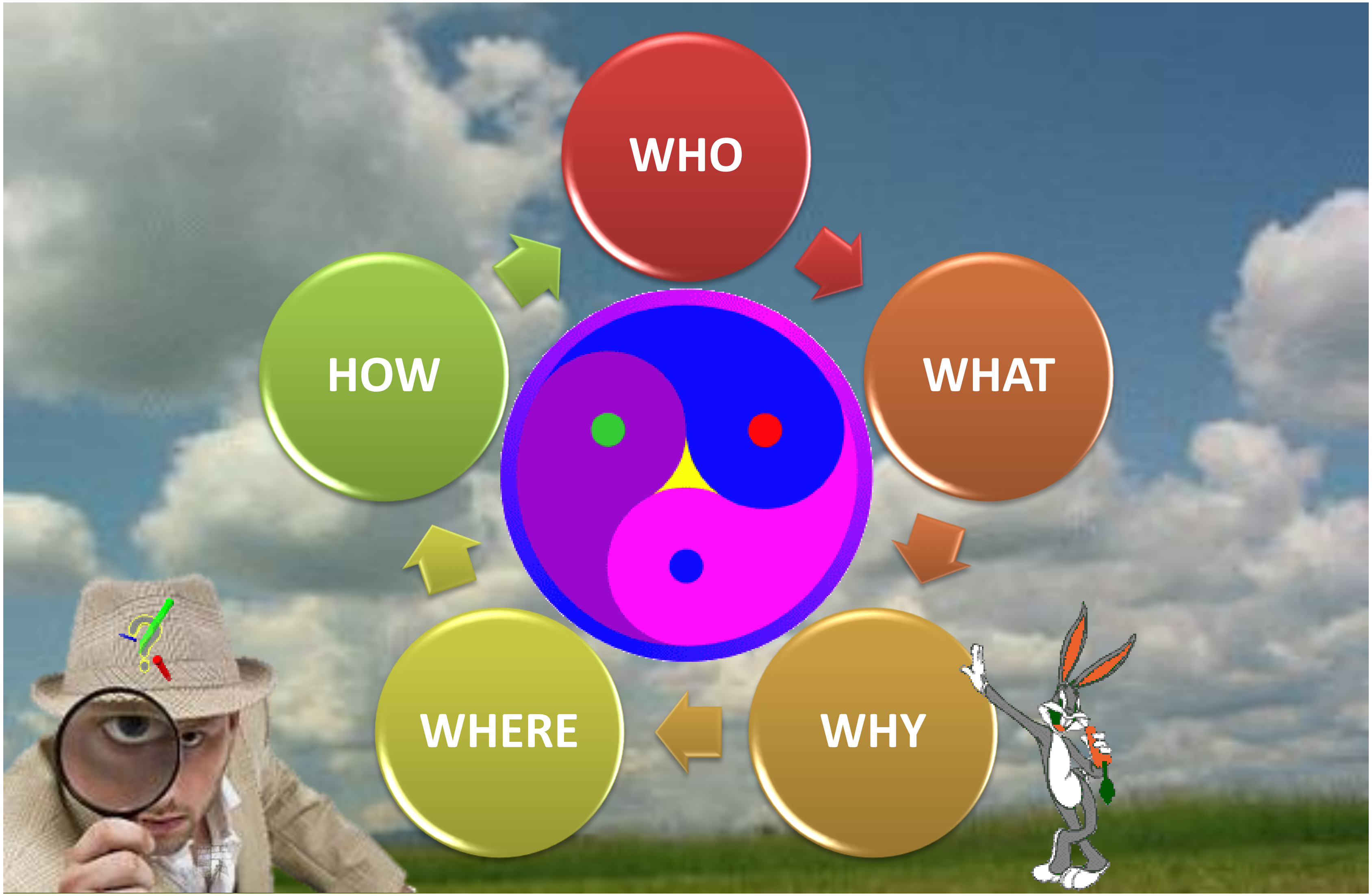
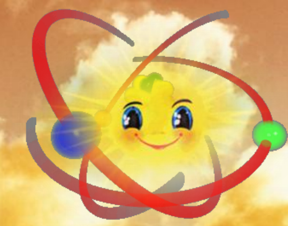
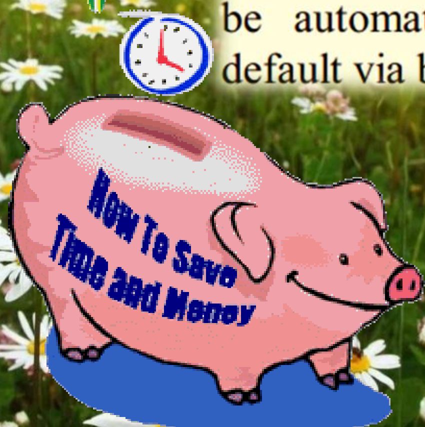
Standard questions



Development of a universal monitor of low intensity neutron + gamma radiation fields



The picture shows the hardware of a modern scintillation spectrometer, i.e. the PC-based MCA containing high voltage bias supply, preamplifier, linear amplifier, analog to digital converter and multichannel analyser system. All components and settings are controlled by software and they can be automatically set by default via batch files.



Requirements

2012 R&D 100 Awards

One detector to be sensitive to neutron and gamma radiation of different energies (up to ~8MeV) and of count rates of ~1-2-3 000 pps

To consist of well known and often used detector's types

Easy to calibrate

Easy to handle , transported, setting-up, powered, readout

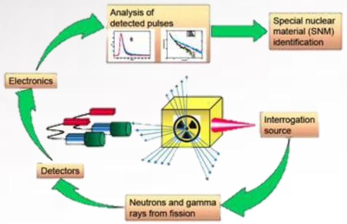
Freeware readout software

Easy check of its operability (serviceability)

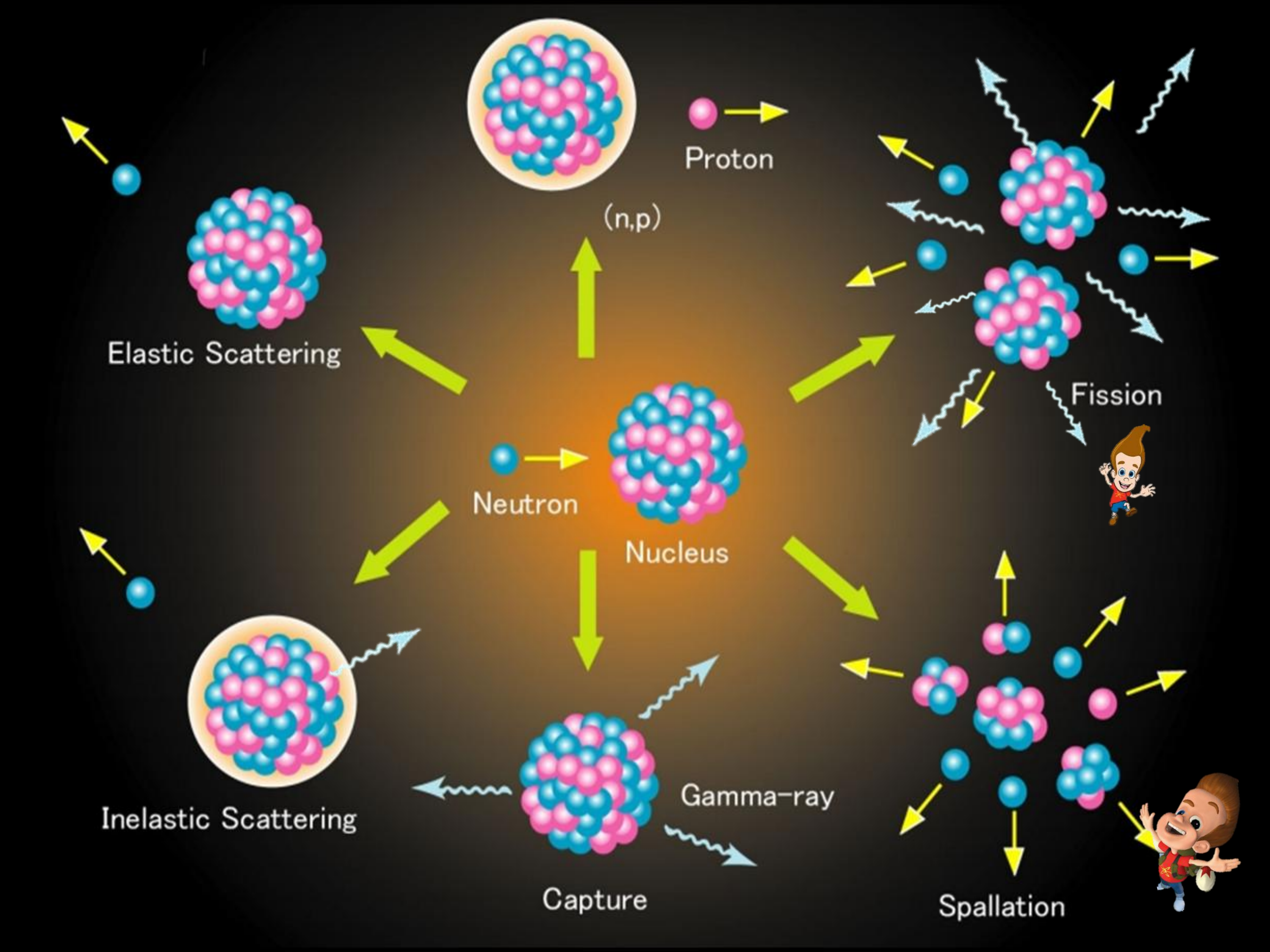
A Solid Solution for Neutron and Gamma-Ray Differentiation

Unification

Relatively cheap in comparison with the other monitors



Everything
should be
made as
simple
as possible
but no simpler
Albert Einstein
"Anything that is complex is not useful and
anything that is useful is simple.
This has been my whole life's motto.“ Mikhail Kalashnikov
"Before attempting to create
something new, it is vital to have
a good appreciation of everything
that already exists in this field.“


Proton
(n,p)
Elastic Scattering
Fission
Neutron
Nucleus
Inelastic Scattering
Gamma-ray
Capture
Spallation

Good Old Multi-detector Gamma-ray Spectrometry Systems

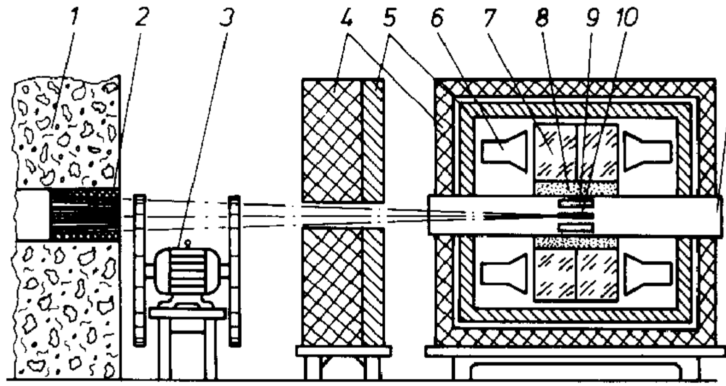
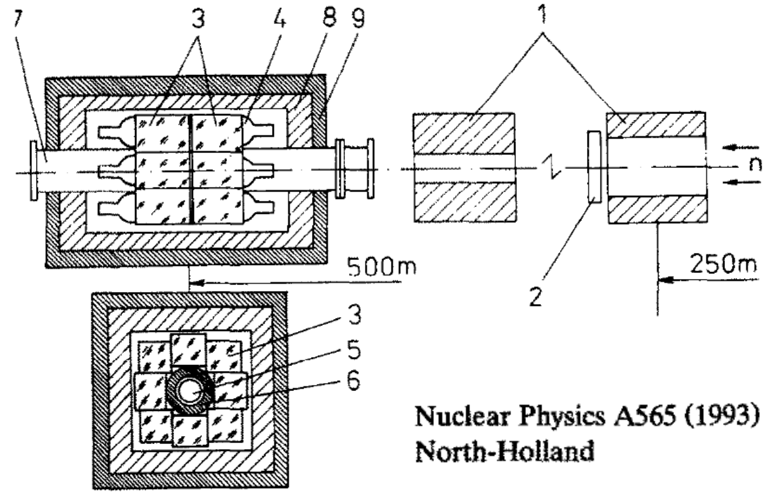
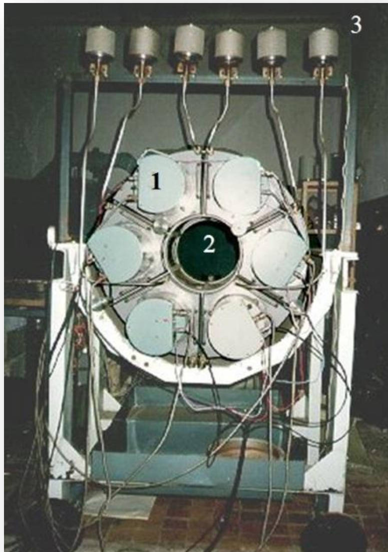


Fig. 1. Experimental equipment: 1 – reactor shielding, 2 – multislit collimator, 3 – neutron chopper, 4 – paraffin with boric acid, 5 – lead, 6 – photomultipliers, 7 – NaI(Tl) crystals, 8 – lithium-6 carbonate shielding, 9 – solid state detectors, 10 – sample, 11 – vacuum sample holders.



Nuclear Physics A565 (1993) 643–656
North-Holland

Fig. 1. Longitudinal and transversal section view of the multisectional scintillation γ-detector "Romashka" (not in scale): (1) collimator; (2) filter; (3) NaI(Tl) crystals; (4) photo multipliers; (5) sample; (6) converter; (7) vacuum tube; (8) lead shielding; (9) B_4C shielding.



Neutron-gamma field intensity and absorbed doses simulation at some points of "Romashka" experimental setup

A.O. Zontikov[1], D. Grozdanov[1,2], I. Ruskov[1,2], Yu.N. Kopatch[1]

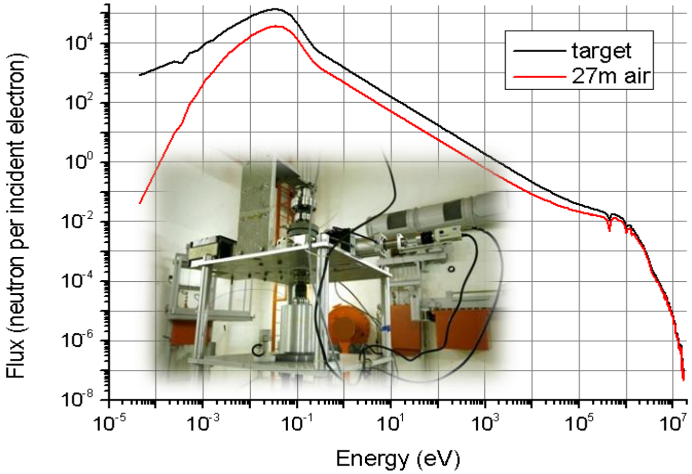


Fig.6 Simulated IREN differential neutron spectra at the target side and corrected spectra at FP/27m (non-vacuum guide)

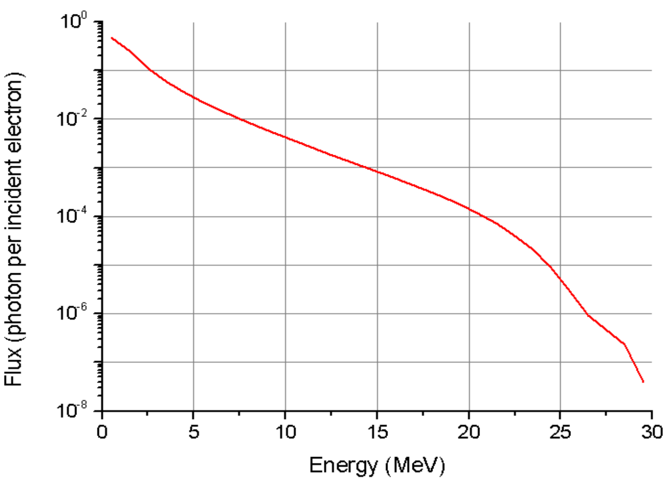


Fig.7 Simulated IREN integral normalized photon spectrum at the target side

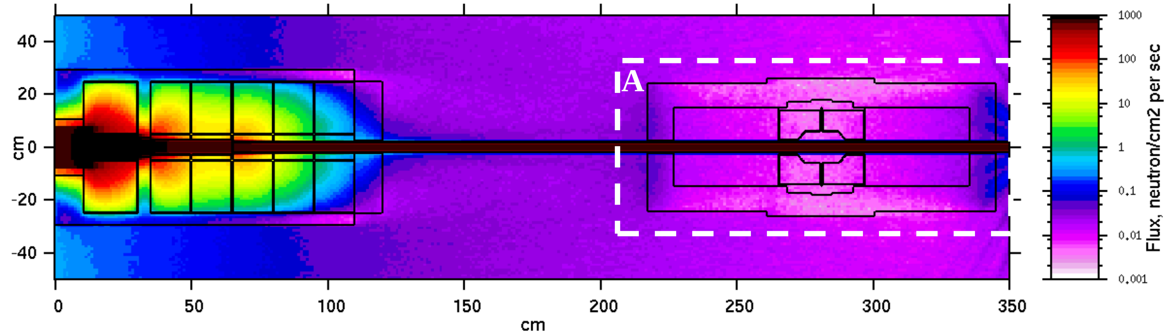


Fig.8 Spatial distribution (central horizontal slice of the setup) of the neutron flux

