Deconvolution

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Tuesday 2nd May, 2017

Introduction

- **Spectrum measured from physical experiments are usually distorted and transformed by different detector effects.**

- **In order to get true photon spectrum from the measured one, it is necessary to take into account these effects by deconvolution/Unfolding technique.**

- **The measured spectrum is connected by response function by following expression,**

$$M(E) = R(E, E_o)\, T(E_o) \qquad (2)$$

$$T(E_o) = R^{-1}(E, E_o)\, M(E) \qquad (3)$$

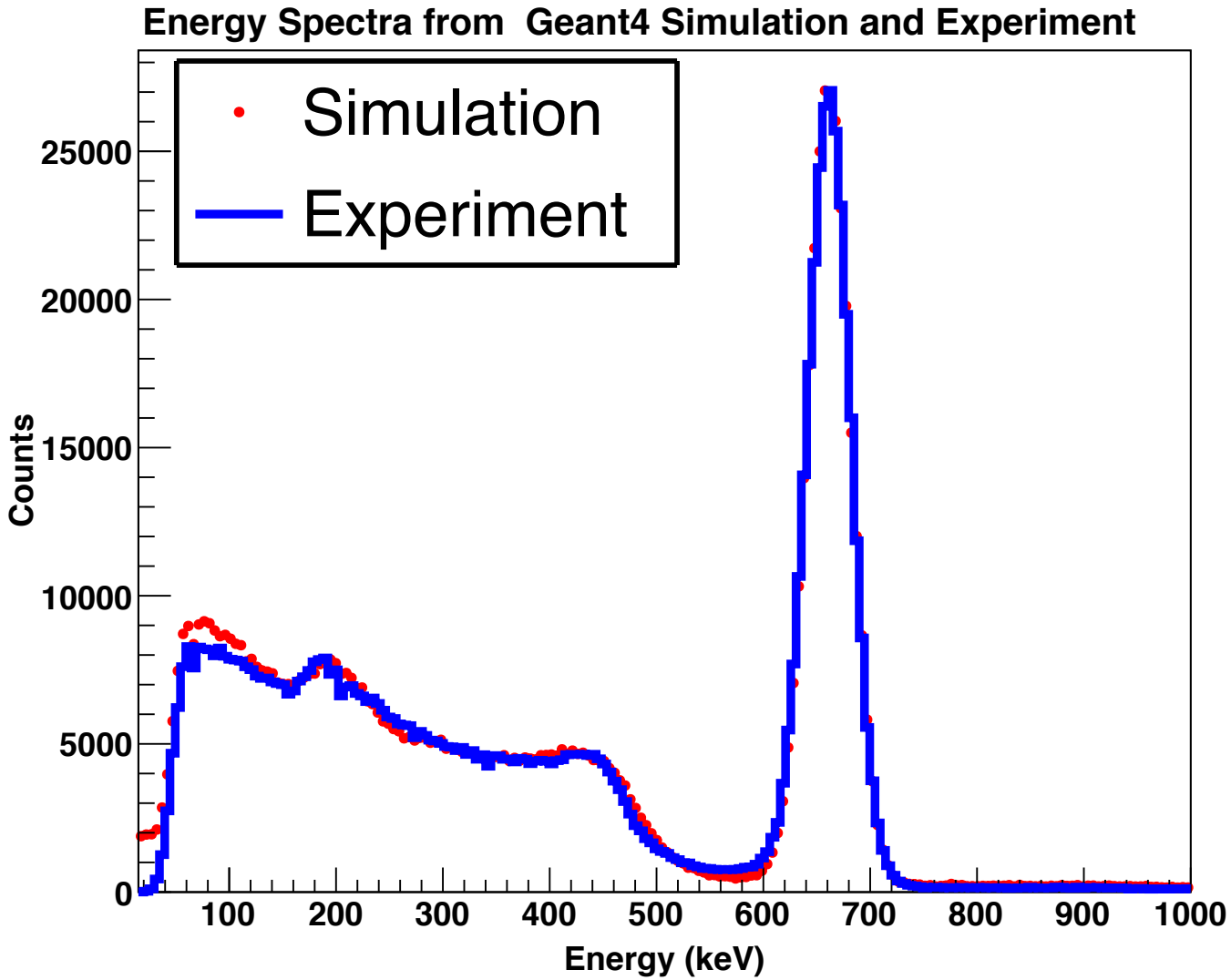
Where;
T=True gamma ray spectrum
M=Measured spectrum
R=Detector response function

