Wire Tension Test Bench for Gaseous Detectors

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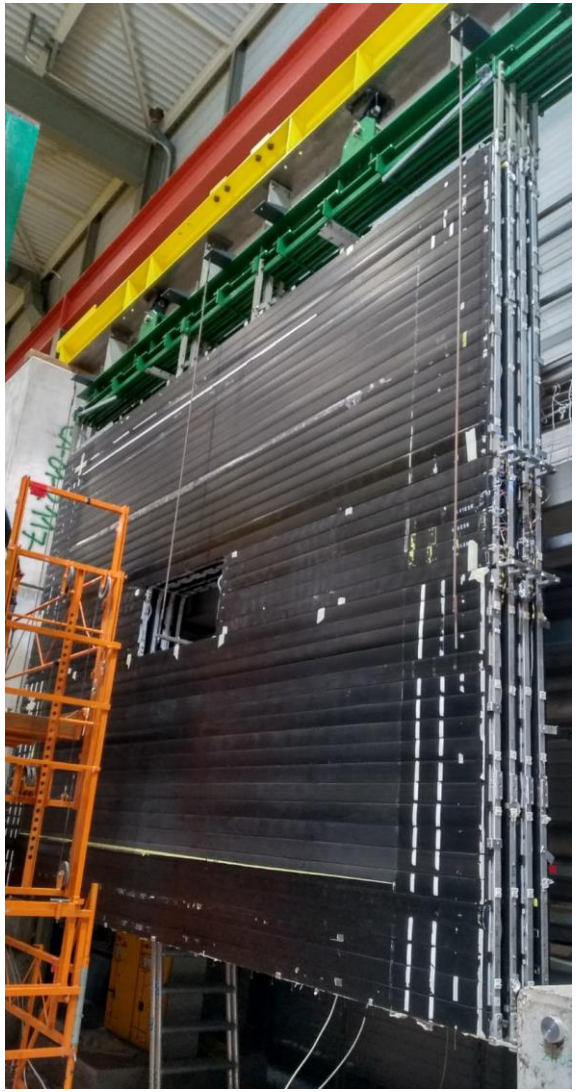
Outline

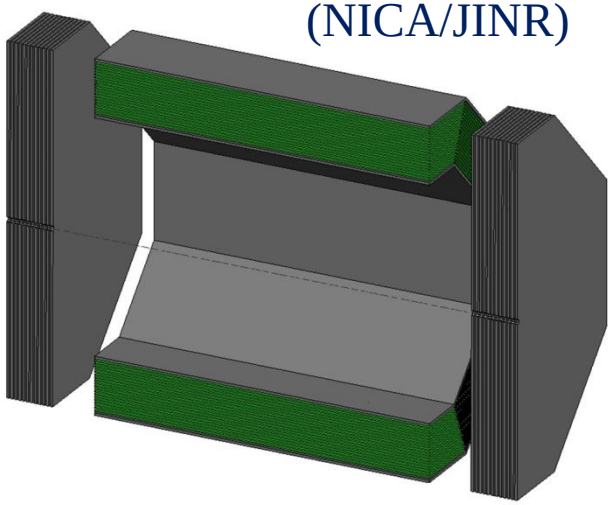
- MDT based Muon Systems in HEP experiments
- MDT detectors
- Physical principles of MDT wire tension test
- Test bench and corresponding software
- Ready to use working prototype
- Results of MDT-detectors testing

Muon Systems in HEP Experiments

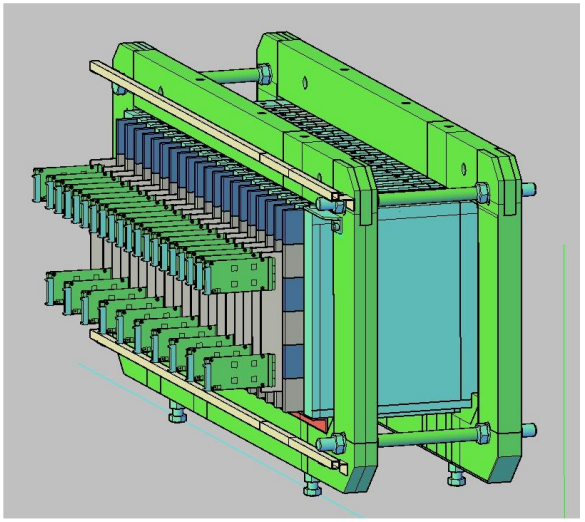
RichWall (COMPASS/CERN)



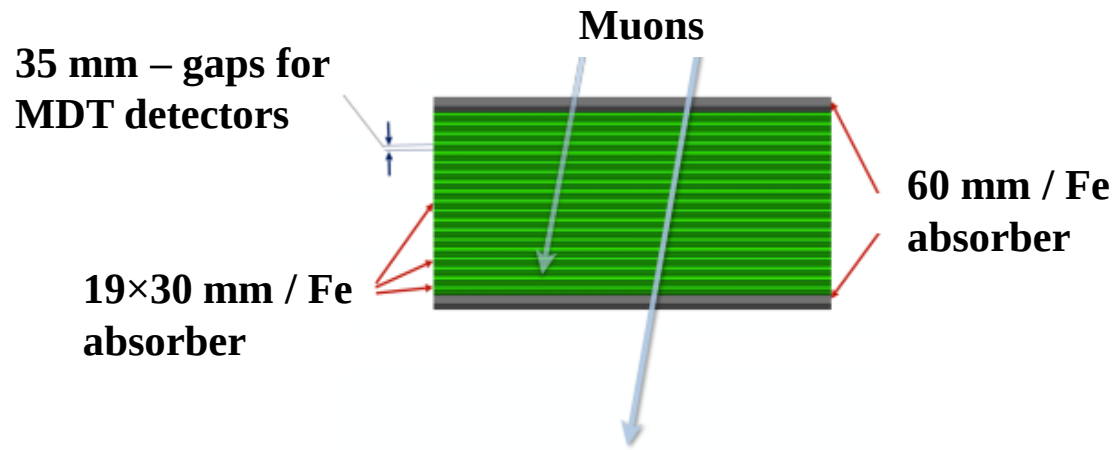
SPD Range System (NICA/JINR)