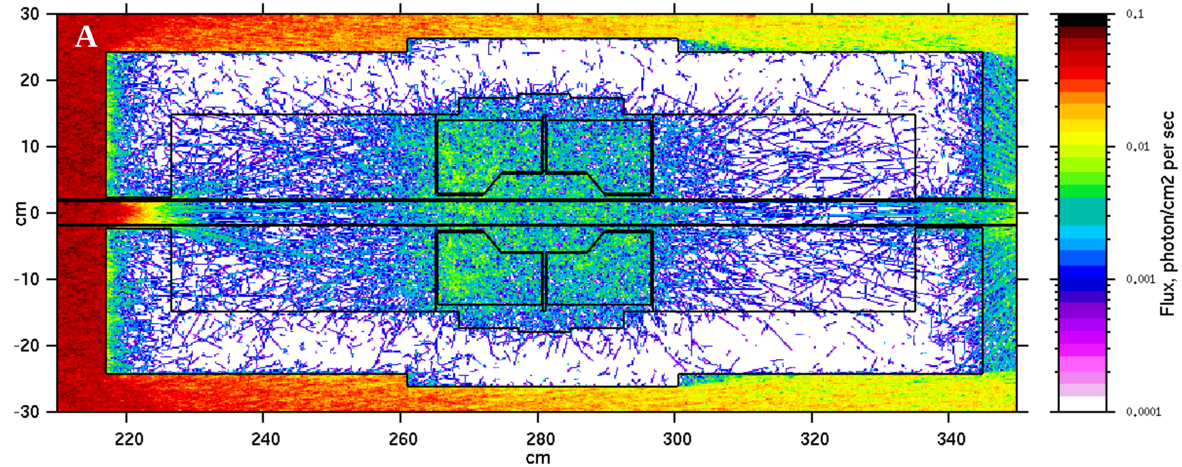
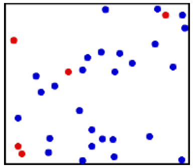
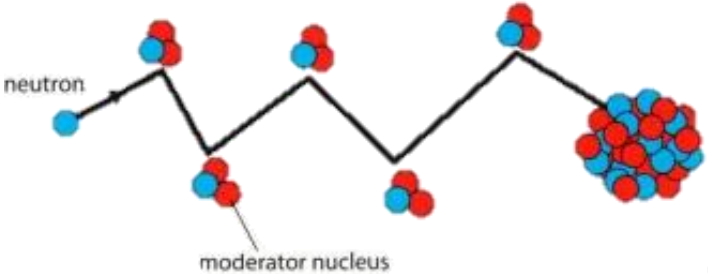


Fig.9 Spatial distribution (central horizontal slice of the shielded detector) of the photon flux generated by the incident neutron beam



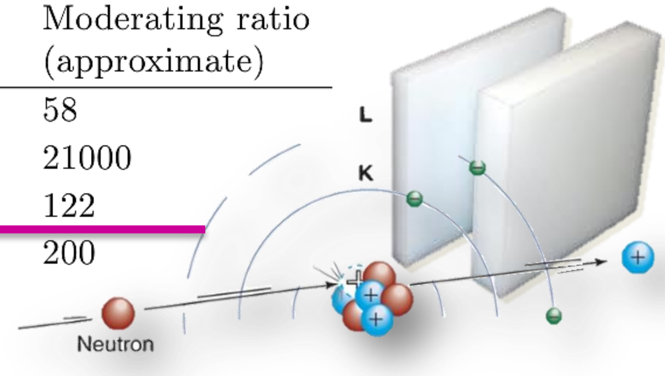


$$\xi = \ln\frac{E_0}{E} = 1 + \frac{(A-1)^2}{2A}\ln\left(\frac{A-1}{A+1}\right) \qquad \xi \simeq \frac{2}{A+1}$$

$$\xi\Sigma_s \qquad \xi\Sigma_s/\Sigma_a$$

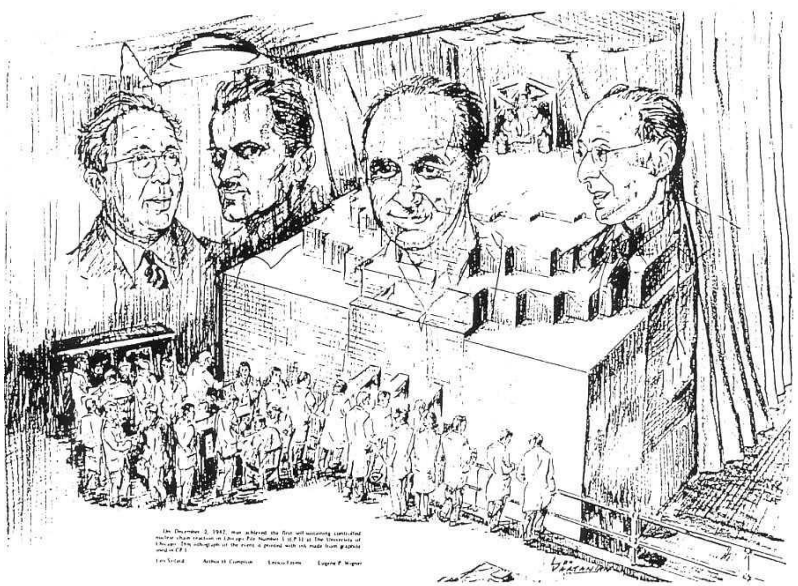
1: The moderating power and ratio of common moderators

Moderator	Moderating power (1 eV - 100 keV)	Moderating ratio (approximate)
Water	1.28	58
Heavy water	0.18	21000
Polyethylene	3.26	122
Graphite	0.064	200



$^1H + {}^1n \rightarrow {}^2H + \gamma$ Gamma ray energy (E_γ) = 2.22 MeV

P. Rinard. Neutron interactions with matter. In D. Reilly, N. Ensslin, and H. Smith, Jr., editors, Passive Nondestructive Assay of Nuclear Materials. 1991.



Charcoal drawing created with the moderator graphite used in the first nuclear chain reaction (from left: Leo Szilard, Arthur Compton, Enrico Fermi and Eugene Wigner)

http://wigner.mta.hu/wigner_en.html

http://www.shieldwerx.com/poly-based-shielding.html#swx201

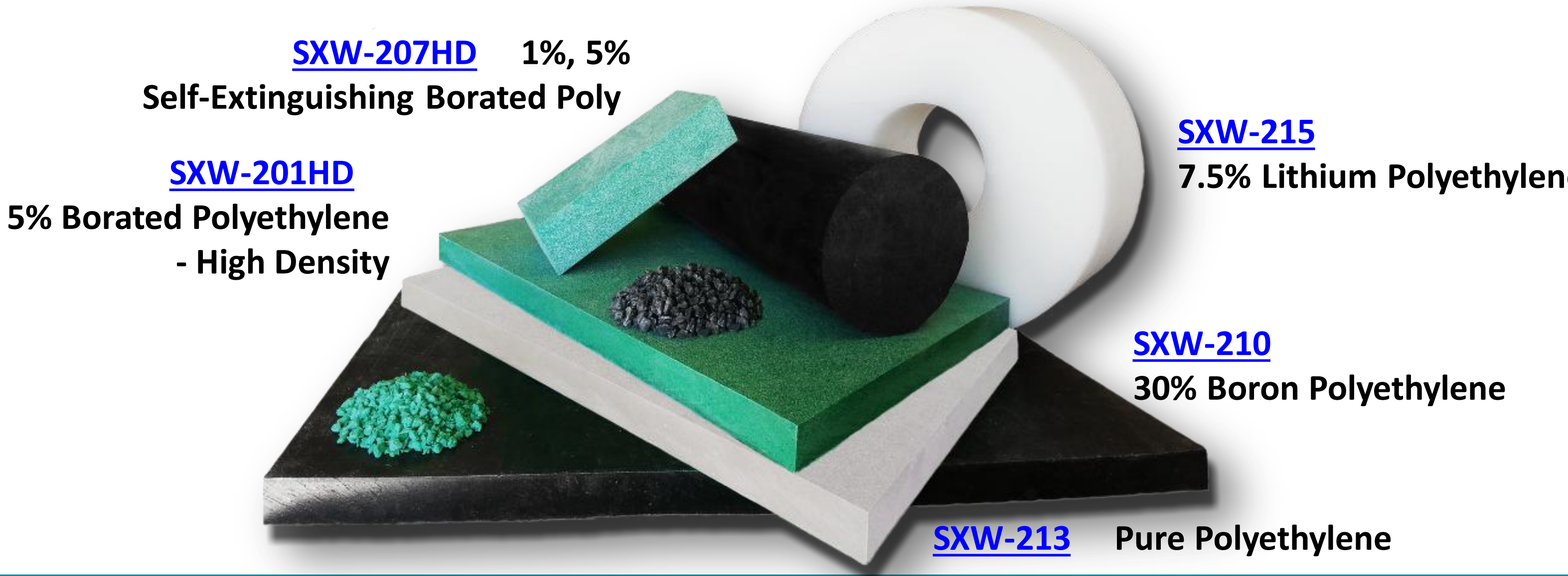
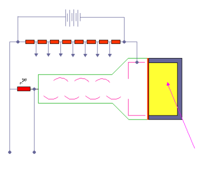
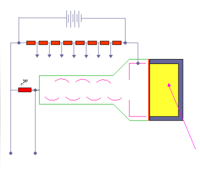
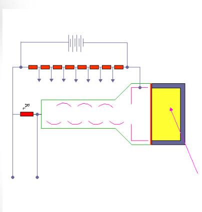


Table 10 The most useful neutron-absorbing isotopes and the key features of the neutron interactions at 25 meV. Cross sections, σ, are tabulated to the nearest 10 barns, and to the nearest 1000 barns for Gd. This helps emphasize the huge stopping power of Gd relative to the other isotopes.

Isotope	State	σ (barns)	Neutron absorption length	Particle energies (keV)		Approximate Range R particle range
^{3}He	Gas	5330	70 mm.atm	p: 573	t: 191	3.8 mm.atm C_3H_8
^{6}Li	Solid	940	230 μm	t: 2727	α: 2055	130 μm
^{10}B	Solid	3840	20 μm	α: 1472	^{7}Li: 840	3 μm
^{10}BF3	Gas	3840	97 mm.atm	α: 1472	^{7}Li: 840	4.2 mm.atm
Nat. Gd	Solid	49000	6.7 μm	Conv^{n} electrons: -30-200		12 μm
^{157}Gd	Solid	254000	l.3 μm	Conv^{n} electrons: -30-200		l2 μm







Active element	Detector type	Concentration (% weight)	Gamma energy (keV)	Net count rate (cps)	Background count rate (cps)
Cd	HPGe	7.5	558.6	1.95±0.01	0.29
			651.3	0.31±0.01	0.21
			806.0	0.24±0.01	0.24
			1209.4	0.07±0.01	0.09
			1364.2	0.06±0.01	0.06
			1399.0	0.05±0.01	0.04
	NaI(Tl)	7.5	558.6	7.46±0.19	34.00
			651.3	2.06±0.14	20.35
Gd	HPGe	10.4	780.0	0.03±0.01	0.41
			897.3	0.08±0.01	0.19
			944.0	0.09±0.01	0.20
			961.8	0.07±0.01	0.20
			977.2	0.04±0.01	0.12
			1107.3	0.04±0.01	0.16
			1186.5	0.13±0.01	0.25
B	HPGe	1	478	4.20±0.01	1.34
	NaI(Tl)	1	478	21.99 ± 1.06	38.33
	BGO	1	478	16.95 ± 0.82	23.82
Cl	HPGe	56.8	786 - 789	0.66±0.01	1.02
			1164.7	0.43±0.01	0.16
			1950 - 1960	0.14±0.01	0.16
	NaI(Tl)	56.8	786 - 789	2.50±0.05	15.63
			1164.7	1.74±0.04	12.12
			1950 - 1960	1.21±0.04	5.93
	BGO	56.8	786 - 789	4.27±0.07	21.36
			1164.7	5.23±0.07	16.31
			1950 -1960	4.20±0.07	10.63

Table 2: The count rates obtained for the different detectors with converters of optimal thickness.

http://www.iaea.org/inis/collection/NCLCollectionStore/_Public/35/066/35066094.pdf

http://joyreactor.cc/post/650987

Use of gamma-ray spectroscopy for direct detection of thermal neutrons

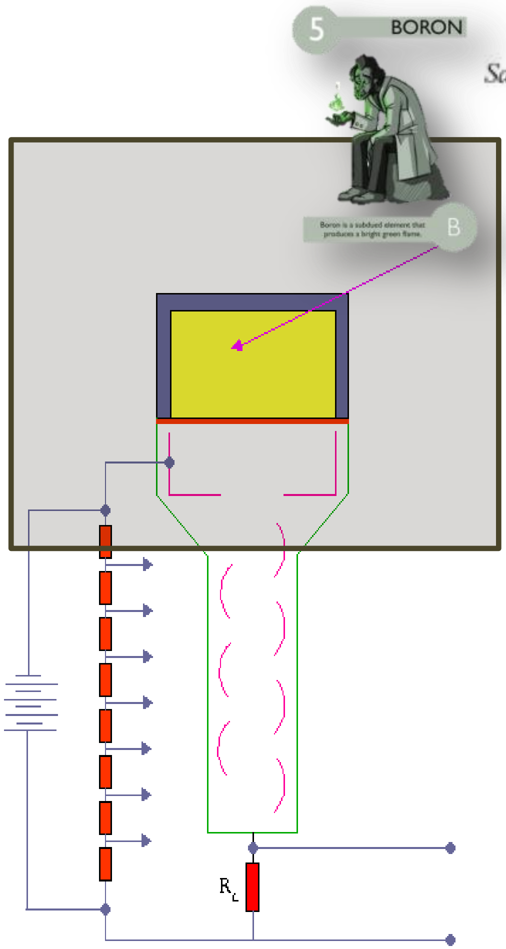
2000

F. Ghanbari, A. H. Mohagheghi

Sandia National Laboratories, P.O. Box 5800, Albuquerque, NM 87185 USA

(Received December 13, 2000)

Journal of Radioanalytical and Nuclear Chemistry, Vol. 248, No. 2 (2001) 413–416

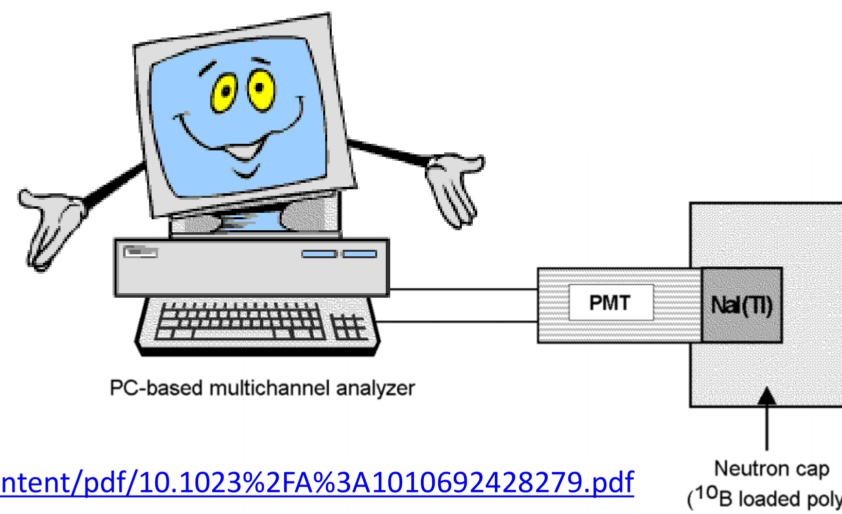


$$^{10}B + ^{1}n \rightarrow \begin{cases} ^{7}Li + ^{4}\alpha, \ ^{7}Li \text{ formed in ground state (6\%)} \\ ^{7}Li^{*} + ^{4}\alpha, \ ^{7}Li \text{ formed in excited state (94\%)} \end{cases}$$

$$\hookrightarrow \ ^{7}Li + \gamma(478 \text{ keV})$$

$$^{23}Na + ^{1}n \rightarrow ^{23}Na^{*} \quad (100\%)$$

σ_{th}=430mb $\quad \hookrightarrow \ ^{24}Na + \gamma(473 \text{ keV})$



$\sigma(^{10}B(n,\alpha))$ = 3840 barn

$\sigma(^{nat}B(n,\alpha))$ = 760 barn

nat: 19.8% -> ^{10}B

70.2% -> ^{11}B

http://link.springer.com/content/pdf/10.1023%2FA%3A1010692428279.pdf

Use of gamma-ray spectroscopy for direct detection of thermal neutrons

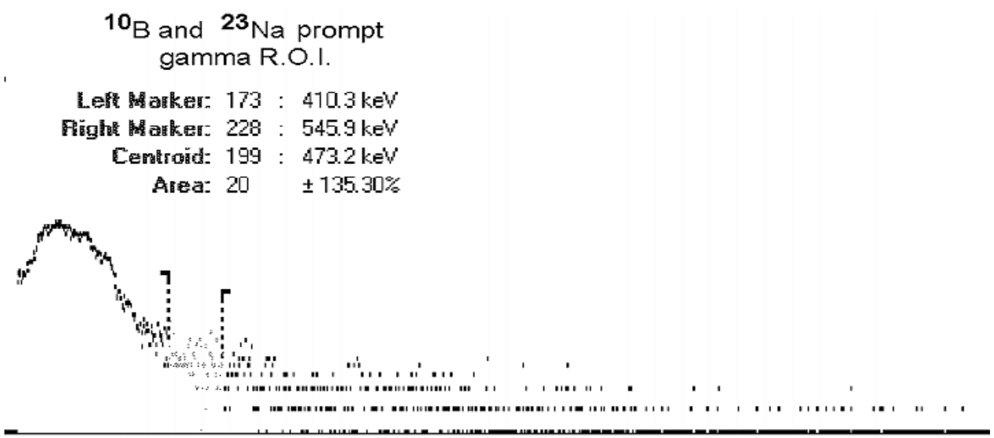
F. Ghanbari, A. H. Mohagheghi

Sandia National Laboratories, P.O. Box 5800, Albuquerque, NM 87185 USA

2000

(Received December 13, 2000)

