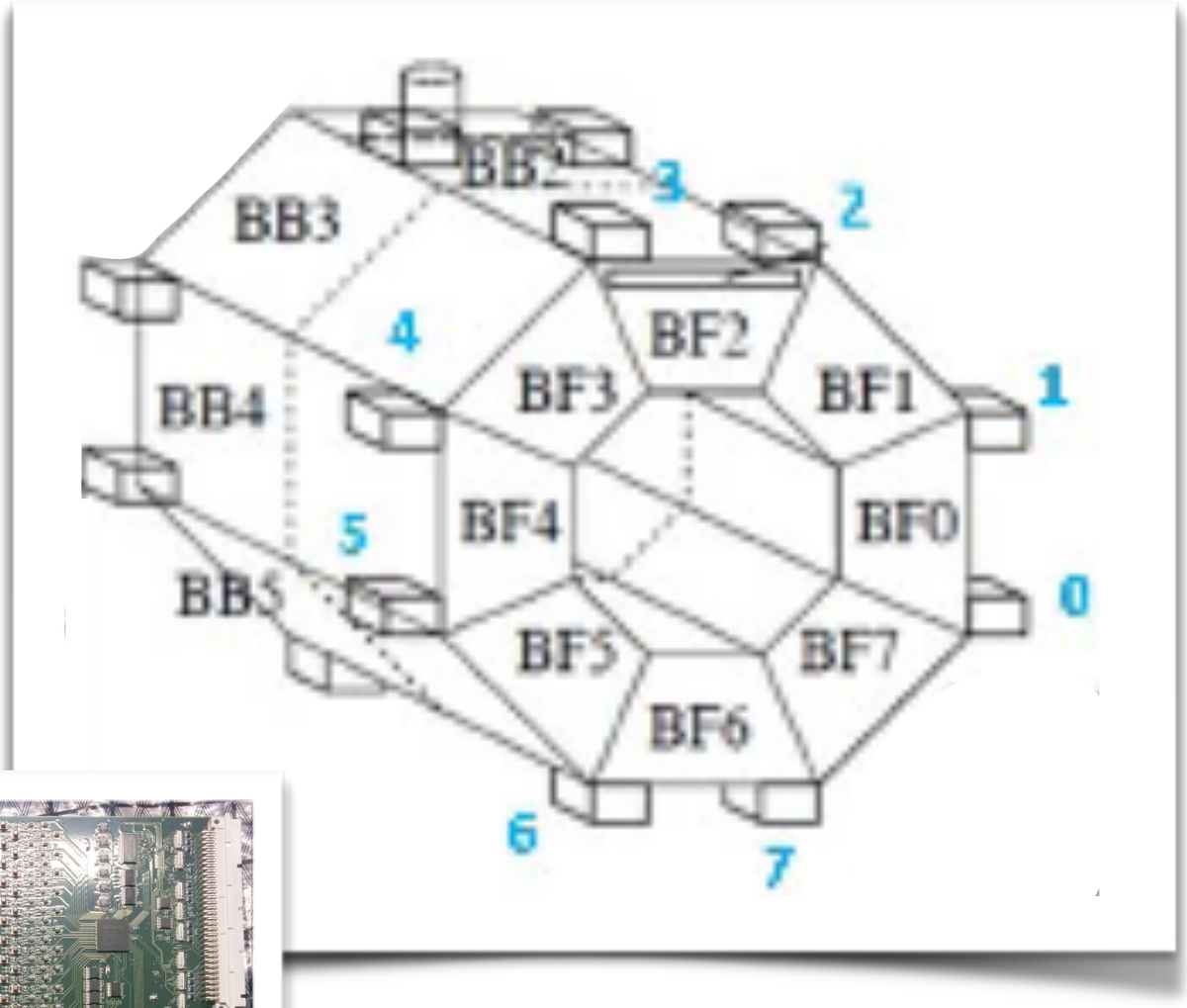
KLM Update

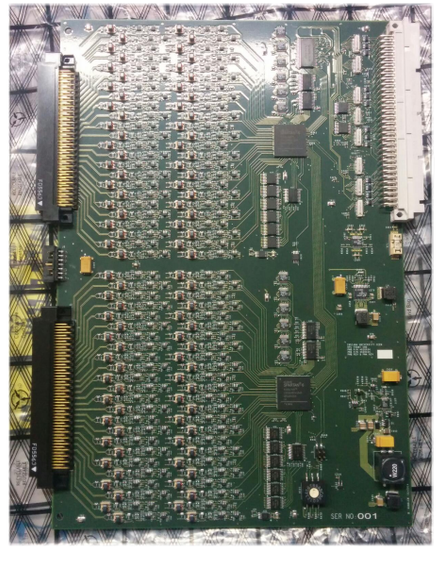
M. Beretta, R. de Sangro, G. Finocchiaro, B. Oberhof, I. Peruzzi, M. Piccolo, A. Russo
INFN - Frascati
P. Branchini, A. Budano, F. Budano, G. De Pietro, E. Graziani, A. Passeri, D. Tagnani
INFN - Roma 3

Meeting Belle II Italia
Pisa - November 20, 2017

KLM RPC front end

- The barrel RPCs FE cards are contained in 16 crates, 8 in the forward and 8 in the backward
  - Total boards: 13*16=**208**
- We placed an order in November 2016 with Artel s.r.l. for the production of **245** boards: 208 + 37 spares





KLM RPC front end

- Test di accettazione a LNF, consegna da parte della ditta direttamente a KEK. Schede ricevute a Frascati:
  - Gennaio 2017: 15 schede (pre-produzione)
  - Aprile: 64 schede (seconda pre-produzione)
  - Giugno: 75 schede
  - Luglio 63 schede
  - Agosto: 31 schede

- Tutte le schede sono state testate, 238 hanno passato il test di accettazione positivamente (95%), alcune dopo piccoli interventi di riparazione, e sono state consegnate a KEK

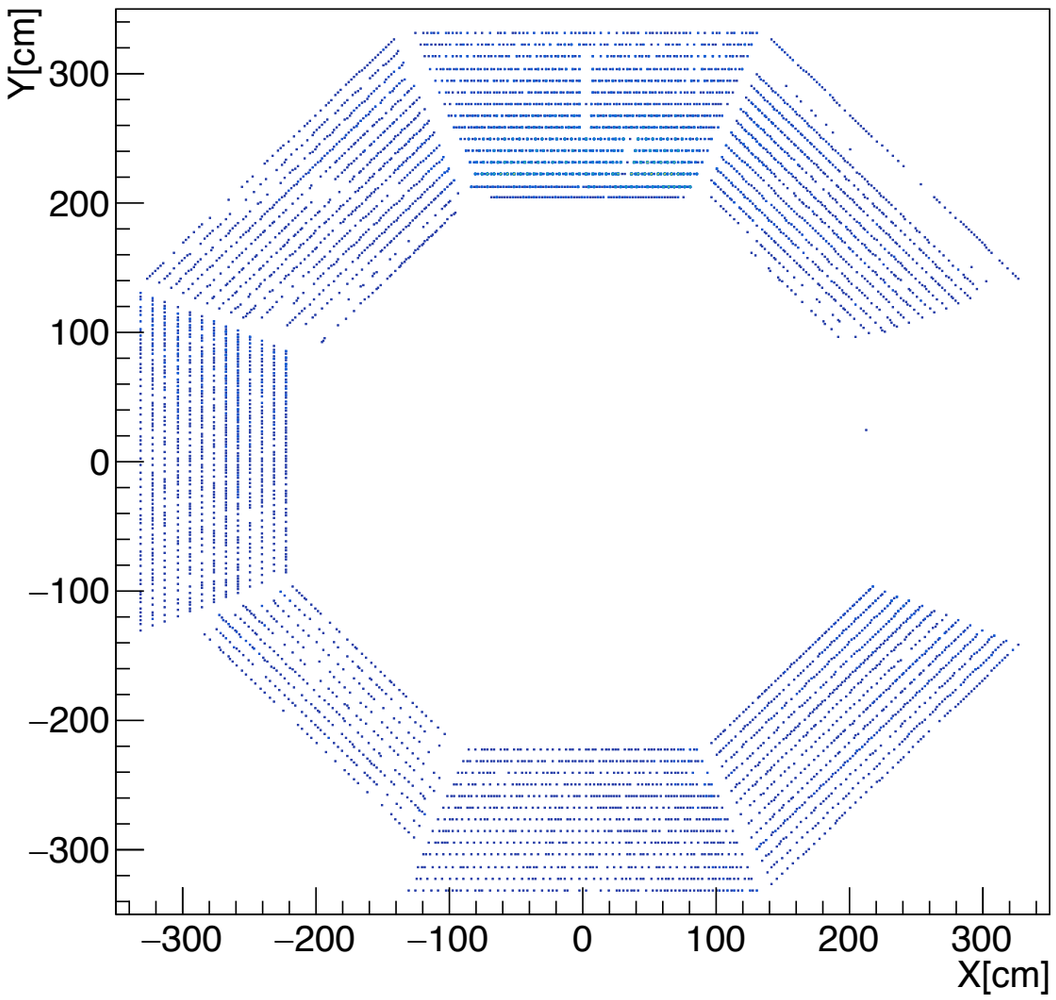
- Le altre sono state trattenute in Italia per ulteriori accertamenti

Test Laboratory @ LNF

KLM RPC front end

Giugno 2017

Installazione del Barrel Forward



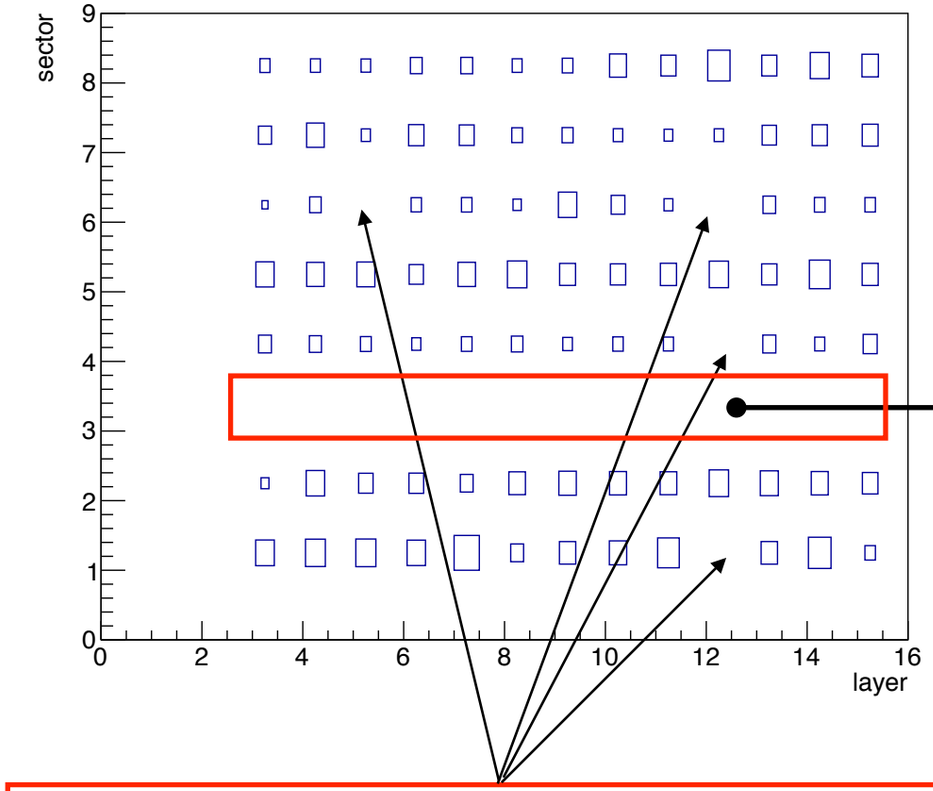
RPC FEE July Installation Report

- 132 tested boards delivered to KEK on July 19th. Needed121 to complete the installation, 11 spares
- All boards installed in crates by July 21st
  - BF5: All boards OK, layer 5 and 12 missing hits → RPC/cable
  - BF0: OK
  - BB0: All boards OK, layer 9 missing hits → RPC/cable
  - BB1: All boards OK, but 13th not installed → **crate problem**
  - BB2: All Boards OK, layer 12 missing hits + layer 4 missing only Phi hits → All RPC/cable
  - BB3: OK
  - BB4: OK
  - BB5: OK
  - BB6: All boards OK, but only boards 1 through 8 installed → **crate problem**
  - BB7: All boards OK, but 13th board not installed → **crate problem**

Plot di occupazione

A fine istallazione, Luglio 2017

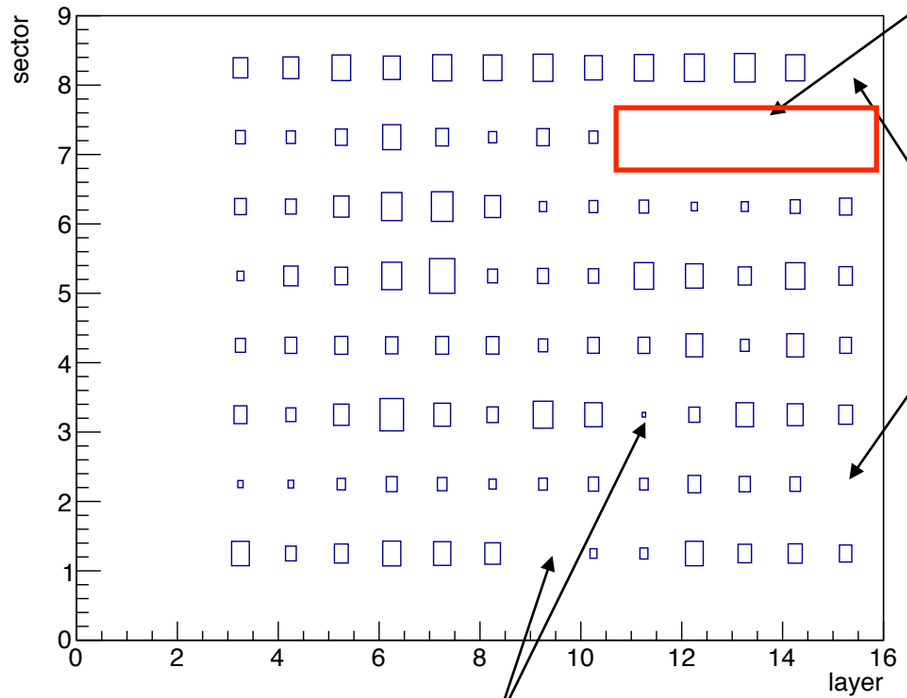
Forward



NB:
BF2 excluded
from DAQ

All “holes” are from tripped RPCs or cable problems

Backward



boards 9 → 13
not installed

13th board not
installed

These “holes” are from tripped RPCs or cable problems

KLM - RPC Front End

- L’installazione si è conclusa a Luglio
  - 16 crate, contenenti ciascuno 13 schede
- La produzione è stata completata in Agosto, con la consegna delle ultime 30 schede, che saranno utilizzate come spares, tutte spedite a KEK

Barrel KLM RPC crates

- In Ottobre abbiamo investigato e individuato la causa del problema riscontrato in 3 su 16 crates contenenti le schede di front end durante l'installazione a luglio

CRATE PROBLEM: BB1, BB6, BB7

- BB1&BB7 were accepting a maximum of 12 FEE boards
- BB6 was even worse: maximum 8 boards
- After countless checks (using different boards, swapping boards, etc…) we were convinced that the **problem was in the crates themselves**
- Accessing (and hopefully solving) the crate problem was the main focus of the Sep/Oct work in Tsukuba Hall
- We brought with us a simple, custom made, connector to be plugged on the VME bus, allowing to measure the +5V and -12 V voltage (but not current) levels
- We soon realized that the issue, for all the crates, was on the **-12 V line**, whose voltage level dropped down to -3.3 V as soon as the problem occurred, almost certainly due to a protection triggered by an exceeded current limit.
- We identified **the 12V Power Supply module**, which has a nominal current limit of **10.2 A**

Barrel KLM RPC crates

- It turned out that, in the 12V PS, there is one **trimmer (max. resistance 500 Ω) used to set the current limit** . Not clear if the miscalibration came with time or it was like this since the start and no one realized (because, as an hypothesis, the old Belle electronics was less demanding in terms of power).

- We measured the power consumption of the FEE boards (not during data taking) on the -12V line and this turned out to be corresponding to ~**170 mA/board, for a total of ~2.2 A, well below the nominal 10.2 A** (DC doesn't induce any load on the -12V line).

- The problem occurred at power ON, when, during initialization, we saw the current going up beyond 4 A and then trigger the protection mechanism

- To restore the full functionality, we had to turn the trimmer on BB1 and BB7 (Diego and Federico managed to complete the operation *in loco*, without removing the crate); on the other hand, it was necessary to replace the trimmer with a 560 Ω resistor on the former BB6 crate (now a working spare)

5

Barrel KLM RPC crates

- This work was presented and the situation discussed at the B2GM KLM parallel session last October

- It was decided to replace all the crates with new ones, remote controlled and switchable
  - Sudan University (X. Wang) will purchase them and install them next summer for the start of the physics run

- PNNL will provide remote-switchable power distribution units from APC to be installed in the crates for Phase 2 to allow at least remote switch on-off capability

KLM Integrazione daq

- Dimostrata capacita' di scrivere i dati degli RPC a 30kHz in standalone

- Dimostrata capacita' di scrivere i dati degli scintillatori a 10 kHz in standalone (last week)

- Contributo italiano in questa fase:
  - G. De Pietro (Roma 3) è a KEK fino al 15/12, aiuterà a scrivere lo slow control del trigger mutuando in parte dal codice esistente dell'ECL
  - M. Beretta (LNF) scriverà una parte del firmware del Data Concentrator per permettere l'aggiornamento in modo automatico e da remoto della flash del DC contenente il FW delle schede di front end degli RPC. Questo sveltirà di molto le operazioni di debug e messa a punto del FW degli RPC

KLM Commissioning

- In corso analisi dei dati dei run di cosmici globali
  - Studio efficienza RPC, con tracce KLM
  - Studio efficienza matching tracce KLM-CDC
- Stiamo cominciando ad interessarci anche a questa parte

Conclusioni

- Abbiamo completato con successo e nei tempi previsti la produzione, installazione e commissioning delle 208 carte di front end per la lettura degli RPC del barrel KLM e relativi spares

- Stiamo attivamente partecipando al commissioning e integrazione del daq di tutto il KLM con importanti contributi su slow control e FW