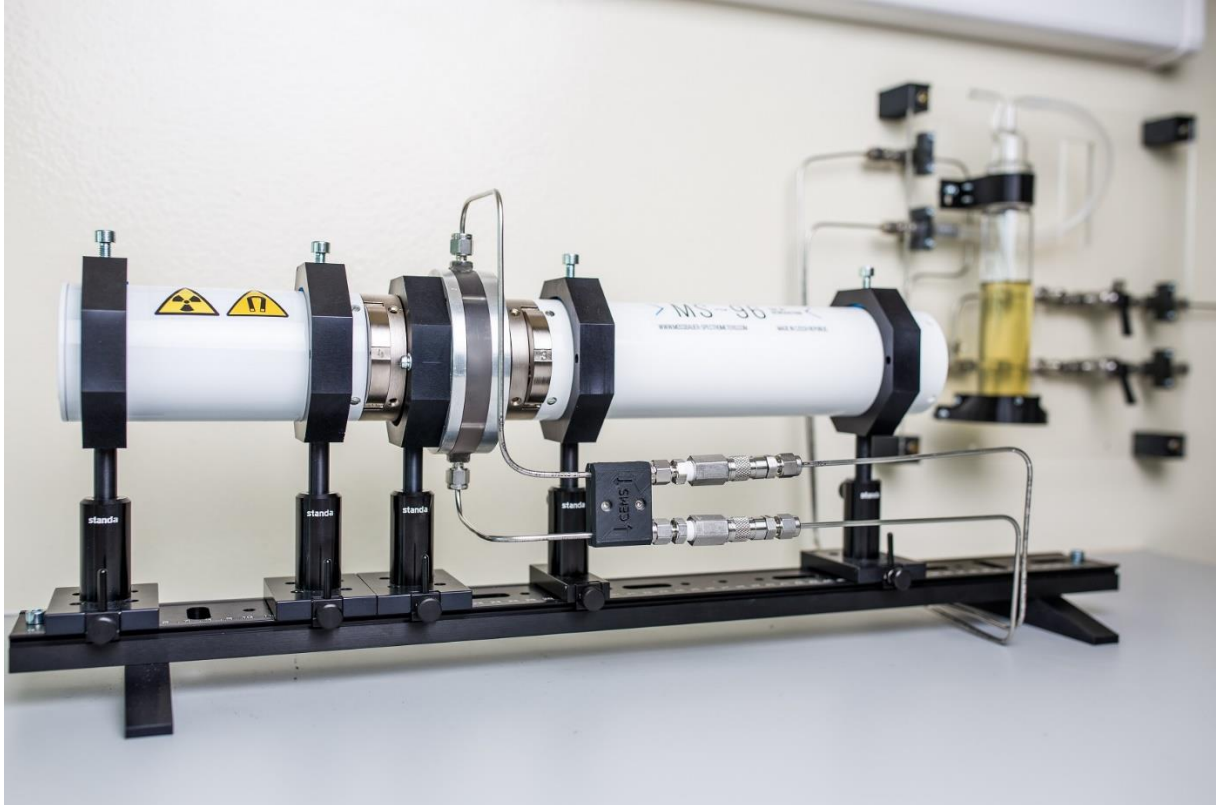


MS96 – THE 3<sup>RD</sup> GENERATION MÖSSBAUER SPECTROMETER  
**DETAILED SPECIFICATIONS**

## OUTLINE

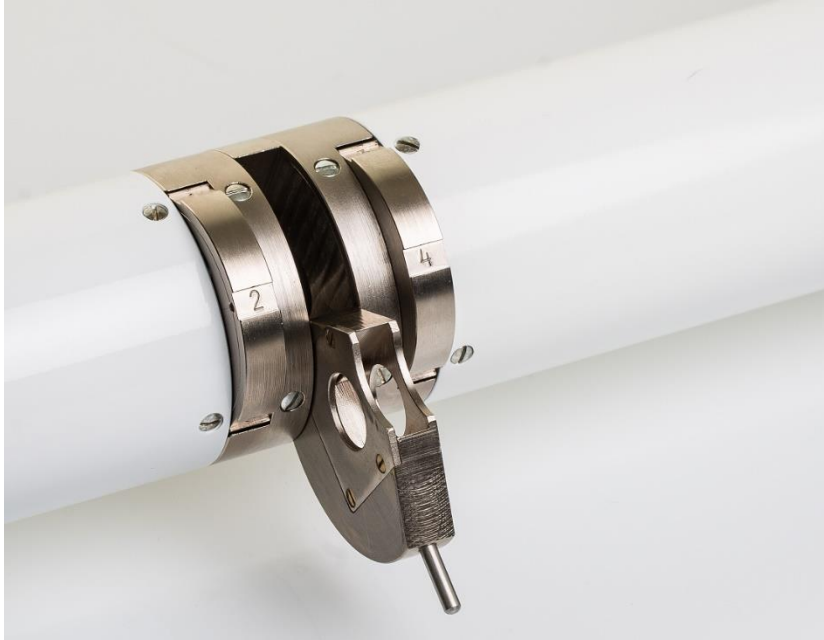
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## EXPERIMENTAL BENCH