Journal of Radioanalytical and Nuclear Chemistry, Vol. 248, No. 2 (2001) 413–416



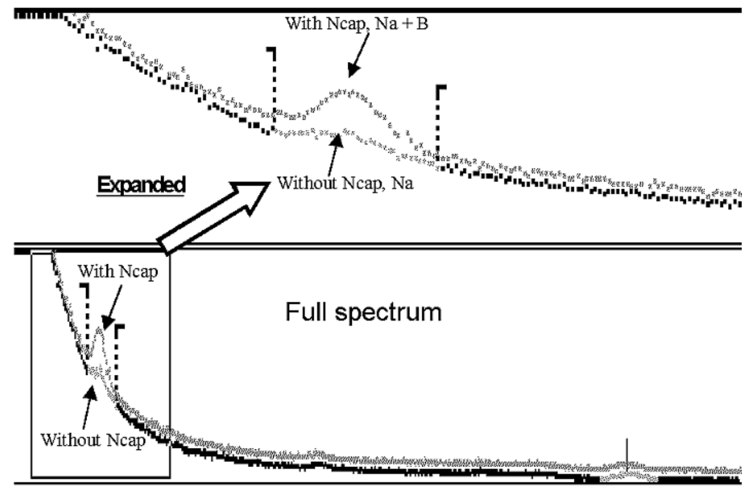


Fig. 5. A comparison of the net counts in the R.O.I of the two spectra in Figs 3 and 4 determined the gamma contribution from the $^{23}Na(n,\gamma)^{24}Na$ reaction to the detection of neutrons

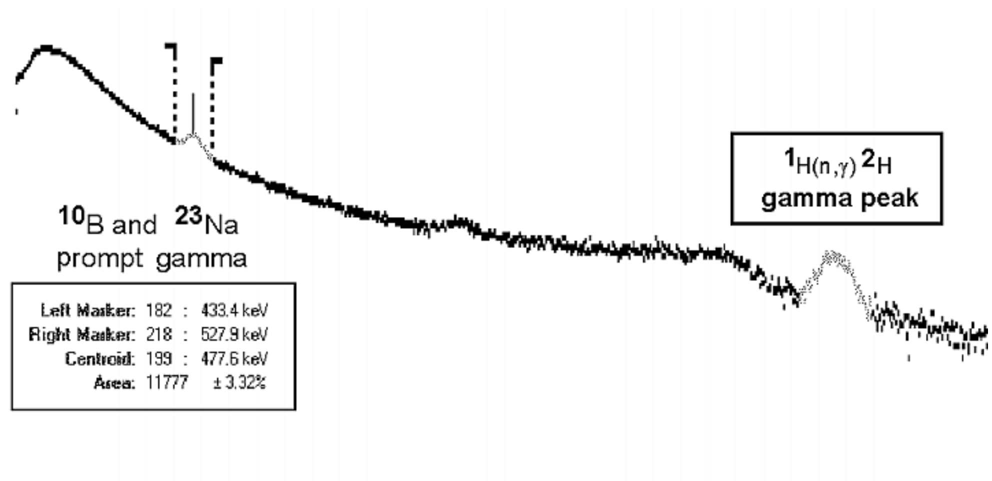


Fig. 3. Gamma-ray spectrum from a moderated ^{252}Cf source with the Ncap in place. The region-of-interest (R.O.I) for prompt gamma-ray from $^{10}B(n,\alpha)^{7}Li^*$ and $^{23}Na(n,\gamma)^{24}Na$ reactions is shown

DOE/NV/25946--407

Using a Borated Panel to Form a Dual Neutron-Gamma Detector

2008

Scott Wilde[a], Raymond P. Keegan[a], Leo Van Ausdeln[b]

[a]*Remote Sensing Laboratory for the U.S. Department of Energy, P.O. Box 98521, Mail Stop RSL-44, Las Vegas, NV 89193-8521, USA.*
[b]*Idaho National Laboratory, 2525 North Fremont Street, P.O. Box 1625, Idaho Falls, ID 83415, USA.*

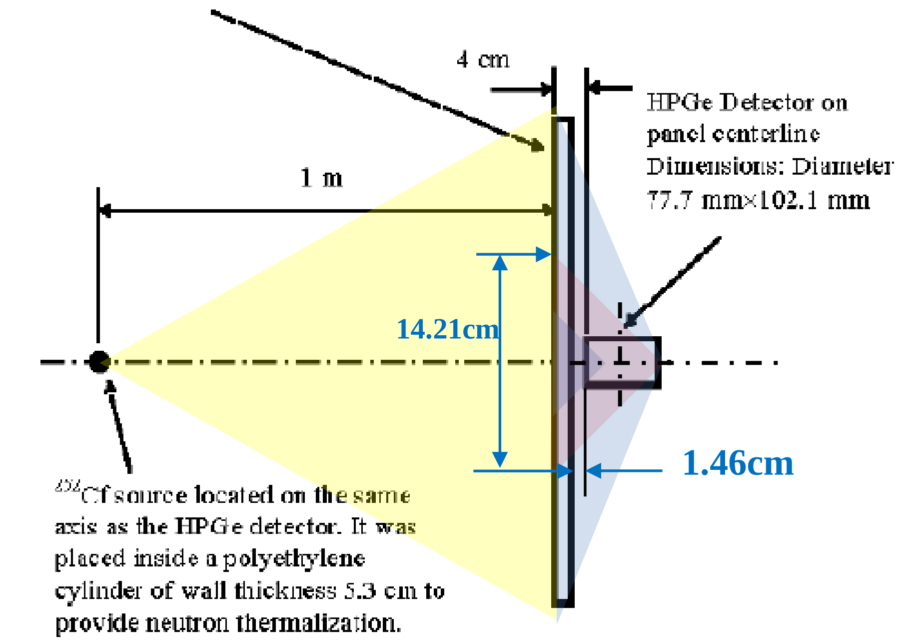


Figure 1: The experimental layout to measure the count rate buildup factor.

RESULTS

Data was collected in February 2007 for a live time of 1,800s. The net counts under the 478 keV peak were 11,286±324. This plane was replaced by a disk cut from a corner of the plane of 9.6 cm diameter. The experimental run was performed again for the same live time yielding 2,462±268. The buildup factor was calculated as the ratio of the plane to disk counts and was found to be 4.6±0.5. A second run was performed in June 2007 for a live time of 7,048s for the plane and 7,200s for the disk with everything else the same as before. The buildup factor was determined as before to be 4.3±0.4. The average buildup factor is therefore 4.4±0.3.

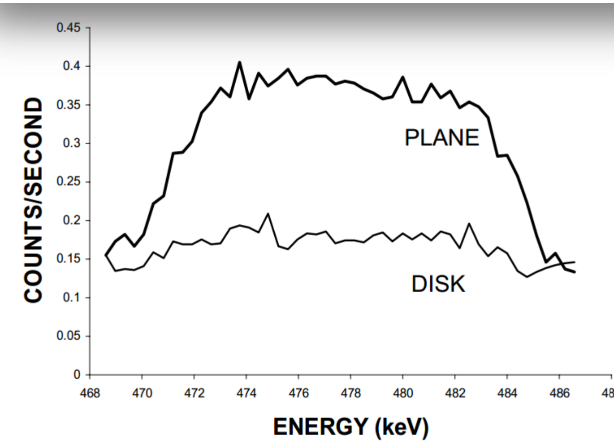


Fig. 1. The countrates of the plane and the disk versus energy of the photons counted, the distance from the source to the detector was 1 meter.

http://www.osti.gov/scitech/servlets/purl/934444

2008-07-01 http://www.osti.gov/scitech/servlets/purl/934442

2013

Nuclear Instruments and Methods in Physics Research A 697 (2013) 59–63

ELSEVIER

Contents lists available at SciVerse ScienceDirect

Nuclear Instruments and Methods in Physics Research A

journal homepage: www.elsevier.com/locate/nima

Neutron detection with a NaI spectrometer using high-energy photons

Philip Holm*, Kari Peräjärvi, Ari-Pekka Sihvonen, Teemu Siiskonen, Harri Toivonen

Radiation and Nuclear Safety Authority (STUK), Laippatie 4/P.O. Box 14, 00881 Helsinki, Finland

A R T I C L E I N F O

Article history:
Received 25 June 2012
Received in revised form
3 September 2012
Accepted 5 September 2012
Available online 12 September 2012

Keywords:
Neutron detection
Gamma spectrometry
NaI

A B S T R A C T

Neutrons can be indirectly detected by high-energy photons. The performance of a 4″ × 4″ × 16″ NaI portal monitor was compared to a ^{3}He-based portal monitor with a comparable cross-section of the active volume. Measurements were performed with bare and shielded ^{252}Cf and AmBe sources. With an optimum converter and moderator structure for the NaI detector, the detection efficiencies and minimum detectable activities of the portal monitors were similar. The NaI portal monitor preserved its detection efficiency much better with shielded sources, making the method very interesting for security applications. For heavily shielded sources, the NaI detector was 2–3 times more sensitive than the ^{3}He-based detector.

http://www.sciencedirect.com/science/article/pii/S016890021201025X

STUK
Säteilyturvakeskus
Strålsäkerhetscentralen
Radiation and Nuclear Safety Authority
Address • Laippatie 4, P.O. Box 14, FI-00881 Helsinki, FINLAND • www.stuk.fi

Neutron detection with NaI spectrometers

Due to the worldwide shortage of ^{3}He , alternative methods to detect neutrons are actively studied. One alternative approach for neutron detection is to use high-energy gamma-rays produced in (n,γ)-reactions. In addition to the neutron capture gamma-rays, neutron sources also emit high energy gamma-rays by themselves. The method has potential in security applications due to the low background, the easy penetration of the high energy gamma-rays and the small amount of modification needed for gamma-spectrometers already in use. STUK studied the use of a NaI portal monitor as a neutron detector.

This work was supported by the Scientific Advisory Board for Defense.

Features

- Performance comparable with ^{3}He-tube
- Gamma-spectrometry up to 8 MeV
- Plastic moderator and converter
- Easy integration in regular gamma spectrometers
- Low background
- Characterization of neutron source properties
- Simple analysis with combined neutron and gamma detection
- Automated detection and consistent with VASIKKA software

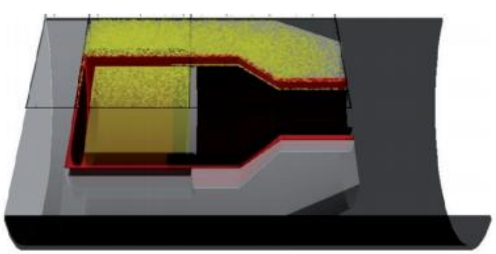


Fig. 1. GEANT4 model of a 5"x4" cylindrical NaI detector surrounded by a moderator. The yellow dots indicate neutron capture reactions.

Fig. 2. 4"x4"x16" NaI detector moderated with PE.

Concept

In field gamma spectrometry often relies on NaI detectors. Spectrometers are normally set to cover the energy region from 0 to 3 MeV. The covered range is partly restricted by the commercially available hardware, i.e., Multi Channel Analyzers, which often only produce spectra with 1024 channels. Recently, integrated systems able to produce 2048 channel spectra have become commercially available. This development enables the extension of energy range up to about 8 MeV without significantly worsening the resolution.

The neutron induced gamma rays up to 8 MeV were measured using a 4"x4"x16" and a cylindrical (diameter 4" and thickness 5") NaI detector [1]. Similar measurements were performed in Ref. [2]. The neutron detection efficiency can be improved significantly by adding moderators and converters around the detector.

Results

Fig. 3 shows the gamma-spectrum of an 18 kBq ^{252}Cf source at a distance of about 55 cm. The measurement, which was performed with the moderated 5"x4" NaI detector, shows the significant yield of high energy gamma-rays in the presence of the neutron source. The peaks at 6.8 MeV and 6.3 MeV are mostly due to iodine, but also sodium. Because of the small and even background, all counts over 3.5 MeV can be utilized for neutron detection.

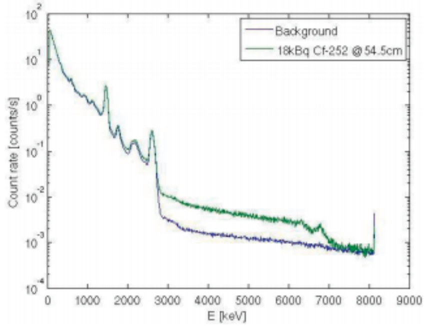


Fig. 3. Spectra showing the increased count rate at high energies due to the ^{252}Cf source. The neutron flux was about 0.06 neutrons/(scm^2) at the detector surface.

The effect on different converters and moderators (Fe, PVC and PE) surrounding the NaI portal monitor was studied. Fig. 4 shows how moderators and converters improve the detection efficiency. Note that with thin converters/moderators, the improvement of the efficiency is due to the moderator. However, with thicker layers of materials, the effect of the converter is significant.

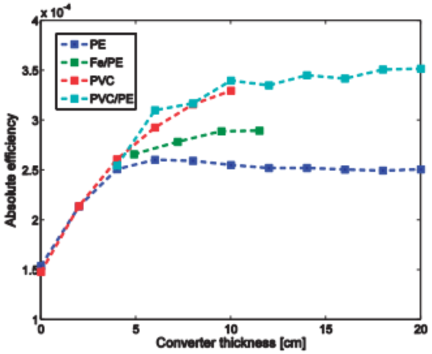


Fig. 4. Absolute neutron efficiencies with boosters of different thickness. The measurements were performed with a Cf-252 source at a source-detector distance of 2 m.

Applications

The NaI portal monitor was compared to a ^{3}He-based portal monitor of similar size. A 10-cm-thick PVC/PE sandwich converter was used with the NaI portal monitor. The minimum detectable activities (MDA) of the portal monitors were similar. In fact, the indirect gamma spectrometric method produced better results for shielded neutron sources. The NaI detector is thus very suitable for neutron portal monitoring and other security applications. The combined neutron and gamma detection is cheap, analysis is easy to perform and neutron sources can to some extent be characterized with the spectral information.

