

# mini Beam-Beam detector

## miniBeBe

Eduardo Moreno Barbosa

*emoreno@fcfm.buap.mx*

Facultad de Ciencias Físico Matemáticas  
Benemérita Universidad Autónoma de Puebla  
México.

By MexNICA collaboration

# MexNica Collaboration



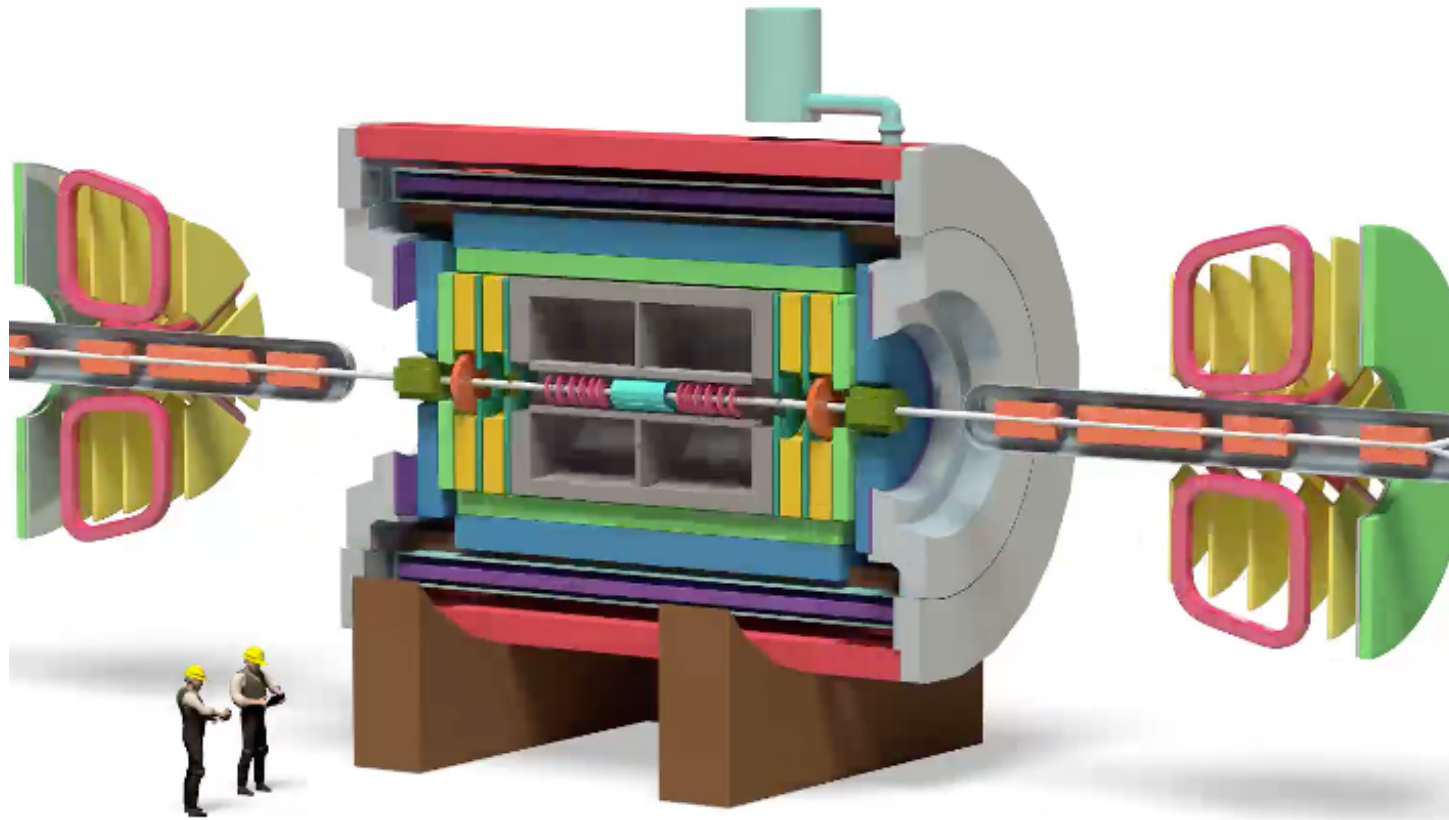
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# NICA MPD

