Monitoring Program for the ECL Trigger System at Belle II

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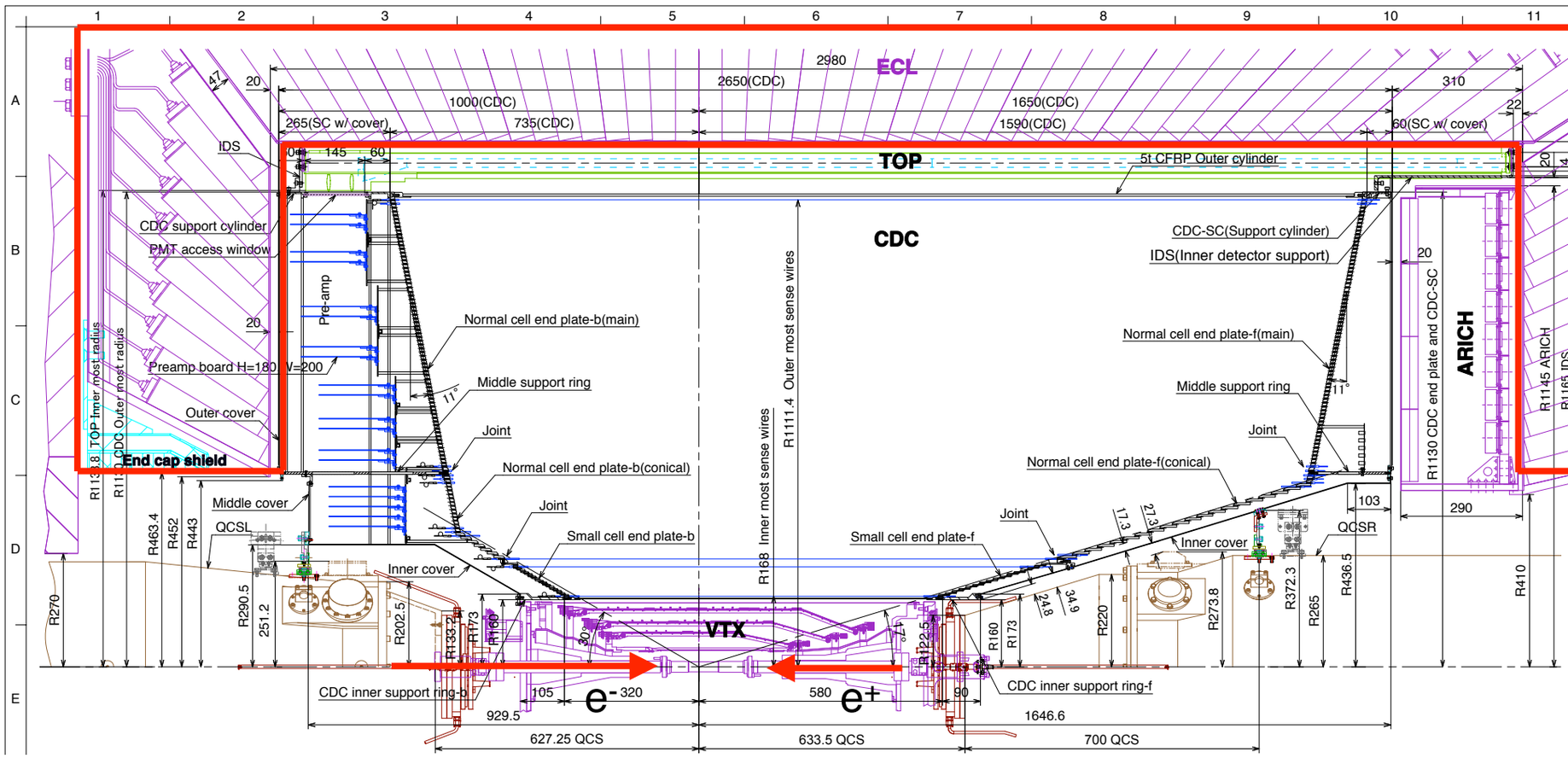
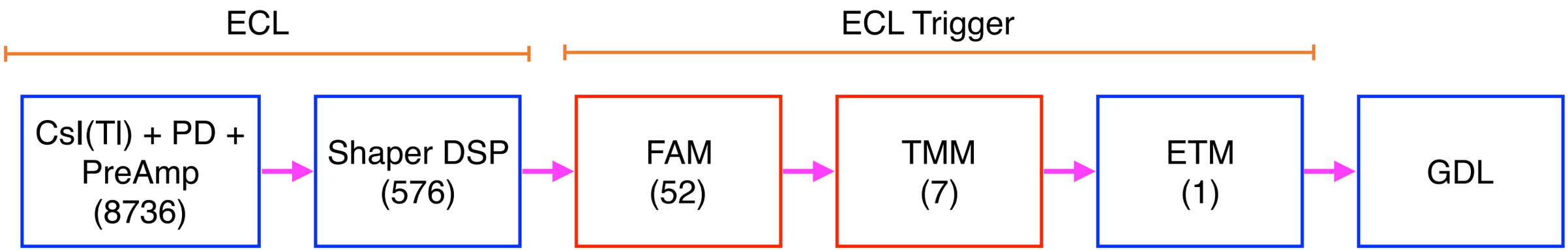
Introduction : ECL (Electromagnetic CaLorimeter)



Electromagnetic CaLorimeter

- 8736 Crystals & 576 TC(Trigger Cell)
- Precise energy/position measurement of charged particles

