

# Semiconductor Detectors & Nuclear Electronics for Radiation Measurements



# Baltic Scientific Instruments, Ltd.

Baltic Scientific Instruments (BSI) was established in 1994 on the basis of Riga Research and Development Institute for Radio-Isotope Apparatus (RNIIRP, est.1966), which belonged to the Ministry for Atomic Energy of the former Soviet Union. RNIIRP had Union-wide responsibility for the development of instruments for radiation detection and measurement for the atomic energy industry, mining, oil and gas industries, space and military applications. RNIIRP developed a broad range of products, and the highest level of technical knowledge and skills to meet the most sophisticated technological demands of the Soviet Union. These are the foundations of the capabilities that BSI now brings to global markets.

Since its founding as a private enterprise BSI has specialized in the development and fabrication of devices for spectrometric analysis based on semiconductor and scintillation radiation detectors. Our products are applied in multiple industries: nuclear power; environmental monitoring; geophysics and the mining industry; medicine and healthcare; research including space sciences; security systems and customs control; and other spheres. To succeed in global markets for radiation detection and analysis equipment BSI has mastered the most demanding quality standards in each market where we have chosen to compete. See our Quality Policy.

BSI is headquartered in Riga, Latvia, one of the most livable cities in Europe with an exceptional cultural life, attractive homes, good schools and within a short drive of rural Latvia as well as some of the finest beaches in Northern Europe. Riga has been called the culture capital of Europe and has been featured as a prime tourist destination.

The Company Baltic Scientific Instruments is certified to ISO 9001:2015 by TÜV Rheinland.



# P-type HPGe Coaxial Detectors GCD

(Liquid Nitrogen cooled)

## Application

Detection of Gamma-rays in nuclear industry and environmental control, in scientific research, medicine and other applications.

### Complete set (standard)

- HPGe coaxial detector
- Preamplifier with State-of-Health (SHP) feature
- Dewar vessel
- Cable set
- Documentation

### Accessories (optional)

- Multichannel Analyzer (MCA)
- Analytical Software packages:
  - quantitative and qualitative analysis
  - $\gamma$ -spectra modeling & efficiency registration calculation for complex geometry objects
  - extended radionuclide library
- Liquid nitrogen storage and filling system
- Liquid nitrogen sensor and monitor
- Cable set extension

## Features

- 10% - 160% and higher efficiency HPGe coaxial detectors are available
- Energy range 40 keV - 10 MeV
- Input window materials: Aluminum
- Built-in or Remote Preamplifier types are available depending on application
- Low instrument background
- High energy rate up to 200000 MeV/s
- Excellent peak symmetry & high resolution
- HV supply protection if detector is warm
- High count rate indicator
- Variable cryostat design modifications

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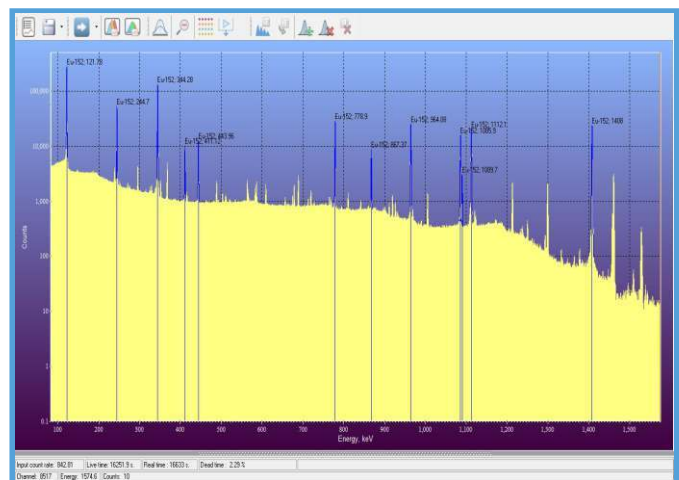
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# Specification

Model	Relative Efficiency, %	Energy resolution		Peak/Compton ratio	Peak Shape	
		122 keV, (eV)	1.33 MeV, (keV)		FW.1M FWHM	FW.02M FWHM
GCD - 10 175	10	800	1.75	41:1	1.9	2.65
GCD - 15 180	15	825	1.80	46:1	1.9	2.65
GCD - 20 180	20	850	1.80	51:1	1.9	2.65
GCD - 25 185	25	850	1.85	55:1	1.9	2.65
GCD - 30 185	30	875	1.85	58:1	1.9	2.65
GCD - 35 190	35	875	1.90	60:1	1.9	2.65
GCD - 40 190	40	895	1.90	62:1	1.9	2.65
GCD - 50 190	50	895	1.90	64:1	1.9	2.65
GCD - 60 200	60	1000	2.00	68:1	2.0	3.00
GCD - 70 200	70	1000	2.00	73:1	2.0	3.00
GCD - 80 210	80	1000	2.10	77:1	2.0	3.00
GCD - 100 220	100	1000	2.10	81:1	2.0	3.00
GCD - 120 220	120	1000	2.10	83:1	2.0	3.00
GCD - 140 220	140	1100	2.20	86:1	2.0	3.00
GCD - 160 220	160*	1150	2.20	88:1	2.0	3.00

\* Detectors with other relative efficiencies are available.

## Plenty of cryostat geometries available







# P-type HPGe Coaxial Detectors GCDX

(with extended energy range)

## Application

Detection of Gamma- and X-rays in nuclear industry and environmental control, in scientific research, medicine and other applications.

### Complete set (standard)

- HPGe coaxial detector
- Preamplifier with State-of-Health (SHP) feature
- Dewar vessel
- Cable set
- Documentation

### Accessories (optional)

- Multichannel Analyzer (MCA)
- Analytical Software packages:
  - quantitative and qualitative analysis
  - $\gamma$ -spectra modeling & efficiency registration calculation for complex geometry objects
  - extended radionuclide library
- Liquid nitrogen storage and filling system
- Liquid nitrogen sensor and monitor
- Cable set extension

## Features

- 10% - 100% and higher efficiency HPGe coaxial detectors are available
- **Extended energy range 3 keV - 10 MeV**
- Input window materials: Aluminum, Beryllium or Carbon-fiber
- Built-in or Remote Preamplifier types are available depending on application
- Low instrument background
- High energy rate up to 200000 MeV/s
- Excellent peak symmetry & high resolution
- HV supply protection if detector is warm
- High count rate indicator
- Variable cryostat design modifications

Gamma-rays

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# Specification

Model	Relative Efficiency, %	Energy resolution			Peak/Compton ratio	Peak Shape	
		5.9 keV, (eV)	122 keV, (eV)	1.33 MeV, (keV)		FW.1M FWHM	FW.02M FWHM
GCDX - 10 175	10	400	720	1.75	41:1	1.9	2.65
GCDX - 15 180	15	450	740	1.80	46:1	1.9	2.65
GCDX - 20 180	20	460	760	1.80	51:1	1.9	2.65
GCDX - 25 185	25	480	775	1.85	55:1	1.9	2.65
GCDX - 30 185	30	500	800	1.85	58:1	1.9	2.65
GCDX - 35 190	35	550	830	1.90	60:1	1.9	2.65
GCDX - 40 190	40	600	850	1.90	62:1	1.9	2.65
GCDX - 50 190	50	620	875	1.90	64:1	1.9	2.65
GCDX - 60 200	60	670	900	2.00	68:1	2.0	3.00
GCDX - 70 200	70	700	950	2.00	73:1	2.0	3.00
GCDX - 80 210	80	750	950	2.10	77:1	2.0	3.00
GCDX - 100 210	100*	800	1000	2.10	81:1	2.0	3.00

\* Detectors with other relative efficiencies are available

Energy range:

3 keV - 10 MeV with Be input window

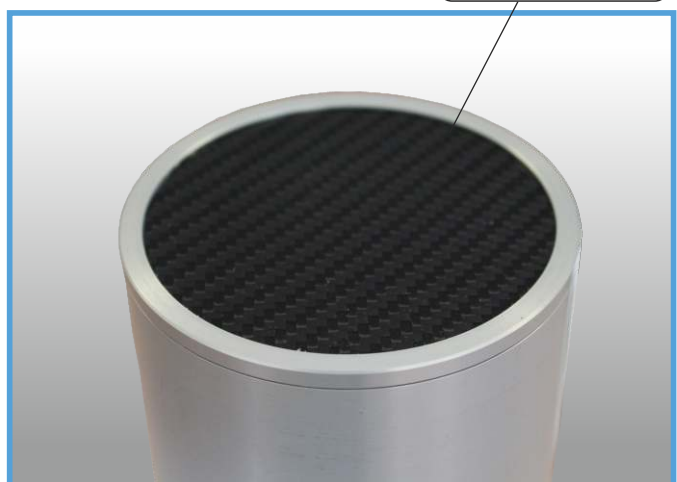
5 keV - 10 MeV with carbon fiber input window

## Advantages

- HPGe detectors with extended energy range GCDX provide outstanding performance not only as regular coaxial detectors but also allowing to go lower in energy range down to 3 keV.
- Thin contact structure of the HPGe detector accompanying with input window made of Beryllium or Carbon fiber guarantee low energy photon transition to the HPGe crystal and its registration.
- Input window of the detector is integrated into the end cap of the detector by using high-tech vacuum-tight materials



Beryllium  
input window



Carbon fiber  
input window



# P-type HPGe Over-Square shape Detectors

(with extended energy range)

## GCDX-OS

### Application

Detection of Gamma- and X-rays in nuclear industry and environmental control, in scientific research, medicine and other applications.

#### Complete set (standard)

- HPGe coaxial detector
- Preamplifier with State-of-Health (SHP) feature
- Dewar vessel
- Cable set
- Documentation

#### Accessories (optional)

- Multichannel Analyzer (MCA)
- Analytical Software packages:
  - quantitative and qualitative analysis
  - $\gamma$ -spectra modeling & efficiency registration calculation for complex geometry objects
  - extended radionuclide library
- Liquid nitrogen storage and filling system
- Liquid nitrogen sensor and monitor
- Cable set extension

### Features

- 10% - 100% and higher efficiency HPGe coaxial detectors are available
- **Extended energy range 3 keV - 10 MeV**
- Input window materials: Aluminum, Beryllium or Carbon-fiber
- Built-in or Remote Preamplifier types are available depending on application
- Low instrument background
- High energy rate up to 200000 MeV/s
- Excellent peak symmetry & high resolution
- HV supply protection if detector is warm
- High count rate indicator
- Variable cryostat design modifications

Gamma-rays

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# Specification

Model	Relative Efficiency, %	Sensitive area, mm <sup>2</sup>	Thickness, mm	Energy resolution		
				at 5.9 keV (eV)	at 122 keV (eV)	at 1.33 MeV (keV)
OS-06350	6	1590	15	350	650	1.75
OS-07390	7.5	2000	15	390	650	1.80
OS-10350	9	2000	20	350	650	1.90
OS-12375	12	2000	35	375	680	1.90
OS-13400	13	2800	20	400	700	1.90
OS-18400	18	2800	25	400	700	1.90
OS-20450	20	3800	20	450	750	1.90
OS-26450	26	3800	25	450	750	1.90
OS-34450	34	3800	30	450	750	1.90
OS-37500	37	5000	25	500	750	2.00
OS-48500	48	5000	30	500	750	2.00
OS-60500	60*	6000	30	500	750	2.00

\* Detectors with other relative efficiencies are available.

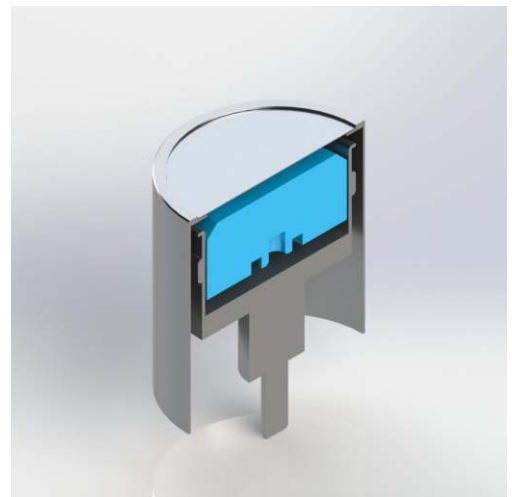
Energy range:

3 keV - 10 MeV with Be input window

5 keV - 10 MeV with carbon fiber input window

## Advantages

- HPGe detectors with extended energy range GCDX-OS are different from GCDX by its shape. It is still allowing to go lower in energy range down to 3 keV and thin contact structure of the HPGe detector guarantee low energy photon transition to the HPGe crystal and its registration.
- Input window made of Beryllium or Carbon fiber of the detector is integrated into the end cap of the detector by using high-tech vacuum-tight materials.
- GCDX-OS HPGe detectors are showing way better performance, such as resolution improvement, if you consider energy range from 100 keV to 662 keV. This is vitally important for those applications where radionuclides with lower energies are required to measure and analyze.
- Over-square shape HPGe crystals of the GCDX-OS detectors provide better efficiency while measuring relatively compact samples like bottles, vials, petri dishes, etc.
- Increase of efficiency is observed due to the fact that HPGe crystal is having similar volume to GCD and GCDX detector but larger diameter in relationship to its height. Therefore, relative intensity and efficiency are higher in energy range 1.5-2 MeV.



Over-Square shape HPGe crystal





# HPGe Planar Detectors GPD

(Liquid Nitrogen cooled)

## Application

Detection of Gamma and X-rays in nuclear energetics and environmental control, in industry and scientific research, in medicine and other applications.

## Complete set (standard)

- HPGe planar detector
- Preamplifier with State-of-Health (SHP) feature
- Dewar vessel
- Cable set
- Documentation

## Accessories (optional)

- Multichannel Analyzer
- Analytical Software packages:
  - quantitative and qualitative analysis
  - $\gamma$ -spectra modeling & efficiency registration calculation for complex geometry objects
  - extended radionuclide library
- Liquid nitrogen storage and filling system
- Liquid nitrogen sensor and monitor
- Cable set extension

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# Specification

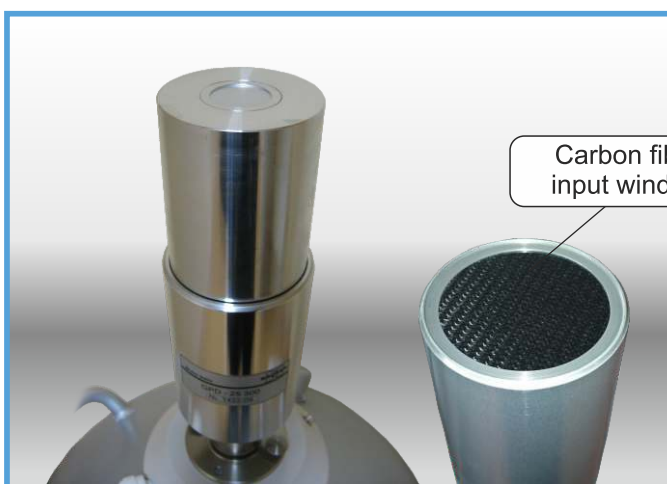
Model	Diameter, mm	Detector Sensitive Area		Energy resolution, eV	
		Area, mm <sup>2</sup>	Thickness, mm	5.9 keV	122 keV
GPD - 05 145	5	20	6	145	465
GPD - 08 155	8	50	6	155	485
GPD - 12 165	12	100	7	165	490
GPD - 12 160	12	100	10	160	490
GPD - 16 180	16	200	11	180	495
GPD - 25 300	25	500	13	300	545
GPD - 36 360	36	1000	13	360	585
GPD - 36 300	36	1000	15	300	560

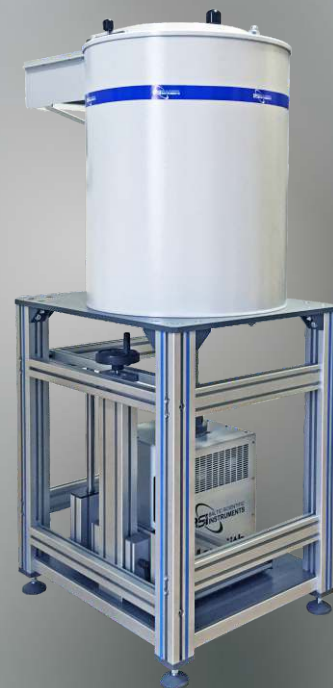
\* Detectors with other parameters are available

## Features

- Built-in or Remote Preamplifier types are available depending on application
- Ability to increase energy rate to 20000 MeV/s
- Energy range from 3 keV to 1500 keV (2500 keV)
- Input window materials: Aluminum, Beryllium or Carbon-fiber
- Excellent peak symmetry & high resolution
- HV supply protection if detector is warm
- High count rate indicator
- Variable cryostat design modifications

## Plenty of cryostat geometries available





# Well-type HPGe Detectors GWD

(Liquid Nitrogen cooled)

## Application

Detection of Gamma-rays in nuclear energetics and environmental control, in industry and scientific research, in nuclear medicine and other applications.

