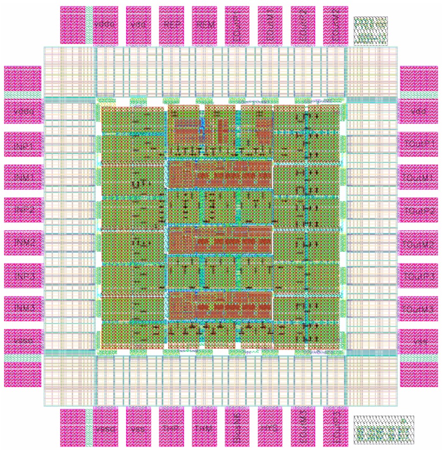


PADI

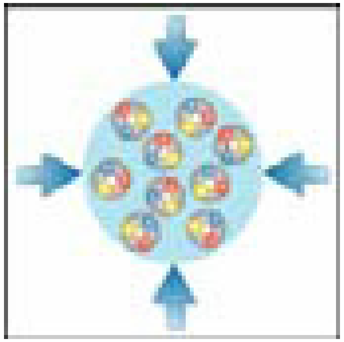
RPC-FEE
Progress Report

Mircea Ciobanu

CBM Collaboration Meeting

September 25 – 28, 2007

FZD-Dresden



Outline

- Status of the FOPI RPC-Front End Electronics.
- For time offsets and position calibration, a new RPC calibration detector has been designed.
- First tests results of the PADI (3ch) prototype connected to a SC 4 pixels Diamond Detector will be presented.
- Summary and Outlook

FEE Status (September 2007)

1. We prepare the ToF FOPI upgrade: 28 super modules are now mounted in the final position and are tested in test beam,

   There are 4480 channels for the main measurement (time and charge) and 64 channels for auxiliary measurements (start, clocks, LAAPD).

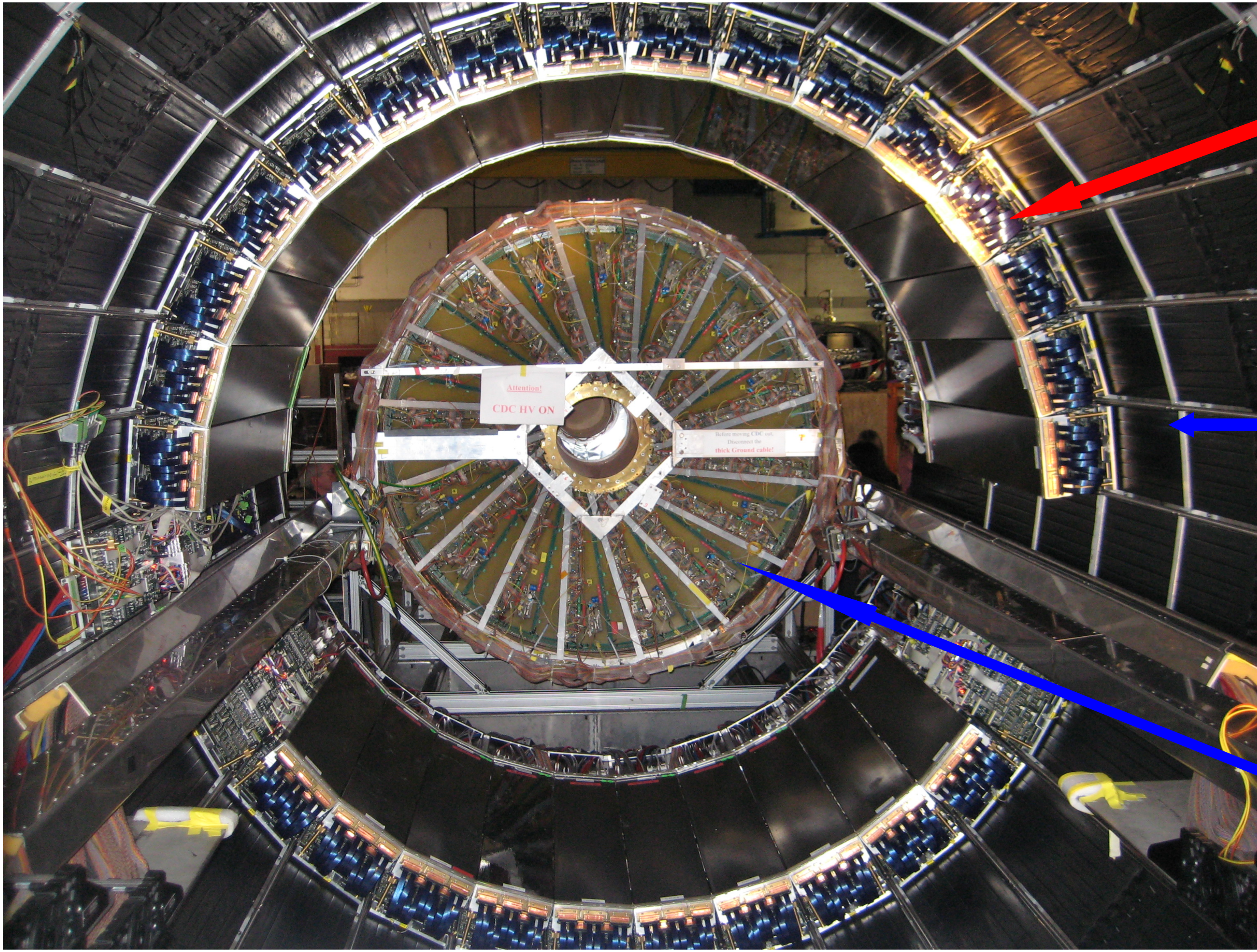
2. We have designed a new auxiliary RPC calibration detector for each RPC super module, to determine independent time offsets, walk and the position with measured data.

3. The new ASIC - PADI (PreAmplifier DIscriminator) was initially designed for RPC detectors, but can also be used to read out Diamond Detectors. We used the opportunity to test PADI under beam conditions, together with a SC 4 pixels Diamond Detector, to evaluate two important issues:

