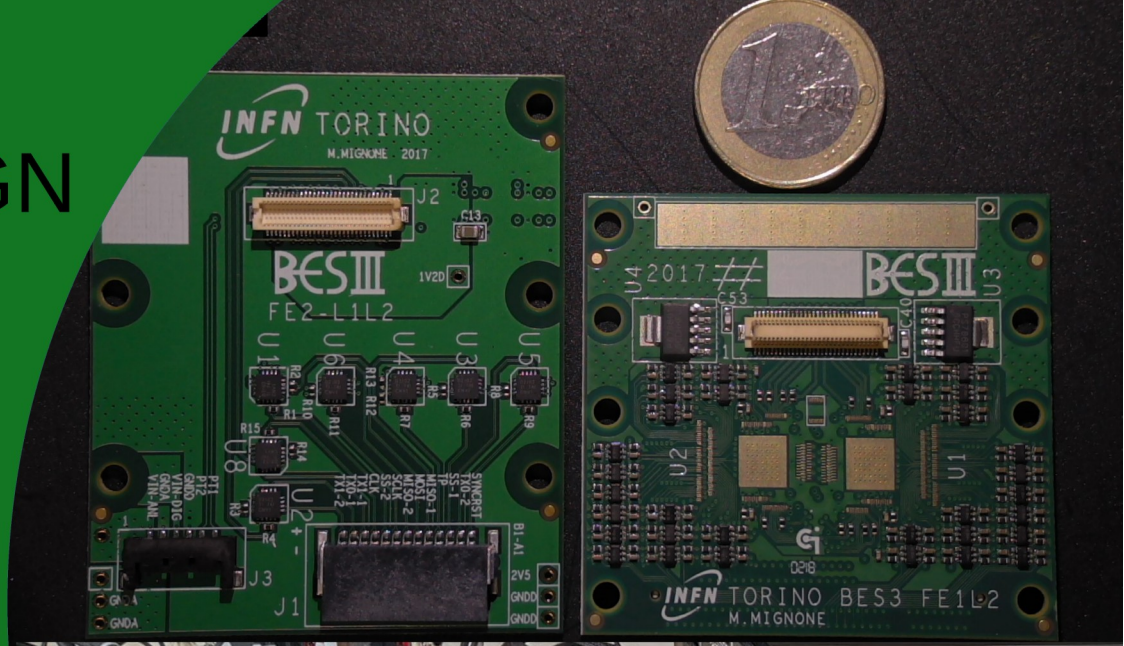
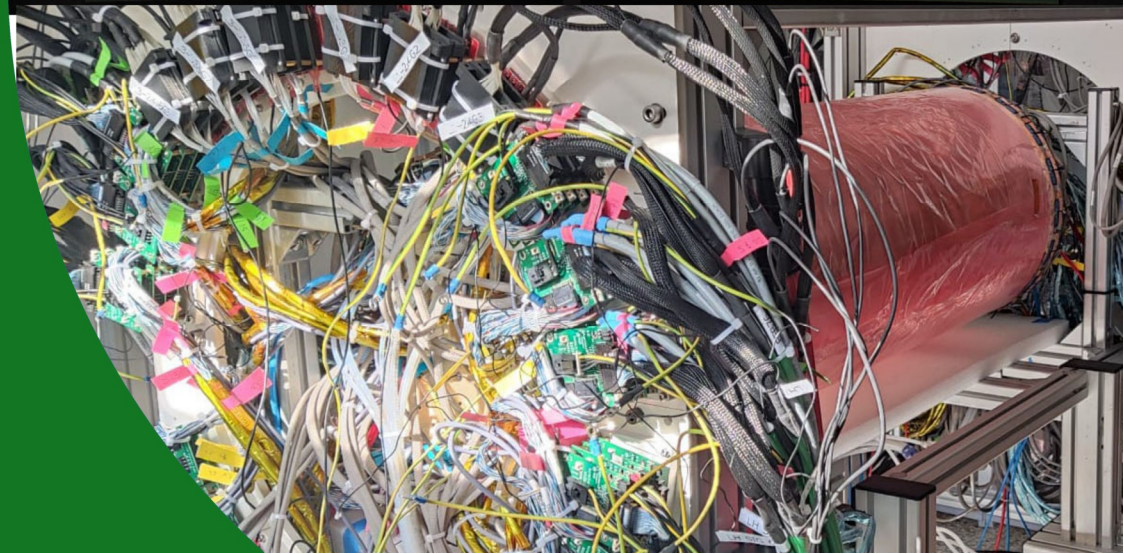
TIGER FRONT END BOARDS - NEW DESIGN