Fast wake up trigger detector

# Introduction

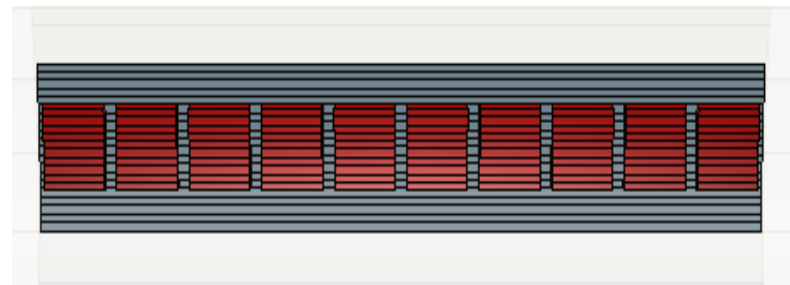
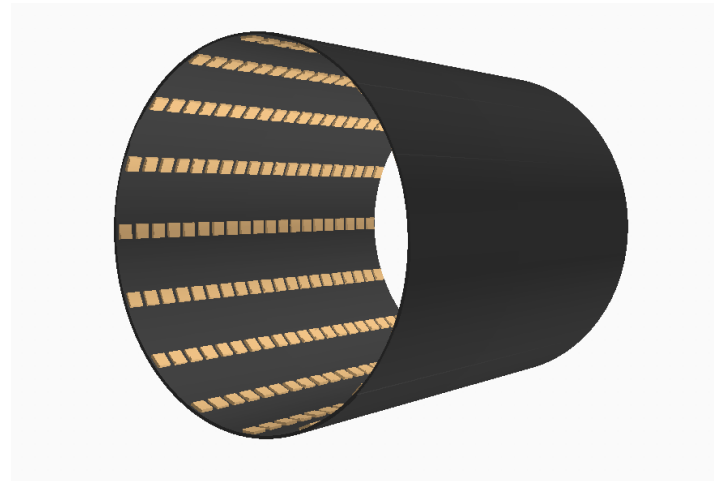
- The miniBeBe detector is a particle counter
- miniBeBe is a detector designed to provide a wake-up trigger signal
- Covers an effective sensitive area of  $1280 \text{ cm}^2$
- Cylinder 60 cm in length (possibility in increase to 100 cm)
- Inner diameter is 22 cm, outer diameter is 26 cm
- The range is from low to high multiplicities.

# Technical characteristics

- Time resolution of 30 ps.
- Silicon Photomultiplier (SiPM) of high speed
- Digital signal for trigger to other systems

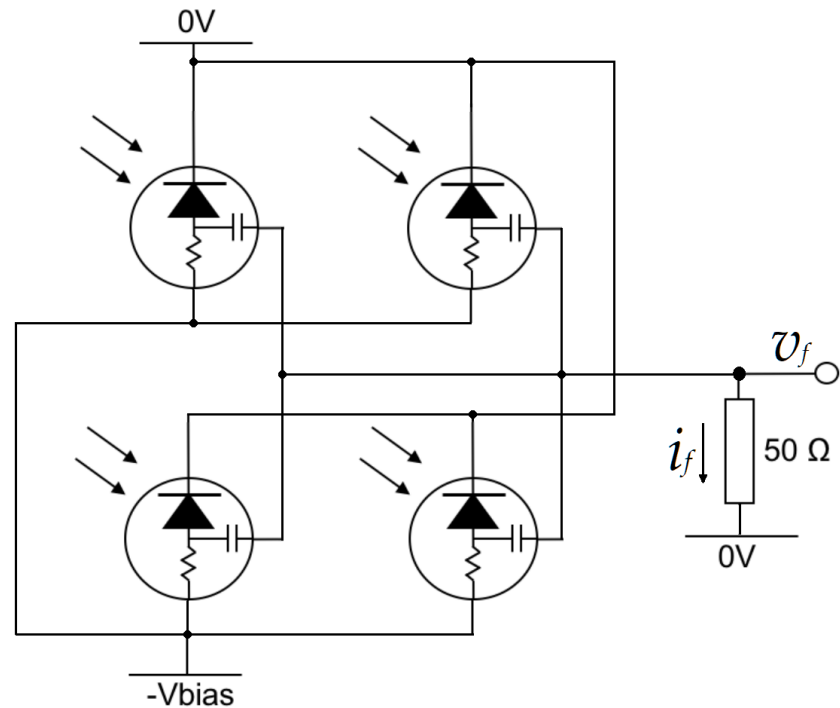
# mini beam-beam detector

- 16 strips of sensors
- 20 cells per strip
- One trigger per cell
- Each cell has:
  - 1 BC422 Scintillator of  $20 \times 20 \times 3 \text{ mm}^3$
  - 4  $6 \times 6 \text{ mm}^2$  SiPM's

