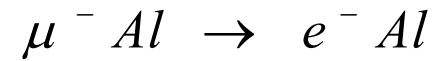# AURORA COMMUNICATION BETWEEN RECBE AND COTTRI BOARD IN COMET EXPERIMENT
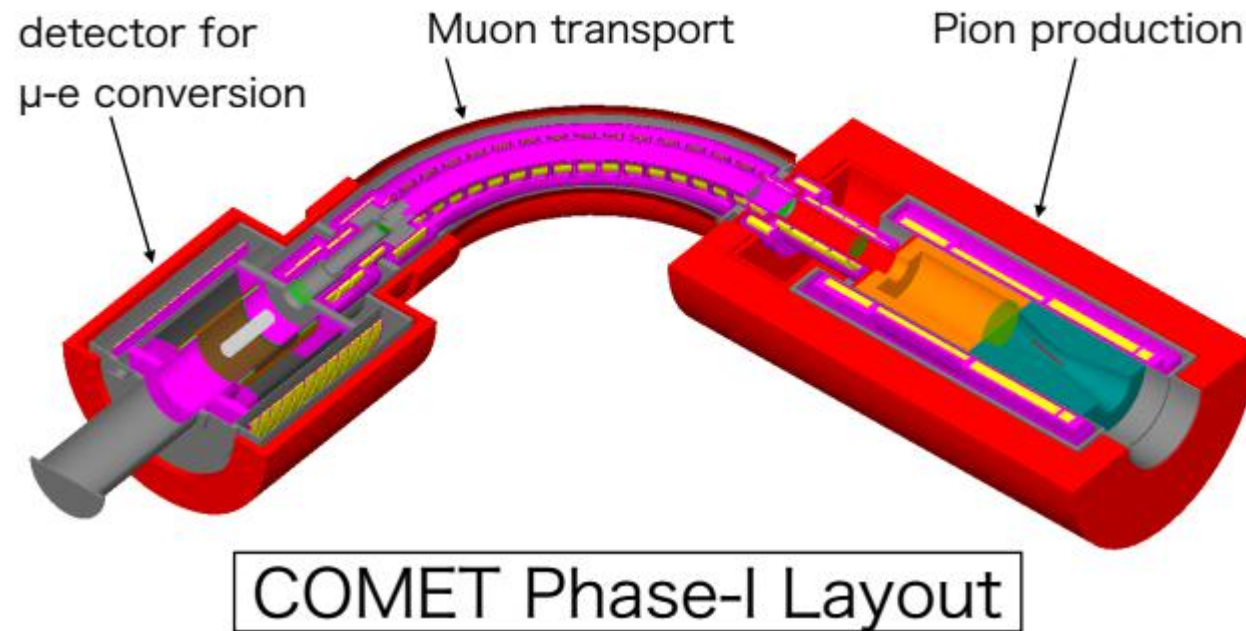
Kuno Laboratory