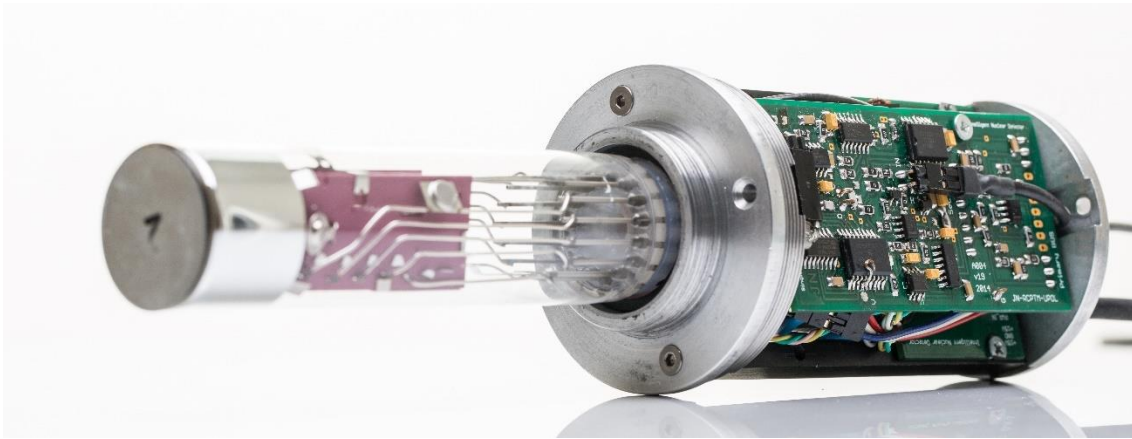
- The spectrometer experimental bench is typically installed on standard optical rail
- This mounting is simply variable and can be extended with any other devices, such as conversion detectors, high-temperature furnace, cryostat, etc.
- The size of complete experimental bench (including optical rail) is 670 x 90 x 25 mm (width x length x height).
- The weight of complete experimental bench (including optical rail) is about 5 kg.

## SAMPLE CHAMBER



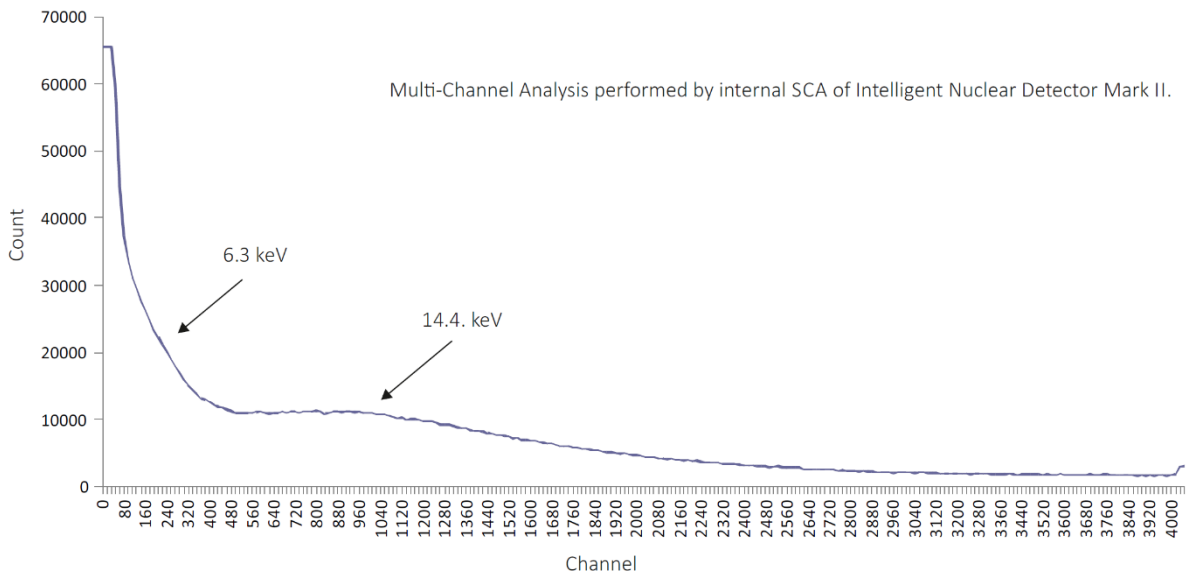
- Standard sample chamber is equipped with two collimators, which can be used for focusing of the gamma beam.
- The sample is inserted into the chamber and closed (for simple handling there are plastic sample capsules).
- The maximum sample size is 25 mm in diameter (the size can be customized).

