GLAST Burst Monitor

High-Energy Calibration of a GLAST Burst Monitor BGO detector

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Abstract:

The understanding of the instrumental response of the GLAST Burst Monitor BGO detectors at energies above the energy range, which is accessible by common laboratory radiation sources (< 4.43 MeV), is important, especially for the later cross-calibration with the LAT response in the overlap region between ~ 20 MeV to 30 MeV.
In November 2006 the high-energy calibration of the GBM-BGO spare detector was performed at the small Van-de-Graaff accelerator at SLAC, which produces a proton beam up to 400 keV. High energy gamma-rays from excited $^{8}Be^{*}$ (14.6 MeV and 17.6 MeV) and $^{16}O^{*}$ (6.1 MeV) were generated through (p, γ)-reactions by irradiating a LiF-target. For the calibration at lower energies radioactive sources (^{22}Na, ^{232}Th, $^{241}Am/^{9}Be$ and the ^{40}K background line) were used. Our poster will summarize the results including spectra, the energy/channel-relation and the dependence of energy resolution.

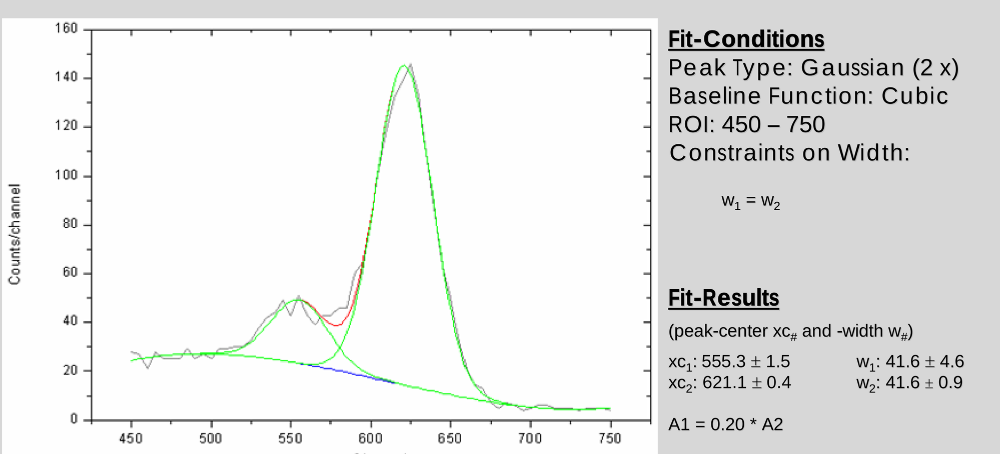
Calibration with radioactive sources:

Before and after the Van-de-Graaff runs spectra with radioactive sources were recorded in order to get a set of low energy lines, obtained at the same conditions (e.g. gain, which is dependent on the PMT high voltage setting and BGO temperature).

<u>Irradiation with an $^{241}Am/^{9}Be$ Source:</u>

The $^{9}Be(\alpha,n)^{12}C$ reaction produces the first excited state of ^{12}C.

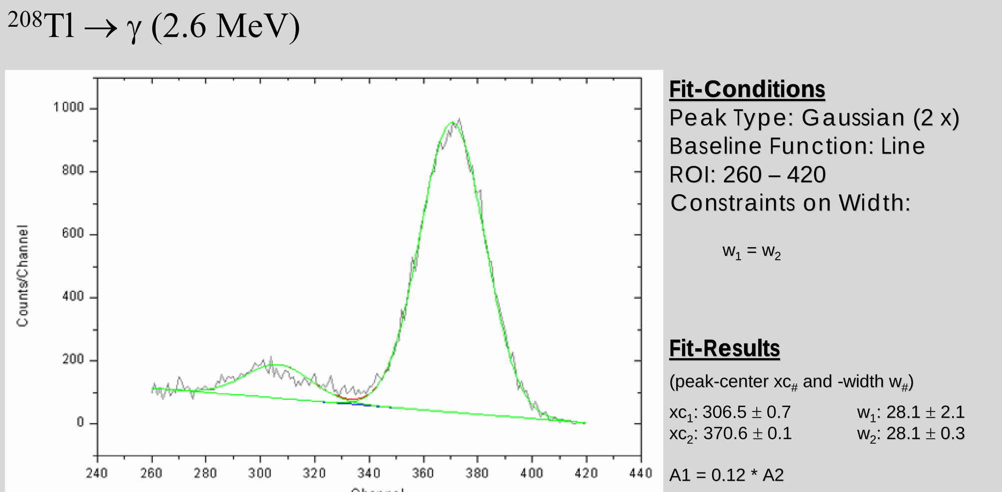
$^{12}C^{*} \rightarrow \gamma$ (4.43 MeV) + ^{12}C (ground state)