- **For the unfolding method described in equation 3, the response function R (E, E_0) should have many energy points.**

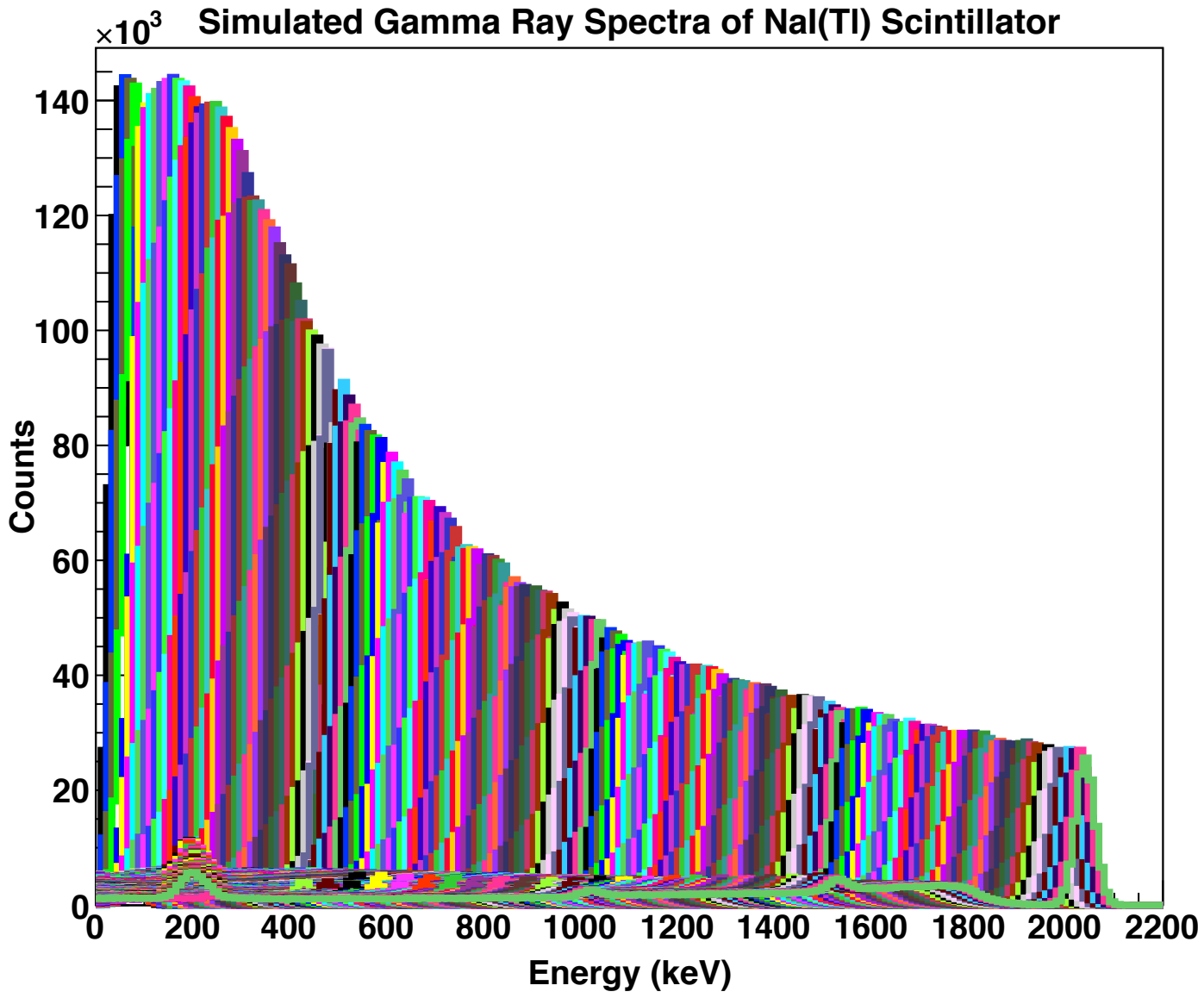
- **Therefore, in this study we used Monte Carlo method for $E\gamma$ = 0.050 - 2.04 MeV.**

- **To check the validity of the simulated results we compare the experiment and simulated spectra obtained from ^{137}Cs source as depicted in Fig. 1.**

