19.04.2022 TB
BeamKiller and FI readout for AMBER

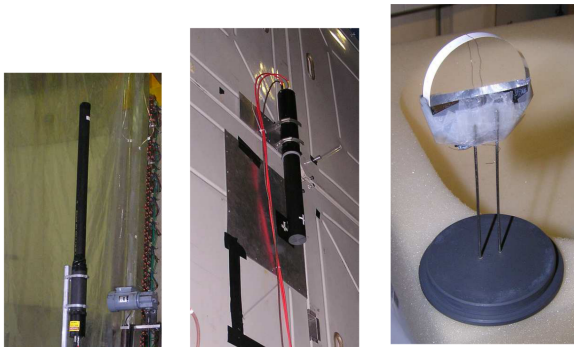Benjamin Moritz Veit

19.04.2022

Beamkiller Setup 2009

Figure 30: Beam killer detectors and beam counter. Left: BK1 at $z_1 = +15$ m. Middle: BK2 at $z_2 = +33$ m, attached to the electromagnetic calorimeter ECAL2. Right: Scintillator disc of the beam counter with holding structure. The disk is surrounded on one half with aluminised mylar to reflect the scintillator light in direction of the photomultiplier tube.

J. Bernhard , Exclusive vector meson production in pp collisions at the COMPASS experiment, Universität Mainz, January, 2014

Requirements for 2022 $\bar{p}$-measurement

- General setup as for 2009 → BK1@≈25 m(SM2) BK2@≈33 m(ECAL2)
- Beam intensity 10^5 - $5 \cdot 10^5$ Hz
- Unprescaled COMPASS DAQ (max trigger rate ≈35 kHz)
- Different beam momenta: 60/100/140/190/230/280 GeV/c

  → If magnet currents not adapted different beam positions:
  BK1
  280 GeV/c at X=55 mm
  60 GeV/c at X=251 mm

  BK2
  280 GeV/c at X= 100 mm
 60 GeV/c at X=473 mm

To minimize setup time for test measurements BK has to be motorized and remote controllable!

BeamKiller1

- Old motor control not working and not remote!
  → **Replacing against closed loop stepper controlled by duet3D board** (integration in DCS)
- Exchange of broken end-stops needed
- Having online position read-out - under investigation.
- Placed on concrete blocks downstream of SM2/FI07
- Travel in X: ≈1300mm
- Travel in Y: ≈700mm
- 30 mm scintillator disc
- 9813kb active base read-out (Max ≈1 MHz)

BeamKiller2
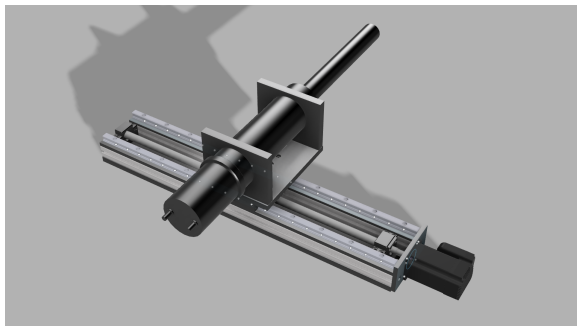
- New mechanical structure fixed on ECAL2 structure
  $\rightarrow$ 550 mm travel in X (fixed in Y)
- closed loop stepper controlled by duet3D board
  (integration in DCS)
- 35mm scintillator disc (5mm thick)
- 9813kb active base read-out (Max rate $\approx$1 MHz)

# Requirements for PRM Test 2022

Test of UTS tracker station!

- Performance: timing, efficiencies, combination of SciFi and Silicon information!
- Close as possible beam conditions of final measurement
- 2 Mhz focused Muon beam
- Need of sandwich of tracking detectors around DUT
- Two proposed positions:
    - **Upstream of COMPASS Target**
      →Fi01 + Fi02 full readout
    - **Downstream of SM2**
      →Fl07+08 (central part)
- Readout with AMBER FriDAQ (streaming)

ReadOut Strategy

Full parallel parasitic read-out of SciFi detectors!
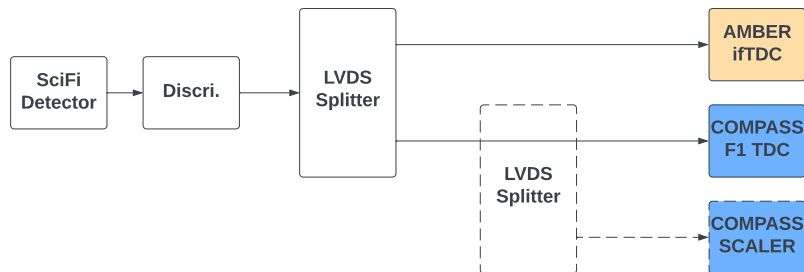
Allows parallel readout of detectors for COMPASS and AMBER!