   - the PADI to detector connection

   - the PADI rate stability under beam conditions

The FOPI upgrade is now in the first test

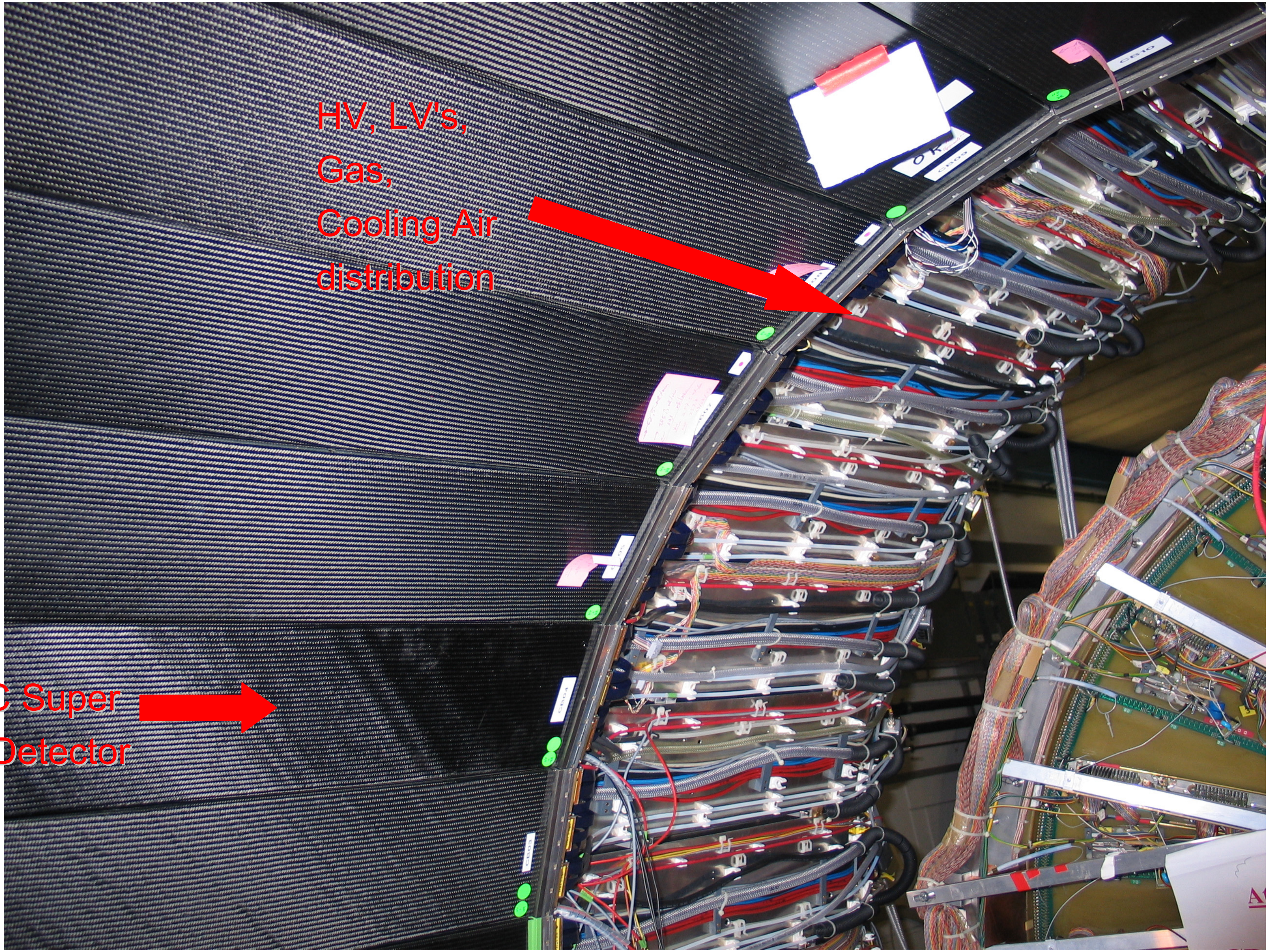


The RPC barrel detector

The Plastic barrel detector

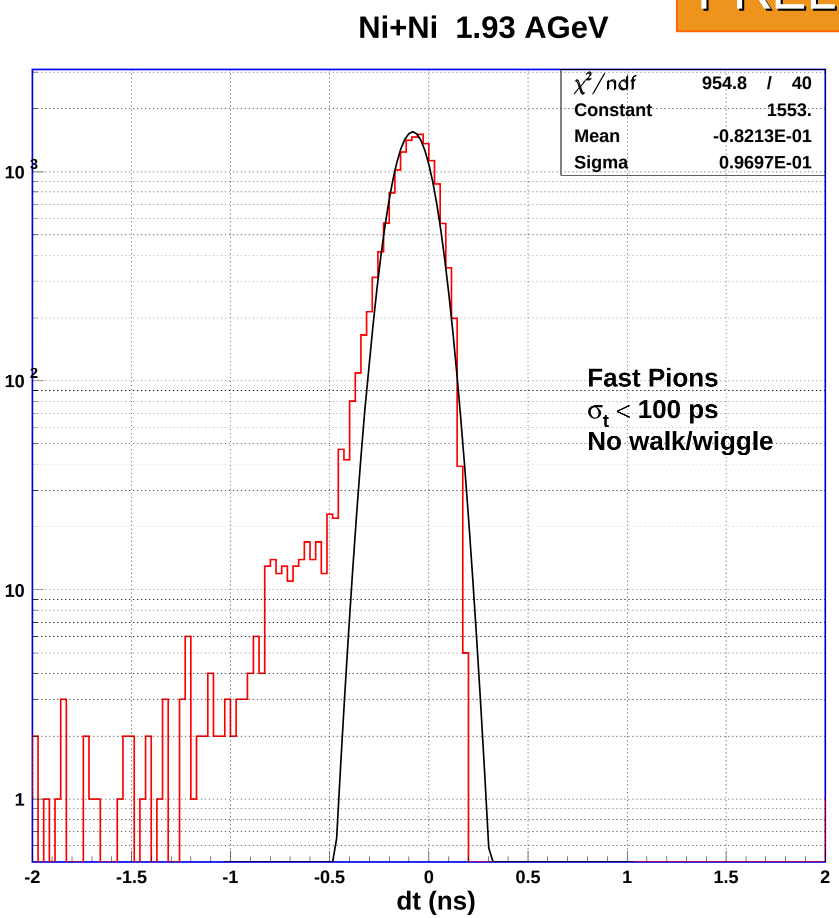
The CDC detector

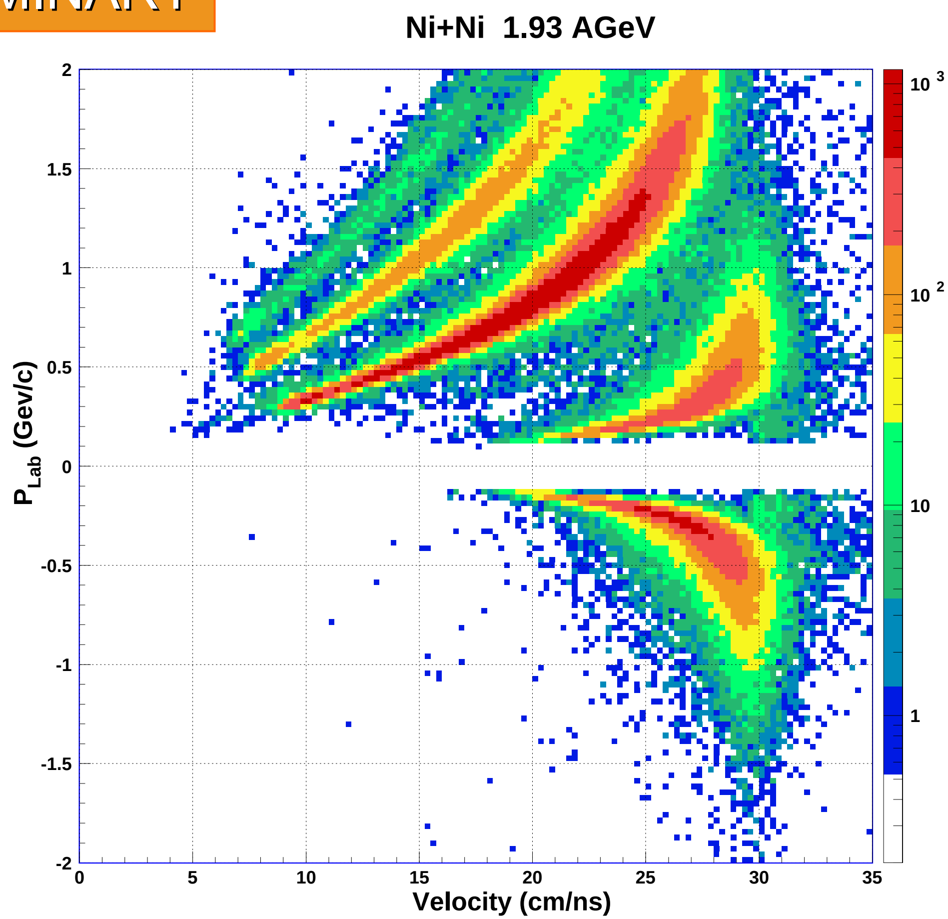
Some details...



First "in beam" results!

PRELIMINARY



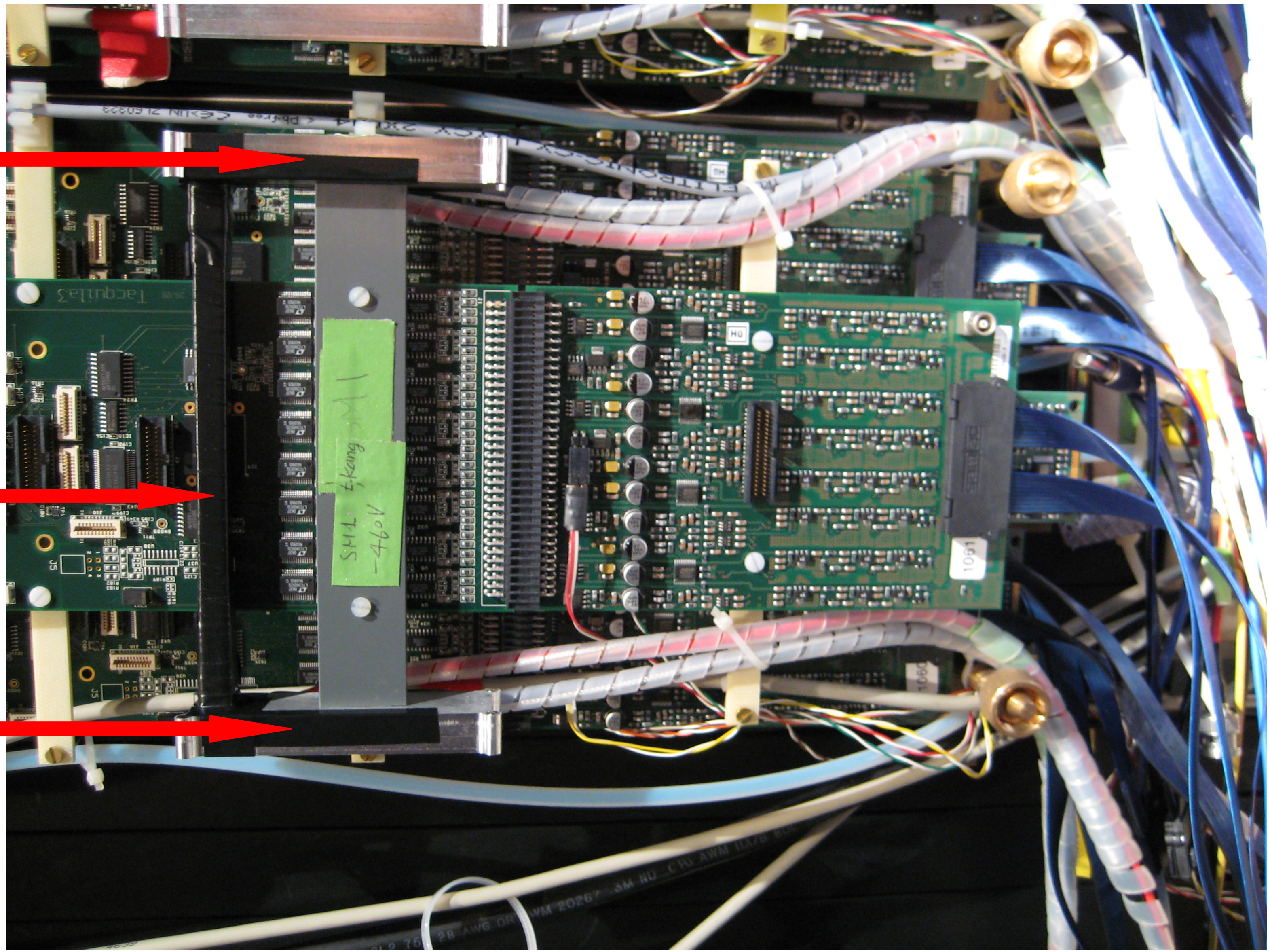


For RPC time offsets and position calibration, a new calibration detector has been designed

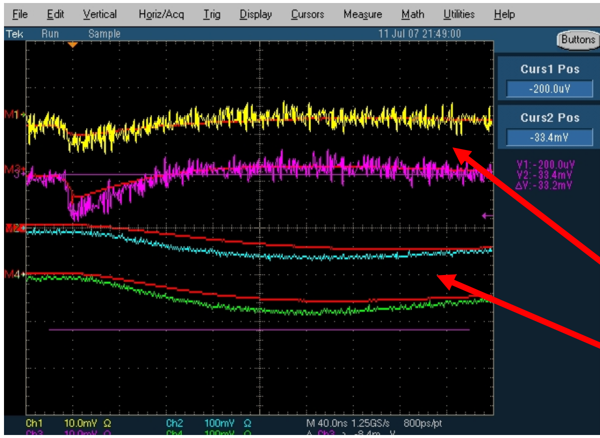
LAAPD
and
TCSPA3

155 mm x
8 x 8 mm^2
plastic
Scintillator
BC408

LAAPD
and
TCSPA3



LAAPD (S8664-60K Hamamatsu) + Scintillator (BC408) + T_CSPA3

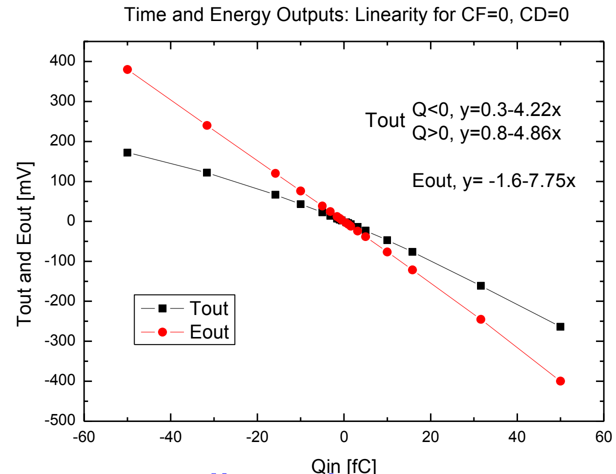


Beta ray

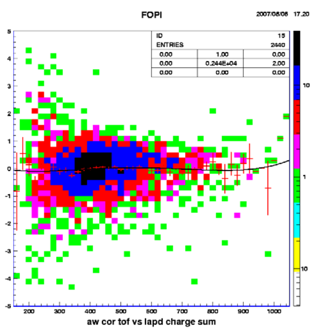
scope signals:

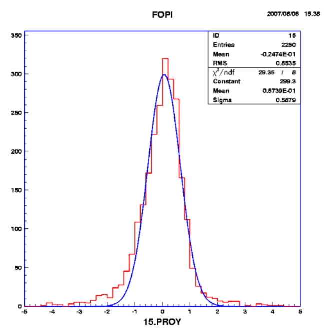
Time Output

Energy Output



linearity



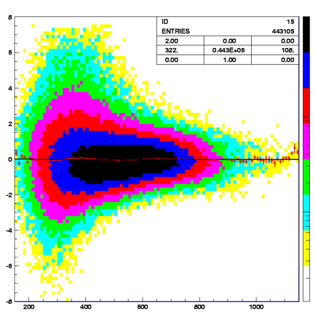


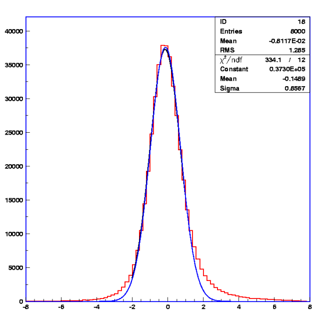
Cosmic ray

σ_T < 600 ps

T_CSPA3

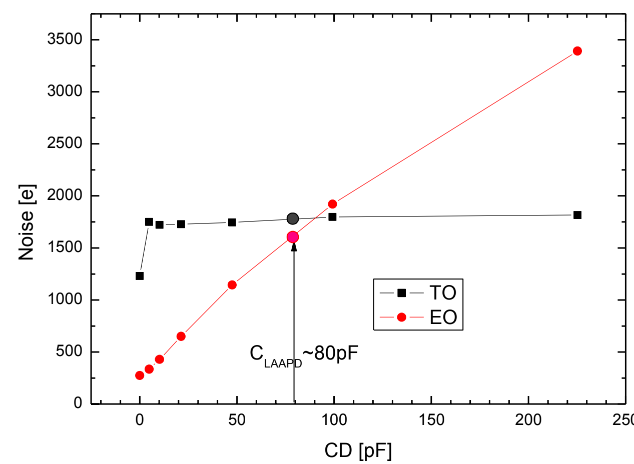
noise





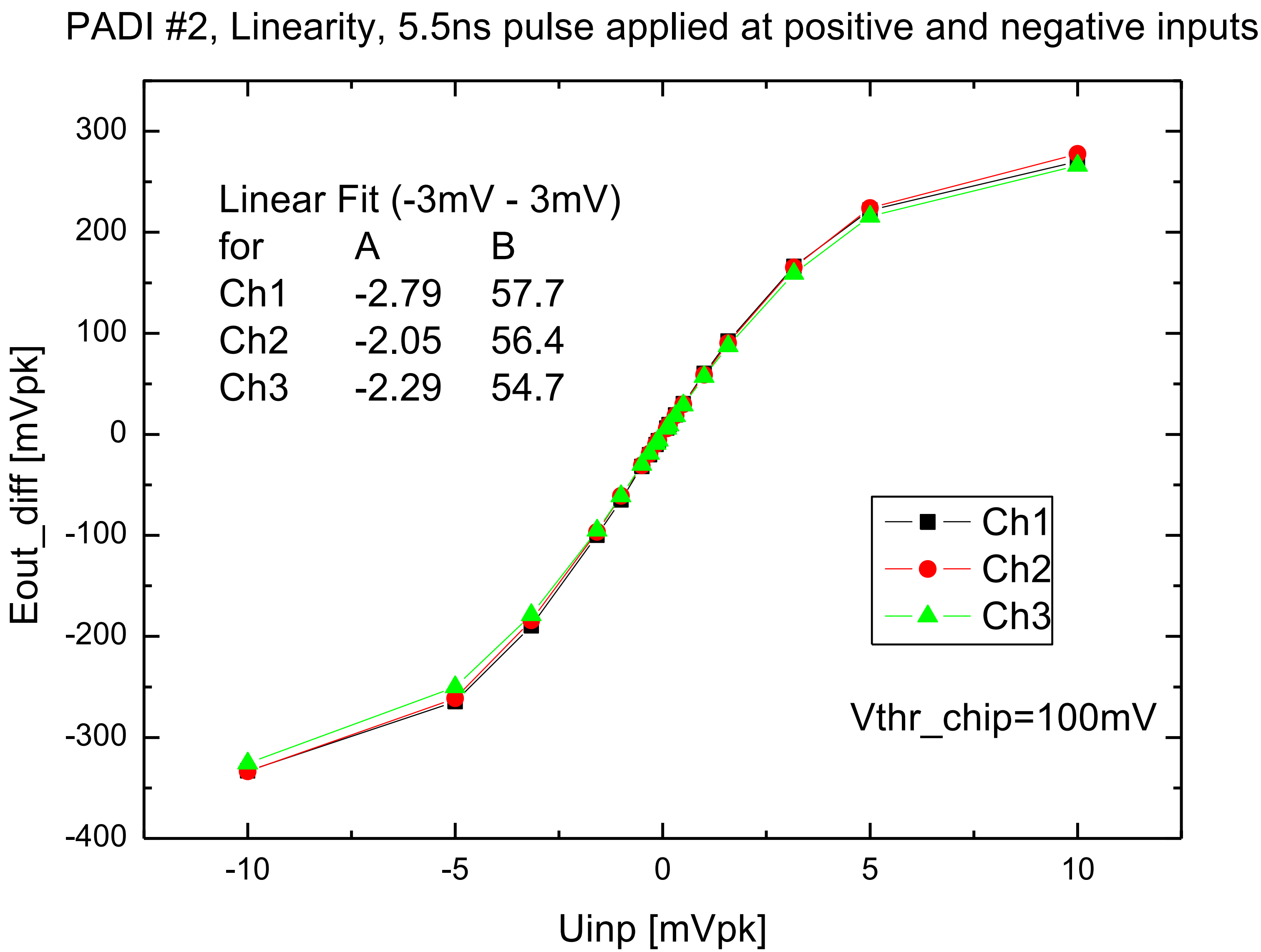
Gamma ray

σ_T < 600 ps

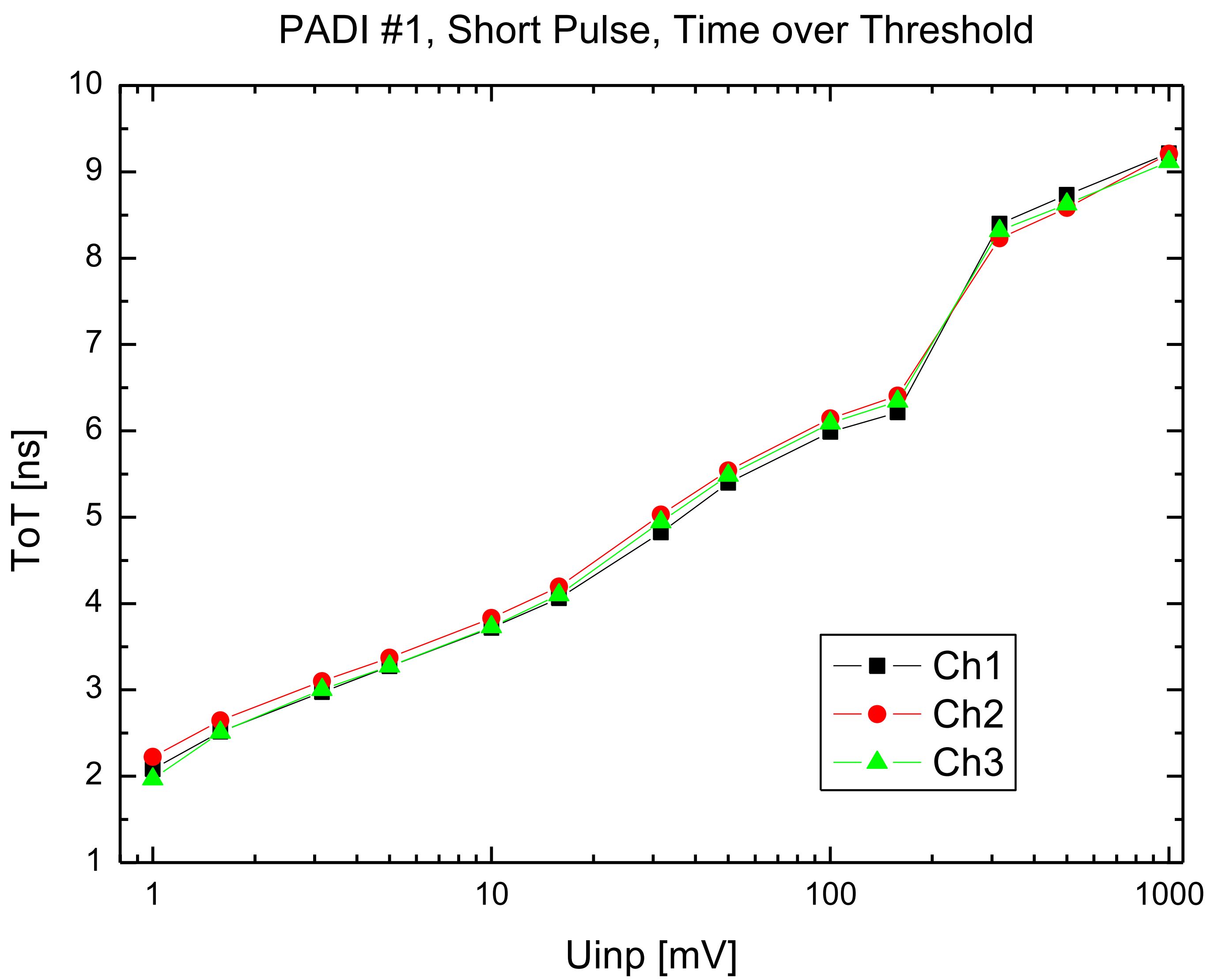


Tae Im Kang

PADI prototype Linearity: Pulse Measurement



PADI prototype   Time over Threshold behavior

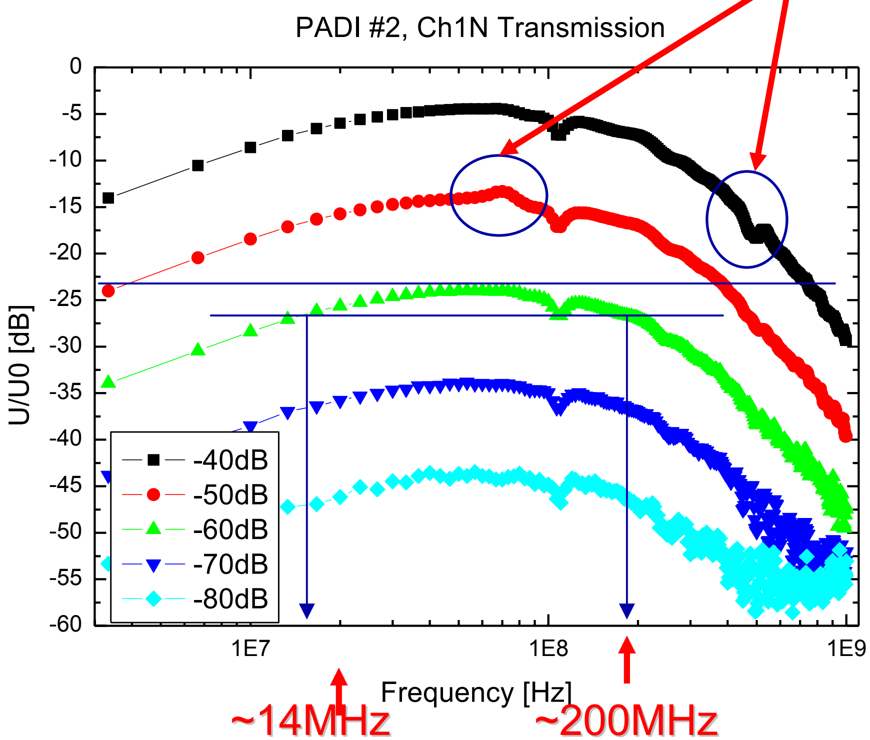


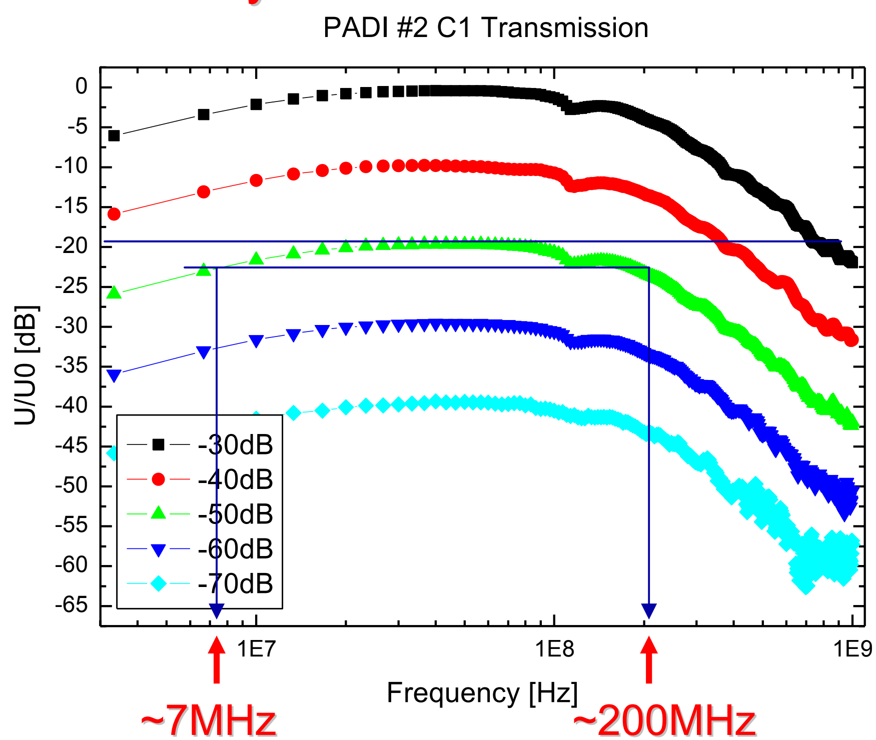
PADI prototype   AC Transmission Measurement

@Rext=24 Ω

@Rext=6Ω

Possible instability!





Gain ~ -23dB+60dB=37dB

Gain ~ -19dB+50dB=31dB

PADI prototype Other Measurements...

