

Overview of November 2022 test beam TORCH meeting

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Introduction

- I hope to give everybody an insight to what happened during the November 2022 test beam
- General message: Very successful test beam, thanks to the hard work by everyone in TORCH
- More detailed talks later

Timeline

Start: 31st October 2022
End: 28th November 2022



PS: November 2022

schedule issue date: 12-Oct-2022

Version: 3.0.0

We did it!

Start of test beam: Setup and preparations

TORCH November 2022 test beam summary:
Lots of hard work, head scratching and satisfaction!

- Week 1: Setup
 - Preparation of T9 zone
 - Setup of T1 and T2 timing stations
 - Proto-TORCH installation
 - Telescope installation

Some wise words

“Test beam builds character”

– Thierry Gys

Start of test beam: Setup and preparations



East Area test beam hall

Start of test beam: Setup and preparations



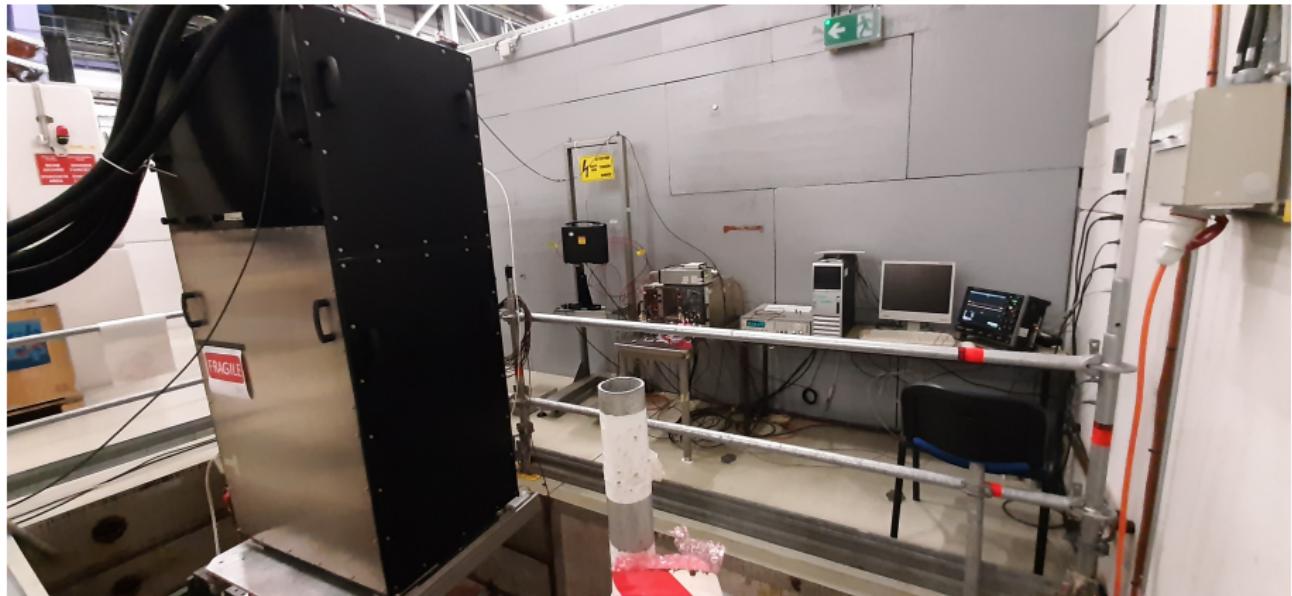
Background: Hole where concrete blocks were removed to fit TORCH
Foreground: Beam telescope

Start of test beam: Setup and preparations



Final setup of T1 timing station, with F1 finger, two crossed scintillators, CFD (Const Fraction Discriminator) and NIM crate.