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FCC collaboration meeting -Ferrara - 27/05/2025

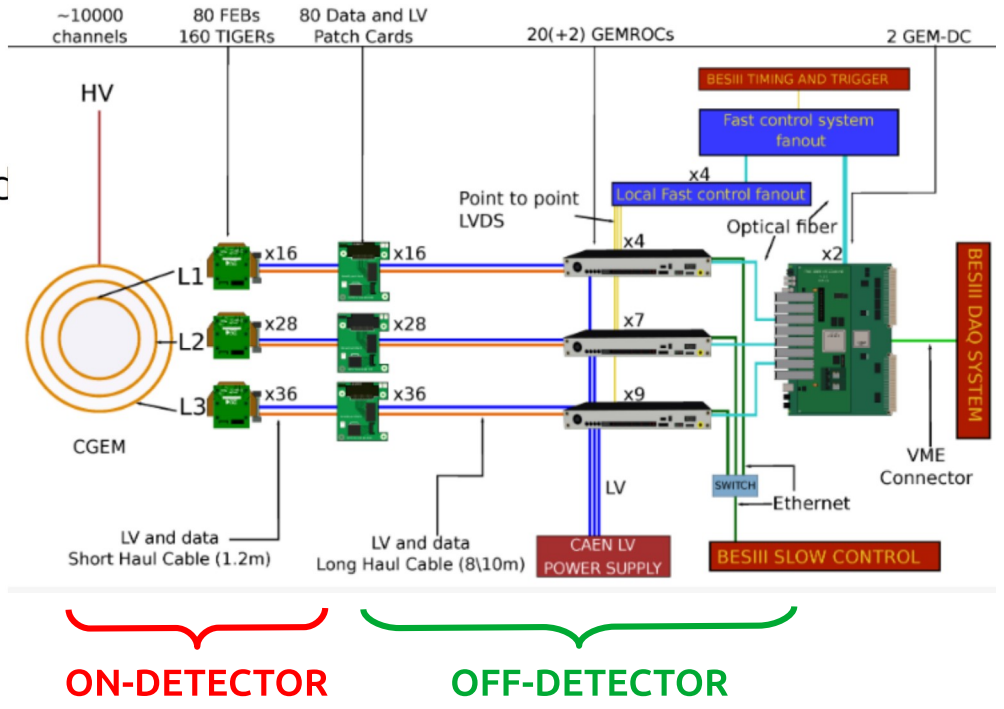
Università degli Studi di Ferrara

OUTLINE:

- TIGER-GEMROC read out
- TIGER integration in BESIII
- FEBs improvement
- Conclusions & outlook

TIGER-GEMROC read out

- The readout chain consists of **ON-detector** and **OFF-Detector** electronics
- The OFF-detector electronics is based on GEM Reac Out Cards (GEMROC) and Data Low Voltage Patch Cards (DLVPC)
- GEMROC is an FPGA based backend module for configuring the ON-detector electronics, powering and managing data flow during acquisition