## Complete set (standard)

- HPGe Well-type detector
- Preamplifier with State-of-Health (SHP) feature
- Dewar vessel
- Cable set
- Documentation

## Accessories (optional)

- Multichannel Analyzer (MCA)
- Analytical Software packages:
  - quantitative and qualitative analysis
  - $\gamma$ -spectra modeling & efficiency registration calculation for complex geometry objects
  - extended radionuclide library
- Lead Shielding for low background measurements
- Liquid nitrogen storage and filling system
- Liquid nitrogen sensor and monitor
- Cable set extension

## Features

- 15% - 70% efficiency HPGe detectors are available
- Sensitive volume available from 90 cm<sup>3</sup> to 360 cm<sup>3</sup>
- Energy range from 20 keV to 10 MeV
- Well materials: Aluminum or Carbon-fiber
- Thin "dead" layer to provide excellent efficiency
- Built-in or Remote Preamplifier types are available
- Almost 4 $\pi$  geometry measurement
- Low instrument background
- High energy rate up to 200000 MeV/s
- Excellent peak symmetry & high resolution
- HV supply protection if detector is warm
- High count rate indicator
- Variable cryostat design modifications

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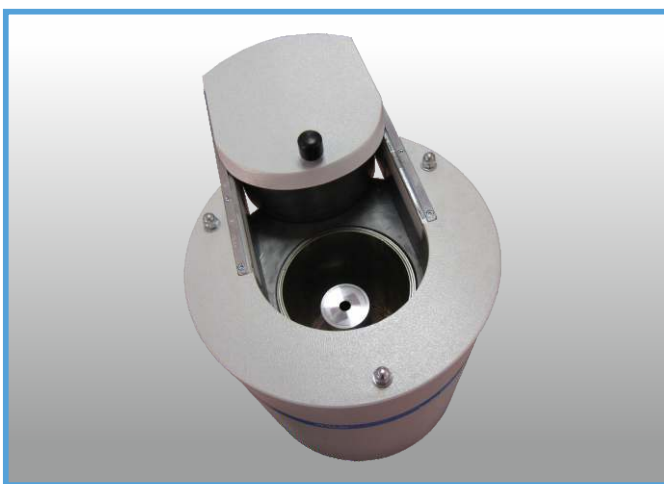
Gamma-rays

# Specification

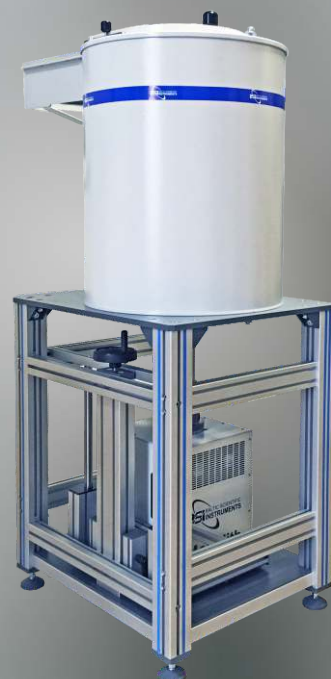
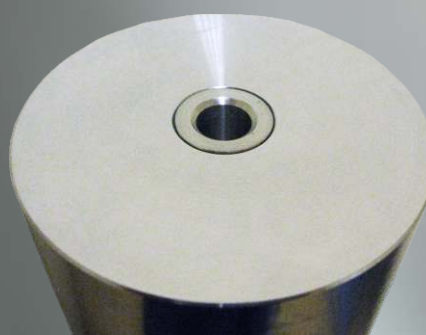
Model	Well diameter	Nominal volume (cc)	Energy Resolution	
			FWHM 122 keV	FWHM 1332 keV
GWD - 15 20	10	90	1.1	2.0
GWD - 15 22	16	100	1.3	2.2
GWD - 20 20	10	110	1.1	2.0
GWD - 20 22	16	120	1.3	2.2
GWD - 25 22	10	130	1.1	2.2
GWD - 25 23	16	140	1.3	2.3
GWD - 30 22	10	150	1.2	2.2
GWD - 30 23	16	160	1.4	2.3
GWD - 35 22	10	170	1.2	2.2
GWD - 35 23	16	180	1.4	2.3
GWD - 40 22	10	190	1.2	2.2
GWD - 40 23	16	200	1.4	2.3
GWD - 60 23	10	280	1.45	2.3
GWD - 70 24	10	360	1.45	2.4
GWD - 70 24	16	360	1.45	2.4

\* Detectors with other parameters are available.

## Plenty of cryostat geometries available







# Well-type HPGe Detectors GWDX

(Liquid Nitrogen cooled)

## Application

Detection of Gamma-rays in nuclear energetics and environmental control, in industry and scientific research, in nuclear medicine and other applications.

### Complete set (standard)

- HPGe Well-type detector
- Preamplifier with State-of-Health (SHP) feature
- Dewar vessel
- Cable set
- Documentation

### Accessories (optional)

- Multichannel Analyzer (MCA)
- Analytical Software packages:
  - quantitative and qualitative analysis
  - $\gamma$ -spectra modeling & efficiency registration calculation for complex geometry objects
  - extended radionuclide library
- Lead Shielding for low background measurements
- Liquid nitrogen storage and filling system
- Liquid nitrogen sensor and monitor
- Cable set extension

## ADVANTAGES

- Detection of Gamma-rays in nuclear energetics and environmental control, in industry and scientific research, in nuclear medicine and other applications.
- Dead layer of the GWDX detectors inside of the well is thinner if to compare to GWD detectors. Therefore, lower limit of the energy range for this type of detectors is way lower than of GWD well-type detectors and is much lower than 20 keV.
- Moreover, special production technology of GWDX detectors allow to guarantee energy resolution at 122 keV not worse than 750-850 eV. Energy range of GWDX HPGe well-type detectors can reach 5 keV.

Gamma-rays

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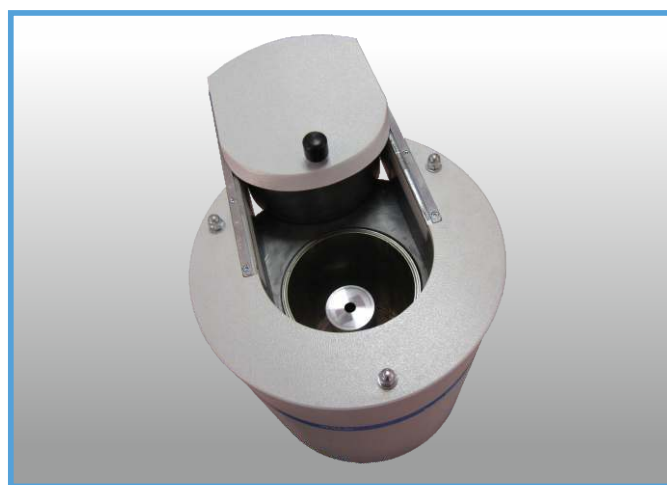
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# Specification

Model	Well diameter	Nominal volume (cc)	Energy Resolution	
			FWHM 122 keV	FWHM 1332 keV
GWDX - 15 20	10	90	<b>0.75</b>	2.0
GWDX - 15 22	16	100	<b>0.8</b>	2.2
GWDX - 20 20	10	110	<b>0.75</b>	2.0
GWDX - 20 22	16	120	<b>0.8</b>	2.2
GWDX - 25 22	10	130	<b>0.75</b>	2.2
GWDX - 25 23	16	140	<b>0.8</b>	2.3
GWDX - 30 22	10	150	<b>0.8</b>	2.2
GWDX - 30 23	16	160	<b>0.85</b>	2.3
GWDX - 35 22	10	170	<b>0.75</b>	2.2
GWDX - 35 23	16	180	<b>0.8</b>	2.3
GWDX - 40 22	10	190	<b>0.75</b>	2.2
GWDX - 40 23	16	200	<b>0.8</b>	2.3
GWDX - 60 23	10	280	<b>0.8</b>	2.3
GWDX - 70 24	10	360	<b>0.8</b>	2.4
GWDX- 70 24	16	360	<b>0.85</b>	2.4

\* Detectors with other parameters are available.

## Plenty of cryostat geometries available





# MONOLITH

## HPGe Detectors with Stirling-cycle refrigerator

### Complete set (standard)

Detection unit Monolith consists from the following integrated components:

- HPGe detector
- Preamplifier with State-of-Health (SHP) feature
- Long-lasting Stirling cooler with low power consumption
- Controller for Stirling cooler
- Protective housing

### Accessories (optional)

- Multichannel Analyzer (MCA)
- Analytical Software packages:
  - quantitative and qualitative analysis
  - $\gamma$ -spectra modeling & efficiency registration calculation for complex geometry objects
  - extended radionuclide library
- Collimator set
- Lead shield with supporting table
- Hand-cart or tripod

### Features

- 10% - 160% efficiency HPGe p-type coaxial detectors are available;
- Energy range from 40 keV to 10 MeV for GCD model;
- Energy range from 3 keV to 10 MeV for GCDX/GCDX-OS models;
- High efficiency of radiation detection;
- High energy rate up to 200000 MeV/sec;
- Excellent peak symmetry;
- Detection of radiation in any spatial orientation depending on cryostat modification;
- Low background and Ultra - low background materials are available.

# Specification

Parameter	Value
HPGe detector relative efficiency	30 %*
Energy resolution**	
at 122 keV	< 850 eV
at 1.33 MeV	< 1900 eV
Peak to Compton ratio	52 : 1
Energy range of detector operation	5*** keV – 3 MeV
Peak shape	
FWTM/FWHM	< 2
FW.02M/FWHM	< 3
Endcap window material	Al / Be / Carbon fibre
Cooling time of the detector, hours	8-10
Orientation in space	Any
AC Power supply	230 V; 50/60 Hz
Power consumption, max	250 W
Power consumption, nominal	120 W
Range of the operating temperatures	0 ... +40, °C
Detection unit weight	21 kg

\* Detectors with higher efficiency are available

\*\* Energy resolution measured in accordance with ANSI/IEEE Std. 325-1996 using Multichannel Analyzer manufactured at BSI.

\*\*\* Depending on detector type and input window.



No LN<sub>2</sub>  
required



Gamma-rays





# Portable HPGe Gamma-ray Detectors

(Liquid Nitrogen cooled)

## Application

Detection, accumulation and processing of gamma spectra in field and industry conditions where small dimensions and weight of spectrometer are important.

## Complete set (standard)

- HPGe coaxial detector
- Preamplifier with State-of-Health (SHP) feature
- Dewar vessel
- Cable set
- Documentation

## Features

- Light weight aluminum construction
- Detection of radiation in any spatial orientation
- Compact low-consuming electronics
- Available with HPGe Coaxial or Planar detector
- Transportation and storage without cooling
- Input window materials: Aluminum, Beryllium or Carbon-fiber
- Dewar vessels available with different volumes from 1l to 7l

## Accessories (optional)

- Multichannel Analyzer
- Analytical Software packages:
  - quantitative and qualitative analysis
  - $\gamma$ -spectra modeling & efficiency registration calculation for complex geometry objects
  - extended radionuclide library
- Hand-cart for Multichannel Analyzer, battery, transformer, etc.
- Additional batteries
- Charger
- Collimators
- Transport case
- Tripod
- Liquid nitrogen storage and filling system
- Cable set extension

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# Specification

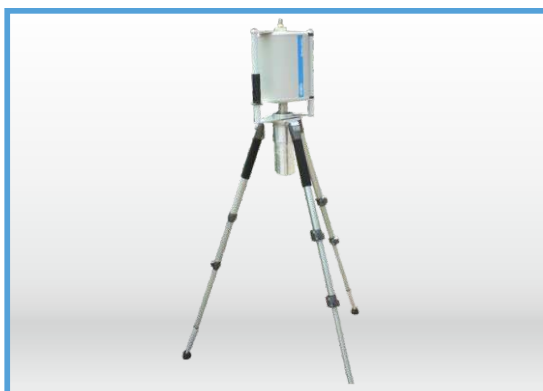
Parameter	Value
Energy range, keV	
Standard	40 - 10000
Extended	3 - 10000
HPGe detector efficiency, %	30*
Energy resolution for 30% efficiency detector, keV at energy	
122 keV	0.875
1.33 MeV	1.85
Peak to Compton ration	58:1
Time of cooling after filling with liquid nitrogen, h	4 - 8**
Time of continuous operation, days	1 - 5**
Al end cup thickness, mm	0.7
Weight of detector with empty Dewar vessel, kg	5 - 12**
Preamplifier cables have standard NIM connectors: POWER DC $\pm 12V$ – D-Sub-9pin, HV – SHV, OUT – BNC, TEST – BNC	

\* HPGe Detectors are available with efficiency from 10% to 100%

\*\* Depending on Dewar vessel volume and/or detector efficiency



## Accessories





# Laboratory HPGe Detector with Lead Shield

(Liquid Nitrogen cooled)

## Application

Radionuclide monitoring of environmental objects (solid, powder, liquid), medicine and biological objects, materials and food.

## Features

- Available in Vertical and U-type cryostat
- Adopting precision gamma-spectrometry methods
- Radionuclide identification and determination of their specific activity
- Low instrumental background
- Low threshold for radionuclide detection
- Separate and simultaneous measurement of activity of 100 radionuclides
- Several grades of instrument material (Al, Cu, etc.) radiopurity are available (ref. p. 59):
  - Standard
  - Low-background
  - Ultra low-background

## Complete set (standard)

- HPGe coaxial detector
- Preamplifier with State-of-Health (SHP) feature
- Dewar vessel
- Lead Shield with a supporting table
- Liquid nitrogen sensor and level monitor
- Cable set
- Documentation

## Accessories (optional)

- Multichannel Analyzer (MCA)
- Analytical Software packages:
  - quantitative and qualitative analysis
  - $\gamma$ -spectra modeling & efficiency registration calculation for complex geometry objects
  - extended radionuclide library
- Liquid nitrogen storage and filling system
- Electrically driven lead door
- Cable set extension

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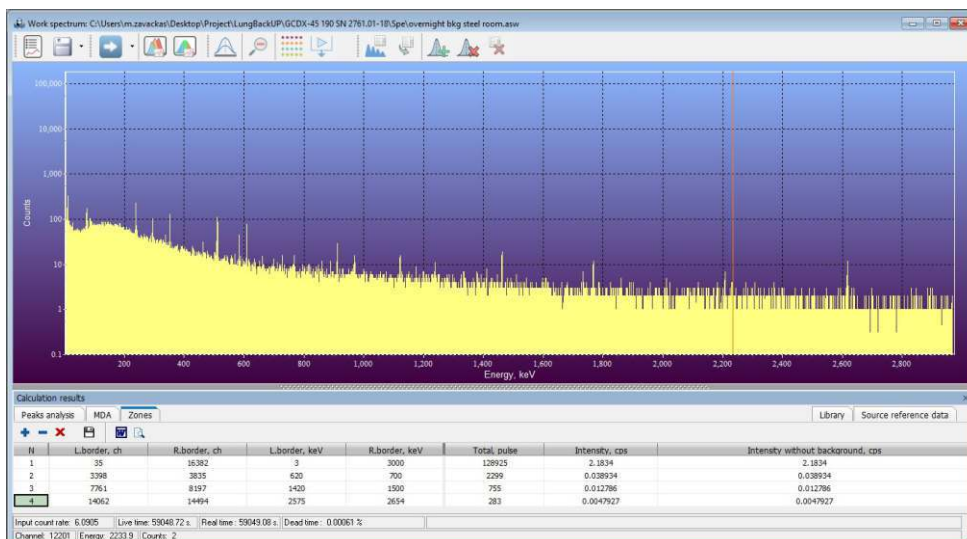
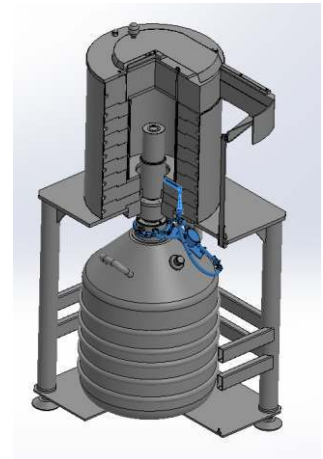
# Specification

Parameter	Standard	Low background	Ultra low background
Detection limit for $^{137}\text{Cs}$ radionuclide specific activity, 30%* efficiency detector, measurement time 1 hour, Bq/kg	0.7	0.3	0.1
Absolute sensitivity to gamma flux for 30%* efficiency detector, pulse/quantum	$4.5 \times 10^{-3}$	$4.5 \times 10^{-3}$	$4.5 \times 10^{-3}$
Instrumental background intensity for energy range from 40 keV to 3 MeV, pulse x s	< 4.5	< 1.5	< 0.5
$^{137}\text{Cs}$ radionuclide specific activity measurement error for 1 hour measurement time, %	< 20	< 20	< 20
Shield thickness			
Lead wall, mm	100	100	100 - 150
Copper wall, mm	6	9	6 - 10
AC power supply			
Voltage, V	230	230	230
Frequency, Hz	50	50	50
Lead Shield internal diameter (without liners)**, mm	200	200	200
Lead Shield internal height (without liners)**, mm	280	280	280
Detector with Lead Shield weight, kg	760	760	> 760

\* Detectors with higher efficiency are available

\*\* Possible to order other Lead Shield dimensions

Purge port is available for your lead chamber to decrease influence of Radon while measuring



Th-232, Cs-137, K-40



Gamma-rays





# Flowing HPGe Spectrometer

(Liquid Nitrogen cooled)

## Application

Highly efficient control of radionuclide materials with low activity in on-line mode (fresh fuel rods, liquid and gas flows)

## Accessories (optional)

- Multichannel Analyzer (MCA)
- Analytical Software packages:
  - quantitative and qualitative analysis
  - $\gamma$ -spectra modeling & efficiency registration calculation for complex geometry objects
  - extended radionuclide library
- Liquid nitrogen storage and filling system
- Liquid nitrogen sensor and monitor
- Cable set extension

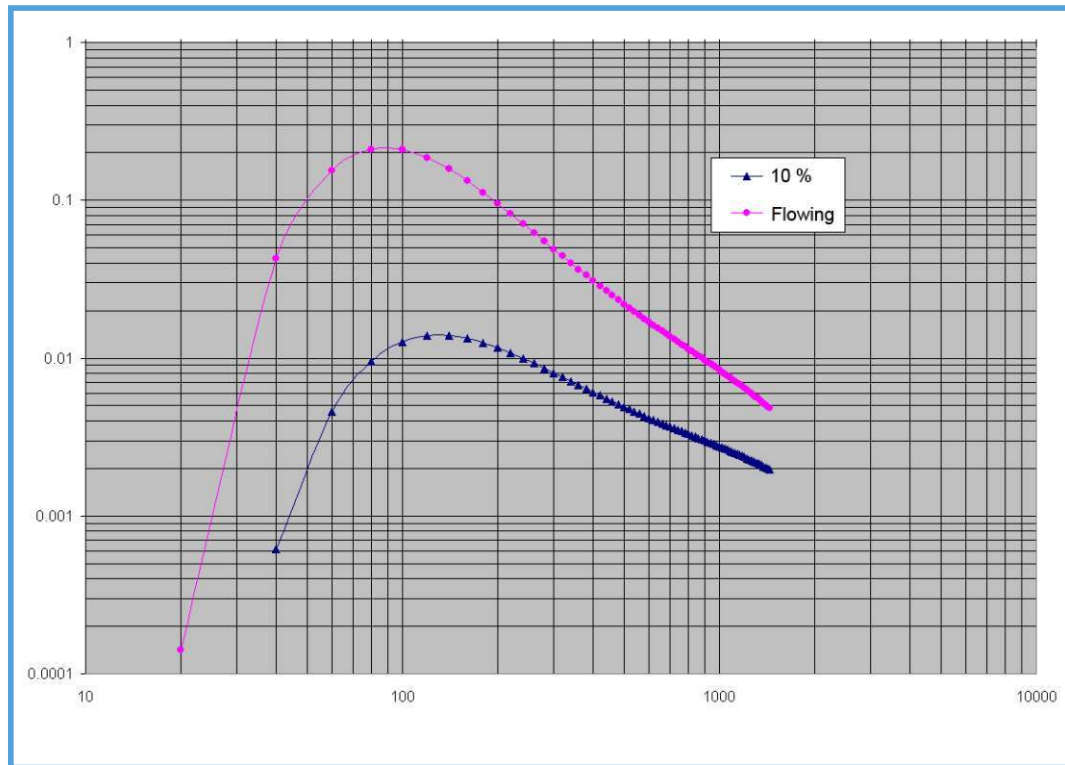
## Features

- Detection unit performs 4 $\pi$  geometry measurements as measuring product is moving inside germanium detector
- Radionuclide efficiency registration is dozen times higher than efficiency registration of standard coaxial detection unit of the same dimensions
- HPGe detector flowing geometry can be developed based on the crystal with equivalent efficiency from 10% to 100%

