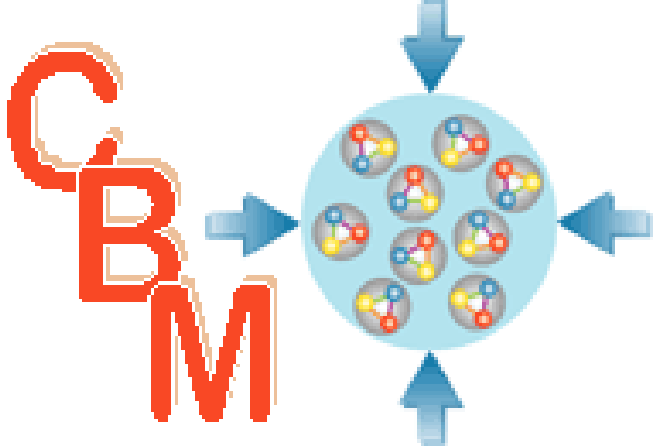
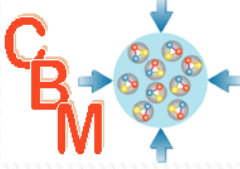




First Results of the new CBM Timing System

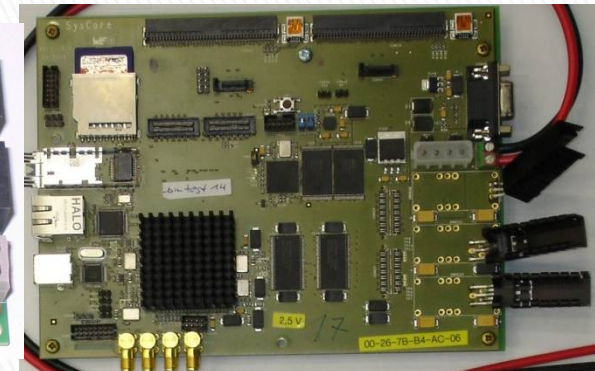
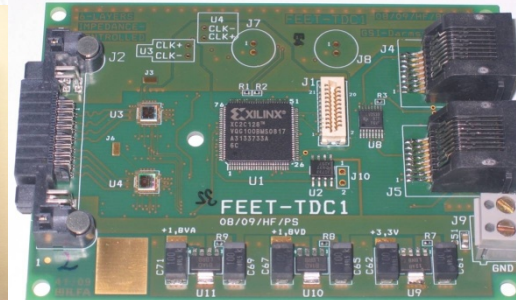
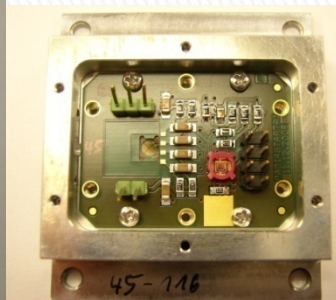
Jochen Frühauf

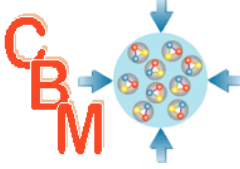
2nd CARAT Workshop @ GSI 13.–15.12.2010



Outline

- ▶ Hardware
 - CLOSY
 - GET4
 - ROC
- ▶ Beamtime August
 - Setup
 - Problems
 - Results
- ▶ Beamtime November
 - Setup
 - Problems
 - Results
 - Conclusions
- ▶ Improvements
- ▶ Outlook

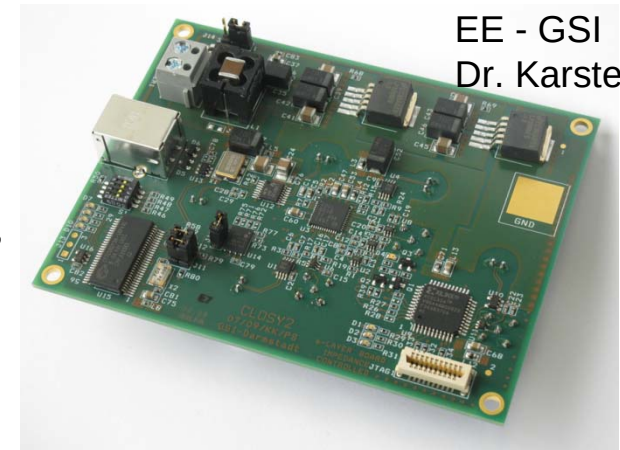




CLOSY (CBM-CLOCK-SYSTEM)

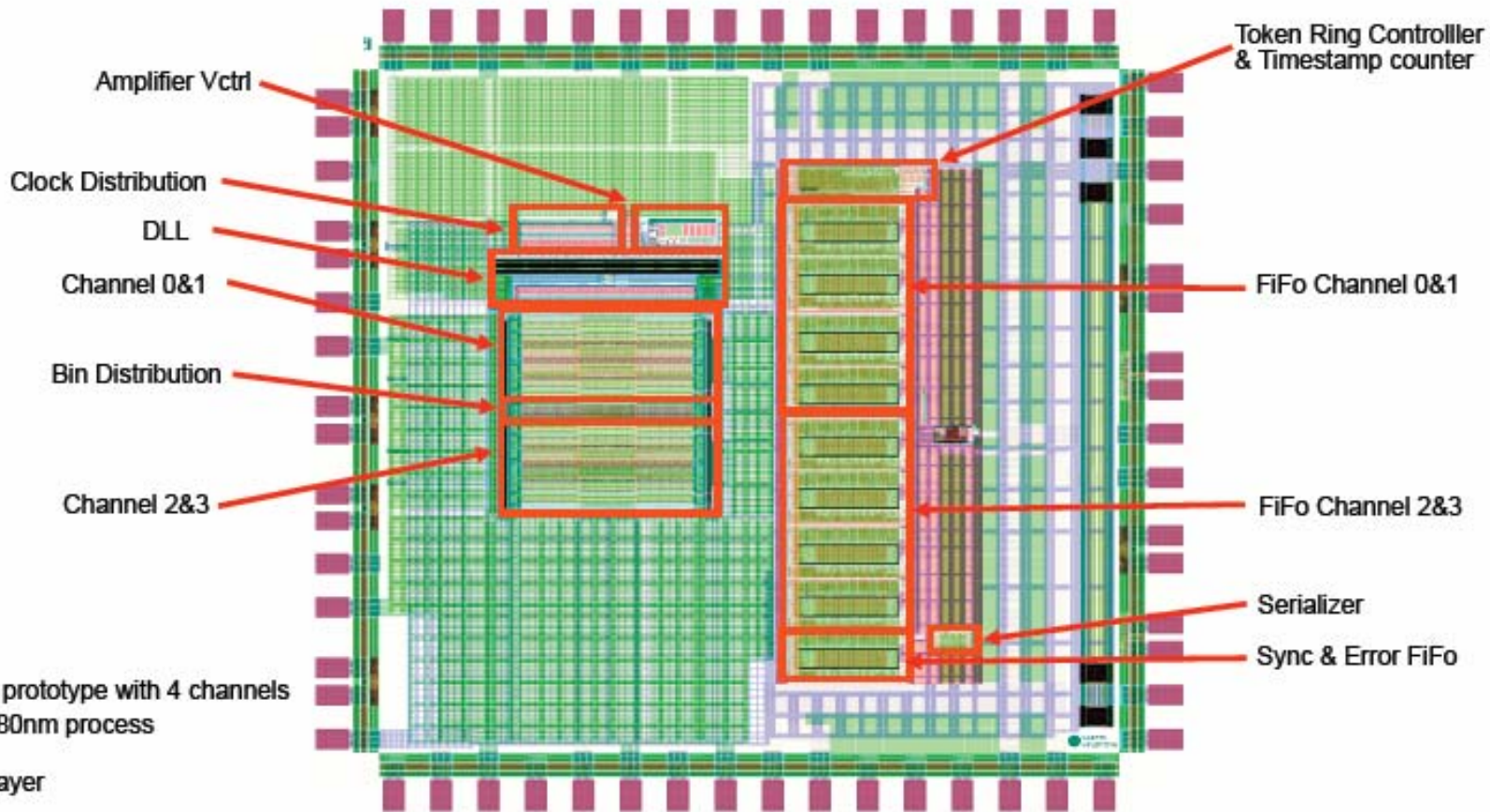
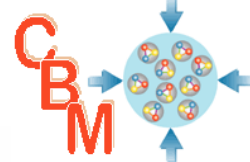
Requirements for CBM-Time of Flight (ToF) detector readout