CHAU THANH TAI

28/12/2017

I. Overview

- Measure the neutrinoless, coherent transition of μ - e in the Al field
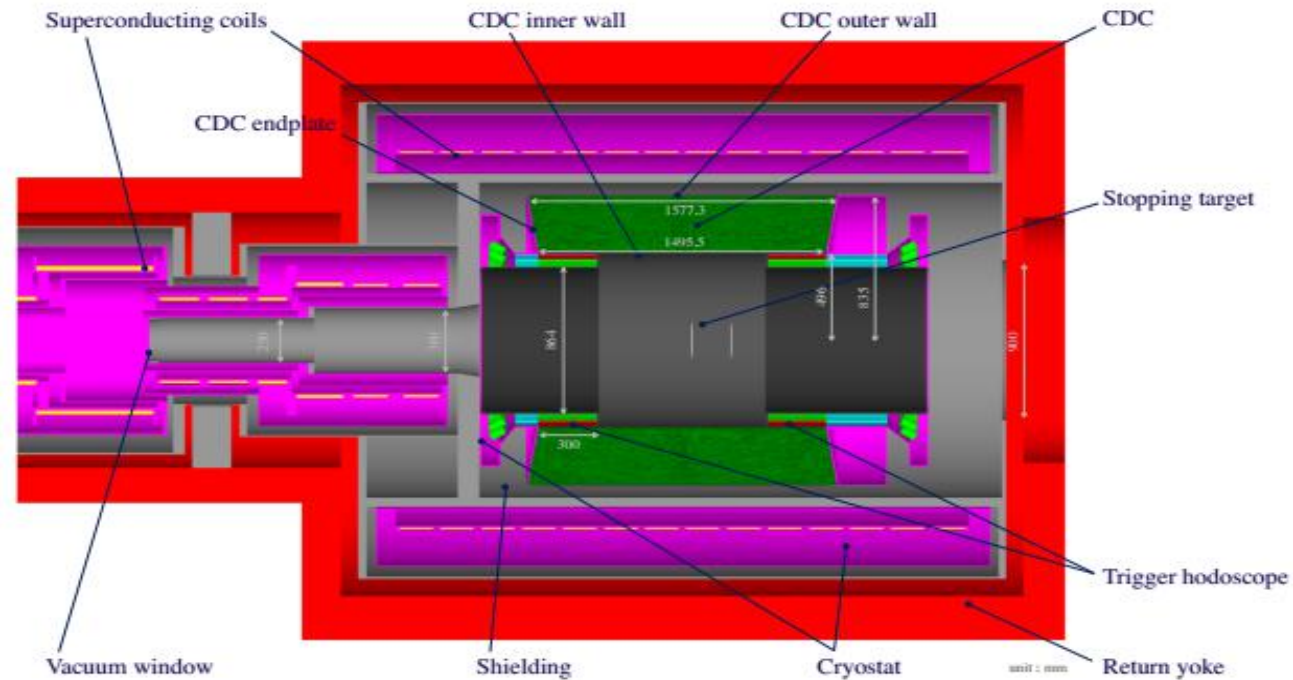
$$\mu^- \; Al \; \rightarrow \; e^- \; Al$$

- Single event sensitivity 3×10^{-15}
- Layout of COMET experiment:

detector for
μ-e conversion

Muon transport

Pion production

COMET Phase-I Layout

I. Overview

- Cylindrical Detector System (Cydet)

- Main detector system for COMET experiment.
- Consist of cylindrical drift chamber (CDC) and cherenkov trigger hodoscope (CTH).

I. Overview

- CDC is used to:

_ Reconstructing tracks of charged particles.

_ Measuring particles's momenta precisely.

- CTH is used to:

_ Make the first level trigger for COMET experiment.

- RECBE (Readout Electronics for Central drift chamber of BElla II experiment) board - chosen as the front-end readout electronics for CDC with approriate modification.