# TRANSMISSION DETECTOR



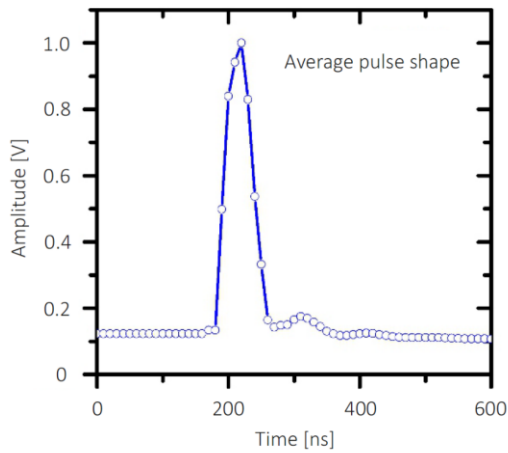
- Detector is optimized for 14.4 keV detection, but it can be simply adjusted for different energies.
- Transmission detection system is based on scintillating detector and has all necessary parts integrated in a small, compact body
- It includes:
  - o 1" YAP:Ce scintillating crystal, 0.3 mm thickness with 20nm of aluminum reflector
  - o 1" Photomultiplier, - 750 V operating voltage
  - o High voltage supply, electronically controllable up to - 1250 V
  - o Pre-amplifier + amplifier, electronically controllable amplification up to 200x
  - o Single-channel analyzer, electronically controllable, range 0 to 4 V (4000 channels).
- Electronic control:
  - o I2C interface serves for high voltage level and amplification adjustment.
  - o The detection system is also equipped with USB-I2C interface and can be simply connected to any PC.
  - o The PC application is used for high voltage and amplification control.
- Input:
  - o  $\pm 12$  V Power input (shared MIC328).
  - o I2C communication interface (shared MIC328).
- Output signal:
  - o Analog pulses, valid signal (14.4 keV) has about 1 V amplitude and 120 ns pulse-width.
  - o Single-channel analyzer output - logic TTL signal.
- Mechanical properties:
  - o Size 62 x 240 mm (diameter x length).

## Multi-channel analysis



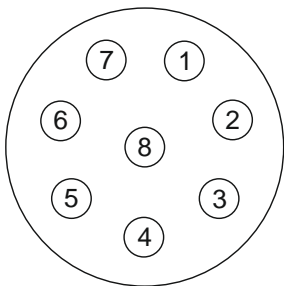
- Multi-channel analysis is performed by single-channel analyzer and PC application (step-by-step).

## Average output pulse shape (analog)



Average pulse shape was acquired as an average of 100 000 analog pulses (directly from amplifier) with amplitudes  $1 \text{ V} \pm 0.05 \text{ V}$ . For this purposes, the NI USB-5133 digitizer was used.

## MIC 328 connection



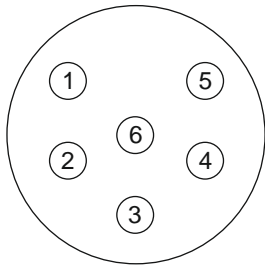
- |   |                        |                |
|---|------------------------|----------------|
| 1 | + 12 V                 |                |
| 2 | GND                    |                |
| 3 | - 12 V                 |                |
| 4 | I2C Dat                |                |
| 5 | I2C Clk                |                |
| 6 | ICSP Clk               | (service only) |
| 7 | ICSP Dat               | (service only) |
| 8 | ICSP programming power | (service only) |

