



Key features of bGamma

BrightSpec NV

25 October 2018
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SUMMARY



Unique

- Unique features → feature not existing in any commercial software



Few

- Outstanding → remarkable implementation of this feature



Highlight

- Highlight → Feature that, as a result of its implementation, could position this product at the top of the selection list even when other similar products would have this feature realized as well.

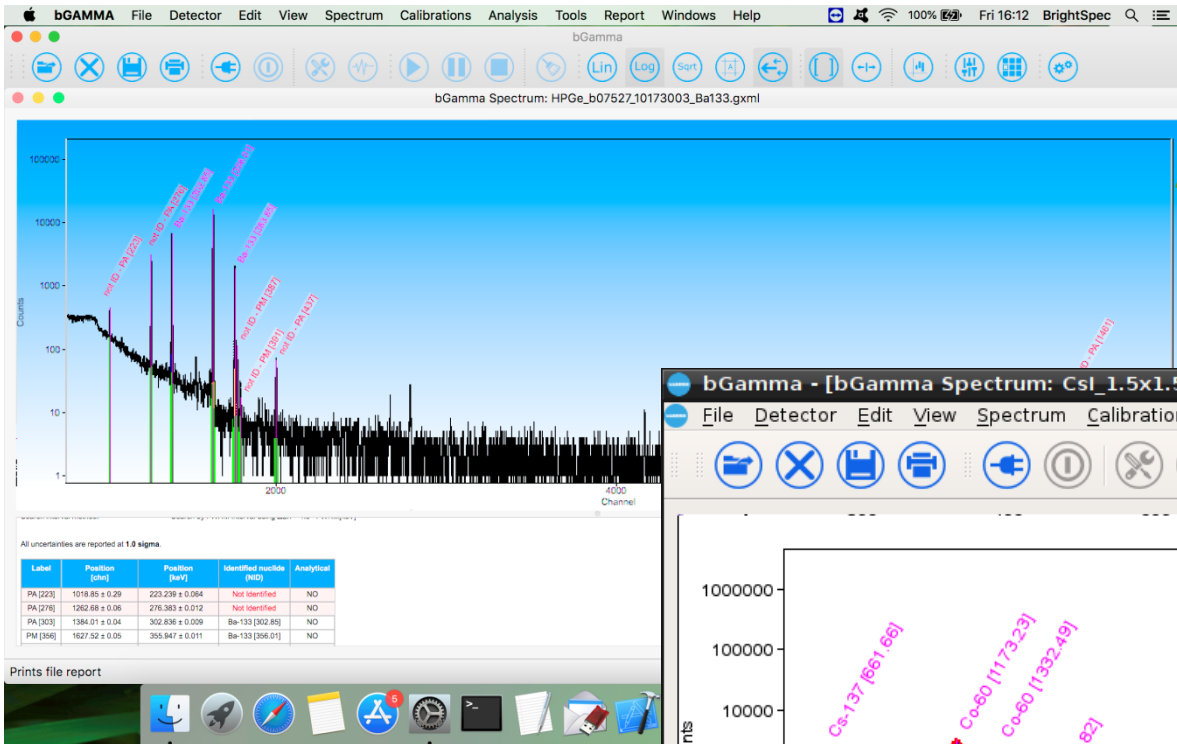
Platform independent

Unique

- Run seamlessly in any Operating system
 - MS Windows:
 - XP, 7, 8 and 10.
 - Linux
 - mac OS
- Wide hardware support
 - X86 (32-bit) μ Processor
 - 64-bit μ Processor
 - ARM μ Processor



