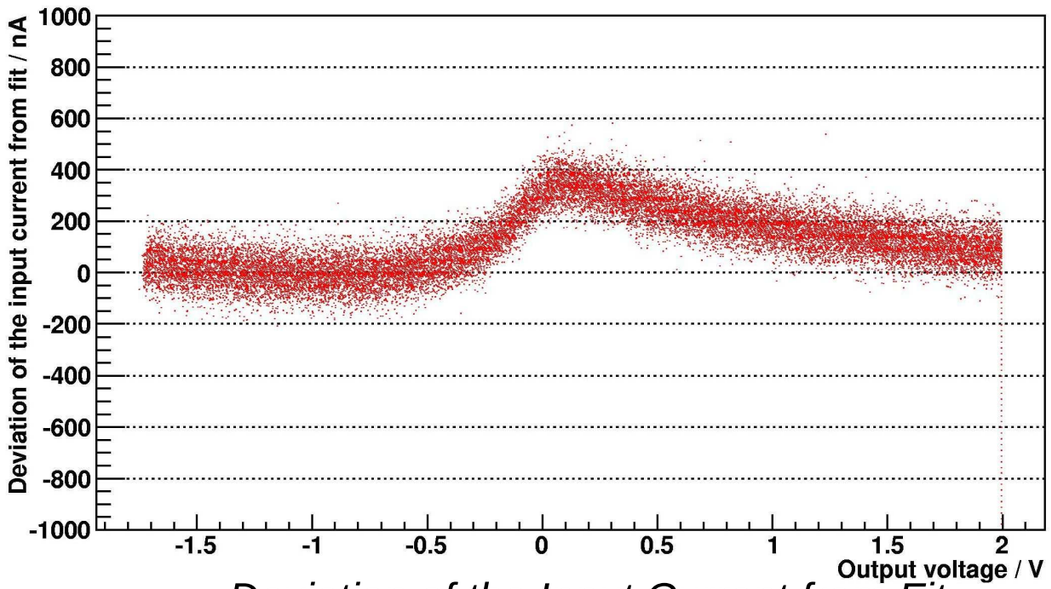
System Upgrade - Amplifiers

- Optimization for low noise and distortion
  - 3rd stage was removed
  - Feedback was modified
- Calibration
  - Nonlinearity when amp is crossing “0” -> operation range shifted to negative values
  - Nonlinearity in the op. range < 0.15 % but it is ~ 15 nA in absolute scale
  - Higher precision might be achieved by software correction