- two phase coupled high-performance frequencies are needed
 - 156.25MHz:
used for the time measurements with an event driven TDC (FEET-board, GET4 TDC chip)
 - 250MHz:
used for the synchronous data transportation (Read Out Controller board, ROC)
 - jitter, less than 5 ps sigma
- to synchronize these frequencies over a long distance epoch markers are needed
 - $t_{\text{epoch}} = 26.2144 \mu\text{s} \Rightarrow \text{Sync Signal}$



EE - GSI
Dr. Karsten Koch

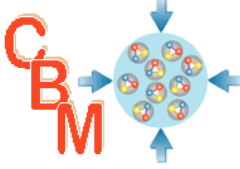
TDC GET4



Full size prototype with 4 channels

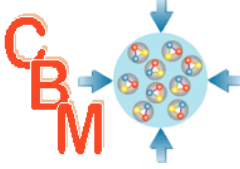
- UMC 180nm process
- 1P6M layer
- 3240µm x 3240µm, 64 Bondpads
- Submitted in Oct. 2008

EE - GSI
Dr. Holger Flemming
Harald Deppe



TDC GET4

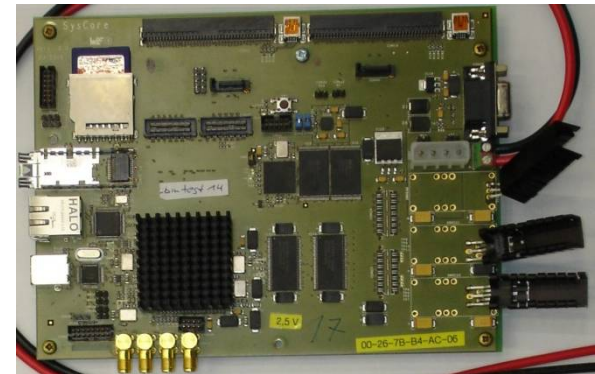
- ▶ Clock frequency: 156.25 MHz
- ▶ Power consumption: 27 mW/Ch
- ▶ Linearity:
 - $\text{DNL} < +/\text{--} 60 \text{ ps} = +/\text{--} 1.2 \text{ LSB}$
 - $\text{INL} < +/\text{--} 80 \text{ ps} = +/\text{--} 1.5 \text{ LSB}$
- ▶ min Puls Width $< 1 \text{ ns}$
- ▶ puls spacing $< 3.2 \text{ ns}$
- ▶ RMS = 25.1 ps



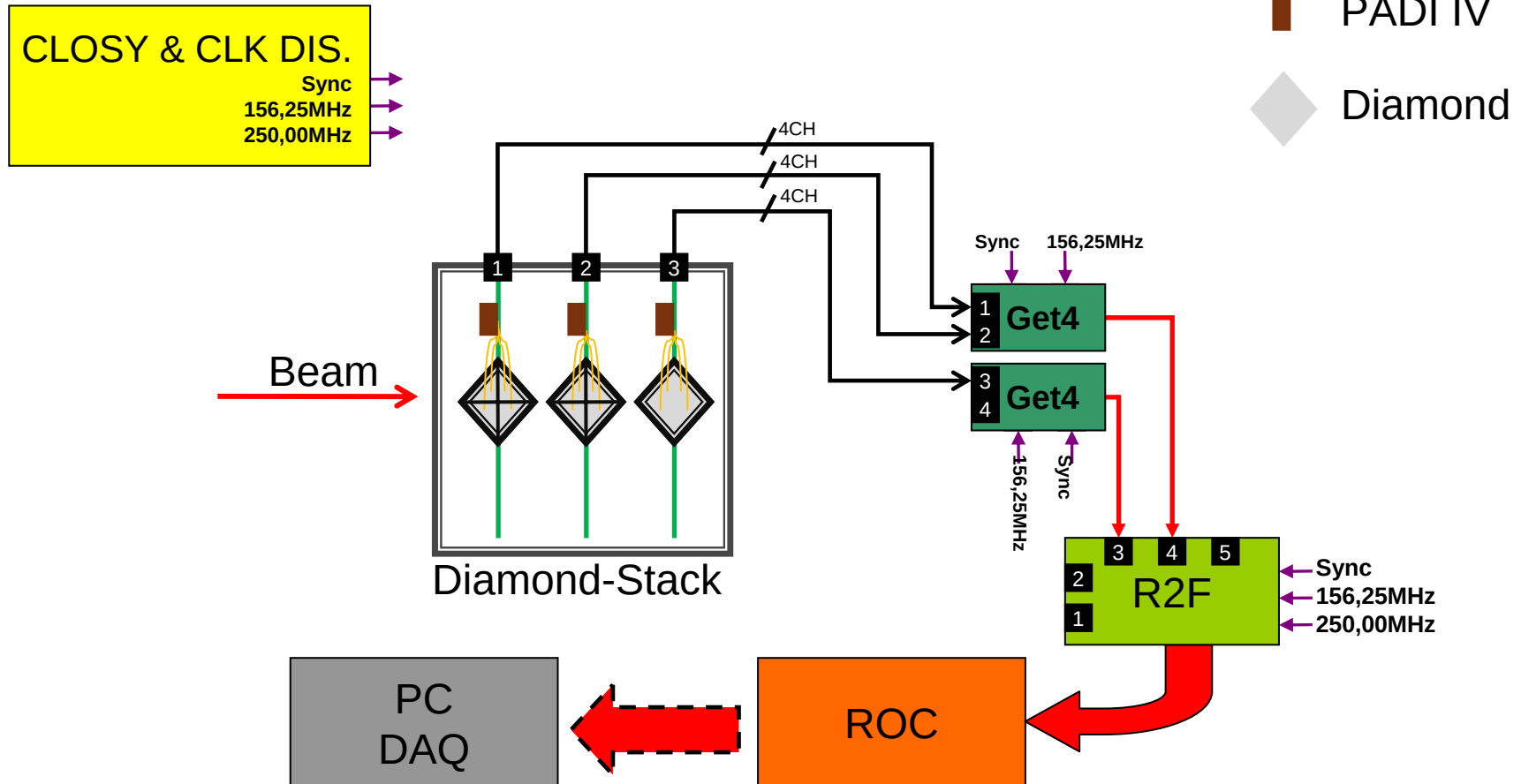
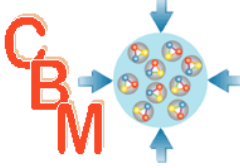
Readout Controller (ROC)