Hardware Requirements

- **Target Position (Full readout ($39 mm^2$))**

| Station	Active Area /cm	# of detectors	#Stripes	channels	Resolution	σ_t
SciFi01	3.9×3.9	X, Y	192	96/96	130μm	0.4 r
SciFi02	3.9×3.9	X, Y	192	96/96	130μm	0.4 r

  - **LVDS Splitter: 12/12 (3 to be modified)**
  - **ifTDC: 6/6**
  - **2m LVDS cable 9/24**

- **SM2 Position (48channel per detector ($28 mm^2$))**

Station	Active Area /cm	# of detectors	#Stripes	channels	Resolution	σ_t
SciFi07	10.0×10.0	X, Y	286	143/143	210μm	0.4 r
SciFi08	12.3×12.3	X, Y	352	176/176	210μm	0.4 r

  - **LVDS Splitter: 20/20**
  - **ifTDC: 10/10**
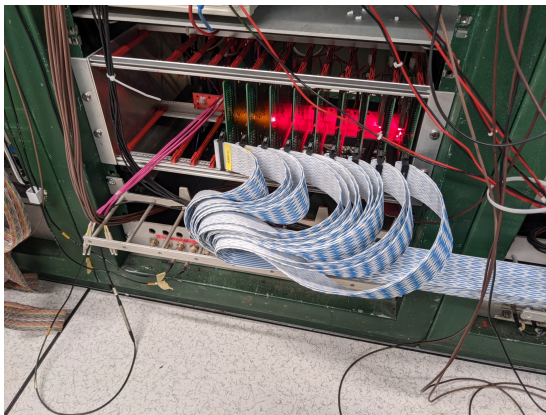 - **2m LVDS cable 9/20**

Infrastructure
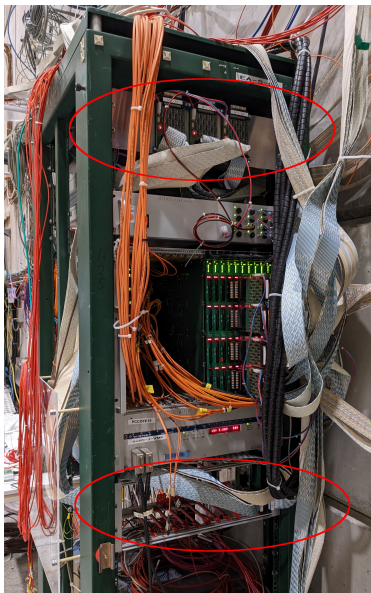
- 192 duplex Fibers are available at Target/SM2/ECAL2
- Target Position:
    - Installation of 3x Splitter + 2x ifTDC and crate done and tested (FI01X)
- SM2 Position:
    - SM2 position and ECAL2 positions would have to be equipped with ifTDC infrastructure!
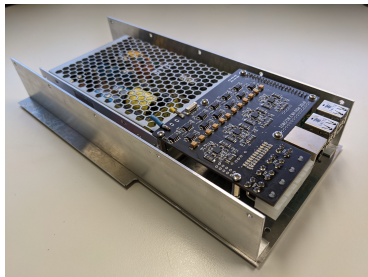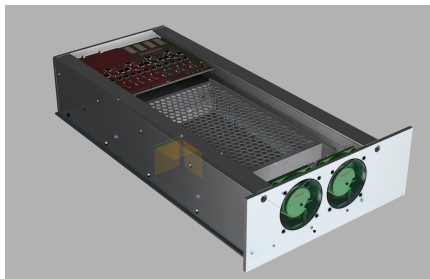
ifTDC Crate

ifTDC Crate for 12 cards and provide power via backplane was developed!

3 available, 1 installed with 9 ifTDCs in Trigger barrack.

(Number of ifTDCs has to be reduced if needed for Fi (14 in total available))

ifTDC Crate Controller

- Crate controller for ifTDC crates
- 210 W 5V power supply
- 12 switchable channels 2.5A each (Voltage,Current,State)
- Controlled via raspberry PI
- RPi as Xilinx JTAG controller

  Software development part of summer student project for AMBER!