Introduction : ECL trigger system

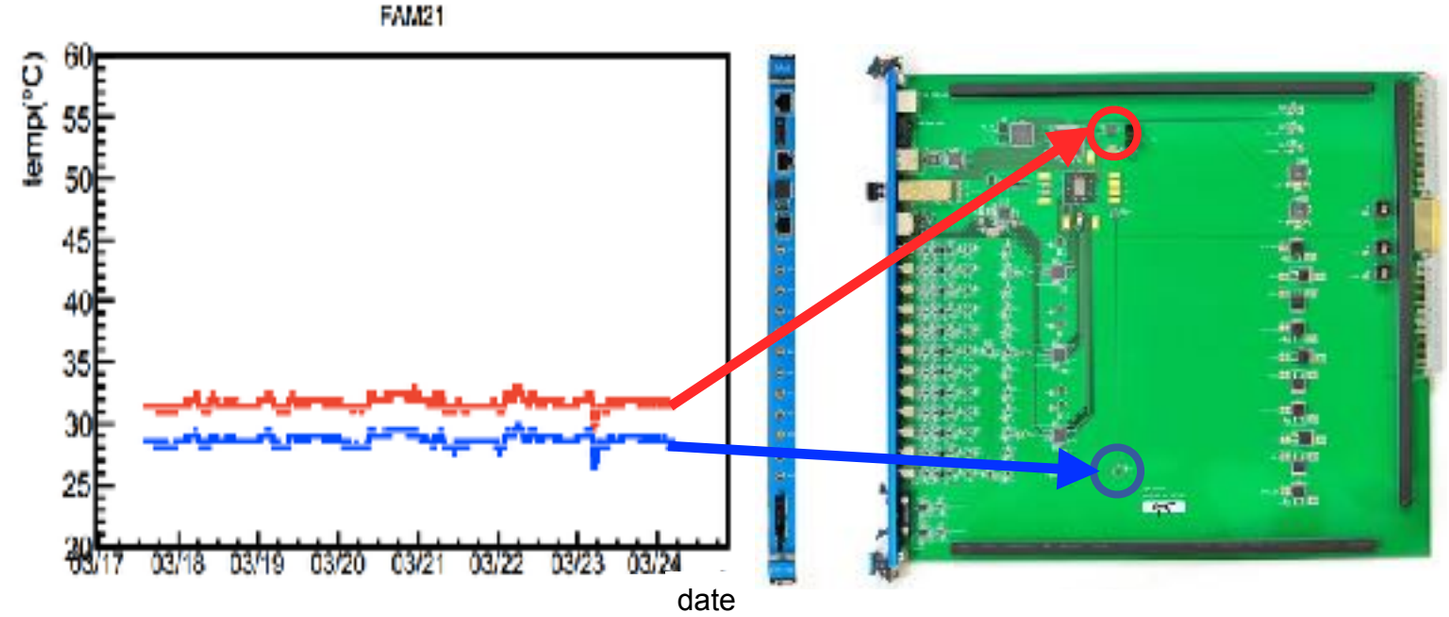


- FAM(FADC Analysis Module) evaluates energy and timing of signal
- TMM(Trigger Merge Module) merges FAM information and sends it to ETM(ECL Trigger Master)
- ETM does trigger decision and send it to GDL(Global Decision Logic)
- Monitoring for checking stability of FAM&TMM

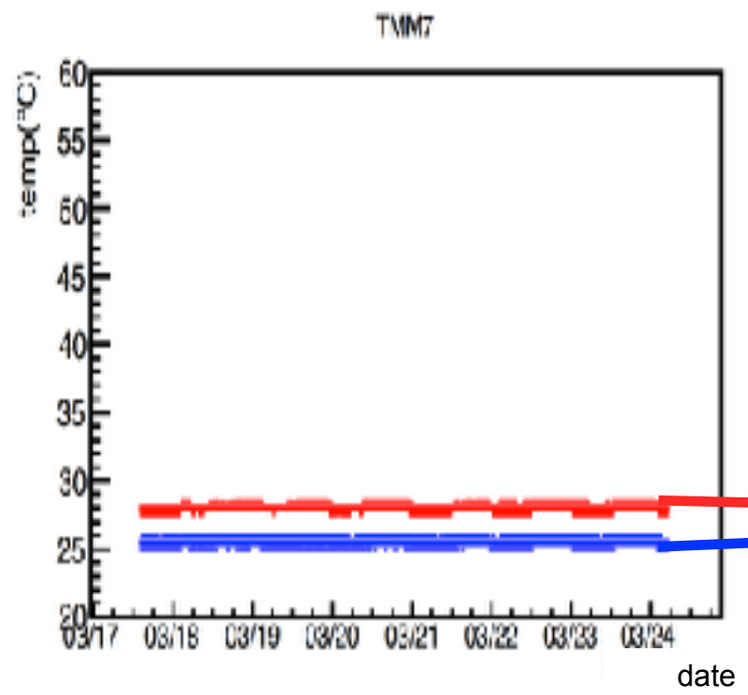
Monitoring contents

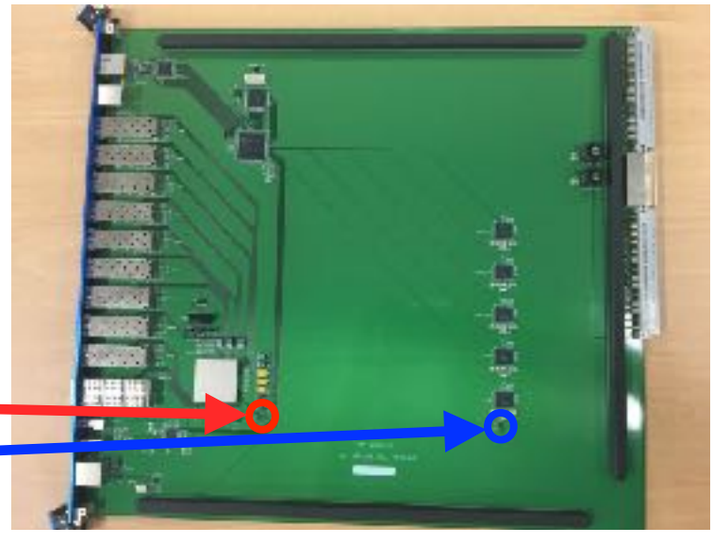
- FAM monitoring
  - Recording noise, pedestal, temperature and hit rate with time at every specific period
- TMM monitoring
  - Recording temperature and hit rate with time at every specific period
- Saving the data in text file classified by each day
- The monitoring program runs continuously