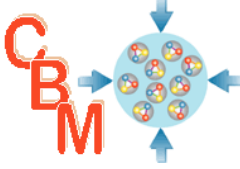
- ▶ SYSCORE V2 = ROC
- ▶ FPGA based readout controller for CBM
- ▶ free running data-processing
 - non triggered system
 - takes everything what the front end card delivers
 - Data Transport: Ethernet & Optic

KIP Heidelberg
Dirk Gottschalk



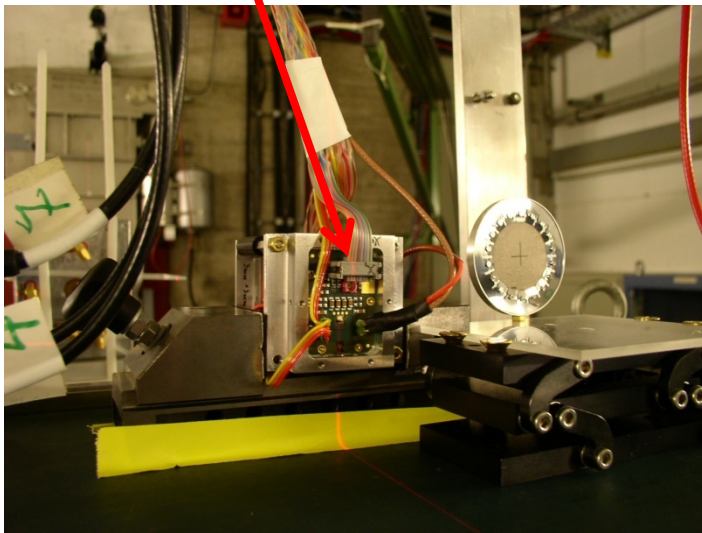
Beamtime Setup End August



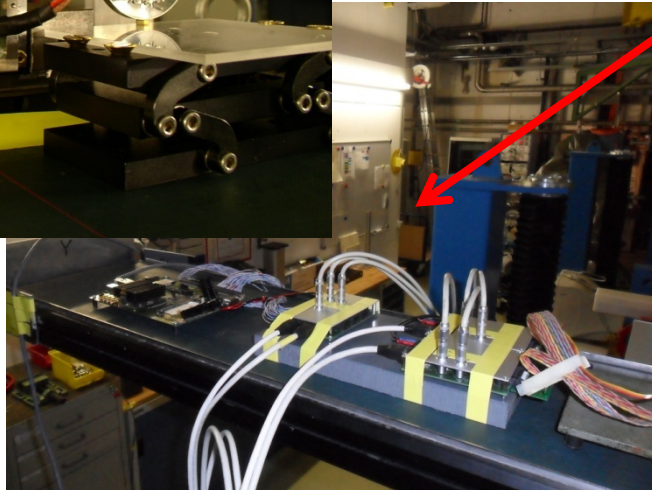


Beamtime Setup End August

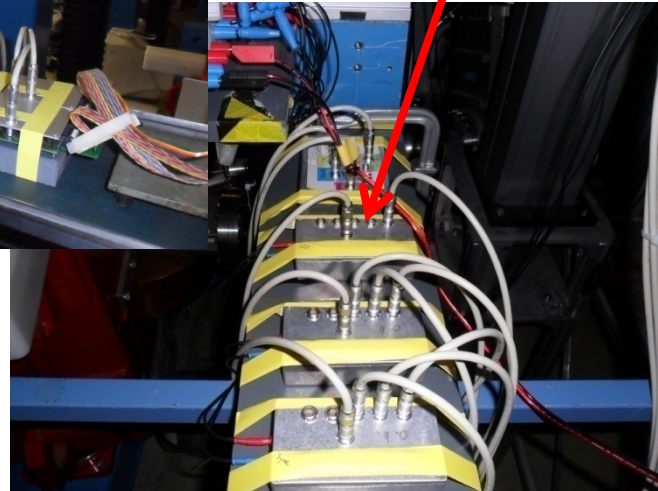
PADI IV with Diamond Detector

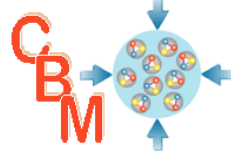


Readout Electronic (GET4-FEET & ROC)



