Calibration/processing of data with new electronics
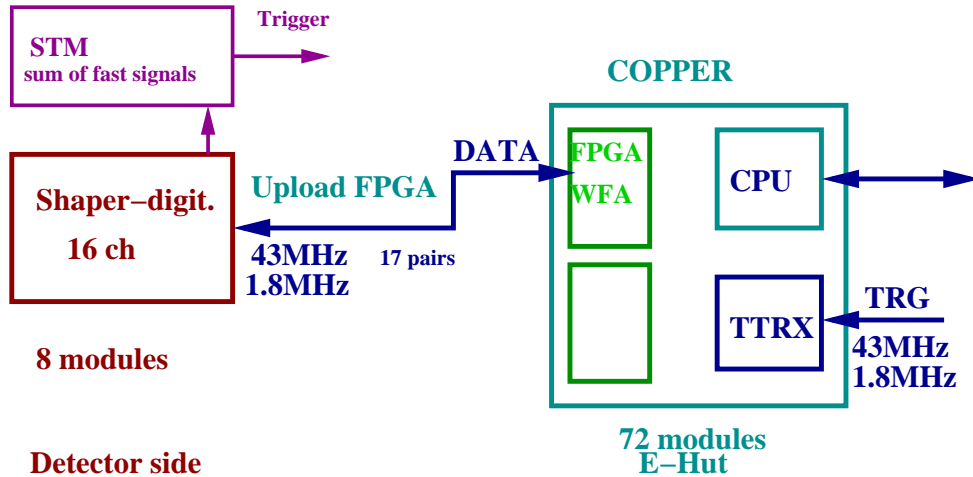
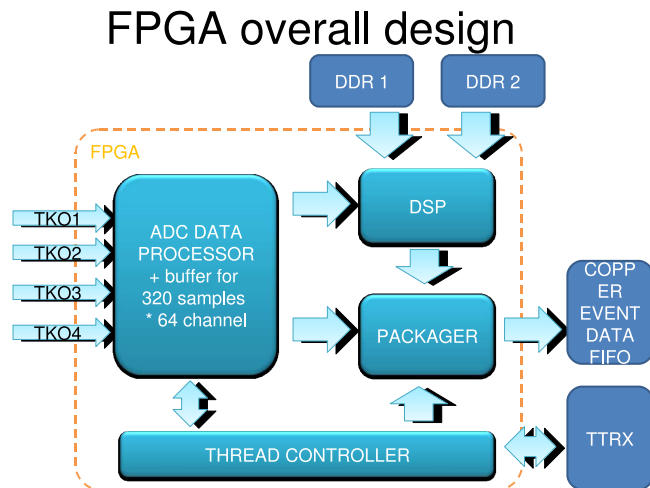**March 19, 2009**

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Outline:

- New electronics runs

- Results on the noise and background suppression

- Software to reconstruct the new electronics data

- Calibration with cosmic

- Calibration with bhabha

- R&D works with pure CsI

- Summary

New Electronics test

STM
sum of fast signals

Trigger

Shaper–digit.
16 ch

Upload FPGA

DATA

43MHz
1.8MHz   17 pairs

8 modules

Detector side

COPPER

FPGA WFA

CPU

TTRX

TRG
43MHz
1.8MHz

72 modules
E–Hut

- **Shaper-digitizer modules for barrel and copper modules has been produced**
- **New electronics allows to fit shape of the signal and determine amplitude and time online**

FPGA overall design

DDR 1   DDR 2

FPGA

TKO1
TKO2
TKO3
TKO4

ADC DATA PROCESSOR + buffer for 320 samples * 64 channel

DSP

PACKAGER

COPPER EVENT DATA FIFO

THREAD CONTROLLER

TTRX

Algorithm details

$$\chi^2(A,p,t_0) = \sum_{i,j}(y_i - Af(t_i - t_0) - p)S_{ij}^{-1}(y_j - Af(t_j - t_0) - p) \to \min$$