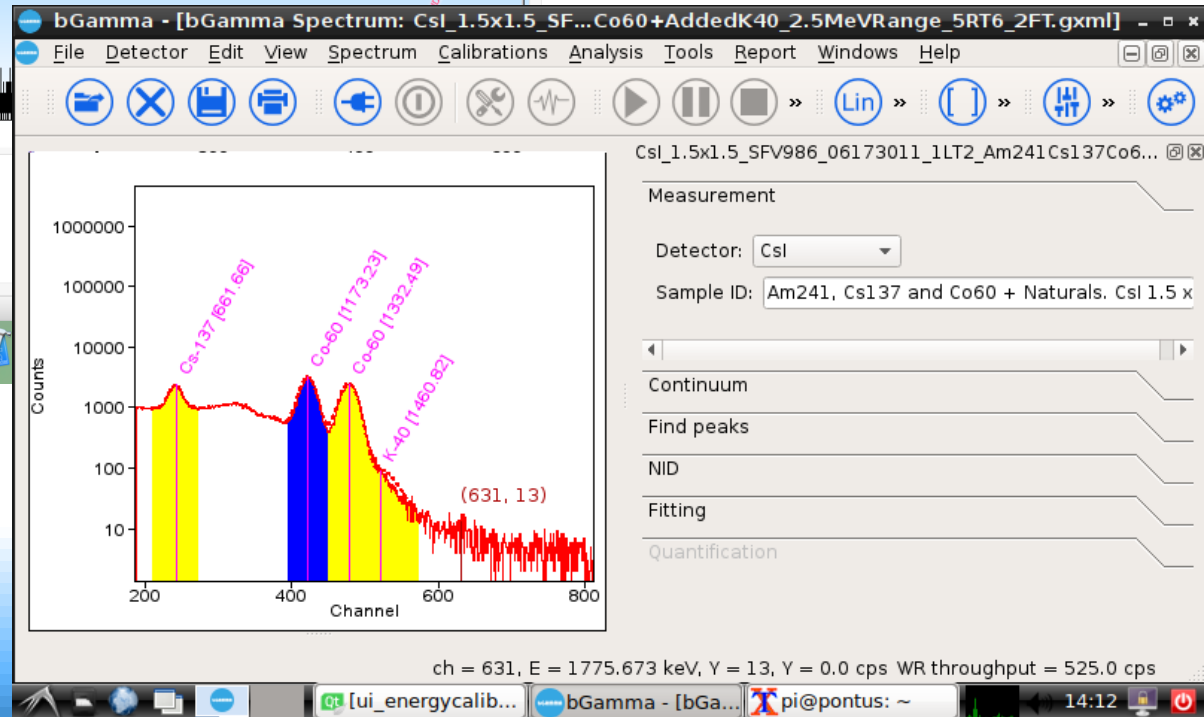
Platform independent



mac OS

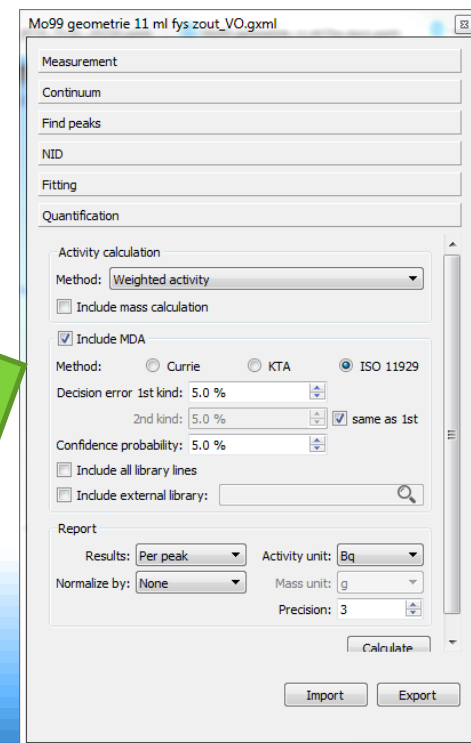


Raspberry Pi



Generic software

- Multipurpose and generic software for gamma-ray
 - Analysis of **ANY** type of Gamma-ray spectra independently of the detector used for its measurements
 - Low-medium-high energy resolution detectors
 - BGO, CsI, NaI(Tl), CeBr₃, Srl₂, LaBr₃
 - HPGe, Si(Li) and CdZnTl
 - All analysis parameters are at hand and saved as “model”.
 - Models can be imported for quick spectrum analysis





MultiDocument

- Allows working with many spectra at same time
 - Can mix spectra being acquired (hardware control) with spectra from saved files
 - Use of docking and floating windows

The screenshot displays the bGamma software interface with several docked windows:

- Top Left:** File menu and toolbar with icons for Open, Close, Save, Print, Connect, Disconnect, Set, Oscilloscope, Start, Pause, Stop, Clear, Lin, Log, Sqrt, Grds, Cursors, Work region, Full, Residuals, Calibrate, Nuclides, Full analysis.
- Top Row (Spectra):**
 - bGamma Spectrum: HPGe_b07527_10173003_Ba133.gxml:** Energy spectrum from 200 to 550 keV. Peaks are labeled: (365, 332), Ba-133 [223.24], Ba-133 [276.40], Ba-133 [302.85], Ba-133 [302.85], Ba-133 [356.01], Ba-133 [356.01], Ba-214 [266.76], Pb-D - Pb [381], Pb-D - Pb [381], and no ID - Pb [437].
 - bGamma Spectrum: bGamma_02123002.gxml:** Energy spectrum from 0 to 1000 keV. Peaks are labeled: (161, 140) and PM [804].
 - bGamma Spectrum: KCL770gr_NaI2x2_in3x3Marinelli.gx...:** Energy spectrum from 0 to 3000 keV. Peaks are labeled: X-ray escape (K-40) [511.02], 864, 384, 961, 6211, 4874, Annihilation [511.02], Escape (K-40) [1460.82], and K-40 [1460.82].
- Middle Row (Acquisition & Reporting):**
 - Data Acquisition:** Parameters table:

| Parameter | Value |
|-----------------|-------|
| Device name | bMCA |
| No. of channels | 1024 |
 - bGamma Spectrum: NaI3x3_S2AA4805_Cs137+Naturals_2...:** Energy spectrum from 0 to 2000 keV. Peaks are labeled: Cs-137 [661.66], Bi-214 [820.32], K-40 [1460.82], and Bi-214 [1764.48].
 - bGamma Spectrum: LEGE_TecnubelAm241Co60Cs137_1...:** Energy spectrum from 1100 to 1500 keV. Peaks are labeled: Co-60 [1173.23], Co-60 [1332.48], and K-40 [1460.82].
- Right Panel (bGamma_02123002.gxml):** Measurement settings including Fitting method: Non-linear least squares, Report uncertainties in: absolute values, and buttons for Do fitting and Clear fit.
- Bottom Row (Reporting & Oscilloscope):**
 - Energy Calibration:** Residuals plot showing data points around a zero line.
 - Sample report:** ID: NaI 3x3 SN= S2AA4805 Cs137 + naturals, Operator: Unknown, Category: Unknown.
 - Peak find report:** Table of peak data:

| PM | ROI | 81 | 15 | 7 | 220 | 0.5 | 6.6 | 0.2 | 20 | 0 | 0 | 9.1 | 0 | 0 | 64 | 76 | 789 | 500 | 4.0 | 6 | (NT D) | |
|----|-----|----|----|---|-----|-----|-----|-----|------|---|---|-----|---|---|-----|----|-----|-----|-----|----|--------|------|
| 1 | 223 | -1 | 15 | 7 | .88 | 1 | 8 | 1 | 0.29 | 0 | 0 | 9 | 2 | 2 | 3.3 | 37 | 74 | 48 | 67 | 87 | 6 | K-40 |
 - MCA Digital oscilloscope:** Time-domain plot showing a signal peak at approximately 60 ns.