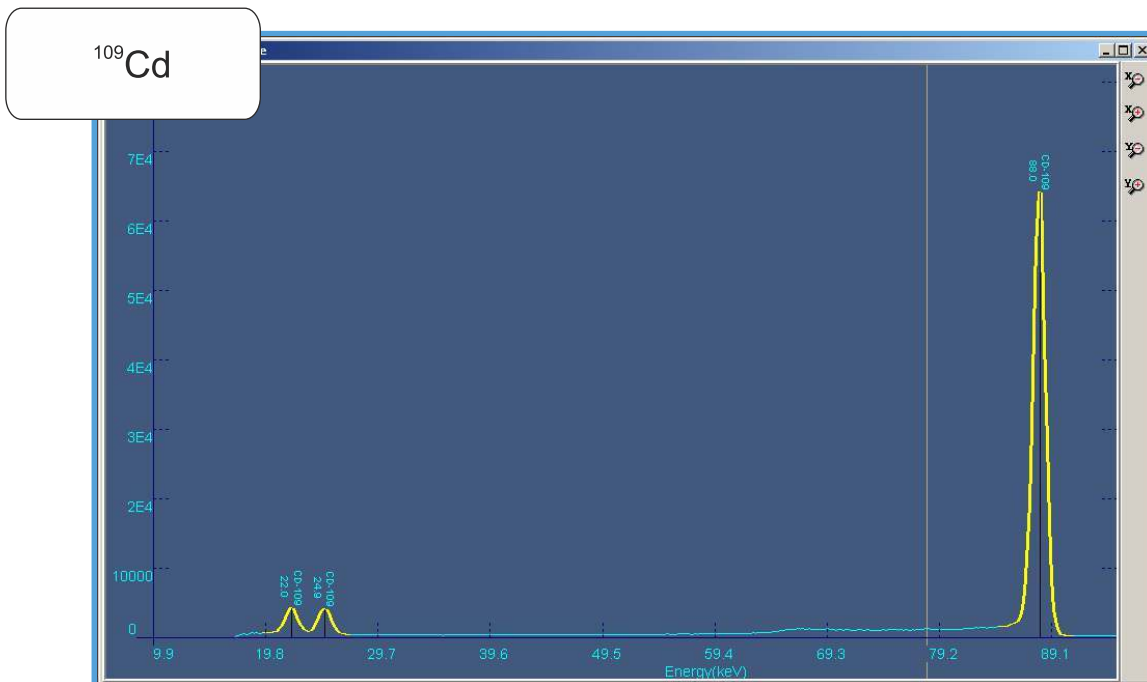
## Complete set (standard)

- HPGe coaxial detector
- Preamplifier with State-of-Health (SHP) feature
- Dewar vessel
- Cable set
- Documentation

# Specification



Absolute efficiency registration comparison curves during gamma-emitting sample positioning inside and outside detector



Spectrum of wire sample containing source  $^{109}\text{Cd}$  of low activity

# NICOLE

## Hybrid cooling system (LN<sub>2</sub> / Electrical)



### Application

The NICOLE hybrid cooling combines liquid nitrogen and electro cooling. Combination of these two cooling systems provides continuous operation for at least 10 months without liquid nitrogen refilling.

### Complete set

- Stirling-cycle cryocooler
- Cryocooler controller
- 28l Dewar vessel
- Liquid nitrogen sensor and level monitor
- Pressure sensor with digital indicator

Parameter	Value
Type of Stirling-cycle cryocooler	Free-piston
Cooler Power	250 W
Dewar vessel volume	28l
Liquid nitrogen holding time when cryocooler is operating (period between refilling)*	> 10 months
Cryocooler MTBF	> 45 000 h

\* In case of cryocooler failure cooling system remains functional, but periodic refilling of liquid nitrogen once per 18 days is required

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# Ultra Low-background HPGe Detectors

## Application

Ultra low-background HPGe detectors are widely used in underground laboratories for determination of radionuclides activities in environmental or industrial samples at  $\mu\text{Bq/kg}$  levels and in scientific experiments such as investigation of magnetic moment of neutrino, dark matter search, etc.



## Design

- Task related design (U-type, vertical, down-looking or portable cryostat)
- Remote not cooled part of preamplifier
- Zeolite is placed near warm part of preamplifier in order to be outside measuring chamber

## Cryostat materials

- Certified materials with low radiation impurities
- Ultrapure aluminium – silicon alloy with U + Th content  $< 1, 0.5$  or  $0.2$  ppb for detector holder and endcap
- Freshly produced electrolytic copper for coldfinger and pedestal
- Tested on radiopurity selected stainless steel screws and sapphire insulators

## Technology

- Transportation of HPGe crystal and cryostat materials by road transport
- Minimal fabrication time when materials are not shielded
- Assembly in a cleanroom
- Cleaning and passivation of copper surfaces
- Storage of crystal and cryostat materials in a container made from materials effectively slowing down and absorbing neutrons (water and Cd)

## Design features

- Fabrication of large volume HPGe detectors without bulletization
- Front end electronics made on low-background Teflon substrate
- Passive screen between front end electronics and HPGe crystal made from Pb with Bi-210 radioactivity  $< 0.1$  Bq/kg
- Double-crystal HPGe detector design
- Multi-crystal HPGe detector design





# Multi Channel Analyzer BOSON

## Complete set

- Boson MCA with software
- Color LCD display with touchscreen
- HV power supply unit
- Preamplifier power supply unit (+/- 12 V; +/- 24 V)
- MCA state display indicator
- Connectors: input; protection control output analogue and digital.
- Available interface to connect to computer: USB, LAN, RS-232.
- Connector for preamplifier power supply unit. Two HV connectors for detector HV power supply. GATE signal connector. Outer power supply connector.
- AC/DC adaptor
- Boson MCA has control for all operation modes by the program installed in remote computer

## Features

- Boson MCA acquires and displays spectra with overlapping by energy range up to 1000 times
- No resolution deterioration at operation in the beginning of spectrum energy range
- Stable operation with preamplifiers of TPR type with output voltage swing up to +/- 10 V and reset duration up to 250 us
- Automated P/Z adjustment
- Improved dead time correction
- Spectrum stabilization
- Setting and control of all parameters using colour LCD display with touch screen
- Complete remote control of Boson MCA via software from PC
- Dead time correction
- Base Line Restorer (BLR)
- Operation with preamplifier TPR
- Built-in oscilloscope

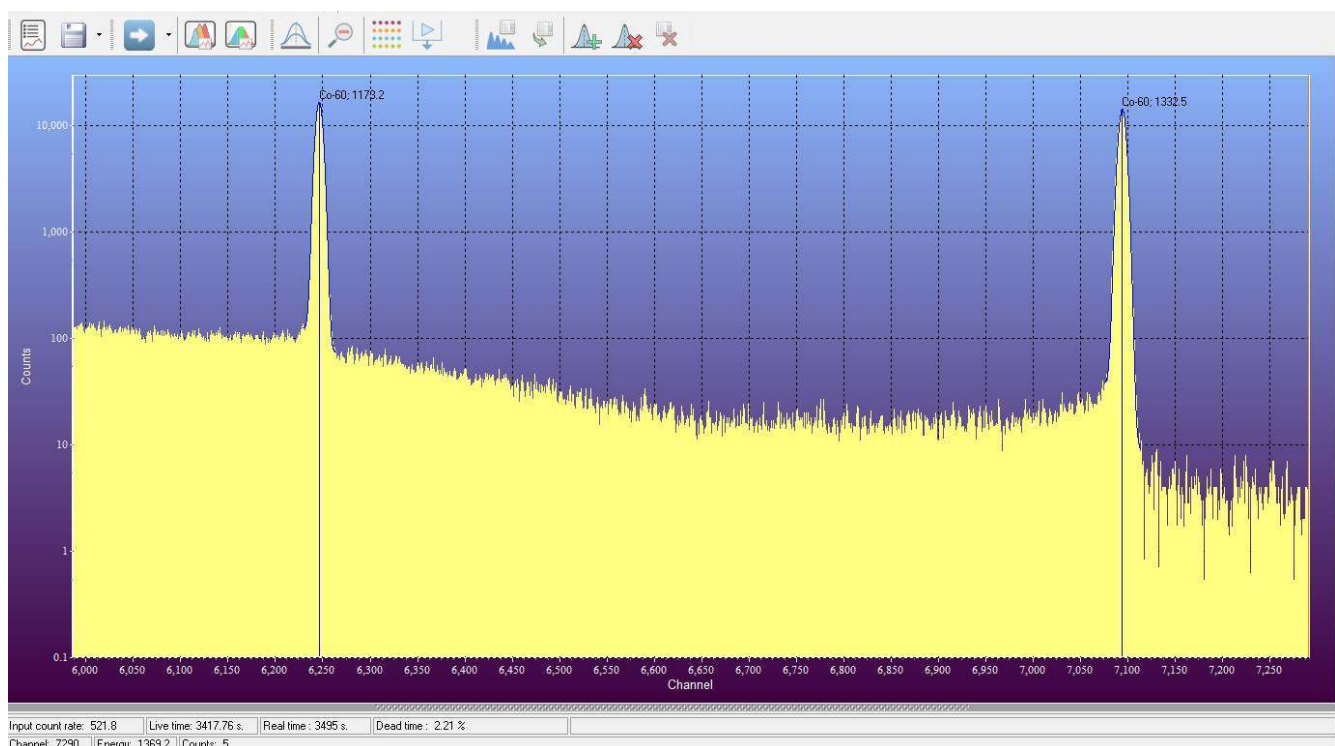
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# Specification

Parameter	Value
Shaping time constant	4 shaping time constant 0,5...24 us (by request)
Coarse gain	5,10,20,40,80,160,320,640 (by request)
Fine gain	1...2
Input signal polarity	+/-
TRP preamplifier	Yes
Integral nonlinearity	+/- 0,025%
Differential nonlinearity	<1%
Gain temperature coefficient	<50 ppm/oC
MCA, chn	16k
Input count rate	up to 200000cps
Power preamplifier	+/- 12V 60mA +/- 24V 40mA
HV	+/-5000 V or +/-2000 V / 0.5 mA
Power supply	+9... 18 V
Consumed power	12 W
Indication	TFT color touchscreen 3.2"
Communication interface	USB; Ethernet; RS-232 or I/O control by request

## Software package





# Digital Multi Channel Analyzer MCA 527

## Description

The MCA527 is a battery powered high performance 16K Multi-Channel Analyzer/Multi-Channel Scaler module with the performance of a laboratory grade MCA.

High voltage supply for detector and preamplifier power supply are integrated as well as an internal coarse amplifier and digital filtering and analysis.

Together with a detector it forms a small-size gamma spectroscopy system, which is well suited to the demands of field measurements for international safeguards, environmental monitoring, nuclear waste treatment facilities, radioactive transport control and similar applications.

## Features

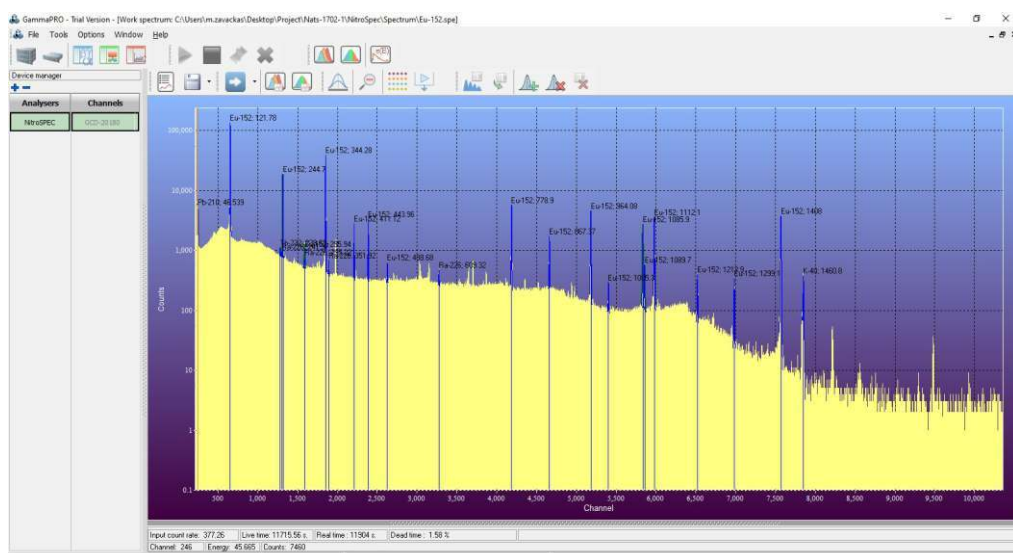
- Automated base line restorer and threshold adjustment,
- Automated or manual pole zero adjustment without oscilloscope,
- System dead time and count rate indication,
- Dead time correction,
- Automated spectrum recording,
- Peak stabilization,
- Basic analysis functions (energy calibration, FWHM, peak area and integral calculations, spectrum stripping and smoothing),
- File menu: write/read functions with drive/path - and file pick list functions,
- Setup menu: ADC, Amplifier, Presets, Memory splitting, MCA mode, MCS mode, Multi spectral recording mode, automated instrument configuration using setup file,
- Analysis menu: Energy calibration und further analysis functions defined according the purpose. Energy calibration with linear calibration curve using 2 peaks or energy channel pairs,
- Acquire control: Start, Stop, Erase, Presets Incorporated.

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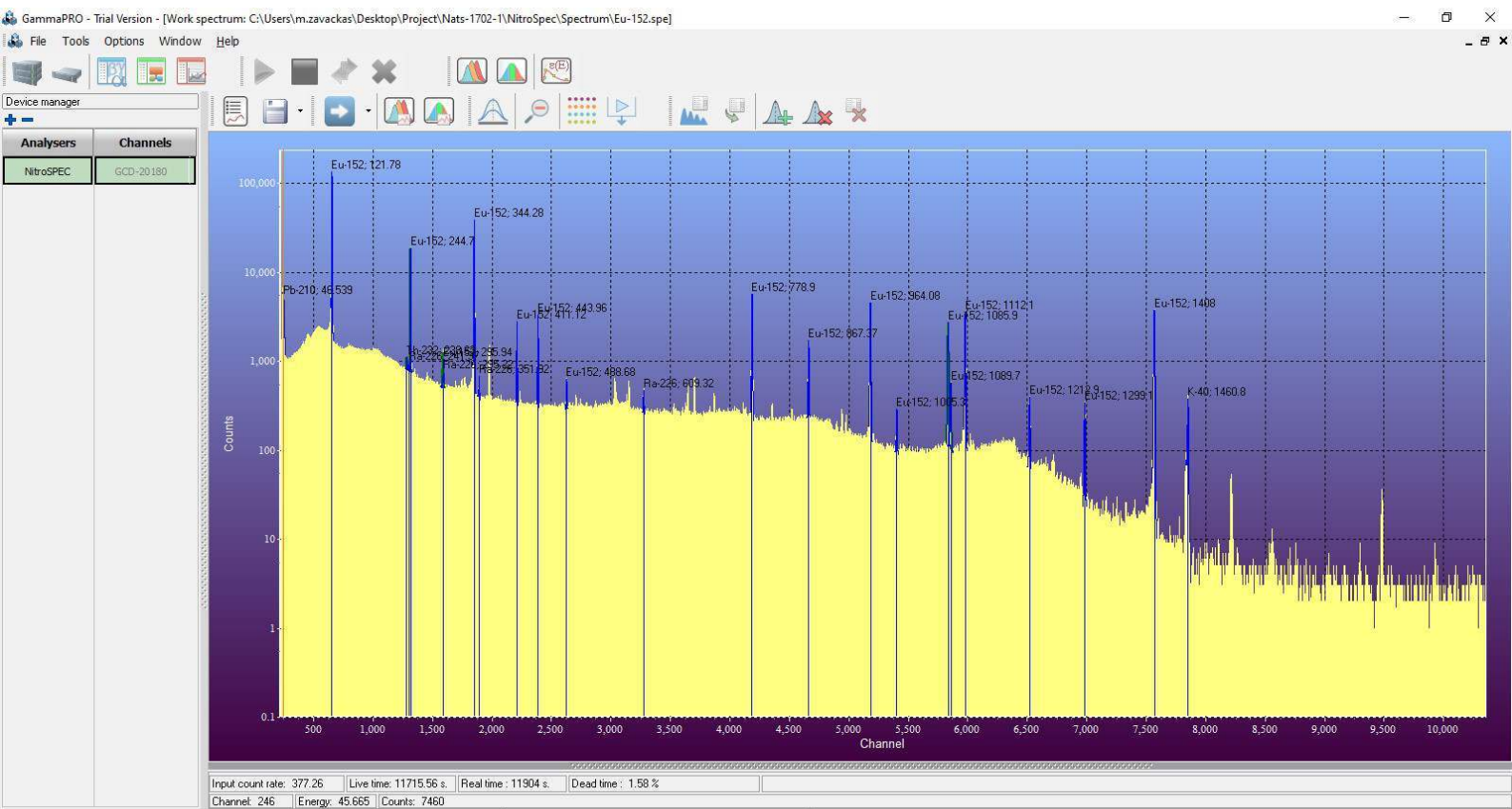
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# Specification

Parameter	Value
Channel Splitting	128, 256, 512, 1024, 2048, 4096, 8192, 16384
Shaping Time	0.1µs to 25.5µs, step 0.1µs
Flat Top Time	0µs to 15µs, step 0.1µs
Differential non-linearity (@4K and 1µs shaping time)	< 1 %
Max counts in a channel	$2^{32} - 1$
Base Line Restorer	BLR with adjustable averaging
Pole Zero Adjustment	Decay time down to 40µs can be compensated
PHA (Pulse Height Analysis)	✓
Pile Up Rejection	✓
MCS (Multichannel Scaling)	✓
Oscilloscope Mode	✓
List Modes (optional)	✓
Preamp Power Supply	±12V, ±60mA ±24V, ±60mA
HV Supply	up to +/- 3600V up to +/- 5000V
Computer Interfaces	USB, Ethernet, RS232







# GammaPRO software package

## Features

GammaPRO provides all the tools necessary for separate peak analysis, namely:

- energy calibration;
- direct peak search in spectrum and peak search considering the radionuclides and their peak energies specified in the library;
- peak and multiplet fit by Gaussian and other functions;
- automatic identification of peaks;
- considering count sample density as a calculation parameter; considering background as a calculation parameter;
- calculation of efficiency curves (efficiency calibration), FWHM calibration, peak shape calibration.

