



*PEBS ECAL meeting , Lausanne 30. April 2009*

## **SiPM readout for ECAL**

---

*[Guido.Haefeli@epfl.ch](mailto:Guido.Haefeli@epfl.ch) ,EPFL Lausanne*

# Overview

- Power consumption of the ECAL
- SPIROC dynamic range
- USB readout
- New SPIROC card for ECAL
- New USB board for PEBS DAQ

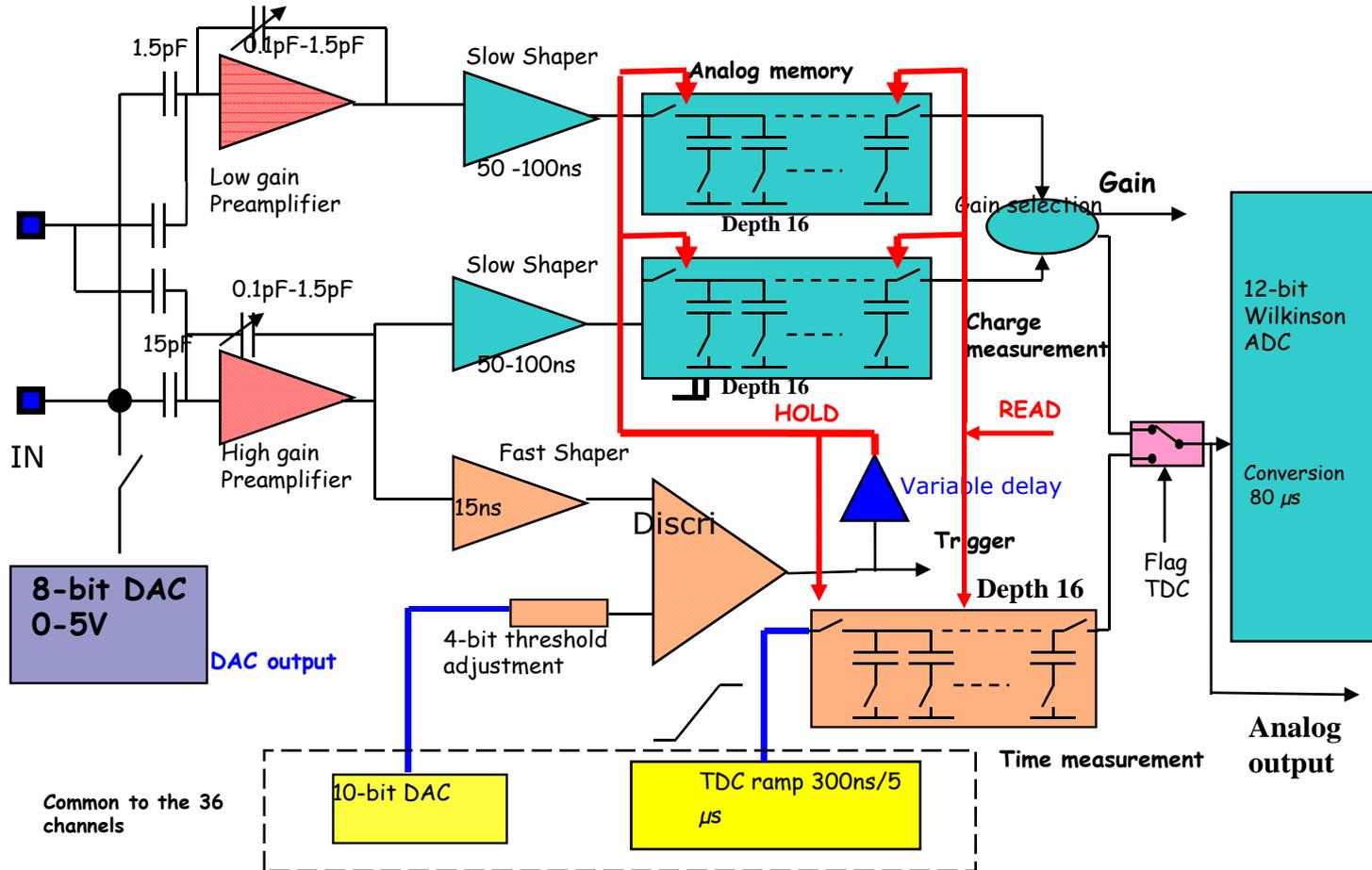
# Power consumption for the ECAL

- The power consumption estimates are based on the values measured at AMS2. Note that the electronics was developed with a lot of effort to reduce power.
- The latest generation of CPLD (Altera MAXII G) used at the Front End Hybrid (FE-Hybrid) and the low power FPGAs (for example Altera Cyclone III) for the Data Reduction Modules (DRM) are very well suited for our application and promise low power consumption.
- Estimate for the **DRM** consumption of **1.2mW** per channel.
  - Note that for a DRM with 8 ADCs can readout for example  $8 \times 6 \times 36 = 1728$  channels for the ECAL or 2048 channels for the fibre tracker → a total of only **3.6 W** is assigned to the **DRM board**
  - The DC-DC and bias power was measured for AMS2 at **2.2mW** per channel.
- For the SPIROC Waclaw has measured 10mW per channel without power saving and 3-5mW per channel if as much as possible of non-used parts are switched off.
- Summary: 120 FE-Hybrids \* 36 channels = 4320 channels
  - Power for FE-cards  $4320 \times 10\text{mW} = 43 \text{ W}$
  - Power for DRM  $4320 \times 1.2\text{mW} = 5.2 \text{ W}$
  - Power for DCDC  $4320 \times 2.2\text{mW} = 9.5 \text{ W}$  **Total: 57.7 W**