Monitoring contents : Temperature



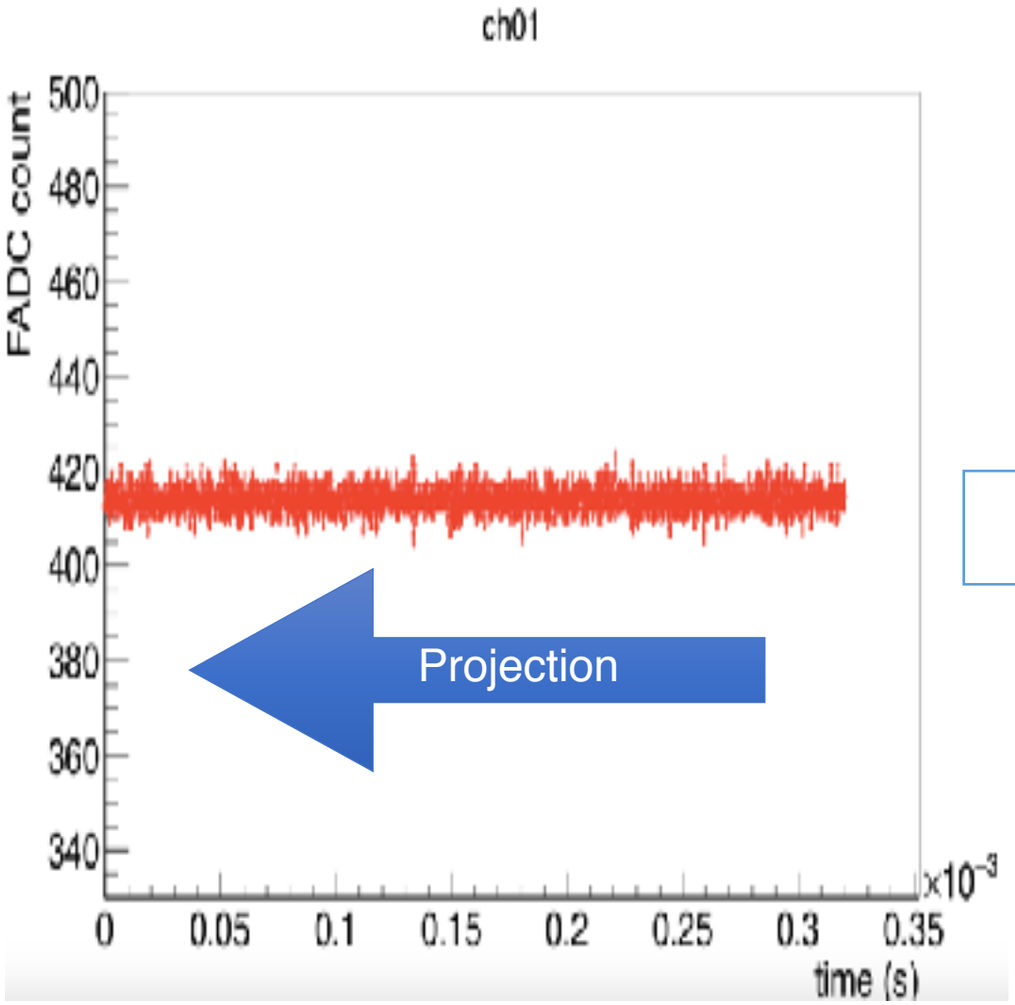
- Electronics can't stand high temperature.
  So we check that there is any abnormal temperature.