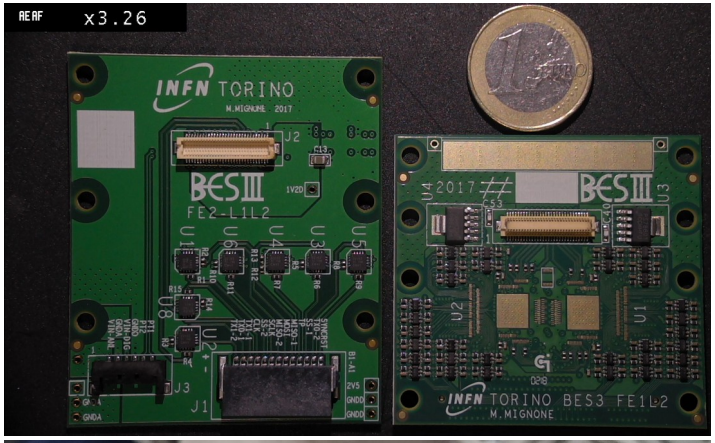


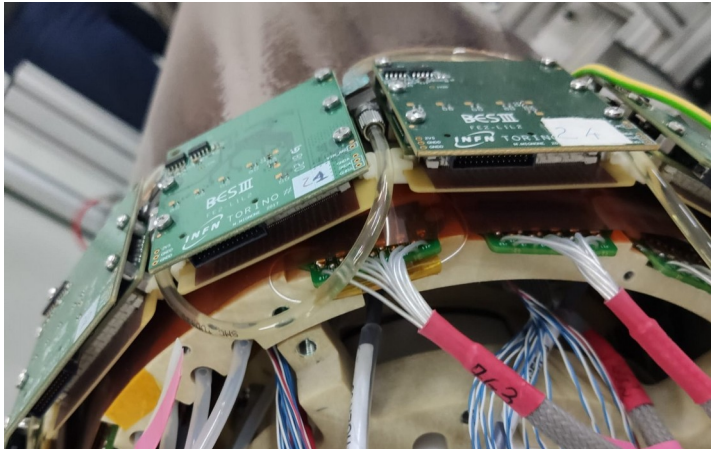
For more details: The CGEM-IT readout chain - A. Amoroso et al 2021 JINST 16 P08065

TIGER-GEMROC read out

- The **ON-Detector** electronics is composed by Front-End-Boards (FEBs). Each FEB host two TIGER ASIC chip
- TIGER (Torino Integrated GEM Electronics for Readout) is a 64-channel mixed signal ASIC capable of performing simultaneous **charge and time measurements**
- Each FEB was calibrated and tested by INFN Turin
- before being installed
- A **cooling system** ensures a constant operating temperature

Photo by M. Mignone





For more details: The CGEM-IT readout chain - A. Amoroso et al 2021 JINST 16 P08065
A mixed-signal ASIC for time and charge measurements with GEM detectors