Acquiring: Elapsed LiveTime= 161.0 and RealTime = 161.4. Dead Time = 0.25 %. ICR = 0.0 cps

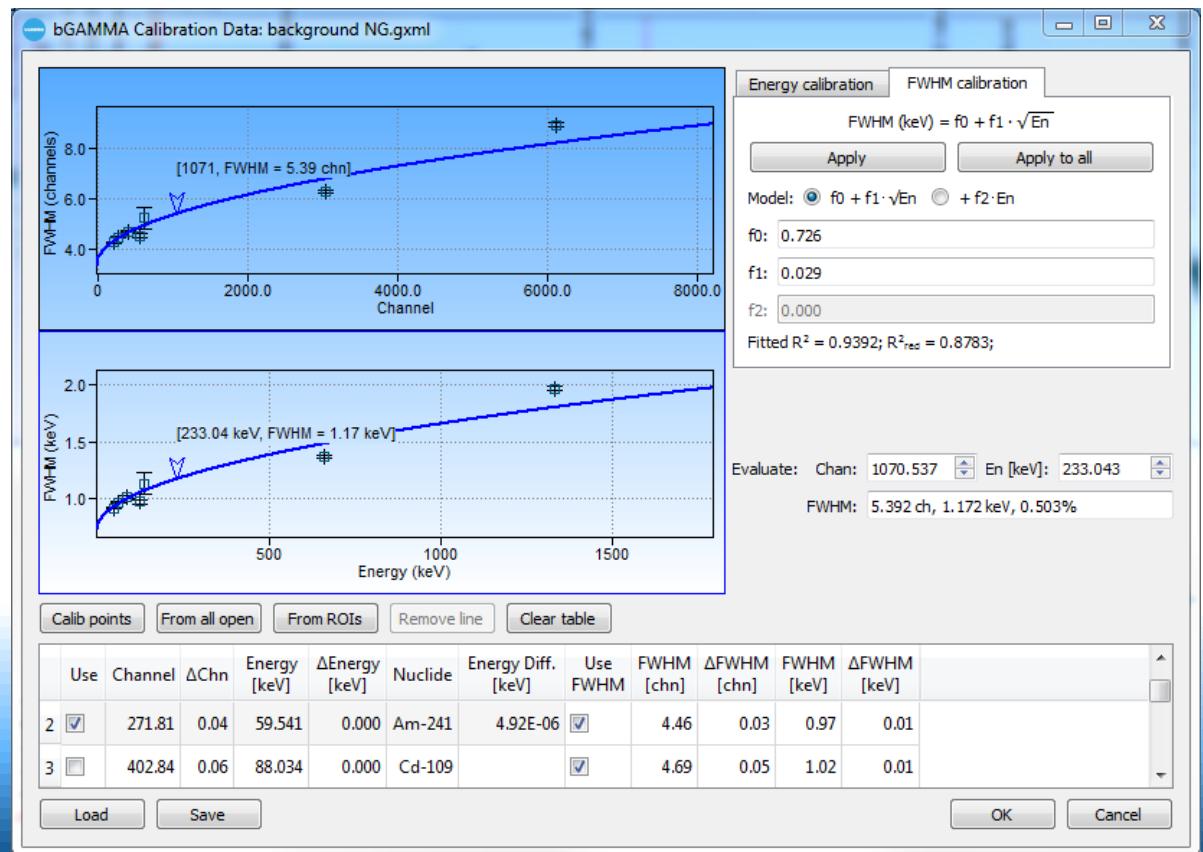
ch = 161, E = 244.039 keV, Y = 140, Y = 0.9 cps. Total throughput = 339.8 cps