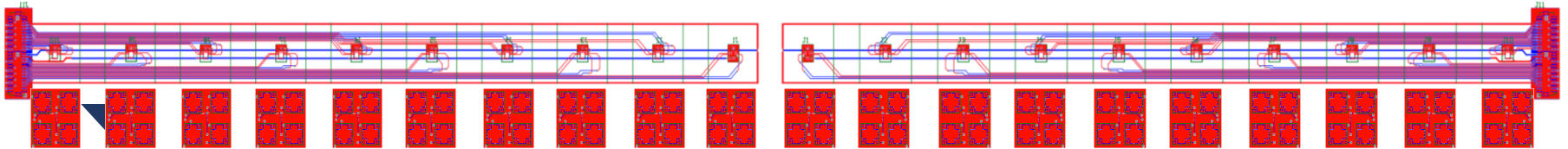


# Front end electronic

- Array 2 X 2 of SiPM
- photo detection efficiency maximized
- Fast trigger signal
  - Improve the response in time
- Analog comparator HMC674



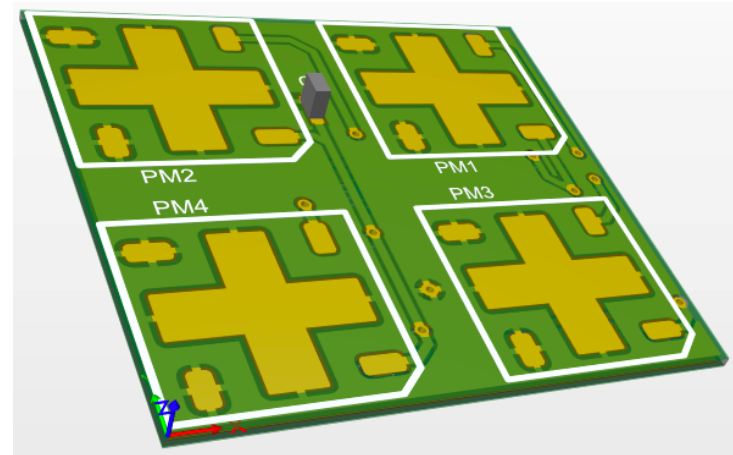
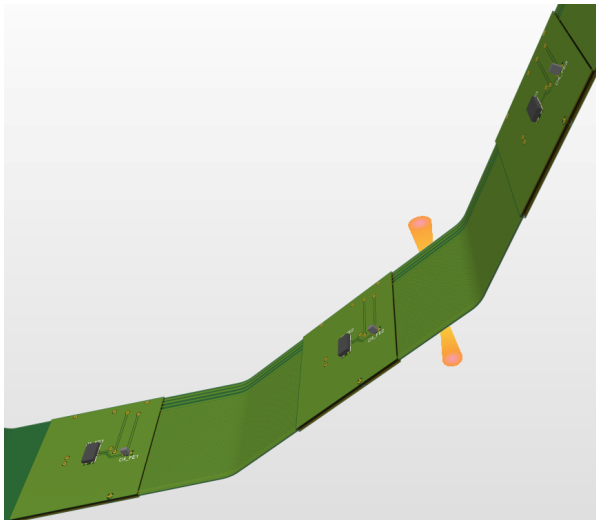
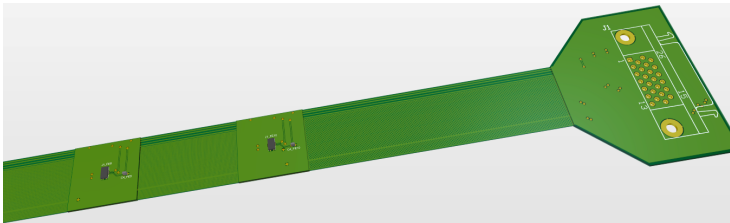
# Front end electronic