Start of test beam: Setup and preparations



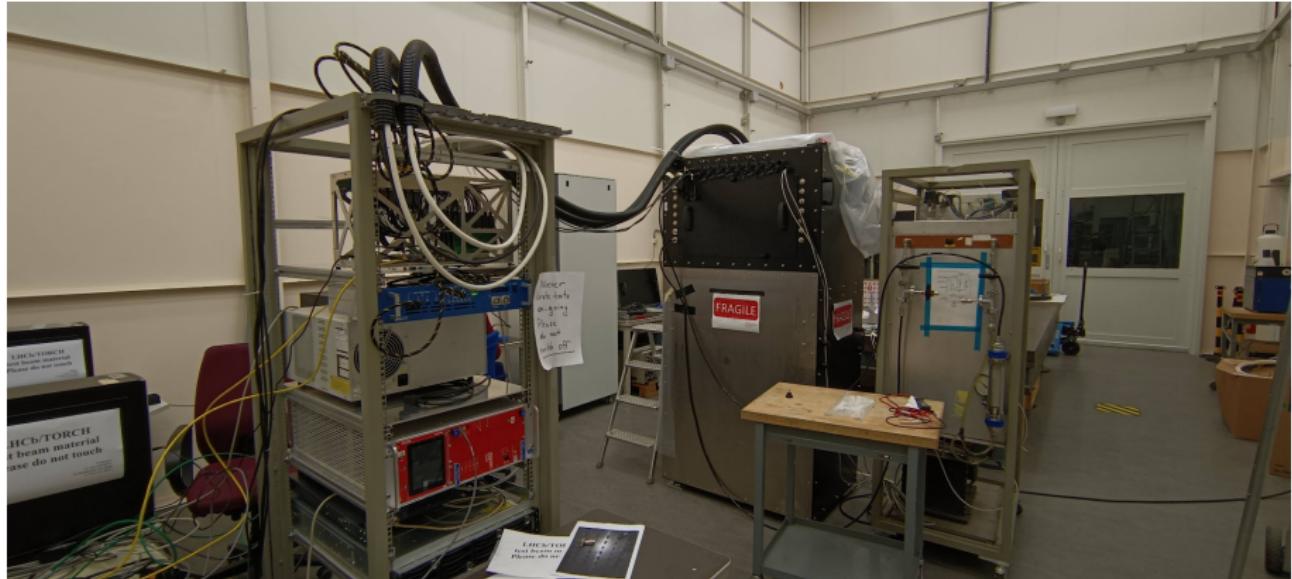
Final setup of T2 timing station, with F2 finger, two crossed scintillators, CFD (Const Fraction Discriminator) and NIM crate.

Start of test beam: Setup and preparations



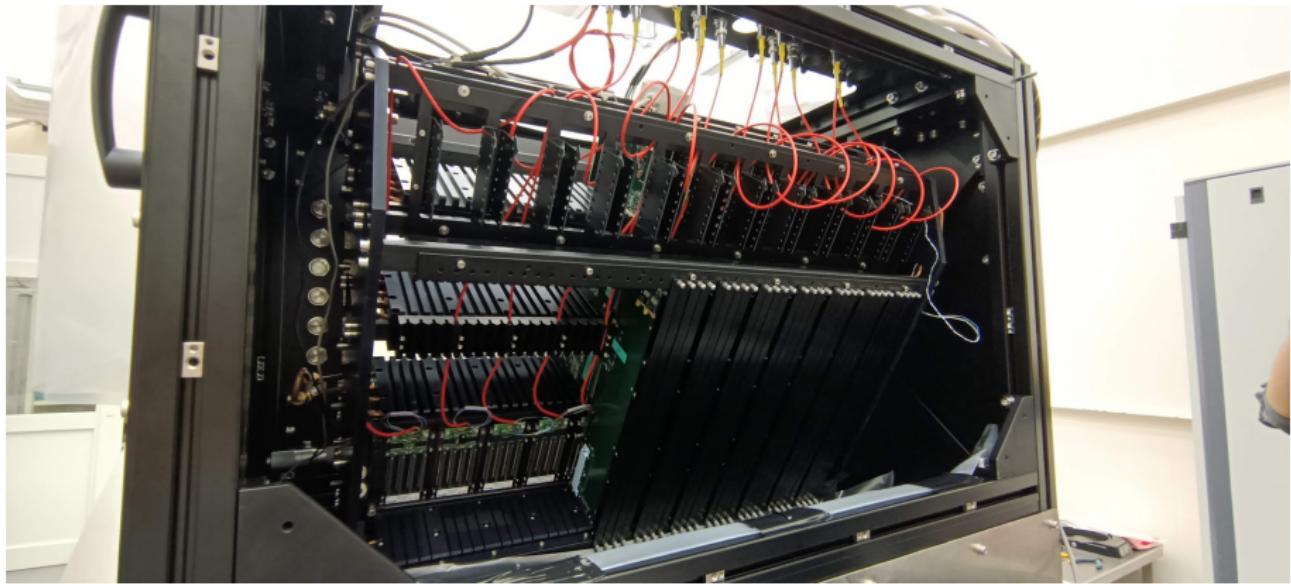
Meanwhile, in the lab, the electronics is prepared carefully...