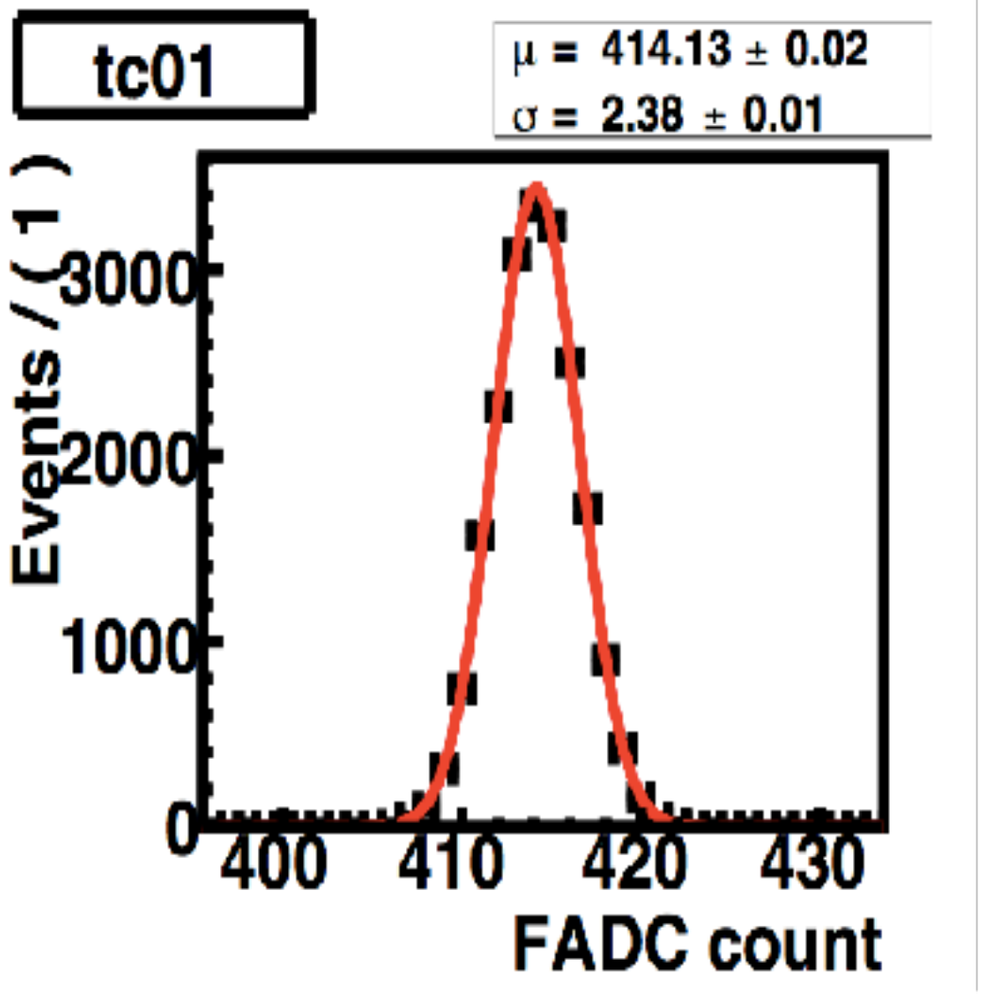


- Temperature is recorded at every 10 seconds

Monitoring contents : Noise level



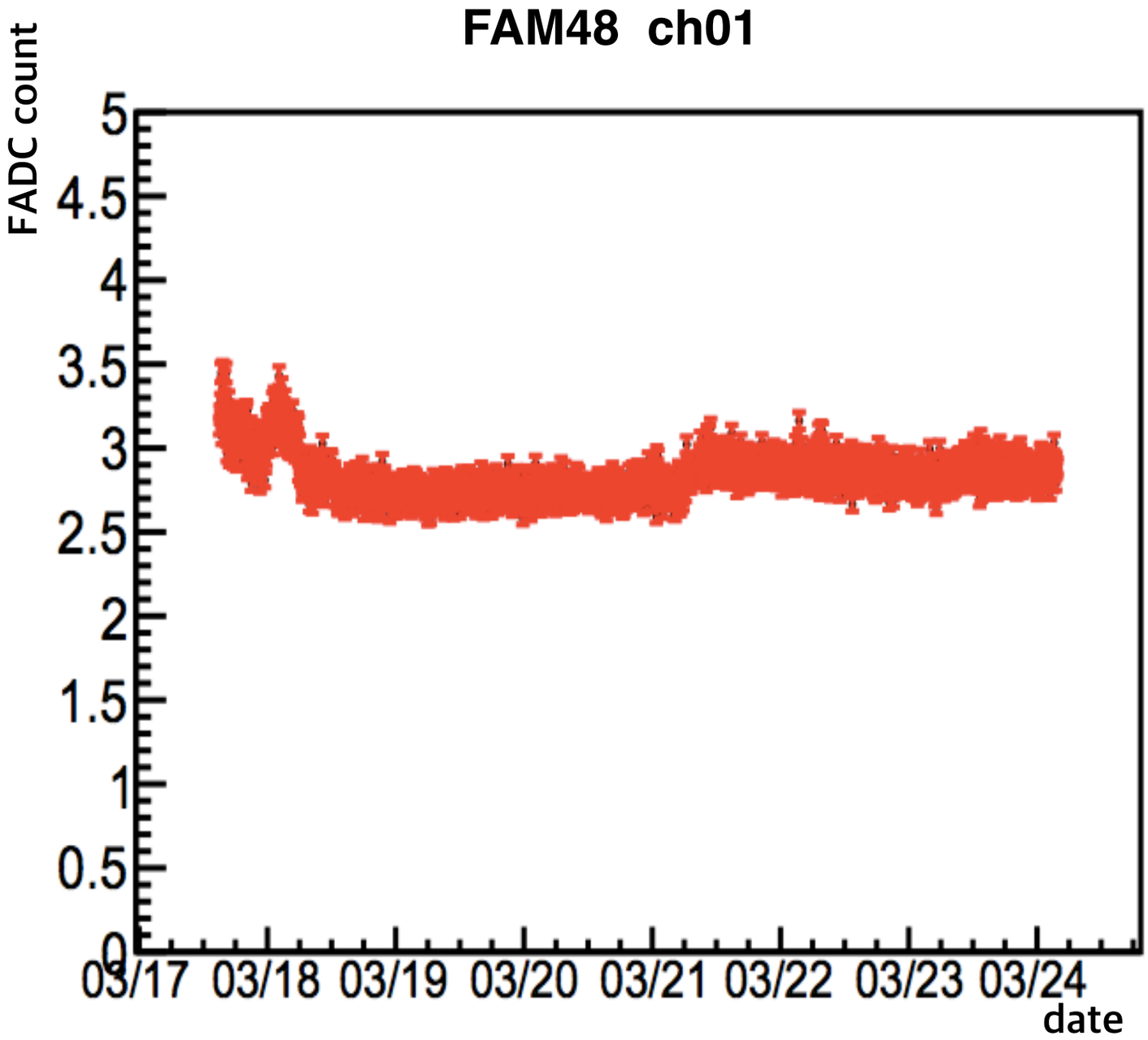
μ : pedestal σ : noise level



- FADC sampling
- Projection to y-axis
- Gaussian fitting

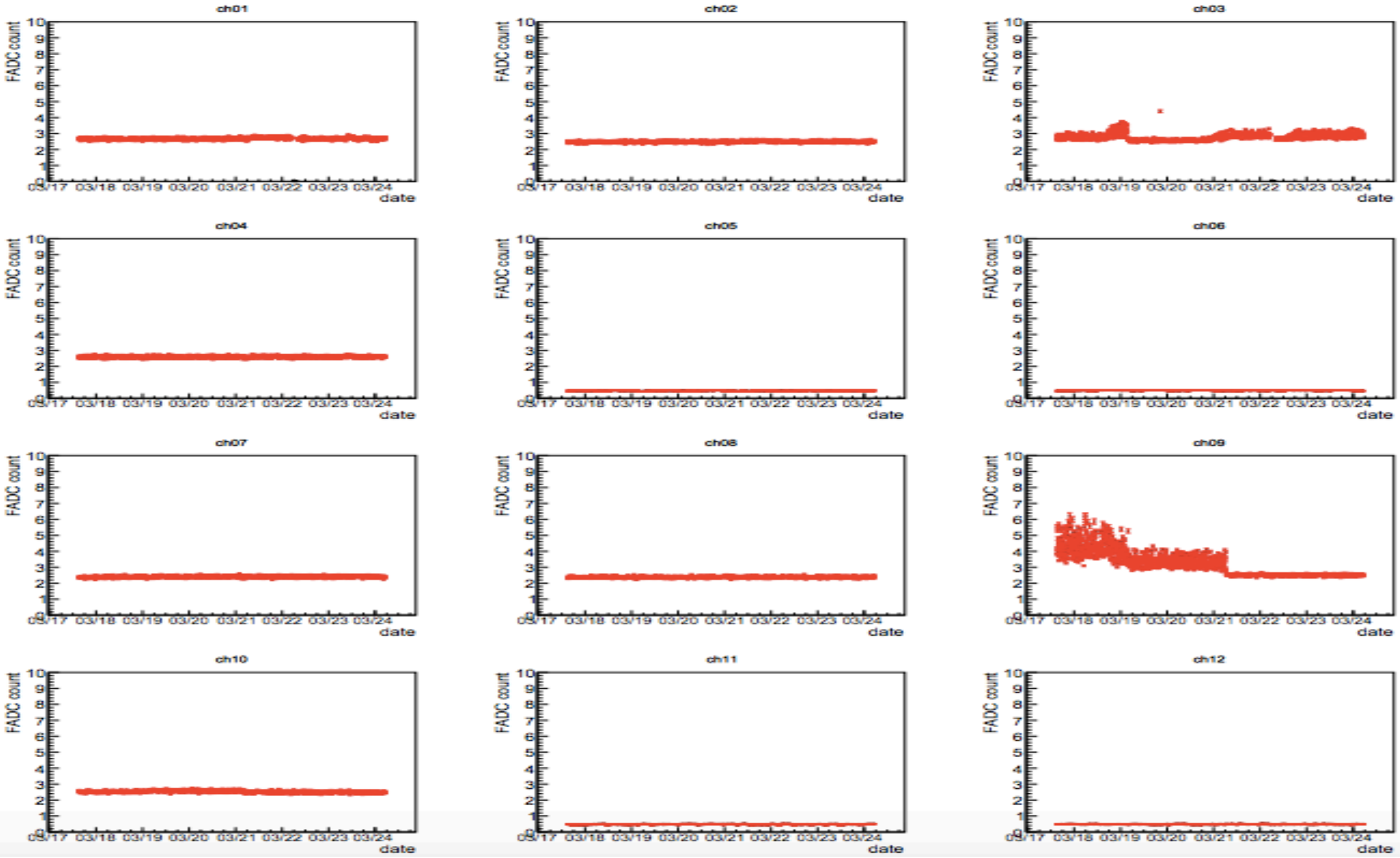