I. Overview

RECBE board

48 channels

ASDs

ADCs

LEMOs

FPGA

Power Supply

RJ45

Trigger I/F

SFP
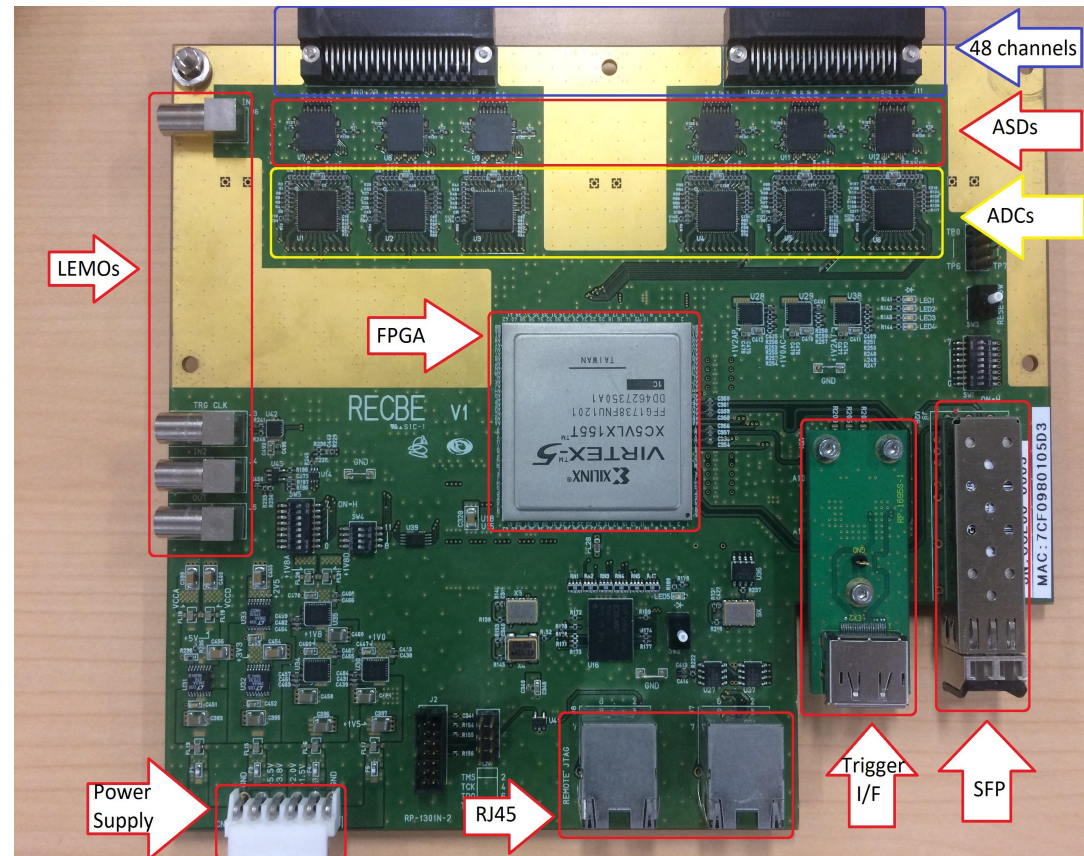
I. Overview

- RECBE board converts the charge data from CDC to hit information by digital processing.

- To reject CTH trigger from background particles:

_ Using hit information from a large number of CDC channels.

_ Then combine to the CTH hit information to make the trigger decision.

=> Need one board this purpose.

=> COmeT TRIgger (COTTRI) board.

- Therefore, transferring CDC hit information from RECBE to COTTRI boad is necessary.

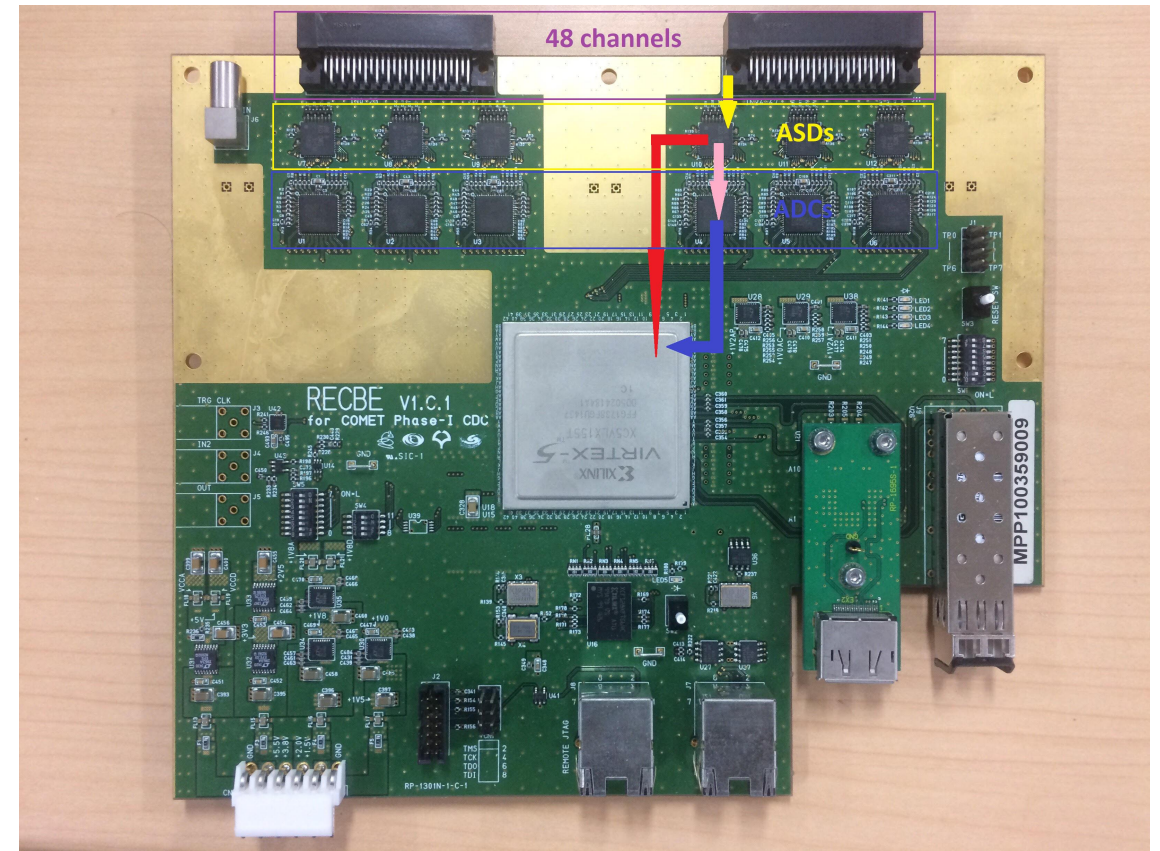- Aurora protocol is used for this purpose.