References

[1] P. Holm et al., Nuclear Instruments and Methods in Physics Research A 697 (2013) 59.
[2] D. J. Mitchell et al., IEEE Transactions on Nuclear Science 57 (2010) 2215.

http://www.stuk.fi/julkaisut_maaraykset/en_GB/stuk-ttl-flyers/_files/88555498122839033/default/Flyer_011_Neutron_detection_with_NaI_spectrometers.pdf

Neutron detection with NaI spectrometers

$$^{127}\mathrm{I} + n \longrightarrow \overset{T_{1/2}=25\ \mathrm{min}}{^{128}\mathrm{I}} + \gamma \xrightarrow{\beta^-} {^{128}\mathrm{Xe}}(93.1\%)$$

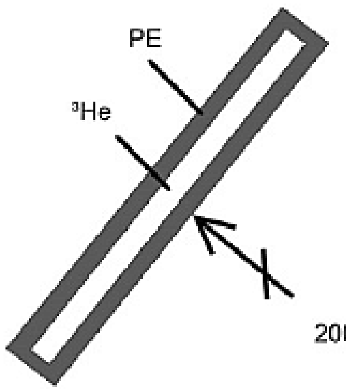
$$^{128}\mathrm{I} \xrightarrow{EC+\beta^+} {^{128}\mathrm{Te}}(6.9\%)$$

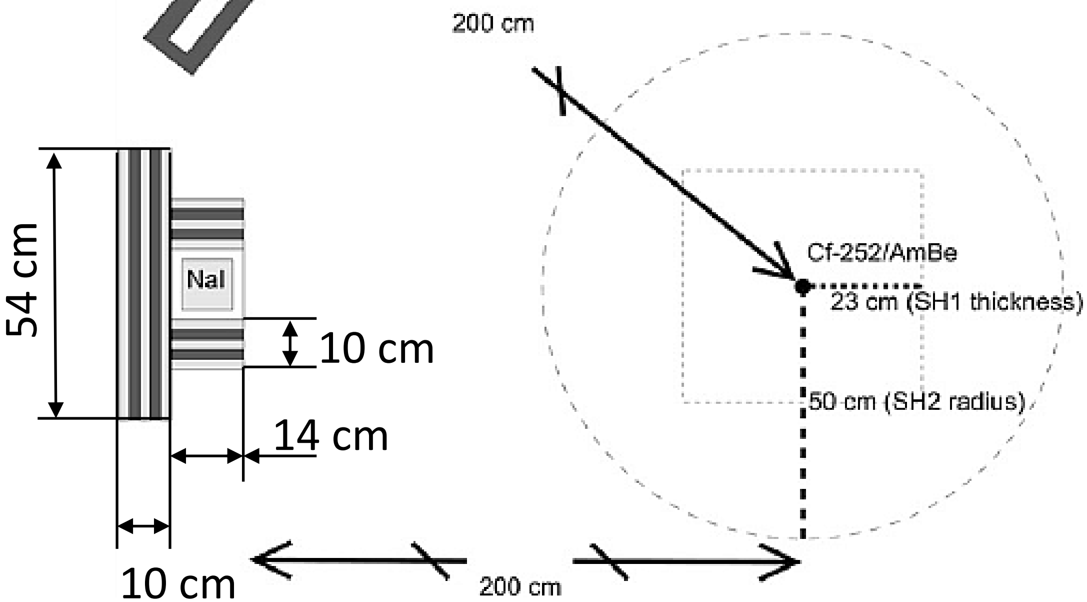
442 keV, 17%

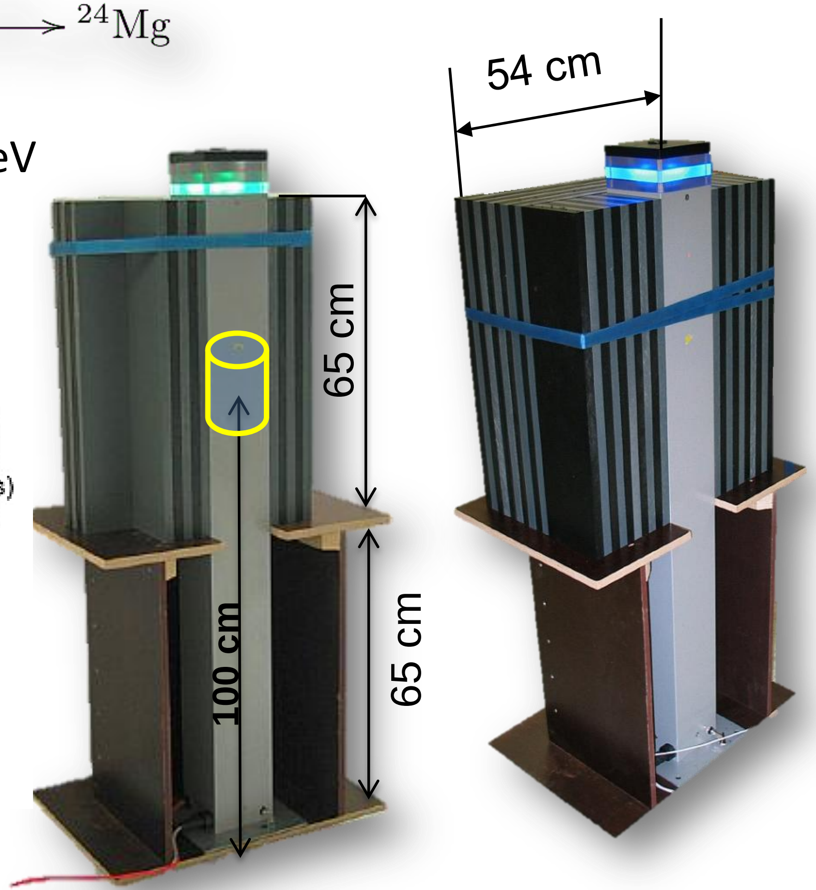
4”x4”x16” NaI(Tl) Portal monitor

$$^{23}\mathrm{Na} + n \longrightarrow \overset{T_{1/2}=15\ \mathrm{h}}{^{24}\mathrm{Na}} + \gamma \xrightarrow{\beta^-} {^{24}\mathrm{Mg}}$$

473 keV

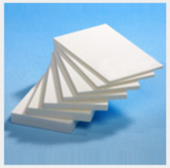






Neutron detection with NaI spectrometers

ПВХ жесткий (компактный)



Пластик ПВХ жесткий (компактный, сплошной) представляет собой плотный с однородной внутренней структурой экструзионный лист с ровной гладкой поверхностью и стабильной плотностью (1.36 - 1,44 г/см3, в зависимости от производителя).
Стандартные листы ПВХ имеют с обеих сторон гладкую матовую поверхность, что обеспечивает высокую степень защиты от ультрафиолетового излучения, а также высокую стойкость к неблагоприятным атмосферным воздействиям.

Одна сторона ПВХ покрыта защитной пленкой.

ПВХ жесткий широко используется в рекламе, пищевой, электротехнической и химической промышленности и в мебельной индустрии.

Достоинства ПВХ жесткого

- высокая ударопрочность и прочность на изгиб
- хорошие механические характеристики
- легкая обрабатываемость обычными инструментами
- поверхность идеальна для различных видов печати, окрашивания
- легкость при склеивании, термо- и вакуумформовании, монтаже
- не подвержен коррозии
- не впитывает воду и атмосферную влагу из воздуха
- высокая степень звуко- и теплоизоляции
- способность поглощать вибрации
- высокая химическая стойкость
- отсутствие токсичности
- низкая воспламеняемость

Область применения жесткого ПВХ

- **Реклама:** выставочные стенды, указатели, вывески, буквы, витрины.
- **Строительство:** сэндвич-панели, оконные откосы, дверные филенки, детали внутреннего интерьера, внутренняя отделка помещений с повышенной влажностью, перегородки, в системах кондиционирования воздуха и вентиляции, тепло- и звукоизоляции и т.д.
- **Промышленность:** отделка холодильных камер, корпуса машин, гальванотехника, лабораторное и фотооборудование, резервуары для химической промышленности, производство вентиляторов, мебели, электротехника.

Купить, как вспененный ПВХ, так и ПВХ жесткий в Санкт-Петербурге вы можете у нас!

Table C.2.1: The absolute efficiency of 6–7.2-cm-thick boosters normalized to the absolute efficiency with the 6-cm-thick PE booster. The measurements were performed with the Cf1 source at a source-detector distance of 2 m. The booster structure (plate order starting from the detector side) is shown in the left column. The standard deviation is ≤1%

Booster structure	Norm. ε_{abs} [%]
PE/PE/PE	100
PVC/PE/PVC	119
PVC/PVC/PVC	112
PE/PE/PE/Fe/Fe/Fe/Fe	108
Fe/PE/Fe/PE/Fe/PE/Fe	107
Fe/PVC/Fe/PVC/Fe/PVC/Fe	101
Fe/Fe/PE/PE/PE/Fe/Fe	96.4
Fe/Fe/Fe/Fe/PE/PE/PE	85.2

Table C.2.2: The absolute efficiency of 10-cm-thick PVC boosters normalized to the absolute efficiency with the PVC/PE10cm sandwich. The measurements were performed with the Cf1 source at a source-detector distance of 2 m. The booster structure (plate order starting from the detector side) is shown in the left column. The standard deviation is ≤1%

Booster structure	Norm. ε_{abs} [%]
PVC/PE/PVC/PE/PVC	100
PE/PE/PVC/PVC/PE	99.9
PE/PE/PE/PVC/PVC	96.1
PE/PE/PVC/PE/PE	95.0
PE/PE/PE/PE/PE	82.7

Amcrys NaI(Tl) & Hamamatsu PMT modules

http://www.amcrys.com/products

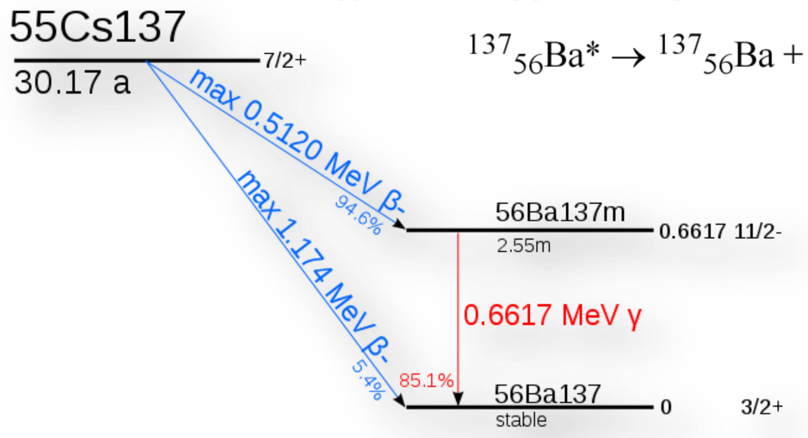
EM/2.VD.HVG

EM/3.VD.PA.HVG.001

Type	Head-on type	Anode to Cathode Supply Voltage	1000 V
Tube Size	Dia.51 mm	[Cathode] Luminous Sensitivity Min.	80 μA/lm
Photocathode Area Shape	Round	[Cathode] Luminous Sensitivity Typ.	110 μA/lm
Photocathode Area Size	Dia.46 mm	[Cathode] Blue Sensitivity Index (CS 5-58) Typ.	12.0
Wavelength (Short)	300 nm	[Cathode] Radiant Sensitivity Typ.	95 mA/W
Wavelength (Long)	650 nm	[Anode] Luminous Sensitivity Min.	3 A/lm
Wavelength (Peak)	420 nm	[Anode] Luminous Sensitivity Typ.	30 A/lm
Spectral Response Curve Code	400K	[Anode] Radiant Sensitivity Typ.	2.6×10^4 A/W
Photocathode Material	Bialkali	[Anode] Gain Typ.	2.7×10^5
Window Material	Borosilicate glass	[Anode] Dark Current (after 30min.) Typ.	2 nA
Dynode Structure	Box-and-grid	[Anode] Dark Current (after 30min.) Max.	20 nA
Dynode Stages	8	[Time Response] Rise Time Typ.	7.0 ns
[Max. Rating] Anode to Cathode Voltage	1500 V	[Time Response] Transit Time Typ.	60 ns
[Max. Rating] Average Anode Current	0.1 mA		

$^{137}{}_{55}Cs \rightarrow {}^{137}{}_{56}Ba^{*} + {}^{0}{}_{-1}e. + \nu\text{-bar}$

$^{137}{}_{56}Ba^{*} \rightarrow {}^{137}{}_{56}Ba + \gamma$



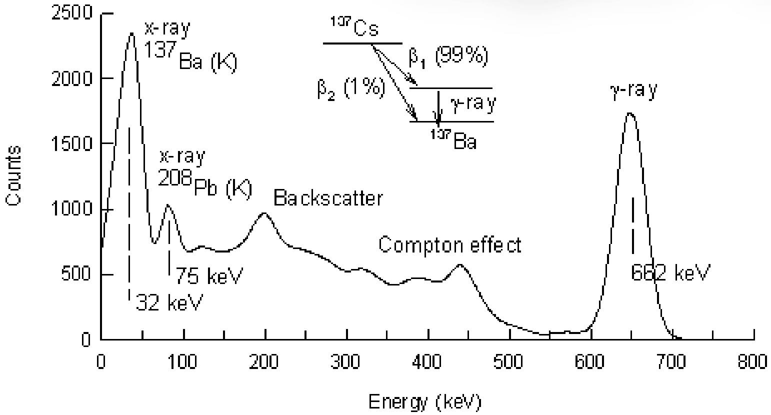


Figure 10.4 - Sample emission spectrum from ^{137}Cs.

32-37keV (7.2%) Ba *K x*-rays

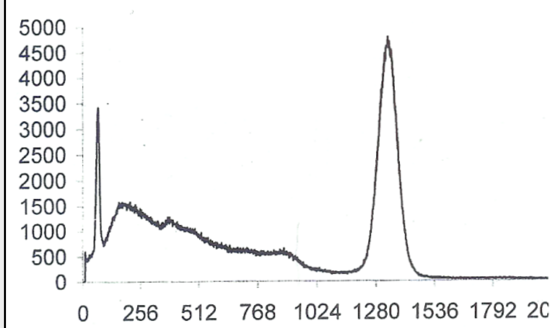
СЕРТИФИКАТ

Продукция: Сцинтилляционная сборка на основе монокристалла NaI(Tl) в форме равностороннего шестигранника размерами: высота 200 мм, длина грани 45 мм с ФЭУ R1306

Дата измерения: 13.01.11
Серийный номер: **3243.01.11**
Тип сцинтилляционной сборки: 12x14S32/2

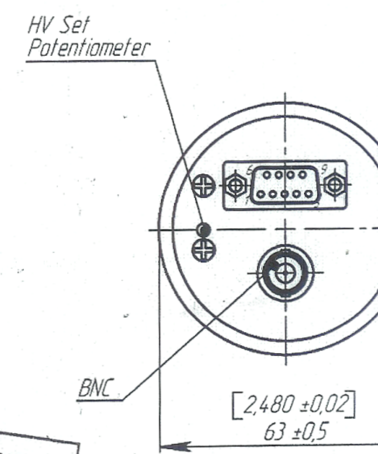
Тип электронного модуля: EM/2.VD.HVG
Размер сцинтиллятора, мм: 78x90x200
Материал контейнера: Алюминий
ФЭУ: Hamamatsu R1306 #SV1934

	Спецификация	Результаты теста
Источник:	Cs^{137} (662 keV)	Cs^{137} (662 keV)
Энергетическое разрешение (FWHM):	Не больше 8,5 %	6.9 % **6.9%**



Com-port (DB-9F) Pin Out

Pin	Function	Direction	Descriptio
5	–	–	Not connecte
9	–	–	Not connecte
4	–	–	Not connecte
8	–	–	Not connecte
3	External Control Voltage	IN	1/1000
7	Control Voltage Return	OUT	1/1
2	HV Return	OUT	1/1000
6	GND	–	HVG Supply
1	+5VDC	IN	



Зав.сектором

В.И.Кошель

Если у Вас есть какие-либо вопросы, касающиеся качества продукции, пожалуйста, свяжитесь с нами по адресу:
QC@isc.kharkov.com

USB Parsek 4k/8k ADC

Parsek LLC
Tel/Fax.: (09621) 4-02-77
e-mail:parsek@dubna.ru
www.parsek.ru

http://www.parsek.ru/en/

141980 Dubna, Moscow region
Ul. Pravdy, 24.

4K spectrometric ADC with USB interface and USB bus supply

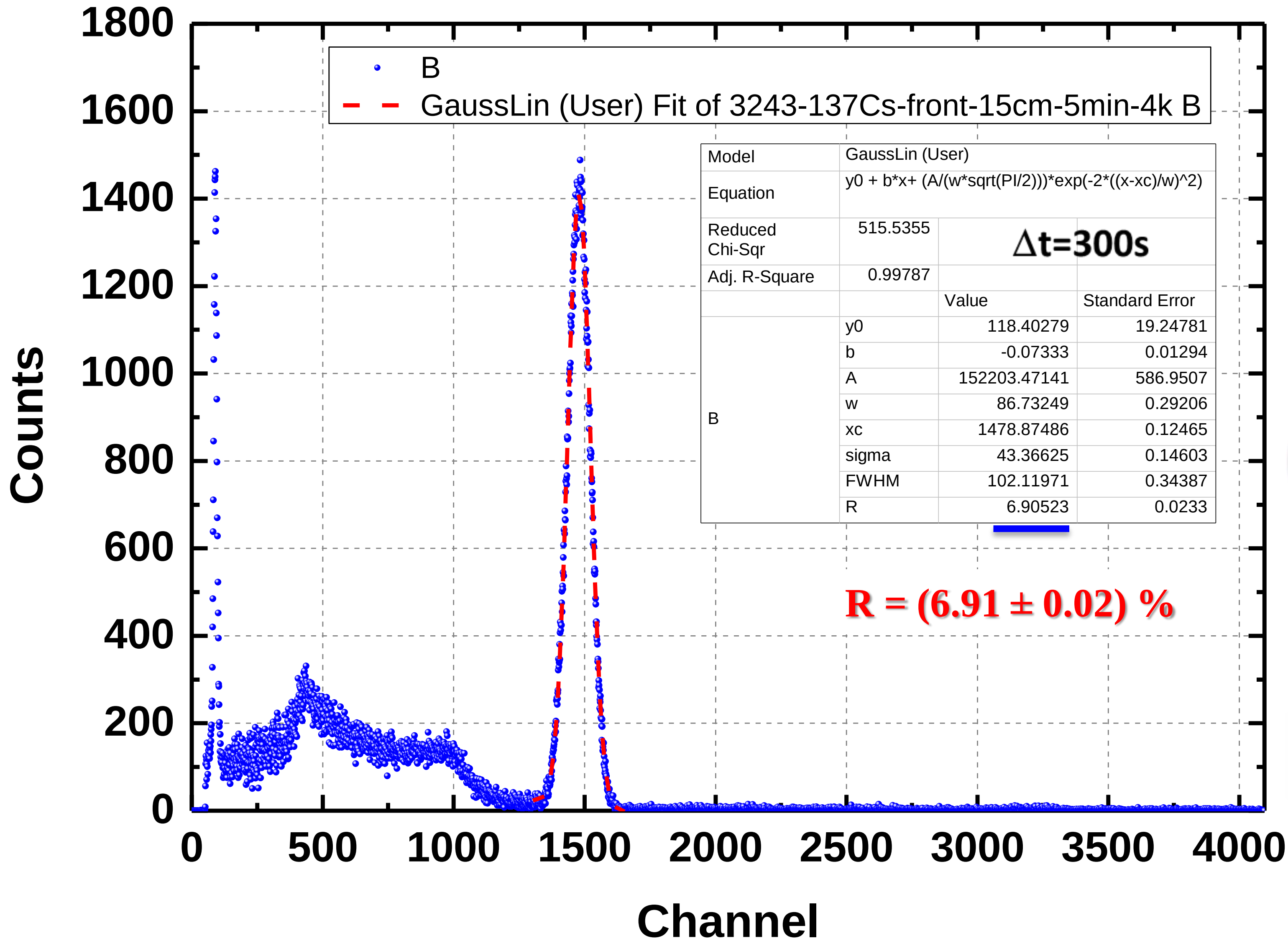
Specification:

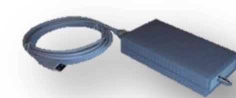
Conversion type	Wilkinson
Number of analog inputs	1
Amplitude of input pulses	40 mV - 4,0 V
Rise time not less not more	 0,5 mks 20,0 mks
Charger channel capacity	$2^{32} \cdot 4096$
Number of output bits (channels)	12 (4096)
Conversion frequency	100 MHz
Integral non-linearity	0,04%
Differential non-linearity	$\pm$1,0 % at the level $5 \cdot 10^4$ in the channel
Value of drift of generating peak, not worse then	0,1% within 8 hours of continuous work
Time of test	5,0 mks (or by order)
Power requirements +5 V	470 mA (2,35 Vatt)
Structure / construction:	Plastic body 150x80x30 mm
Bus type	USB


8k
EM/2.VD.HVG
4k
15cm

USB Parsek 4k ADC

^{137}Cs 661.7 keV γ-rays amp. spectrum (- bkg)

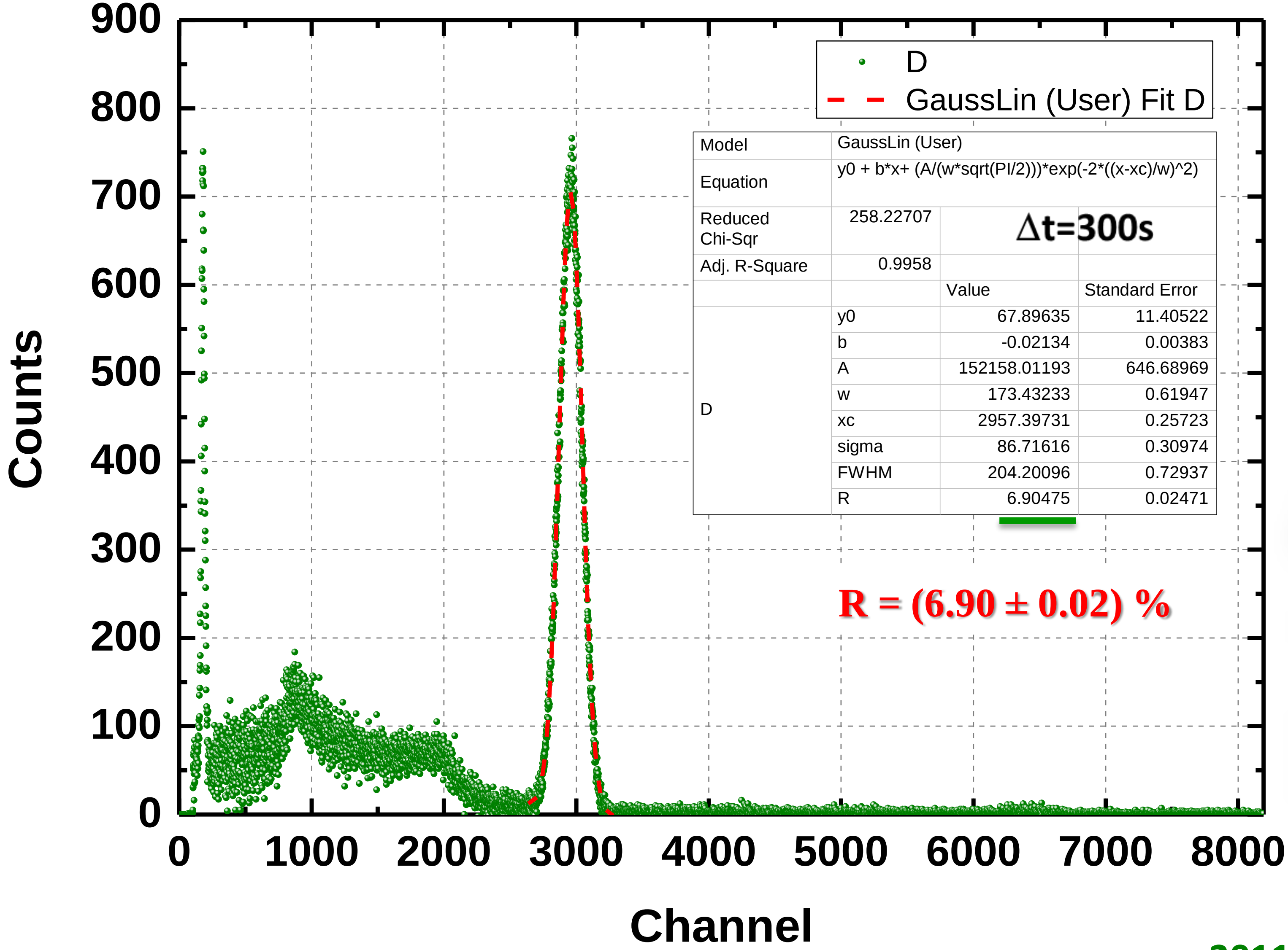




2011, I. Ruskov

USB Parsek 8k ADC

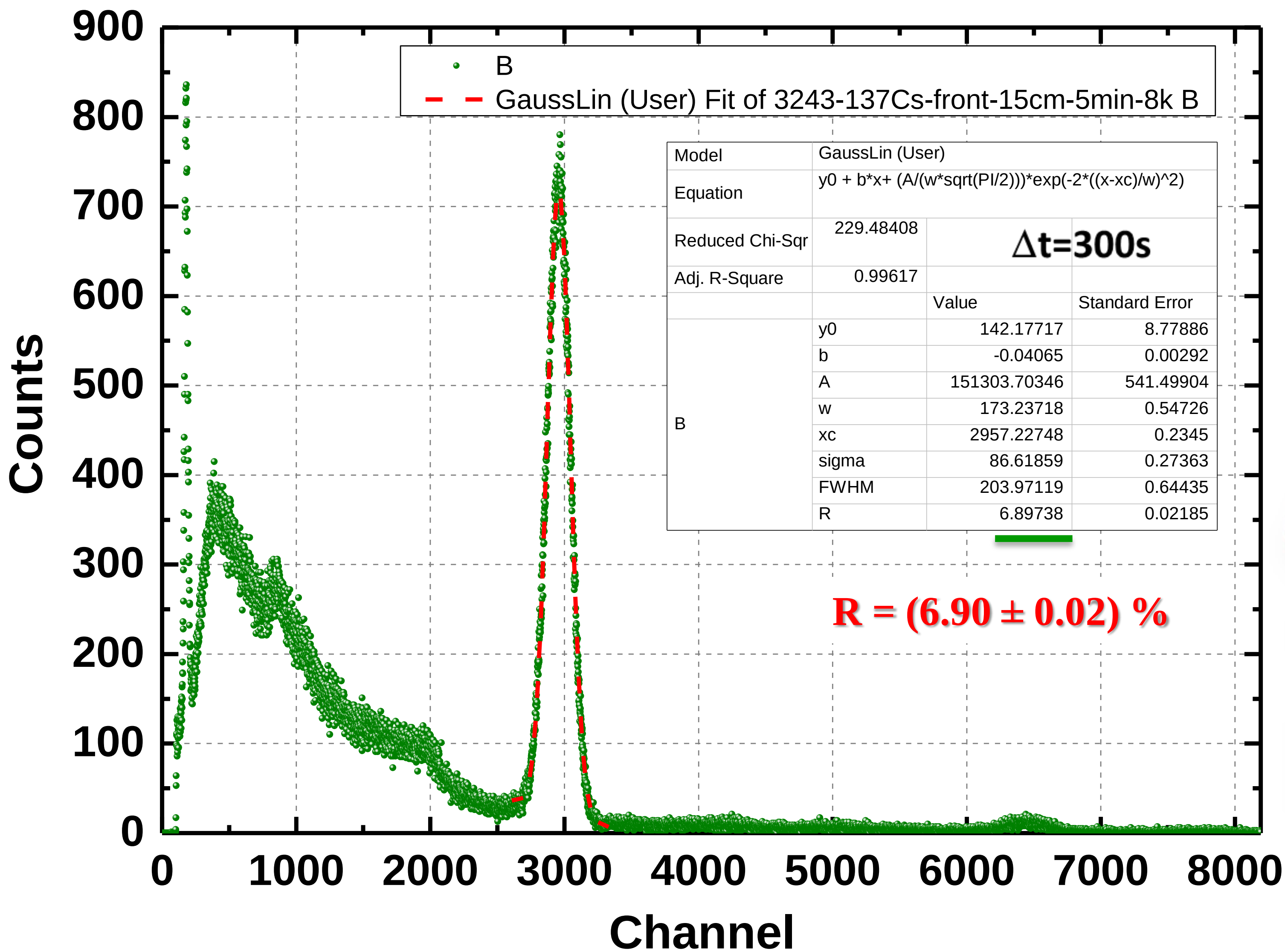
^{137}Cs 661.7 keV γ-rays amp. spectrum (- bkg)

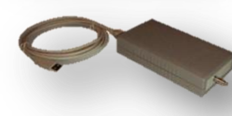


2011, I. Ruskov

USB Parsek 8k ADC

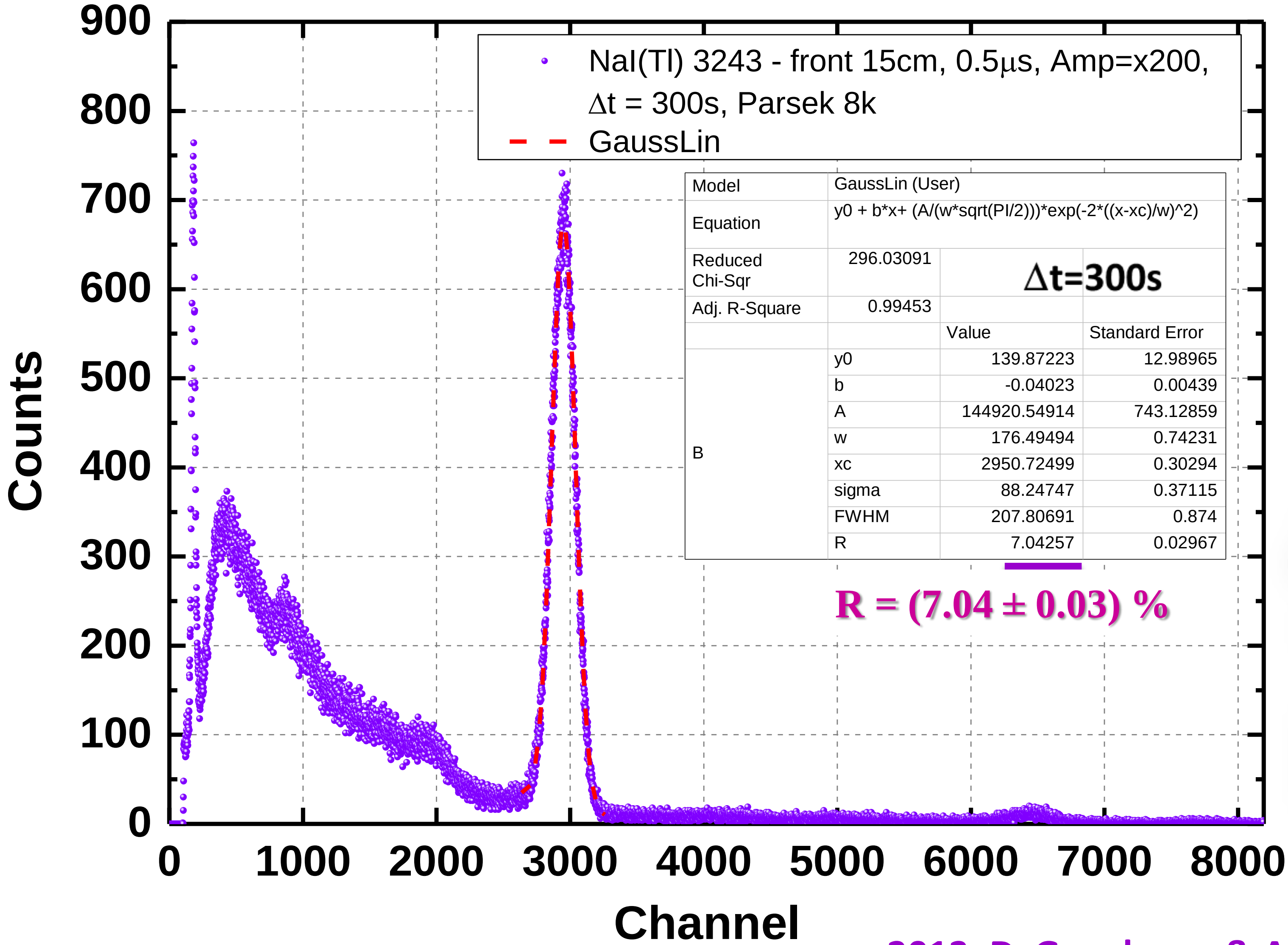
^{137}Cs 661.7 keV γ-rays amp. spectrum (+ bkg)



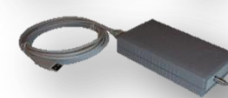


2011, I. Ruskov

^{137}Cs 661.7 keV γ-rays amp. spectrum (+ bkg)



Model	GaussLin (User)		
Equation	y0 + b*x+ (A/(w*sqrt(PI/2)))*exp(-2*((x-xc)/w)^2)		
Reduced Chi-Sqr	296.03091		
Adj. R-Square	0.99453		
		Value	Standard Error
B	y0	139.87223	12.98965
	b	-0.04023	0.00439
	A	144920.54914	743.12859
	w	176.49494	0.74231
	xc	2950.72499	0.30294
	sigma	88.24747	0.37115
	FWHM	207.80691	0.874
	R	7.04257	0.02967



2013, D. Grozdanov & A. Issatov

New way to analyze gamma radiation

without the need for expensive NIM based systems

Table III. Properties of typical soundcard.

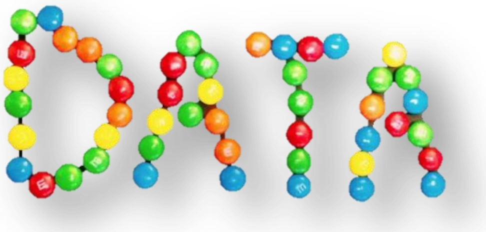
	Soundblaster Digital music PX (Creative tech. LTD.)
Connection	USB (External Connection with Computer)
Sampling rate	44.1 kHz
Band width	20 kHz
Resolution	Signed 16 bit
Full Scale	$\pm 2V_{rms}$

or PCI

C-Media CMI 8738 4-Channel PCI Sound Card

The sound card has 16 bits for a range from-2V to+2 V (line-in full scale) and 15 bits for positive inputs.

A 10-bit effective resolution requires the peak widths (standard deviation σ) to be less than 5-bits wide ($< 2^5 = 32$- channels).



AAPT PHYSICS EDUCATION
AMERICAN JOURNAL of PHYSICS

http://scitation.aip.org/content/aapt/journal/ajp/81/10/10.1119/1.4816264

2013

Development of the low-cost multi-channel analyzer system for γ-ray spectroscopy with a PC sound card

CrossMark

Kenkoh Sugihara[1,a)], Satoshi N. Nakamura[1], Nobuyuki Chiga[1], Yuu Fujii[1] and Hirokazu Tamura[1]

+ VIEW AFFILIATIONS

a) Electronic mail: sugihara@cmpt.phys.tohoku.ac.jp

Download PDF

Am. J. Phys. **81**, 792 (2013); http://dx.doi.org/10.1119/1.4816264

A low-cost multi-channel analyzer (MCA) system was developed using a custom-build interface circuit and a PC sound card. The performance of the system was studied using γ-ray spectroscopy measurements with a NaI(Tl) scintillation detector. Our system successfully measured the energy of γ-rays at a rate of 1000 counts per second (cps).