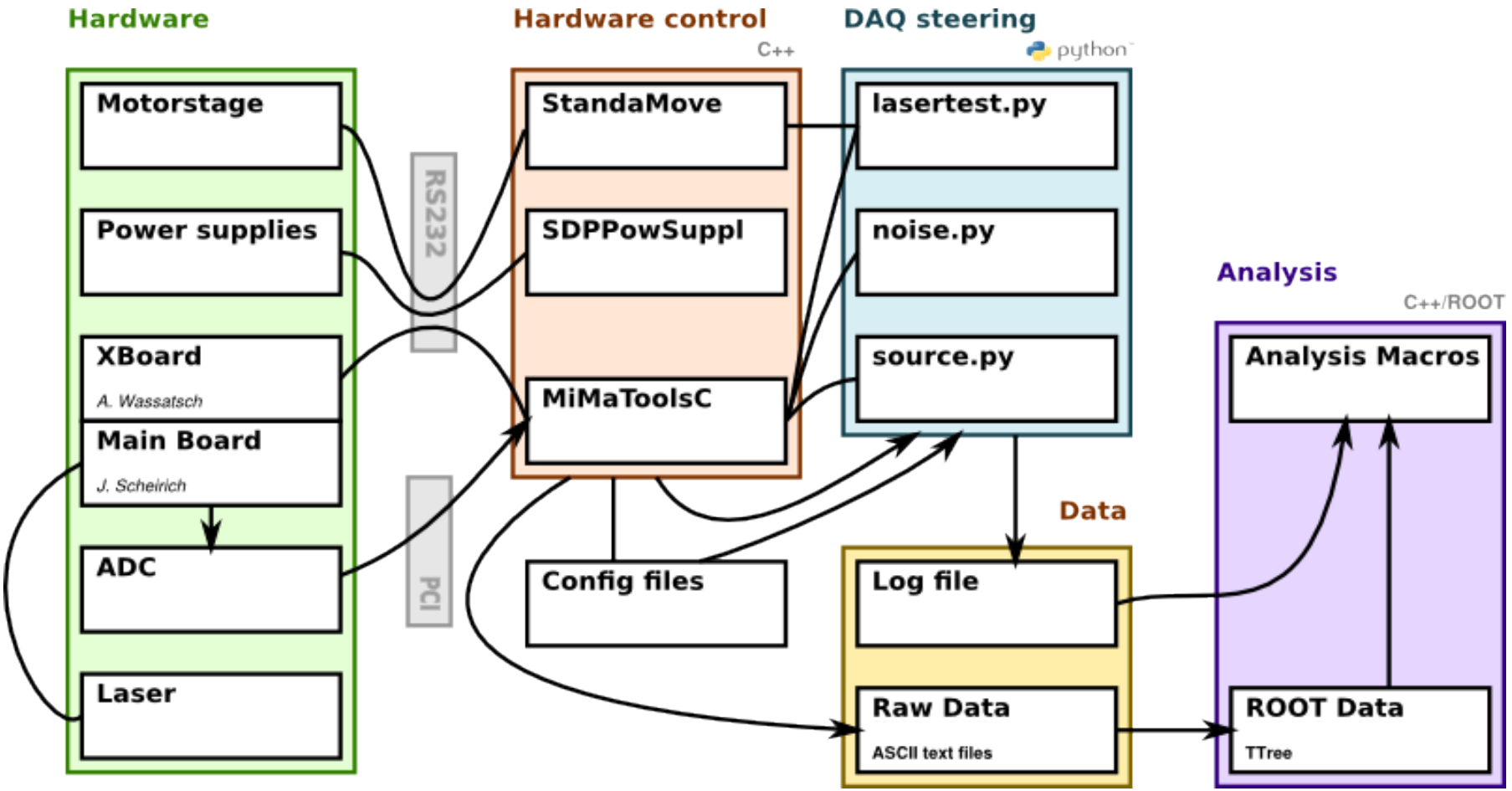


Amplifier

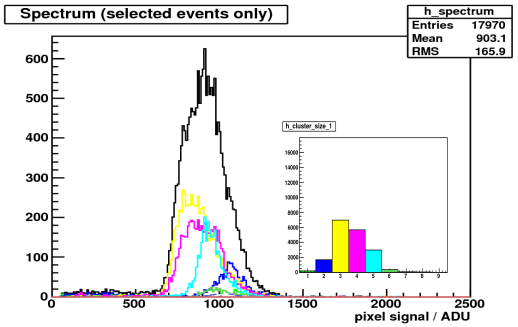


Deviation of the Input Current from Fit

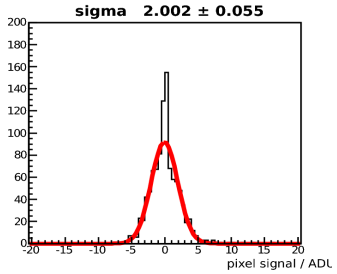
Overview of the software package



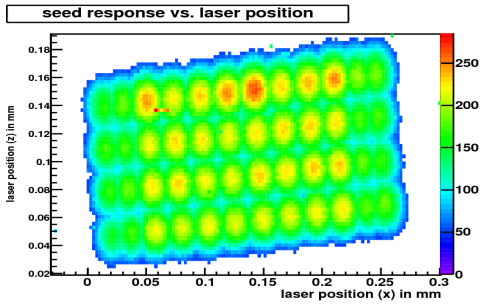
Summary