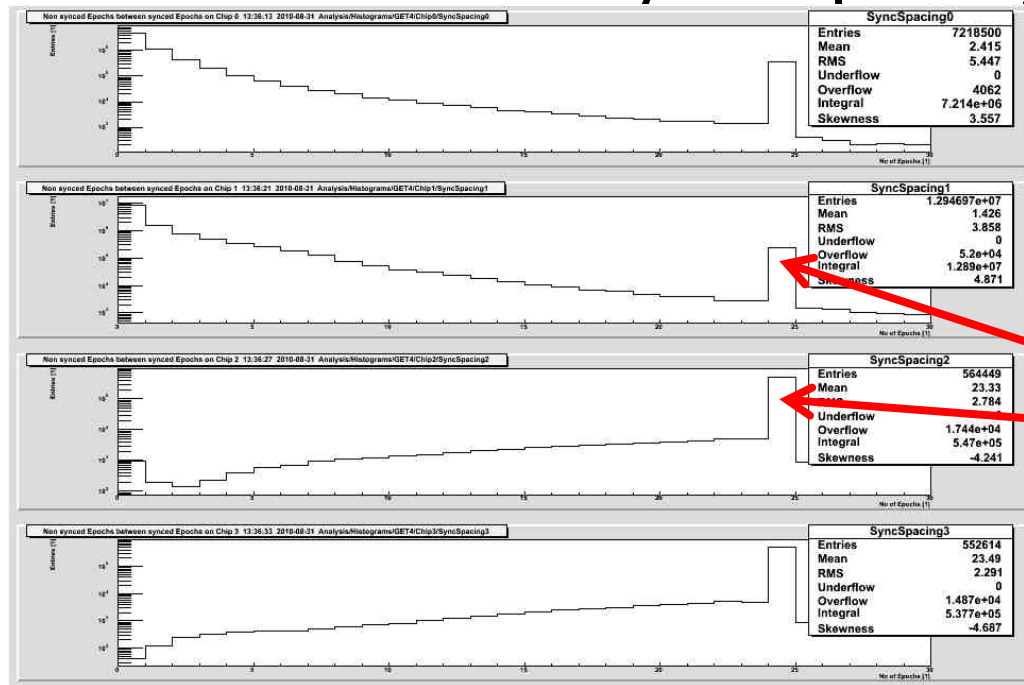
Clock Distribution





Problems with one FEET-GET4

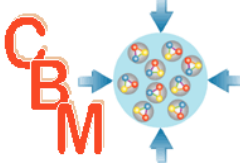
- ▶ Due to problems on first GET4-FEET-PCB the data shows bad sync-spacing behavior



(should be a peak at 25)

- ▶ only data of the second PCB is useable
 - ref. Diamond

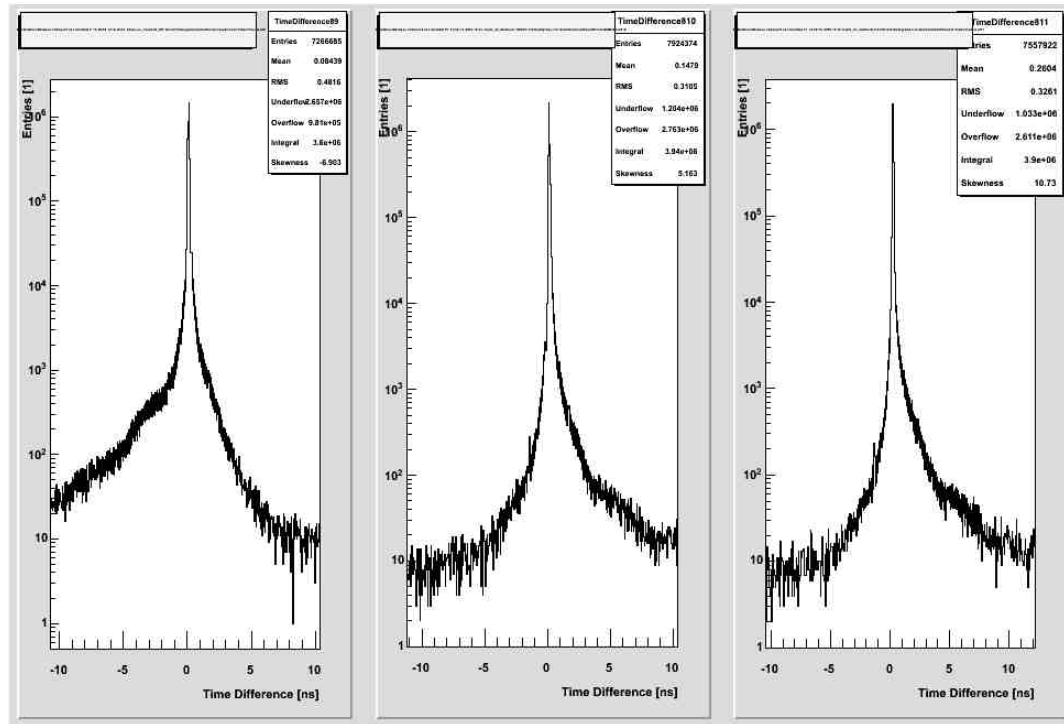
Correlation between the 4 working Channels (log)