Start of test beam: Setup and preparations



... and the MCPs are safely installed and cabled inside proto-TORCH

Start of test beam: Setup and preparations



11 MCPs are installed in total, 7 MCPs have readout electronics

Get ready to turn everything on: Will it work?

- Week 2: TORCH enters T9
 - Transport of Proto-TORCH from lab to T9
 - Lots of cabling
 - Safety inspection



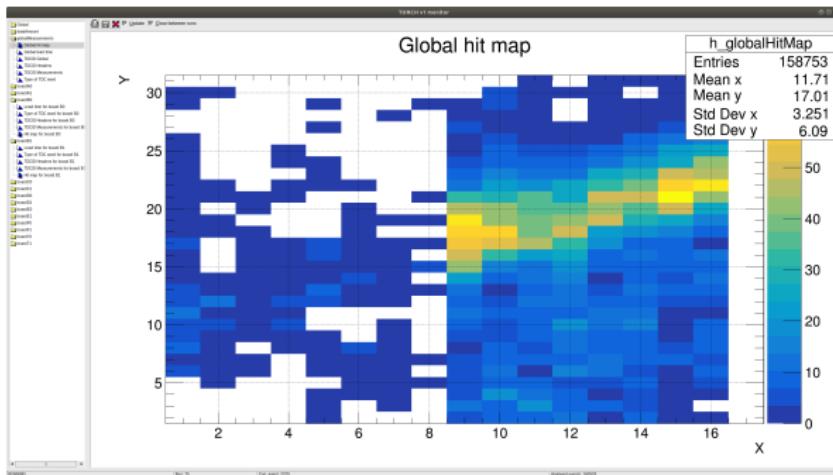
Lesson from safety inspection: HDMI cables are dangerous!

Get ready to turn everything on: Will it work?



Get ready to turn everything on: Will it work?

We see light!



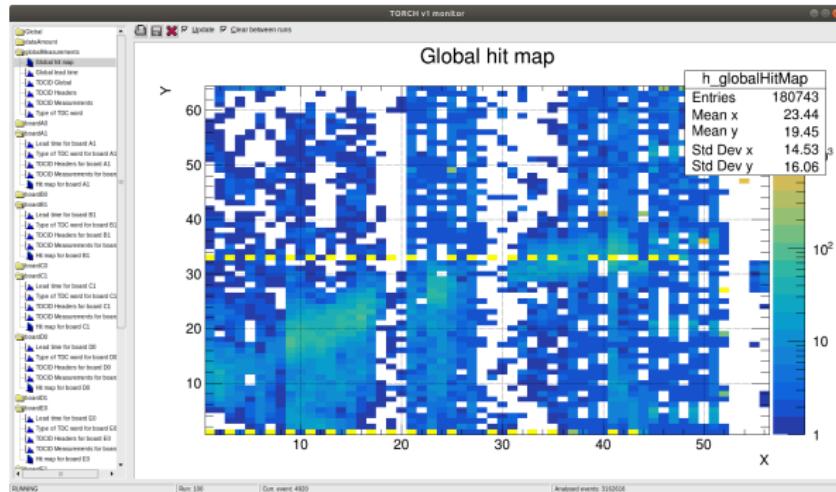
Logbook entry 107

First global hitmap

Global hitmap with MCP A and B, we can clearly see a band!

Get ready to turn everything on: Will it work?

But things weren't always running smoothly...



Logbook entry 113

Global hit map today

We've got a partially good global hit map after 3 hours of power cycling

Get ready to turn everything on: Will it work?

... but we were always optimistic and together we found a solution!

Logbook entry 130

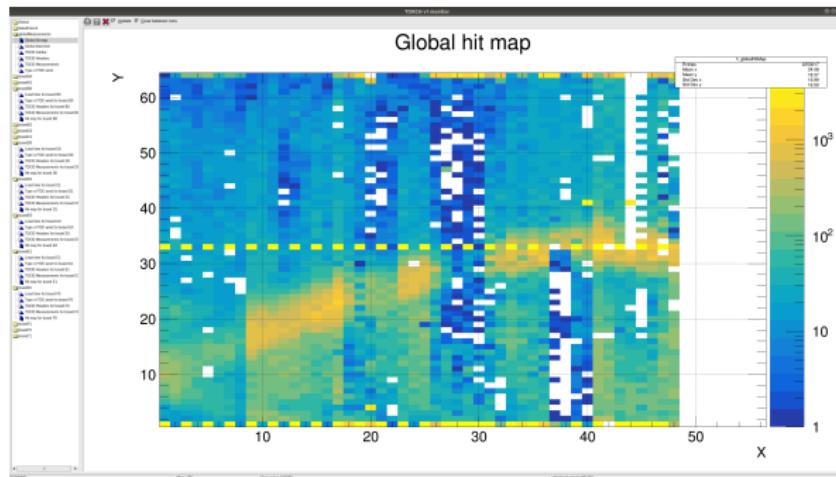
Run 163

Today we managed to get the MCPs powered up and in a stable condition in less than 1 hour!

From our experience, to ensure stable running we must:

- ① Follow Marion's MCP startup procedure (logbook entry 125)
- ② Custom NINO thresholds (logbook entry 140)
- ③ Increase HV on MCP C, D, E, F (logbook entry 141)

Get ready to turn everything on: Will it work?



Logbook entry 143

Run 176

This run contains mostly good data ...

Get ready to turn everything on: Will it work?

However, not everything went smoothly and we had to accept that we cannot always have what we want

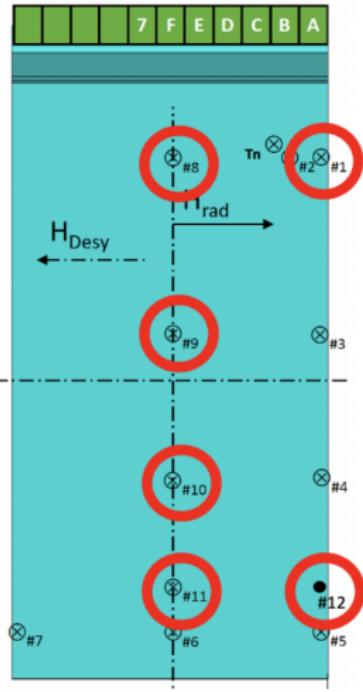
Logbook entry 139

Summary of MCPs

- We don't use MCP 7
- MCP D have a huge deficit in the middle, this agrees with measurements from the lab
- E1 is missing time references and but we see TORCH photons
- F1 has some NINO threshold issues and we've tried to set these many times without any improvement

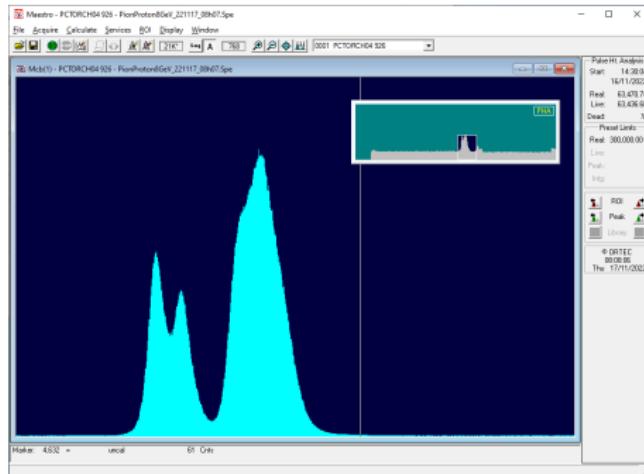
Let's collect data: Beam positions

- Week 3+4: Collect data!
 - Huge dataset!
 - New positions: 8, 9, 10, 11, 12
 - Position 1 for comparison with previous test beam
 - 24/7 operation for 2 weeks
 - INL runs at 8 GeV, with 100 million events per position



Let's collect data: Beam momentum

The regular runs contain data taken at 3, 5, 8 and 10 GeV



Beam momentum can be calibrated exactly using the ORTEC module

Number of events in regular runs

Systematic data taking at each beam momentum and beam position

Number of events in regular runs

# \ p	10 GeV	8 GeV	5 GeV	3 GeV
1	882623	1283522	395017	62167
12	1086330	1054173	431413	56231
11	1706747	1018446	425828	57904
10	1071997	1012901	394197	70452
9	790394	1008021	412670	72505
8	1241379	1023918	402732	62167

Around 1 million events at 8 and 10 GeV, less at 3 and 5 GeV

Number of events in special

We also had time for special runs at the end, with different beam momenta and Cherenkov pressures

Number of events with different Cherenkov pressures

# \ P	5 GeV	8 GeV	10 GeV	12 GeV	14 GeV	15 GeV
8	155603	300402	466233	592427	536363	547406
9	181862	405189	1460513	1062475	1077304	575346

Number of events with same Cherenkov pressures

# \ P	3 GeV	5 GeV	8 GeV	10 GeV
8	24654	116874	110861	126796

Summary

- Week 1: Setup and installation went smoothly
- Week 2: We successfully stabilised the system
- Week 3+4: We collected the largest dataset that the TORCH collaboration has ever seen!
- More detailed talks by David, Rui, Stoyan, Christoph, Rok, Marion, Michal and Ivan

Thank you all for a successful test beam!

More wise words

“Teamwork divides the task and doubles the success”

– The Internet

Backup: Database of runs

- I also tried to make an overview of all runs
- No way to make it readable or useful...
- Solution: I put the whole spread sheet into a pandas dataframe!
- Available on EOS: `/eos/experiment/torch/data/BeamTests_Data/2022/PS_T9/TORCH_runs.pickle`
- Instructions for loading dataframe:

```
$    lb-conda default/2022-12-06 python
>>> import pandas as pd
>>> df = pd.read_pickle('TORCH_runs.pickle')
```

Backup: Database of runs

```
>>> df[25:30]
   Run p Position Events    INL  Special  HighPr  LowPr           Comment
25  265  8          12  95176  False  False     NaN     NaN  MIMOSA0 missing
26  267  8          12  38516  False  False     NaN     NaN  MIMOSA0 missing
27  268  8          12  21142  False  False     NaN     NaN
28  270  8          12  89594  False  False     NaN     NaN
29  271  8          12   3312  False  False     NaN     NaN

>>> df[(df['INL'] == True) & (df['Position'] == 9)]
   Run p Position Events    INL  Special  HighPr  LowPr           Comment
58  363  8          9    NaN  True  False     NaN     NaN
59  364  8          9    NaN  True  False     NaN     NaN
60  365  8          9    NaN  True  False     NaN     NaN
65  374  8          9    NaN  True  False     NaN     NaN

>>> df[(df['Special'] == True) & (df['p'] == 8)]
   Run p Position Events    INL  Special  HighPr  LowPr           Comment
157 586  8          9  236853  False  True      9.0    2.0
158 588  8          9  168336  False  True      9.0    2.0
178 625  8          8  300402  False  True      9.0    2.0
188 635  8          8  100246  False  True      2.0    2.0
189 636  8          8   10615  False  True      2.0    2.0
```