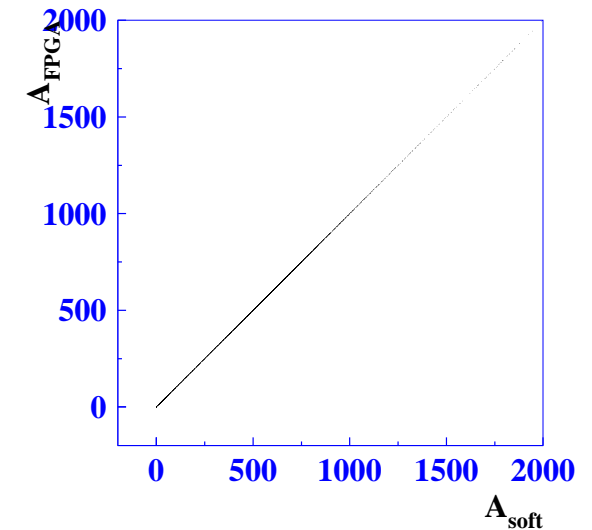$$S_{ij} = \overline{(y_i - \overline{y})(y_j - \overline{y})}$$
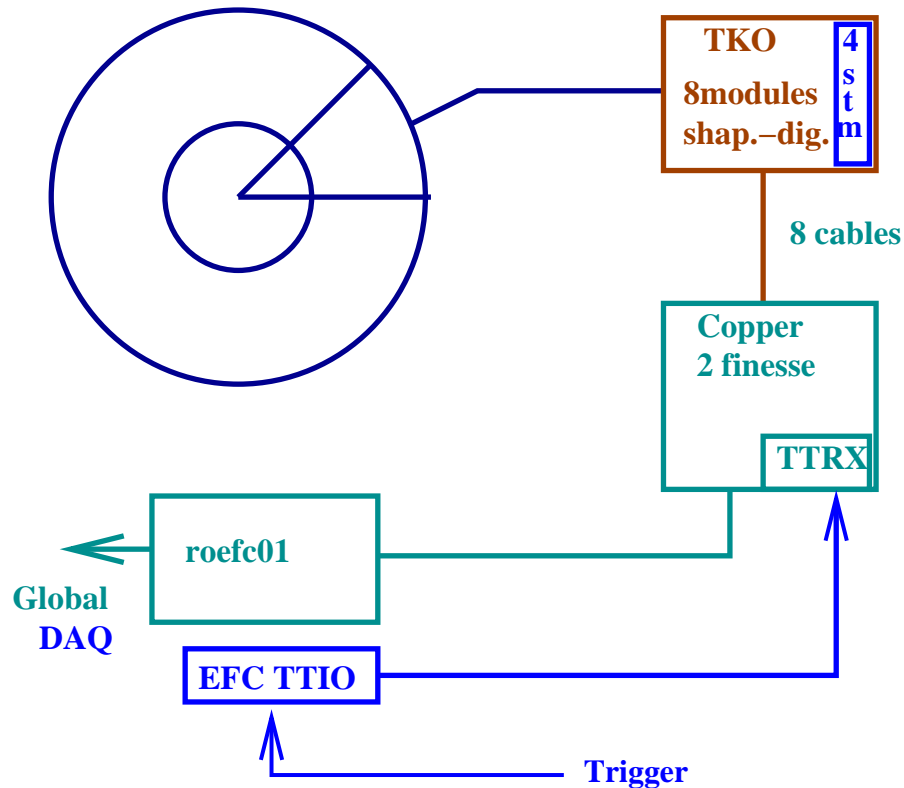
$f(t)$ – counter response

$$Af(t_i - t_1 - \Delta t) = Af(t_i - t_1) - A\Delta t f'(t_i - t_1) = Af(t_i - t_1) + Bf'(t_i - t_1)$$

where t_1 – initial time (trigger time)

$$\sum_{i,j} f_i S_{ij}^{-1}(y_j - Af_j - Bf_j' - p) = 0$$

$$\sum_{i,j} f_i' S_{ij}^{-1}(y_j - Af_j - Bf_j' - p) = 0$$

$$\sum_{i,j} S_{ij}^{-1}(y_j - Af_j - Bf_j' - p) = 0$$

$$A = \sum_i \alpha_i y_i$$

$$B = \sum_i \beta_i y_i \Rightarrow \Delta t = -B/A$$

$$p = \sum_i \gamma_i y_i$$

A_{FPGA}

A_{soft}

Readout scheme

- In summer 2008 120 channels (1/8 of the BE) were connected to 8 new shaper-digitizer boards with read out by the copper module.

- Other ECL channels were in the usual status.

- In the beginning of experiment Oct.16-23, 2008 ECL was running in this configuration.

