

Multi-Wire Proportional Chamber detectors at FRS

- [Current status of detectors](#)
 - Performance during previous beamtimes
 - [FRS beamtime 2021](#)
 - [Before FRS beamtime 2021](#)
 - [FRS engineering run 2019](#)
 - [How to operate CFDs of MWPC](#)
 - [How can detectors be tested](#)
 - [Where to find MWPC electronics in Messhuetette](#)
-

Current status of detectors

- **Exchange of preamps** at MW11 and MW31, 19 - 20.04.2022. The new generation preamps which we put with Ivan and Elena are low gain, these are bad for our purpose. Thus had to be replaced again.
 - **MW11:** preamp V5 replaced. The gain is adjusted to ~ 160 for anode signals and ~ 400 (inverting) for the cathodes, see plots for [anode](#) and [cathodes](#) from M. Traeger. **Very probably that L, R, U, D are mixed up!**
 - **MW31:** R and L preamps replaced. The gain is adjusted to ~ 160 for anode signals and ~ 400 (inverting) for the cathodes, see plots for [anode](#) and [cathodes](#) from M. Traeger. **Preamp box to be picked-up from det lab and installed on detector!**
- **Gas test with Orbisphere 3600** for O₂ content, 05.04.2022 and 19 - 20.04.2022:
 - **MW11:** Orbisphere reading **O₂ content < 120 ppm**, this is a good number, **no leak**.
 - **MW31:** at 5 l/h rate outside (mixing cabinet) there is 3 l/h gas rate inside on the detector output after gas valve S3_2 was completely opened (was partly closed?). Orbisphere reading **O₂ content < 200 ppm**, **no leak**.
 - **MW51:** at 5 l/h rate outside NO rate on the detector input. 10 l/h outside - 3 l/h rate on input, but 0 l/h i.e. NOTHING on detector output. There is for sure **a big leak!**
 - **MW71:** Orbisphere reading **O₂ content < 450 ppm**, **a small leak!**
 - **MW81:** Orbisphere reading **O₂ content < 250 ppm**, **no leak**.
 - **MW81+MW82:** Orbisphere reading **O₂ content < 110 ppm**, **no leak**.
- MWPC11, 31, 82 are operational. 31: preamps for R,L cathodes were exchanged, their polarity is now positive. It is not an issue, TDC works with

both polarities.

- MWPC51, 71, 81 showed no rate with sources (either ^{90}Sr or ^{60}Co). Some signals appear < 1 per minute, maybe MIPs. Efficiency is still very low.
- Gas ratio was again reported wrong and fixed in mid December 2021 by Holger Risch from det lab. Before ratio was 40/60 (Ar/CO₂), but unknown for how long (since March 2021 or later?) and how it happened to change. From 10.12.2021 it is correctly calibrated again to Ar/CO₂ 80/20. Be careful: meter of CO₂ gas flow is broken - shows always zero!
- See Table from 17.12.2021 for latest test results.

17.12.2021

Detector	Va (kV)	Ia (uA)	Signal from source (mV)					Source	Note
			Anode	Cath R	Cath L	Cath U	Cath D		
MWPC11	2	2.9	-30	-5	-10	-20	-20	$^{90}\text{Sr}^*$	Tried to use gap, no increase of amplitude and tripped
MWPC31	2.16	6.7	-70	+10	+10	-60	-40	^{90}Sr	Current jumped to 100 uA after 30 min staying on
MWPC51	2.9	0.6	-5	-10	-10	-10	-10	^{90}Sr	Very low signals, maybe noise
MWPC71	2.4	0.0	< -10	< -10	< -10	< -10	< -10	^{90}Sr	Very low signals, maybe noise
MWPC81	2.1	0.0	-	-	-	-	-	$^{60}\text{Co}^{**}$	No to very rare signals
MWPC82	1.85	0.0	~ -20	-15	-15	-15	-15	^{60}Co	Good signals. If HV > 1.85 kV sparks stat, current > 1 uA.

Table 1. Test of MWPC detectors with gas (Ar/CO₂ 80/20). *Built-in ^{90}Sr beta source.