- Only FAM records noise level

Monitoring contents : Noise level

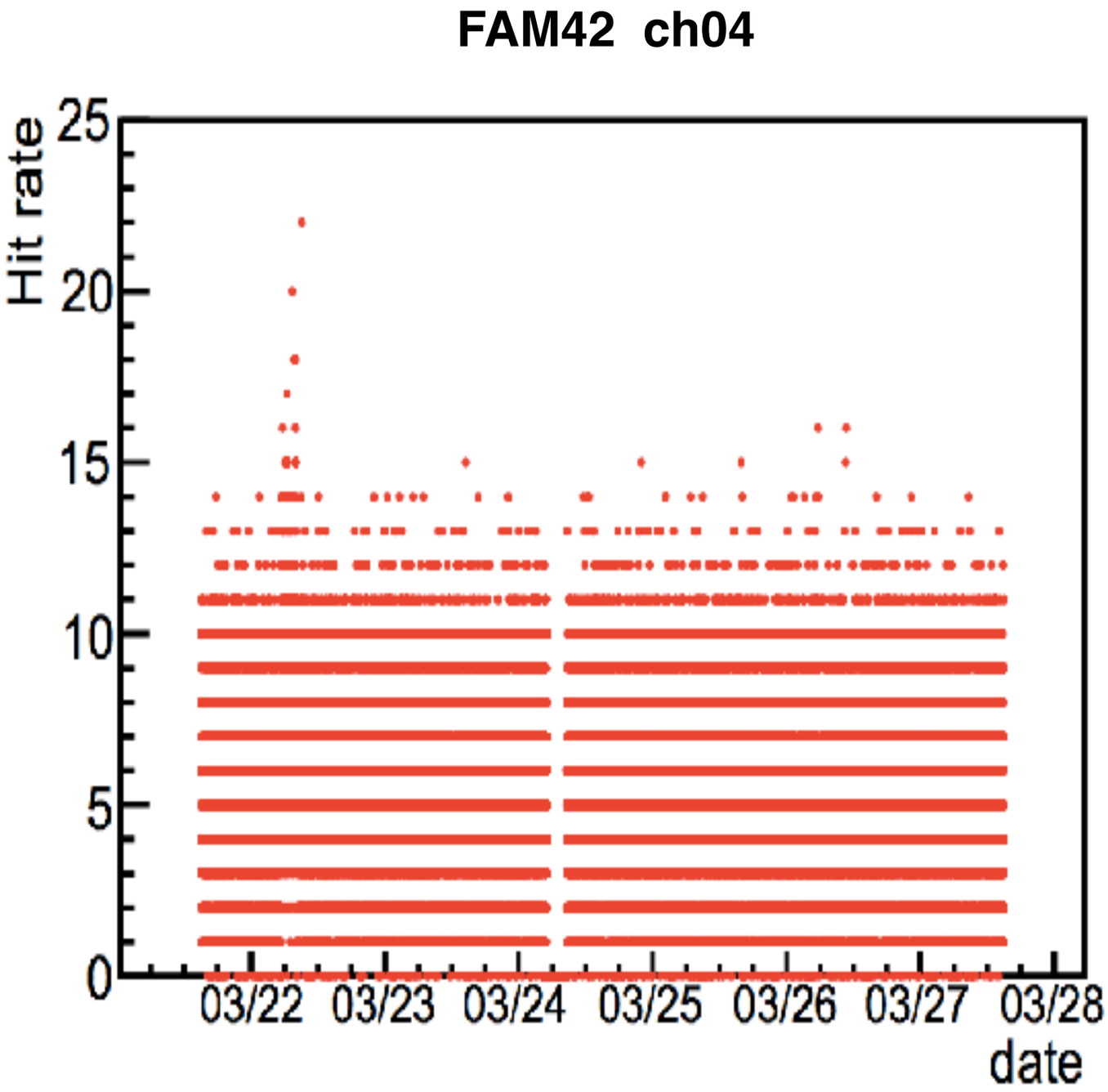


- Noise level means fluctuation of the ground level
- Noise level is recorded at every 5 minutes
- Noise level can increase during working in the ECL side