SPD Range System prototype

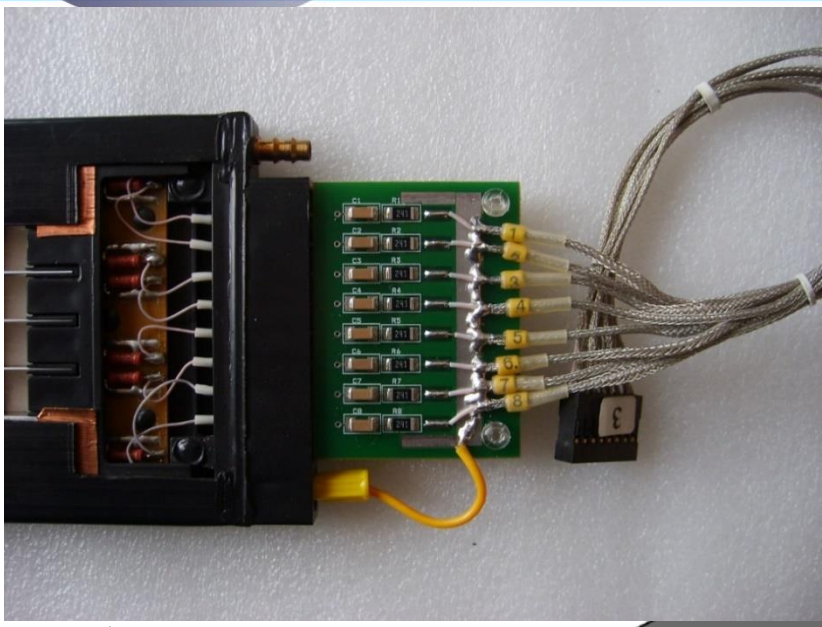


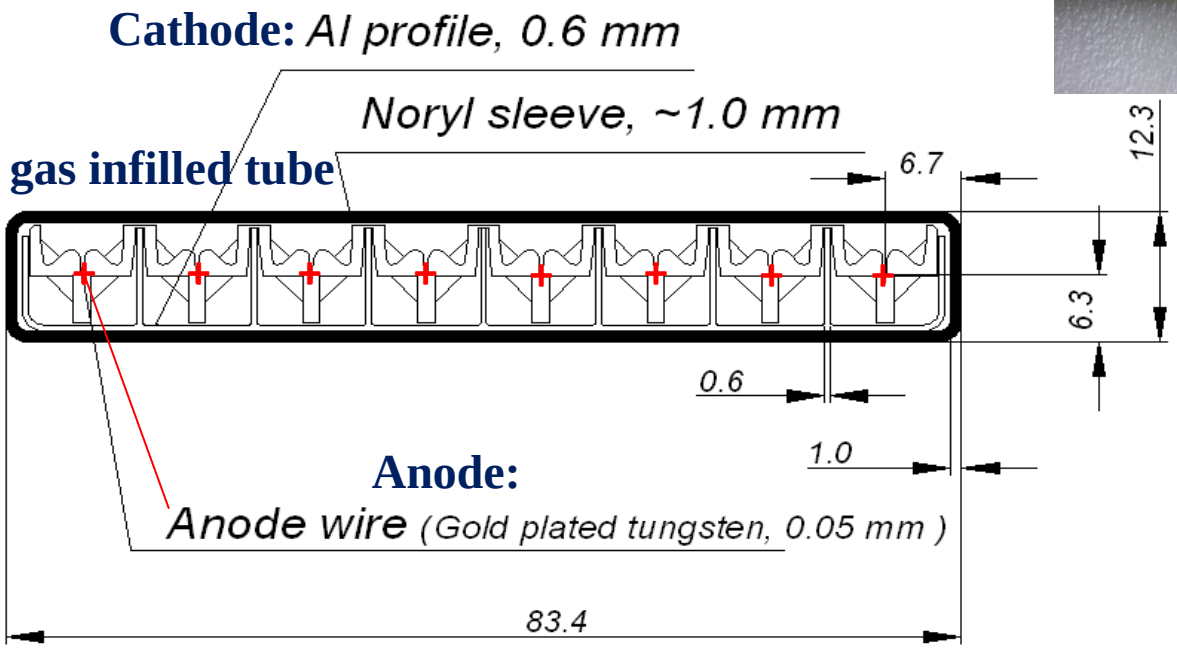
Layered structure of the Range System



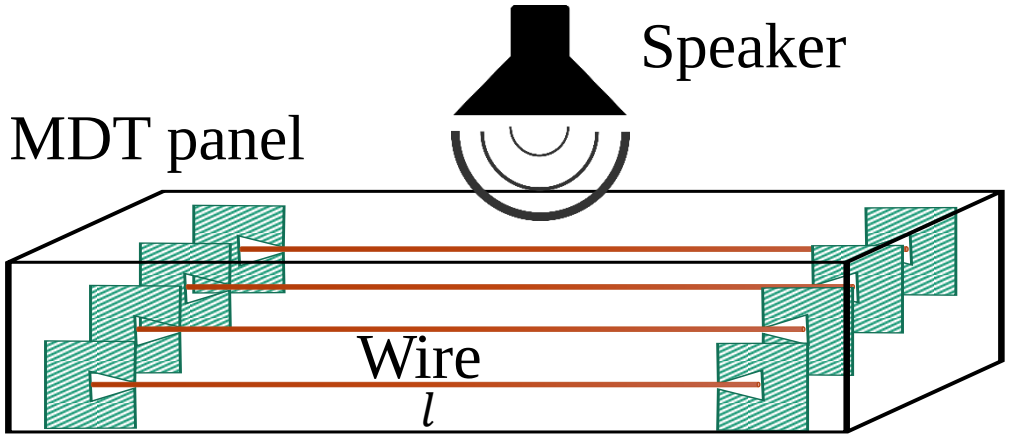
MDT Detectors

Mini-Drift Tube





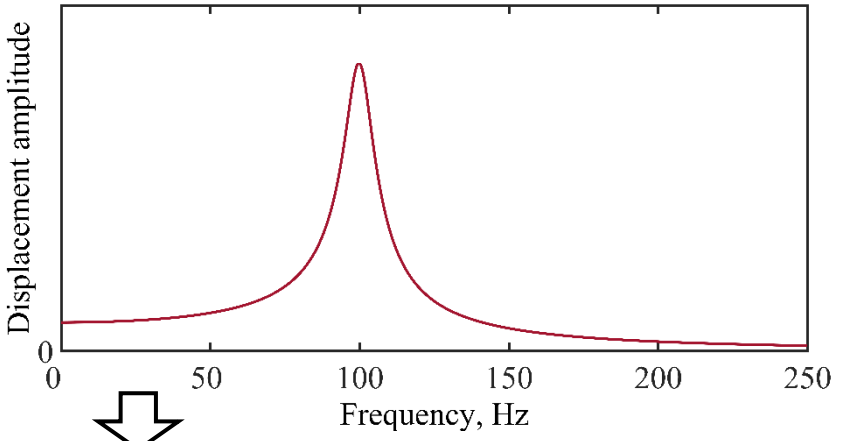
Physical Principles of MDT Wire Tension Test