<u>γ-Radiation from Thorium Welding Rods:</u>

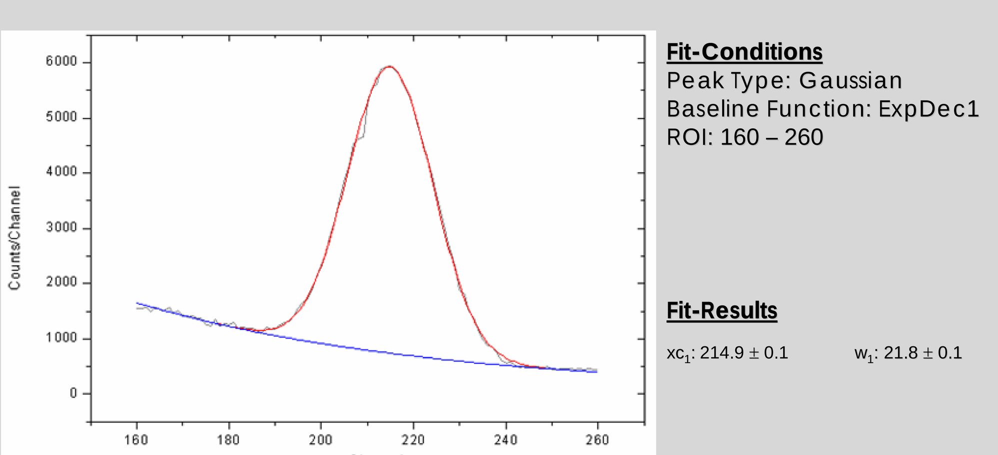
1.4 x 10^{10} yr. ^{232}Th nat. with decay products

$^{208}Tl \rightarrow \gamma$ (2.6 MeV)



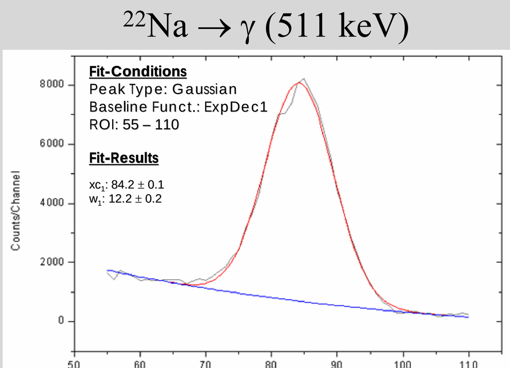
<u>γ-Radiation from Natural Background:</u>

$^{40}K \rightarrow \gamma$ (1.46 MeV)