Noisy FAM : FAM45 ch 3, 9 03/18 ~ 03/24

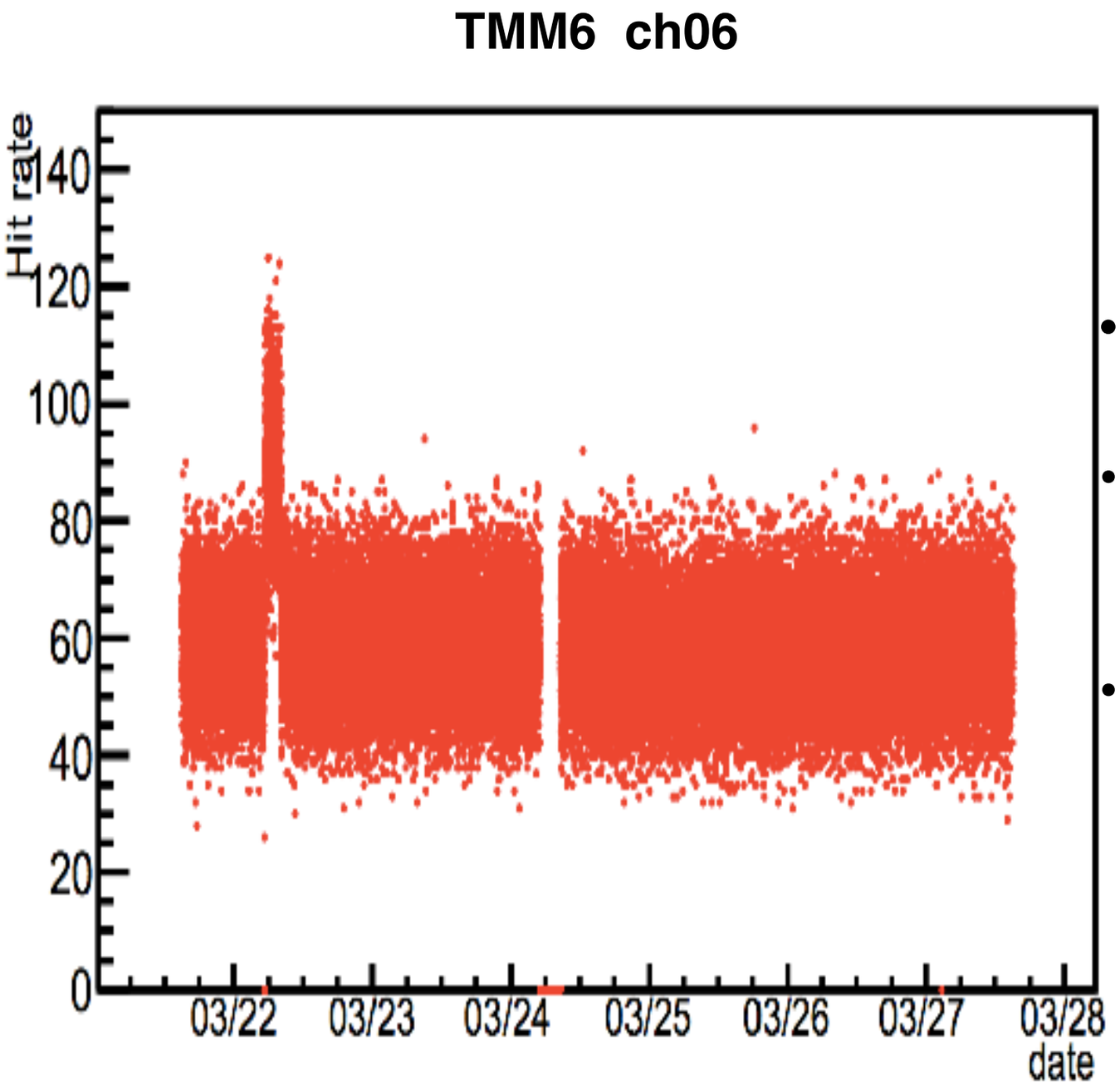


Monitoring contents : Hit rate (FAM)



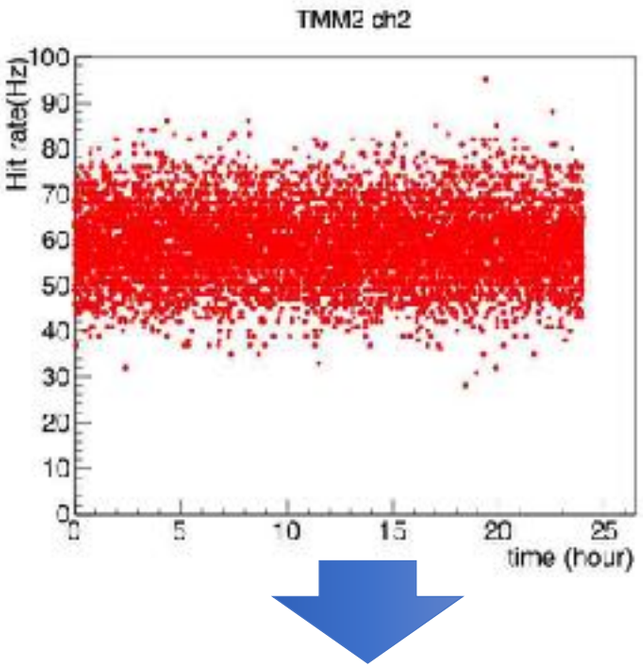
- When a pulse height is over the threshold level, hit rate is counted
- Hit rate is average over 1 second
- Hit rate is recorded at every 10 seconds
- Hit rate can increase when someone change threshold level

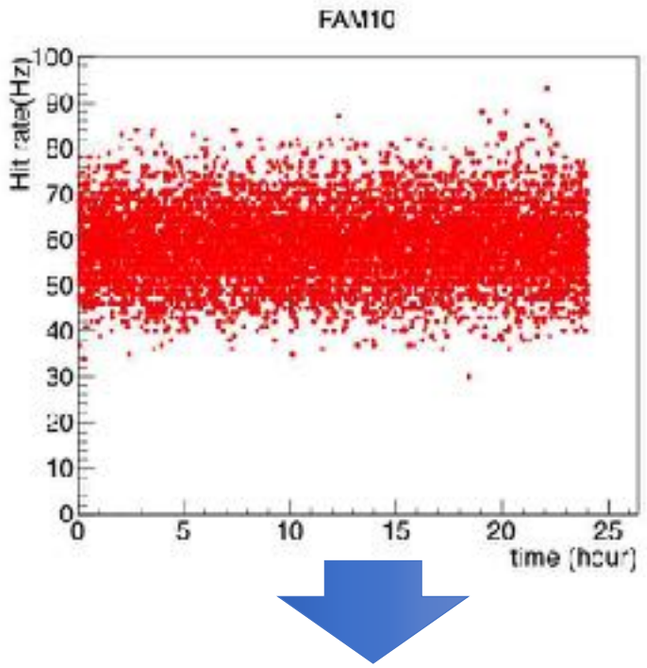
Monitoring contents : Hit rate (TMM)

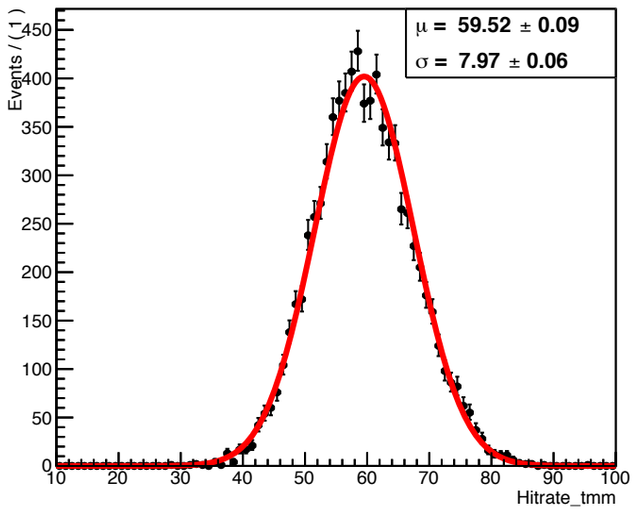


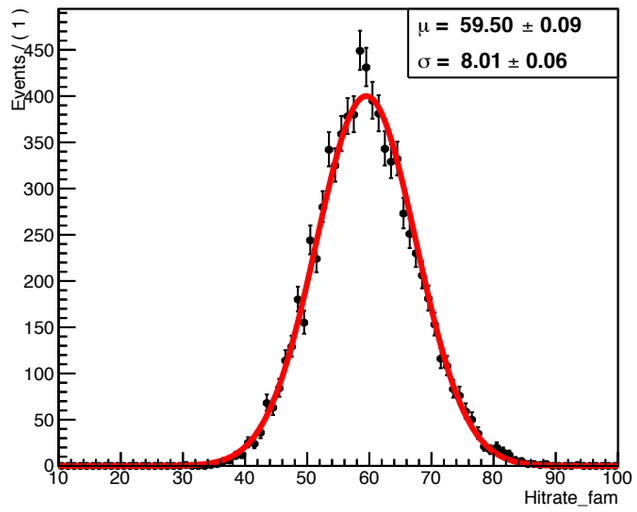
- Recording condition is same as FAM
- Each channel of TMM corresponds to sum of all channels of one FAM
- TMM information should be consistent with information from FAM