Outstanding GUI



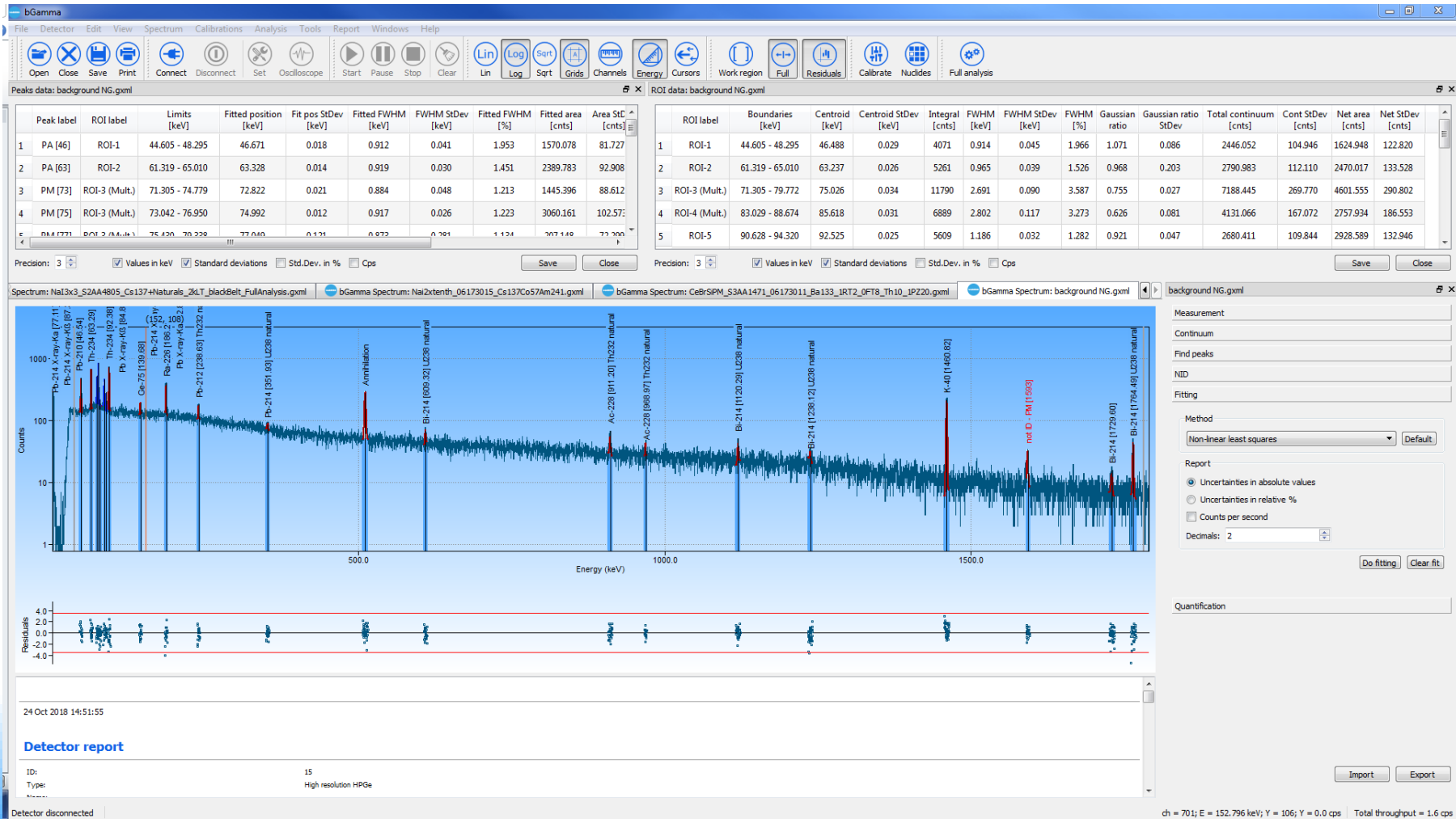
- Modern, comprehensive, powerful graphical user interface (GUI).
 - Nearly any analysis or calculation step is provided with visual feedback

Shape Calibration



Outstanding GUI

- Peaks and ROI results data at hand.
- Each spectrum plot with residuals and its individual report panel



Accurate calculations



Unique

- All... absolutely all and any calculated magnitude is reported with corresponding uncertainty value
- **Co-variances** are taking into account for uncertainty calculations