TIGER-GEMROC software

GUFI – **G**raphical **U**ser **F**rontend **I**nterface → python based software

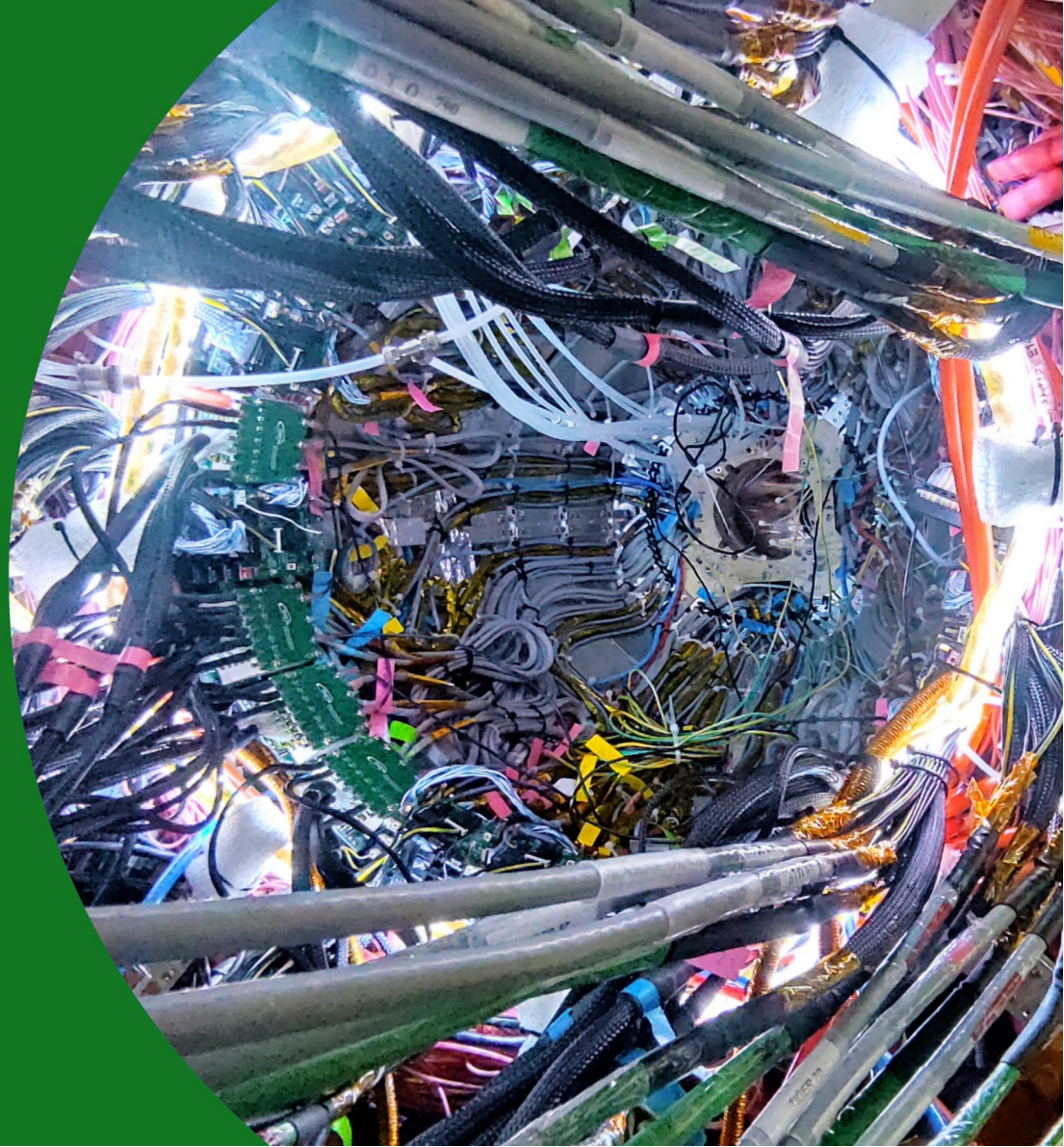
- Interface with GEMROCs and TIGERs
- Manages the data acquisition
- Measures noise rate and other performance
- User-friendly interface (user mode/expert mode)

CIVETTA (**C**omplete **I**nteractive **VE**rsatile **T**est **T**ool **A**nalysis)

- Data sampling
- Decode
- Calibration and mapping
- OFF-LINE analysis

For more details: Deployment of the readout electronics for the BESIII Cylindrical GEM Inner Tracker A. Bortone - 16/11/2021

TIGER integration
&
Identified areas
for improvement



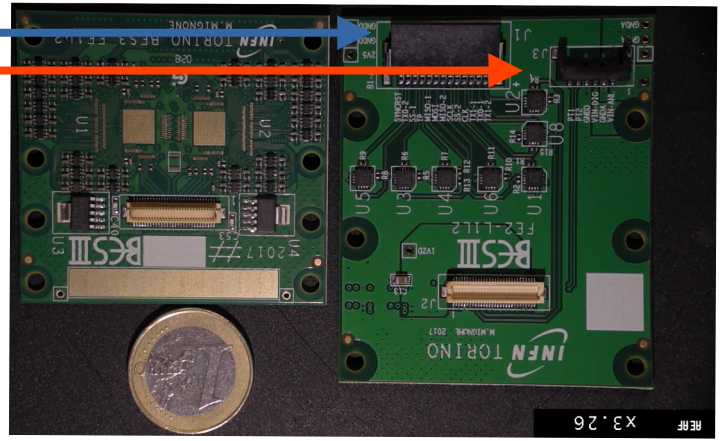
CGEM-IT installation

- In December 2024 the integration of the TIGER electronics was completed
- During operations, several system peculiarities were highlighted
- Extensive research has been conducted to enhance system stability and performance

  → This help us to identify several improvement for our system!