The GammaPRO software features multiple window interface and enables a number of opportunities for spectrum analysis such as:

- visualization of spectra and spectrum acquisition progress;
- peak search and identification of radionuclides;
- calculation of efficiency curves and sensitivities;
- mathematical operations (sum, subtraction, normalization etc);
- processing of set of spectra;
- calculation of integral nonlinearity;
- conversion into other formats and translation into other applications such as MS Word, Excel, MS Access, MatLab;
- calculation of ambient dose equivalent rate in auto mode.

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# Specification

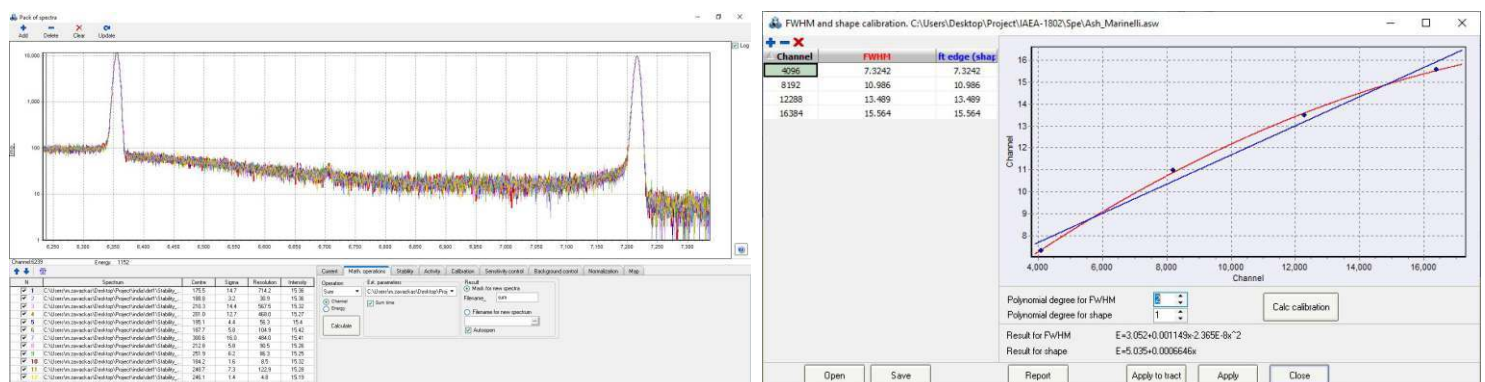
The GammaPRO software enables solution of specific spectrometric problems such as:

- calculation of activity of naturally occurring radionuclides and effective specific activity in situ and in samples
- calculation of conformity factors for food and materials
- calculation of radon flux density and volumetric activity in different conditions
- calculation of radionuclide activity applying methods of physical and radiochemical concentrating
- calculation of radionuclides activity in a human body and its organs as a part of whole body spectrometer measurements

The matrix method enables automatic calculation of activity of a sample provided its radionuclide composition is known. The method is used for routine measurements of food, building materials, water and other substances subject for permanent radiological control.

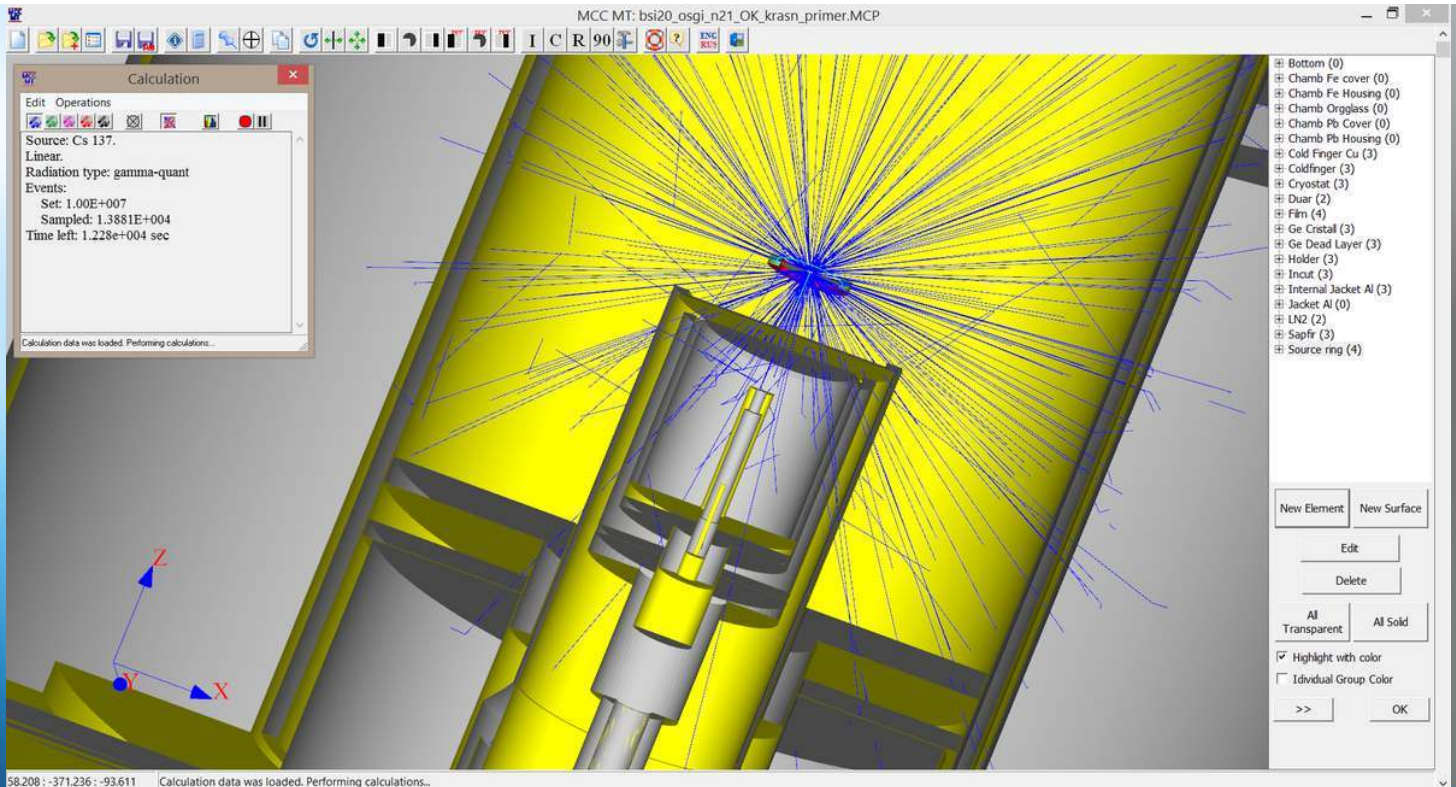
The superposition method is mainly used for control of correctness of activity calculations in case of hard-to-analyse (multiple peak) low-resolution spectra (acquired by scintillation detectors). Such a tool enables visual estimate of the degree of similarity between an acquired and calculated spectrum. Additionally, calculation data can be adjusted until the spectra completely coincide.

The Software features an integrated system for report generation which provides automatic creation of measurement results. The settings for report generation can be adjusted by user.



The GammaPRO software provides the following additional service options for optimization of routine measurements:

- auto adjustment (quality assurance), that is, control and adjustment of a spectrometric tract without user's involvement;
- database which provides transfer and storage of measurement results in a database (MS Access etc);
- log which provides automatic registration and storage of measurement and quality assurance results; radionuclides library editor. This module is necessary for creation of library files used for calculation of activity of radionuclides;
- TRIOMAP is a module for performing measurements in field and mapping;
- barcoding is an integrated system of barcode identification which enables input of sample data in the software by means of a barcode scanner;
- quality assurance in spectrometric path for peaks analysis method comprises the following tasks: Gain adjustment, Resolution and efficiency test, Background test. Those tasks parameters are collected in groups. Compliant to ISO-11929 standard.
- sample loader is a module for automatic measurements using various types of count sample loaders.



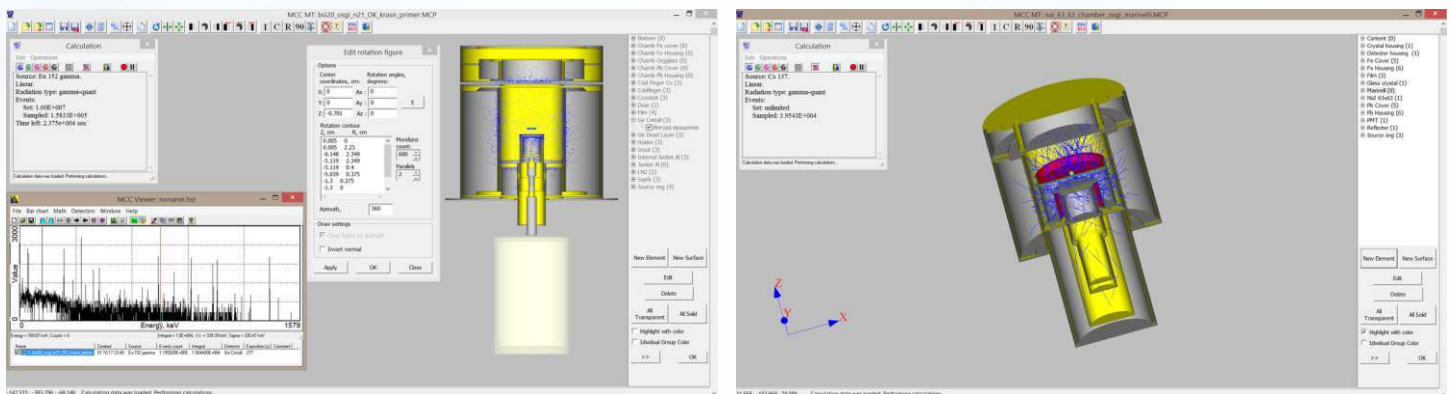
# Advanced software package MCC-MT

## Monte Carlo simulations

### Description

Software package MCC-MT (Monte Carlo Calculation Multi Thread) is intended for 3D-modelling of physical experiments and calculation of radiation detectors response functions using Monte Carlo simulation method.

Software MCC-MT based on multi-threading technology providing significant increasing the rate of simulation and getting fast result as spectrum.



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# Specification

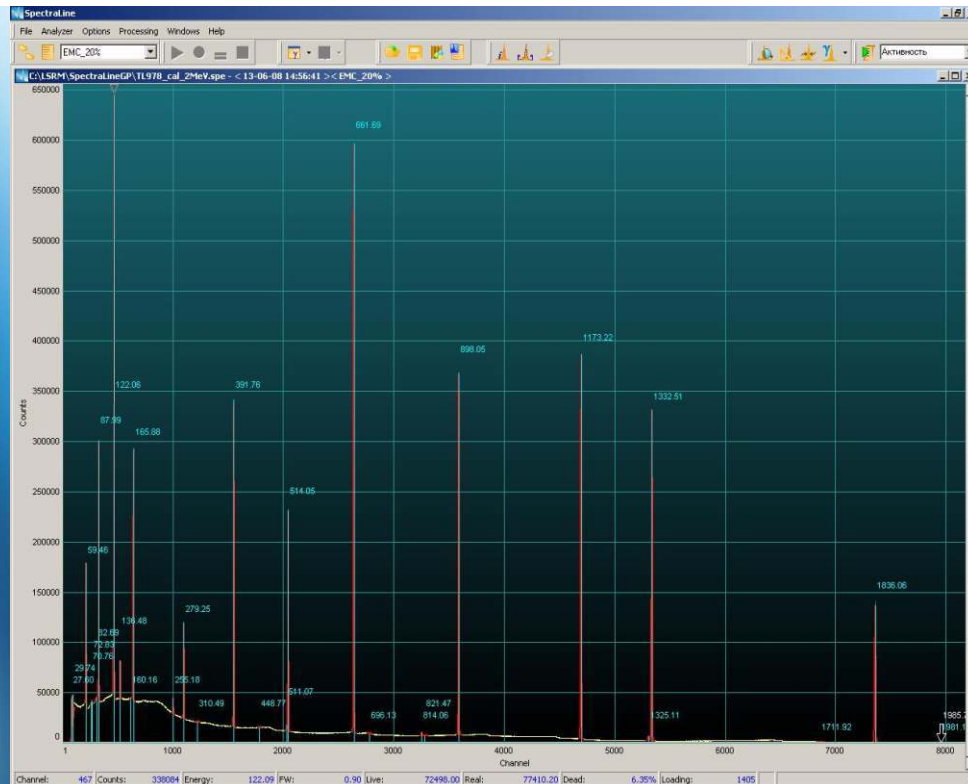
## Application

- Monte Carlo simulation spectra of gamma, beta and alpha radiation
- Calibration of instruments used for ionizing radiation detection and measurements
- Calculation of detection limits and minimum detectable activity of radionuclides
- Determination of a characteristics of a registration system for inaccessible radioactive sources
- Reduction of experimental investigations with using the hazardous ionizing radiation for human health
- Obtaining clear picture of the internal processes of radiation transfer in order to optimize the design of the measuring devices and their protection
- Comparative demonstration of the different systems of protection against ionizing radiation and its detection systems
- Training of personnel in working with ionizing radiation detection systems without using of an expensive equipment and radioactive sources
- Training of specialists in the field of measurement and protection from ionizing radiation
- Acceleration, simplification and reduction in the cost of design and optimization of ionizing radiation detection systems
- Characterization detectors and detection systems

## Features

- High accuracy of calculations
- Simplicity of using for a wide range of tasks
- Detailed 3D-scene based on Open GL graphics technology providing maximum representation and visibility of modeling
- Availability of replenished database of sources and materials
- Possibility of creating the maximally complex measuring systems
- Forming multidetector systems and schemes of coincidence
- Display of the results in the form of an ideal and real spectrum
- Tracing and drawing trajectories of particles during calculation process
- Availability of the ready and test projects in the distributive package (HPGe, scintillation detectors, protective lead shielding, volumetric sources and samples, etc.)
- Accounting cascade summation ('Full cascade' source type)
- Using of the specified number of computer processors in order to implement multithreading and speed up the calculation
- Automatic creation of efficiency curves
- Network version for 2 and more PC is available





# SpectraLineGP software package

## Application

SpectraLine Gamma Precision (GP) software has been developed for a wide range of application tasks in spectrometry using gamma-ray semiconductor detectors.

The tasks are as follows:

- Examination and certification of food products and building materials.
- Radiation monitoring of environmental and other objects.
- Certification of radiation samples.
- Determination of the enrichment level for uranium, plutonium and other elements.
- Fuel analysis in scientific research, etc.

# Specification

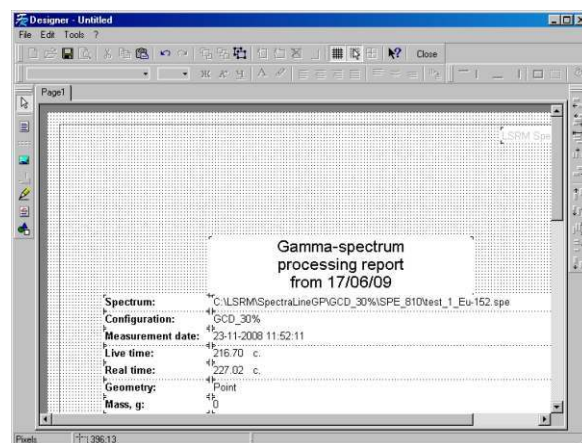
- Automatic peak search with the required level of detection (peak search results are stored in files).
- Calibration by energy, half-width, and peak shape.
- Calculation of the peak parameters (position, half-width, area), with storing the results in a text file.
- Calibration by efficiency; construction of approximate efficiency curves.
- Activity calculation by different methods;
- Correction for true summation in view of the subsequent gamma-ray intensity correction.
- Storing the measured spectra and results of processing in the database in order to analyze the repeated measurements for convergence in the given criteria (the quality estimation).
- Simultaneous processing of an arbitrary (optional) number of spectra; the use of several spectra peaks from different energy ranges at calibration by shape.
- Quantitative and visual control over the calibration quality.
- Connection of an arbitrary (optional) number of measuring channels.
- Independent control, start, stop, spectra storage and visualization in all measuring channels.



Radionuclide	Half-life	Other parameters
Ag-110m	243.75 day	
ANNIGL	1E009 year	
Na-22	2.6013 year	
I 511	180.88	0.36
I 1274.543	99.94	0.01
K-40	1.26E009 y...	
Tl-44	63 year	
Mn-54	312.116 day	
Co-56	77.9 day	
Co-57	271.81 day	
Co-60	5.2714 year	
Zn-65	244.12 day	
Y-88	106.617 day	
Zr-95+	64.02 day	
Ru-103	39.36 day	
Rh-106	367 day	
Cd-109	453 day	
Sn-113	115.09 day	
Sb-125	2.77 year	
Ba-133	10.536 year	
Cs-134	2.062 year	

It is possible to create libraries of arbitrary (optional) configuration depending on the task to be solved is involved in the program.