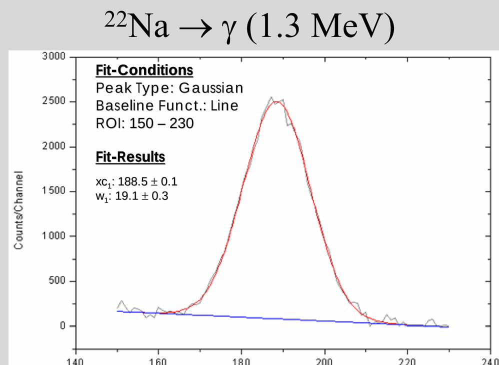


<u>γ-Radiation from a ^{22}Na laboratory source:</u>

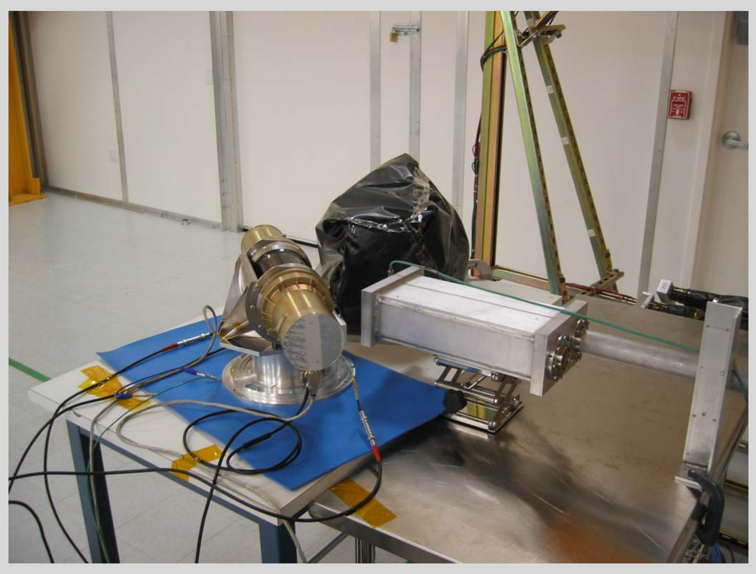
$^{22}Na \rightarrow \gamma$ (511 keV)