- About 965 pb-1 were collected

Noise measurements

Without beam

Incoherent noises :

5.7 counts (330keV) (outer layers)
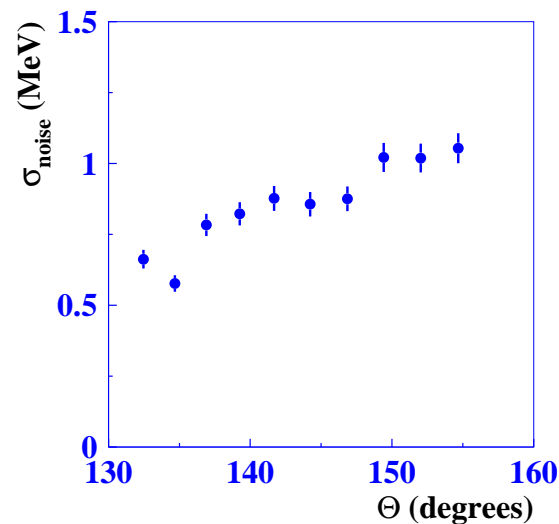
7.1 counts (410keV) (inner layers)

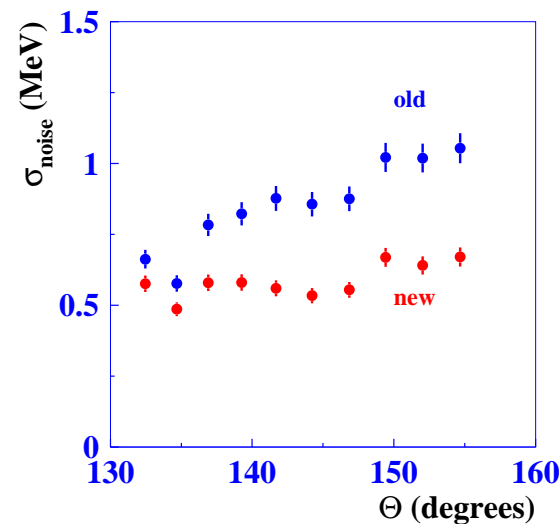**Coherent noises :**

1.2 counts (70 keV) for 1 module

0.6 counts (30keV) for 8 modules

With beam

Old electronics

σ_{noise} (MeV)

Θ (degrees)

New electronics
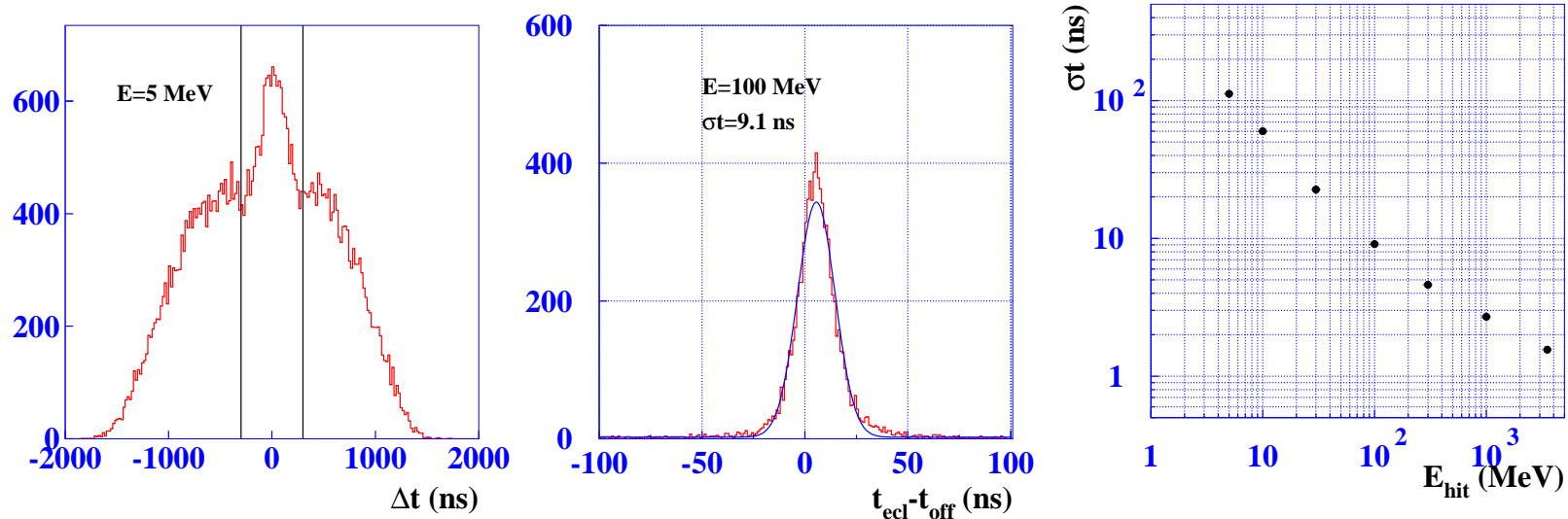
σ_{noise} (MeV)

old

new

Θ (degrees)