- **DC Power Consumption:** **31[mW/ch]**

- **DC Threshold Calibration:**
  The transfer characteristics from the threshold voltage applied to PADI terminals to energy output is: 0.334 (σ=0.022)

- **Input impedance measurements:**

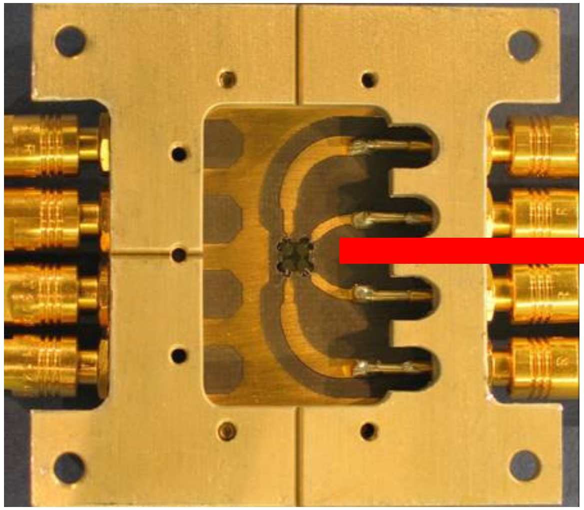
	$Z_{INP}[\Omega]$
1. AC method : Questionable!	27-96
2. TDR method adapted for low level signals, with "T"	35-67
3. TDR adapted for low level signals, with a directional coupler	42-59
4. Short pulse method for low level signals, directional coupler	48-58

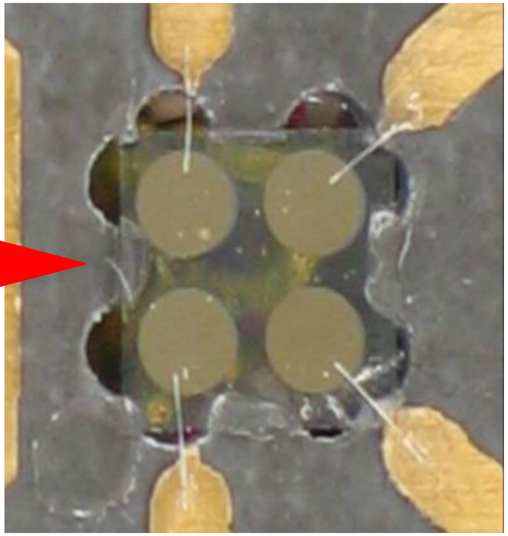
- **Crosstalk measurements:**

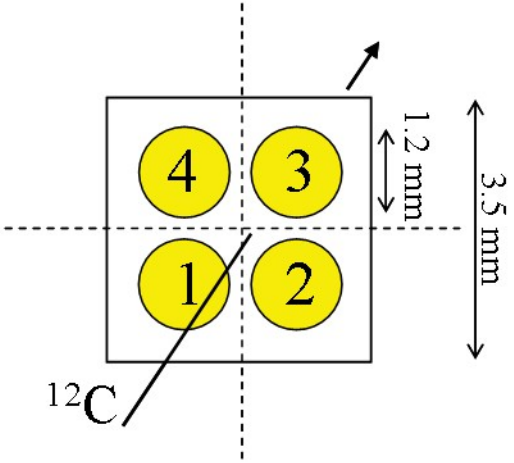
	CTRR32	CTRR31
PADI (AC @75MHz) [dB]	25-30	22-27
PADI Pulse Meas. [dB]	>40	