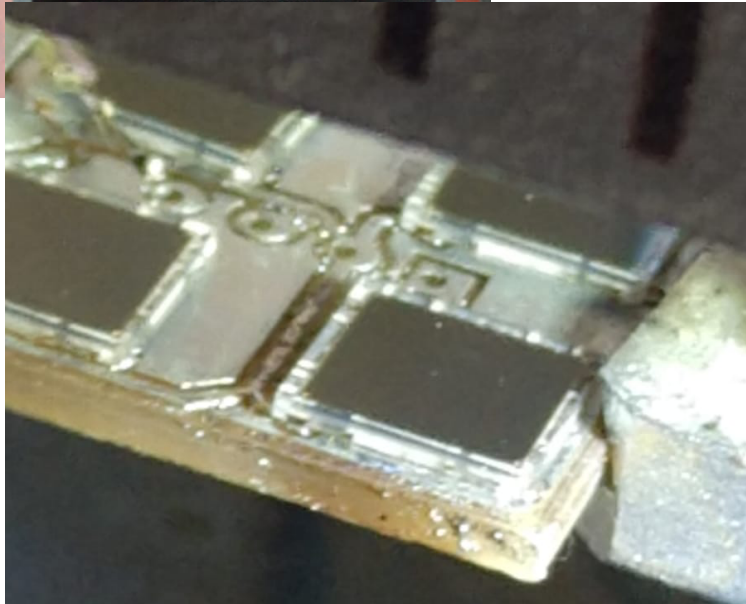
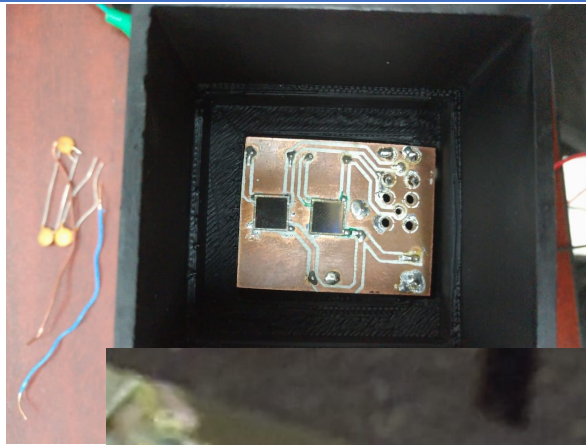
- The logic voltage level for the trigger signal is a positive *emitter-coupled logic*
- Flame Retardant FR4 material
- Each FE card is attached to a ribbon Rigid-Flex
- Flexible PCB Backplane (minimize material)