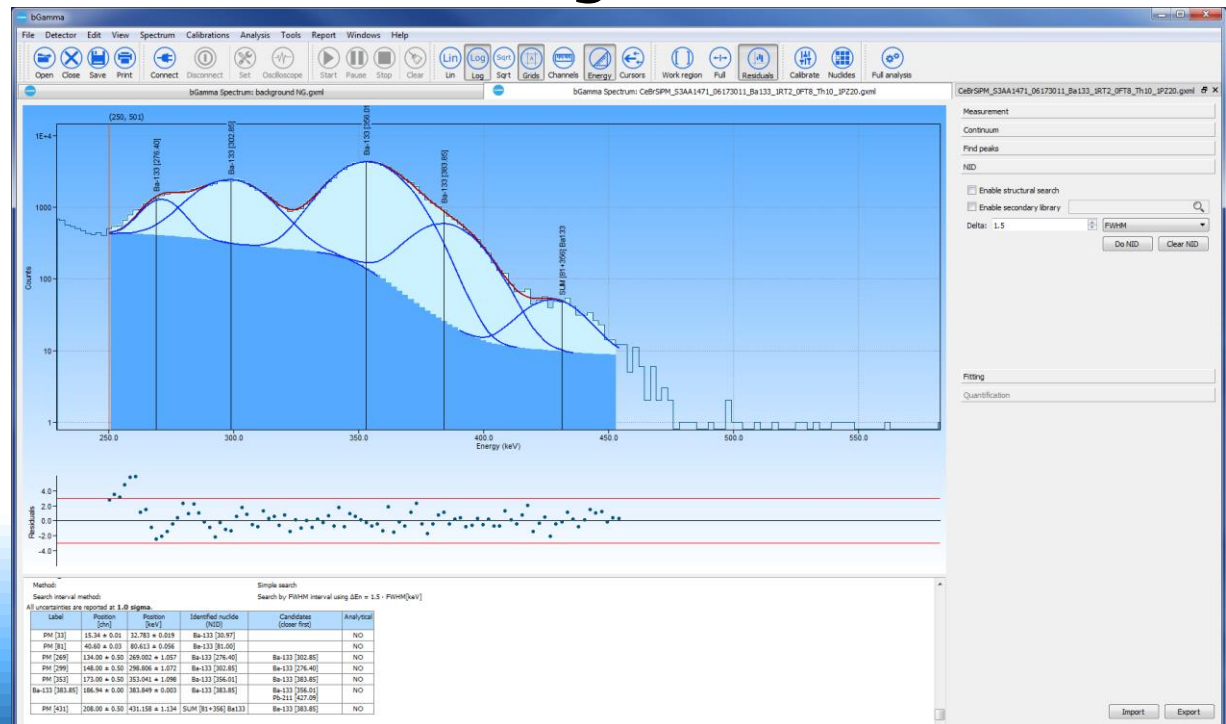
Unique

Manual or Visual operation

- Ability to insert/remove peaks and ROIs by several methods

Few

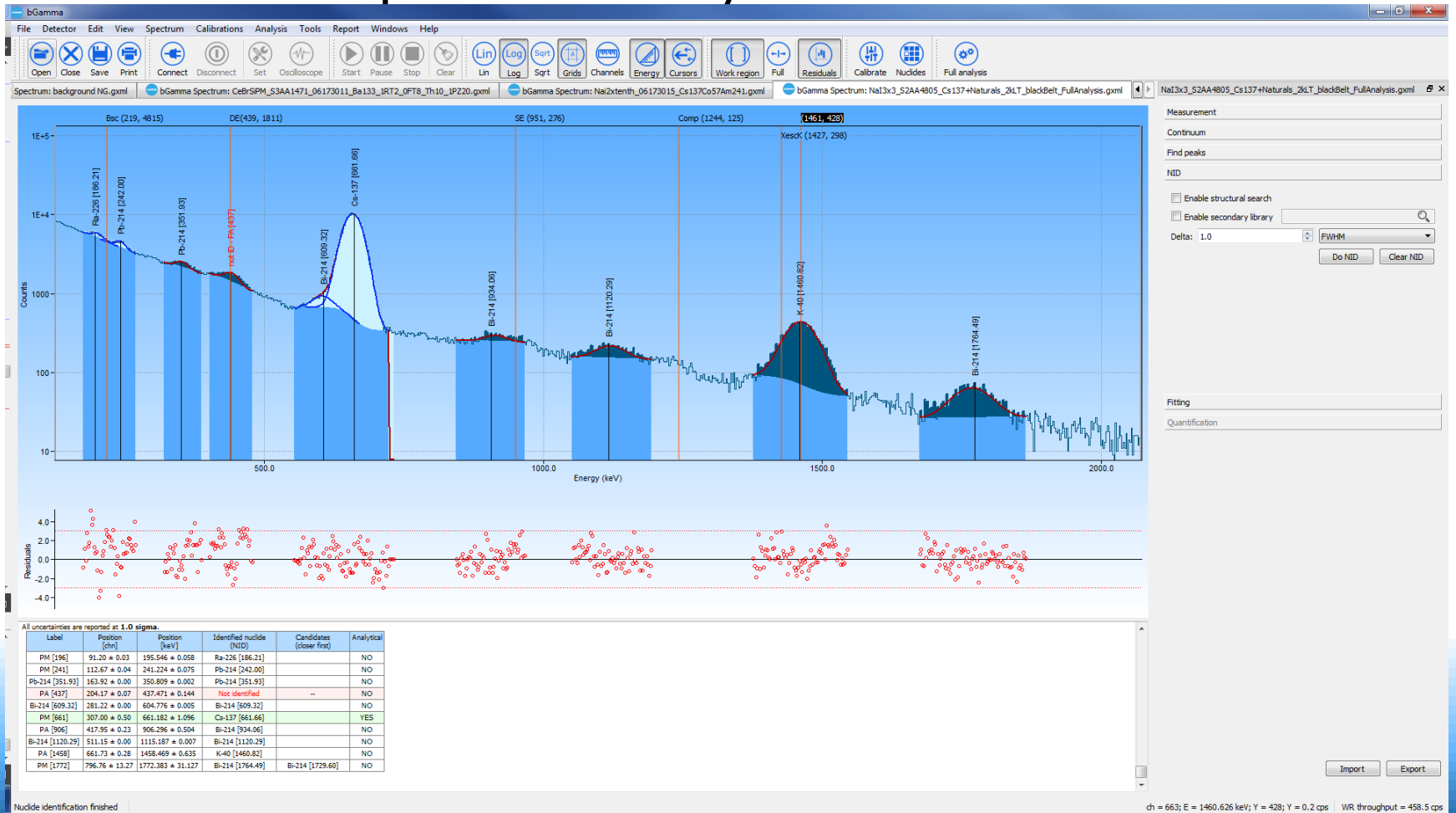
- Visually via GUI
- By nuclide library
- Automatic by mathematical algorithms



Manual or Visual operation

- Use of Multi-cursors

- The use of “Spectroscopy-aware” cursors make easier the spectrum analysis and visual NID