- **Common Mode Rejection Ratio Measurement**
  PADI Pulse Meas. [dB] 26-40

Detector used: Diamond SC with 4 pixels



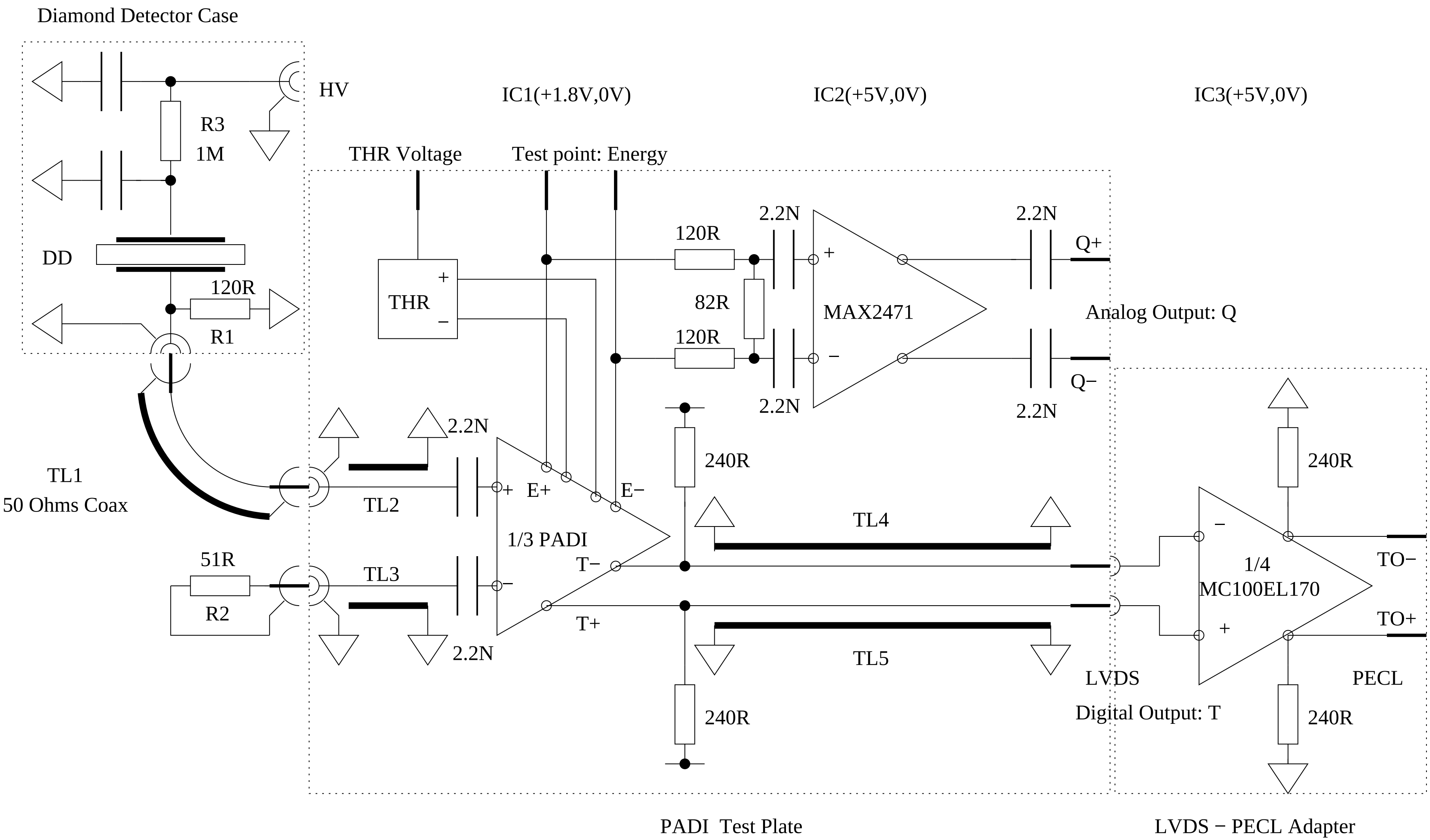




Diamond mounting case

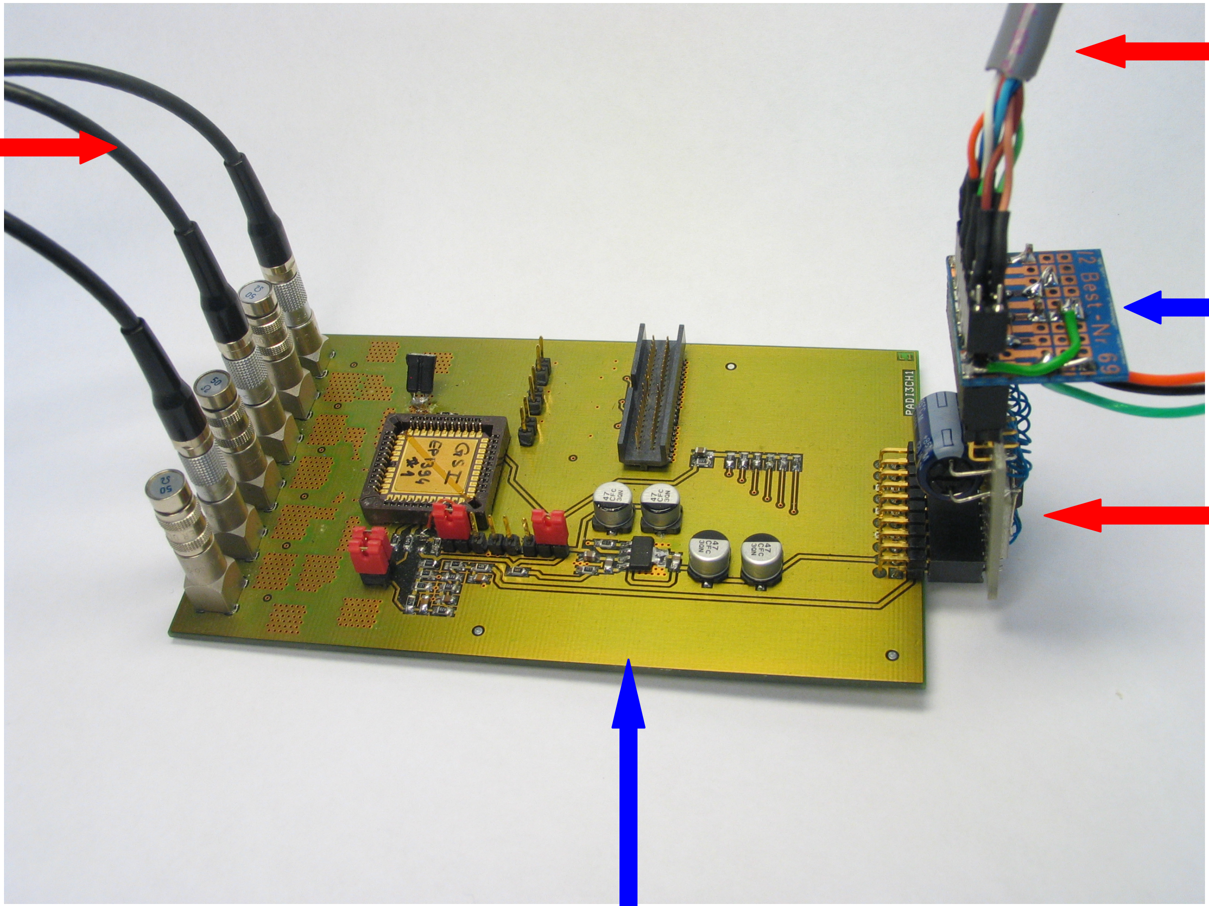
SC Diamond with 4 pixels

PADI one channel schematics



The PADI together with a SC Diamond (4 pixels) detector

Connection's with SC Diamond Pixel Detector



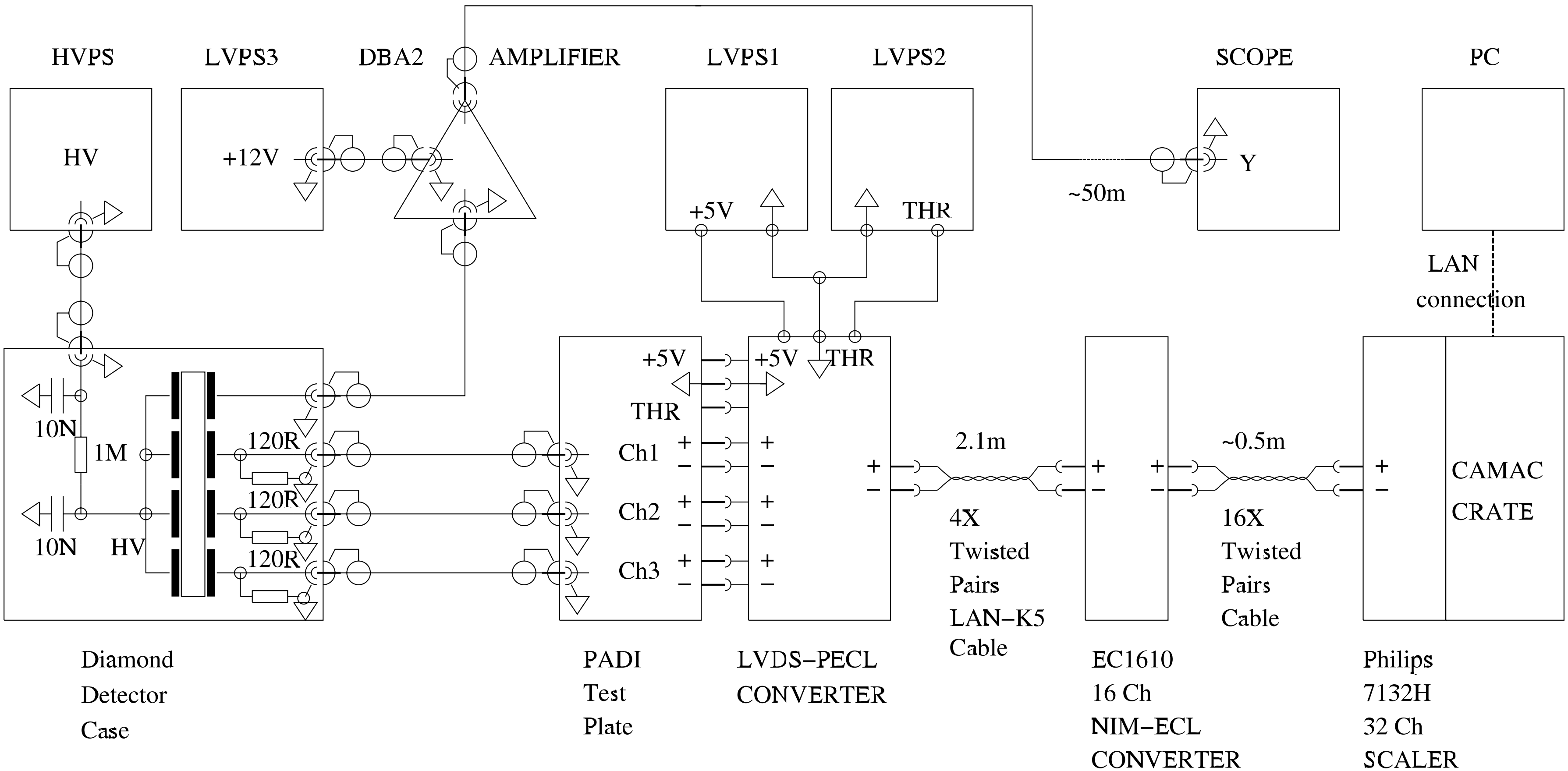
Time Output's LAN-K5 cable ~2.1m

Interface PCB +5V,GND,THR connections

LVDS-PECL Converter PCB

PADI test PCB

The whole block schematics setup



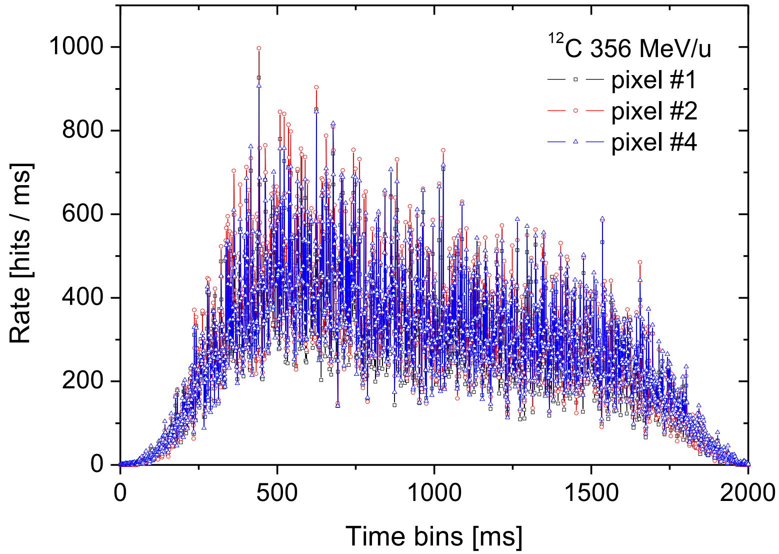
The scaler was programmed to measure rates in 1ms time slices.

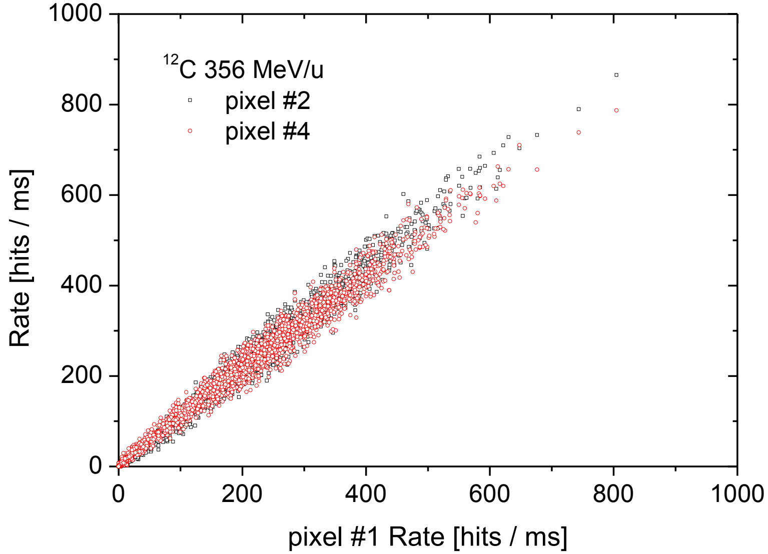
The setup was optimized for high rate measurements:

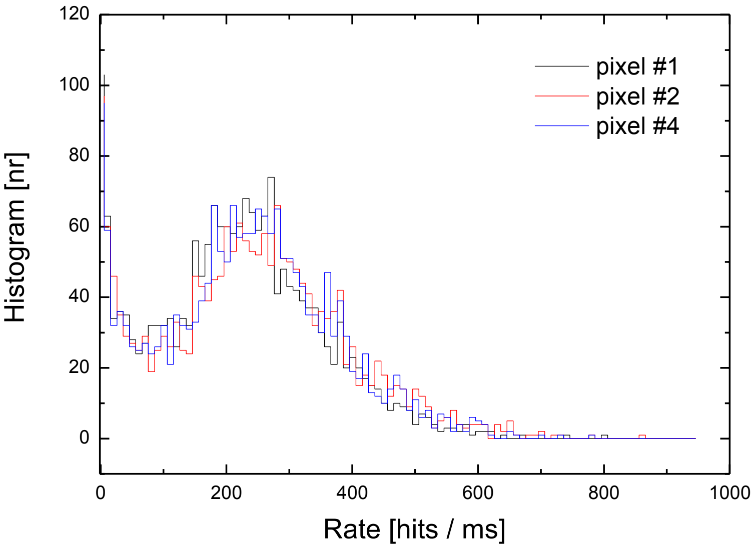
For each channel the maximal rate is 1.5×10^8 [hits/s]

Typical results in one spill time

- Time structure
- Pixels comparison
- Rate histogram

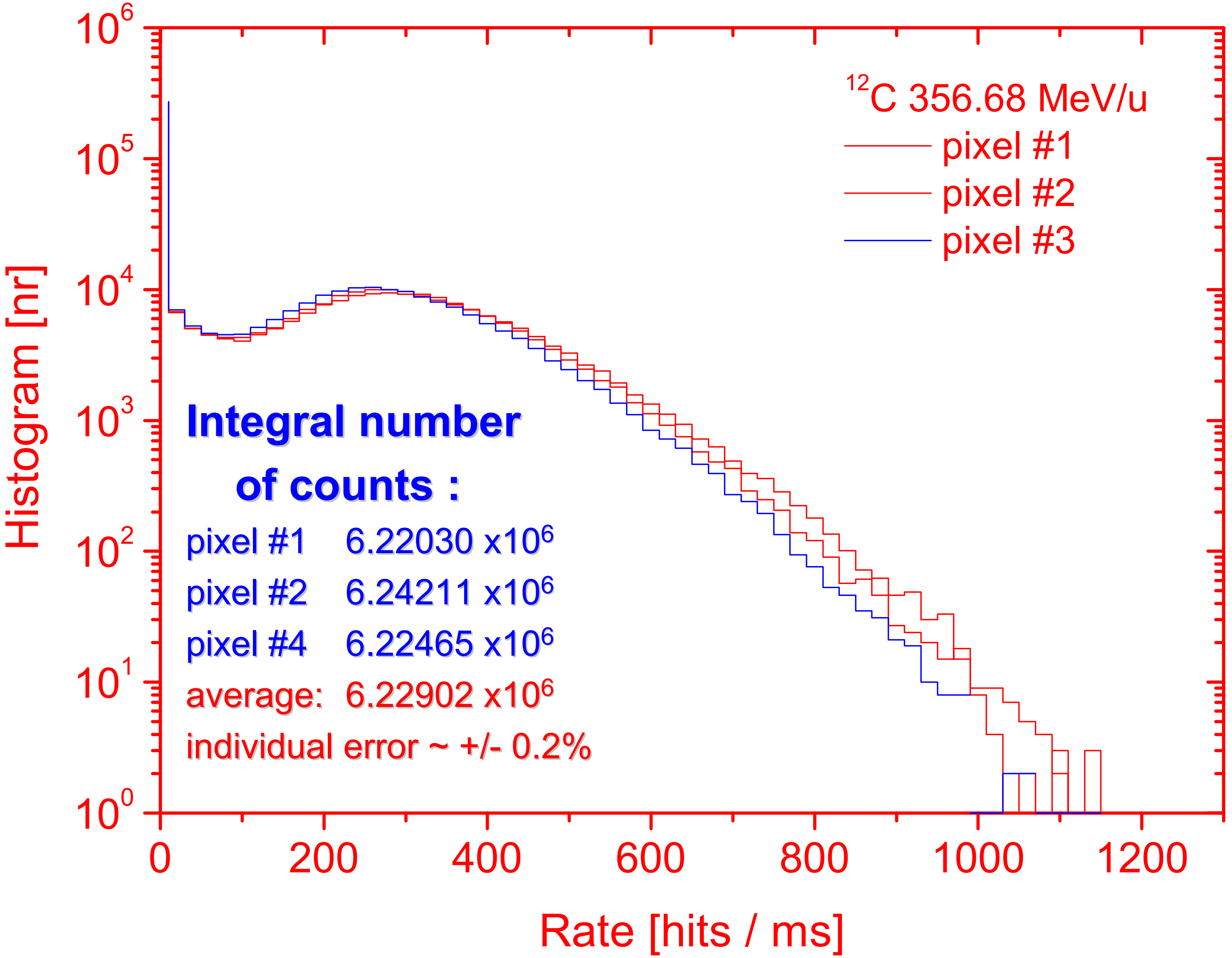




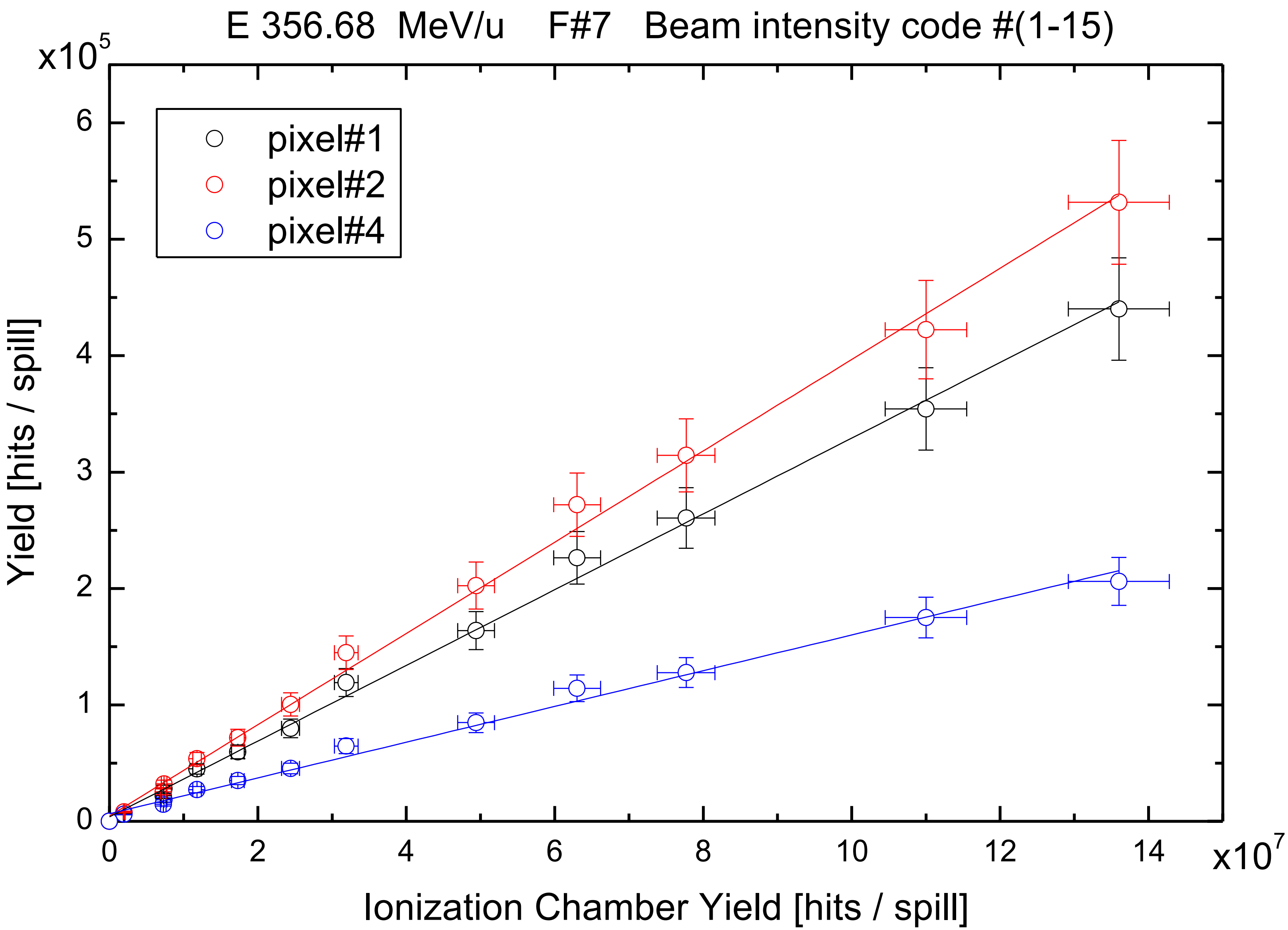


Rate Histogram for 110 spills

(the beam has a fixed position)

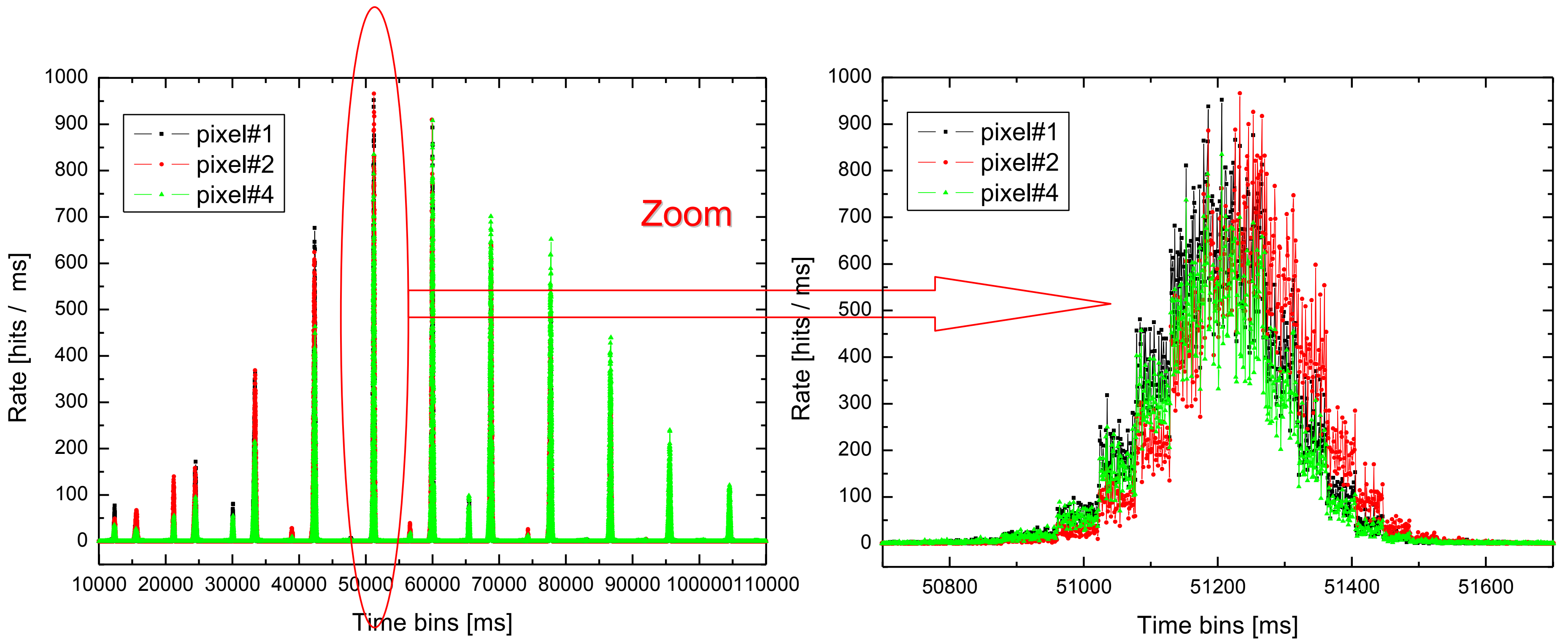


The beam has a fixed position and a variable intensity



A beam sweep

The carbon ions have an initial energy of 88.83MeV/u with constant focus (#7) and intensity (#1).
The sweep covered an area of 120mm x 20mm with 671 points.