OA

Development of multichannel analyzer using sound card ADC for nuclear spectroscopy system

Maslina Mohd Ibrahim[1], Nolida Yussup[1], Lojius Lombigit[1], Nur Aira Abdul Rahman[1] and Zainudin Jaafar[1]

+ VIEW AFFILIATIONS

AIP Conf. Proc. **1584**, 50 (2014); http://dx.doi.org/10.1063/1.4866103
Conference date: 30 September–2 October 2013
Location: Kuala Lumpur, Malaysia

This paper describes the development of Multi-Channel Analyzer (MCA) using sound card analogue to digital converter (ADC) for nuclear spectroscopy system. The system was divided into a hardware module and a software module. Hardware module consist of detector NaI (Tl) 2" by 2", Pulse Shaping Amplifier (PSA) and a build in ADC chip from readily available in any computers' sound system. The software module is divided into two parts which are a pre-processing of raw digital input and the development of the MCA software. Band-pass filter and baseline stabilization and correction were implemented for the pre-processing. For the MCA development, the pulse height analysis method was used to process the signal before displaying it using histogram technique. The development and tested result for using the sound card as an MCA are discussed.

http://scitation.aip.org/content/aip/proceeding/aipcp/10.1063/1.4866103

The History of Sound Card Spectrometry

Sound **C**ard **S**pectrometry was developed in Australia **by Marek Dolleiser**.

Marek works at The University of Sydney, with third year physics students, and developed **PRA** as an educational tool for his students.

His novel pulse shape algorithms and software performed so well, he decided to offer it to **everyone for free.**

After the Fukushima nuclear disaster the software became popular in Japan and spread to the rest of the world like wild fire.

This in turn inspired many other software writers, who also added their own versions of free sound card spectrometry software.

To this day, the software is being improved, and there is healthy competition between software authors, who can produce the best version.

Take your pick below, **PRA**, **BecqMoni**,
Theremino, **GeigerBot**, **Fitzpeaks**,
all work well and have their own features and benefits.

I do recommend you start with **PRA**
which was the original and still in my opinion the one that consistently performs to scientific standards.

Steven Sesselmann

Fitzpeaks (NaI) with GS-1100A

Gamma Spectrometry Software

The FitzPeaks Gamma Analysis Software is a combined research and general purpose gamma spectroscopy analysis and calibration program capable of operating on spectral data from a variety of different manufacturer's systems. It is designed to run under all 32 bit versions of Microsoft® Windows™

The main algorithms used for finding and fitting peaks, and performing the quantitative analysis are based on methods presented in a paper describing the program SAMPO80 produced by M.J. Koskelo, P.A. Aarnio and J.T. Routti of the Helsinki University of Technology, Finland.

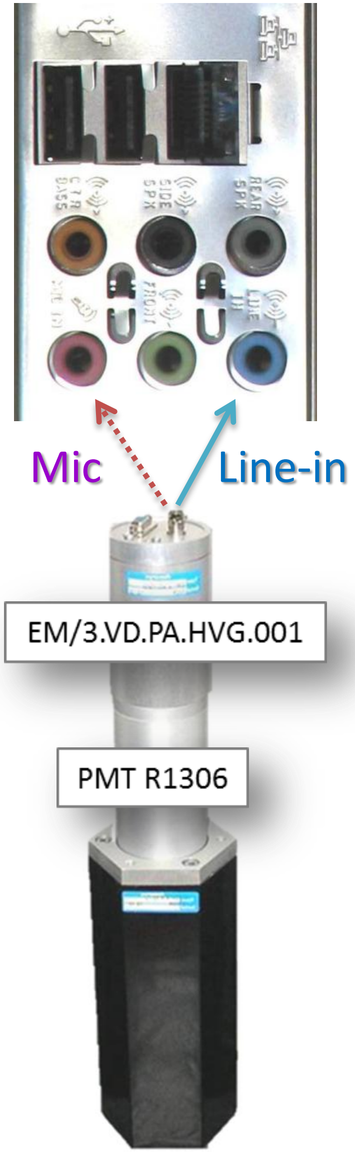
The peak search algorithm is based on finding minima in the smoothed second difference of the spectral data. The peak fitting is performed using a linear least squares routine, fitting the data to a Gaussian function with an exponential tail on either the low energy, or both sides of a peak. There is an optional iterative fitting for peak position, width, and low energy tailing.

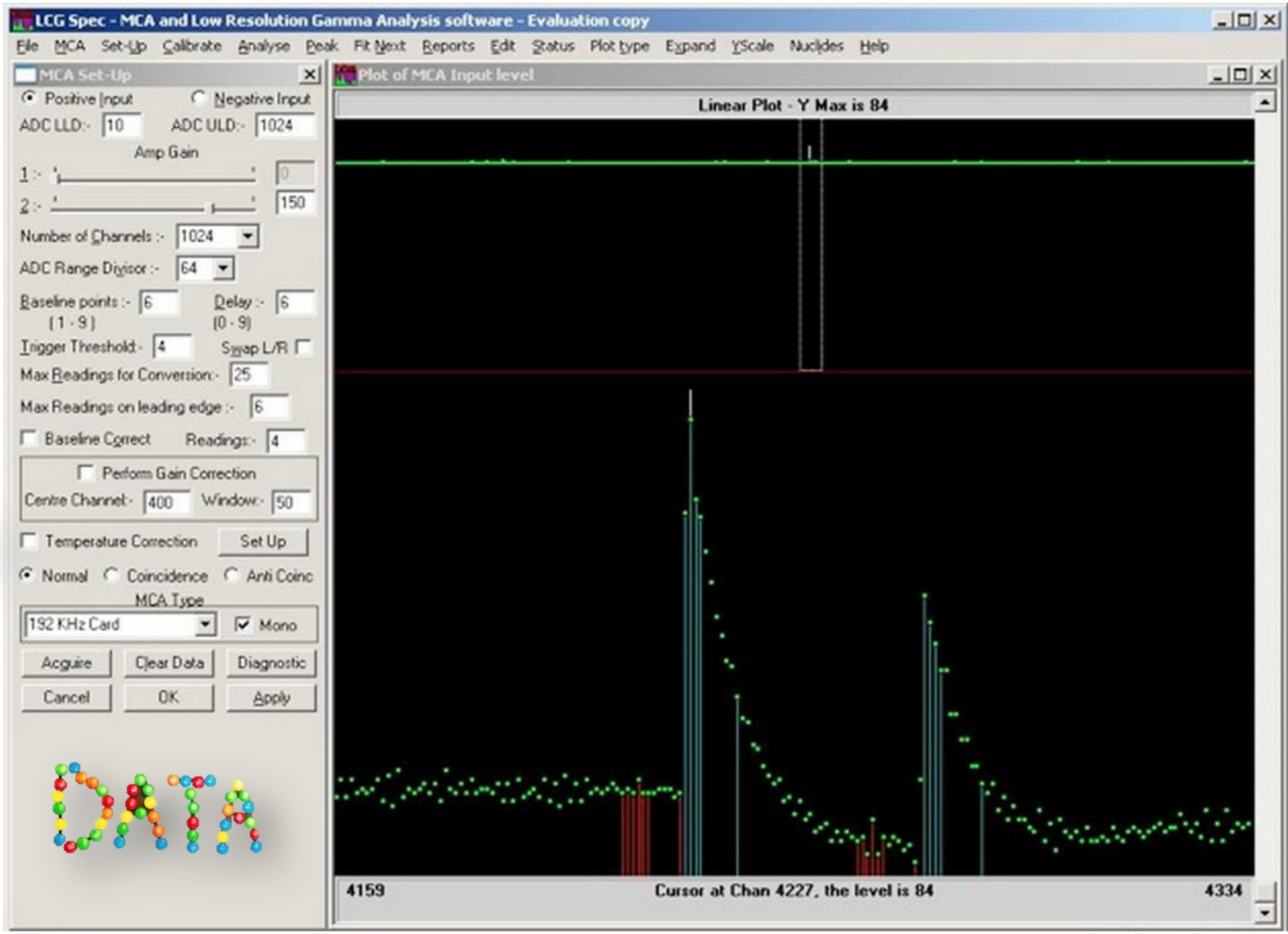
The program is capable of operating in a range of modes, from a fully automated analysis through to a completely interactive mode. In the interactive modes comprehensive displays are presented, allowing the user to insert new peaks into the spectrum, change the widths of fitting regions, change the type of background continuum used, etc.

GS-1100A with Fitzpeaks (NaI) version gives excellent results (see screen dumps below).

An evaluation version of Fitzpeaks (NaI) can be downloaded from http://www.jimfitz.demon.co.uk/