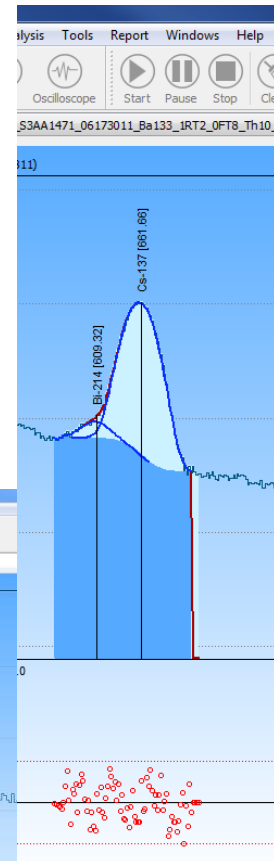
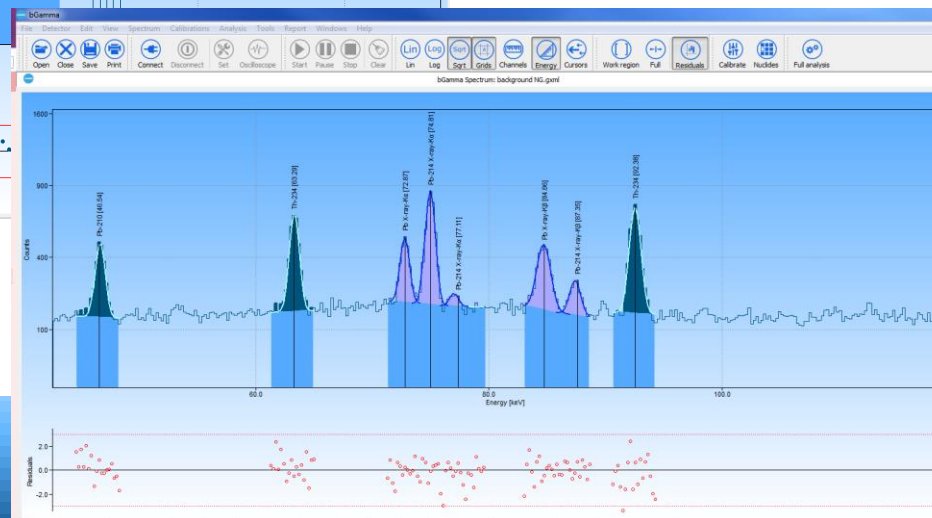
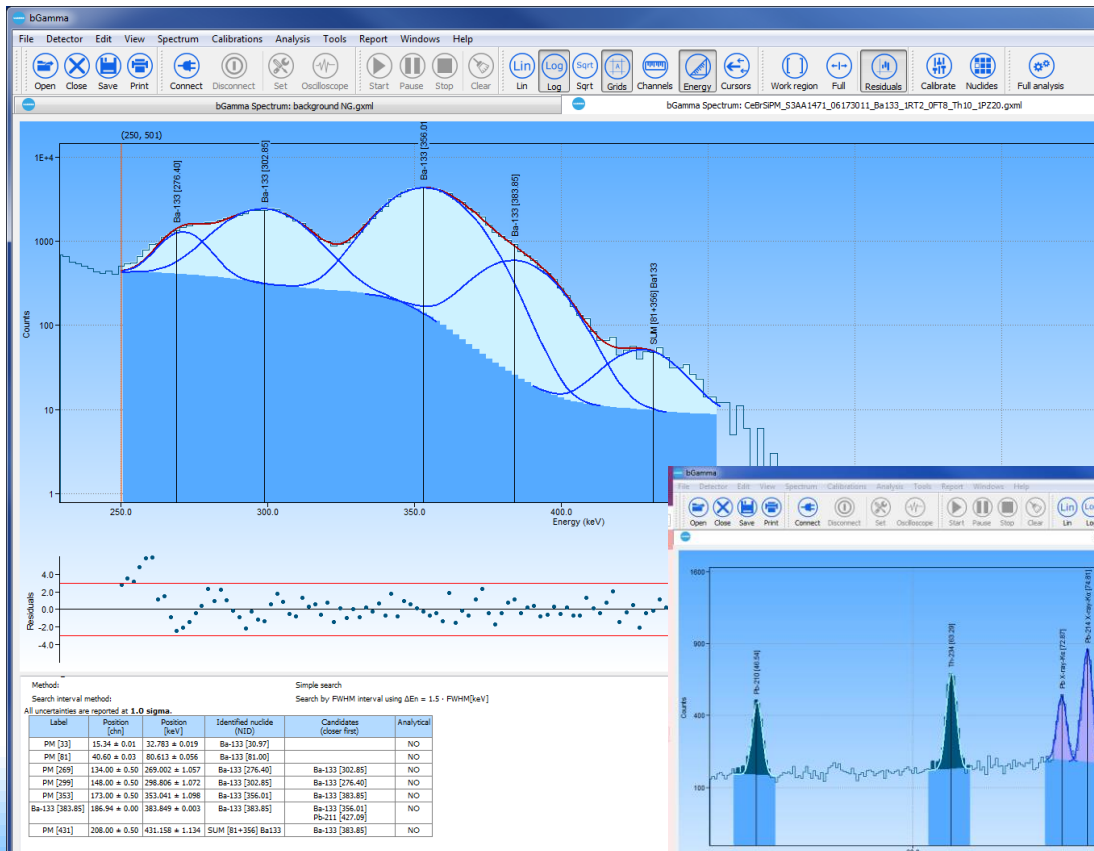
Computational algorithms

- Large selection of computational algorithms, included in the standard version of the software
 - Continuum models
 - By entire spectrum or per individual peaks
 - Extensive ROI calculations
 - Peak search and marking
 - 7 peak search methods
 - 4 peak marking and ROI identification algorithms
 - Three (3) peak fitting algorithms
 - Includes Bayesian peak fitting
- This wide range of choices warrants the success of the spectrum analysis from any type of detector, energy range and/or energy resolution

Highlight

Computational algorithms

- Outstanding peak fitting and multiplet deconvolution
 - With visual feedback (residuals plot)
 - And Statistical qualifiers in the report (e.g. colored χ^2)




Computational algorithms

- Implements **Bayesian peak fitting**
 - Minimum input parameters
 - Does NOT rely on shape (FWHM) calibration





Import files

- Can open files from:
 - IAEA (*.spe)
 - Canberra, binary (*.chn) 
 - NO need of Canberra VDM or run time libraries installation
 - Ortec (*.chn)
 - ANSI N42.42
 - Including latest edition N42.42.2012
 - Generic text file



Reports

- bGamma produces colored, rich-formatted and aligned reports
- HTML-based reports

15 Oct 2018 11:17:17

Peak fitting results report

Method used: Non-linear least squares

All uncertainties are reported at 1.0 sigma.