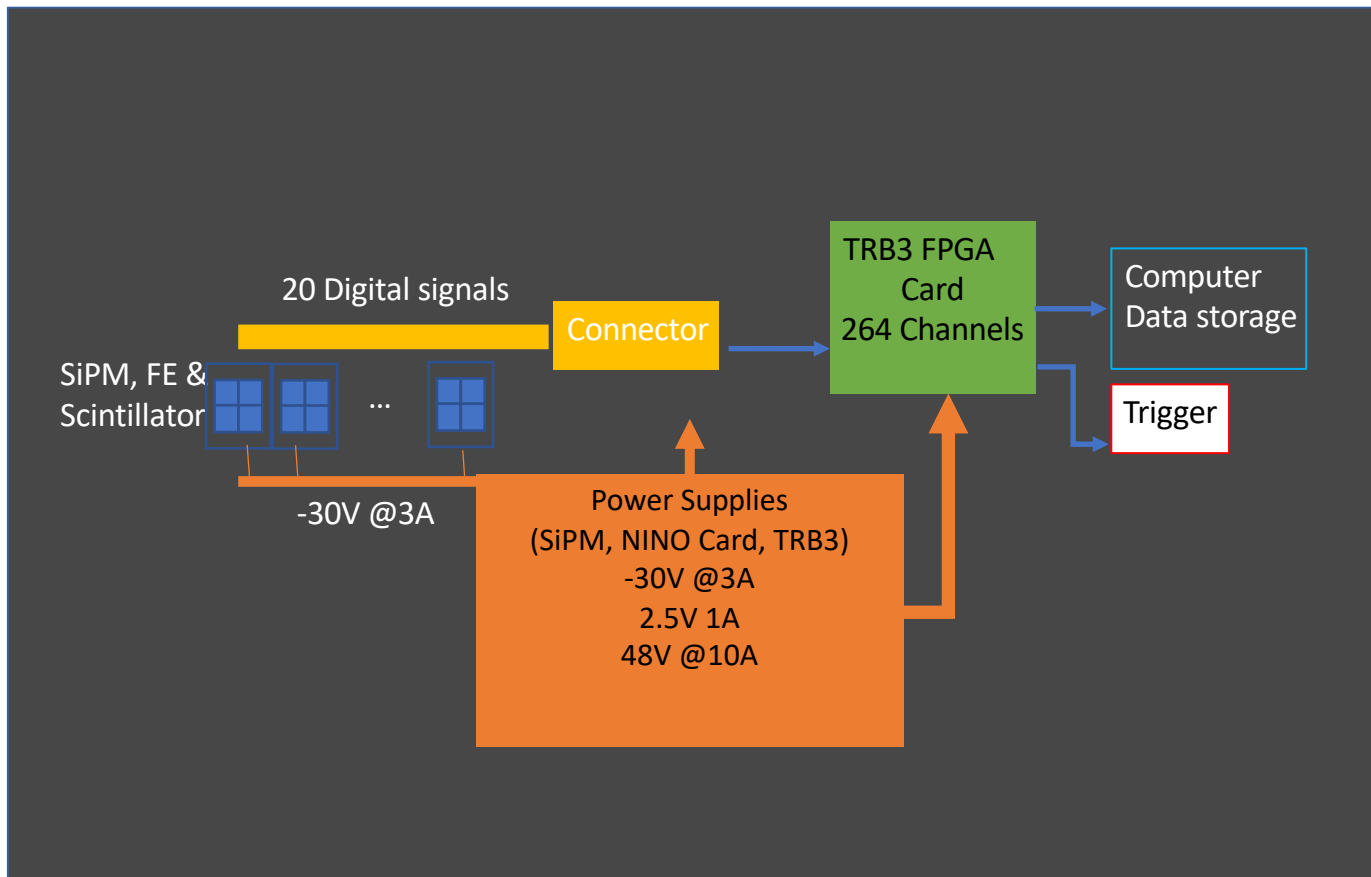
# Front end electronic



# Test of first Front end electronic



# Trigger generation



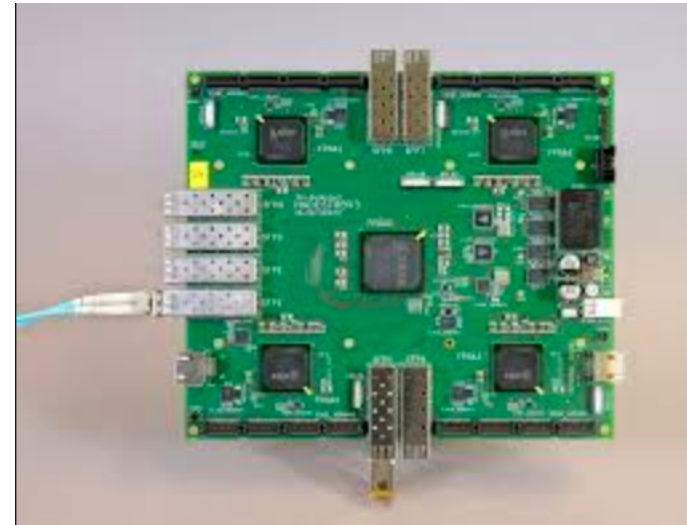
# TRB3 Platform

- TRB platform Trigger and Readout Board
- TDC channels ..... 260
- Max hit rate ..... 50 MHz
- Connectivity ..... 95 Mbytes
- TRB Network for internal communication
- Direct GbE connection for data and slow control; no CPU on board, all implemented in FPGA
- Usable for large system as well as stand alone system: just 48V and GbE are needed to take data
- Can be used as a pure digital board, for example as a data/trigger hub
- Applications: The time information encoded in the discriminated detector signal can be measured with FPGA-TDCs: Leading edge and pulse width