Source test

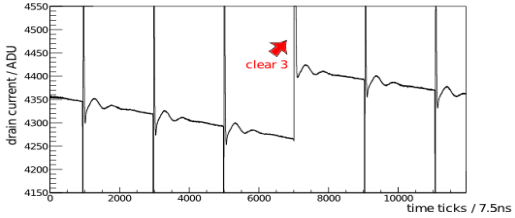


Noise measurement

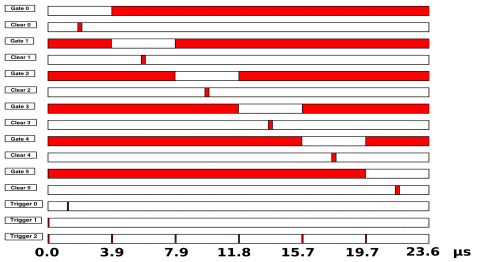


Laser test

MiMa Setup

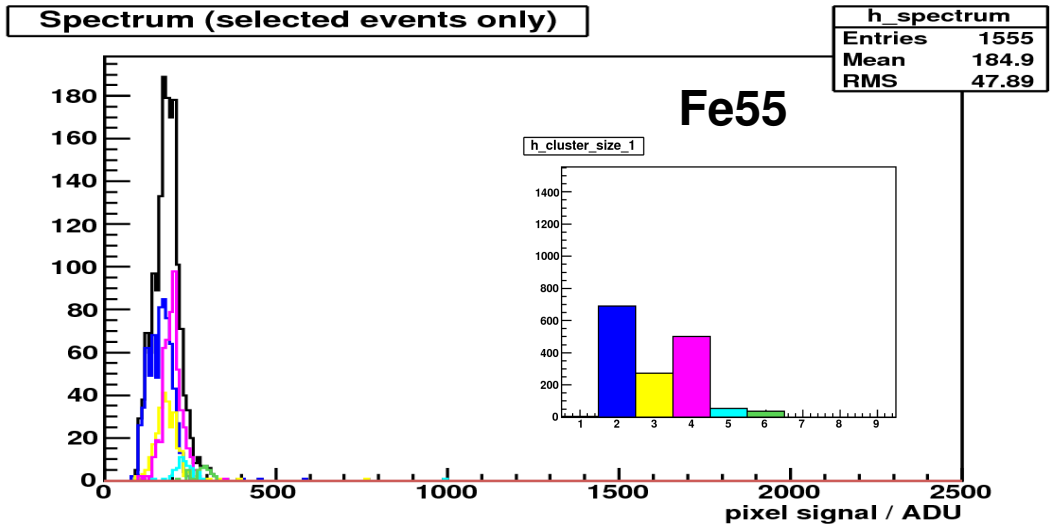


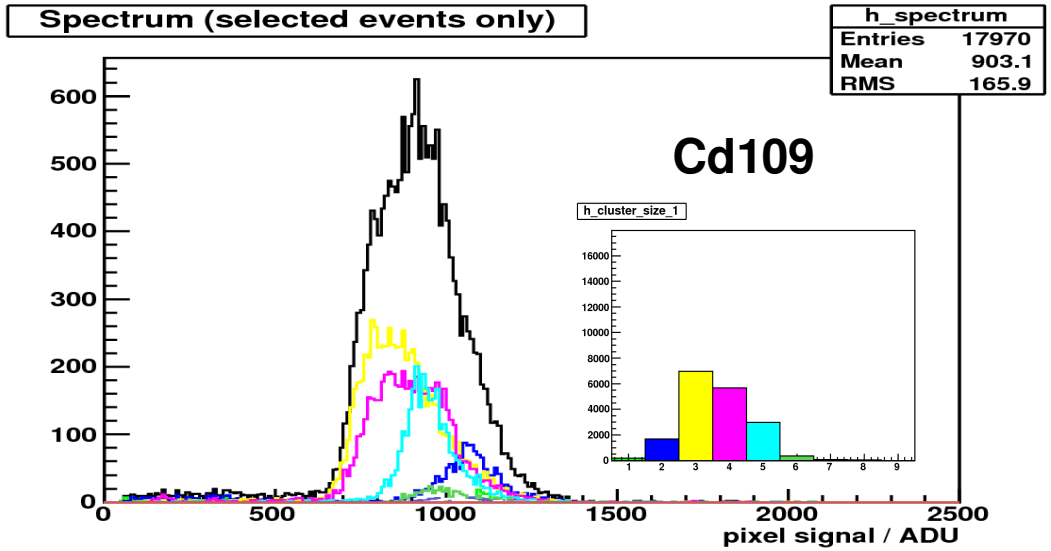
Raw data = full scope signal



Flexible readout sequences