| Peak label | Related ROI | Position Std.Dev. [chn] | Position Std.Dev. [keV] | FWHM Std.Dev. [chn] | FWHM Std.Dev. [keV] | FWHM Std.Dev. [%] | Area Std.Dev. [cnts] | Continuum Std.Dev. [cnts] | Fit χ^2 [aunits] | Identified nuclide (NID) |
|------------|-------------------|---------------------------|---------------------------|-----------------------|-----------------------|---------------------|------------------------|-----------------------------|-----------------------|-------------------------------|
| PA [46] | ROI-1 | 212.52 0.08 | 46.67 0.02 | 4.20 0.19 | 0.91 0.04 | 1.95 0.09 | 1570.08 81.73 | 2446.05 104.95 | 0.57 | Pb-210 [46.54] |
| PA [63] | ROI-2 | 289.25 0.06 | 63.33 0.01 | 4.23 0.14 | 0.92 0.03 | 1.45 0.05 | 2389.78 92.91 | 2790.98 112.11 | 0.65 | Th-234 [63.29] |
| PM [73] | ROI-3 (Multiplet) | 332.99 0.10 | 72.82 0.02 | 4.07 0.22 | 0.88 0.05 | 1.21 0.07 | 1445.40 88.61 | 7188.45 269.77 | 0.36 | Pb X-ray-Ka [72.87] |
| PM [75] | | 342.98 0.06 | 74.99 0.01 | 4.23 0.12 | 0.92 0.03 | 1.22 0.03 | 3060.16 102.57 | 7188.45 269.77 | 0.36 | Pb-214 X-ray-Ka [74.81] |
| PM [77] | | 352.46 0.56 | 77.05 0.12 | 4.02 1.30 | 0.87 0.28 | 1.13 0.37 | 207.15 72.30 | 7188.45 269.77 | 0.36 | Pb-214 X-ray-Ka [77.11] |
| PM [85] | ROI-4 (Multiplet) | 387.91 0.12 | 84.75 0.03 | 6.01 0.25 | 1.30 0.05 | 1.54 0.06 | 2026.04 97.82 | 4131.07 167.07 | 0.46 | Pb X-ray-KB [84.86] |
| PM [88] | | 400.25 0.21 | 87.43 0.04 | 4.89 0.40 | 1.06 0.09 | 1.21 0.10 | 718.39 71.45 | 4131.07 167.07 | 0.46 | Pb-214 X-ray-KB [87.35] |
| PA [93] | ROI-5 | 423.99 0.06 | 92.58 0.01 | 4.88 0.14 | 1.06 0.03 | 1.15 0.03 | 3017.33 100.59 | 2680.41 109.84 | 1.14 | Th-234 [92.38] |
| PA [144] | ROI-6 | 658.61 0.38 | 143.53 0.08 | 4.48 0.89 | 0.97 0.19 | 0.68 0.13 | 311.92 67.62 | 2330.19 102.59 | 0.40 | Ge-75 [139.68] |
| PA [185] | ROI-7 | 852.25 0.11 | 185.60 0.02 | 4.35 0.25 | 0.94 0.06 | 0.51 0.03 | 1168.76 77.24 | 2604.89 114.10 | 0.36 | Ra-226 [186.21] |
| PA [238] | ROI-8 | 1095.49 0.35 | 238.47 0.08 | 4.70 0.81 | 1.02 0.18 | 0.43 0.07 | 336.93 63.97 | 2140.51 103.60 | 0.32 | Pb-212 [238.63] Th232 natural |
| PA [351] | ROI-9 | 1615.83 1.26 | 351.63 0.27 | 8.27 2.24 | 1.80 0.49 | 0.51 0.14 | 168.16 57.36 | 1586.99 93.45 | 0.21 | Pb-214 [351.93] U238 natural |
| PM [511] | ROI-10 | 2348.03 0.15 | 511.02 0.03 | 11.96 0.32 | 2.60 0.07 | 0.51 0.01 | 3015.46 96.05 | 1990.47 141.12 | 0.74 | Annihilation |
| PA [609] | ROI-11 | 2798.66 0.62 | 609.22 0.14 | 6.31 1.44 | 1.37 0.31 | 0.23 0.05 | 188.83 47.25 | 1045.90 79.35 | 0.25 | Bi-214 [609.32] U238 natural |
| PA [911] | ROI-12 | 4181.72 0.64 | 911.07 0.14 | 8.14 1.47 | 1.78 0.32 | 0.20 0.04 | 225.13 44.94 | 861.17 80.35 | 0.54 | Ac-228 [911.20] Th232 natural |
| PM [969] | ROI-13 | 4446.17 0.79 | 968.86 0.17 | 5.73 1.74 | 1.25 0.38 | 0.13 0.04 | 99.72 34.22 | 407.92 32.00 | 0.27 | Ac-228 [968.97] Th232 natural |
| PA [1120] | ROI-14 | 5137.35 0.67 | 1120.03 0.15 | 8.56 1.53 | 1.87 0.33 | 0.17 0.03 | 201.86 40.03 | 672.28 73.39 | 0.35 | Bi-214 [1120.29] U238 natural |
| PA [1238] | ROI-15 | 5676.49 1.55 | 1238.07 0.34 | 7.87 3.58 | 1.72 0.78 | 0.14 0.06 | 73.72 36.67 | 780.67 81.46 | 0.26 | Bi-214 [1238.12] U238 natural |
| PA [1461] | ROI-16 | 6693.02 0.10 | 1460.91 0.02 | 8.94 0.20 | 1.96 0.04 | 0.13 0.00 | 1904.11 58.98 | 243.16 46.80 | 1.27 | K-40 [1460.82] |
| PM [1593] | ROI-17 | 7294.77 0.50 | 1593.01 0.11 | 8.98 1.03 | 1.97 0.23 | 0.12 0.01 | 216.10 29.93 | 229.94 37.20 | 0.33 | Not identified |
| PA [1731] | ROI-18 | 7920.95 1.25 | 1730.60 0.27 | 11.55 2.87 | 2.54 0.63 | 0.15 0.04 | 93.75 26.03 | 258.99 50.87 | 0.36 | Bi-214 [1729.60] |
| PA [1766] | ROI-19 | 8079.82 0.31 | 1765.53 0.07 | 9.46 0.64 | 2.08 0.14 | 0.12 0.01 | 385.51 32.06 | 239.78 48.95 | 0.50 | Bi-214 [1764.49] U238 natural |