I. Overview

- COTTRI board
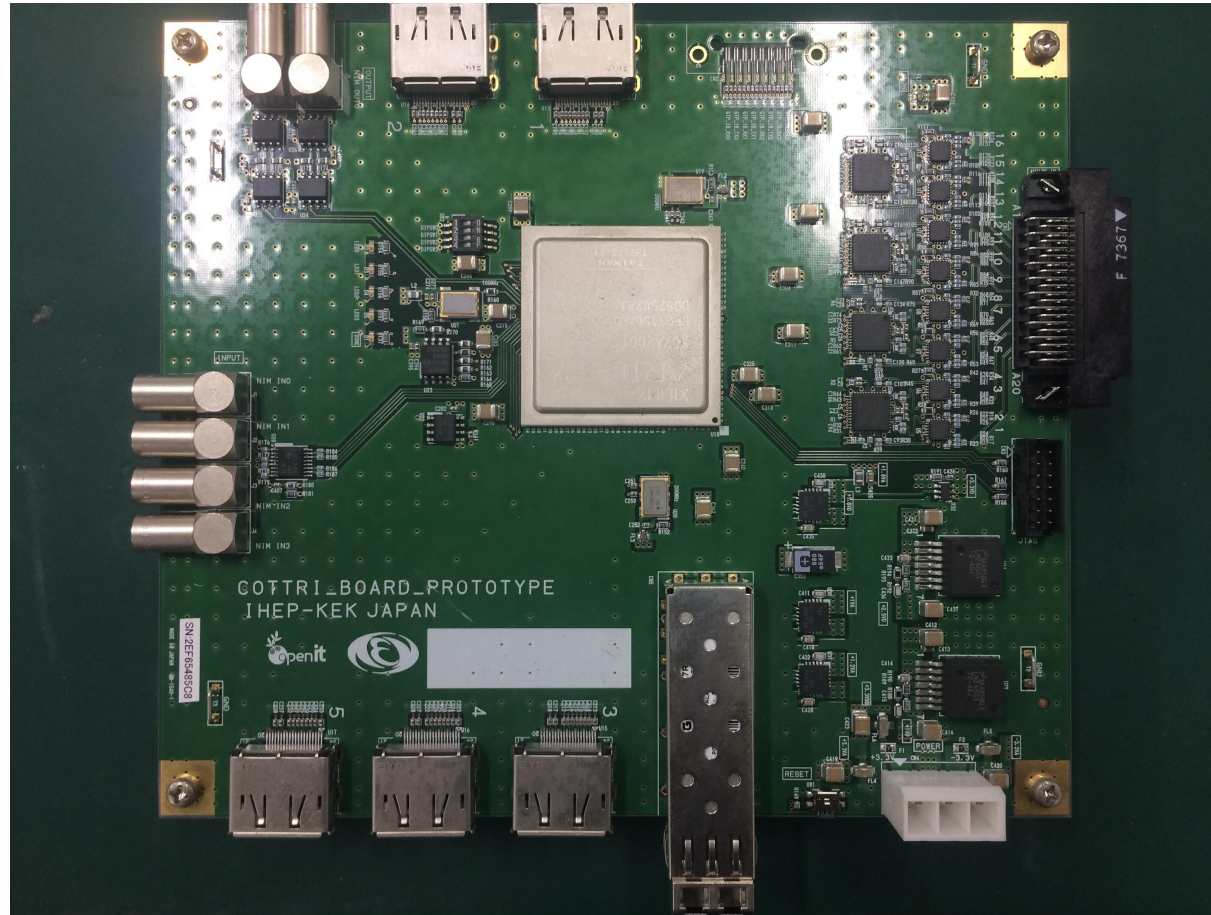
II. Experimental details
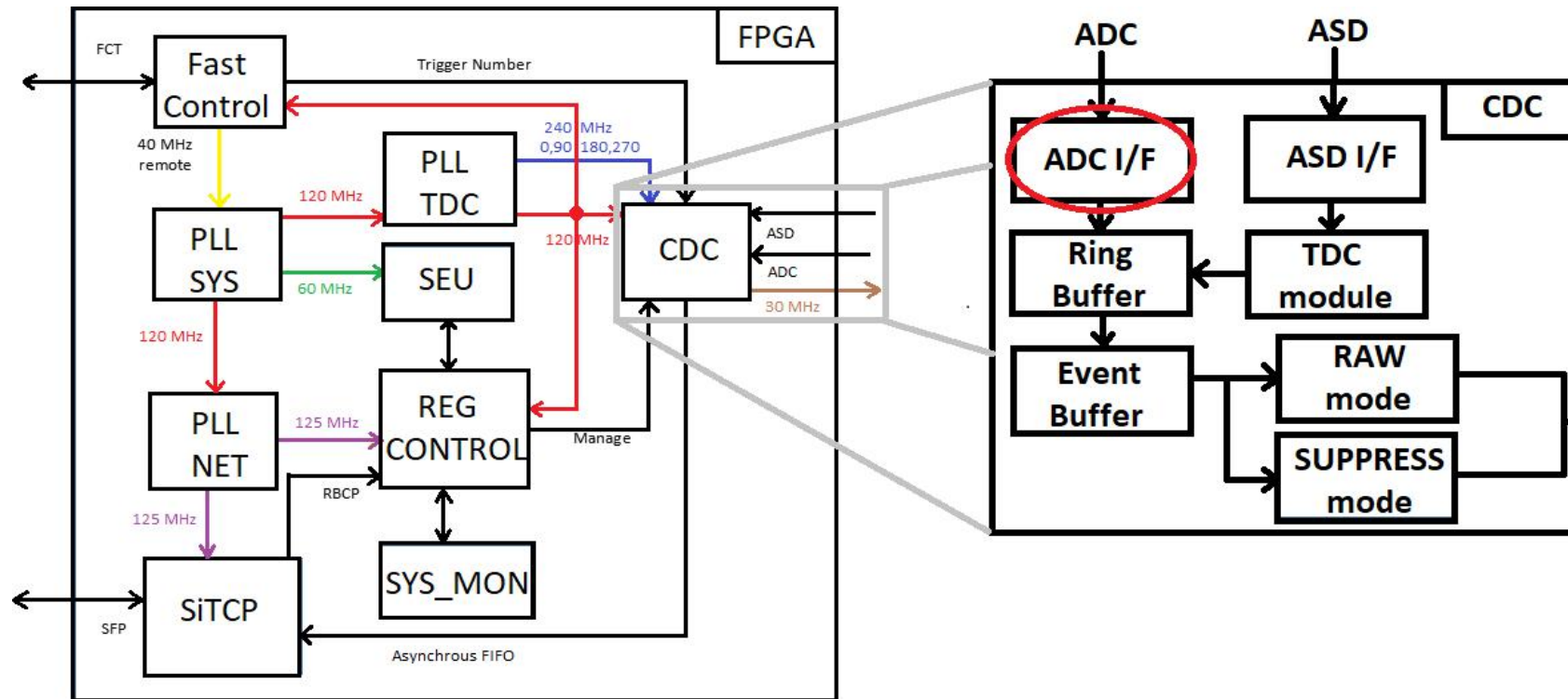
1) Data processing on RECBE board:

- analog aignals (yellow line).
- analog signals (pink line).
- digitial signal (red line).
- digital signal (blue line)

II. Experimental details

2) FPGA firmware - ADC I/F:

- FPGA firmware of RECBE board:

II. Experimental details

- ADC I/F : serialize separately data coming from ADCs for 48 channels in one samples.