# Note on the dynamic range of the SPIROC

- In the data sheet of the SPIROC is stated that the dynamic range of the SPIROC is 1-1000pe !
- The dynamic range of the chip for a constant setting as it is intended be used for the ECAL is at most 1-100pe
  - Only if auto gain selection is used the dynamic range is increased by a factor 10. The low and high gain are automatically selected. In the PEBS ECAL we do not have any information about which mode was selected because the digital data is not readout.
- Waclaw has seen in his tests that above 35pe a important dead time is occurring (order of ms). This is due to some saturation in the chip. Useable dynamic range even smaller??

# SPIROC overview



# Measurement from Orsay I

High gain channel output

680fC ( ~4 pe @SiPM gain= $10^6$ ) in SPIROC

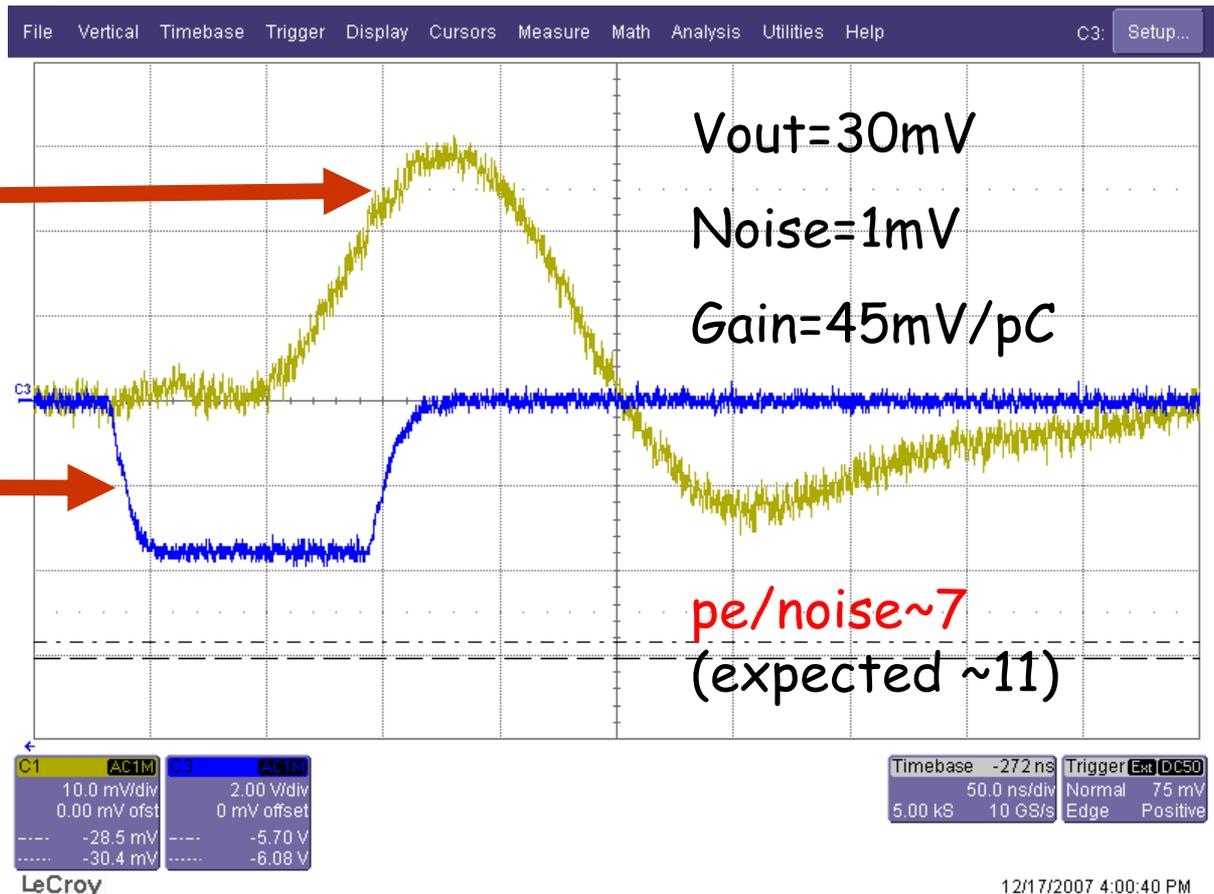
Charge measurement

Auto trigger

Set up:

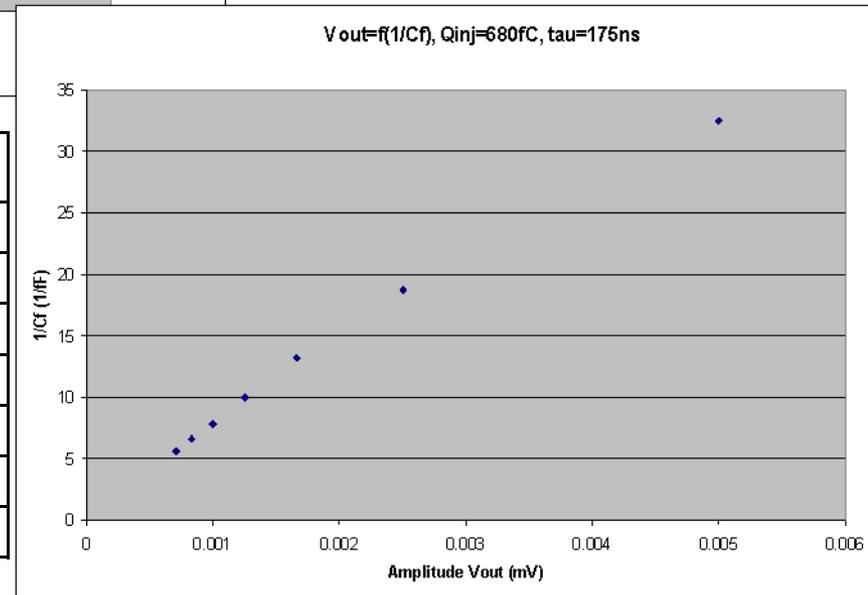
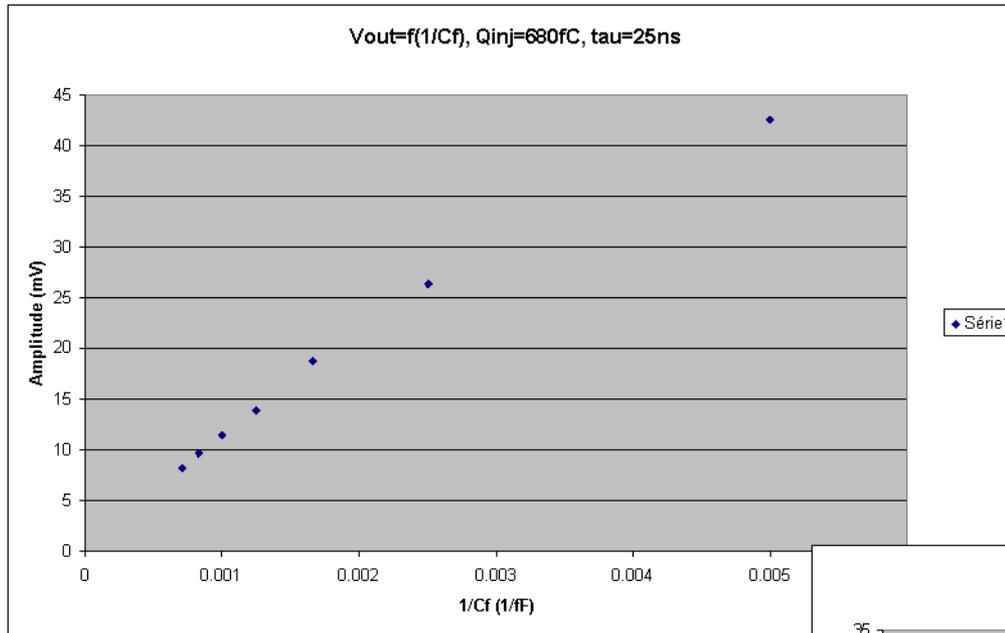
$C_f=400\text{fF}$

$\tau=50\text{ns}$



# Preampfier measurement

$Q_{inj} = 680fC$  (~4pe at SiPM gain of 10)



Cf (fF)	noise RMS(mV) 25s	noise RMS (mV) 175ns	Vout (mV) 25ns	Vout (mV) 75ns
200	1.2	2.2	42.6	32.5
400	1.0	1.3	26.3	18.7
600	0.92	1.15	18.8	13.2
800	0.9	1.0	13.9	10
1000	0.9	0.95	11.4	7.8
1200	0.9	0.9	9.6	6.6
1400	0.9	0.9	8.2	5.6

# USB readout

- 2 boards now used in EPFL SiPM testing
- 3 boards delivered to Aachen last week, VA32 and SPIROC card readout was successfully tested in internal and external trigger mode.
- Small webpage made available to access design resources
  - [http://lphe.epfl.ch/tell1/usb\\_board/](http://lphe.epfl.ch/tell1/usb_board/)
  - User manual written
  - C-code version 1 released
  - VHDL (firmware) version 1 released
- Some fixes in c-code needed and root file writer will be implemented for version 2.
- Power supply still not available for about one more month.

# USB readout for PEBS

- A USB board made for low power and with crate power supply could be made for the readout of the complete PEBS detector.
- A USB Hub (USB 2.0 provides 480Mbit/s) data bandwidth could be used for data collection to a PC.
- Measure the performance with the current USB boards and a Hub to understand if this is a feasible option.