Spectra

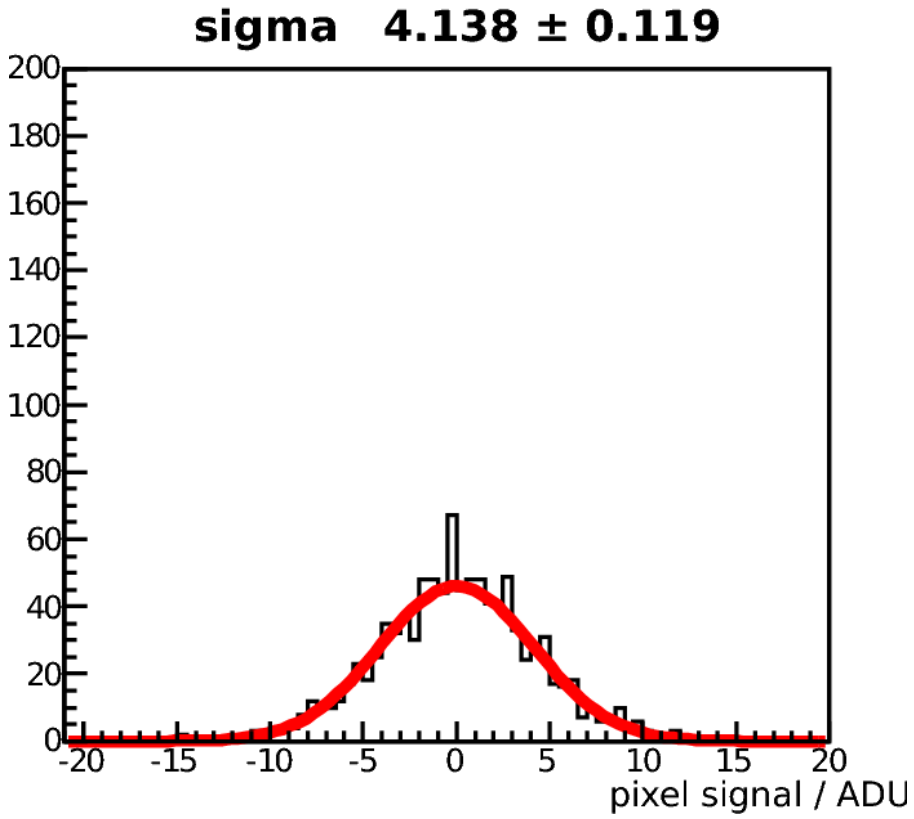




- **Significant differences in charge collection depending on cluster size**
- **Estimation of the internal amplification:**

$$g_q = \frac{dI}{dQ} \approx \frac{\Delta I}{\Delta Q} = 269 \ldots 419 \; pA/e^-$$