CH 8-9

CH 8-10

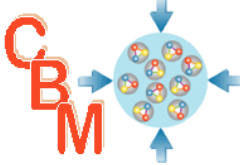
CH 8-11



Sigma: 53.00ps

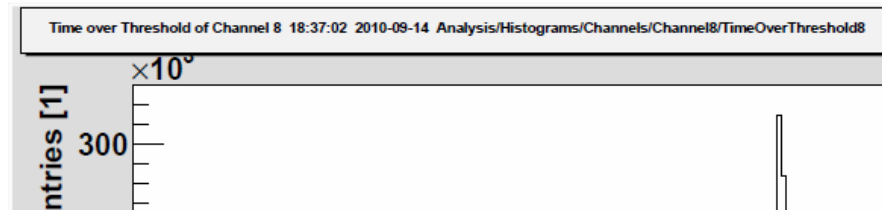
33.74ps

42.40ps

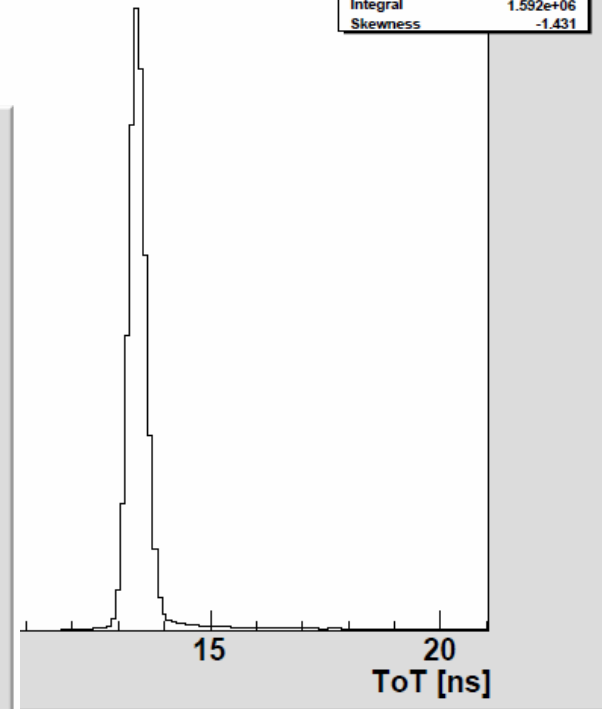
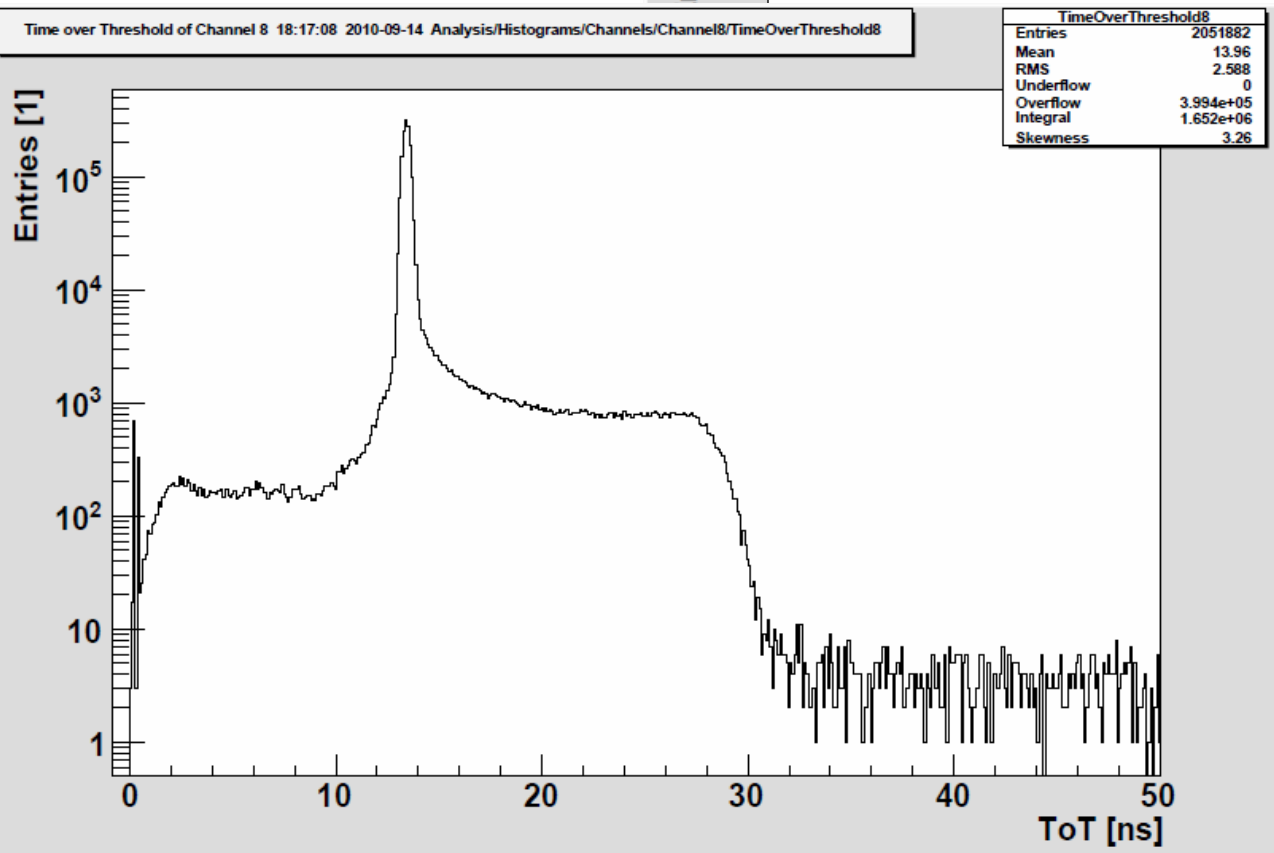


TOT Measurement (log/lin)

TOT CH8



TimeOverThreshold8	
Entries	2051882
Mean	13.53
RMS	1.33
Underflow	0
Overflow	3.994e+05
Integral	1.592e+06
Skewness	-1.431