People:

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A. Schuettauf

Monika Rebisz
A. Heinz
B. Voss

Summary

- FOPIs ToF-upgrade was successful: first experimental data, without walk and wiggle corrections show σ_T<100 ps which allow a Kaon identification up to P_{LAB} < 1GeV/c.

- The PADI design was successful tested, together with a 4 pixels SC diamond detector. The system was stable in under beam conditions.

- The AC transmission measurements shows a possible instability of the PADI preamplifier cell.

- The connection of PADI with the detector is critical: the line used should have a flat frequency characteristic of the impedance to avoid particularly resonances.

- If the input signal is near the threshold limit, the discriminated output signal has a very low width (~1ns). We have tried to transport such signals through a 110 Ω twisted pair LAN-K5 cable and the channel rate limit was 1.5 x 10^8 hits/s.

Outlook

- We know the PADI rate capability, but we must test the timing behavior. For low rates (1 kHz) we will use the RPC detector.

- In the next test we will connect two PADI test plates to a standard RPC to evaluate the three important issues: connection particularities to RPC, the stability problem and the timing behavior.

- We will make simulations and measurements to understand the system stability problem.

- The actual critical point in PADI design for a high bandwidth is the parasitic capacitance present to the preamplifier input and output ports. Can it be reduced?

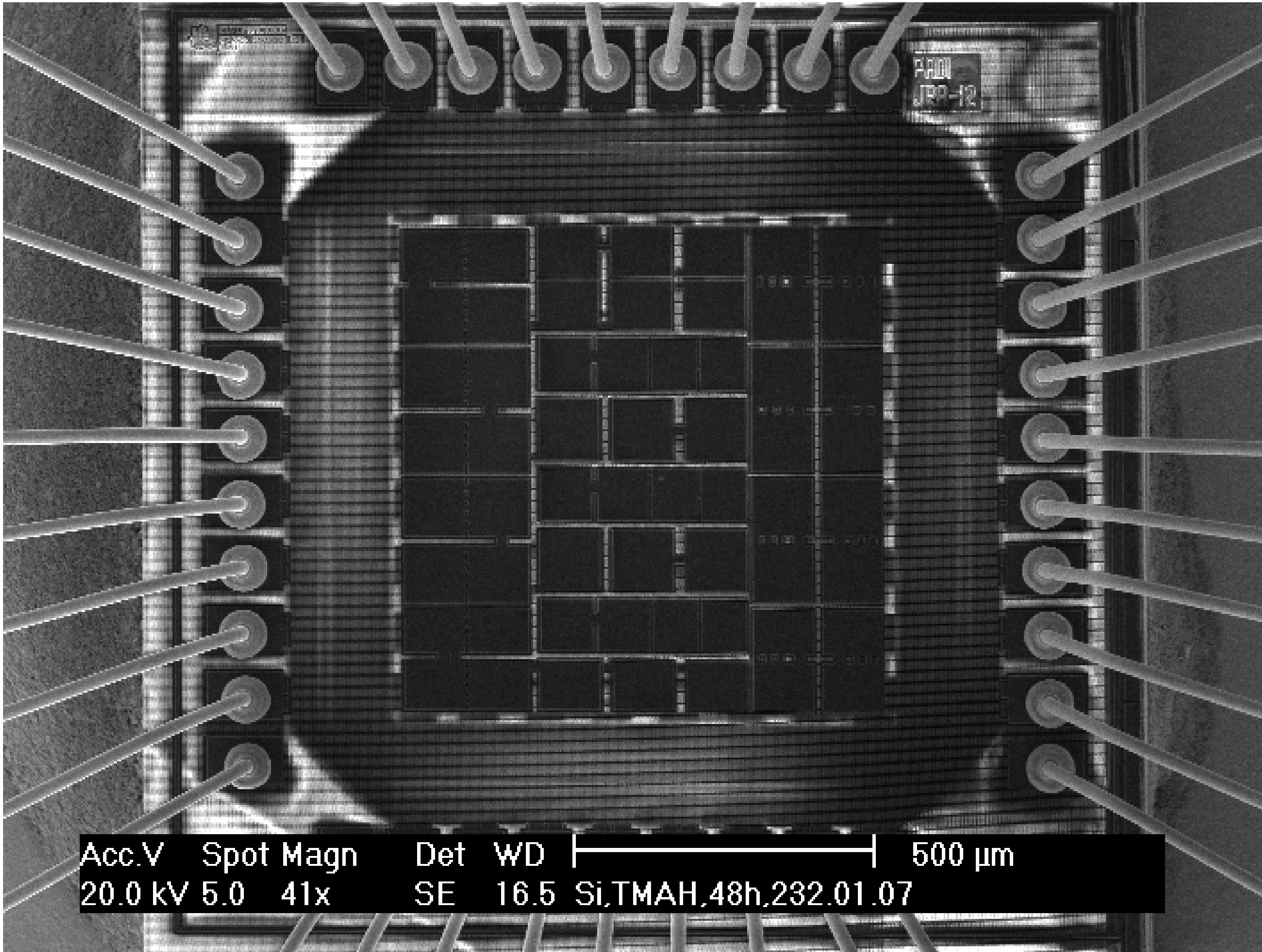
- Can we decrease the spread of PADI parameters due to technological corners?

HadronPhysics I3

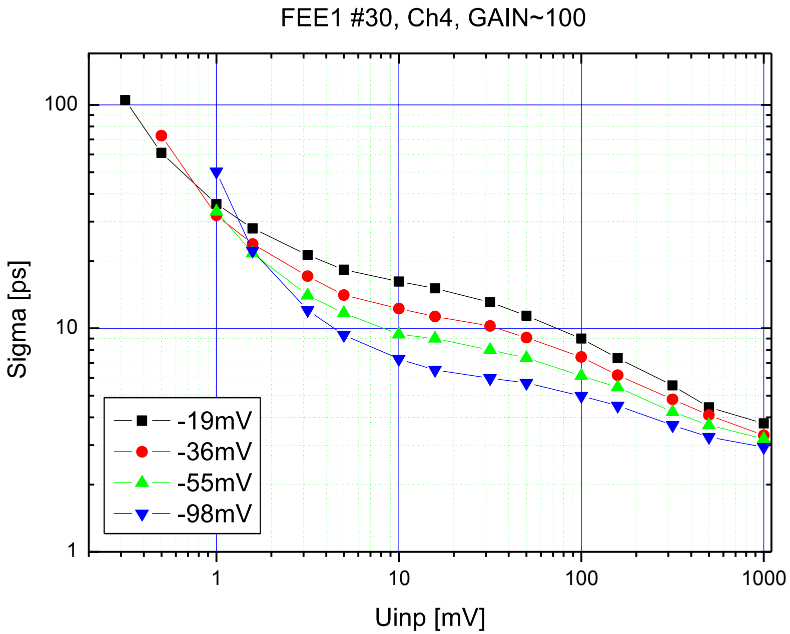
Study of Strongly Interacting Matter

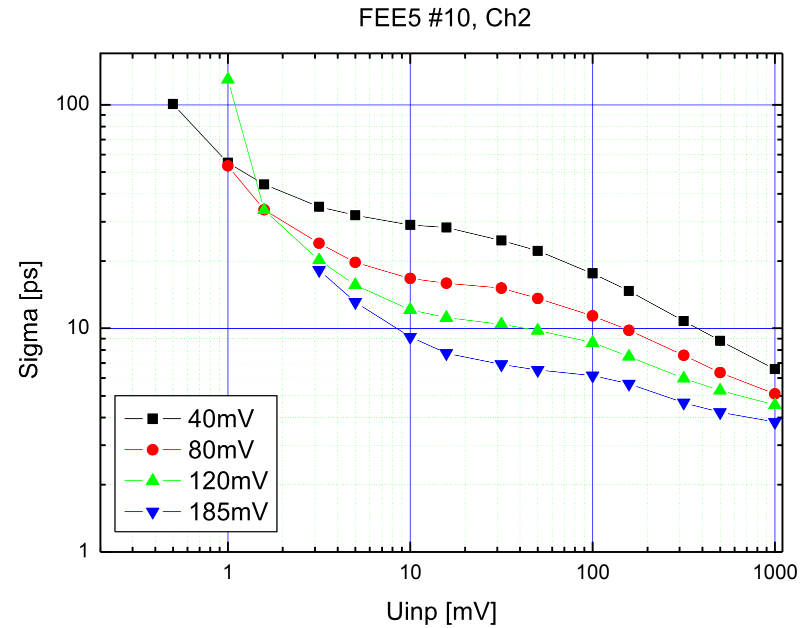
We acknowledge the support of the European Community-Research Infrastructure Activity under the FP6 "Structuring the European Research Area" programme (HadronPhysics, contract number RII3-CT-2004-506078).