- For one samples, ADC data (480 bit) can be obtained for 48 channels.

- This data is too big to transfer from RECBE board to COTTRI board.

=> This ADC data need to be suppressed from 480 bit to 96 bit.

=> It means that 10-bit resolution is reduced to 2-bit for 1 channels.

=> 96 bit data is suitable for RECBE transfer.

II. Experimental details

- The idea for getting the 96 bits data:

_ 480 bits ADC data for one sampling can be seperated into 10 bits for every channel.

_ For one channel, we sum the ADC data for every 3 samples.

- Compare sum of ADC for every 3 samples with conditions.

- Then obtain the values 0,1,2,3 (2 bits) corresponding to conditions satisfied.

- 2 bits / 1 channel => 96 bits / 48 channels (data being considered)

II. Experimental details:

3) Conditions to compare with ADC data:

- Besides e from μ - e conversion, charged particles such as protons, pions, v.v. can be detected in CDC.

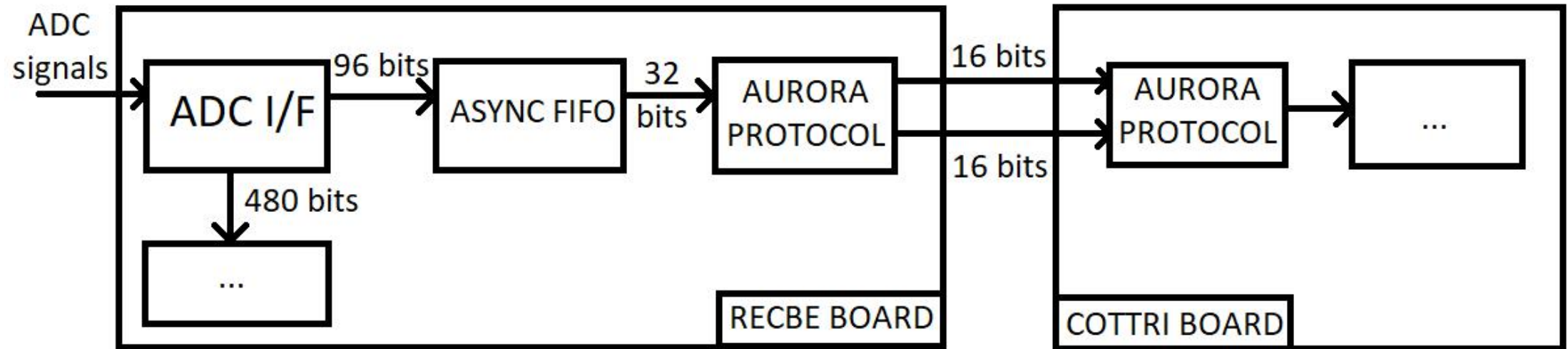- The energy loss of these particles in CDC is higher than electron.

=> Need upper threshold to suppress the ADC data.

- To reject the background caused by low-energy particles, the lower threshold for ADC data is also set up

=> Need lower threshold to suppress the ADC data.

II. Experimental details:

4) Diagram to transfer data:

- 96 bits data goes into asychronous fifo and 32 bits data is output.
- Then 32 bits data go to Aurora protocol to transfer to COTTRI board.

III. Results and Prospects:

Results:

- Used Aurora protocol example to transfer the sample data between RECBE boards before expanding RECBE to COTTRI.

- The firmware for sum of every 3 ADC samples.

- The firmware to connect asynchronous fifo and aurora protocol.