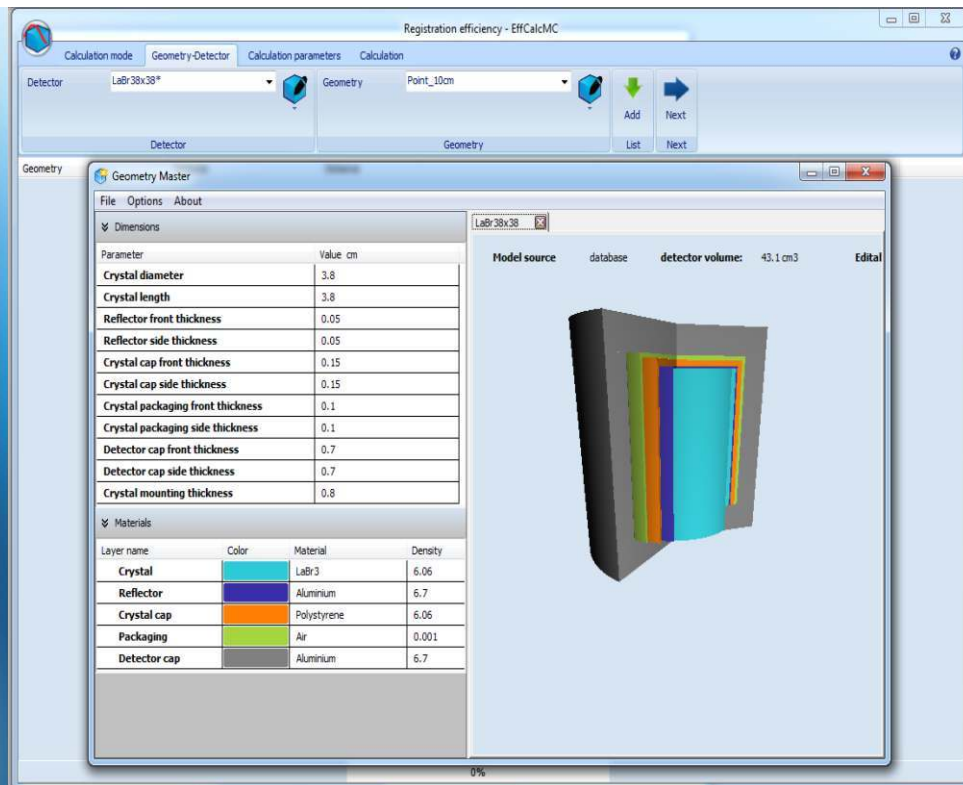
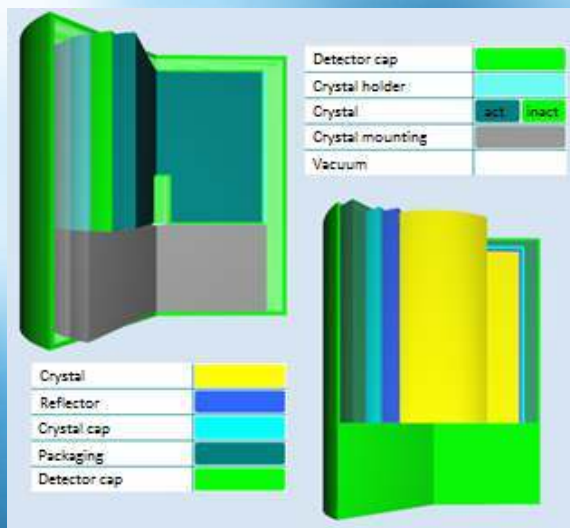
Information is provided on the radionuclide designation, its half-life period, line energy, line intensity, and absolute error.



SpectraLineGP Software has a user-friendly interface and offers the following options:

- Color scheme adjustment of the window.
- Data copying into the spectrum windows.
- Addition/deletion of peaks and zones in a spectrum.
- Viewing the parameters of indicated zones or separate peaks.
- Zone integration or splitting into smaller zones;
- Viewing of calibration results, corrections, calculations, etc.

The program has a built-in editor, which allows making up the reports of various forms and connecting external programs.



# Nuclide Master Plus software package

## Application

Nuclide Master Plus software package has been developed for calculation of detection efficiency and correction factors for true coincidences. It is also used for correction of gamma radiation intensities in radionuclides library. EffCalcMC (Efficiency Calculation Monte-Carlo) is the main program.

The calculation is based on Monte-Carlo method using parameters of the required nuclides from the library of evaluated nuclear structure data ENSDF. The factors can be calculated for different detectors types (semiconducting and scintillation) which are saved in database compatible with EffMaker software. Marinelli vessels, cylinder and point can be used as the measurement geometries.

TCCFCALC (True Coincidence Correction Factor CALCulation) utility is created to solve true-coincidence summing in/out effect problem in different applications of gamma-spectrometry. It allows to perform calculations for any known gamma-emitting radionuclides and for a wide set of measurement geometries including scintillation and HPGe detectors with point and volumetric sources (Marinelli or cylindrical beaker with arbitrary dimensions).

# Specification

- detectors and measurement geometries parameters setting and saving in database;
- lines and radionuclides lists creation;
- calculation of detection efficiency and correction factors for true coincidence using Monte-Carlo method;
- data filtering;
- creation and addition of correction factors for true coincidence library;
- data viewing and saving in detection efficiency library;
- correction of gamma-radiation intensities in radionuclides library;
- batch processing possibility for several geometries and energy ranges.

True coincidence factors calculation - EffCalcMC

Calculation mode: Geometry-Detector    Calculation parameters: Calculation

Run Stop Efficiency Save \*.asf file Save \*.tcf file Expand Collapse Check View

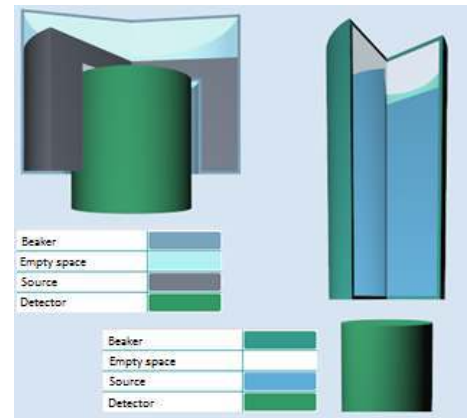
I > 3  
DEF <= 0.1  
DCF <= 0.5

Calculation Filter

Nuclide	Half-life	Test numbers	Finish time			
<input checked="" type="checkbox"/> <b>Point 10cm</b>	LaBr3@x38	10 cm	(54%) Eu-152			
<input checked="" type="checkbox"/> <b>Co-60</b>	1925.28 D	10000000				
<input type="checkbox"/> 1173.2	99.85	0.03	1.0105	1.18	0.00572	0.42
<input type="checkbox"/> 1332.5	99.983	0.0006	1.0076	1.18	0.00585	0.41
<input checked="" type="checkbox"/> <b>Ni-60</b>	Stable	10000000				
<input checked="" type="checkbox"/> <b>Eu-152</b>	13.517 Y	10000000	14.08.2014 14:26:12 (7.8%)			
<input type="checkbox"/> 121.78	28.58	0.1967	1.0238	9.84	0.0037	3.45
<input type="checkbox"/> 244.7	7.5834	0.2471	1.0146	17	0.00464	5.99
<input type="checkbox"/> 344.28	26.52	1.6	1.01	8.94	0.0048	3.15
<input type="checkbox"/> 367.79	0.86057	0.5547	1.125	48.6	0.00528	16.67
<input type="checkbox"/> 411.12	2.234	0.1899	1.0769	31.44	0.00475	10.91
<input type="checkbox"/> 443.97	2.8214	0.6641	1.0259	26.1	0.00533	9.17
<input type="checkbox"/> 688.67	0.85658	0.9375	1.0571	47.16	0.00545	16.44
<input type="checkbox"/> 778.9	12.942	0.1434	1.0018	11.86	0.00555	4.19
<input type="checkbox"/> 867.37	4.2454	0.4414	1.0165	20.88	0.0055	7.35
<input type="checkbox"/> 964.08	14.605	0.1466	1.005	11.56	0.00519	4.08
<input type="checkbox"/> 1085.9	10.207	0.2098	1.0348	12.7	0.00625	4.45
<input type="checkbox"/> 1089.7	1.7272	0.3685	1	34.56	0.0049	12.22
<input type="checkbox"/> 1112.1	13.644	0.157	0.99839	11.34	0.00575	4.01
<input type="checkbox"/> 1212.9	1.4219	0.4518	1.0147	34.18	0.00613	12.04
<input type="checkbox"/> 1299.1	1.623	0.4902	1	34.56	0.00521	12.22
<input type="checkbox"/> 1408	21.005	0.1147	0.97543	9.3	0.00549	3.31
<input checked="" type="checkbox"/> <b>Sm-152</b>	Stable	10000000				
<input checked="" type="checkbox"/> <b>Gd-152</b>	1.08E+14 Y	10000000				
<input checked="" type="checkbox"/> <b>Sm-148</b>	7E+15 Y	10000000				
<input checked="" type="checkbox"/> <b>Nd-144</b>	2.29E+15 Y	10000000				
<input checked="" type="checkbox"/> <b>Ce-140</b>	Stable	10000000				

Finish time: 14.08.2014 14:25:21

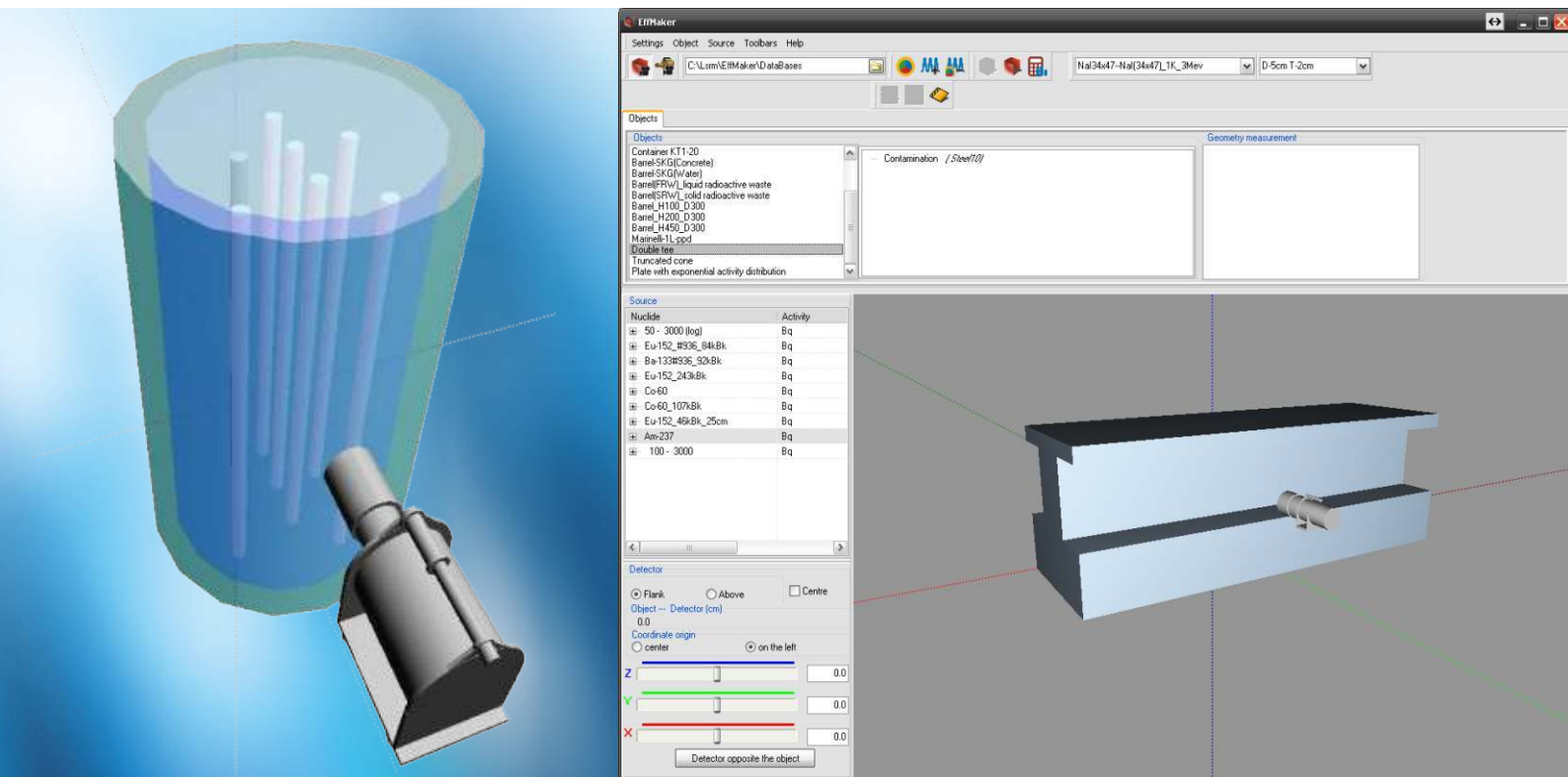
54%



TCCFCALC (True Coincidence Correction Factor CALCulation) utility has been added to Nuclide Master for:

- calculation of true coincidence correction factor and correction of gamma radiation intensities in radionuclides library;
- calculation of detection efficiency.





# EffMaker software package

## Application

Software complex EffMaker is designed for modeling of gamma-spectra and the calculation of registration efficiency for complex shaped objects that are obtained with the use of semiconducting and scintillation detectors of gamma radiation. The modeling is realized by Monte-Carlo method. For the increase of the calculations' speed for the prescribed detector there is modeled its response function that represents a set of spectra for monochromatic radiation in the prescribed range. The response function is transformed to the response matrix which takes into account number of channels of present spectrometer and its resolution. The gamma spectrum of the object (the physical spectrum of the source) in the point of the detector's location is modeled independently. The apparatus spectrum of the source is obtained as convolution of the physical spectrum with the detector's response matrix.

The main possibilities of the software EffMaker are :

- Detectors characterization to use detector parameters to calculate registration efficiency;
- Calculation registration efficiency and activities of radionuclides for objects with arbitrary geometries and composition;
- Multiple matrix correction, density, transmission correction;
- Calculation of activities of radionuclides for nonuniform distribution of activities of radionuclides in containers;
- Test beam;
- Collimator modeling tool.

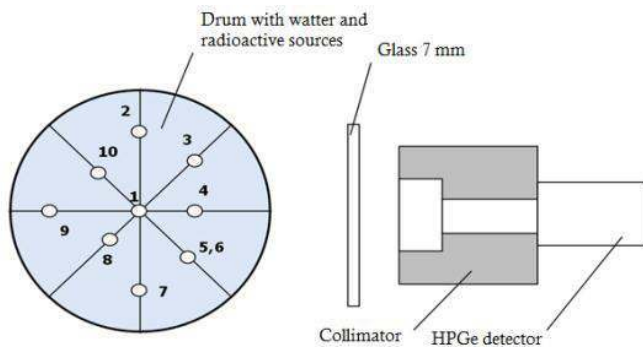
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# Specification

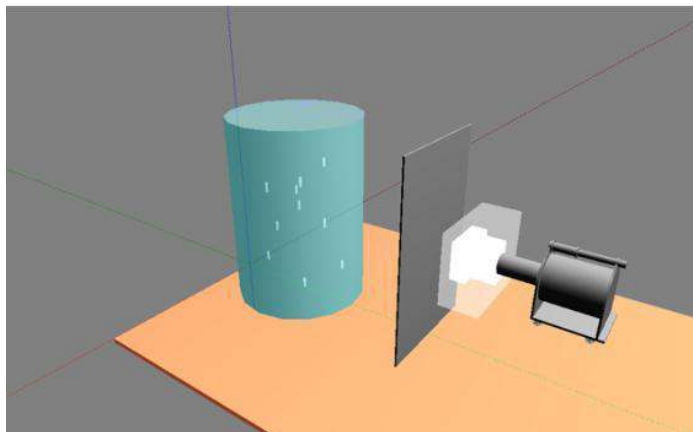
Modelling of gamma-spectra and calculation of registration efficiency for complex shaped objects

EffMaker performs mathematical efficiency calibration (without using calibration sources) of the detector for arbitrary measurement geometries, different shapes and dimensions of the source, disposal and distance from the detector, content and density of the matrix. The calculation of registration efficiency is carrying out on the base of Monte-Carlo method by the EffMaker software for containers with arbitrary geometries and composition such as (sphere, cylinder, parallelepiped etc.).



Detector characterization and for example the following templates of geometries could be provided:

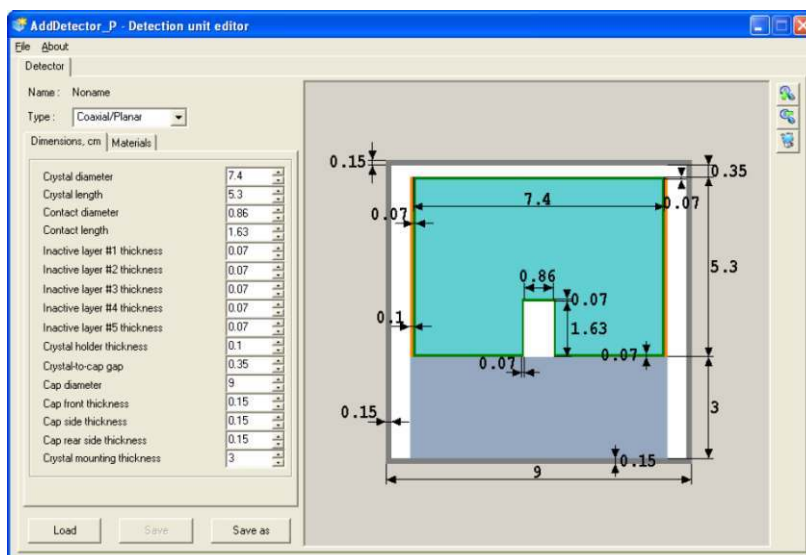
- Complex parallelepiped;
- Complex cylinder;
- Pipe;
- Marinelli;
- Pipe with internal/external contamination;
- Square pipe with internal/external contamination;
- Room/parallelepiped with contaminated internal surface;
- Wall/plate;
- Other geometries according to customer needs including multilayer geometries.