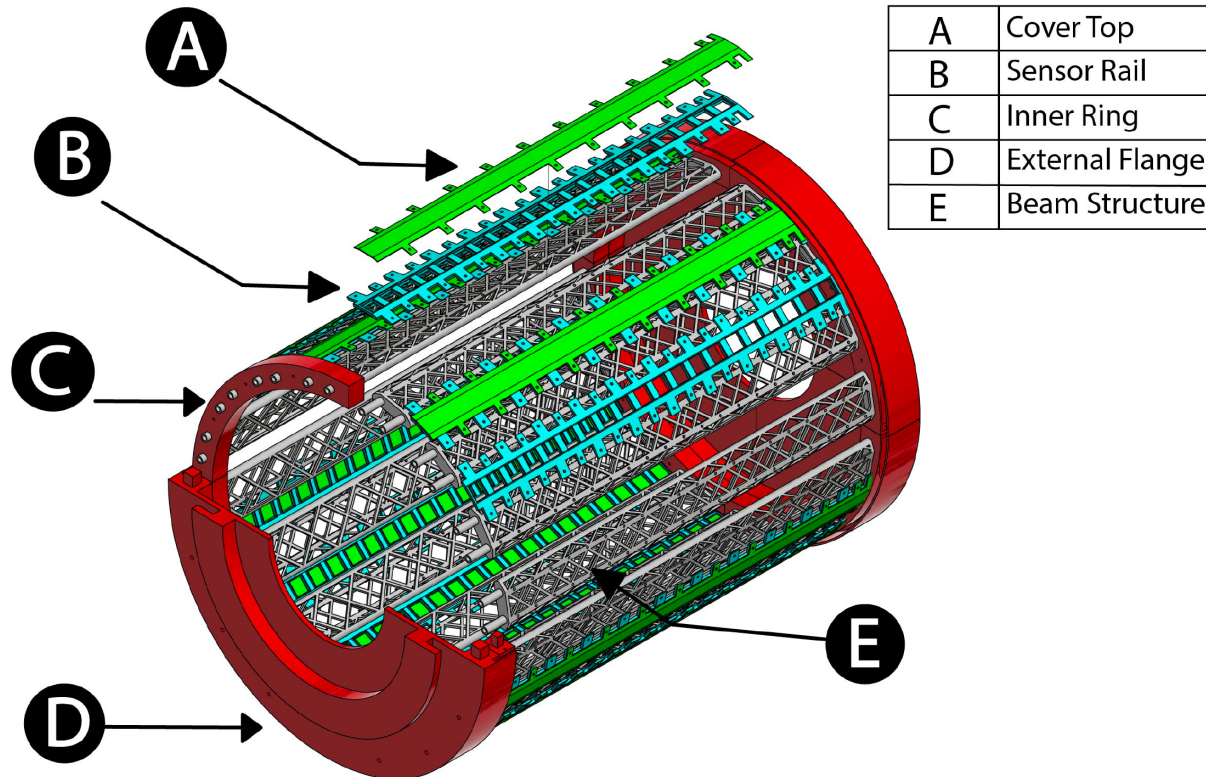


# GbE connectivity

- TRB3 Designed to be used as
  - Stand-alone measurement device
  - Part of a complex system
- Different communication solutions
  - Based on 3.2 GB ps optical links
  - Links configured by groups of 4
  - Managed by central FPGA
  - Transmission of collected data
  - Board or Whole system control



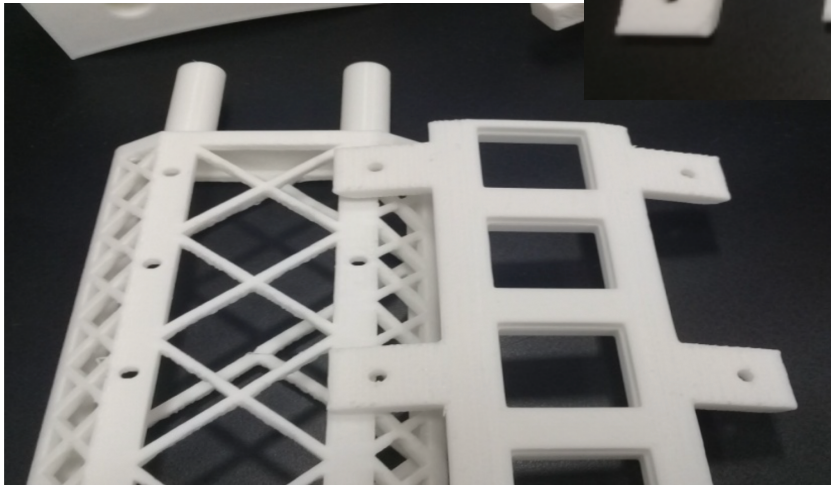
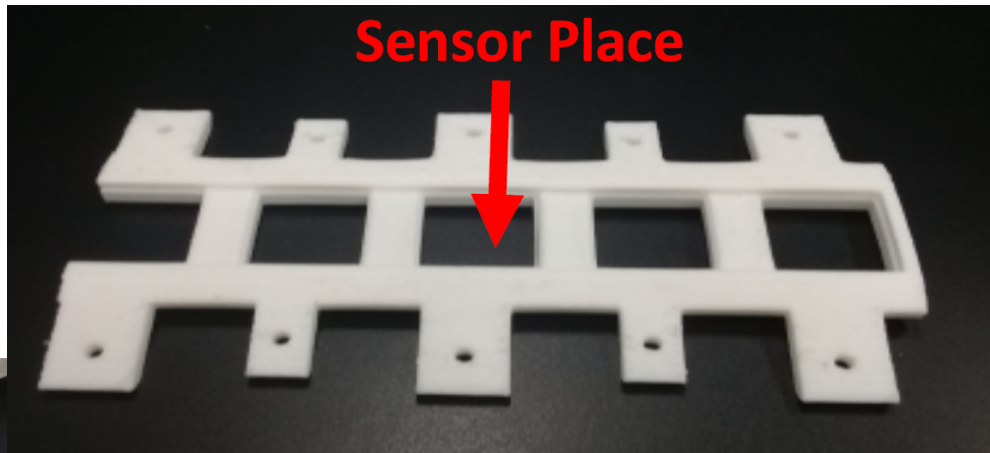
# Mechanical structure