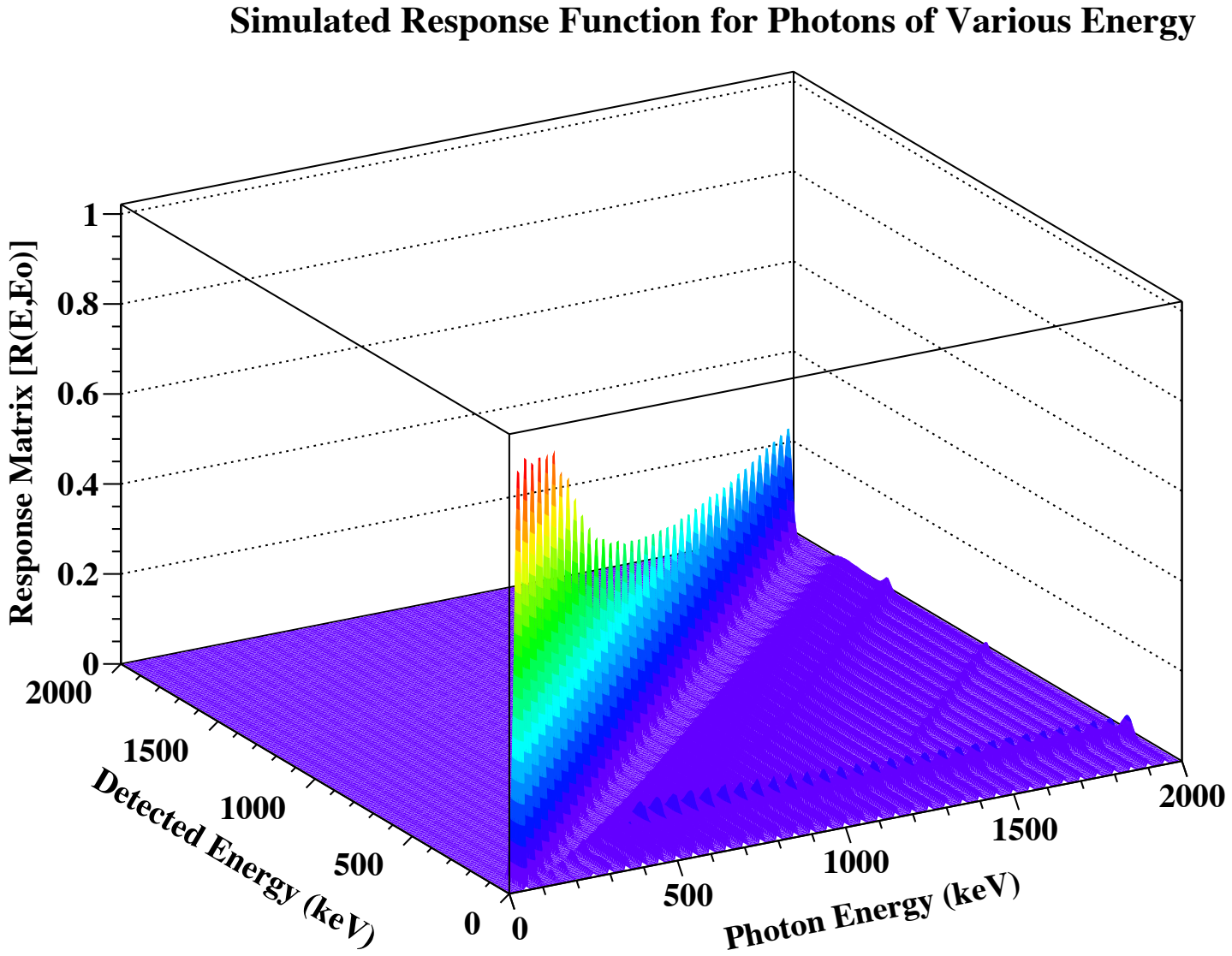
Results and Discussions



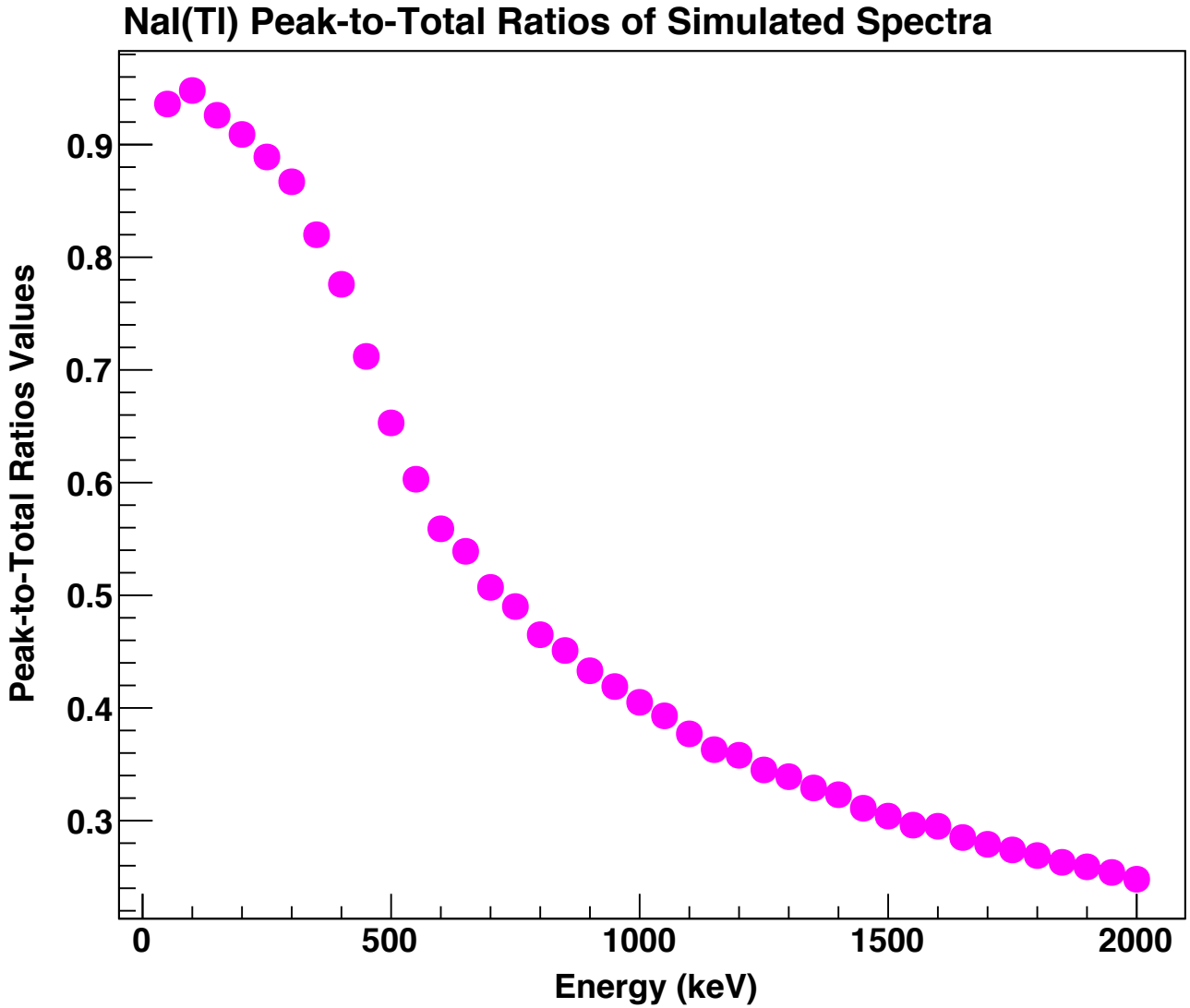
- **Good agreement is observed between measured and simulated spectra.**



- **PHD from 200 mono-energetic gamma ray from 50 keV to 2040 keV in the interval of 10 keV.**