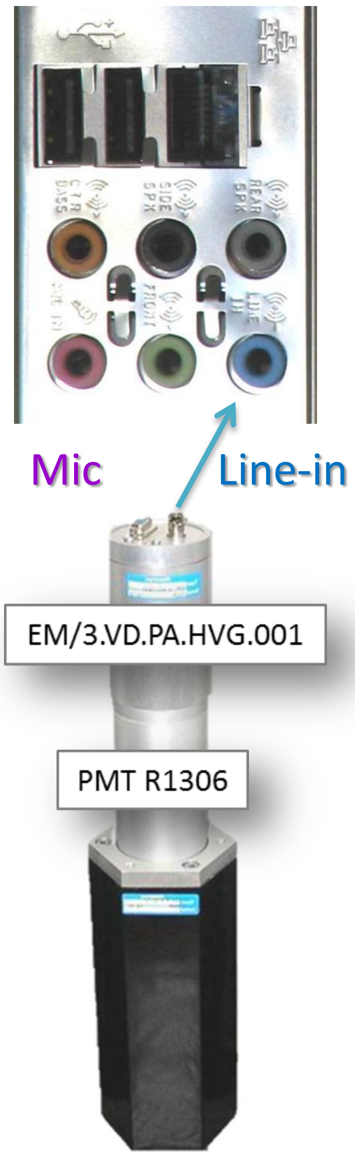
FitzPeaks with NaI(Tl) and Sound card

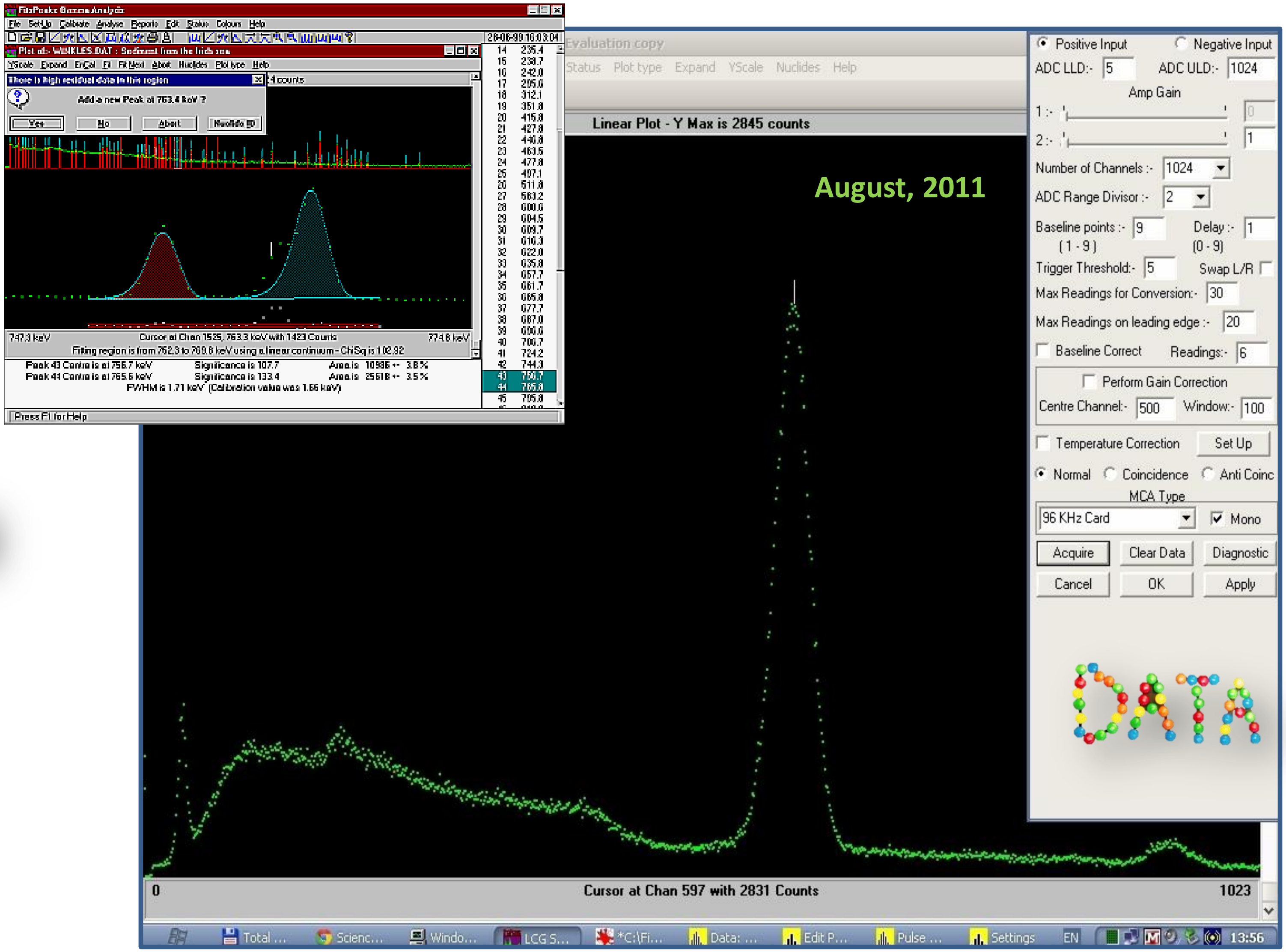




http://www.jimfitz.demon.co.uk/

FitzPeaks with NaI(Tl) and Sound card



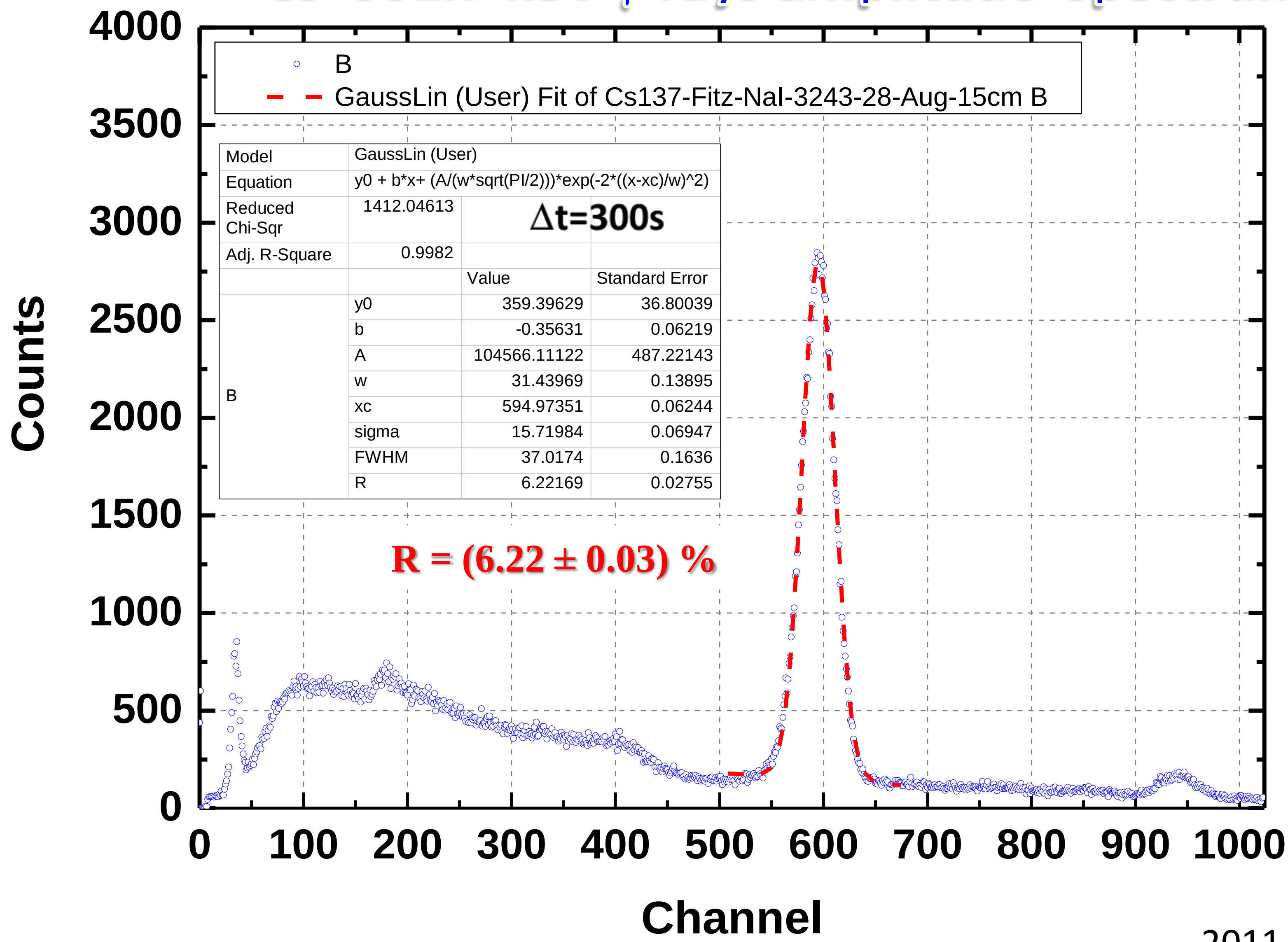


http://www.jimfitz.demon.co.uk/install_nai.exe

2011, I. Ruskov

FitzPeaks with NaI(Tl) and Sound card

^{137}Cs 661.7 keV γ-rays amplitude spectrum

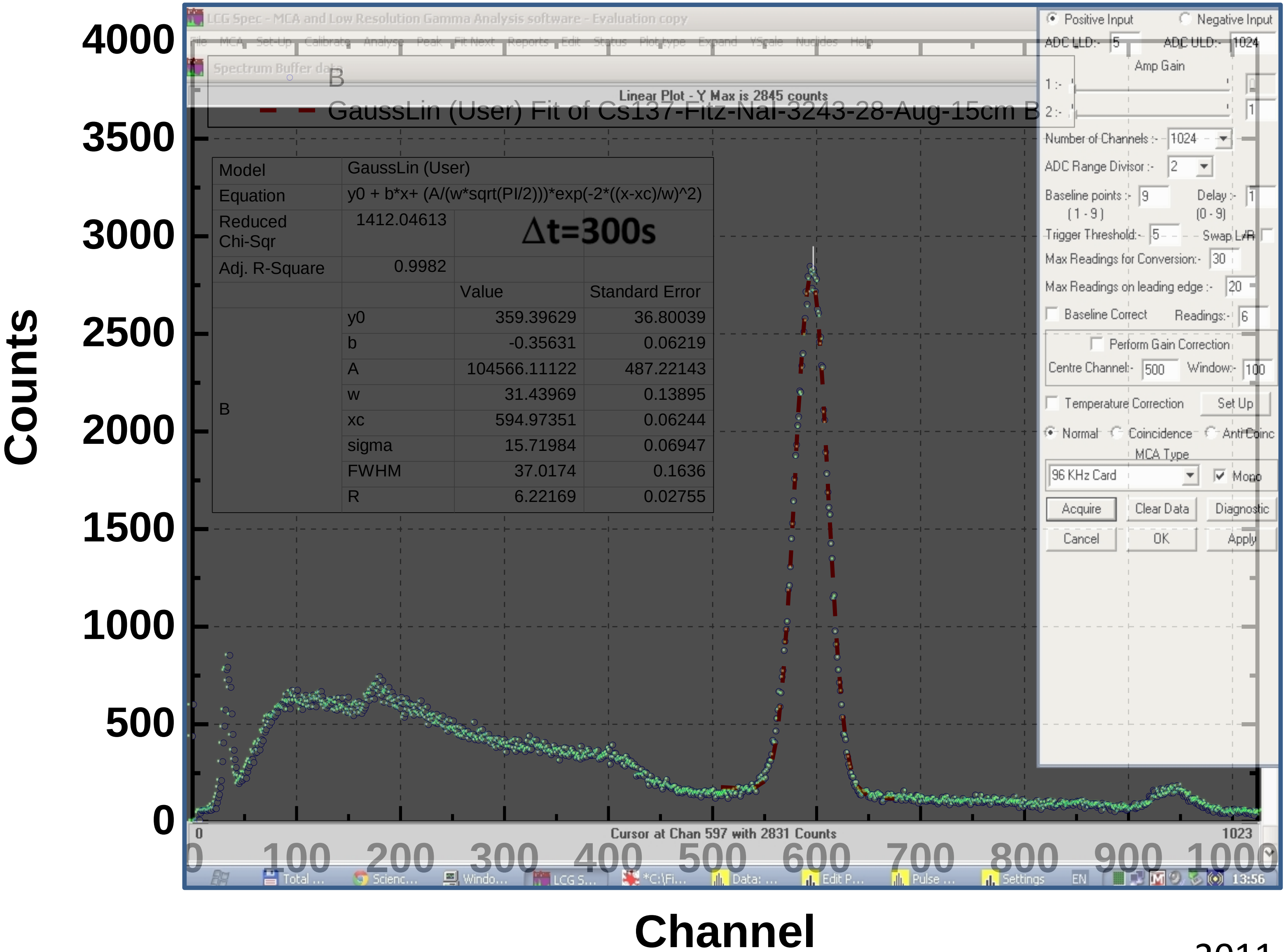


Model	GaussLin (User)		
Equation	y0 + b*x+ (A/(w*sqrt(PI/2)))*exp(-2*((x-xc)/w)^2)		
Reduced Chi-Sqr	1412.04613		
Adj. R-Square	0.9982		
		Value	Standard Error
B	y0	359.39629	36.80039
	b	-0.35631	0.06219
	A	104566.11122	487.22143
	w	31.43969	0.13895
	xc	594.97351	0.06244
	sigma	15.71984	0.06947
	FWHM	37.0174	0.1636
	R	6.22169	0.02755

2011, I. Ruskov

FitzPeaks with NaI(Tl) and Sound card

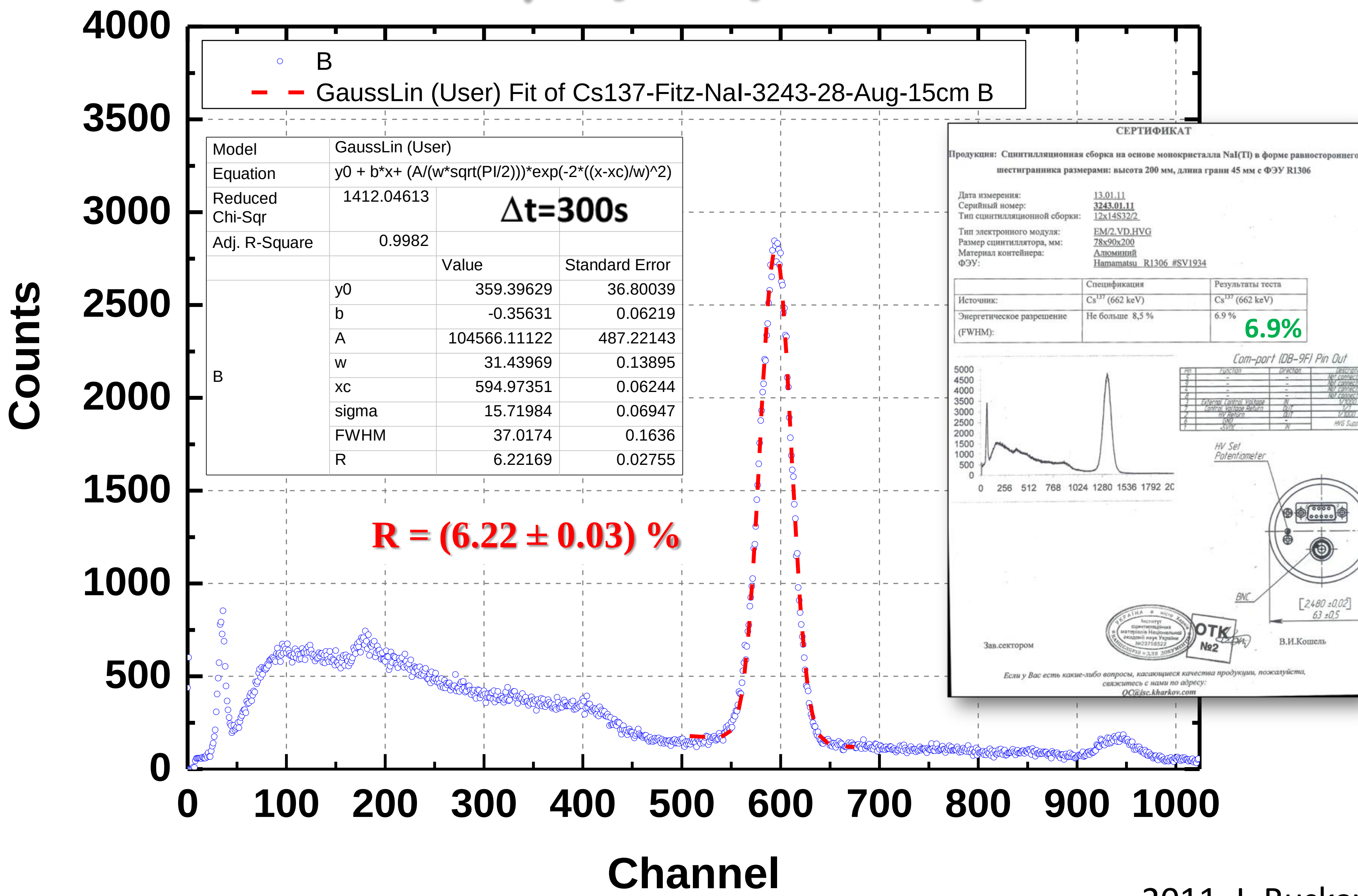
^{137}Cs 661.7 keV γ-rays amplitude spectrum



2011, I. Ruskov

FitzPeaks with NaI(Tl) and Sound card

^{137}Cs 661.7 keV γ-rays amplitude spectrum



Model	GaussLin (User)		
Equation	y0 + b*x+ (A/(w*sqrt(PI/2)))*exp(-2*((x-xc)/w)^2)		
Reduced Chi-Sqr	1412.04613		
Adj. R-Square	0.9982		
		Value	Standard Error
B	y0	359.39629	36.80039
	b	-0.35631	0.06219
	A	104566.11122	487.22143
	w	31.43969	0.13895
	xc	594.97351	0.06244
	sigma	15.71984	0.06947
	FWHM	37.0174	0.1636
	R	6.22169	0.02755

СЕРТИФИКАТ

Продукция: Сцинтилляционная сборка на основе монокристалла NaI(Tl) в форме равностороннего шестигранника размерами: высота 200 мм, длина грани 45 мм с ФЭУ R1306

Дата измерения: 13.01.11
Серийный номер: **3243.01.11**
Тип сцинтилляционной сборки: 12x14S32/2

Тип электронного модуля: EM/2.VD.HVG
Размер сцинтиллятора, мм: 78x90x200
Материал контейнера: Алюминий
ФЭУ: Hamamatsu R1306 #SV1934

	Спецификация	Результаты теста
Источник:	Cs^{137} (662 keV)	Cs^{137} (662 keV)
Энергетическое разрешение (FWHM):	Не больше 8,5 %	6.9 %

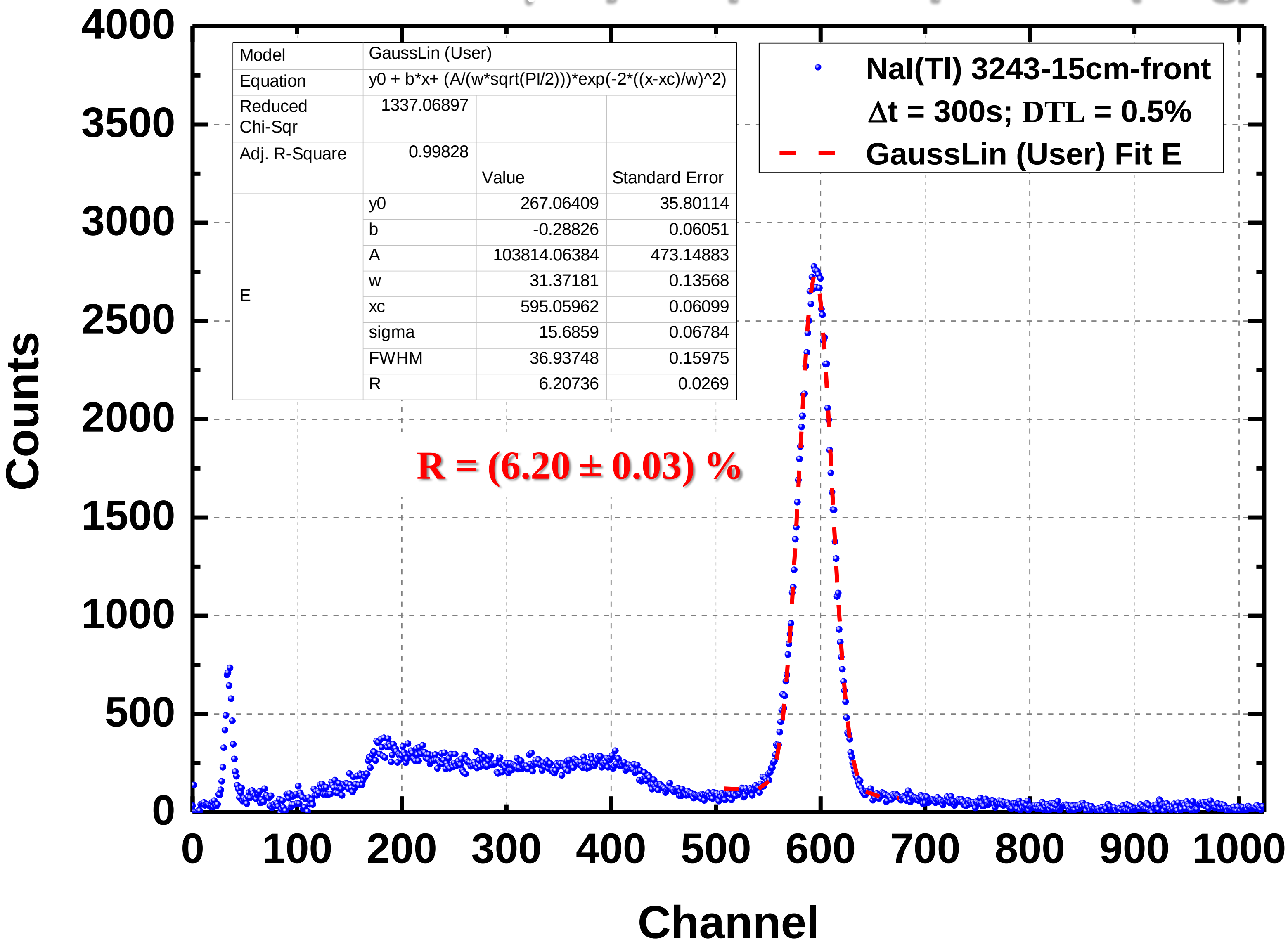
Зав.сектором В.И.Кошель

Если у Вас есть какие-либо вопросы, касающиеся качества продукции, пожалуйста, свяжитесь с нами по адресу: QC@isc.kharkov.com

2011, I. Ruskov

FitzPeaks with NaI(Tl) and Sound card

^{137}Cs 661.7 keV γ-rays amplitude spectrum (-bkg)



Language

GammaSpectacular.com

Shopping Cart
0 item(s) - A$0.00

Search

You are logged in as Ivan (Logout)

Home | Wish List (0) | My Account | Shopping Cart | Checkout

Product Categories | Software Downloads | Videos | Sample Gamma Spectra | Links | Other Projects | Old Website | Forum

- PRA - Gamma Spectroscopy Software
- Theremino MCA
- Geiger Bot iPhone and iPad App
- Safecast for iPhone & iPad
- BecqMoni (Japanese MCA)
- Intune Audio Analysis Software

Welcome to Gamma Spectacular

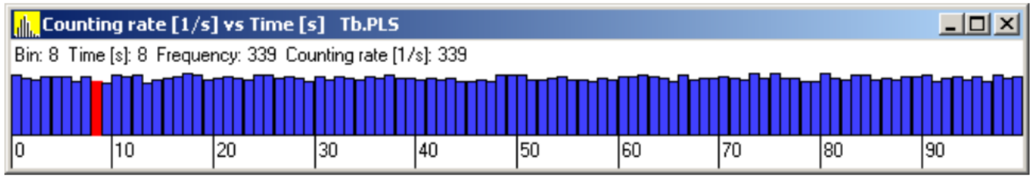
https://www.facebook.com/pages/Gamma-Spectacular/146649762066972

Our gamma spectroscopy (spectrometry) systems are as good as any, and our prices start from as little $299.- (B.Y.O. Detector). These systems are perfect for teachers and students, and anyone who want's to discover the invisible world of nuclear radiation.