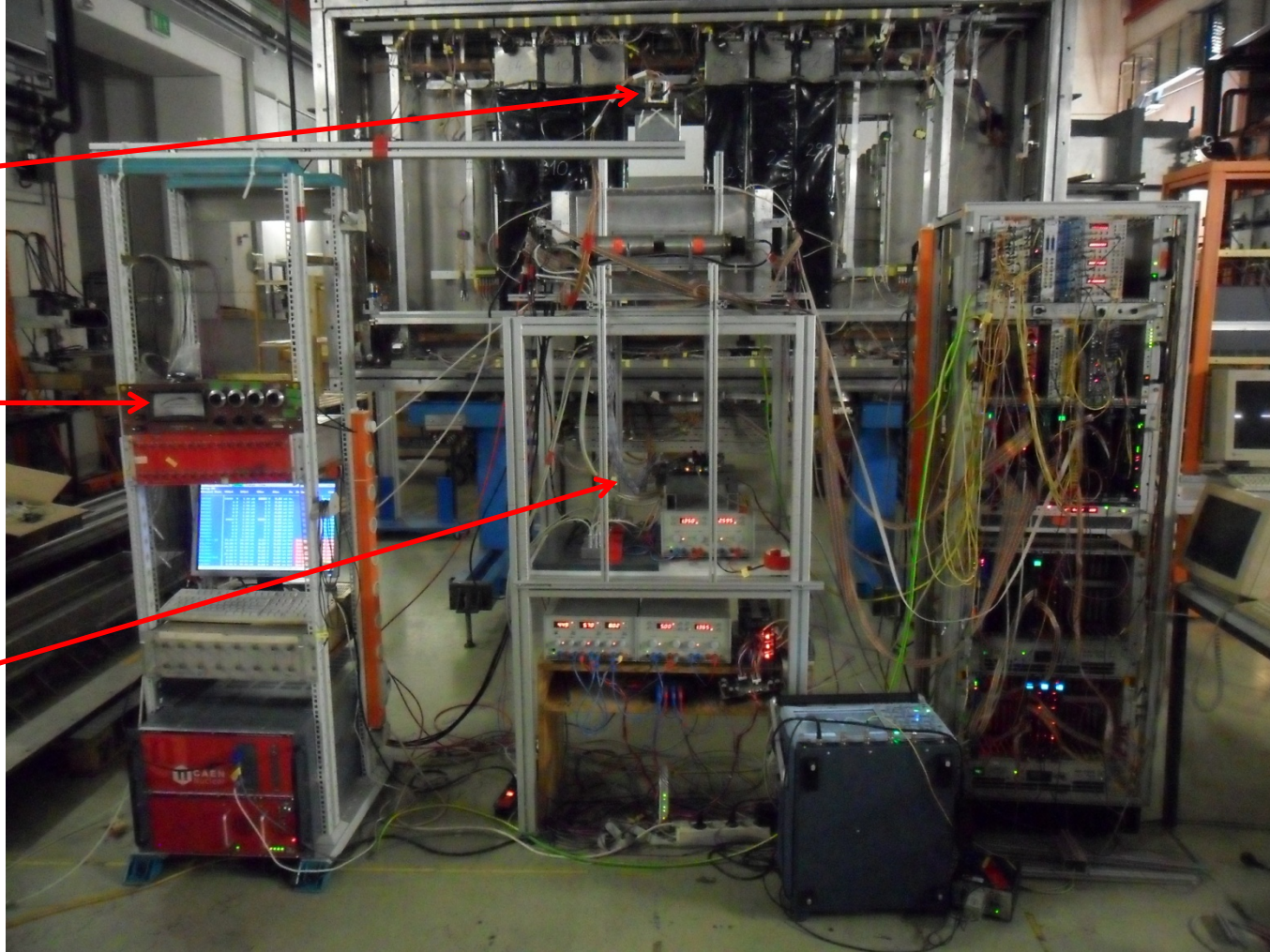


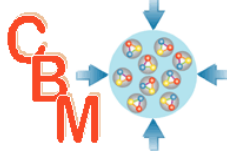
Beamtime November Setup

Diamond
Stack

HV

ROC
Power
Clock

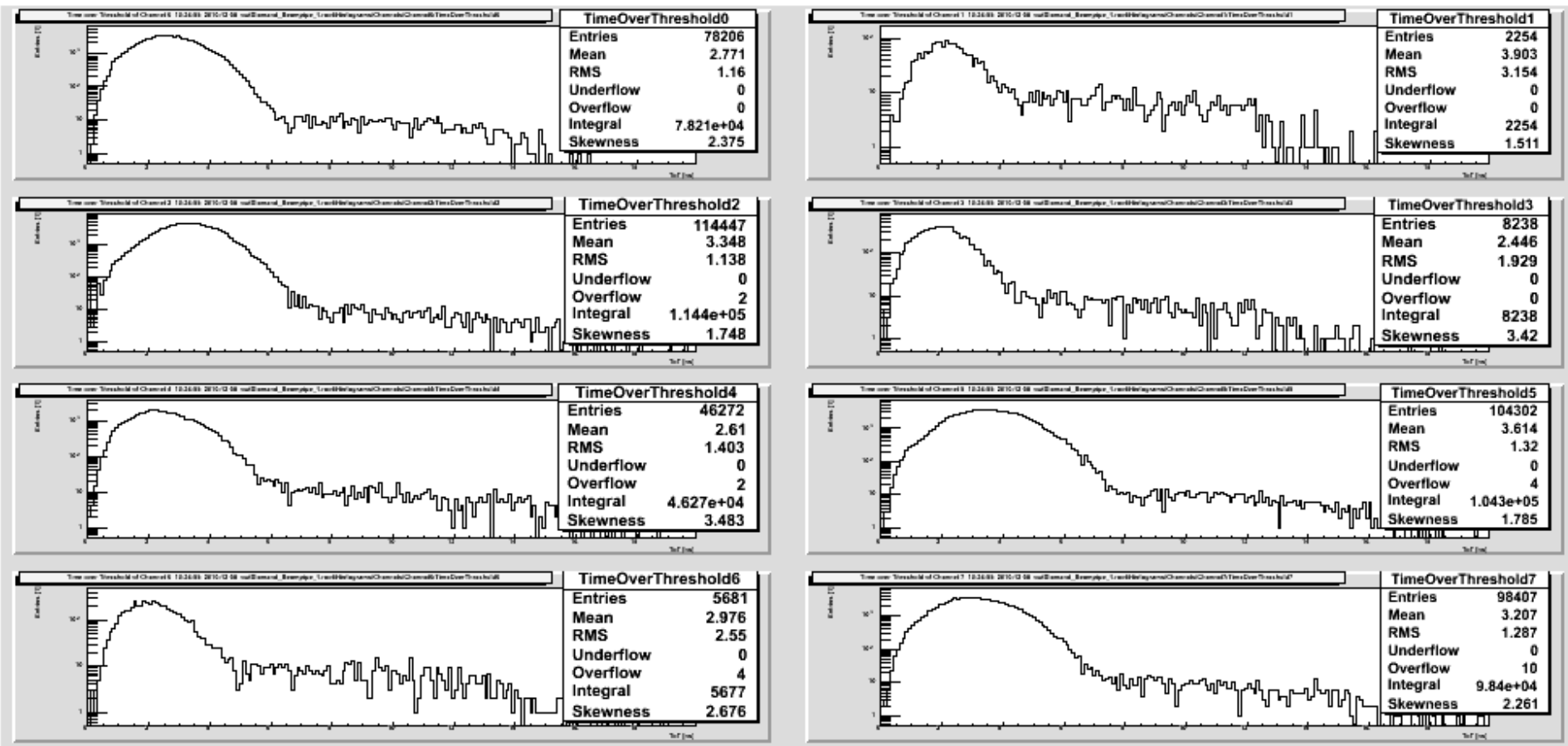




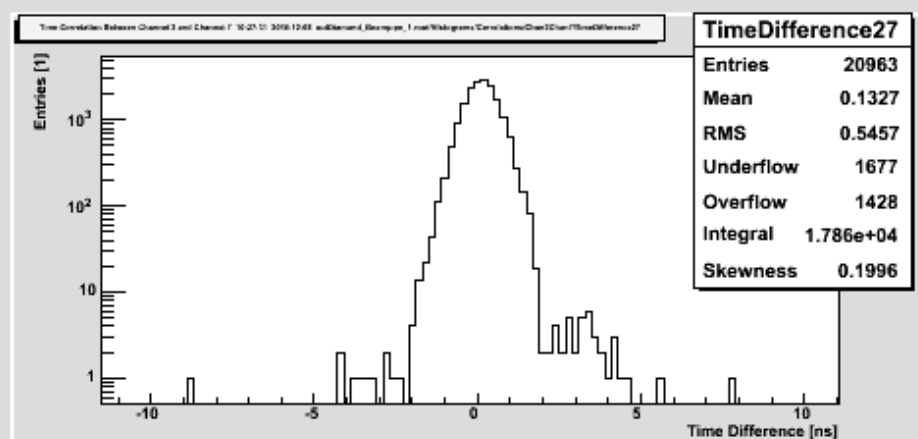
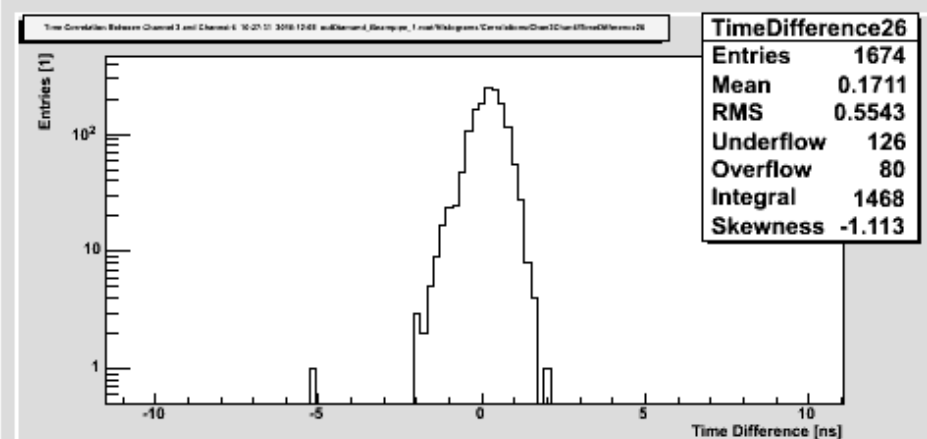
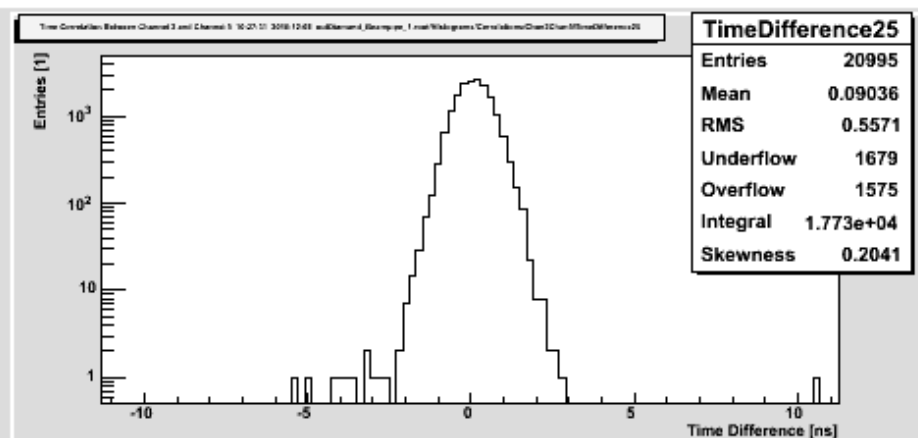
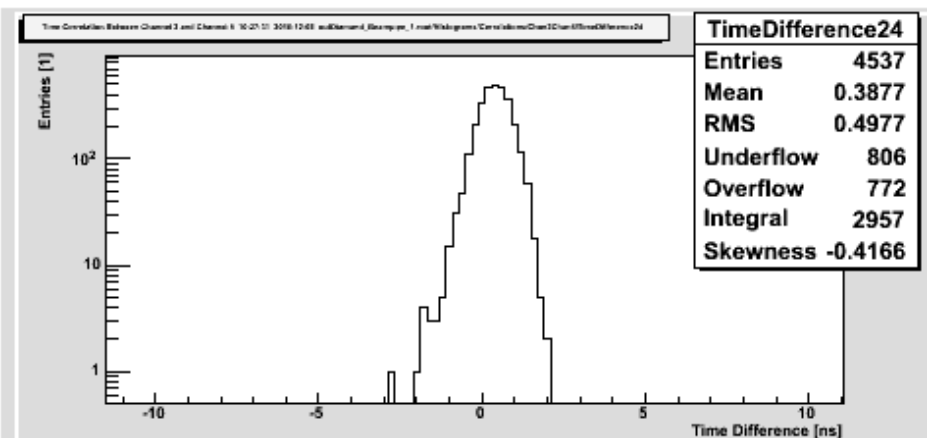
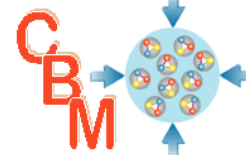