New electronics allows to suppress pile-up noise

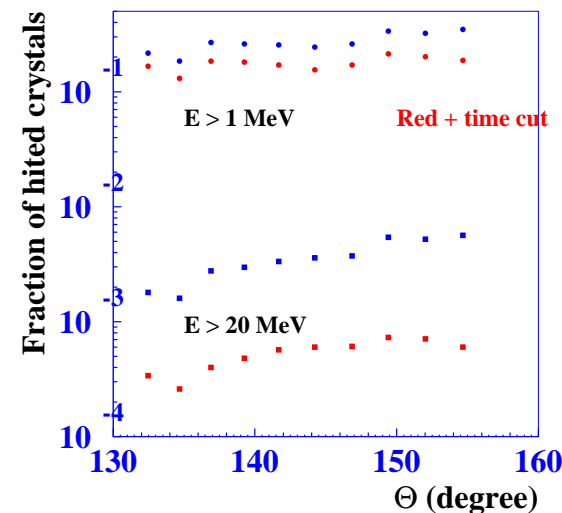# Time measurement and background suppression

Time resolutions about 100 ns for 5 MeV and 3 ns for 1 GeV counters

Background is distributed uniformly. Applying cut for time we got about 7 times fake clusters suppression for E>20 MeV keeping > 97% efficiency. (In agreement with simulation)

New electronics allows to suppress pile-up noise

simple software for cluster reconstruction

Nakamura_san have prepared software to process data with new electronics.

- The data from new electronics are unpacked from EFC to
  rawecl_chits (cid, dspamp,dsptime, dspflag(2bits)
  rawecl_cwaveform (cid, wf(40))

- The reconstruction code was modified and data from new electronics are reconstructed to data_ECL table. Than the standard procedure of ECL reconstruction is performed.

- Bhabha data with new electronics have been processe and saved to disk.

Calibration

Calibration constants were taken from exp 65.

About 15% higher for new electronics
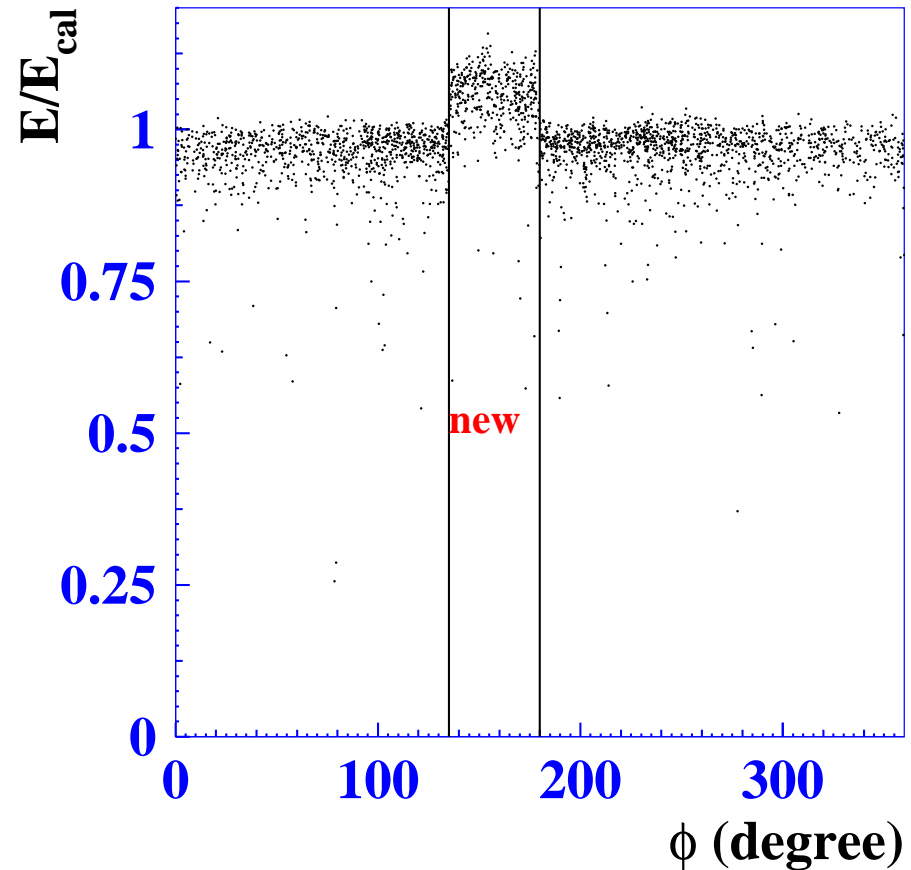
Total number bhabha events in the new electronics region is about 500.