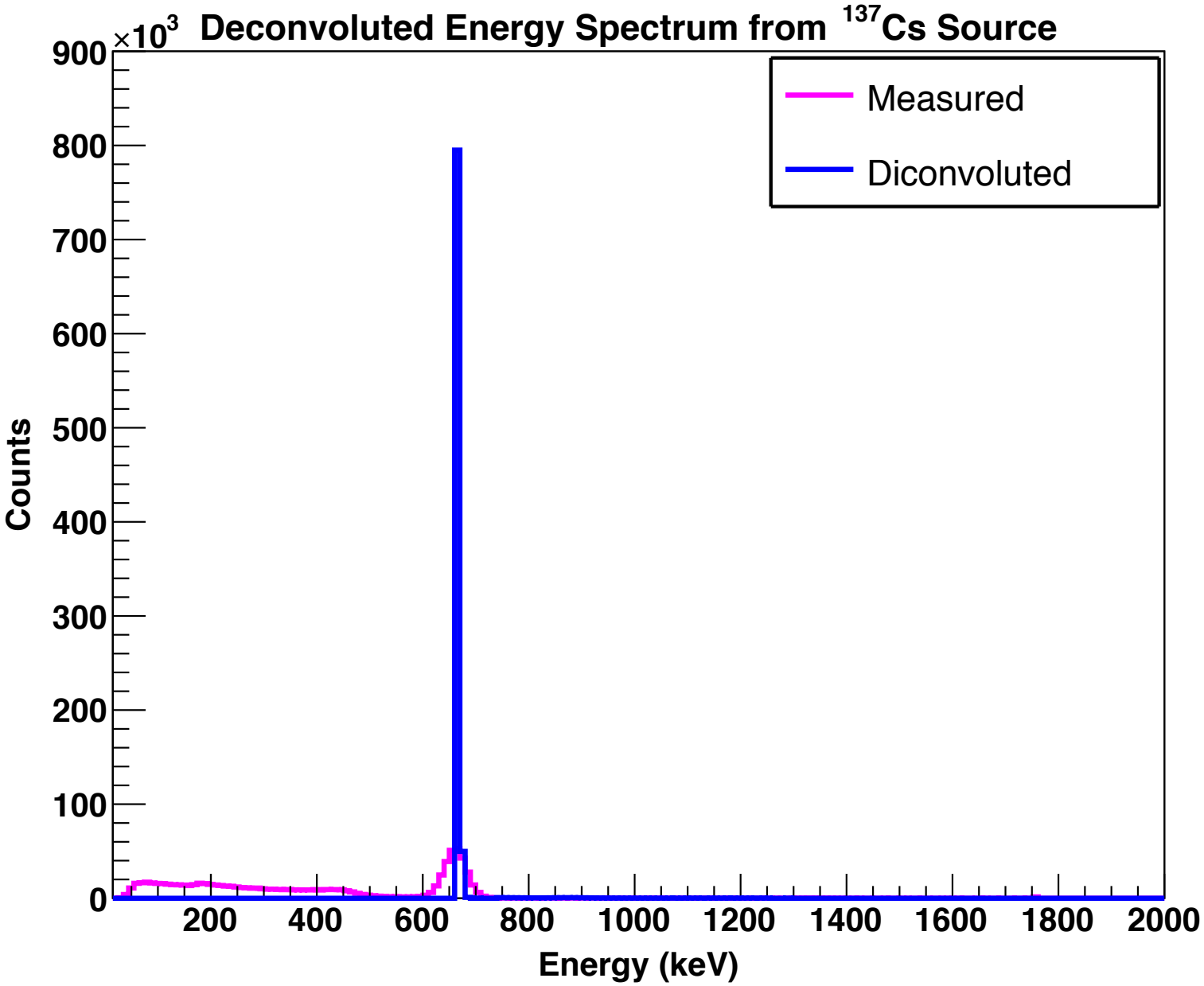
- **Example of NaI(Tl) response matrix $R(E,E_o)$ for photons of various mono energetic energies (in 2D histogram).**



- **The P/T curve describes the probability a photon energy E_o, when detected, is completely absorbed.**
- **P/T ratio gives the diagonal element of the response matrix.**

Inverted matrix result

- **Formation of 200 by 200 detector response matrix.**
- **The obtained matrix was inverted and the results confirmed with the measured spectrum (^{137}Cs).**
- **The results shows that P/T before and after inverted matrix are 0.53 and 0.93 in the photo-peak of the measured spectrum (0.40 increment).**
- **Using direct matrix inversion,there is significant improvements of the peak-to-total ratio.**


Deconvoluted Energy Spectrum from ^{137}Cs Source
$\times 10^3$
900
800
700
600
500
400
300
200
100
0
Counts
200
400
600
800
1000
1200
1400
1600
1800
2000
Energy (keV)
Measured
Diconvoluted

^{60}Co Gamma ray Spectrum

- **The results in ^{60}Co shows that P/T before inverted matrix are 0.33 and 0.25 for energies 1173 and 1332 keV respectively.**

- **Using obtained inverted matrix,the results in ^{60}Co shows that P/T after inverted matrix application are 0.53 and 0.42 for energies 1173 and 1332 keV respectively.**