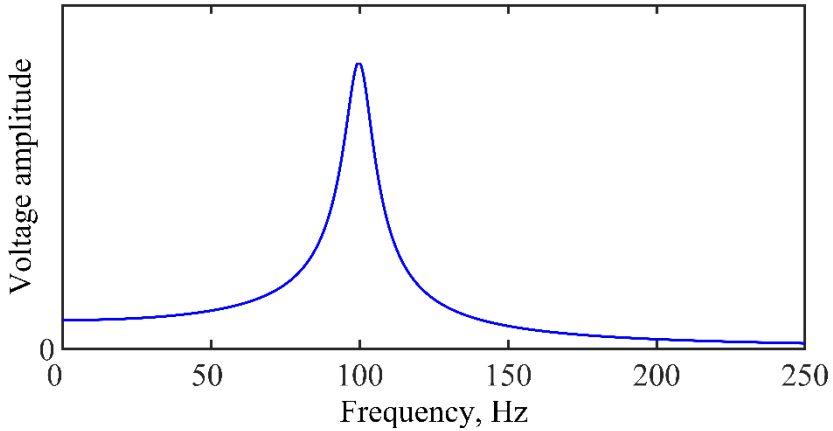
$$f_{res} \leq f_0 = \frac{1}{2l}\sqrt{\frac{T\text{-tension}}{\rho S}}$$

Wire properties:
tungsten, $\rho = 19{,}1\ g/cm^3$;
cross-section, $S = 0{,}078\ mm^2$;
length, l depends on the detector.

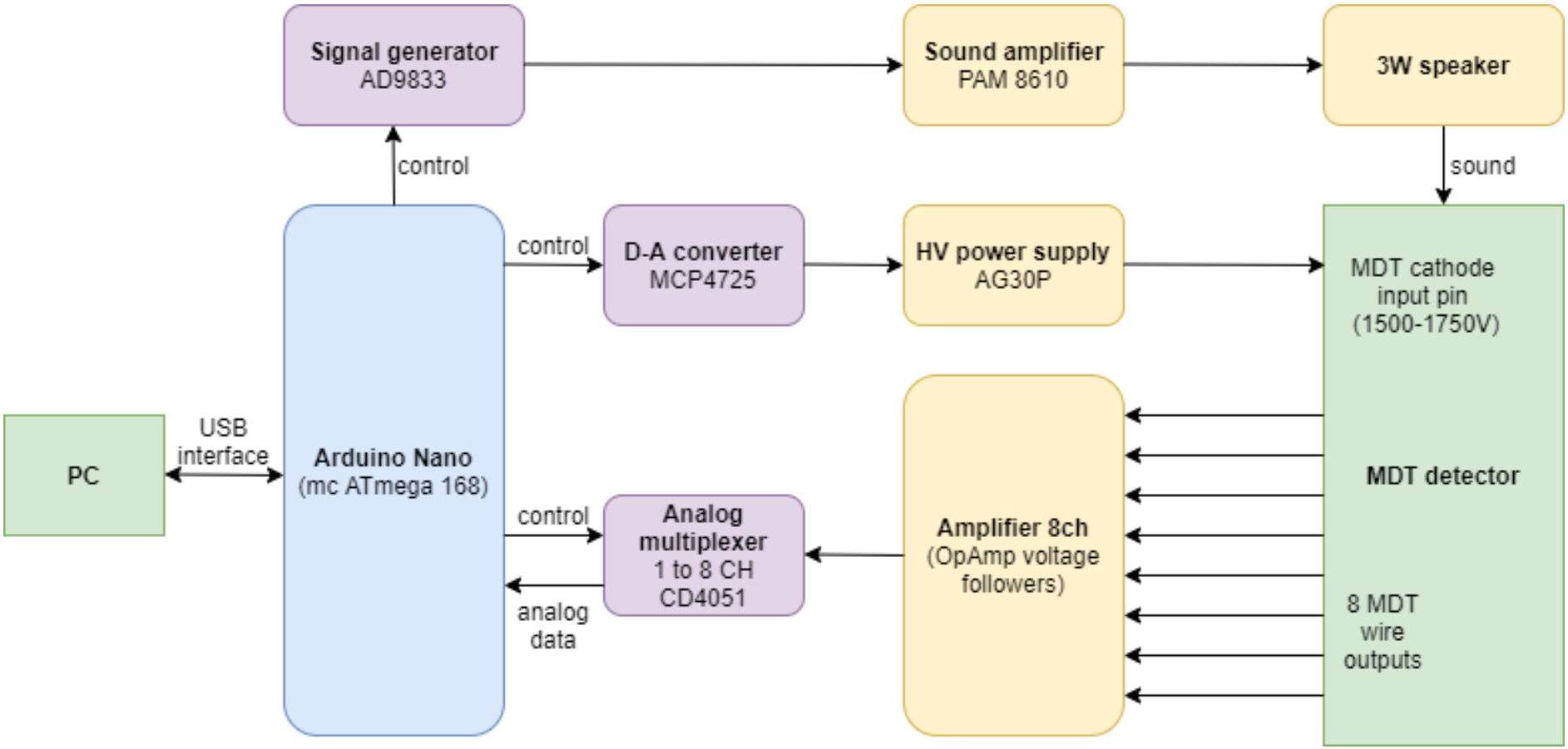
Ideal frequency response of a single wire:



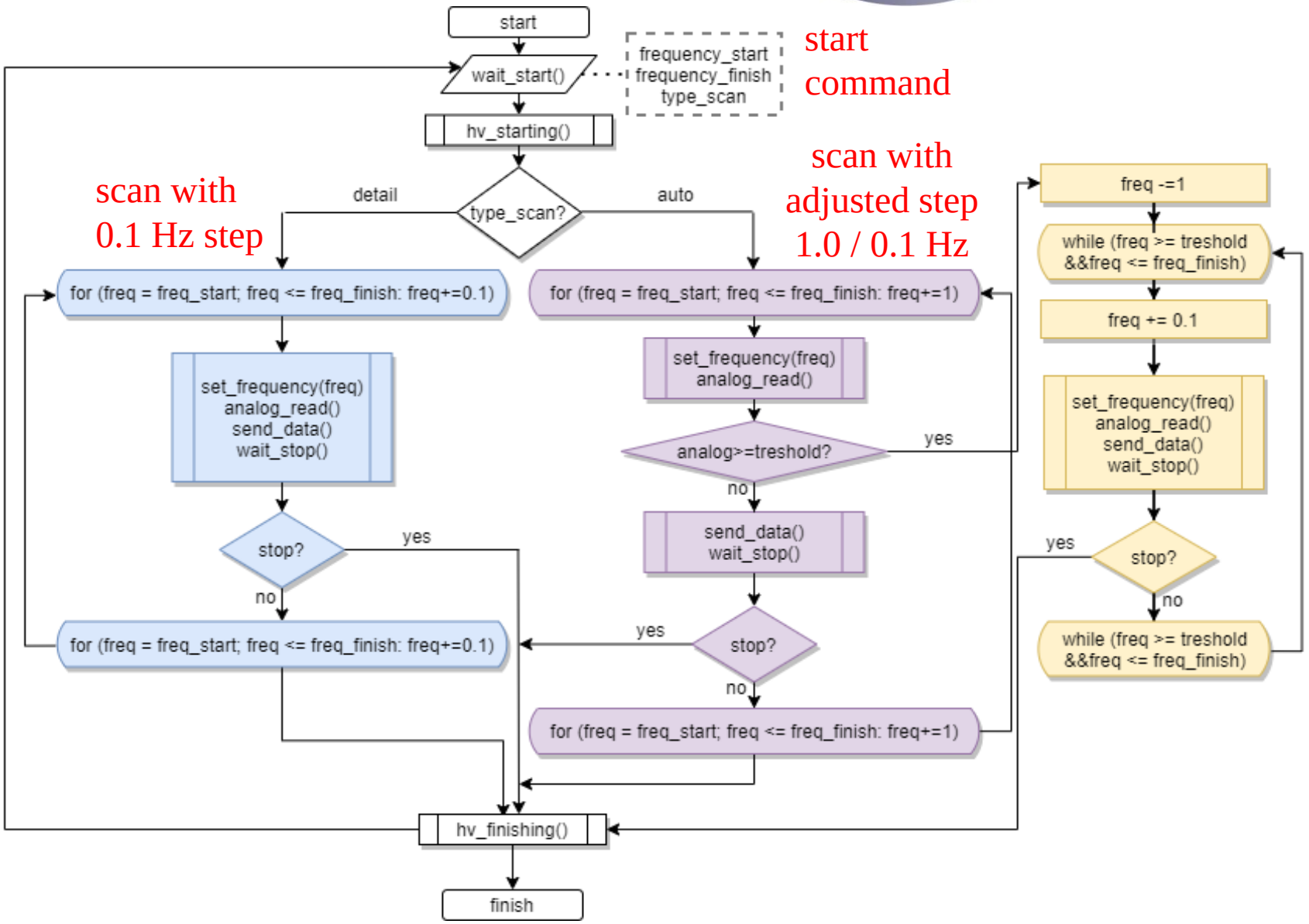
Expected frequency response to be recorded:



General Device Diagram



Block Diagram of Arduino Sketch

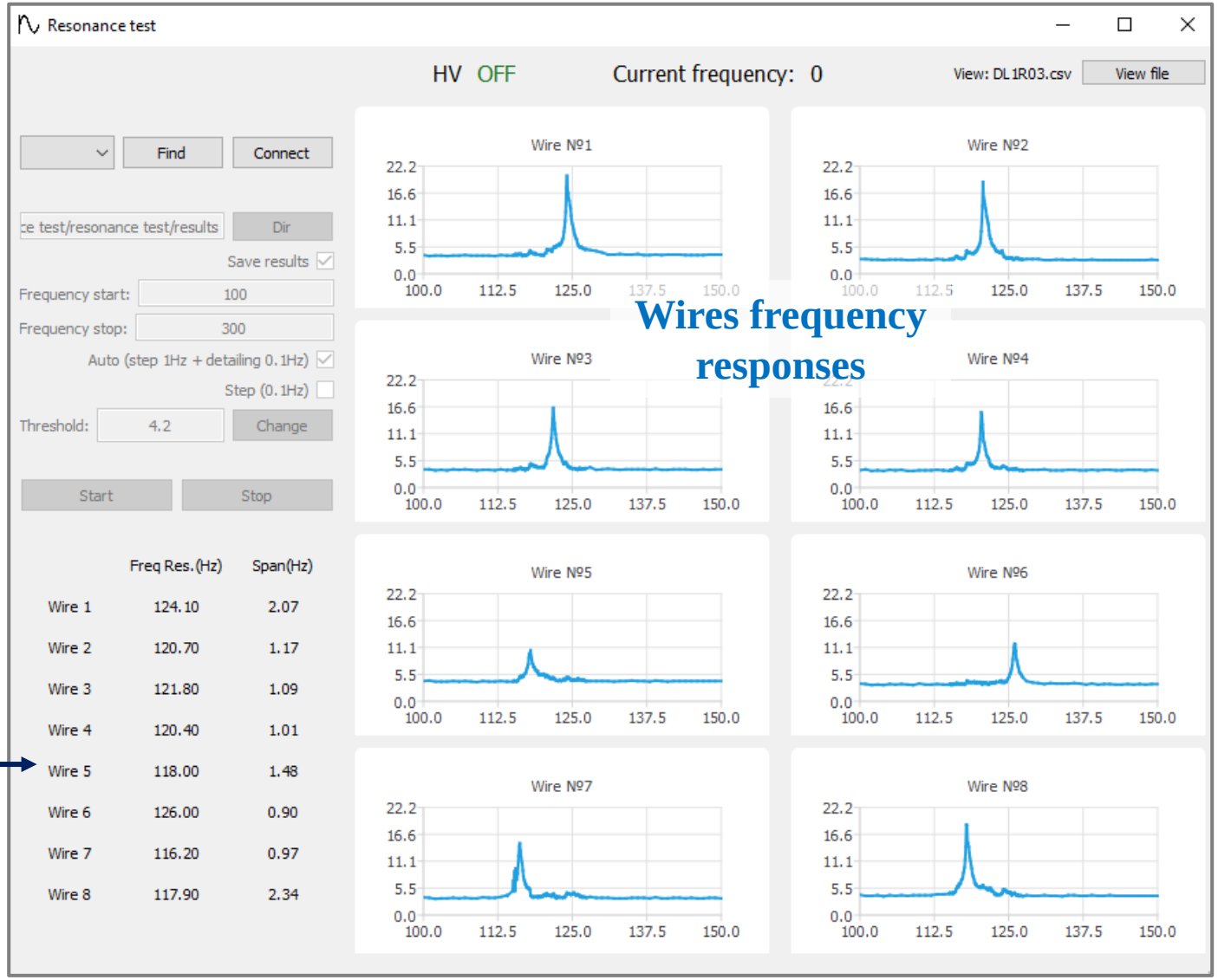


Interface and Capabilities

Program setup:

- File saving option
- Scanning frequency interval
- Detailed or Auto mode
- Threshold level for AutoDetect mode