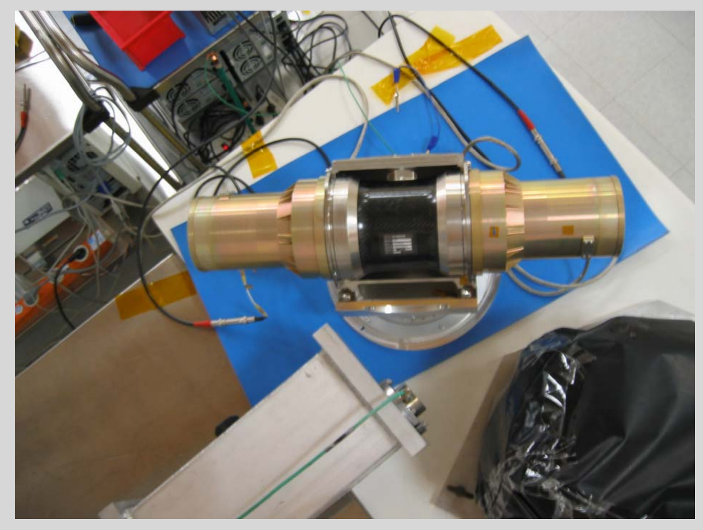


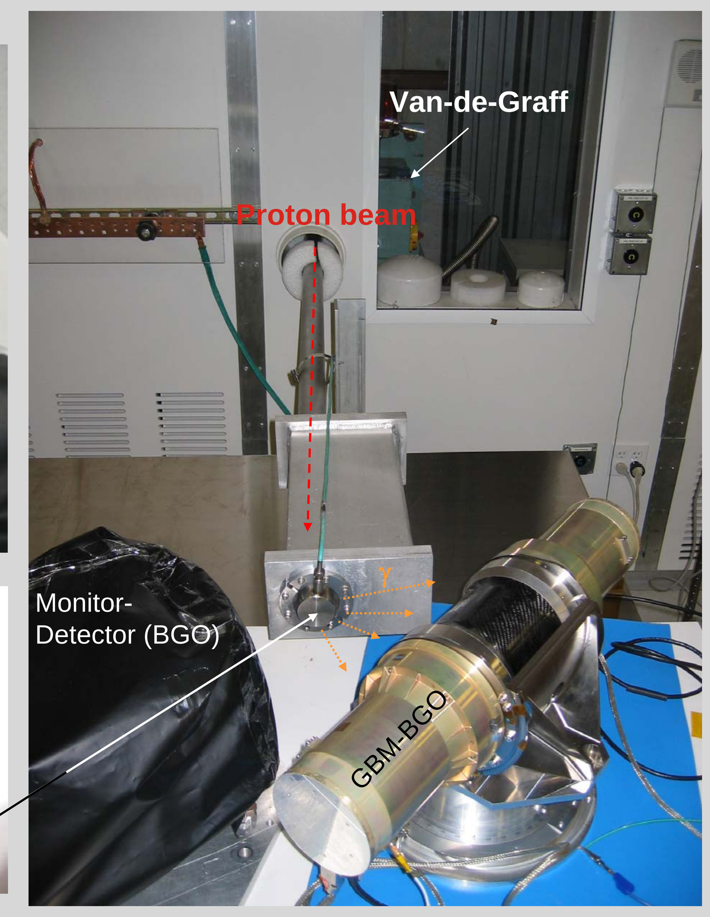
$^{22}Na \rightarrow \gamma$ (1.3 MeV)

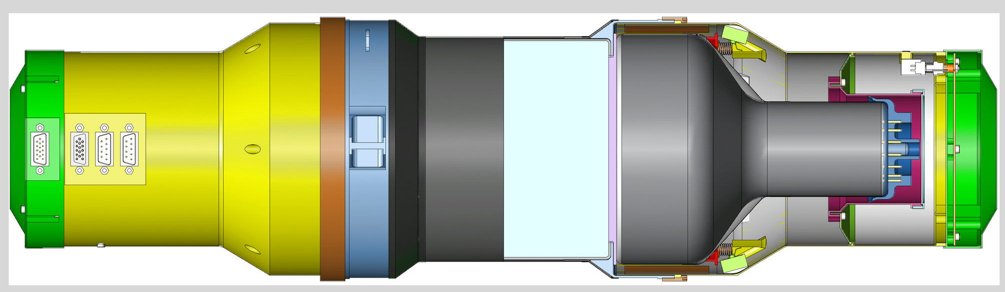


Setup at SLAC:







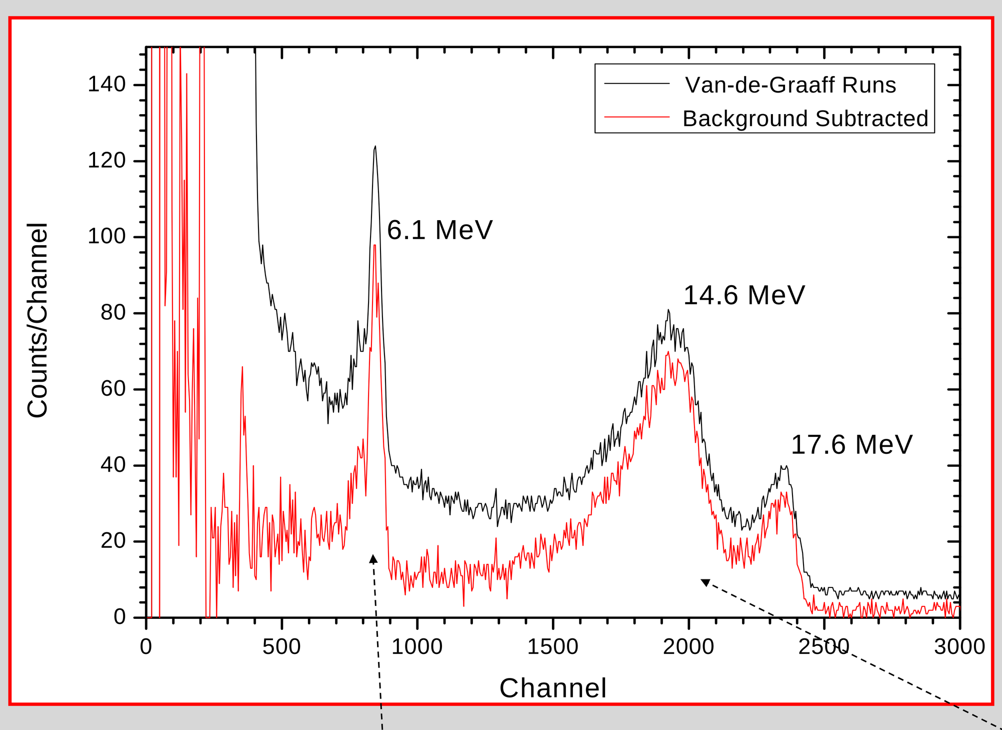


Van-de-Graaff Runs:

The Van-de-Graaff at SLAC is a small electrostatic accelerator that produces a up to 400 keV proton beam. The proton beam strikes a LiF target that terminates the end of the vacuum pipe and produces 6.1 MeV, 14.6 MeV, and 17.6 MeV gammas via the reactions:

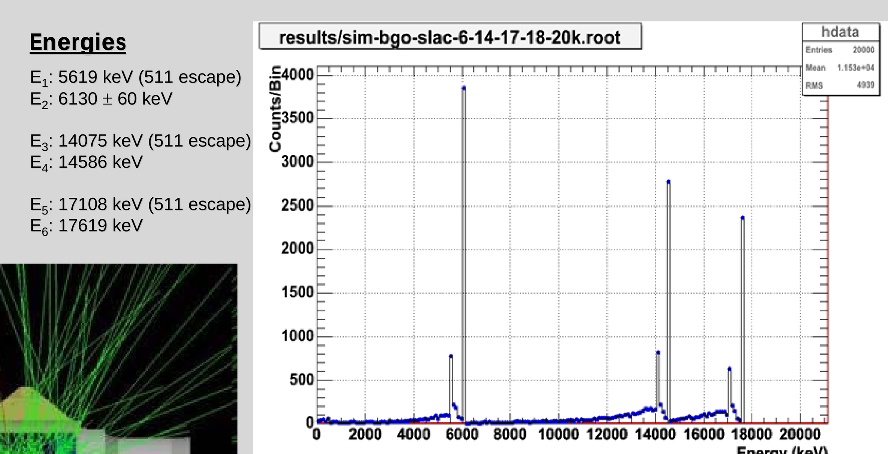
p(~ 340 keV) + $^{7}Li \rightarrow ^{8}Be\ (1+)^{*} \rightarrow ^{8}Be + \gamma$ (14.6 or 17.6 MeV)
→ 14.6 MeV line is intrinsically broader than detector resolution!

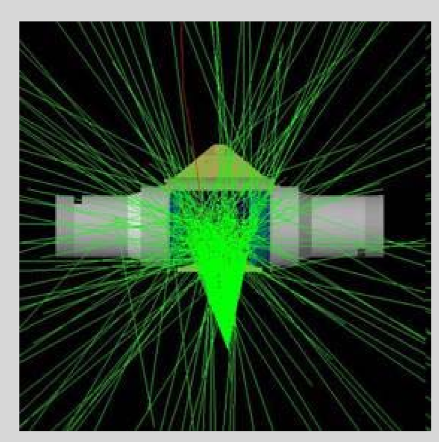
p (340 keV) + $^{19}F \rightarrow ^{16}O^{*} + \alpha \rightarrow ^{16}O + \gamma$ (6.1 MeV)