Pulse Recorder & Analyzer – PRA Software

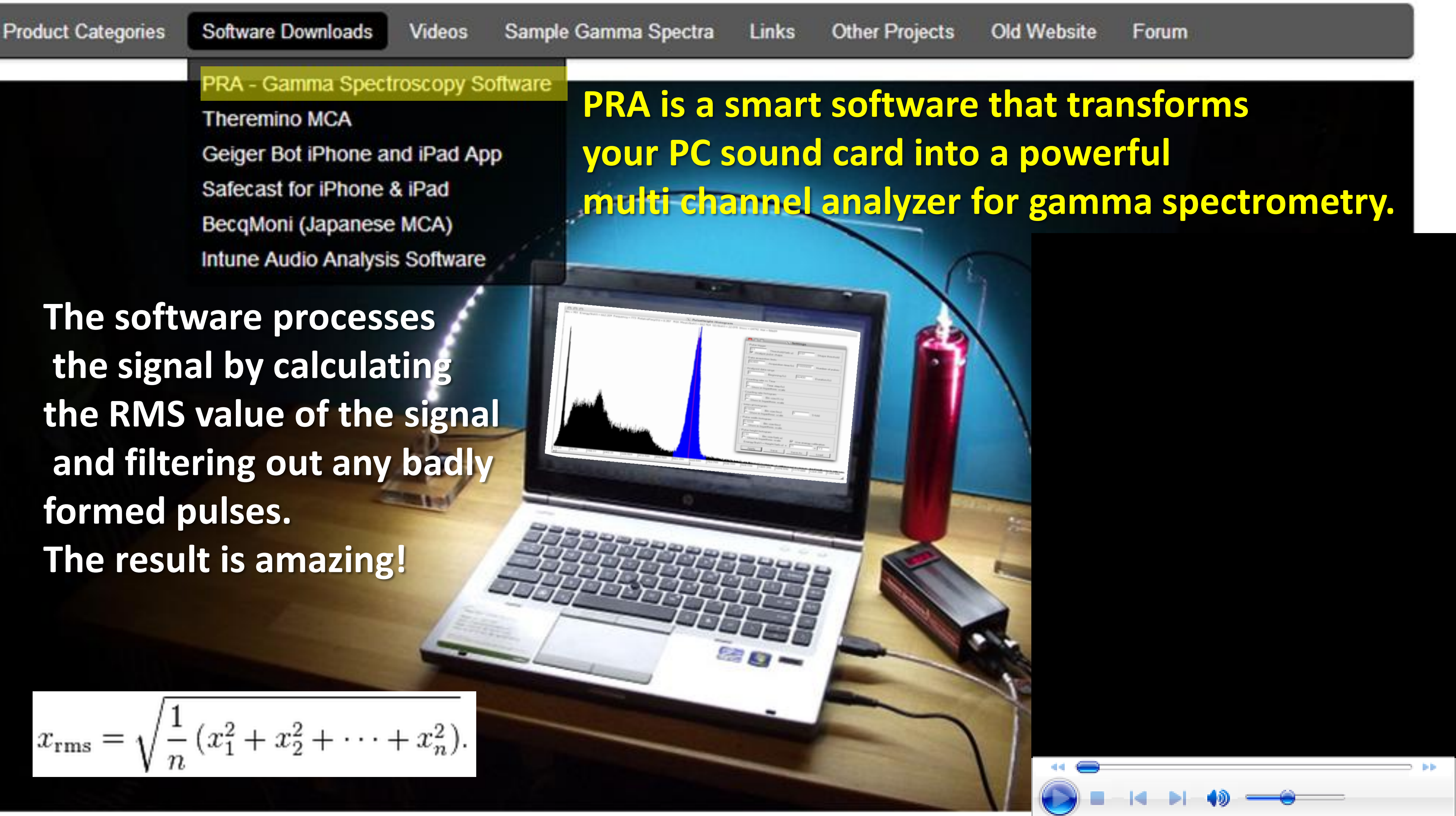
GammaSpectacular.com

Counting Rate vs Time



http://www.gammaspectacular.com/gamma_spectra/cs137-spectrum

http://www.youtube.com/watch?v=T-bX0OjaxQM#t=58



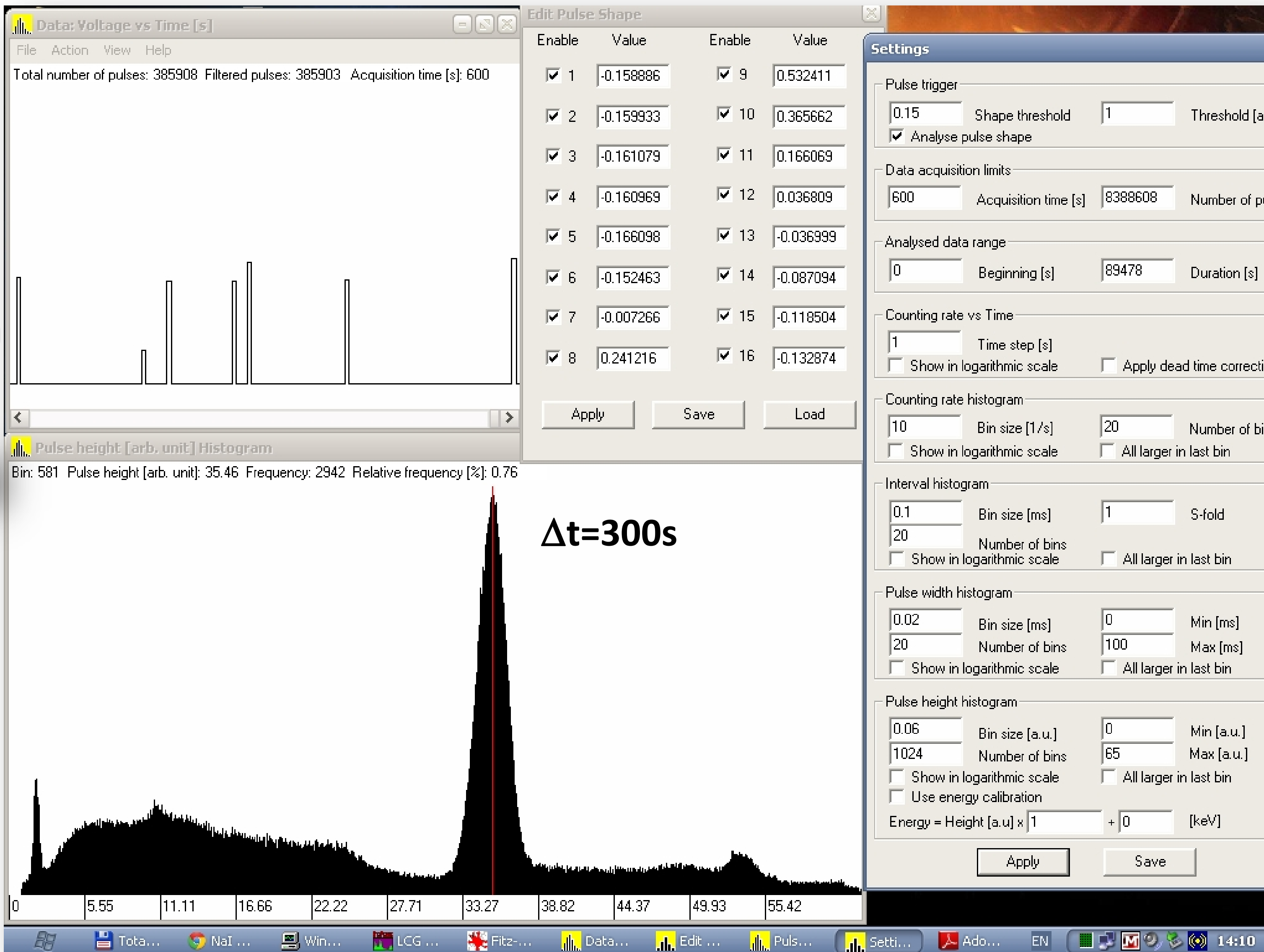
PRA is a smart software that transforms your PC sound card into a powerful multi channel analyzer for gamma spectrometry.

The software processes the signal by calculating the RMS value of the signal and filtering out any badly formed pulses. The result is amazing!

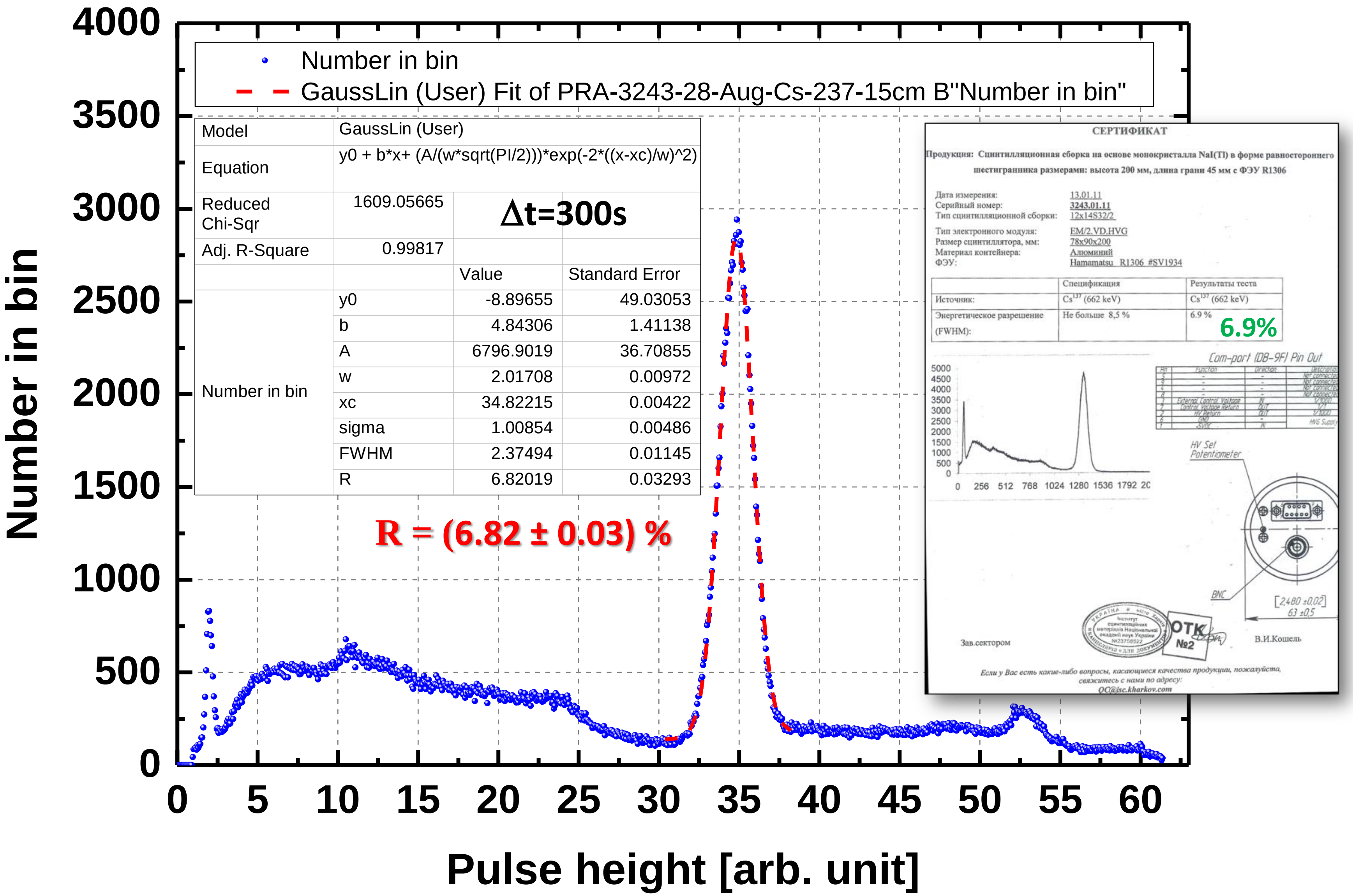
$$x_{\mathrm{rms}} = \sqrt{\frac{1}{n}\left(x_1^2 + x_2^2 + \cdots + x_n^2\right)}.$$

^{137}Cs 661.7 keV γ-rays amplitude spectrum

Pulse Recorder & Analyzer – PRA Software



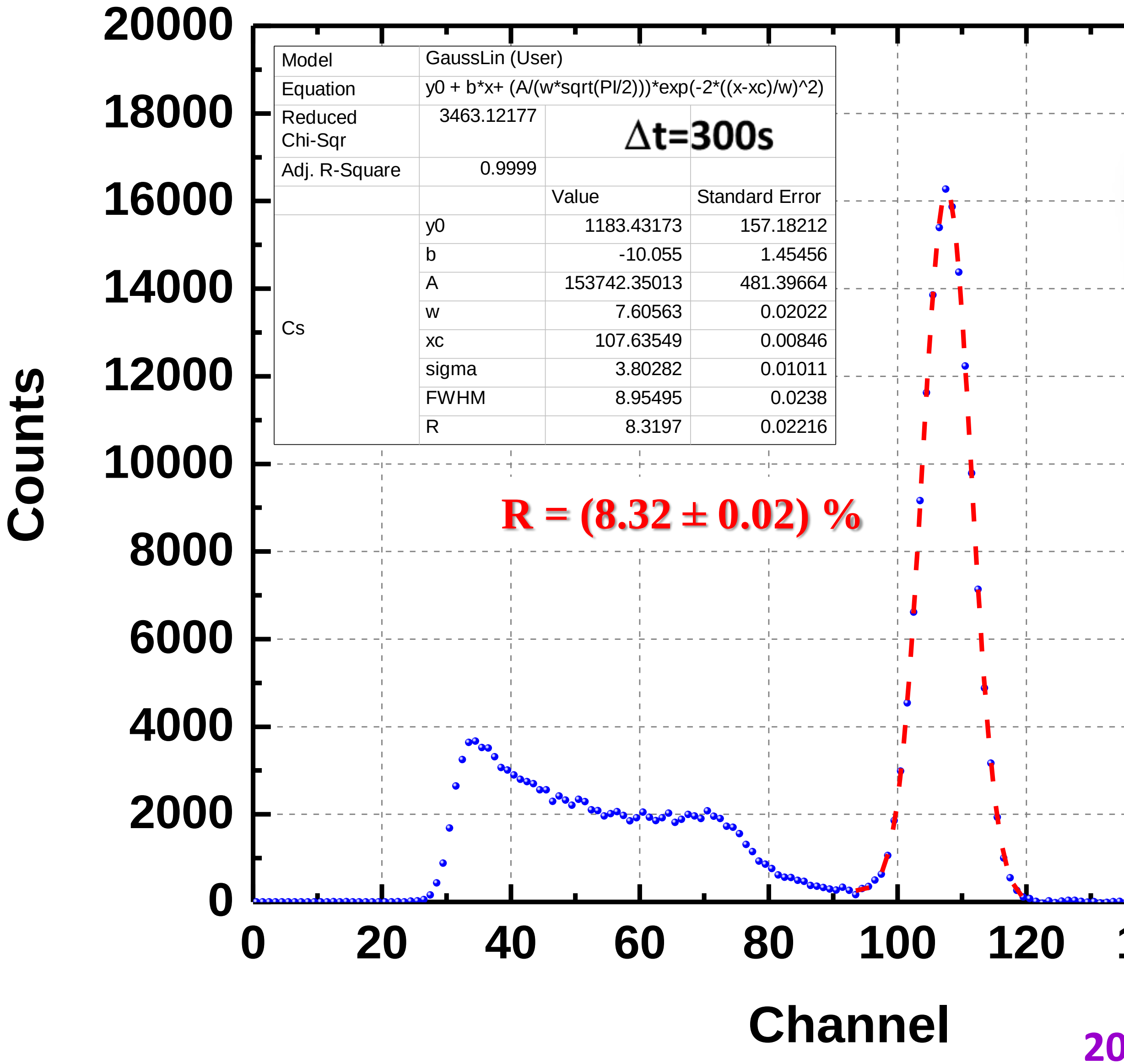
^{137}Cs 661.7 keV γ-rays amplitude spectrum



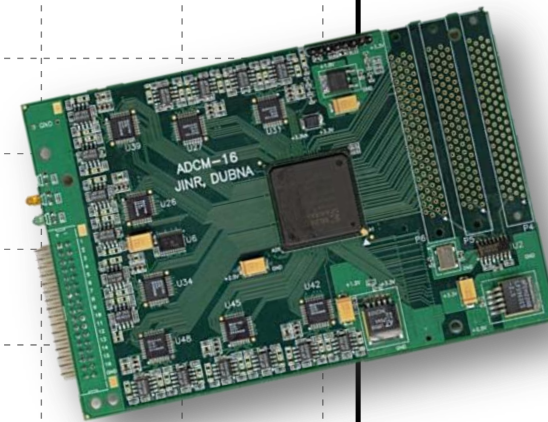
Model	GaussLin (User)		
Equation	y0 + b*x+ (A/(w*sqrt(PI/2)))*exp(-2*((x-xc)/w)^2)		
Reduced Chi-Sqr	1609.05665		
Adj. R-Square	0.99817		
		Value	Standard Error
Number in bin	y0	-8.89655	49.03053
	b	4.84306	1.41138
	A	6796.9019	36.70855
	w	2.01708	0.00972
	xc	34.82215	0.00422
	sigma	1.00854	0.00486
	FWHM	2.37494	0.01145
	R	6.82019	0.03293

ADCM16-LTC

^{137}Cs 661.7 keV γ-rays amplitude spectrum



Model	GaussLin (User)		
Equation	y0 + b*x+ (A/(w*sqrt(PI/2)))*exp(-2*((x-xc)/w)^2)		
Reduced Chi-Sqr	3463.12177		
Adj. R-Square	0.9999		
		Value	Standard Error
Cs	y0	1183.43173	157.18212
	b	-10.055	1.45456
	A	153742.35013	481.39664
	w	7.60563	0.02022
	xc	107.63549	0.00846
	sigma	3.80282	0.01011
	FWHM	8.95495	0.0238
	R	8.3197	0.02216



16-channel 14-bit 100 MHz Flash ADC with a signal processing core, in couple with a CCB-PCIe carrier board, utilizes one PCI slot of the PC.

2013, D. Grozdanov & A. Sariev


To Do:
1KCP-1M
N761970
HAIN
PURE FOODS
IODIZED SEA SALT
THIS SALT SUPPLIES IODIDE, A NECESSARY NUTRIENT
MADE FROM EVAPORATED SEA WATER
NET WT 26 OZ (1 LB 10 OZ) 737g
СОЛЬ
СОЛЬ
BULLSHIT AMPLIFIER / DETECTOR
INPUT FREQUENCY 950 - 2050 FECAL Hz
BOTTOM SCALE
SHIT X 10
PVC
It does not matter how slow you go so long as you do not stop.
~Confucius Wisdom
www.gauraw.com


ThankYou
СПАСИБО!