Mathematical characterization of measuring object, detector and collimator based on Monte-Carlo method by means of EffMaker program

EffMaker software package modules

- Module for creating and editing parameters of spectrometers – detector, analyzer, collimator
- Module for response functions calculation
- Module for response matrices of gamma spectrometers calculation
- Module for measuring objects creation and editing
- Module for energy spectra generation
- Module for physical spectra generation
- Module for apparatus spectra generation



Detector characterization window of EffMaker software



# HPGe Mobile Spectrometer WAM Mobile

## Application

Registration of Gamma and X-ray spectra for the radiological control of environmental objects, industrial and agricultural products, objects and plants of nuclear energetics and enterprises dealing with the storage and processing of radioactive wastes

## Complete set

- HPGe detector for gamma spectroscopy
- Multichannel analyzer of operating with a laptop PC or tablet PC
- Software packages for quantitative and qualitative analysis
- Advanced software package for characterization using Monte-Carlo calculations
- Lead Shielding with collimator set
- Manual or electrically driven trolley
- Laser distance meter
- Cable pack and documentation

## Features

- Optimal sizes and weight for mobile application
- Detection unit is placed on a manually or electrically driven trolley
- Trolley is equipped with a lead shield and collimator set
- Lead shield thickness can be 25mm or 50mm depending on the application
- Detection unit can be LN2 or electrically cooled
- Possible to equip with large capacity batteries for autonomous operation in the field even with electrically cooled detection unit
- Equipped with laser distance meter for more accurate measurement
- Complete spectrometer can be characterized at factory
- Simplicity of operation and servicing

Gamma-rays

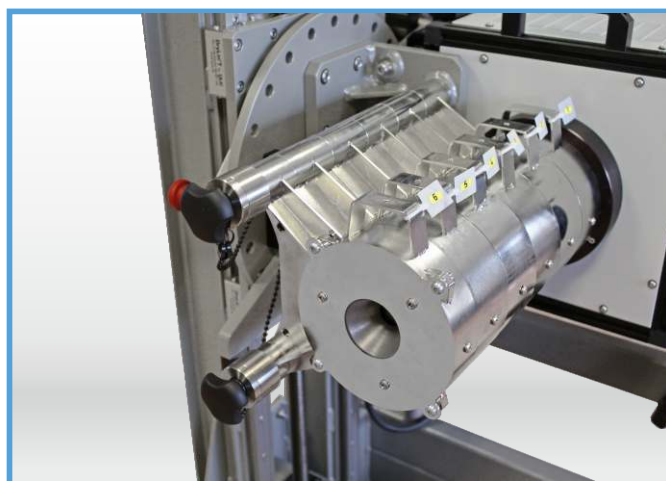
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# Specification

Parameter	Value
Top measurement point in horizontal position, mm	1250
Bottom measurement point in horizontal position, mm	450
Bottom measurement point in vertical position (looking down), mm	95
Maximum speed on flat (for electrically driven trolley)	Slow Mode - 1.25km/h Fast Mode - 4.00km/h
Complete system dimensions (L x W x H), mm	1498 x 722 x 1588
Wheelbase, mm	945
Ground Clearance, mm	100







# Robotic Gamma Spectrometer with Sample Changer (HPGe detector based)

## Complete set

- Gamma-ray detector based on HPGe detector with LN2 or Electrical cooling;
- Lead shield;
- Multichannel Analyzer;
- Software for spectra processing, identification of radionuclides and calculation of their activities;
- As option available: advanced analysis software and software for complex geometry sample calibration using Monte-Carlo method;
- Automatic sample changer based on Robot arm;
- Table with sample holders and safe cabinet;
- Barcode reader together with Barcode printer;
- First level software for Robotic Spectrometer control.

## Application

Robotic Gamma Spectrometer is intended for the detection and analysis of radio nuclides from various types of environmental objects such as rocks, minerals, sludge, slag, soil, plant, sediment and particulate matter in air and water. The spectrometric system is able to determine the composition of a sample based on the photon energy and the activity based on the photon flux. The low-background lead shielding together with the HPGe detector gives precise results even for low activity materials.

The fully automated sample changer enables the user to measure more than 56 samples, without having to interact with the Robotic Spectrometer. This reliable robotic sample changer increases the productivity and reduces the possibility of health risks for the operator.

# Specification

## HPGe detector with Lead Shield

Parameter	Value
Detection limit for Cs <sup>137</sup> radionuclide specific activity, measurement time 1 hour, Bq/kg	0.5
Absolute sensitivity to gamma flux for 30%* efficient detector, pulse/quantum	$4.5 \times 10^{-3}$
Instrumental background intensity for energy range from 40 keV to 3 MeV, pulse/keV x sec	$5 \times 10^{-4}$
Cs <sup>137</sup> radionuclide specific activity measurement error for measurement time 1 hour, %	20

\* HPGe Detectors are available with efficiencies from 10% to 100%



## Samples

Measurement geometries are:

- Bottle 500ml,
- Bottle 250ml,
- Denta 60ml,
- Denta 30ml,
- Marinelli,
- Petri vessels,
- etc.

Given numbers are applicable to a specific model but it is not a limitation. The system is flexible enough to be adjusted in accordance to specific requirements.

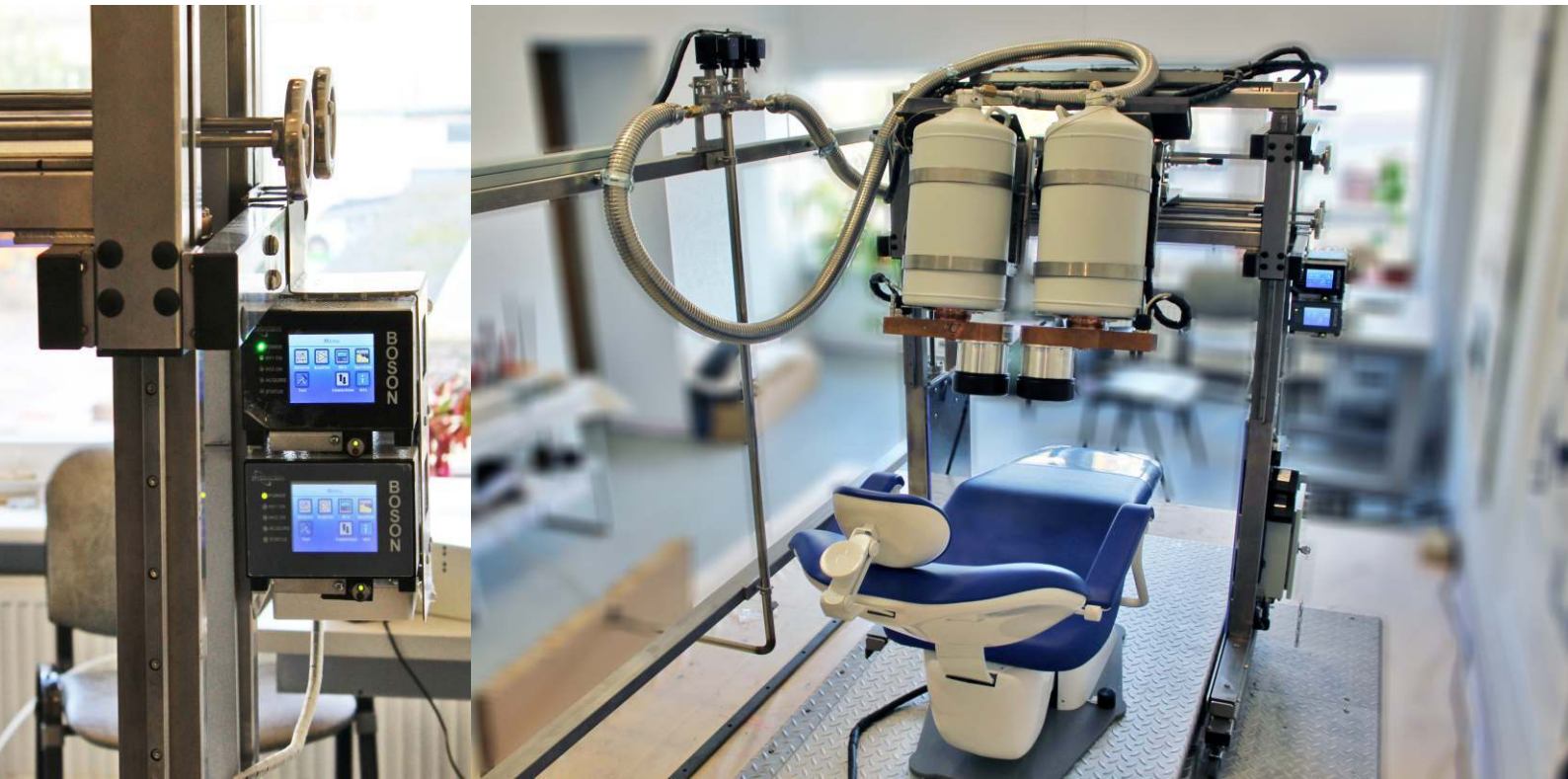
## Barcode Reader and Printer

To assure the correct processing of all data during the measurement and analysis process, the samples are marked by using a barcode printer that is connected to the workstation. Using the bar code reader, the information stored in the database is retrieved for each sample before the measurement process is started.



## Automatic Sample Changer

- Machine vision
- 7-axis manipulator
- Payload: 3 kg
- Reach: per request
- Accuracy: +/- 0.01 mm
- Fastest 7-axis robot
- All motors and cablings enclosed
- Compact controller



# Whole body counter WBC HPGe detector based

## Complete set

### Spectrometer:

- One, two or more HPGe detectors (scintillation detectors optional)
- Multichannel analyzers MCA (or one MCA with multiple input channels)
- Analytical software for quantitative and qualitative analysis
- Liquid nitrogen monitors (in case detectors are cooled with LN2)
- Automatic filling station with LN2 (in case detectors are cooled with LN2)

### Main assembly:

- Steel Fixing platform
- Detectors holders and positioning mechanisms
- Ergonomic chair with hydraulic mechanism for changing position of the body
- Crate for electronics

Related cables and connectors

## Features

- Quantitative and qualitative analysis using high-resolution HPGe detectors (GCDX-OS suggested)
- Adjustable to measure any part of the body
- Comfortable for the examined person
- Available with one or multiple HPGe detectors
- HPGe detectors can be LN2 or electrically cooled
- Option: available with scintillation detectors like NaI, LaBr, SrI, etc.
- Simple and intuitive software interface
- Automatic filling station for LN2 (in case detectors are cooled with LN2)

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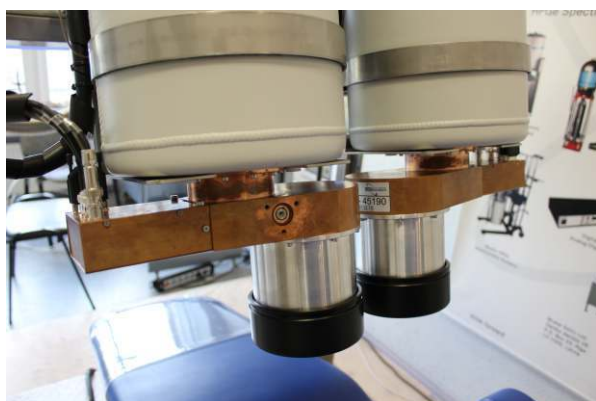
Gamma-rays



# Specification

Parameter	Value
HPGe detector relative efficiency	45 %*
Energy resolution	
at 5.9 keV	< 500 eV
at 14.4 keV	< 650 eV
at 122 keV	< 700 eV
at 1.33 MeV	< 1900 eV
Peak to Compton ratio	60 : 1
Energy range of detector operation	3 keV – 3 MeV
Peak shape	
FWTM/FWHM	< 2
FW.02M/FWHM	< 3
Endcap window material	Carbon fibre

\* Other detector types and relative efficiencies are available.







# Whole Body Counter WBC Bed-type

## Complete set

The Bed-type Whole Body Counter allows a variety of analyses to be performed including counts for mixed fission products, Thorium, Radium-226, as well as routine energy calibrations. The Bed-type Whole Body Counter system features a continuous background monitoring capability which reduces counting time and increase accuracy. Electronic components are chosen for long term unattended operation and stability. The system is interfaced to a microcomputer which serves as a multichannel pulse height analyzer, a multiscaling analyzer, and a data processing unit, as well as a general-purpose scientific computer. Various configurations are available, depending upon customer needs.

## Description

- Based on compact Classic Shield
- Quantitative and Qualitative analysis
- Provides approximate location of gamma emitters
- Background monitored continuously except during count
- Computer adjustable scanning speeds
- May be used optionally with Magnetic Cards or Bar Codes, etc.
- The Bed-type Whole Body Counter can be equipped with different detector and its combinations. For example:
  - One NaI(Tl), 20x10 cm
  - One HPGe detector with LN2 or Electrical cooling, One NaI(Tl), 3"x3"
  - Two HPGe detectors with LN2 or Electrical cooling, One NaI(Tl), 3"x3"
  - Or any other combination

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# Thyroid & Lung monitors

Parameter	Value
Detector type*	NaI, Ø63*63mm
Spectrometer provides registration of gamma-radiation in the energy range	0.05 - 3.0 MeV
Radionuclides activity measurement range, for 5 min	85...10 <sup>5</sup> Bq for I-131 110...10 <sup>5</sup> Bq for I-133
Minimum measured activity: measurement for 30 min	30 Bq for I-131 45 Bq for I-133
Number of ADC channels	512 – 4k
Typical resolution at 662 keV (137Cs)	< 7,5%
Measurement instability	±1% max.
Working temperature range	+10°C...+35°C
Operation mode setup time	10 min

\* Other detector types and relative efficiencies are available.

## Application

Whole body counting system, is designed for identification of radionuclides content in human body and organs, in particular thyroid gland. By its sensitivity WBC system is in compliance with up-to-date requirements for radiation standards in internal irradiation level control of personnel on facilities and plants of nuclear-fuel cycle, in medical facilities in regions with high probability of pollution by induced radionuclides, etc.



Thyroid measurement version of BSI Whole Body Counting system (WBC) is made of light and compact aluminum construction which is really easy to handle for everyday usage. The main holder has wheel base and handle to move the measuring part around the facility. When it is fixed in certain location, the operator is capable of adjusting the position of the detector in vertical and horizontal position to find the most convenient position for the person being analyzed.



# HPGe Spectrometer with Lead Shield

for Liquids and Gaseous Flows Radionuclide Analysis

## Application

HPGe Spectrometer with shield is designed for defining the composition and activity of radionuclides in the flow of liquids and gases in automated technological processes such as those in nuclear energetics, environmental monitoring and industrial applications.

## Complete set

- HPGe coaxial detector
- Multichannel Analyzer
- Lead Shield with a supporting table
- Control unit with valves
- Sensors for liquid and gas flow
- Emulation and analysis software
- Cable set

## Features

- Definition of composition and activity of radionuclides in real time mode
- Display of current values for specific activity of controlled radionuclides
- Indication of activity level increase of any chosen radionuclide
- High registration efficiency
- Wide range of measured activities
- Operation rates in fully-automatic mode: measurement, washing, purging, pre-starting
- Liquid nitrogen level indicator with alarm system

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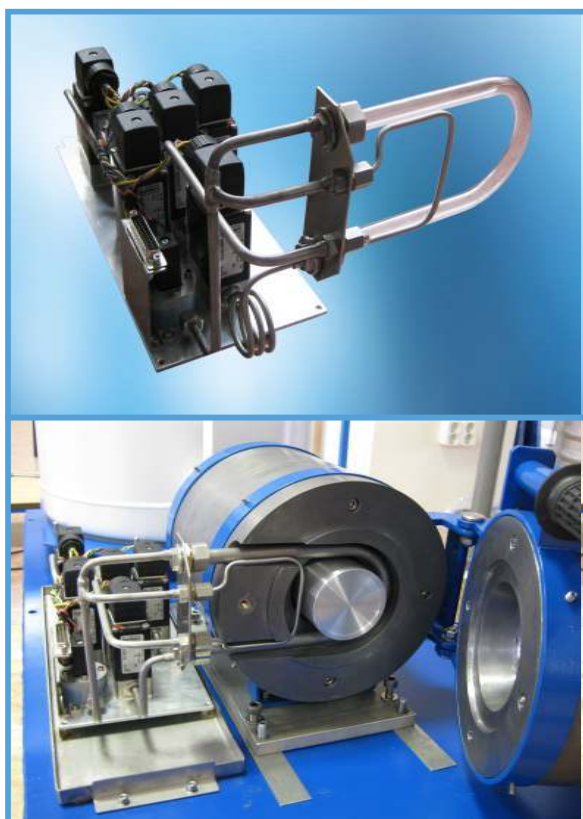
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# Specification

Parameter	Value
Energy resolution, MeV	0.05 - 2.8
HPGe detector efficiency, %	10*
Detection limit for $^{131}\text{I}$ radionuclide specific activity, measurement time 600 s, Bq/l	$0.8 \times 10^3$
Absolute sensitivity to gamma flux for 30% efficiency detector, pulse/quantum	$7.3 \times 10^5$
Continuous autonomous operating time after filling with liquid nitrogen, days	18
Ambient temperature, °C	+5 to +40
Supply voltage, V/Frequency, Hz	220+10 / 50+60
Overall dimensions	
Lead shield, support and detector, mm	1300 x 580 x 480
Spectrometric device Multispectrum, mm	490 x 230 x 490
Lead shield, support and detector weight, kg	170

\* Detectors with higher efficiency are available

## Installations







# Waste Assay Monitor HERCULES

(based on HPGe and/or scintillation detectors)

## Application

Waste Assay Monitor Hercules is intended for the measurement and determination of activities, activity concentration, total activities and total activity concentrations of selected radionuclides which emit gamma radiation in a range from 100 to 1500 keV. Solids and subjects are measured with average density up to 2055kg/m<sup>3</sup> located in standard drums with volume of about 0.2m<sup>3</sup> and 0.4m<sup>3</sup> and not standard packages of wastes of different matrixes.

## Features

Waste Assay Monitor Hercules is a complex measuring system which is intended for monitoring of radioactive waste in standard 200-litre drums and not only.

Hercules includes following systems:

- Spectrometric unit based on High-resolution HPGe detector (or multiple HPGe detectors) suitable to perform segmented gamma-spectrometric scanning for determination of activities of selected radionuclides in individual drum segments with vertical motion and collimator,
- Dose rate monitor, which measures dose rate of the segment in defined distance from the drum,
- Dose rate monitor measures the background dose rate,
- Rotary table,
- Control and power supply switchboards.