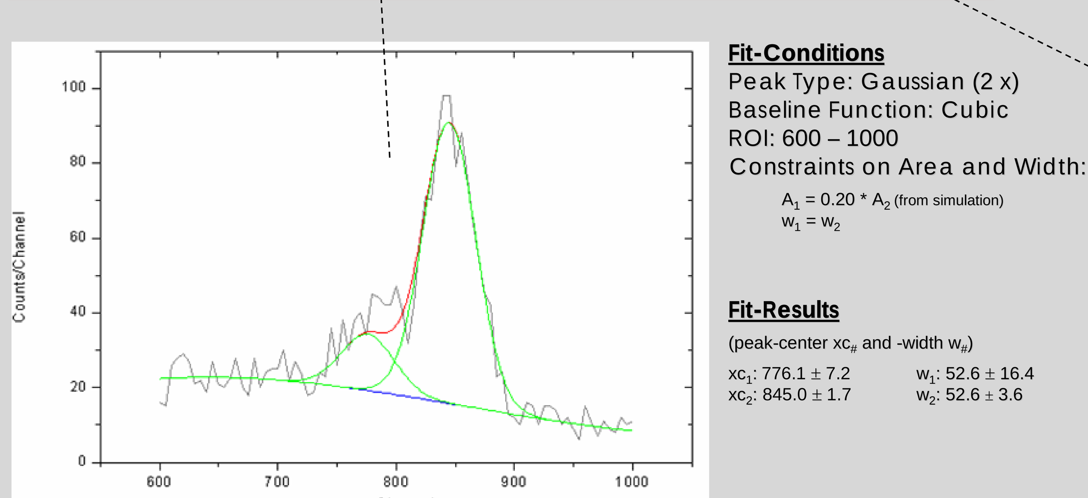


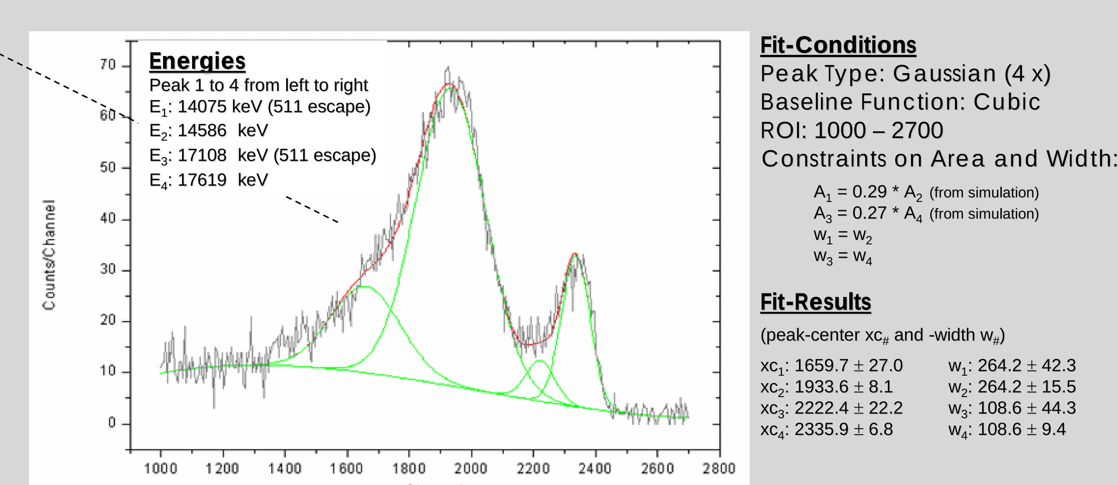
<u>Simulations:</u>

– Purpose: Determination of the photo-peak / escape-peak ratio
– Ratio will be used as constraint for the peak area in the fits!