Problems with Beam Intensity

- ▶ unfortunately the lithium beam was too light for reference diamond
 - signal is shared between 4 PADI channels
 - same threshold for all 3 diamonds
 - only data of the first two diamonds are useable

TOT Measurement (log)



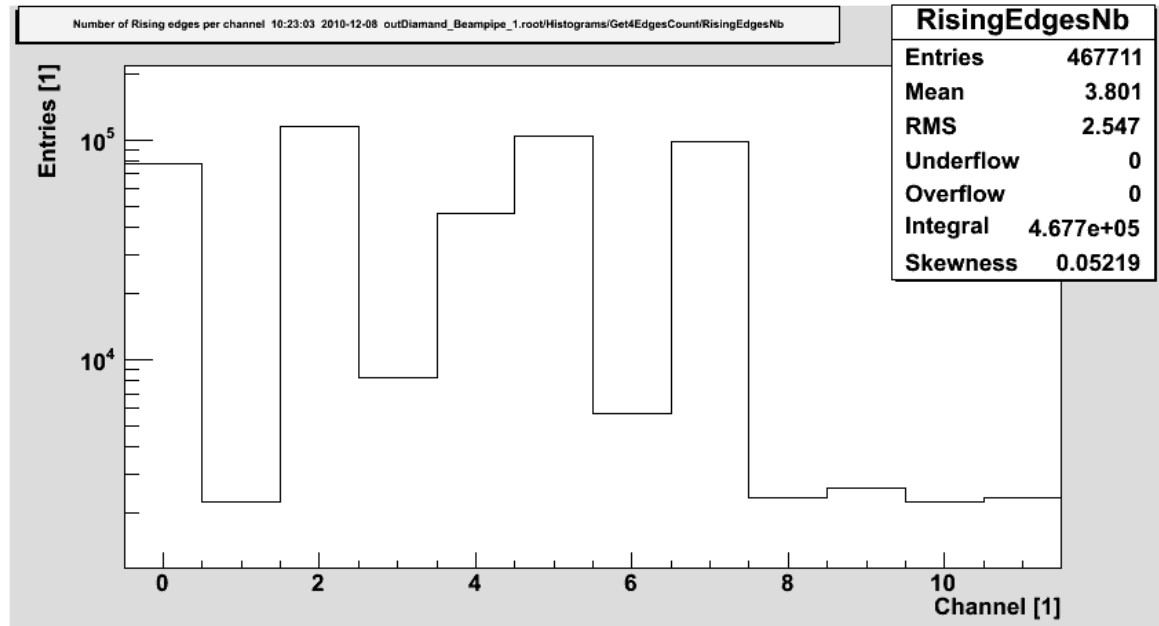
Correlation between the Diamond_1(CH2) & Diamond_2(CH4-7)