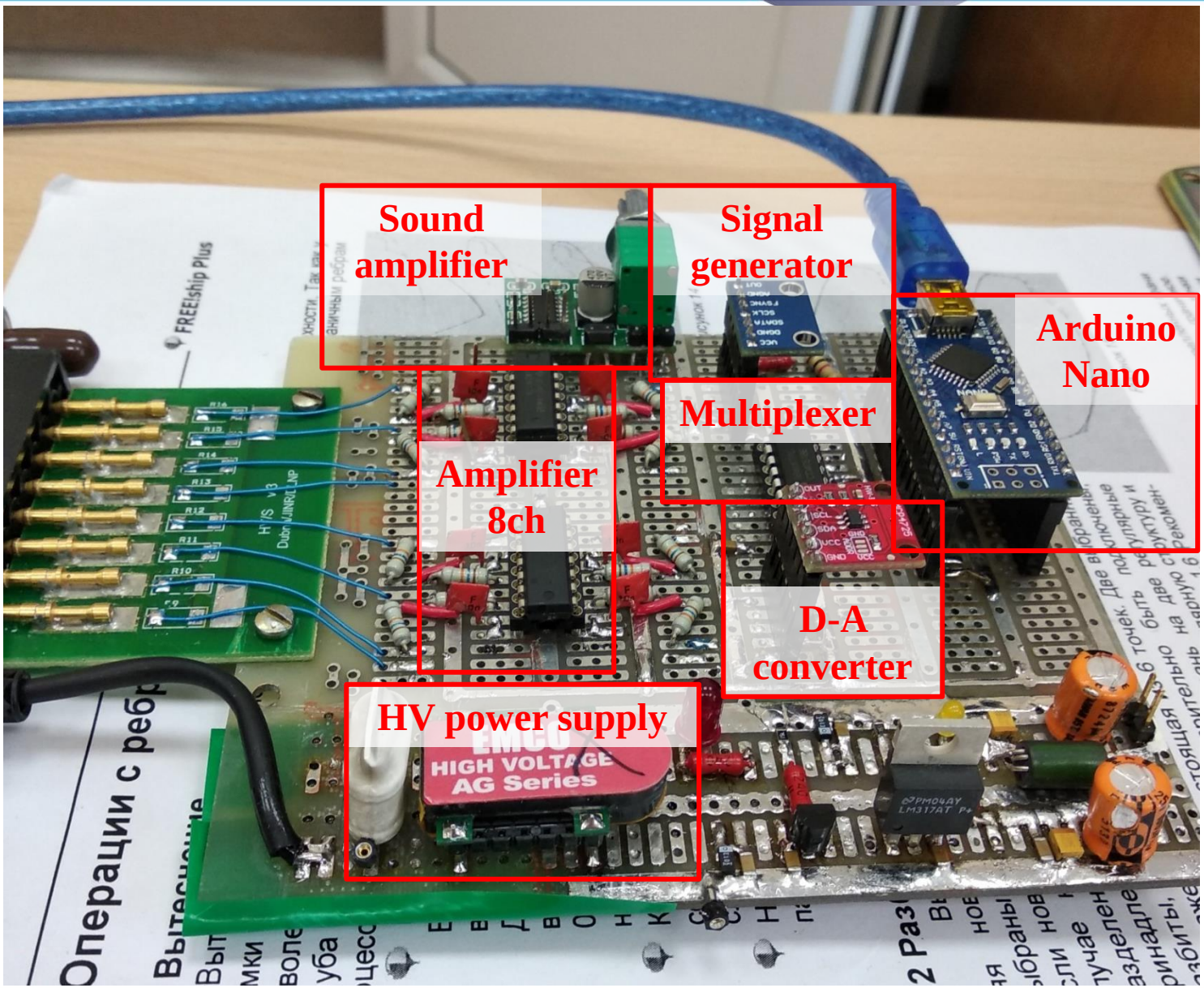
Measured resonance frequencies →



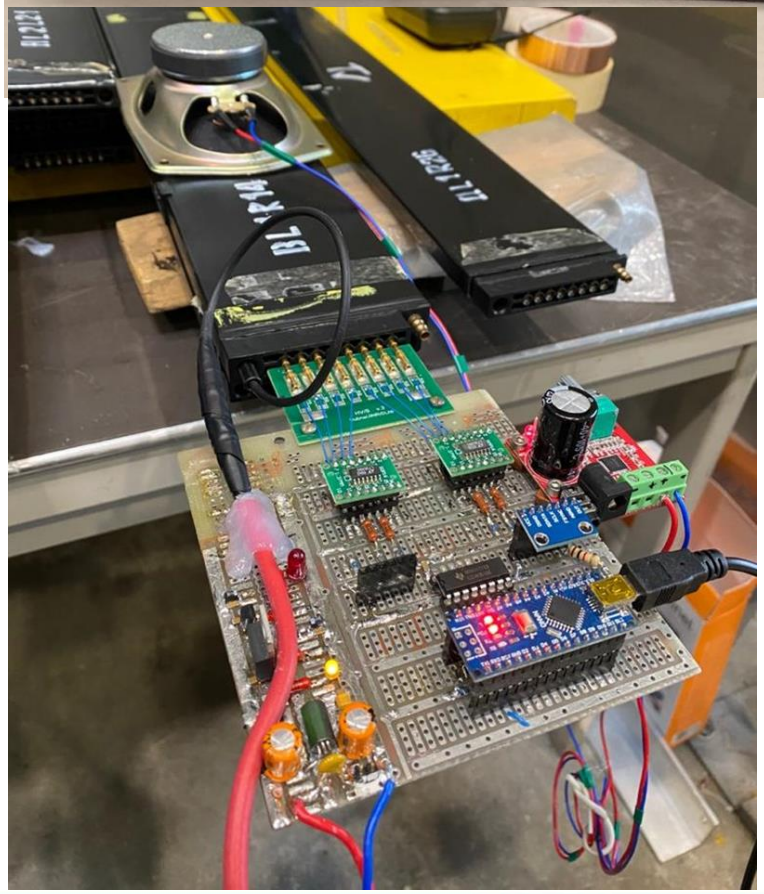
	Freq Res.(Hz)	Span(Hz)
Wire 1	124.10	2.07
Wire 2	120.70	1.17
Wire 3	121.80	1.09
Wire 4	120.40	1.01
Wire 5	118.00	1.48
Wire 6	126.00	0.90
Wire 7	116.20	0.97
Wire 8	117.90	2.34