# VELOCITY TRANSDUCER



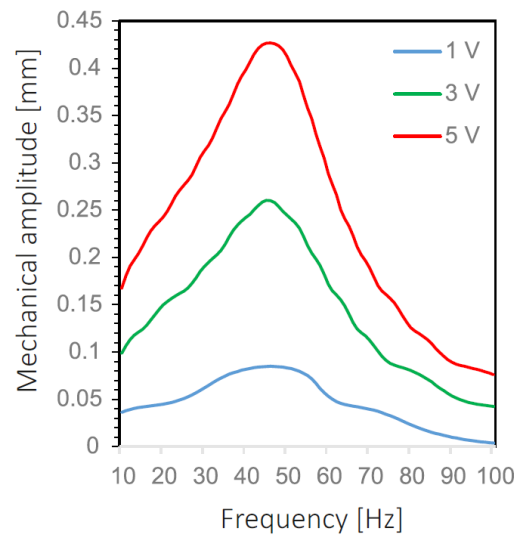
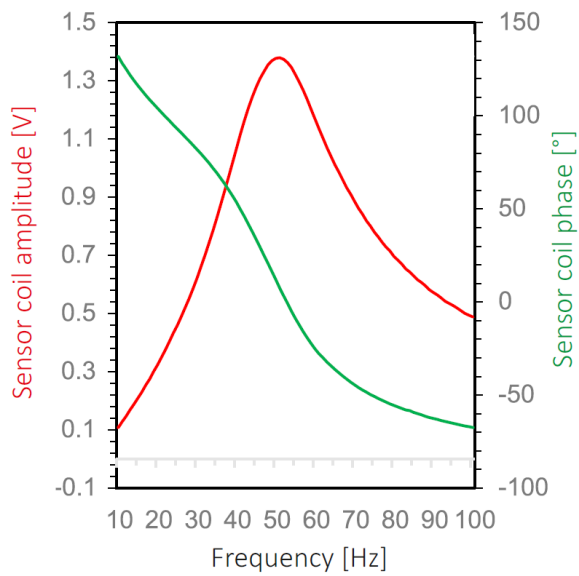
- Velocity transducer is based on two coils, which are moving inside of the strong magnetic field.
- Analogue PID velocity regulator is integrated inside of the body of the velocity transducer device.
- Operating parameters:
  - Maximum velocity range  $\pm 30$  mm/s.
  - Conversion ratio approx.  $1.6 \text{ V} = 10 \text{ mm/s}$ .
  - Non-linearity less than 0.1%.
  - Line-width  $0.276 \pm 2\%$  (MRA.2.6. calibration sample – RITVERC).
  - Resonant frequency 30 – 50 Hz (see figures below)
- Input:
  - From  $\pm 12 \text{ V}$  up to  $\pm 15 \text{ V}$  power input (MIC346 see connection below).
  - Velocity drive signal (BNC).
- Output:
  - Actual velocity signal (BNC).
  - Actual velocity error (BNC).
- Mechanical properties:
  - Two coils fixed with flexible nylon strings.
  - Four strong neodymium magnets.
  - Size 56 x 110 mm (diameter x length).

### MIC 346 connection



9	+ 12 V
10	Not connected
11	GND
12	Not connected
13	- 12 V
14	GND

### Resonant characteristics





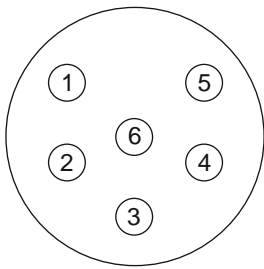
## MAIN PROCESSING UNIT



- NIM type main spectrometer unit contains all necessary spectrometer hardware.
- Stand-alone version main spectrometer unit contains all necessary spectrometer hardware plus PC).
- Spectrum registration electronics:
  - o Capable of two spectras simultaneous recording (for example transmission + conversion).
  - o Logic signal input (two BNCs).
  - o Each spectrum has 1024 channels (unfolded).
  - o Maximum channel value is  $2^{32}$  counts.
- Velocity generator:
  - o Constant acceleration symmetric regime.
  - o Velocities up to 30 mm/s (up to  $\pm 4.8$  V output).
  - o Approx. 30 Hz signal frequency.
  - o Velocity signal period consists of 32 768 points.
- Personal computer:
  - o Windows OS and spectrometer software installed.
  - o Can be connected to the internet and accessed remotely.
- Input:
  - o Stand-alone version 110V AC or 230 V AC Power input (Euro Connector).
  - o NIM version  $\pm 12$  V Power input (NIM connector).
  - o Detector 1 signal (BNC).
  - o Detector 2 signal (BNC).
  - o Standard PC IO connectors (Stand-alone version only).

- Output:
  - Velocity signal (BNC).
  - Velocity period start signal (BNC).
  - Velocity channel signal (BNC).
  - $\pm 12$  V Power output (2x MIC 336).
  - Status display (Stand-alone version only).