# Specification

Parameter	Value
Energy range, keV	100 to 2500 keV
Radionuclides measured *	$^{134}\text{Cs}$ , $^{137}\text{Cs}$ , $^{60}\text{Co}$ , $^{54}\text{Mn}$ , $^{59}\text{Fe}$ , $^{95}\text{Nb}$ , $^{65}\text{Zn}$ , $^{95}\text{Zr}$ , $^{58}\text{Co}$ , $^{51}\text{Cr}$ , $^{144}\text{Ce}$ , etc.
Measuring range	from 2.5 kBq (for background of 300 nSv/h, for $^{60}\text{Co}$ in $0.2\text{ m}^3$ drum with an average material density of $300\text{ kg/m}^3$ and measuring time of 30 min.) up to 1GBq
Measurement precision	+/-20% (for the uniform activity distribution and the density in the volume measured) maximum 50% for the material density of $1000\text{ kg/m}^3$ in the drum
Material density	up to $2500\text{ kg/m}^3$
Material volume	up to $0.4\text{ m}^3$ (or other by request)
Material weight	up to 1000 kg (or other by request)
Measured object	Different drum, boxes, containers made of steel concrete, etc.
Detector	HPGe, NaI, LaBr, Srl and other
Dimensions	2500 x 700 x 2200 mm (depends on modification)
Communication interface	X2X, CAN, RS-485, Wi-Fi
Protection Marking	IP 54 or better

\* Nuclide list can be changed accordingly

## Modifications



Equipped with roller based conveyor



Segmented scanner based on scintillators

Gamma-rays



# Free Release Monitor HERCULES-FRM

(based on HPGe and/or scintillation detectors)

## Application

Free Release Monitor HERCULES-FRM main working principle can be described in the following way. Any loading mechanism like forklift or a crane gently puts measuring object to the movable platform on the front roller-based conveyor. Scales which are inbuilt in the front conveyor are determining weight of the measuring object and automatically transfers information to the analytical software. Further actions are performed totally automatically or in manual mode. Measuring chamber opens front doors and movable platform slides inside of measuring chamber. Doors are closed and measurement starts. The FRM is equipped with 16 plastic scintillators surrounding the measuring object from all sides. Plastic scintillators are connected to digital multichannel analysers located in the control box. Analytical and control software packages guarantee total remote control and data acquisition from all plastic scintillators simultaneously. All analytical performance of the FRM is set up previously by inputting all information concerning measuring object, geometry, sizes, weights, filling of containers, etc. in the software package. After measurement is finished, operator is alarmed, record is stored in the database and report can be printed any time. In order to change the measuring object, the FRM opens the front doors and slides the platform out for further unload by the forklift or a crane. In case the operator needs to measure specific object, it is possible to open back doors to load the measuring object from the back. The whole measuring chamber is securely covered with stainless-steel for easy decontamination.

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# Specification

## General

- Overall dimensions of the FRM: 5000x2300x2100mm (LxWxH)
- Overall weight of the FRM: 10000kg
- Operation temperature: +10...+35°C
- Ready to accommodate object with size 1.2m x 0.8m x 1.0m (L x W x H)
- Lead walls not less than 50mm thick
- Stain-less steel protection
- External and internal automatic conveyor
- Inbuilt scales

## Plastic scintillators (HPGe detectors optional)

- 16 or 24 or more plastic scintillators equipped with PMTs
- Energy range from 100 to 3000 keV
- Detection limit for Co-60 is less than 300 Bq

## Software

- Total activity calculation
- Visualization of measurement and diagnostic information
- Storage of measurement data, controlled parameters and fixed constants in internal memory
- Control of all mechanically movable mechanisms
- Control and reset of the FRM in case of failure of automation
- Self-diagnostics control
- Visual and audible alarm in case of failure or exceed of previously set levels
- Alarm in case of fixed level activity exceed for separately chosen radionuclide
- 3D visualization interface for measurement object monitoring and setting geometrical parameters in order to decrease measurement uncertainties
- Visualization of inhomogeneities in activity distribution
- Automatic change of measurement parameters depending on measurement geometry (Geometry must be set up preliminary)
- All software packages run under Windows operation system

## Control box

- Control box of the FRM includes the following components:
- Set of MCAs for reading and transforming signals from PMTs of plastic scintillators
- Set of power supplies for different modules of the FRM
- Set of controllers to manage all components of automation process
- Indicators for operator
- Control panel with colour LCD display and touchscreen
- An emergency stop button is provided on the control box and the measuring chamber



# AirTrack Aerosol Monitoring Station

with high performance detector assembly and automatic filter changer



## Features



- Touch screen user interface, easy to learn and intuitive operation;
- Update period of the radionuclides concentration information is 1 minute;
- Gamma spectrometric chain made of scintillation detector  $\text{SrI}_2(\text{Eu})$  high resolution and digital 4K MCA;
- Automatic stabilization of the energy scale of gamma radiation spectrometric channel is implemented using a K-40 built-in source;
- Calibration of alpha/beta/gamma radiation energy scale using reference sources in filter geometry;
- Full load of filter cartridge provides up to three months of autonomous operation;
- Automatic control of the operations, emergency messages about equipment faults in case of operation failure and built-in testing procedures.

### Main operational functions:

- Acquiring alpha-beta and gamma spectra in real-time;
- Calculating activity of radionuclides on the filter [Bq] and concentration of radionuclides in the air [ $\text{Bq}/\text{m}^3$ ];
- Indication of the concentration of Radon in the ambient air and automatic compensation its progenies;
- Two programmable thresholds (notification and alarm) for radiological events in each measurement chain (alpha, beta and gamma emitters);
- Automatic filter replacement depending on its contamination degree, integrity damage, or after measurement time;
- Automatic control of filter condition, including measurement of differences in the air pressure  $\Delta p$  at the inlet and outlet of the filter;
- Measurement of the flow rate of the incoming air;
- Data transfer via LAN, USB and 4G interfaces in the ANSI 42.42/EURDEP format to the end-user;
- Control of all AirTrack operations from a remote computer.

**AirTrack** is the State of the Art among Aerosols Monitors, in terms of advanced design solutions and performances of the Alpha/Beta and Gamma spectrometric measurement chains.

It is a budget friendly alternative to its higher performance version **AirTrack-Ge** equipped with electrically cooled HPGe detector.



$\alpha$ -,  $\beta$ -,  $\gamma$ -rays

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# AirTrack-i

## Iodine Monitoring Station

with automatic cartridge changer and on-line spectrometric analysis



### Features

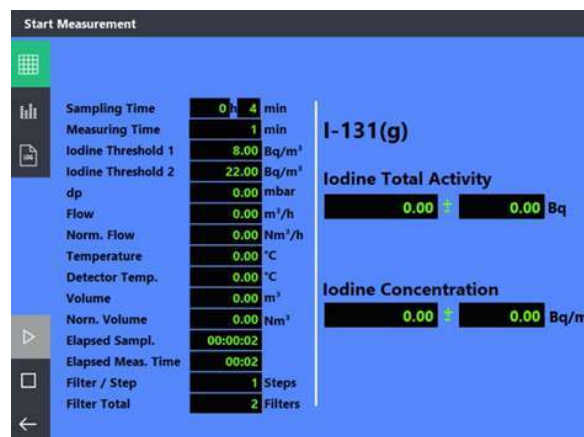
- Automatic stabilization of the energy scale of gamma radiation spectrometric channel is implemented using a K-40 built-in source (for scintillator);
- TEDA (triethylene di-amine) impregnated Carbon filter cartridge with a high affinity for the adsorption, chelation and retention of the various species of Iodine;
- Gamma spectrometric chain made of scintillation detector SrI2(Eu) high resolution and digital 4K MCA;
- Update period of the I-131 concentration information is 1 minute;
- Touch screen user interface, easy to learn and intuitive operation;
- Full load of filter cartridge provides up to three months of autonomous operation;
- Automatic control of the operations, emergency messages about equipment faults in case of operation failure and built-in testing procedures.

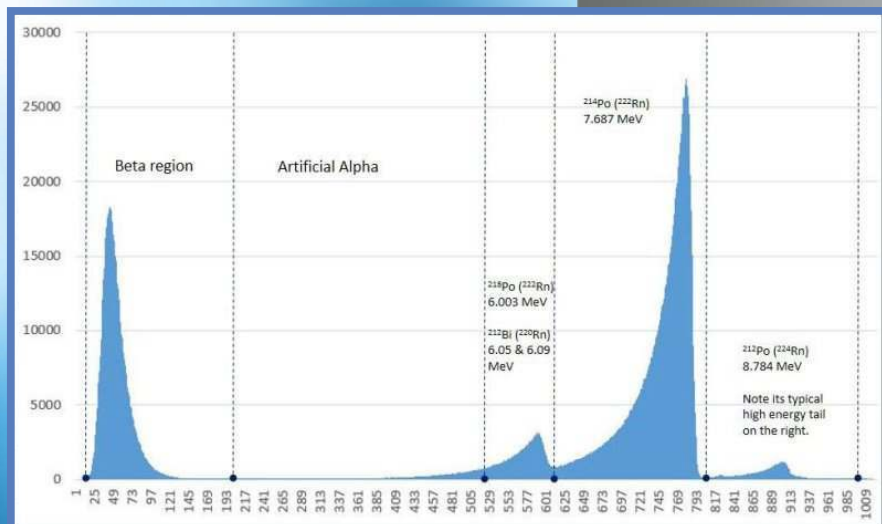
### Main operational functions:

- Acquiring gamma spectra in real-time;
- Measuring the activity of I-131 on the filter [Bq] and calculating the concentration of I-131 in the air [Bq/m<sup>3</sup>];
- Automatic filter replacement depending on its contamination degree, integrity damage, or after the expiration of the specified measurement time;
- Automatic control of filter condition, including measurement of differences in the air pressure  $\Delta p$  at the inlet and outlet of the filter;
- Measurement of the flow rate of the incoming air;
- Ambient air temperature measurement;
- Two programmable thresholds (notification and alarm) for radiological events;
- Audio and color alarm signals about operation modes and exceeding threshold values;
- Data transfer via LAN, USB and 4G interfaces in the ANSI 42.42/EURDEP format to the end-user;
- Control of all AirTrack operations from a remote computer.

AirTrack-i is the state-of-the-art among Iodine monitors in terms of advanced design solutions for automatic gamma spectrometric measurements and cartridges changer mechanics.

The innovative unique use of a SrI<sub>2</sub>(Eu) scintillation crystal with high energy resolution and low intrinsic background ensures maximum reliability in the identification of radioactive iodine and reduces the detection limit of its concentration. It shares the same functional and mechanical design of the AirTrack-Sr Aerosols Monitoring station. Both monitors are constructed on a modular principle and have interchangeable parts, but AirTrack-i uses special charcoal filters. This charcoal material is selective, it will not trap other gases, and therefore the sample will be enriched with only I-131. When it is impregnated with some chemicals, the activated charcoal can effectively adsorb both organic and elemental iodine.





# AirTrack-Mobile

## $\alpha$ & $\beta$ monitor

### Description

AirTrack-Mobile, is a transportable Monitoring Station made of two sub-units, installed on a trolley for easy transport and operability. The AirTrack-Mobile is made of two Modules, an Alpha/Beta Continuous Aerosol Monitor with an optional a wide-range Gamma dose rate monitor, and a Meteorological Station. A compact collapsible mast for weather sensors mounting (3m when deployed) and integrated LTE/3G data modem completes the AirTrack-Mobile assembly.

The basic AirTrack-Mobile includes only the Aerosols Monitor unit, the other modules that are part of the AirTrack-Mobile may be added optionally, depending upon additional needs of the Client.

### Accessories

- External Gamma Dose Rate Meter GDRM
- Meteo Station
- Battery set for 30 min autonomous operation

### Features

- On-line alpha/beta spectrum acquisition and readout
- Automatic filter replacement depending on its contamination, possible damage or measurement time
- 3 months of autonomous operation
- Radon progeny and gamma background measurement/compensation
- Evaluation of alpha and beta artificial concentrations in air
- Evaluation of total collected activities
- Management of alert/alarm thresholds and trips
- Flow-rate measurement
- Measurement of pressure drop through the filter
- Inlet air temperature measurement
- Sampling head for outdoor operation
- Control of all AirTrack-Mobile operations
- Data transfer via LAN, USB and 4G/5G interfaces in the ANSI 42.42/EURDEP format
- Touch screen user interface

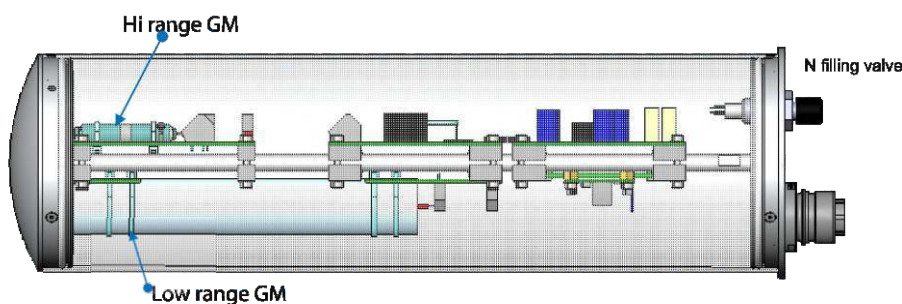
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# Specification

Parameter	Value
Measurement ranges	<ul style="list-style-type: none"> <li>- Alpha and Beta natural emitters: <math>10^{-1}</math> to <math>10^5</math> Bq/m<sup>3</sup></li> <li>- Alpha long lived emitters: <math>10^{-2}</math> to <math>10^5</math> Bq/m<sup>3</sup></li> <li>- Beta long lived emitters: <math>10^{-1}</math> to <math>10^5</math> Bq/m<sup>3</sup></li> <li>- Alpha energy range: 2 MeV to 10 MeV</li> <li>- Beta energy range: 80 keV to 3 MeV</li> <li>- Radon and Thoron measuring range: <math>10^{-1}</math> to <math>10^5</math> Bq/m<sup>3</sup> with automatic Radon progenies compensation</li> </ul>
Alarms	<ul style="list-style-type: none"> <li>- Programmable thresholds for alpha and beta concentration alert/ alarm</li> <li>- Visual indicators</li> </ul>
Detectors	<ul style="list-style-type: none"> <li>- SIID Silicon Ion Implanted Detector with active area: 600mm<sup>2</sup></li> <li>- Active gamma background compensation through additional dedicated SIID detector</li> </ul>
Air flow-rate	2 to 6 m <sup>3</sup> /h
Air inlet temperature	from -40 to +70 °C
Filter type	Filter tape
Filter tape	<ul style="list-style-type: none"> <li>- PTFE, (Glass Fiber, Cellulose - optionally)</li> <li>- 15 meters lengths, 50 or 60mm wide, 90 days autonomy</li> </ul>

## Gamma Dose Rate Monitor GDRM

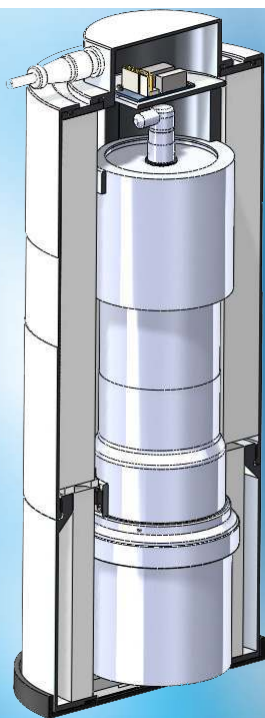


### Description

GDRM is meant for determining the dose rate that can be generated by accidental releases in NPP. GDRM is designed for indoor area and outdoor monitoring. GDRM has very low power consumption, compact dimensions and is lightweight. It is easy in operation and needs minimal operator's intervention. GDRM is energy-compensated in accordance with IEC 60846-1, which makes it suitable for measuring ambient dose equivalent rate  $H^*(10)$ .

Parameter	Value
Energy range	from 24.6 keV to 10MeV
Dose rate range	from 0.05 $\mu$ Sv/h to 5 Sv/h (up to 100 Sv/h)
Power supply	10 ÷ 30 VDC, 1.5W
Enclosure	Ø 100 x 400 mm
Weight	1.5 kg
Class	IP67





# AirSPEC & WaterSPEC

Dose rate meter and gamma radionuclide identification

## Application

AirSPEC & WaterSPEC are monoblock units, comprising scintillation detector, photoelectronic multiplier, HV converter, amplifier, multichannel pulses analyzer and processor unit.

AirSPEC & WaterSPEC measurement systems is autonomous, automated and provide calculation of the ambient equivalent dose rate  $H^*(10)$  in real time, as well as identification of the most common natural and artificial gamma radionuclides. The results of the identification and dose rate are then transmitted to the upper-level computer via exchange protocol.

AirSPEC & WaterSPEC have automatic stabilization of the spectrometry channels by means of tracking the position of the K-40 1460.8 keV full energy peak provided by the potassium salt located in the cartridge near scintillation crystal.

**AirSPEC** provides an additional feature of thermostabilizing housing to provide a wider range of operating temperatures. The housing provides both high degree of thermal insulation and automatic control and active adjustment of the temperature inside the device. The IP67 degree of protection allows to use AirSpec in severe weather conditions.

**WaterSPEC** is designed for indoor or outdoor use in aquatic environments. The waterproof housing has IP68 degree of protection: dust-tight (full protection against dust and other particulates) and protected against extended immersion in water to a maximum depth of 2 meters.

# Specification

## AirSPEC & WaterSPEC

Parameter	Value
Detector type	Nal(Tl) Ø51 × 51 mm (LaBr <sub>3</sub> , CeBr <sub>3</sub> , Srl <sub>2</sub> – optional)
Measured energies range	80 – 3000 keV
Gamma dose rate measuring range	from 0.01 to 100 mkSv/h
Relative energy resolution on the line 661,7 keV	< 8% for Nal(Tl) < 3.5% for Srl <sub>2</sub>
MCA channels	1024
Power supply voltage	4.5 – 18 V
Data transfer interface	RS-485
Shell protection level	Ip67
List of identified radionuclides	Ce-144, Te-132, I-131, Ba-140, Cs-134, Cs-137, Zr-95, Mn-54, Co-60, La-140

## AirSPEC

Parameter	Value
Power consumption:	
- Thermostabilizing OFF	1.5 W
- Thermostabilizing ON	25 W
Operation temperature	-25 °C ÷ +60 °C
Dimensions	155 × 370 mm
Weight	6.4 kg

## WaterSPEC

Parameter	Value
Operation temperature	0 °C ÷ +30 °C
Dimensions	76 × 420 mm
Weight:	
- without a cable	2.8 kg
- with a cable 20 m	3.7 kg



# Gamma Spectrometer All-In-One

(based on NaI Detector)

## Description

Gamma Spectrometer combines NaI(Tl) crystal of different sizes, a photomultiplier tube, a high voltage power supply, a preamplifier and a multi-channel analyzer module from within one rugged housing.

The whole system is entirely powered from the USB interface. Due to the integration of all hardware components required for a gamma spectroscopy system in one package, only one USB cable is required to connect the detector to a computer. This simplifies the usage and lowers the total costs of the gamma spectrometer.

Gamma Spectrometer is operated with GammaPRO software package. The only requirement is that the host computer has an integrated USB high power hub or host port.

## Features

- Spectrum stabilization
- Entirely Powered from USB Interface
- Low Power Consumption,
- Well Suited for Laptop Operation
- Small Size, Compact Housing
- Only one Cable Required for Operation
- High Integration
- Useable with many Application Programs
- Easy to Use
- Low Price

## Complete set

- Gamma Spectrometer based on NaI or other scintillation detector;
- GammaPRO software package;
- 2m USB cable;
- Documentation.