Consistency







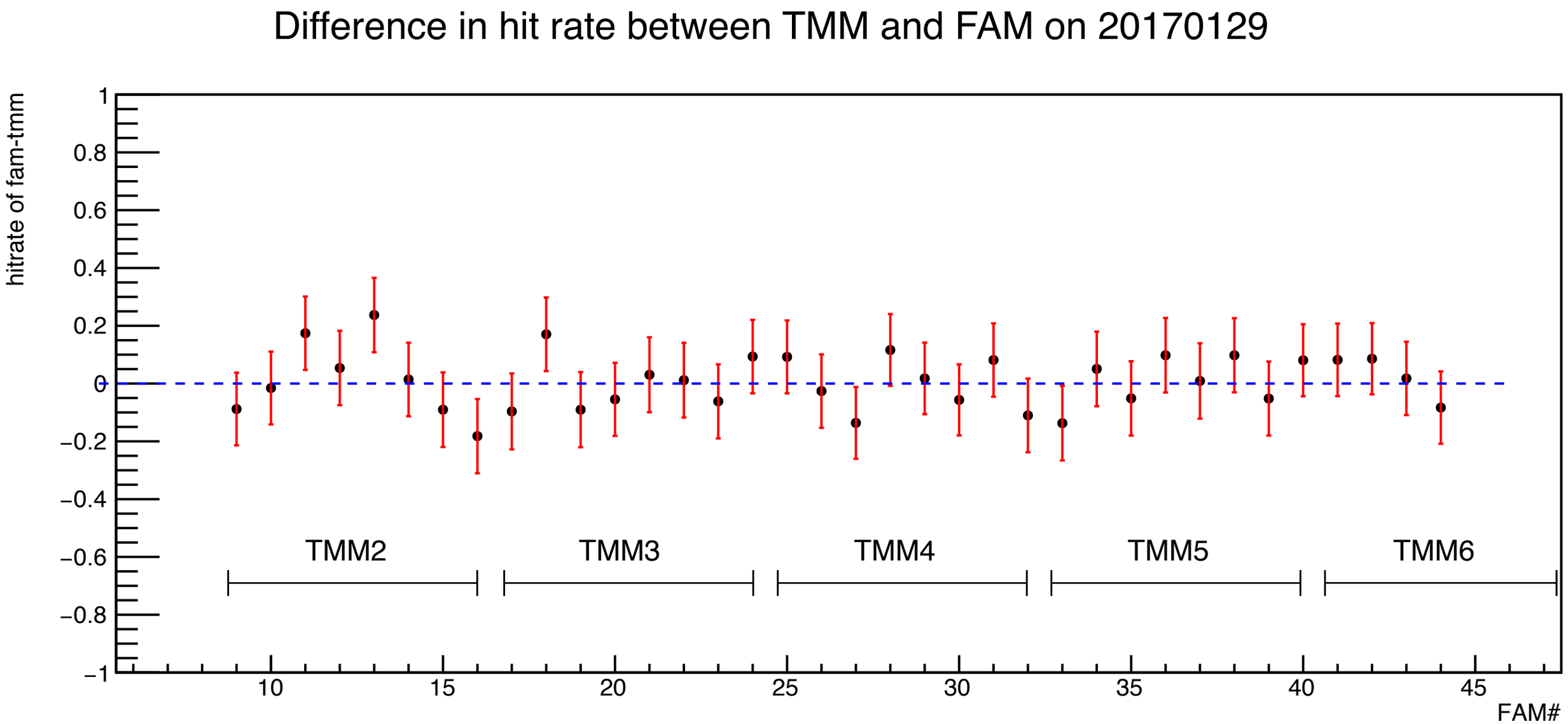


- We should check a consistency of data from TMM and FAM

Comparison TMM with FAM on 20170129

- FAM10 corresponds to TMM2 ch2
- Project above two graphs to y-axis. Then we get below histogram.
- Fit to Gaussian P.D.F.
- Compare two results