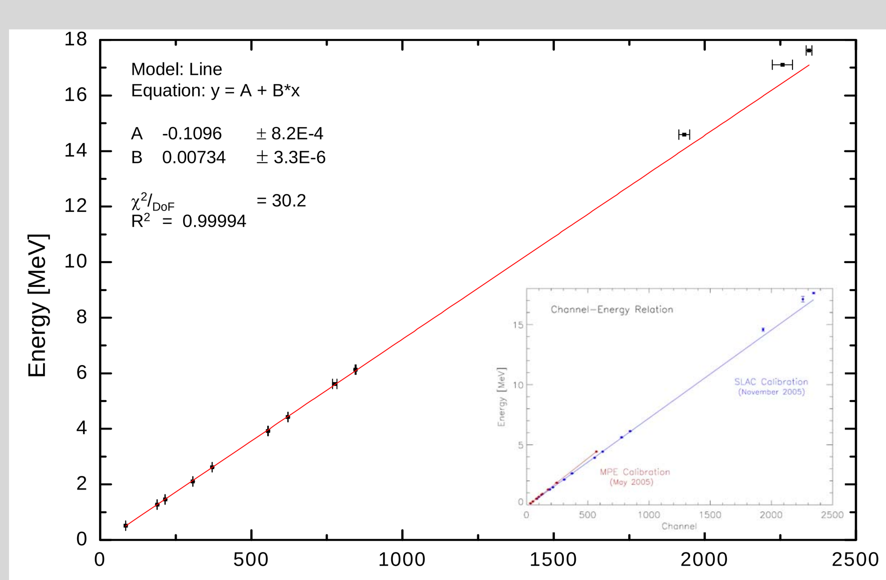


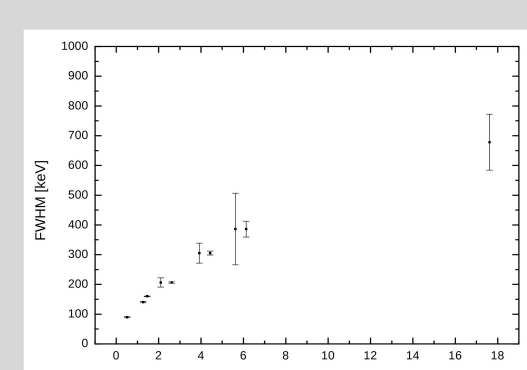


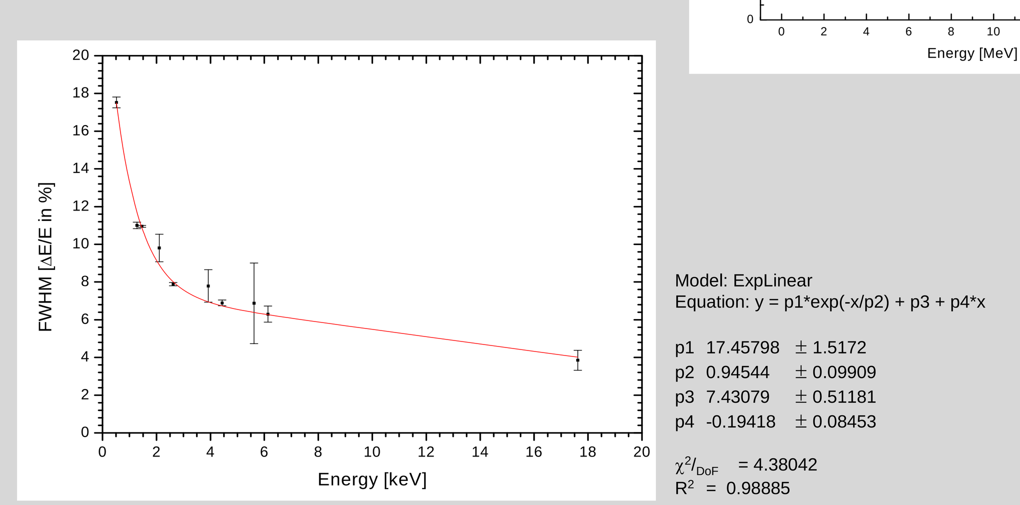


Calibration Results:

The channel-to-energy conversion and linearity of the BGO detector (EQM only) and the resolution FWHM (abs./rel.) of the detector at various energies.







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