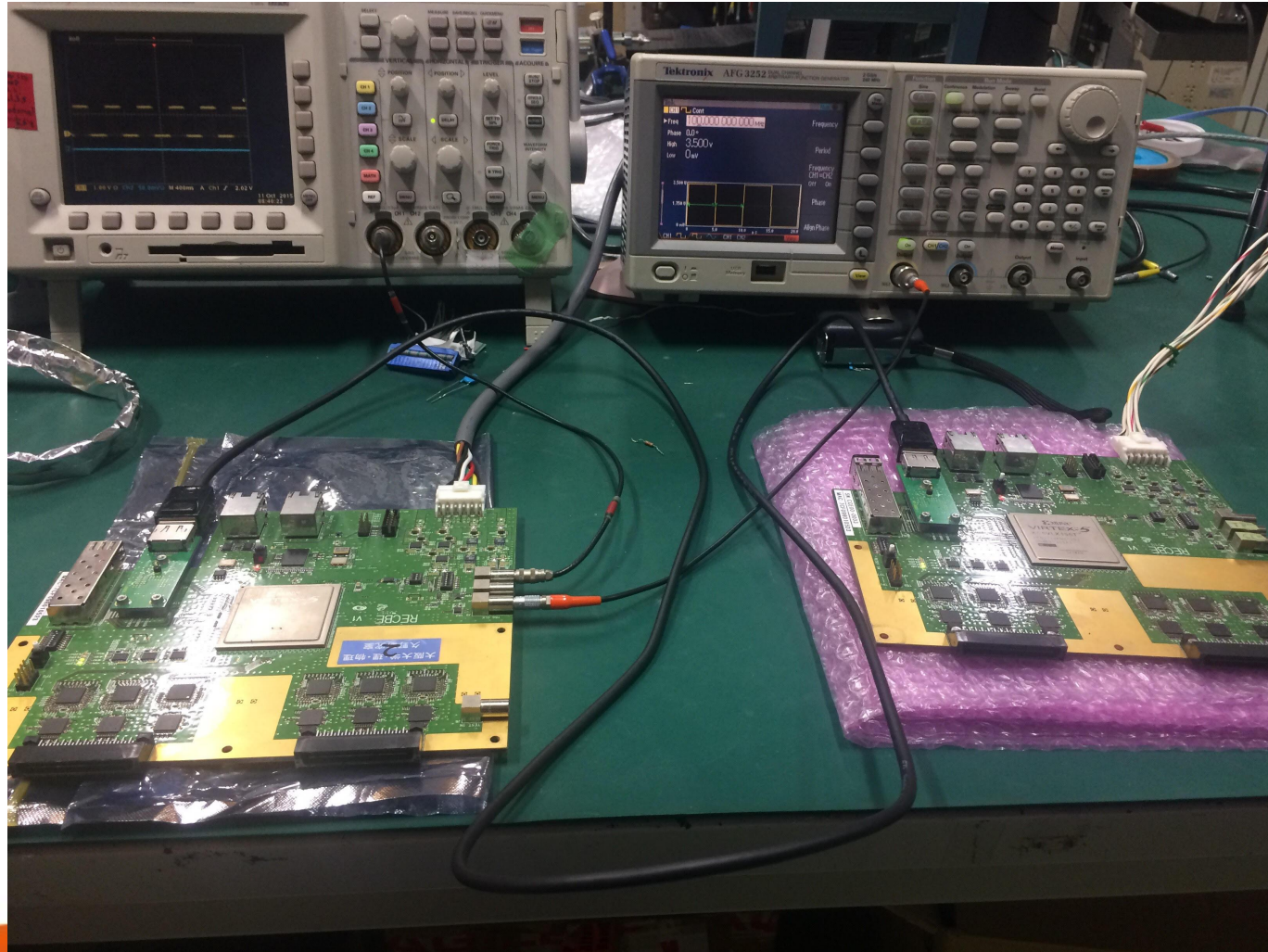- Simulation of connection two above firmware work well.

Prospects:

- In the next time, the firmware need to be implemented to FPGA of RECBE board to see how it works.

- The firmware for Aurora Protocol for COTTRI will be written.

Thank you for your attention

BACK UP

AURORA COMMUNICATION RECBE & RECBE

| LED |
| COUNTER |

RECBE(1)

| LED |
| COUNTER |

RECBE(2)

Sum of 3 sampling of ADC data: