Figure 7.2: $N_{\text{hits}}$ and $N_{\text{pe}}$ energy calibration curves for monoenergetic gamma rays. The $N_{\text{hits}}$ and $N_{\text{pe}}$ distributions for each gamma-ray energy are fitted to a Gaussian distribution. (a) energy dependence of $N_{\text{hits}}$; (b) detector resolution dependence on gamma-ray energy calculated based on $N_{\text{hits}}$ distributions; (c) $N_{\text{pe}}$ dependence on gamma-ray energy; (d) detector resolution dependence on gamma-ray energy calculated based on $N_{\text{pe}}$ distributions. The degradation of the detector resolution calculated based on $N_{\text{pe}}$ is a consequence of the convolution of the charge resolution of the photomultiplier tubes to the $N_{\text{hits}}$ spectrum. The lines are linear and quadratic fits to the energy calibration curve, with the quadratic curve giving a slightly better fit. The “improvement” in energy resolution at $E \leq 3$ MeV is an artifact of the 10-hit hardware threshold.
Neutron Captures on Gd vs. Concentration

Fraction of Captures on Gd

Percentage of Gd by Mass in Water

10^{-4} 10^{-3} 10^{-2} 10^{-1} 1
At Super-K, a calibration source using GdCl$_3$ has been developed and deployed inside the detector:

Am/Be source
\[ \alpha + ^9\text{Be} \rightarrow ^{12}\text{C}^* + n \]
\[ ^{12}\text{C}^* \rightarrow ^{12}\text{C} + \gamma(4.4 \text{ MeV}) \]

Inside a BGO crystal array

(BGO = Bi$_4$Ge$_3$O$_{12}$)

Suspended in 2 liters of 0.2% GdCl$_3$ solution
Data was taken for the first time earlier this year.

We’ve made the world’s first spectrum of GdCl$_3$’s neutron capture gammas producing Cherenkov light!

More study (and data) needed, but a really promising early result!

Also, first GdCl$_3$ “in” SK!