**External ^{60}Co gamma source with activity > 200 kBq, borrowed from DESPEC.

Status of MWPC detectors, 02.11.2021

Name	Status during beamtime 2021	Logbook	Problems	Status
MWPC11	No L cathode -> no X, only Y.	S483, p. 17	Check L cathode.	Replaced preamps V3 (left) and V5 (right). Right gives ~ 4 times smaller signals than others. In the pream box the order is (from left to right): V1 (A), V2, V4, V3 (L), V5 (R). But, all cathodes are present now. All to be checked with gas and source!
MWPC31	All cathode signals are missing.	S455, p. 35	Check all connections!	Changed power supply box (+12 -6 V) for preamps. Now only R is missing. R to be replaced, all to be checked with gas and source!
MWPC51	All cathodes work. But efficiency is around 20%, signals are small! In 2020 (S467) this was not the case with same beam.	S455, p. 36, 40, 44, 45 file s455_03_mw51_71_0020	May be gas is leaking somewhere.	All to be checked with gas and source!
MWPC71	All cathodes work. But efficiency is less than 1%, signals are small! In 2020 (S467) this was not the case with same beam.	S455, p. 37	May be gas is leaking somewhere.	All to be checked with gas and source!
MWPC81	All cathodes work. Constant noise about 50 mV. Signals are small, efficiency low about 1% (gas mixture fixed but didn't help)! Drive problem - shows out when in.	S455, p. 51, 66, 85, 91 S515, p. 190, 200, 224, 250, 263, 264, 267 s515 part 2, p. 6	May be gas is leaking somewhere.	All to be checked with gas and source!
MWPC82	Worked during s455 with 20% larger efficiency than MW81. During S515 worked at the beginning but then burned one night with operational voltage (at least according to logbook.	S455, p. 51 S515, p. 190, 197 (when burned)		Burned. To be taken out.

Performance during previous beamtimes

FRS beamtime 2021

During the R3B exp. S455 (28.03 - 01.04) with ^{238}U was found out:

- MWPC31 is missing both Left and Right signals cathodes (also no pulser passes through).
- MWPC51, 71, 81 show only up to -60 mV signals (with U should be more or?) with voltages around 2 - 2.3 kV. Further increase of voltage was risky. Also, detectors counted much less than scintillators, efficiency about 20% only? why?
- MWPC81 exhibits constant noise (some harmonic function) of about 50 mV.
- According to [FRS logbook](#) (page 51), MWPC82 signal of about 10 mV is hardly visible within the noise of 10 mV. I think voltage was never increased from 1.7 kV, see screenshot from Geco below!

MW11_A	355.00 μ A	2100.000 V	0.000 μ A	0.000 V	Off
MW21_A	355.00 μ A	1500.000 V	0.000 μ A	0.000 V	Off
MW22_A	355.00 μ A	1500.000 V	0.000 μ A	0.000 V	Off
MW31_A	355.00 μ A	1900.000 V	0.010 μ A	1899.960 V	On
MW51_A	355.00 μ A	2200.000 V	0.010 μ A	2200.040 V	On
MW71_A	355.00 μ A	2350.000 V	0.020 μ A	2350.005 V	On
MW81_A	355.00 μ A	2200.000 V	0.000 μ A	2200.005 V	On
MW82_A	355.00 μ A	1700.000 V	0.010 μ A	1699.975 V	On

- According to same logbook, the drive of MWPC81 was "green" in the device control, however physically still stayed in the the beam line! Thus, it had to be moved out manually from the electronics room of Messhuette.

Gas mixture prolem was revealed (end March):

The gas misture required for correct MWPCs operation is a mix of Argon (80%) and CO₂ (20%). The level of CO₂ was discovered to be 0%, this was fixed with the help of det lab colleagues. This issue could be a source of such low efficiency of the detectors.

Later, during the next R3B run S515 (24.04 - 02. 05) with ¹³⁶Xe the status was the following:

- MWPC81. It was operated at 2.3 kV anode voltage, still constant noise (some harmonic function) of about 50 mV is there. And still VERY LOW EFFICIENCY of about 1%
- MWPC82. During evening 24.04 it was operated at 2.5 kV anode voltage, efficiency was about 20% higher than MWPC81. However, on next day 25.04 MWPC82 stopped working, i.e. no signals at all with HV applied. Was is burned? Probably.

Before FRS beamtime 2021

Status of MWPC detectors before and during beamtime 2021, 11.03.2021

Name	HV anode, kV	Imon, uA	Anode signal ampl., mV	Cathode signal ampl., mV	Comment	Status before beamtime 2021
MWPC11	2.2 2.3	0.0 2.0	- 20 - 30 mV (beta source)	Input: bipolar signals from generator (+20 -20 mV) L +100 -800 mV R +100 -800 mV U +100 -800 mV D +100 -800 mV	1. Voltage supply (+6 V -12 V) was repaired. Problem remained. 2. Signal from R cathode was missing, exchanged preamp. Problem remained. 3. Fixed by checking connections on intermediate connection panel at S1. Sparks > 2.4 kV	All cathode signals are fine. Anode signal is fine. LEFT cathode is missing.
MWPC31	2.0 2.2	0.0 0.0	- 20 - 40 mV - 30 - 50 mV	L +400 -800 mV R +400 -800 mV U +500 -1200 mV D +500 -1200 mV	Noise > 2.4 kV Cathode noise ~ 40 mV	All cathode signals are fine. Anode signal is fine. Ready.
MWPC51	2.6	0.01	- 20 - 40 mV	L +200 -1000 mV R +200 -1000 mV U +200 -1000 mV D +200 -1000 mV	Noise > 2.7 kV	All cathode signals are fine. Anode signal is fine. Ready.
MWPC71	2.6 2.7	0.0 0.0	-60 - 100 mV	L +200 -1000 mV R +200 -1000 mV U +200 -1000 mV D +200 -1000 mV	ok	All cathode signals are fine. Anode signal is fine. Ready.
MWPC81	2.3	0.0	-60 mV	L +100 -600 mV R +100 -600 mV U +100 -600 mV D +100 -600 mV	ok. No noise up to 2.6 kV.	All cathode signals are fine. Anode signal is fine. Drive to be checked!
MWPC82	2.5 2.3	2.0 2.9	- 30 - 50 mV - 40 mV	L +100 -600 mV R +100 -600 mV U +100 -600 mV D +100 -600 mV	(Dec. 2020) Anode signal was missing, detector was repaired in detector lab. Installed back in vacuum at S8. Test with gas done after repair. Noise ~ 1 mV . (Feb. 2021) Detector was not moving. Reason: 5-pole cable (operating pneumatic drive and detecting the MWPC82 position) was not connected. The cable has been reconnected. (Mar. 2021) Noise starts at ~ 2 kV (abrupt increase of current).	All cathode signals are fine. Anode signal is fine. Drive to be checked!

After engineering run 2019 (before FRS beamtime 2020)

Status of MWPC detectors based on the results from engineering run (er) 2019

04.02.20

Name	Beam, rate per spill	HV anode, kV	Anode signal ampl., mV	Cathode signal ampl., mV	File name	Comments (before er, 11.19)	Comments (after er, 01.20)	Status before beamtime 2020
MWPC11	⁴⁰ Ar 550 MeV/u S2: 30k	2.3	100-150	50-75	mw11_0909.lmd mw11_0910.lmd	fixed by replacing the pre-amplifier (V5 notation)	X and Y are swapped.	Swapped X and Y again. Ready
	²³⁸ U 850 MeV/u S2: 10k	1.7			mw11_charge_states_u_0889.lmd			
MWPC31	⁴⁰ Ar 550 MeV/u S2: 30k	2.5	100-150	50-75	mw31trig_0008.lmd	Exchanged voltage supply for preamp (needs +6 and -12 V)	ok	Ready
	²³⁸ U 850 MeV/u S2: 2k	1.7			No file, see plot in logbook-eng-run-p238-288.pdf on p. 12			
MWPC51	⁴⁰ Ar 550 MeV/u S2: 30k	2.7	100-150	50-75	MW51_trig_MW510143.lmd counting rate 40 Hz	ok	ok	Ready
MWPC71	⁴⁰ Ar 550 MeV/u S2: 30k	2.7	100-150	50-75	MW71_trig_MW71_0144.lmd MW71_trig_MW71_0145.lmd counting rate 17 kHz	ok	ok	Ready
MWPC81	⁴⁰ Ar 550 MeV/u S2: 30k	2.7	No signal (even cosmics)	No Left cathode signal even with pulser	No file written	ok	No counting rate at all due to the absence of anode signal (trigger).	Fixed by checking connections. Ready
MWPC82	⁴⁰ Ar 550 MeV/u S2: 30k	2.7	~ 70 mV	No Up cathode signal	No file written	Fixed by re-checking connections and taping the cables, Up cathode has signal ~ 5mV with cosmics	Very less counting rate (less than Hz) with already 2.7 kV on anode!!!	Ready to measure X coordinat

How to operate CFDs of MWPC

Important note: CFDs are controlled using Mesycontrol software. This software is installed under profi user and is also used to control other Mesytech modules e.g. MCFDs for ToF scintillators. Inside the software, one can open the setup file and choose which CFDs to control. However, the CFDs of MWPCs can be controlled only locally, meaning on the machine to which the remote control module (MRC) is physically connected to! This machine is lxg1267, it is located in the Messhuette ("go4" machine). Connection via ssh does not work, so please go locally.

1. Open mesytec control software for CFDs under profi user locally on lxg1267 machine

In terminal:

```
bash
```

```
alias mwpc_cfd
```

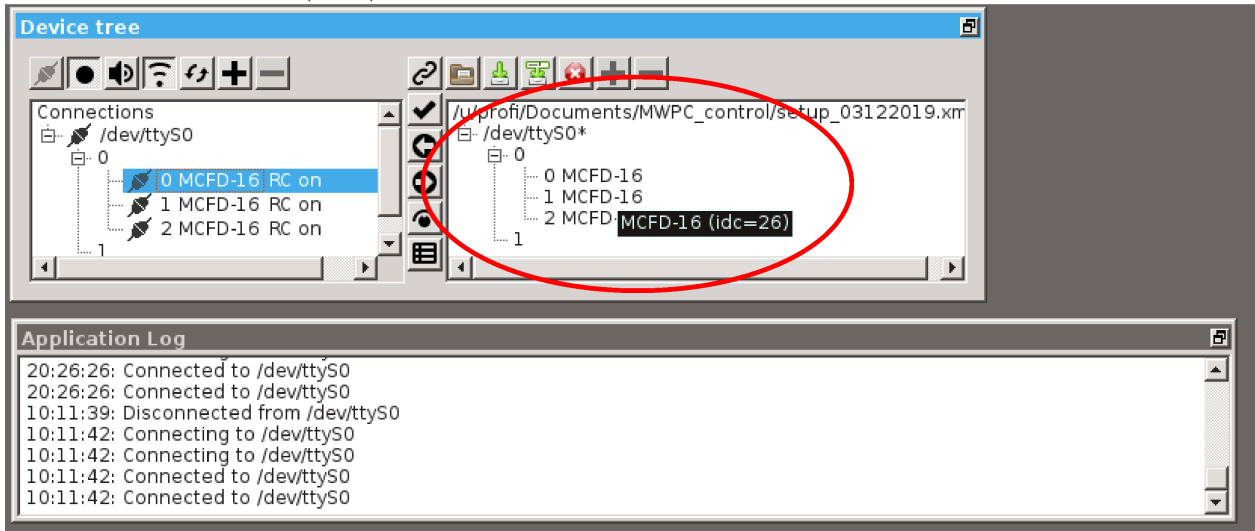
It opens mycontrol soft for CFDs.

Open CFD menu using Device tree window:

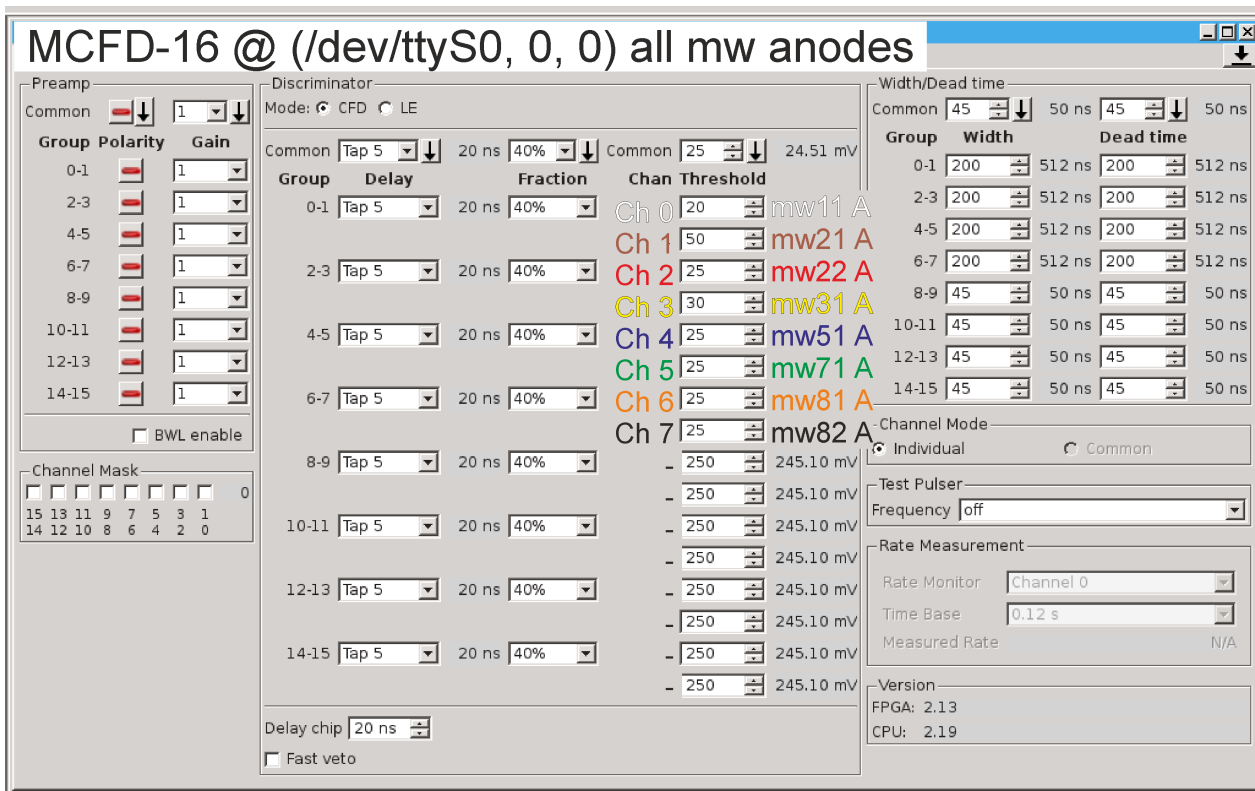
0 - CFD for mw11, 21, 22, 31, 51, 71, 81 and 82 anodes

1 - CFD for mw11, 21, 22 and 31 cathodes

2 - CFD for mw51, 71, 81 and 82 cathodes



2. Select thresholds for anodes. The typed value is automatically sent.



3. Select thresholds for cathodes. The typed value is automatically sent.

How can detectors be tested

Cathodes are tested with generator. It is connected in FRS Messhuetten. Generator produced bipolar analog signal, see Fig. 1. The signal is fed into the chain with cathodes. Output signal from cathode should look smth like this, see Fig.2.

If signal is missing, several things are possible:

- Some connection is broken/loose. Very often it is so, go to the caves to check this.
- Preamp is defect and should be replaced. Either preamp box can be removed from detector without opening it (possible with some MWPCs, e.g. MW11), or one has to take detector to the detector lab for repair (like it was done for MW82 in 2020).
- Voltage supply for pream (+6V -12V) is broken.

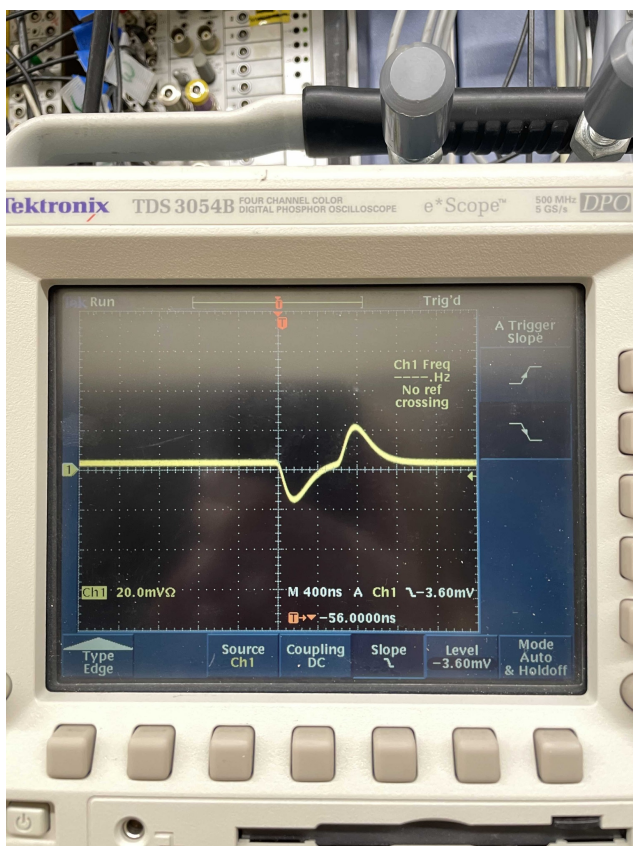


Fig.1 Signal from generator.

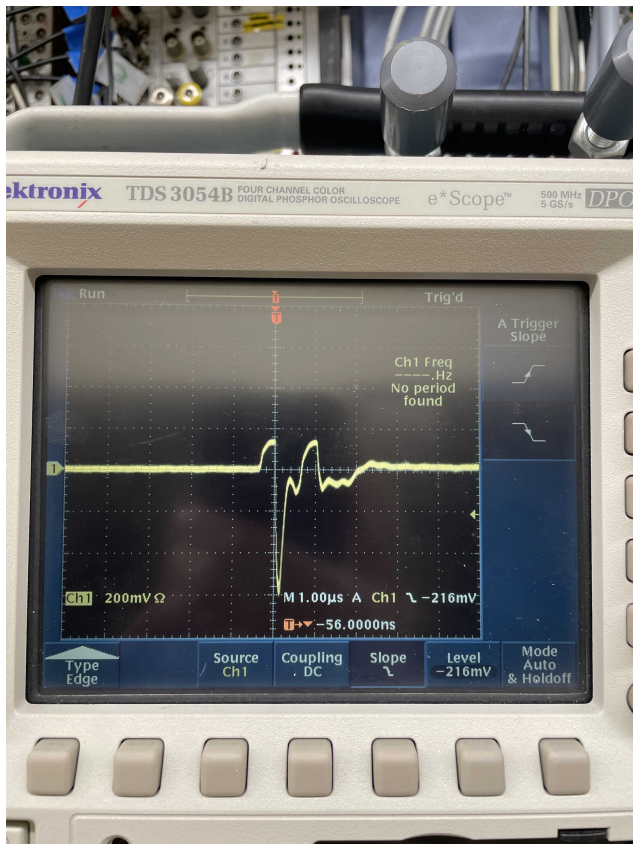


Fig.2 Signal from cathode if generator is fed to it.

Anodes are tested only with voltage on (and detectors should be filled with gas!). All detectors except the ones at S8 are equipped with ^{90}Sr beta source. MW81 and MW82 can only be tested on cosmics.

Starting from some value of voltage (from 2 kV and up, different for each detector), detectors begin to generate noise. This can be traced by looking at the anode current. During normal operation and with no beam the current is zero. For example, MW82 generates no noise up to 2 kV on anode (with 0.0 μA current), and starting from 2.1 kV (abrupt increase of current to 2 μA) one can see constant noise signals. If the voltage is too high, one can see also sparks. On the scope those look like huge saturated signals. If sparks start to appear, reduce the voltage immediately!

Where to find MWPC electronics in Messhuetette

The patch panel of the MWPCs and all the corresponding electronic modules are located in the electronic room of the Messhuetette, see the Figures below.



Fig.5 Back side of the NIM crate. Make sure connection between MRC-1 and CFDs is there!

*Delay is introduced to the logic signals from all the anodes and 11, 21, 22, 31 cathodes. Those signals require to be delayed because the corresponding TDC (V775, geo 8) is configured for common start. Logic signals from 51, 71, 81, 82 cathodes are sent to the TDC (V775, geo 9) configured for common stop. The mapping of the TDCs can be found under profi in e.g. `/lynx/Lynx/frs/usr/profi/mbsrun/sec_expfeb21/vme_user/mapping`

Web page of MWPCs by Hemlut Weick

Can be found [here](#), but it is partly not up-to-date.