# Mechanical structure

- Carbon fiber material.
- Skeleton based on CERN ITS design.
- Stripe sensor supported on pyramidal structure.
- Current work on structural strength.
- 3D printing is in progress for prototyping

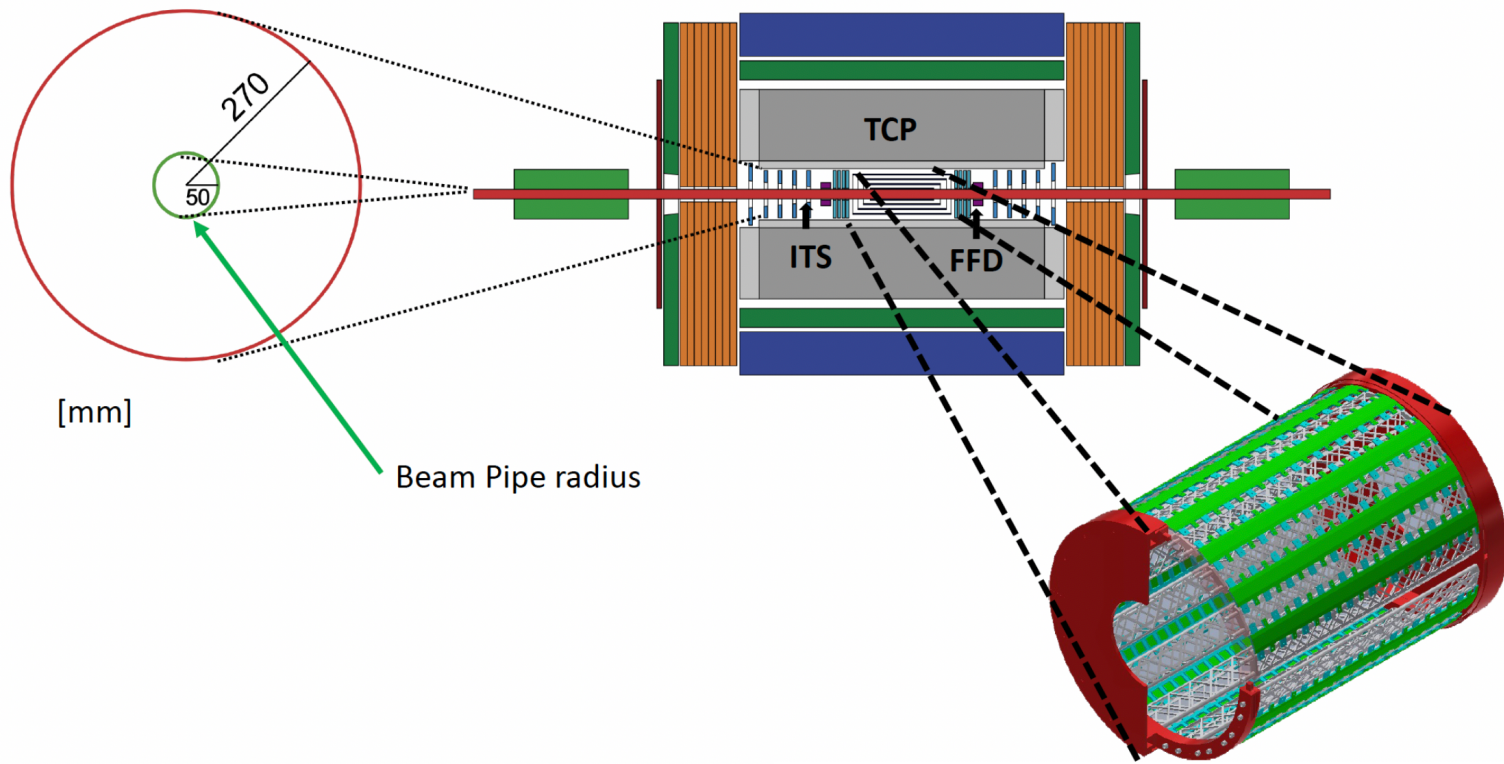
# Models 3D





# Mechanical structure

## LOCATION OF THE MBB DETECTOR



# Status

- Final design of FE and ribbon Rigid-Flex
- Test of the front end electronics (1, 2 & 3 SiPM)
- Test of digital trigger of a one cell
- Model of the first proposal of mechanical design
- First printed 3-d model of support

# Future work

- Test of FE + scintillator + PCB under radiation conditions.
- Tests with the front end for time resolution estimation.
- Construction of the triggering circuit for a single strip and full triggering system.
- Front-end interconnection with TRB3 for processing
- Mechanical structure construction for prototyping.