Wires frequency responses

Working Prototype



Testing MDT Detectors

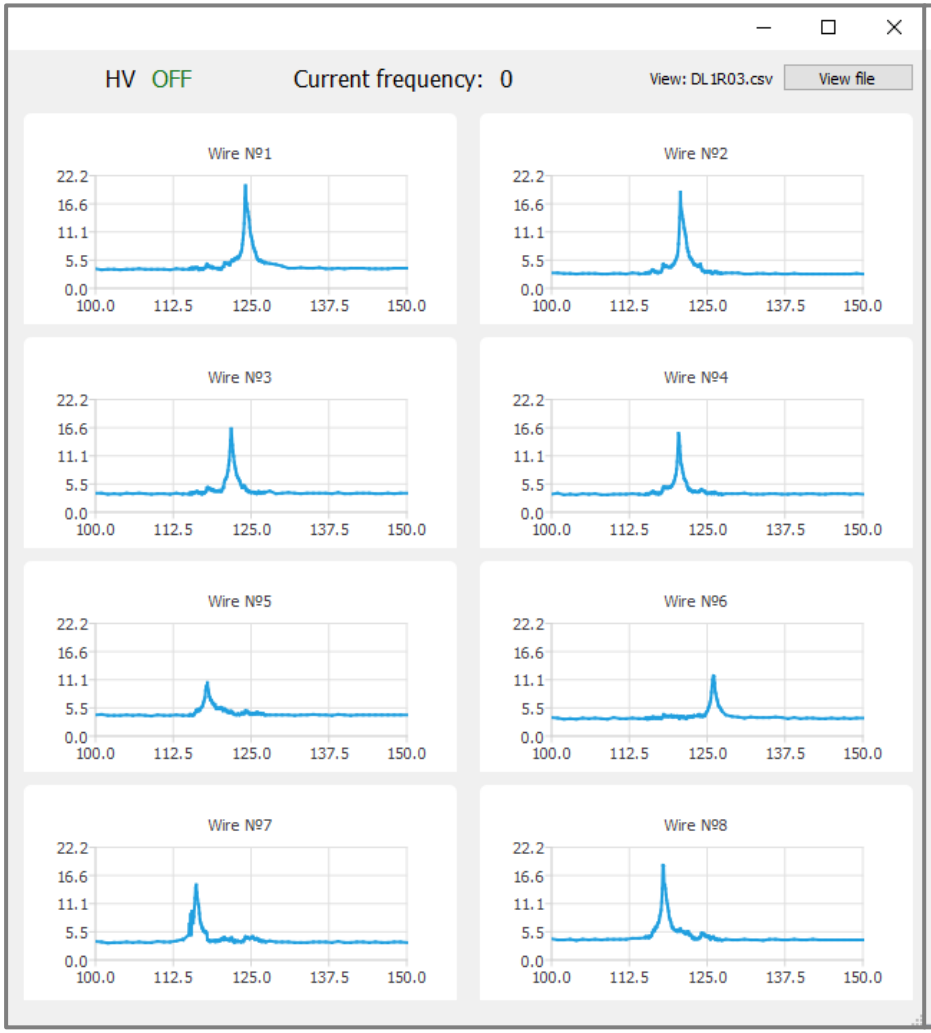


Device tuning on short MDTs produced for SPD RS Prototype

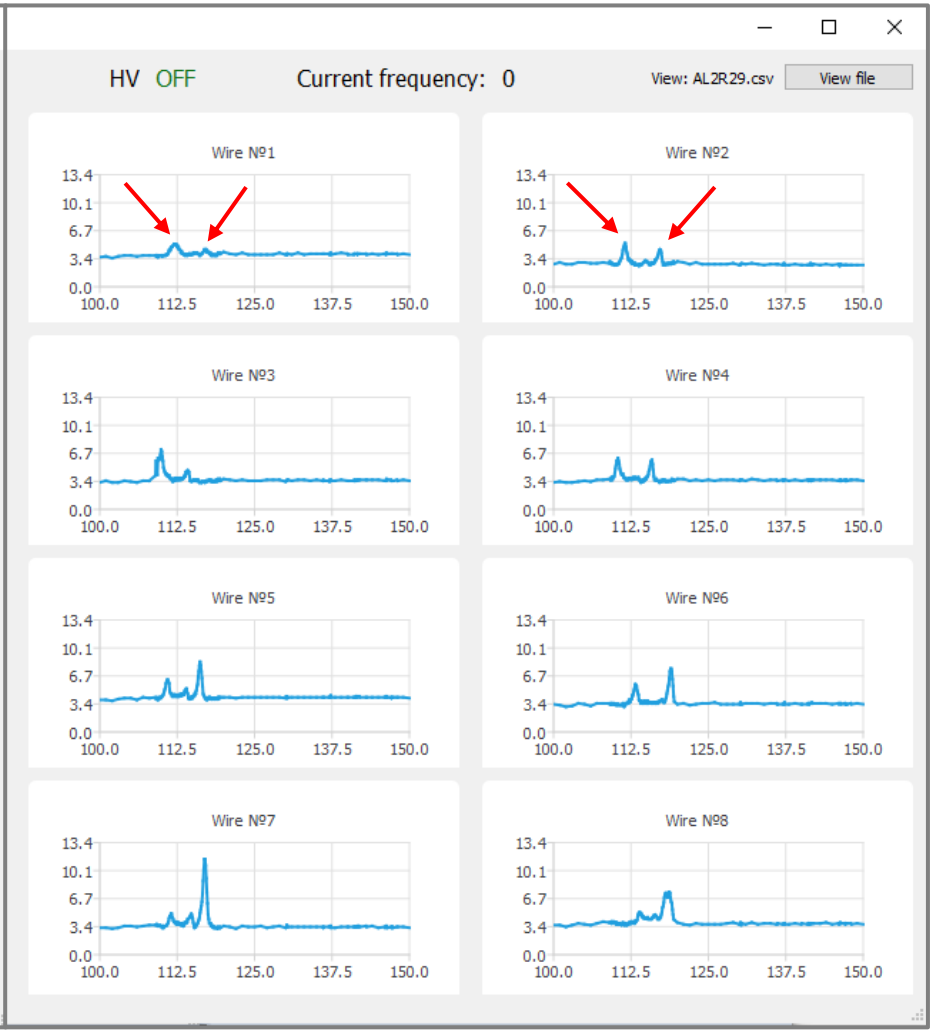
Application at the RichWall repair

Results of Testing

Short type



With a spacer/plastic support

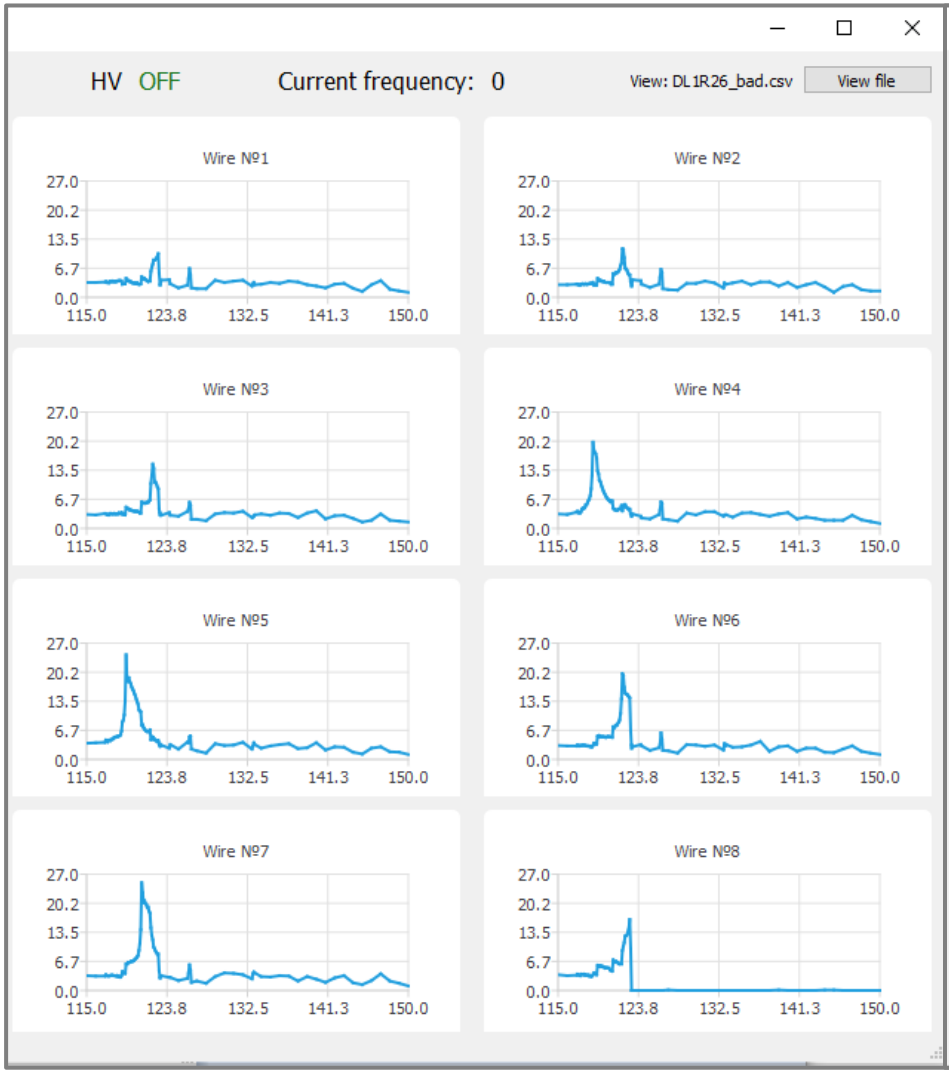


Results of Testing

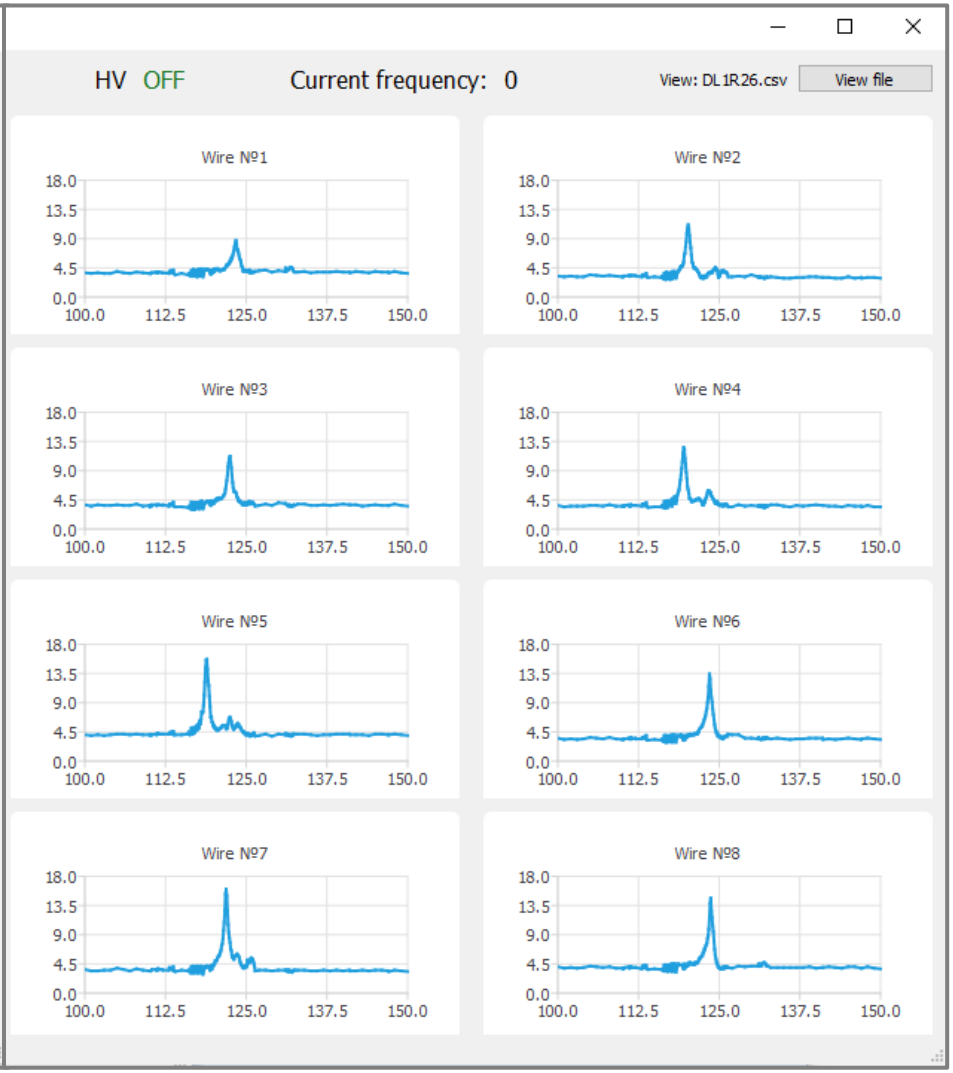
Dzhelepov Laboratory of Nuclear Problems

Joint Institute for Nuclear Research

Before repair



After repair



Conclusion

- A device for testing the tension of the anode wires in the MDT detectors has been designed and realized. It is a portable equipment compatible with Windows OS. Device is stable and fast working: one frequency step lasts for about half a second.
- The device controlling software contains all necessary options for automatic device operation and data representation, including the dynamically updated multiple charts.
- This device was successfully tested during the repair of the Rich Wall detector (COMPASS/CERN) and during the production of detectors for the prototype of the SPD Muon Range System (NICA/JINR).
- In the future new features will be added, such as the control of high voltage and data transmission/receiving via Wi-Fi.

Thank you for your attention!