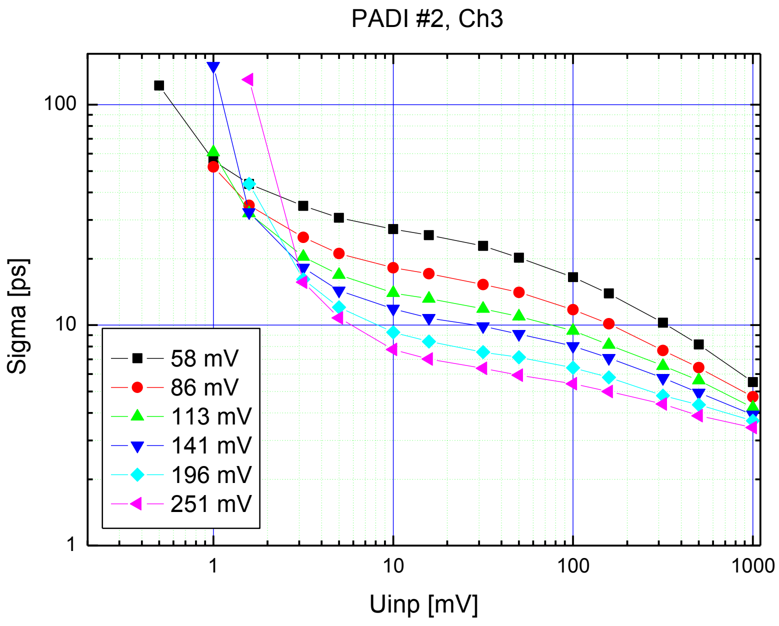
PADI-3Ch Preamplifier-Discriminator

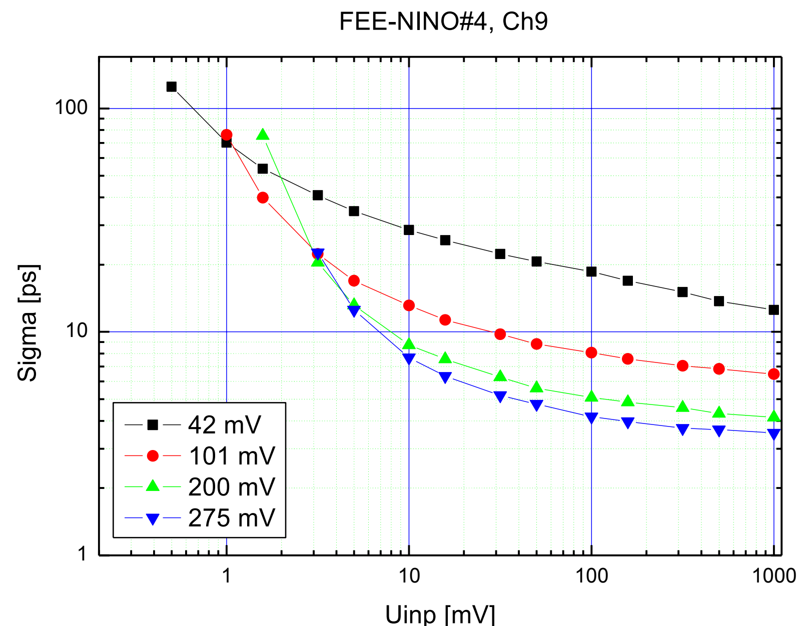


Comparison: The time resolution of all designs

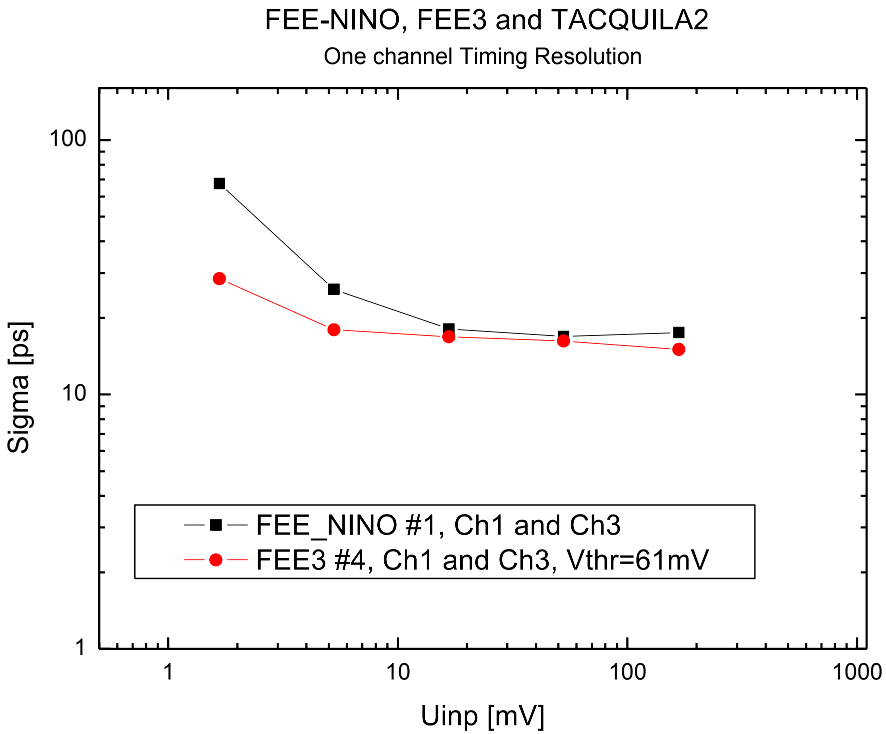




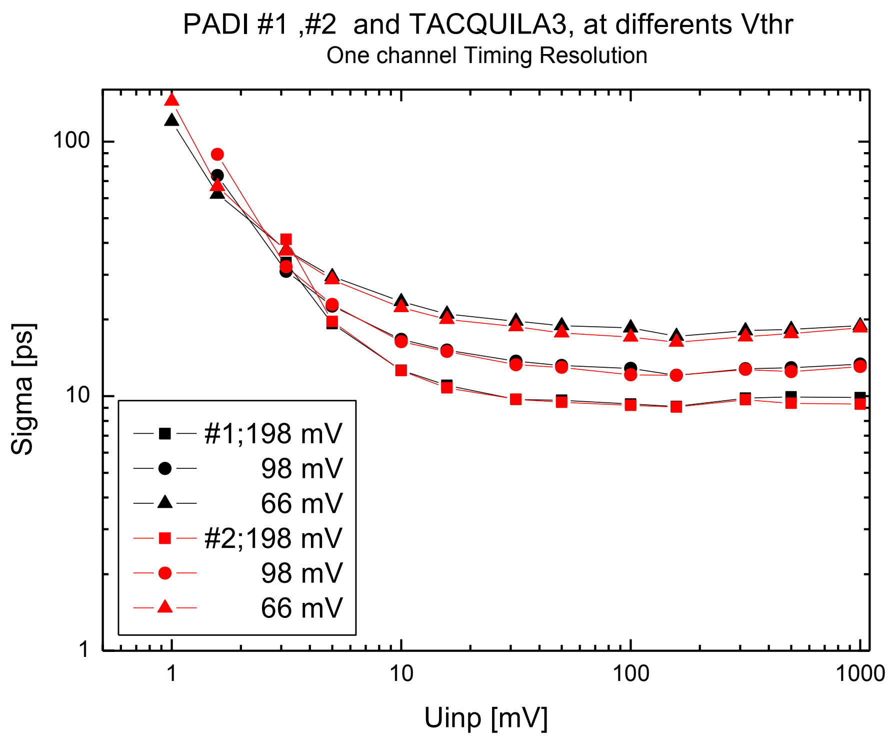




Comparison: PADI and TACQUILA3 versus FEE3 or NINO and TACQUILA2



@ 07.2005



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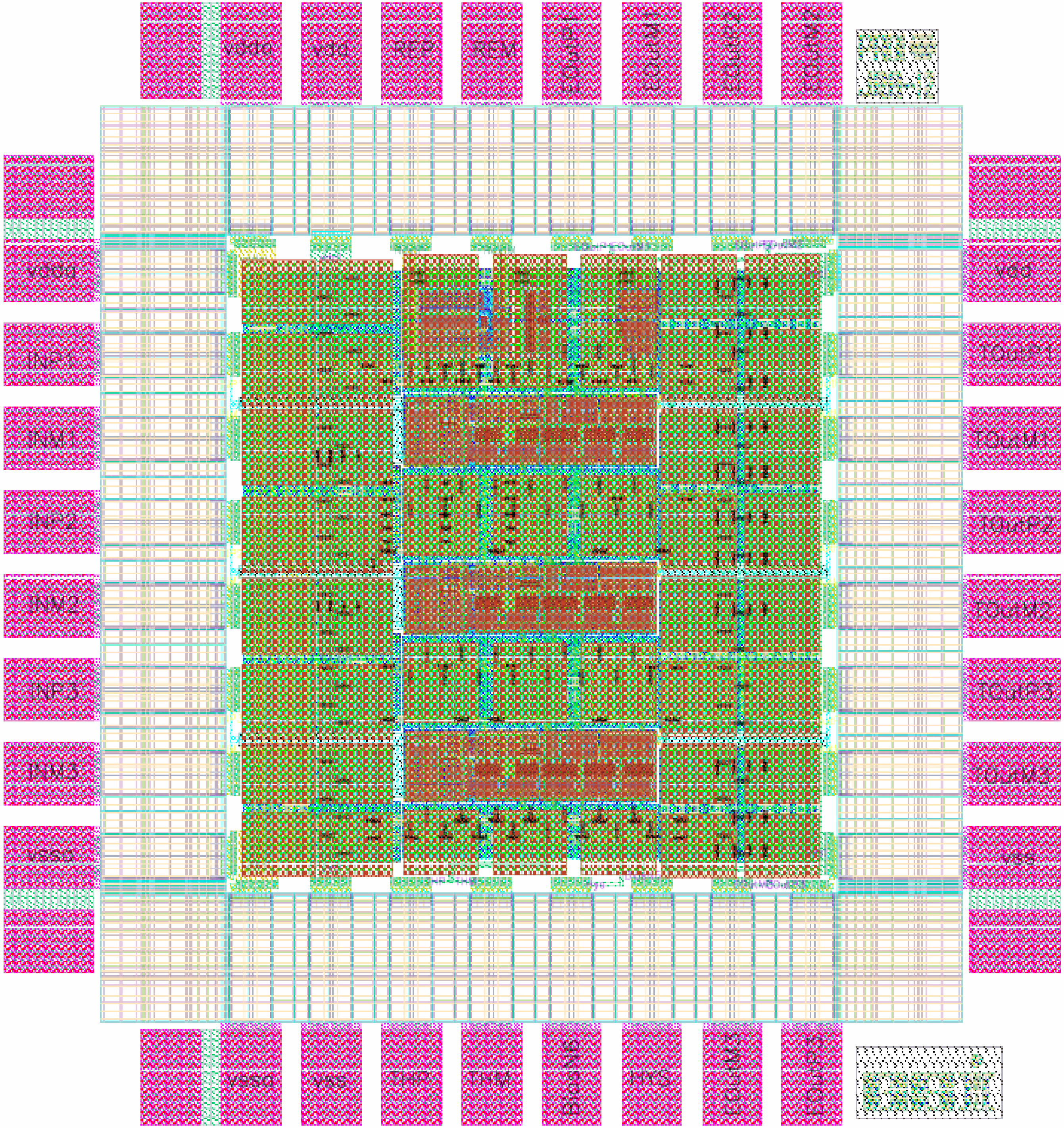

PADI

!NEW ASIC!

The prototype is a 3 channels preamplifier & discriminator in 0.18μm CMOS technology 1.5x1.5mm^2