Thanks

Questions?

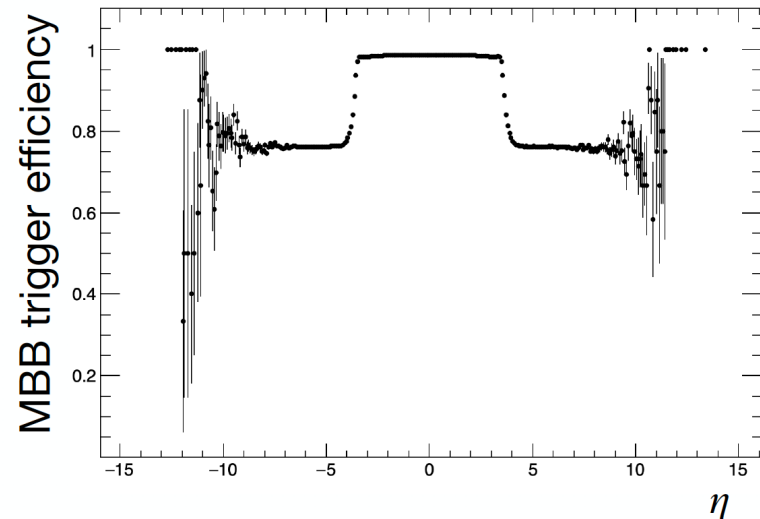
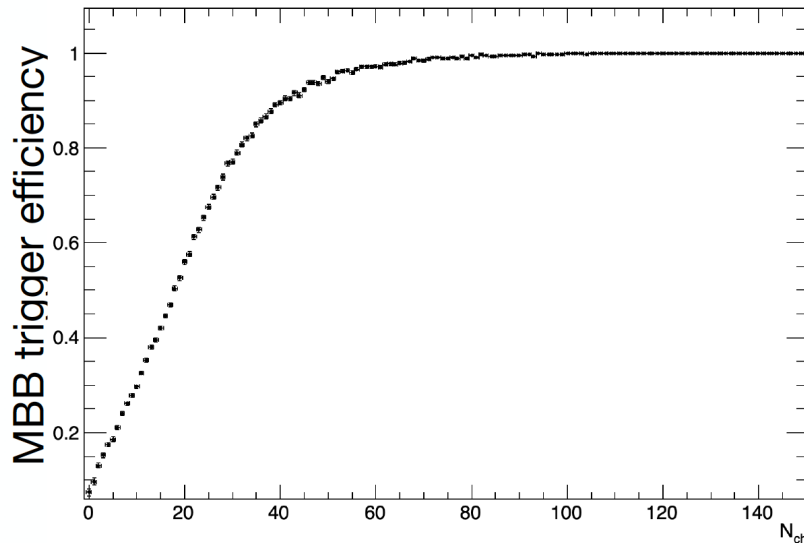


Backup slides

# miniBeBe efficiency

Trigger definition: at least one hit in MBB (like Minimum Bias)

## Monte Carlo study: Beam-gas



MBB detector is 100% efficiency within its acceptance.

The MBB trigger inefficiency is not 100% for low multiplicity events for forward events (not in MBB acceptance)

# Voltage levels

Parameter	Symbol	Min	Typ	Max	Units
High Level	$V_{OH}$	1.03	1.09	1.14	V
Low Level	$V_{OL}$	0.65	0.71	0.81	V
Differential Swing		440	760	980	mV p-p

# Power supply requirements

Parameter	Symbol	Min	Typ	Max	Units
1 SFED voltage	$V_{SFED}$	27.5	29	30	V
1 SFED current	$I_{SFED}$	80	100	120	mA
1 Analog comparator Power consumption		-	140	-	mW
1 Analog comparator Voltage	$V_{ACOMP}$	-3.3	-	3.3	V
TRB3 Voltage	$V_{TRF3}$	-	48	-	V
TRB3 current	$I_{TRF3}$	-	10	-	A