Consistency

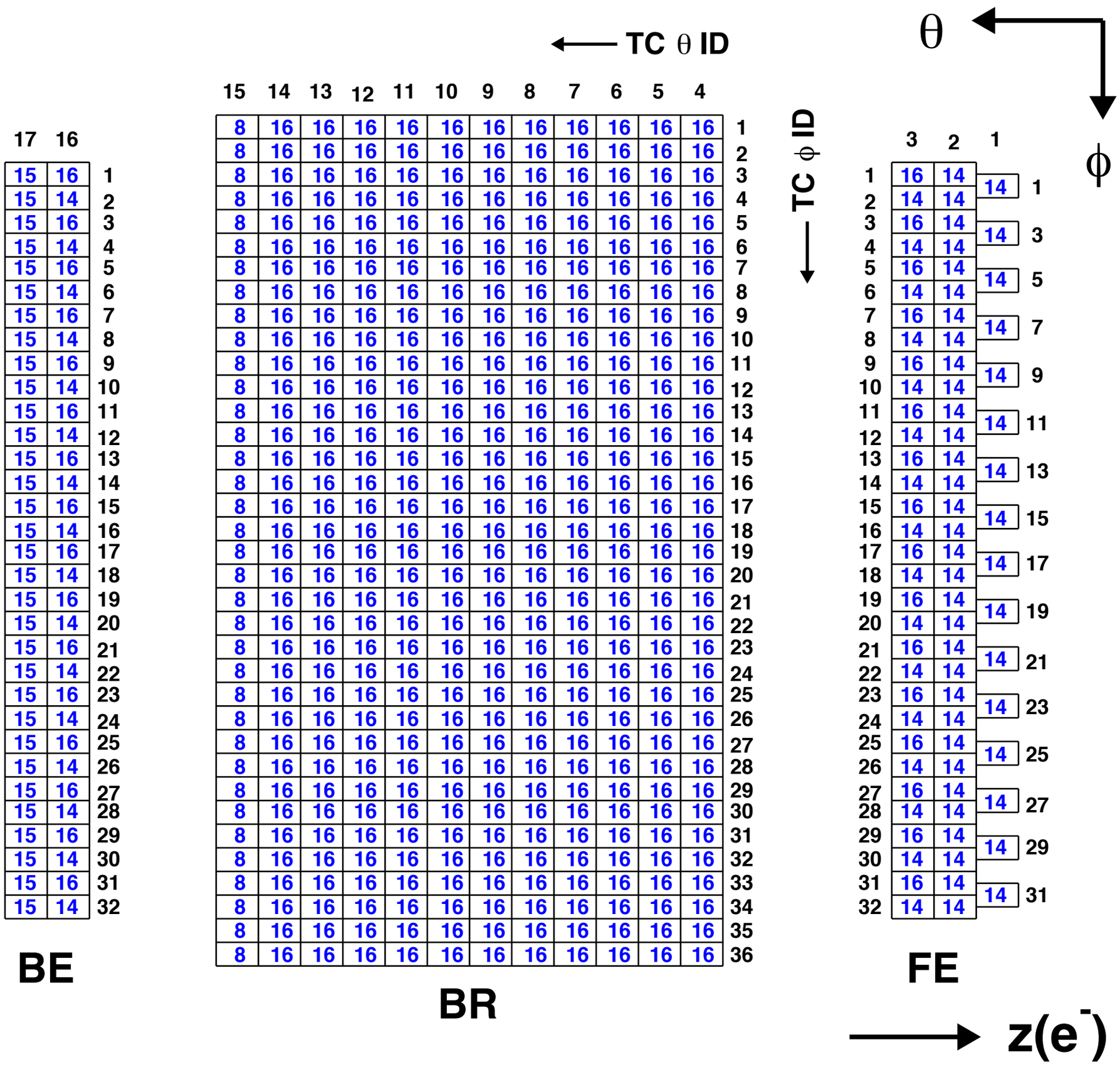


Status and Plan

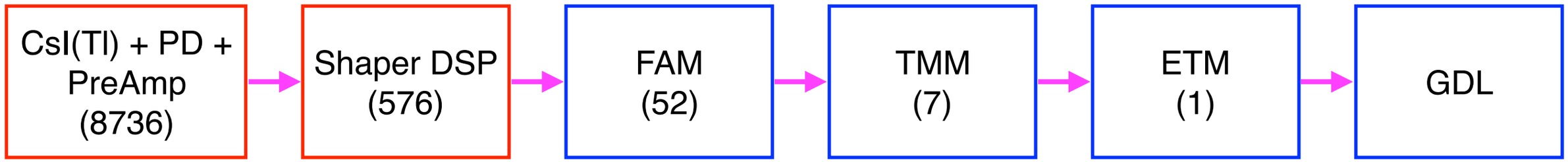
- Status : Weekly report
  - All contents of FAM and TMM
  - Consistency with the ECL work schedule
- Plan
  - Slow control
  - Archiver
  - Alert system for high temp. & hit rate

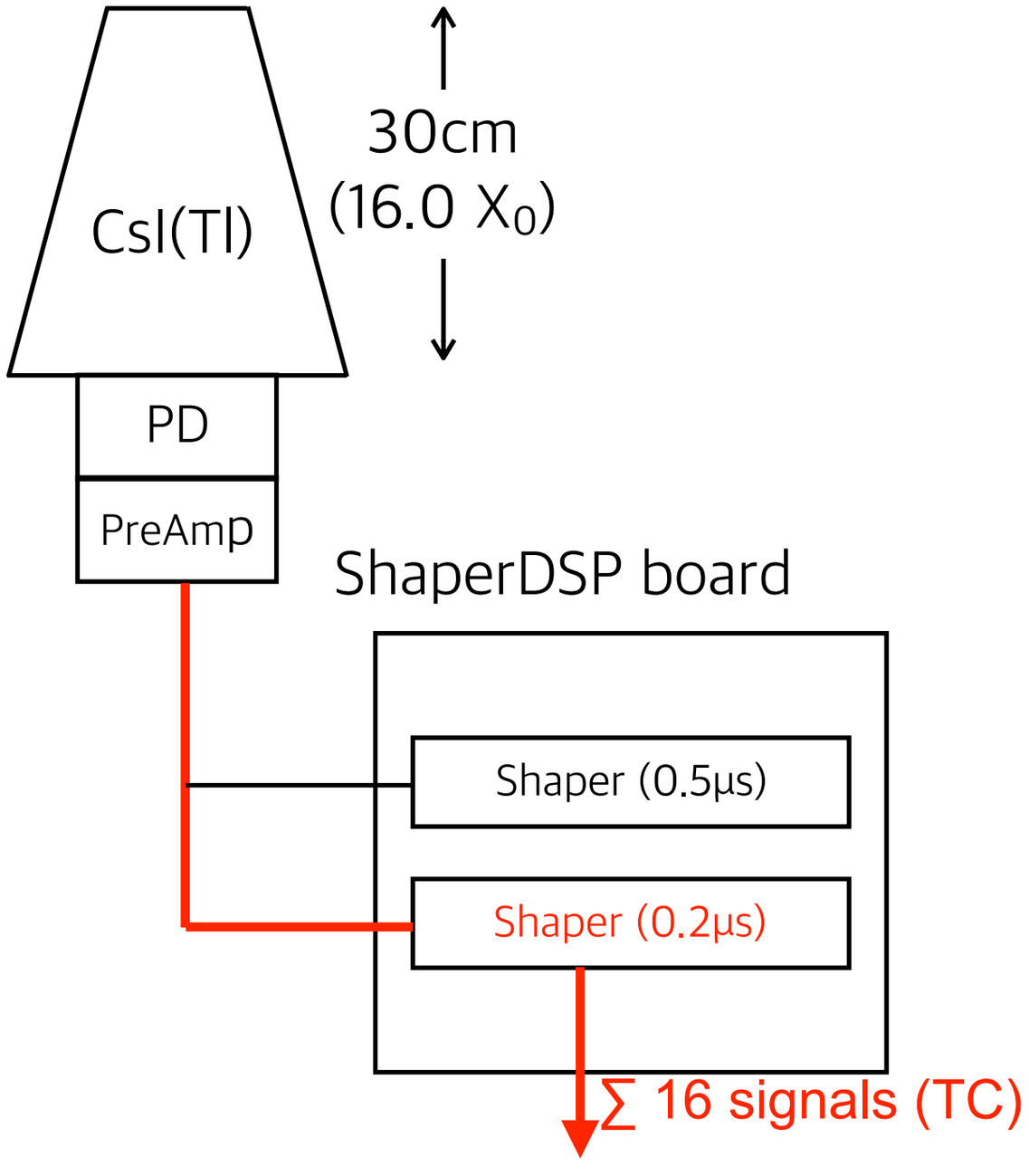
Back up

TC map (# of crystals)



Calorimeter and Shaper





8736 CsI(Tl) crystals

- 5.5×5.5 cm^2 in front face
- Reuse Belle crystals
- Endcap to pure CsI in the future

- 16 counters per board
- Slow one for precise energy
- Fast one for ECL trigger
- Merge 16 Fast ones → 1 TC
- 576 Trigger Cell(TC) in total