### MIC 336 connection



- |   |               |
|---|---------------|
| 1 | + 12 V        |
| 2 | Not connected |
| 3 | GND           |
| 4 | Not connected |
| 5 | - 12 V        |
| 6 | GND           |

### Stand-alone version



### NIM version

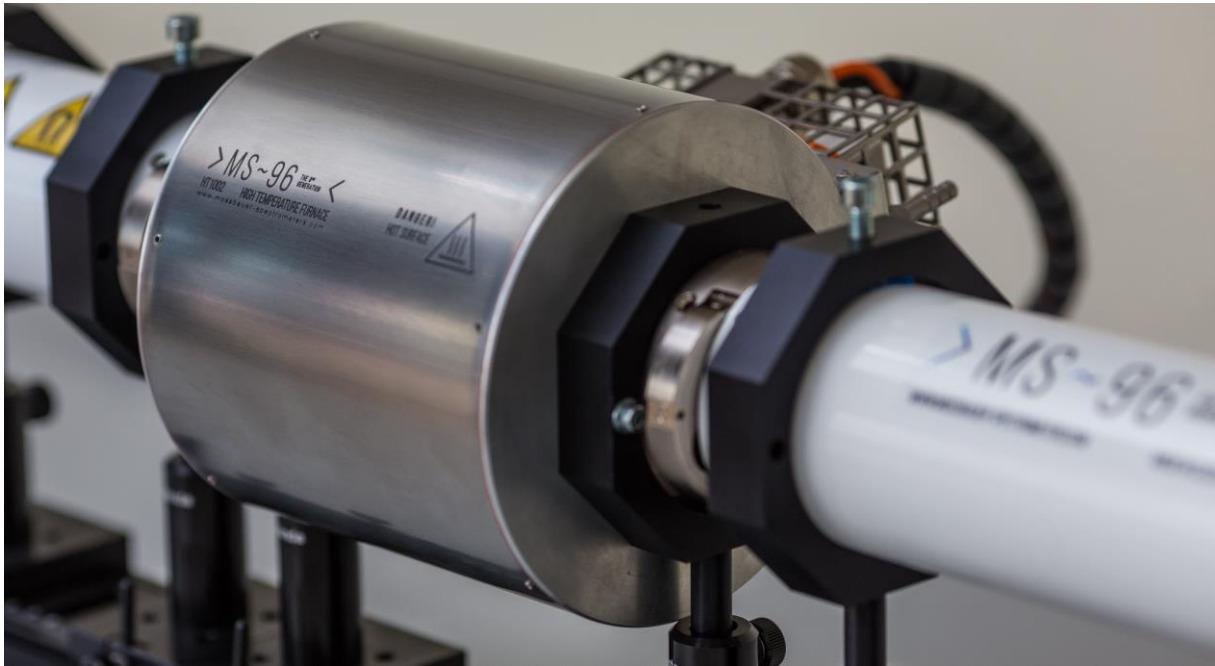


## CONVERSION DETECTORS



- Gas flow detector designed for conversion electron (or x-rays) detection.
- This detection allows user to study the surface of sample.
- All necessary electronics, such as amplifiers and high voltage power supply is built in separated body or in standard NIM housing.
- Operating parameters for conversion electrons detection:
  - o 90%He + 10%CH<sub>4</sub> gas mixture
  - o 1 600 V – 1 800 V high voltage level
  - o Depth sensitivity approx. 200 nm (highly depends on sample)
- Operating parameters for X-rays detection:
  - o 90%Ar + 10%CH<sub>4</sub> gas mixture
  - o 1 600 V – 1 800 V high voltage level
  - o Depth sensitivity approx. 10 μm (highly depends on sample)
- Input of detector:
  - o High voltage up to 2000 V for detector (SHV)
- Input of signal processing electronics:
  - o ± 12 V Power input
  - o ± 24 V Power input
  - o I2C communication interface
- Output of signal processing electronics:
  - o High voltage
  - o Analog pulses, valid signal has about 1 V amplitude and 120 ns pulse-width.
  - o Single-channel analyzer output - logic TTL signal.

## HIGH-TEMPERATURE FURNACE



- High temperature furnace can be easily inserted into standard transmission setup.
- Operating parameters:
  - o Temperature range from room-temperature up to 1000°C (1 273.13 K).
  - o Sealed construction allows usage of gas filling (for example inert gas).
  - o Separated controller for temperature control.

## LOW-TEMPERATURE GEOMETRY



- The spectrometer can be also easily equipped with low-temperature cryostat.
- For this purpose, the optical rail is separated and mounted on sides of any type of cryostat.

## LOW-TEMPERATURE NITROGEN CRYOSTAT



- Low-temperature nitrogen cryostat is a bath type cryostat (it requires liquid nitrogen filling).
- Operating parameters:
  - o Temperature range from room-temperature down to 100 K.
  - o Temperature sensor is mounted near to sample (approx. 2 mm).
  - o Temperature is controlled by PC application.