Identified areas for improvement

- **Low voltage** and **data** connectors



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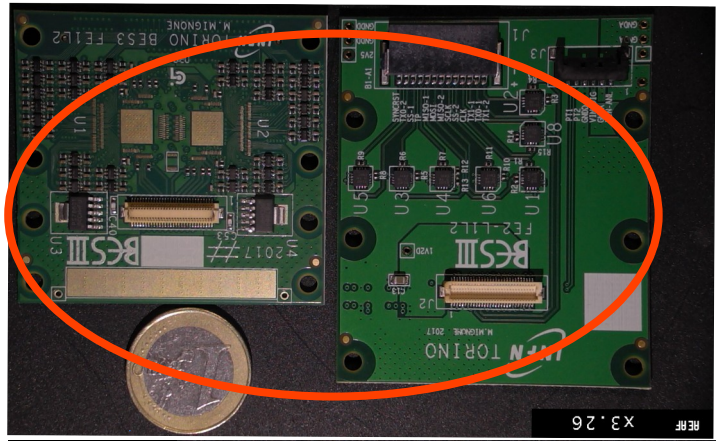
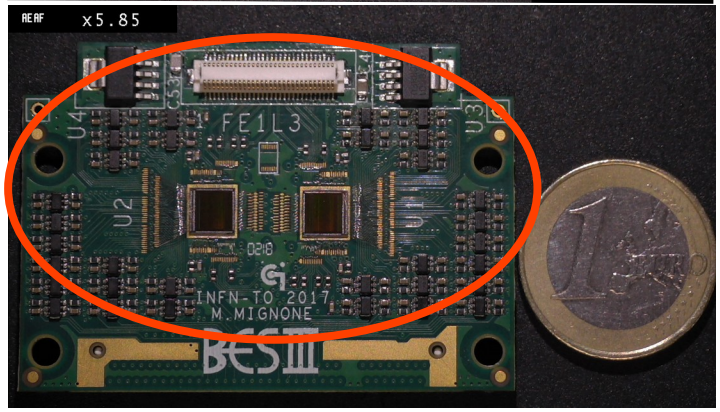
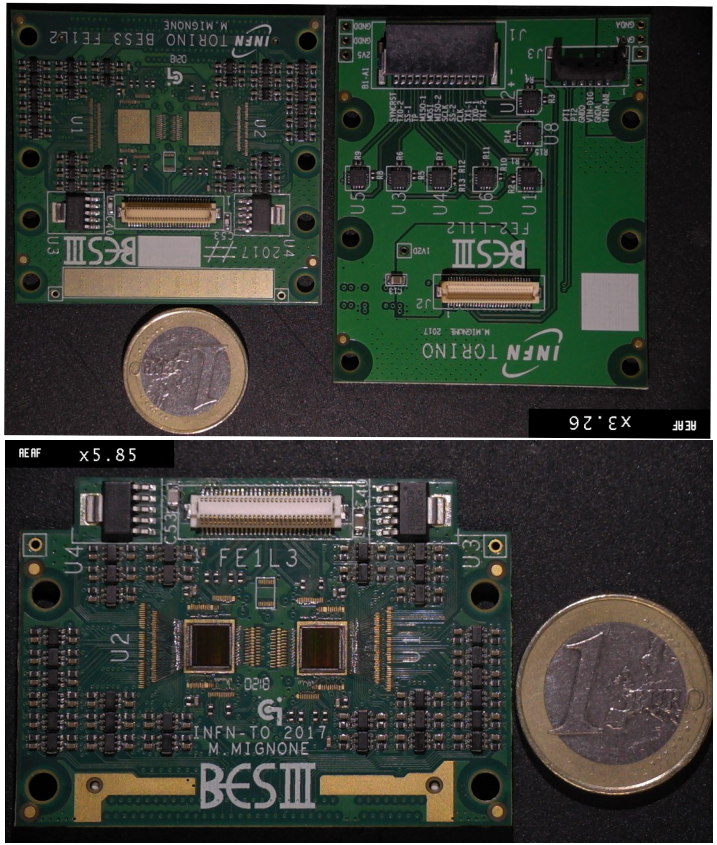