It gives 2-7 events per counter and will provide about 1-2% accuracy of the calibration.(not good)

Calibration procedure to calibrate the new electronics is in preparation.

Plans

- **To fix the calibration procedure and carry out the bhabha calibration**

- **To compare data of runs with new electronics with the normal data**

- **Implement algorithm of background suppression**

- **Compare π^0 resolution with and without background suppression**

Plans for new run.

- **To make simple local run procedure for new electronics**

- **To prepare DQM histograms**

- **To make one more run with new electronics if collaboration will approve it. (Change old electronics with new one and backcan be done in maintanence day)**

Long-term stability

- **Two counters (one which was irradiated) have been monitered for two years.**

- **Peak corresponding to cosmic energy deposition was measured.**
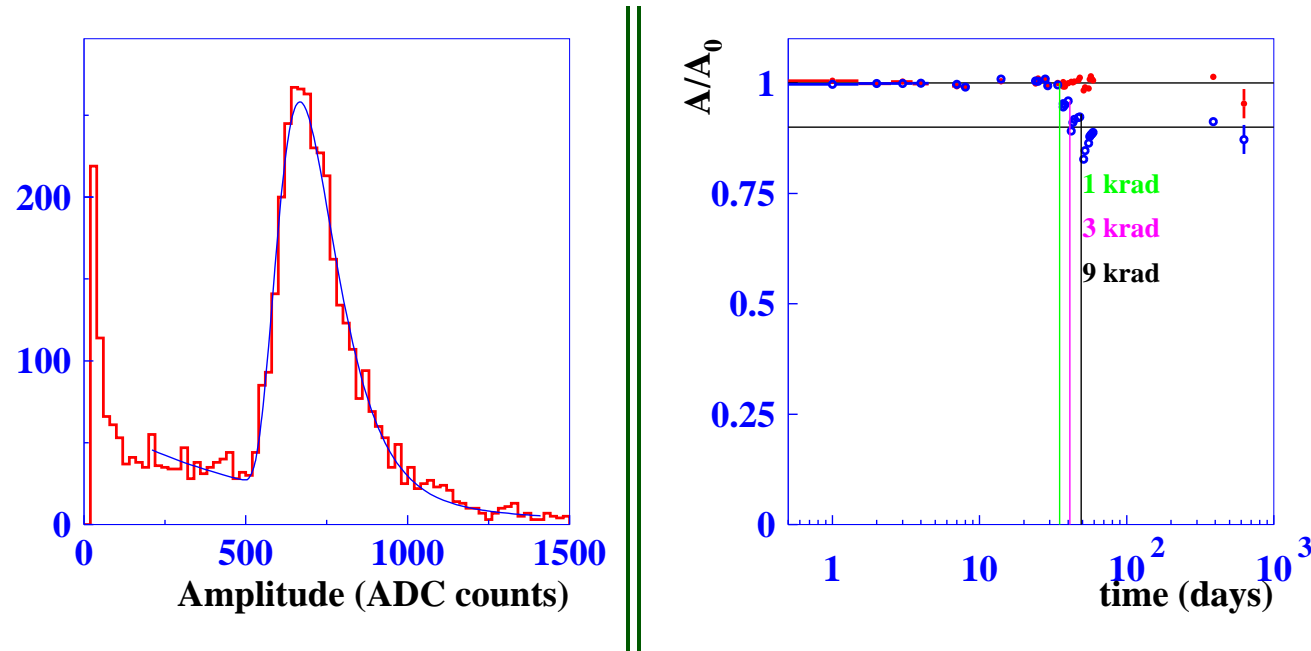
- **The counter is stable within 2%.**

- **More long term study of Photopentodes in magnetic field is necessary.**

   Alexey Garmash returned to BINP and joined to ECL team. He'll work with longterm stability of PP in magnetic field.

Summary

- Run with new electronics showed pile-up noise suppression and good time resolution

- Software to reconstruct clusters from new electronics has been prepared.

- Bhabha calibration procedure is in preparation.