National Taiwan University
High Energy Physics Group

The BGO System for Real Time Beam Background Monitoring in BEAST II

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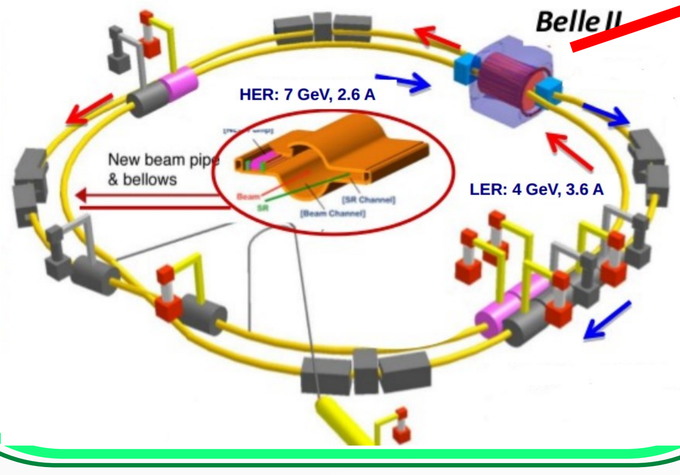
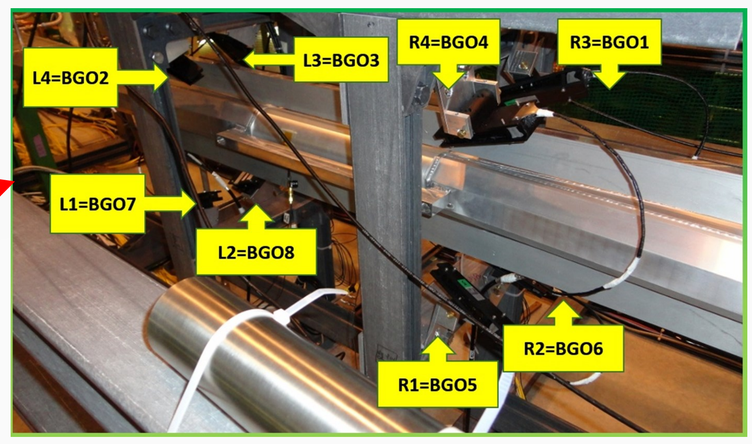
Introduction

- SuperKEKB at KEK has started phase 1 beam commissioning this year (target beam energy without collision).
- BEAST II experiment is to study the beam background at the SuperKEKB/Belle II.
- NTUHEP group developed a BGO system for beam background monitoring in BEAST II.



BGO SYSTEM



1.Scintillator

- BGO ($Bi_4(GeO_4)_3$) x 8
- about 2cm x 2cm x 13 cm
- mostly in visible light region and peaked at 480 nm

40m optical fiber
special light-tight treatments with BGO and MAPNT

2.MAPMT

- HAMAMATSU H7546B
- 8 out of 8 × 8 pixels (2mm × 2mm per pixel)
- working voltage: 700~800V

3.Readout Board

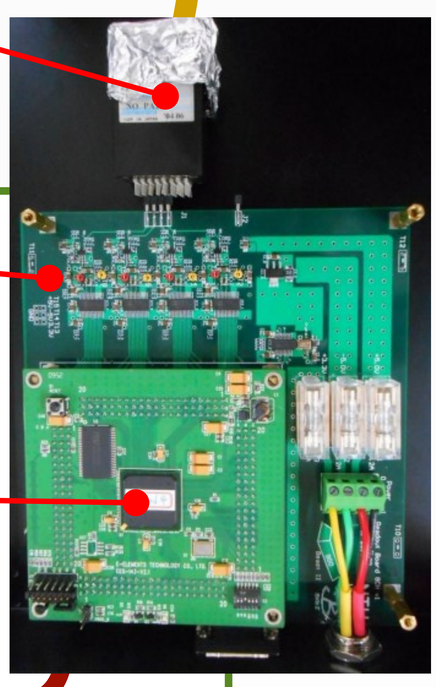
- main board
Pre-amplifier :
- charge-voltage converter: 0.91 V/pC
- shaping time 187ns

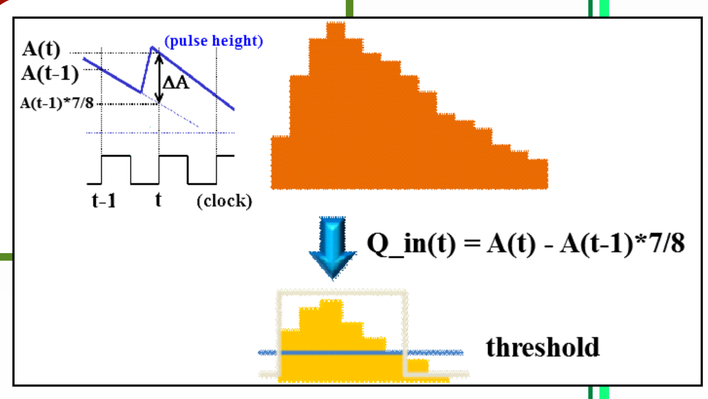
ADC:
- 10-bit ADC (0~2V)

- FPGA board:
- clock: 40MHz
  1. gain adjustment
  2. synchronization
  3. pulse to charge calculation
  4. threshold application

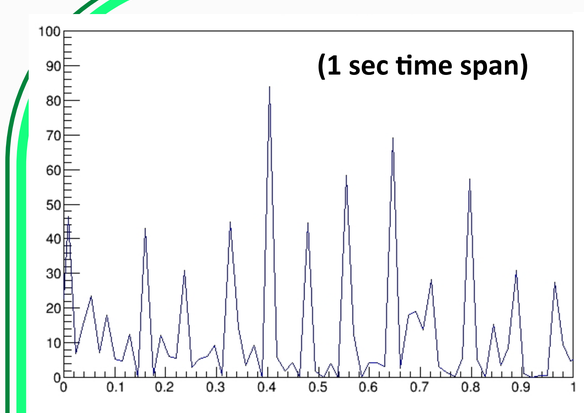
- gain (preliminary)
11 ADU/photo-electron
22 photo-electron/GeV

- Link to the BEAST II DAQ
- UART (RS232-USB)
- data rate 60Hz

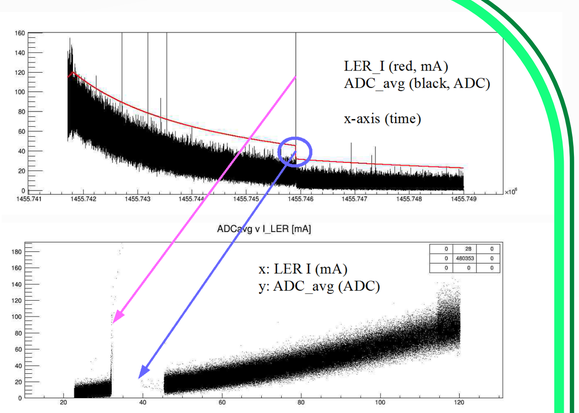




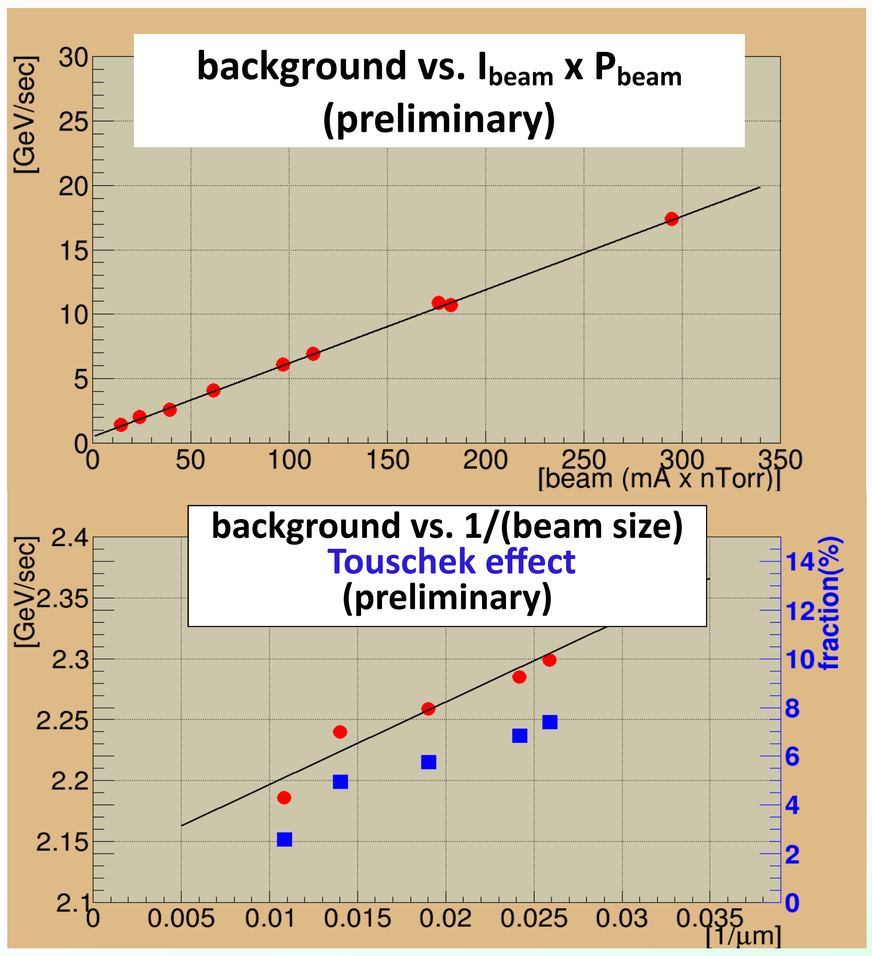
PHASE 1 COMMISSIONING



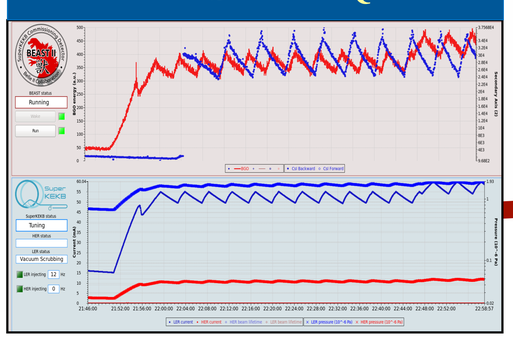
response to the injection bunch



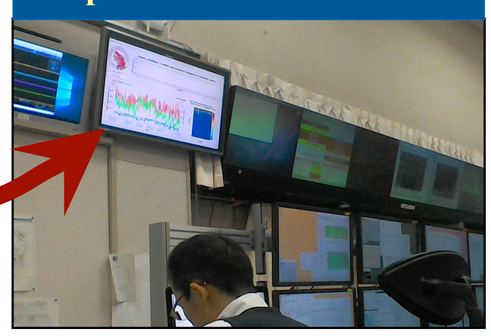
background vs. I_{beam}
(noise due to beam lost seen)



BEAST II DAQ



SuperKEKB control center



Summary

NTUHEP has deployed a beam background monitoring system for the SuperKEKB phase 1 commissioning, using BGO crystals and a FPGA based DAQ board. The background variation versus beam condition is well observed and the online monitoring is fed back to the SuperKEKB control center in real time.

Reference

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[4] Y. S. Velikzhanin, *et al.*, "Design of a general purpose data collection module for the NuTel telescope", Nucl. Instr. Meth. A **552** (2005).