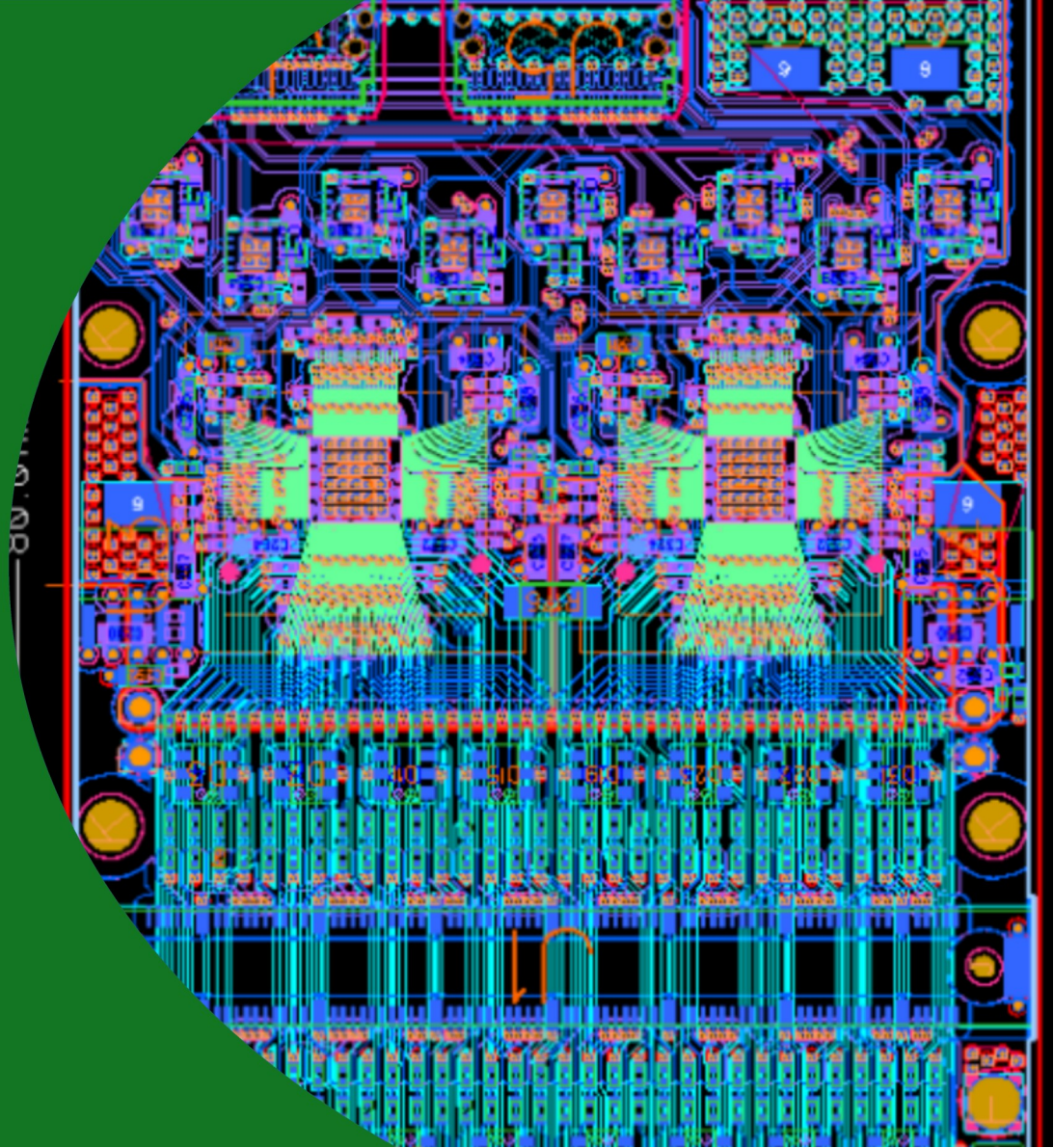


Identified areas for improvement

- **Low voltage** and **data** connectors
- Sub-optimal cable shielding and reliability
- High density of components
  (due to BESIII mechanical constrains and requirements)
- DLVPCs not ideal shield
- Some channels at the connector's edges are noisier than others