Noise



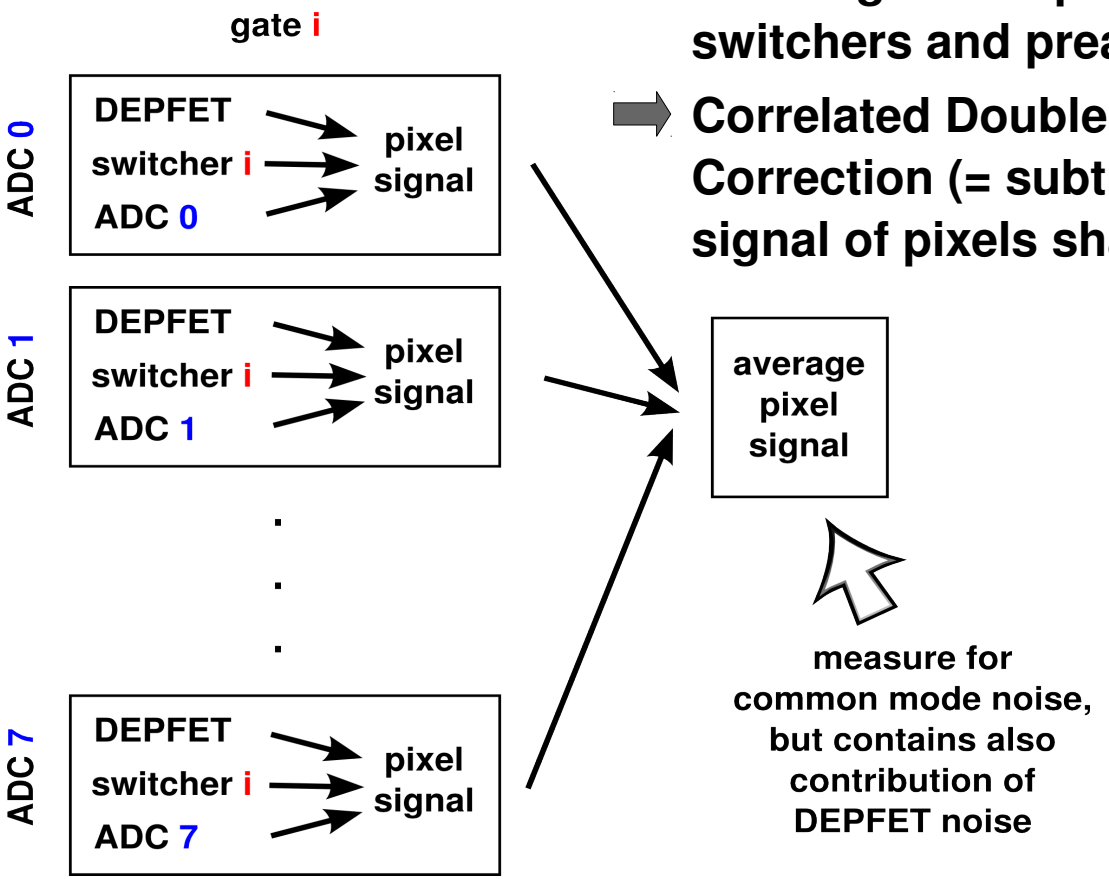
- **Acquisition of 1000 frames in black box**
- **Noise distribution = distribution of pedestal subtracted pixel signal**
- **Does not correspond to the noise of a spectrum (see previous silde!)**

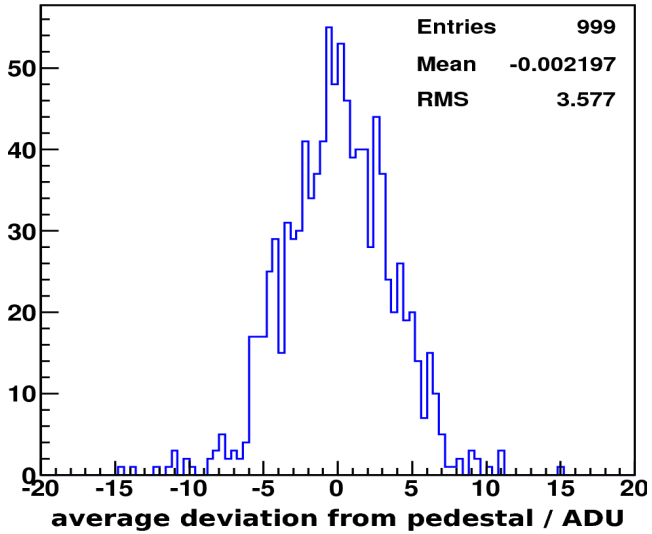
4.138 *ADU* = 8.516 *nA*

= 20…32 e^-

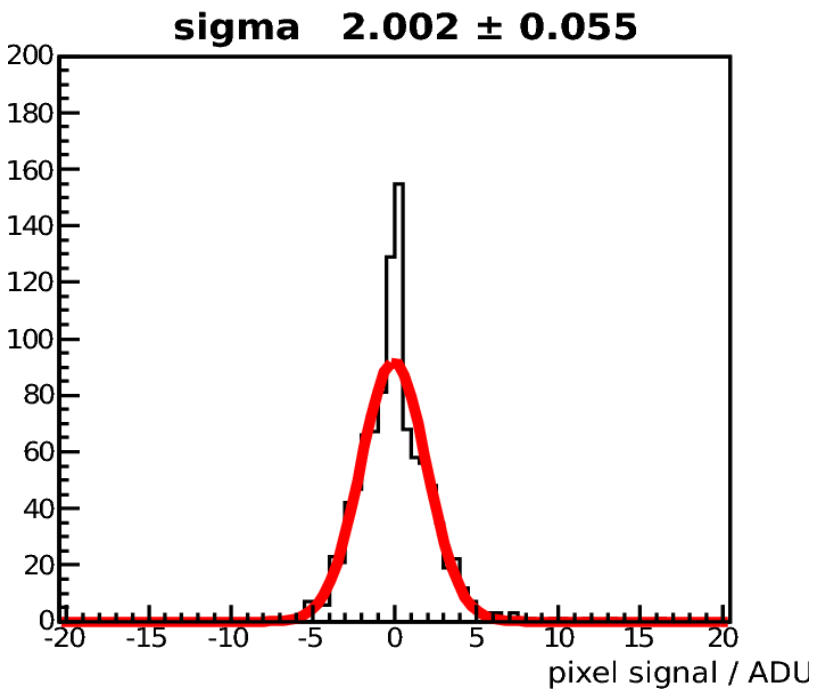
Contributions to the pixel signal

- **Pixel signal tampered with contributions from switchers and preamplifiers/ADCs**
- ➡ **Correlated Double Sampling and Common Mode Correction (= subtraction of the average pixel signal of pixels sharing the same switcher)**





Common mode correction

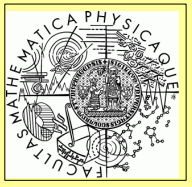


common mode corrected pixel noise

- **CM corrected distribution is not Gaussian anymore**
- **Overcorrection results in a too optimistic noise estimation**
- **Correction factor $\sqrt{n/(n-1)}$ assuming similar noise in all pixels**
- **CM corrected pixel noise:**

$$\sqrt{8/7} \times 2.00\ ADU = 2.14\ ADU$$
$$= 4.41\ nA$$
$$= 11 \ldots 16\ e^-$$

The common mode correction cannot be applied to measurements with pixel signal other than noise (source, laser) - not enough pixels



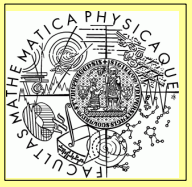
Status & Plans

- **Hardware: amplifiers & switchers upgraded to improve noise properties**
- **Software: System ready to perform all standard measurements**

- **Hardware update: measurement of gate/clear current**
- **Software update: PXD6 matrices**

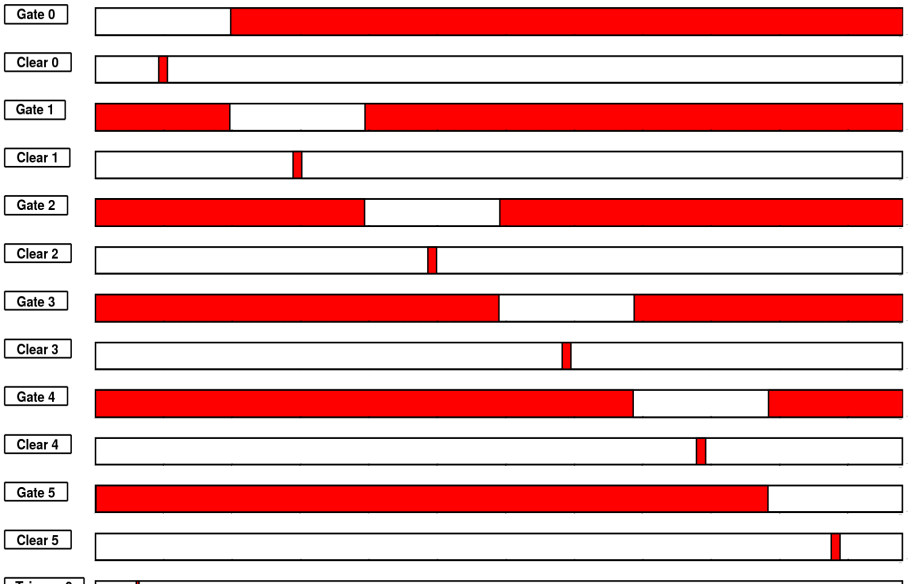
- **2 new setups in preparation for MPI + LMU**

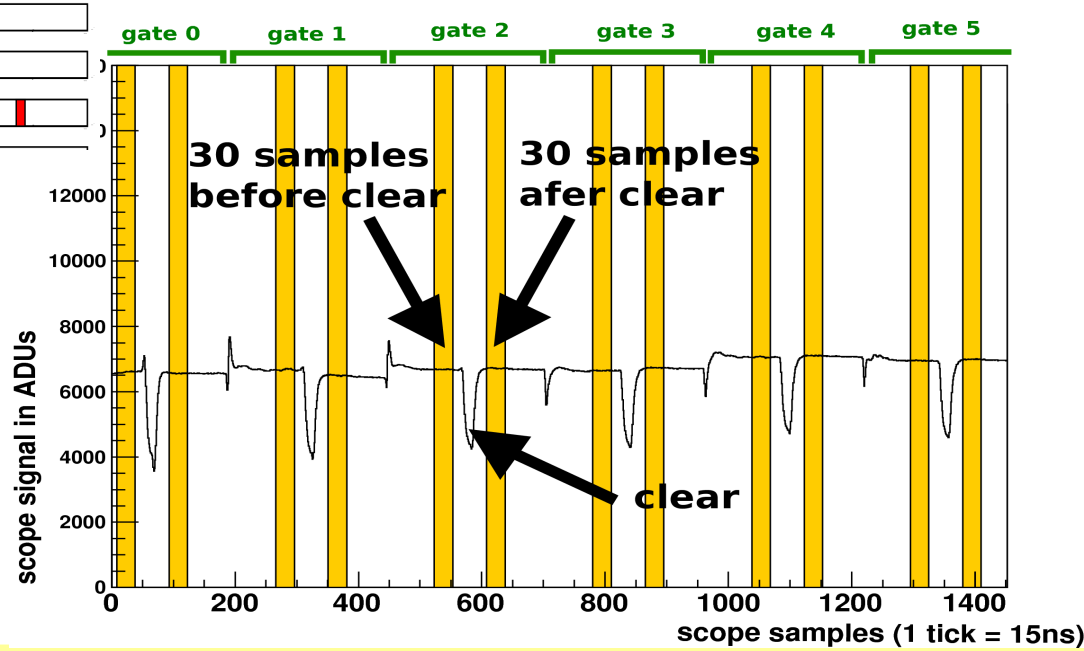
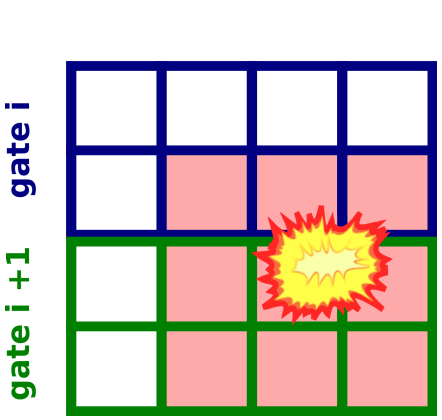
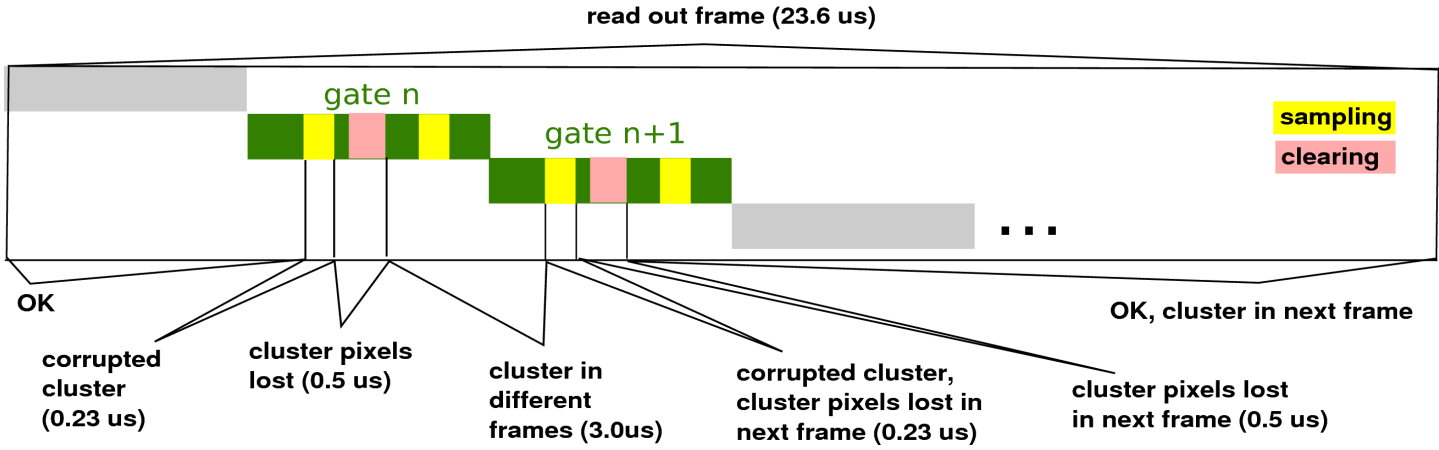
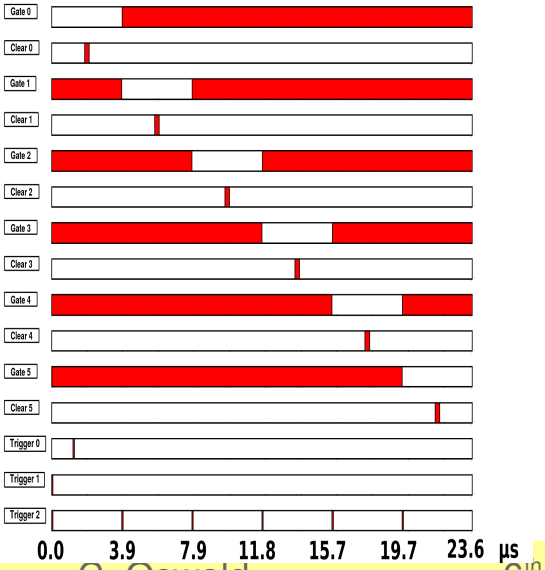
THANK YOU FOR YOUR ATTENTION!



BACKUP

Readout sequence + Raw data





Source measurements with slow readout times