Reports

- Reports contain colored and well formatted tables
 - Colors are used to flag statistically doubtful calculation results
- Dedicated reports for specific sections
- Reports can includes plots images (e.g. spectrum plot with fitting results)
- Report templates can be created , using HTML commands, for more specific or user-defined spectrum analysis reports
 - HTML markup is widely supported and easy translatable to other applications (e.g. MS Explorer)
 - No need to learn dedicated or specific scripting languages and/or commands
- Reports can be exported into PDF

Nuclide library



- Broader meaning of nuclide library
- bGamma includes the whole decay radiation data from 3386 nuclides
 - NuDat decay data files
 - Recommended and maintained by INDC and BNL (USA)
- Any radiation is always at hand
 - No need for getting out of the analysis to “search” for the correct nuclear radiation or edit the nuclear library file.
 - Spectrum analysis steps are fully reproducible, since it does not contain links to external nuclear data files
 - Provision of “fast radiation search”, tagged isotopes or isotope radiations, etc.



Hardware control

- Within bGamma you can connect, set and control any BrightSpec hardware for data acquisition
- Provision of an auto-updated applet, according to connected hardware capabilities
 - Extensive counting preset modes
- Provision of a dockable digital oscilloscope for hardware troubleshooting

Device settings

Acquisition mode
 PHA MCS

PHA MCS GPIO
 Time Counts External
 Live time Real time
Time [sec] 600.0
Counts 1000
Start channel 4
End channel 4095
Select Roi (none)

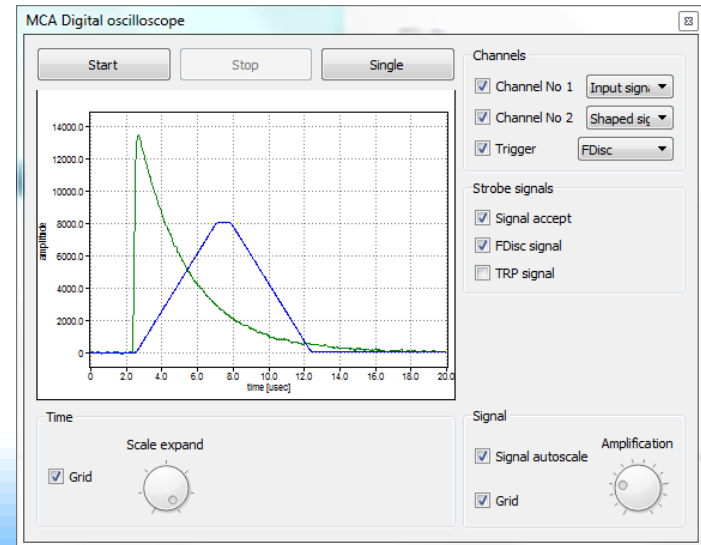
MCA
No of channels 1024
LLD 4 ULD 4095

Amplifier
Coarse gain x 1
Fine gain 1.0000
Input polarity Positive Negative

Digital settings Advanced
Threshold [chn] 7
Rise time [usec] 3.20
Flat top [usec] 1.00
Pole Zeros [units] 1.80
 Digital BLR Pile-up reject

High voltage
Status HV Off
High voltage value [volts] 640.0
 HV On

Close Export Load Save into device Apply Info



SUMMARY OF FEATURES

Brief summary of most important application features



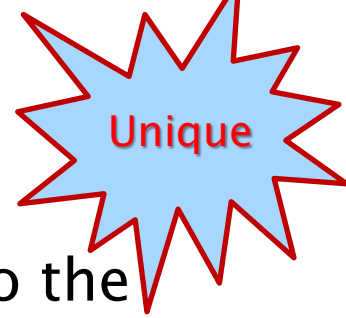


Unique

Unique features

- OS-independent
 - **The only software in the market that runs on MS Windows (XP, 7, 8 and 10), Linux and mac OS**
 - With wide support of μ Processors:
 - X86, 64-bit and ARM
- Inclusion of **Bayesian** peak fitting algorithms
 - Allows the possibility to fit spectra with minimum input data (e.g. calibrations)
 - Mark/insert a peak and fit straight-away

Unique features



- Entire nuclear decay radiation data embedded into the application.
 - Fast access to any decay radiation
 - ALL decay radiations are quickly at hand
 - No need for external nuclear library files
 - Spectrum analysis goes smoother. No need for endless cycles of exiting application or spectrum analysis process to edit/search nuclide library for specific radiations.
 - No links to external files (e.g. nuclide library file) which can be missing and therefore impossible to recreate the spectrum analysis
- Every calculated magnitude is reported with its uncertainties
- Covariance inclusion on the uncertainties treatment
- Outstanding Graphical User Interface
 - Many features (see previous slides)
 - Possibility to view all calculated parameters and magnitudes in tables and most of them updated on “real time” even while data acquisition is performed



Few

Outstanding feature

- Can analyze any gamma-ray spectrum. Independently of the detector used, energy resolution or energy range
- Easy but comprehensive methods for energy and shape calibrations, with provision of visual feedback
- Calculation of MDAs following ISO11929 standard (up-to latest revision), with clear results and recommendations



Highlighted features

- HTML-formatted reports
 - Including tables with colored cells for data results warnings
- Import of foreigner file formats, like Canberra CNF does not need any extra files or libraries to be installed
 - Imports N42.42 (up to latest edition)
- Simple and “automatically updated” window for hardware control
- Spectrum analysis parameters can be exported\imported as Model.
- Fats and intuitive operations within an outstanding GUI.
 - Peaks insert\delete, multi-cursor, nuclide search, etc.
 - Residuals plots, model parameters at hand, etc.