Improvements for the readout chain

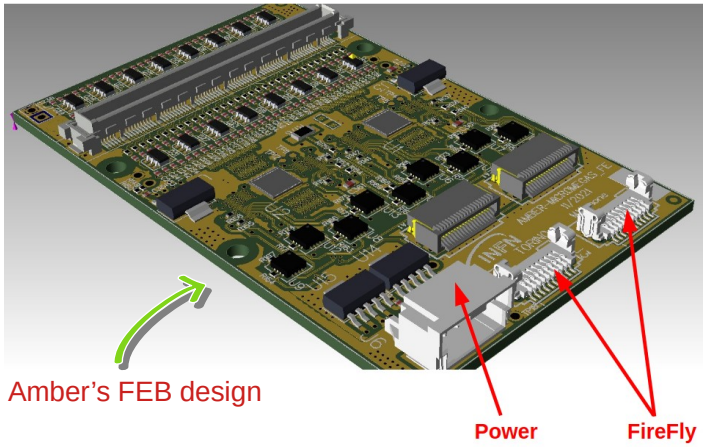


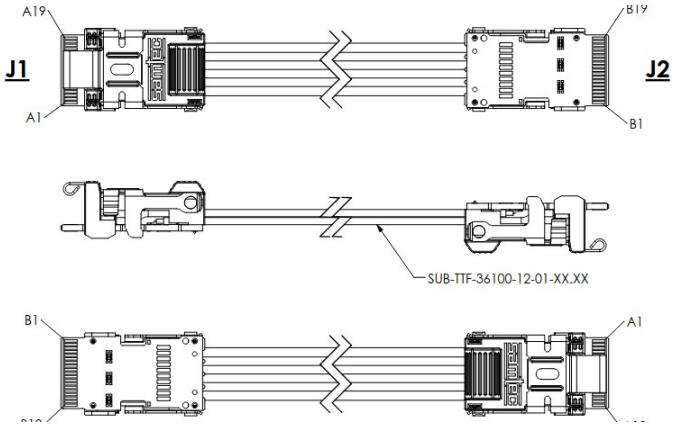
Improvements for the readout chain

- New connector for both low voltage and data

  → FireFly connector has been proposed (strong & reliable)

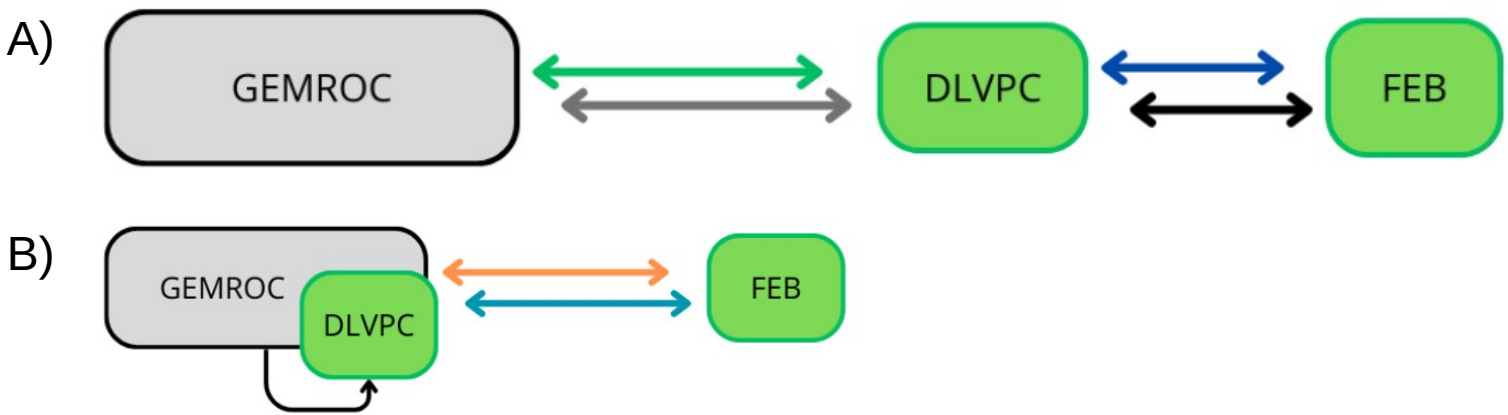
- New FEBs design: from 2PCBs → 1PCB
- New configuration of the protection circuit of TIGER channels (design and definition still ongoing)
- Larger ground connection on the FEBs (APV style)