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# Specification

Parameter	Value
Crystal Size	63mm x 63mm*
Energy Resolution (FWHM @ 662keV)	6.2% typ. / 7% max
Energy Range	20keV to 3MeV
Number of Channels	128, 256, 512, 1024, 2048
Digital Filter	adjustable
Maximum Throughput	>100,000cps
Special Features	- Integrated Temperature Sensor - MCS-mode
Computer Interface	USB2.0 compliant, Micro-B Receptacle
Power	Supply entirely powered from USB
Power Consumption (typical)	<1W (Idle / Measurement)
Dimensions	83.5mm x 296mm
Operating Temperature Range	0°C to 40°C
Weight	1350g

## Accessories (optional)

- Tripod;
- Lead shield;
- Marinelli beakers, etc.



	Dimensions, DxH	Energy Resolution at 662 keV, %	Energy Range, keV	Efficiency, %	Advantages
NaI(Tl)	51x51	<7	20keV to 3MeV	0.65	Low price
	63x63	<7,5		1.2	
	76x76	<8		2	
	150x100	<12		7.5	
LaBr3(Ce)	51x51	<3,1	20keV to 3MeV	1	High resolution
	63x63	<3,3		1.5	
	76x76	<3,5		2.5	
CeBr3	25x25	<4,2	20keV to 3MeV	0.14	Low background and MDA
	38x38	<4,3		0.4	
	51x51	<4,3		1	
SrI2	25x25	<2,8	20keV to 3MeV	0.14	Low background and MDA
	38x38	<2,9		0.4	

Stabilization:  
LED system or Am source

Gamma-rays





# TRIO Spectrometer – radiometer

## Application

Spectrometer TRIO is designed for registration of gamma-, beta- and alpha radiation and for measuring activity (specific and volumetric activity) of natural radionuclides (for example Ra-226, Th-232, K-40, Rn-222), technogenic radionuclides (for example Cs-137, Cs-134, Co-60, mTc-99, Sr-90 and etc.) in water, food, vegetation, building materials, soil samples, radiopharmaceuticals, rocks, chemical industry materials, alloys, scrap metal and other technological products. Also, it is used for measuring gross specific activity of beta- and alpha- emitting radionuclides in water.

## Features

- Ability to manage several channels simultaneously
- Intuitive and user-friendly software
- Low Power Consumption
- Compact size of each chamber
- Free to choose channels of your interest depending on application
- Easy extension of channel quantity
- 100% remote control of the spectrometer TRIO via software package

## Complete set (standard)

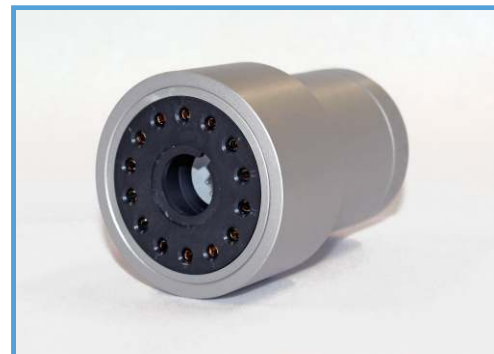
- Detection unit for each channel
- Lead shielding with stable platform
- Multichannel analyzer (MCA)
- Analytical software package
- Cable set
- Documentation set

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# Specification

Parameter	Value
Type of detectors	NaI(Tl) CsI(Tl) LaBr <sub>3</sub> (Ce) Polystyrene ZnS(Ag)
Energy range, keV	
- for gamma radiation	40-3000
- for beta radiation	65-4000
- for alpha radiation	1500-10000
Relative energy resolution on the line 661,7 keV,	
- for NaI(Tl) (63x63mm)	< 8,5
- for NaI(Tl) (76x76mm)	< 9
- for NaI(Tl) (150x100mm)	< 12
- for CsI(Tl) (50x50mm)	< 9
- for LaBr <sub>3</sub> (Ce) (38x38mm)	< 3,5
Relative energy resolution on the conversion electron line 624 keV	
- for Polystyrene detector	< 15
Integral nonlinearity in the gamma energy range from 40 to 3000 keV, %	< 1
Integral nonlinearity in the beta energy range from 65 to 4000 keV, %	< 2
Detection sensitivity for beta radiation of <sup>90</sup> Sr- <sup>90</sup> Y (energy range 550-2300 keV), cps/Bq	
- for Polystyrene detector	> 0,15
Detection sensitivity for alpha radiation of <sup>239</sup> Pu, cps/Bq,	
- for ZnS(Ag) detector	> 0,3
Maximum throughput, cps	> 5·10 <sup>4</sup>





# Mobile Radiation Monitor GammaCART

## Application

Mobile spectrometric system Mobile Radiation Monitor is designed to measure gamma radiation energy distribution, identify gamma emitting radionuclides, as well as calculate specific and surface activity of gamma emitting radionuclides under conditions of their natural occurrence and at nuclear industry premises. In addition, the system can be used for radiation monitoring, e.g., for examination of large areas, searching lost or stolen gamma radiation sources, study of radionuclide precipitation near radiation hazardous sites without preliminary sampling.

## Accessories

There are various modifications of system Mobile Radiation Monitor:

- Containing spectrometer with 1 or 2 NaI(Tl) scintillation detectors;
- Containing spectrometer with 1 or 2 LaBr<sub>3</sub>(Ce) scintillation detectors;
- Containing spectrometer with 1 or 2 HPGe detectors

## Complete set (standard)

- Electric vehicle as a mobile platform
- Gamma radiation spectrometer containing:
  - Gamma radiation detector(s);
  - Multichannel channel analyser Polynom;
- Thermostabilization system (for NaI(Tl) or LaBr<sub>3</sub>(Ce) detectors) containing:
  - Thermostabilizing housing with a built-in heat exchanger;
  - Cooling and heating system box;
  - Hoses for circulation of the cooling liquid;
- Navigation system including a external antenna;
- Shockproof toughbook operable in harsh conditions;
- Router with antenna which provides connection between the analyser, navigation system and toughbook;
- Fixation and positioning system for the detection units;
- Charger for the electric vehicle.

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# Specification

Parameter	Value
Relative energy resolution for LaBr <sub>3</sub> (Ce)	3.5%
Registration efficiency for LaBr <sub>3</sub> (Ce)	at least 0.6%
Energy range	40 keV ÷ 3000 keV
Integral nonlinearity	< ±1.0 %
Energy conversion function (during 24 hours)	< ±1.0 %
Maximum throughput of the spectrometer	at least 5·10 <sup>4</sup> cps
Speed range of the electric vehicle	
fast mode	4 km/h – 25 km/h
slow mode	0.5 km/h - 4 km/h
Operation setting time	<10 minutes
Continuous operation time	at least 8 hours
Completely charged	10 hours
Temperature range	from -10°C to +55°C
The average MTBF	10000 hours



## Surface activity measurement

Distance between the detector's surface and the ground, cm	Radionuclide	Activity measurement range, Bq/kg
25	<sup>137</sup> Cs	0.035 ÷ 1300
	<sup>60</sup> Co	0.021 ÷ 650
	<sup>134</sup> Cs	0.024 ÷ 500
40	<sup>137</sup> Cs	0.04 ÷ 1400
	<sup>60</sup> Co	0.023 ÷ 720
	<sup>134</sup> Cs	0.025 ÷ 560
60	<sup>137</sup> Cs	0.046 ÷ 1600
	<sup>60</sup> Co	0.028 ÷ 820
	<sup>134</sup> Cs	0.028 ÷ 620



A large, white Greek letter alpha ( $\alpha$ ) is centered on a blue gradient background.

# Silicon Ion Implanted Alpha Particle Detectors SIID

## Application

Ion Implanted Silicon Alpha Particle Detectors is a product for the precise alpha spectroscopy. The thin entrance window of the detector provides good energy resolution even in close location of the alpha radioactive source and also provides high efficiency registration of alpha particles.

## Features

- The detectors can operate without hermetization due to location of P-N junction inside of the detector crystal
- Contacts are formed using ion-implantation method and provide thin, well-formed junction
- Relatively thin dead layer (less than 500 Å)
- High solidity entrance window
- Possibility working in vacuum
- The detectors may be equipped with BNC or MICRODOT connectors adapted for different customer needs.
- The detectors are manufactured with open window as well as with metalized window.

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# Specification

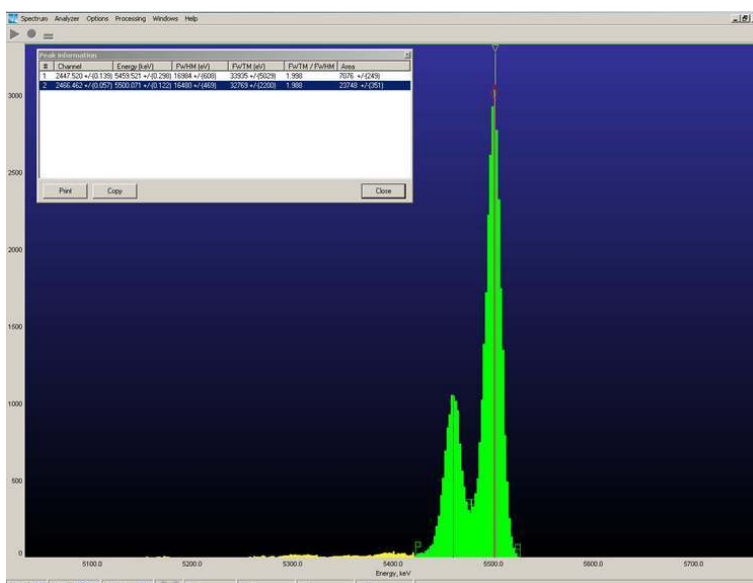
Detector area, mm <sup>2</sup>	Energy resolution*, keV Alpha	Beta	Detector type	Thickness, $\mu$ m	Detector bias voltage, V
50	12	6	Open	300 +/- 30	50 - 70
100	14	8	Open	300 +/- 30	50 - 70
300	16	14	Open	300 +/- 30	50 - 70
450	20	15	Open	400 +/- 30	50 - 70
450	25	17	Metalized	400 +/- 30	50 - 70
600	25	23	Open	400 +/- 30	50 - 70
600	30	20	Metalized	400 +/- 30	24 - 48
900	25	20	Open	400 +/- 30	50 - 70
1200**	35	30	Open	400 +/- 30	50 - 70

\* Shaping time – 1  $\mu$ s.

\*\*The detectors of other sizes are available.

The Ion Implanted Silicon Alpha Particle Detectors with metalized coating of entrance window can be used as a part of radioactive aerosol monitors. This is special version of the detectors having following features:

- Allows the detector operation in ambient light
- The metal coating provides mechanical and chemical protection. The thickness of entrance window is less than 2  $\mu$ m
- Opportunity of operation at bias voltage - from +15 to +24 V.



<sup>238</sup>Pu spectrum





# Alpha Spectrometer Amber

## Description

Alpha Spectrometer is intended for the amplification, analogue filtration of the electric pulses coming from alpha radiation detectors.

The complete spectrometer consists of vacuum chamber from stainless steel, power supply, preamplifier, pulse generator, discriminator and a counter.

Vacuum chamber allows to put in the majority types of detectors, including Silicon Ion Implanted Alpha Particle Detectors SIID with high resolution and up to 1200 mm<sup>2</sup> square. Sample holder inside vacuum chamber allows to adjust the distance between sample and the detector from 4 to 48 mm with 4 mm step.

## Features

- Device management with external PC software
- Vacuum gauge with pressure display and control via software
- Detector current meter from 1 nA to 10  $\mu$ A
- High Voltage inhibit in case of vacuum breaking
- Reverse bias on the sample holder
- Integrated Multichannel Analyzer
- Calibration pulser
- Vacuum chamber from stainless steel
- Fits up to 50 mm (2 inches) diameter samples
- Possibility to use alpha detectors up to 1200 mm<sup>2</sup>
- Adjustable sample-detector distance from 4 to 48 mm (with 4 mm step)

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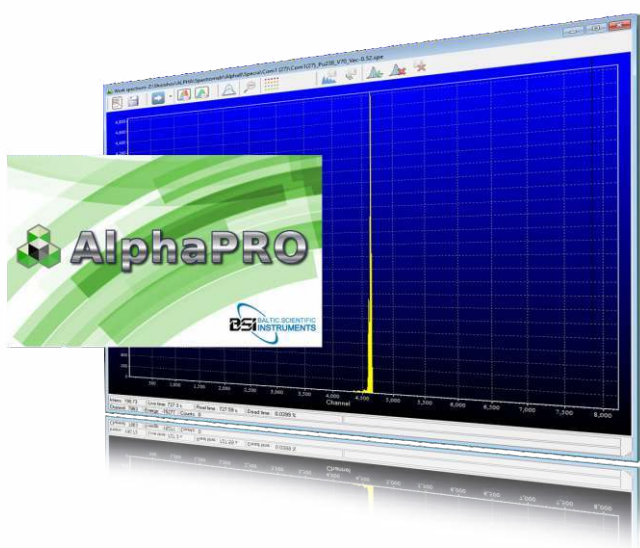
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# Specification

Parameter	Value
Registration energy range, keV	up to 10000
Shaping time constants, us	1
Integral nonlinearity, %	< 0.04
Maximum value of High Voltage, V	+150
Operation temperature range, °C	+5...+35
Temperature instability, %/C	< 0.01
Time of continuous operation, hour	> 24
Consumed power, Wt	< 10
Supply voltage, V	+/-12 +/-24
Energy resolution at 5.49 MeV for 450 mm <sup>2</sup> detector, keV	< 20
Absolute detection efficiency, %	> 20

Analytical software package AlphaPRO allows to:

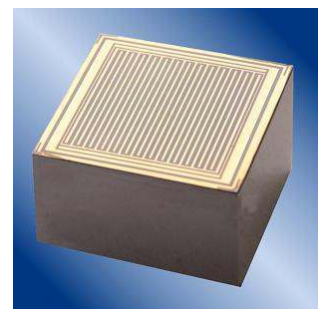
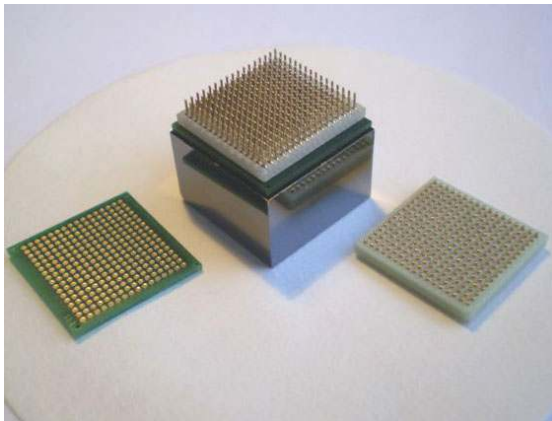
- Execute spectra acquisition for the set time,
- Mark and select regions of interest and examine them on a separate plane,
- Increasing or reducing scale on horizontal and vertical axes,
- Perform energy calibration of spectra on two known energies;
- Determine centroids and area of peaks with background deduction and without background deduction;
- Make an estimation of energy resolution at one second and one tenth height of full absorption peak;
- Carry out an automatic serial spectra acquisition with automatic record on a disk;
- Print out spectrum window;
- Compare different spectra in one window simultaneously reducing or decreasing scale;
- Calculation of activities of alpha emitting radionuclides.





# CdZnTe/CdTe detectors and associated electronics

CdZnTe/CdTe is a room temperature semiconductor which allows to create X- and gamma-ray detectors with comparably high energy resolution and high count rate capability without cooling. Detectors performance allow to use CdZnTe/CdTe detectors successfully in Nuclear Industry and Medicine, Safeguard and Homeland Security, many others industrial and laboratory applications.



Baltic Scientific Instruments develops and fabricates detectors based on CdZnTe/CdTe and accompanying electronics for them base on general electronic components and ASICs.

We are flexible in our technological processes and provide engineering design service and custom fabrication of small and medium volumes of devices.

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# μSPEC Gamma-Radiation CZT Micro Spectrometer

## Description

Gamma CZT Micro Spectrometer μSPEC is a high performance device based on room temperature CdZnTe semiconductor detectors and MicroMCA527. The μSPEC allows measuring, storing and processing gamma-radiation spectra in a PC through the USB port. The Spectrometer has changeable CdZnTe quasi-hemispherical detectors of different volumes of 60 mm<sup>3</sup>, 500 mm<sup>3</sup> or 1500 mm<sup>3</sup>.

Detector type	CdZnTe
Detector volume	60-1500mm <sup>3</sup>
Energy range	20keV - 3.0MeV
Energy resolution at 662 keV	
μSPEC60, μSPEC500	<2.5%
μSPEC1500	<3.5%
Maximal throughput	<100 kcps
Number of channels	128, 256, 512, 1k, 2k
PZC adjustment	automated
Connector	Micro USB
Dimensions, mm	25 x 25 x 70
Weight, gram	80



## SDP500, SDP1500, SDP4000 Spectrometric Detection Probes



Spectrometric Detection Probes SDP310/Z, SDP500S, SDP1500 and SDP4000 are room temperature operating portable devices with large volume CZT detectors. The detection probes are designed for application in equipment for recording and analysis of gamma-radiation energy spectra. The detection probes consists of the CZT detector and charge sensitive preamplifier.

Detector	Probe head dimensions, mm	Detector volume, cm <sup>3</sup>	Bias Voltage, V	Energy Resolution at 662keV, %	Peak/Compto at 662keV
SDP500	Ø24 x 58	0.5	≤ 1500	< 2.5	> 4.0
SDP1500	Ø32 x 58	1.6	≤ 2500	< 3.5	> 4.0
SDP4000	Ø40 x 58	4.0	≤ 3000	< 4.0	> 4.0

# SERVICE & SUPPORT

Except for developing and manufacturing of Spectroscopy systems, Baltic Scientific Instruments is also offering service, maintenance and repair of HPGe, SiLi and CZT detection units and electronics produced by BSI and other manufacturers.

Baltic Scientific Instruments specialists are available at the factory and can travel to the site of installation of the equipment to perform the following activities:

- Installation and commissioning of the equipment,
- Routine maintenance,
- Preventive maintenance,
- Repair Detectors and electronics,
- User training.

Scope of repair activities available:

- Vacuum restoration,
- Repair and replacement of preamplifier,
- Replacement of damaged cryostats, end caps and other parts. Radioactive-pure materials like Aluminum, Copper, etc. are available. Ultra low-background materials are also possible to use.
- Replacement of broken input window made of Aluminum, Beryllium, Carbon fiber and Polyimide,
- Old Germanium detector transfer into a new cryostat,
- Recovery of detector parameters,
- We provide warranty for our services.

Contact our service team for more information: [service@bsi.lv](mailto:service@bsi.lv).



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