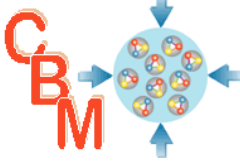
Sigma ~ 490ps

Conclusions

- ▶ all 12 Channels were working

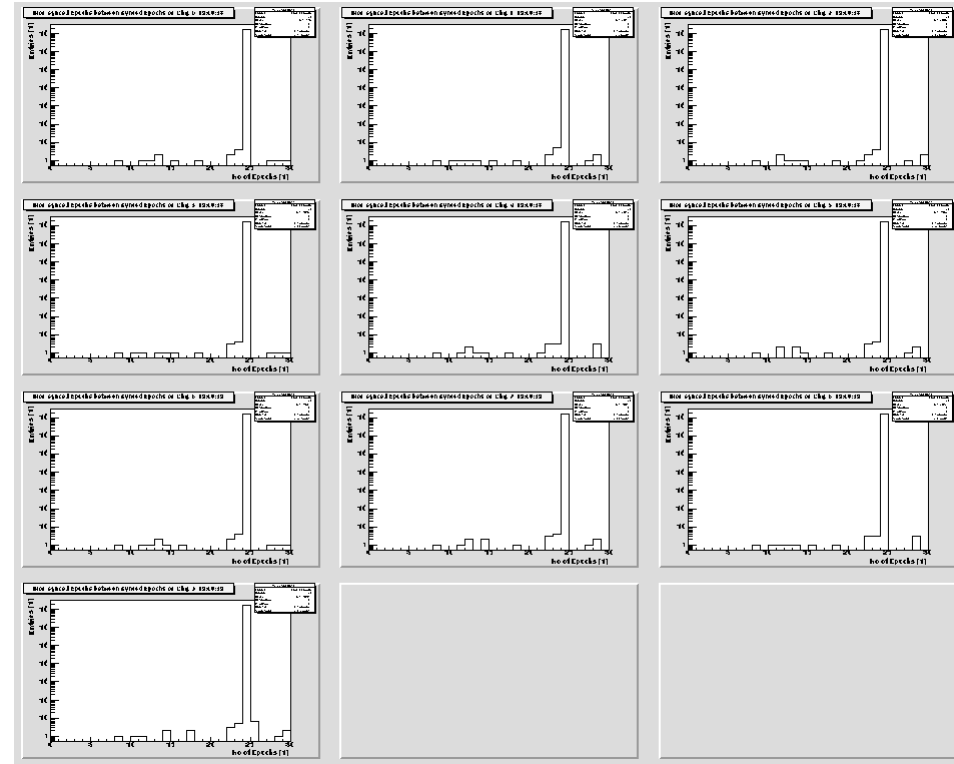
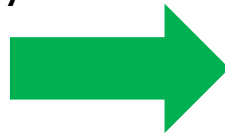


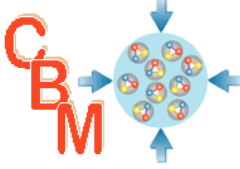
- ▶ due to the different thresholds of PADI4 it is necessary to be able to set values separately to reach better results



Improvements (FPGA Code)

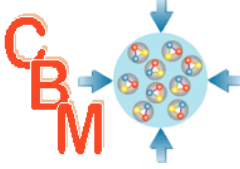
- ▶ up to "now" we had problems in data-sorting due to missing "Sync-messages" in the data stream => time ordering not possible
 - sync messages have now a higher priority (FPGA)
 - input stage of the ROC should not miss any sync message from GET4





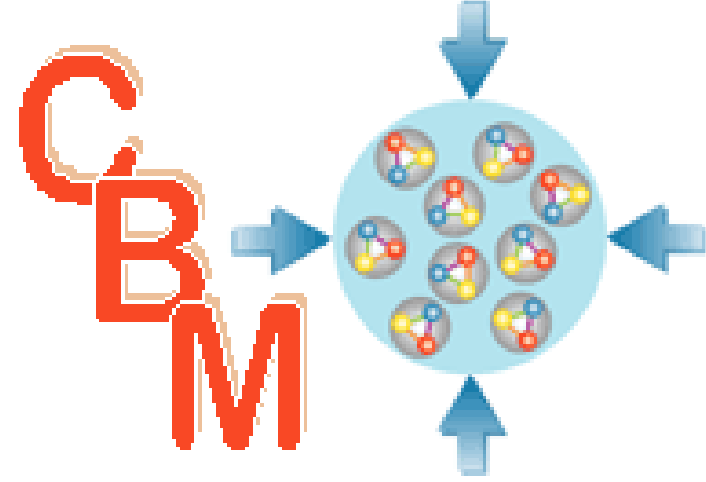
Improvements (analyzing Data)

- ▶ GO4 online monitoring & data cleaning
 - time ordering
 - Time over Threshold spectra
 - correlations
- ▶ free running System with additional trigger
 - injection of an external trigger into Get4
 - stored with a timestamp in the data stream
- ▶ ROOT Analyses
 - cutting on conditions
 - e.g. 4PMTs in the data stream? => time window cut
 - cutting on external trigger => time window cut
 - Data calibration (under construction)



Outlook Get4

- ▶ new test chip of GET4 CORE
 - improvement nonlinearity (ordered)
 - new layout:
 - expertise layout – strategy (shielding)
 - beginning 2011
 - layout GET4 test chip with intelligent readout
 - beginning of 2011
- ▶ end 2011 new version of GET4
 - improvement nonlinearity & shielding



Thank you for your attention