Improvements for the readout chain

New design of DLVPCs, elimination of Long haul cables, DLVPCs directly connected to GEMROCs → it simplifies the system, allowing for increased **robustness** and **straightforward operation**



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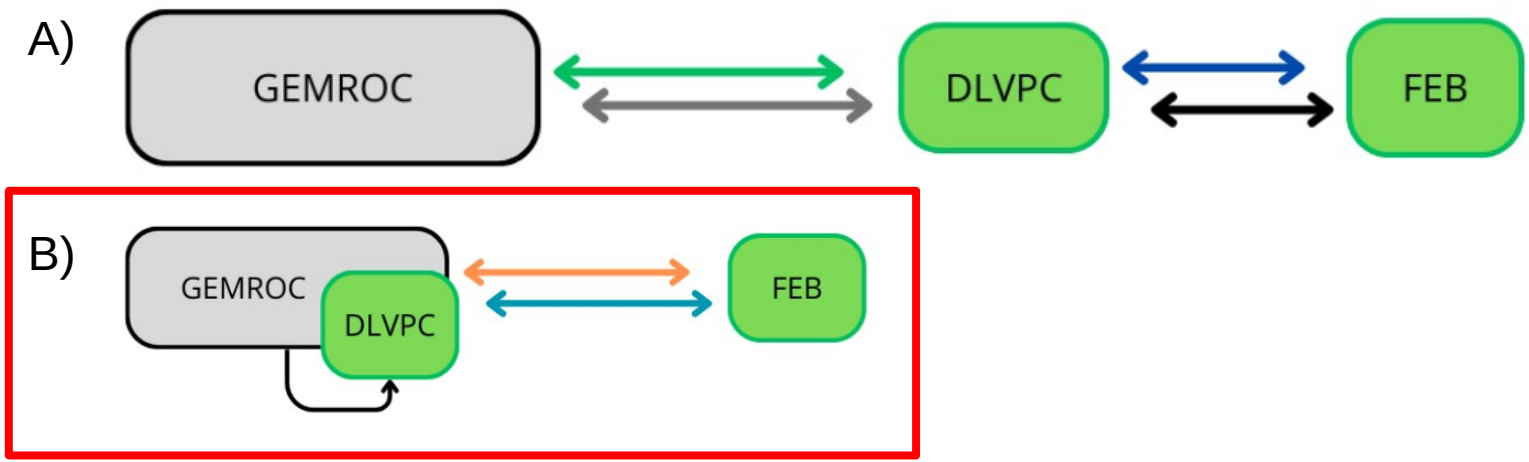

Conclusion & outlook

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- The innovative FEB design is developed to **maximize the potential of the TIGER chip**, unconstrained by the previous mechanical limitations of BESIII
- The new DLVPCs configuration make the system simpler to implement and compact (i.e. elimination of long haul, better ground, etc…)
- The design is still ongoing:

  → FEBs desing, M. Da Rocha Rolo, M. Greco and M. Mignone INFN Torino

  → DLVPCs design, A. Cotta Ramusino INFN Ferrara

Conclusion & outlook

- To test the new FEBs coupled with μ-RWELL a test beam is being planed (November 2025)

  → DUT: 1-D μ-RWELL, TRKs: GEMs, Read out: TIGER/GEMROC

Conclusion & outlook

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→ we will give you update regarding the operation schedule as soon as possible!

THANK YOU FOR YOUR ATTENTION!

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