Response Function of NaI(Tl) Detector and Response Matrix

The crystal size of NaI(Tl) used in this simulation is 2 inches by 2 inches = 5.08 cm by 5.08 cm

15th March, 2017

Introduction

- **Distributions measured in physical experiments are usually distorted and transformed by different equipment effects.**

- **In order to reproduce the real spectrum from the measured one, it is necessary to take into account these effects by the means of the response function.**

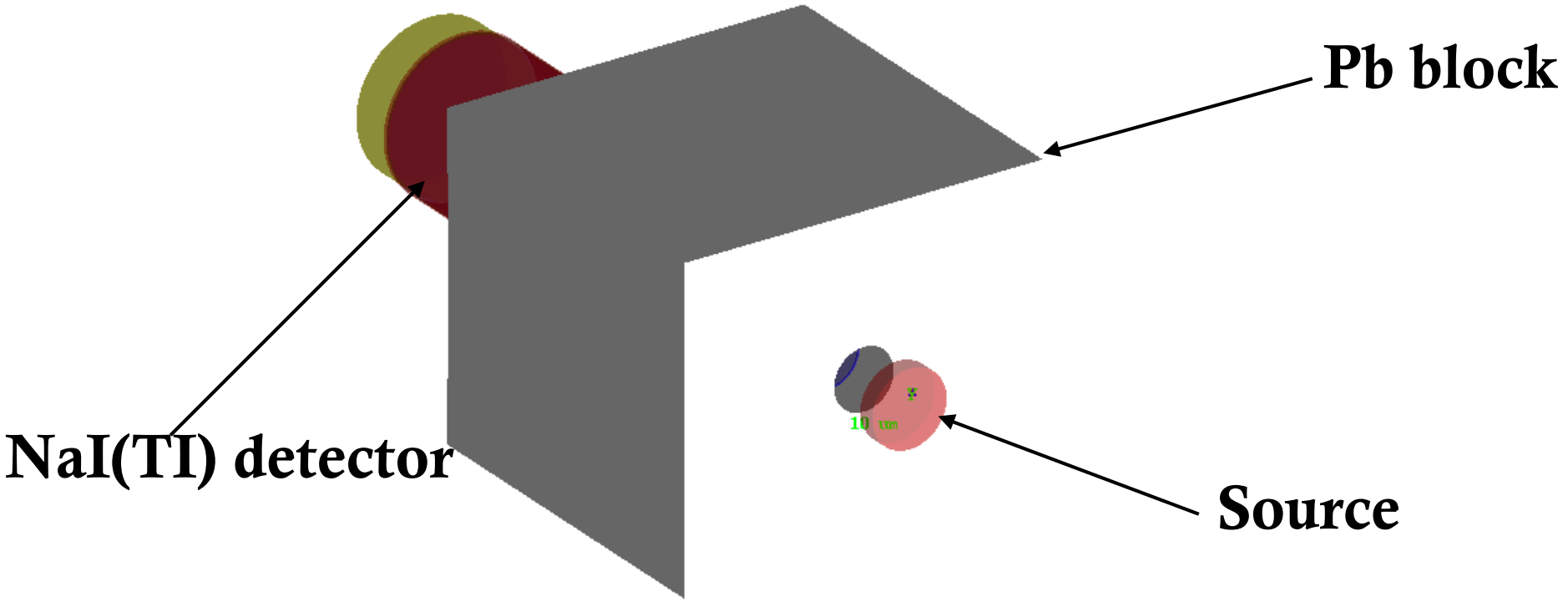
- **Normally this response function can be approximated by a response matrix, as obtaining the following expression,**

$$m = RI$$

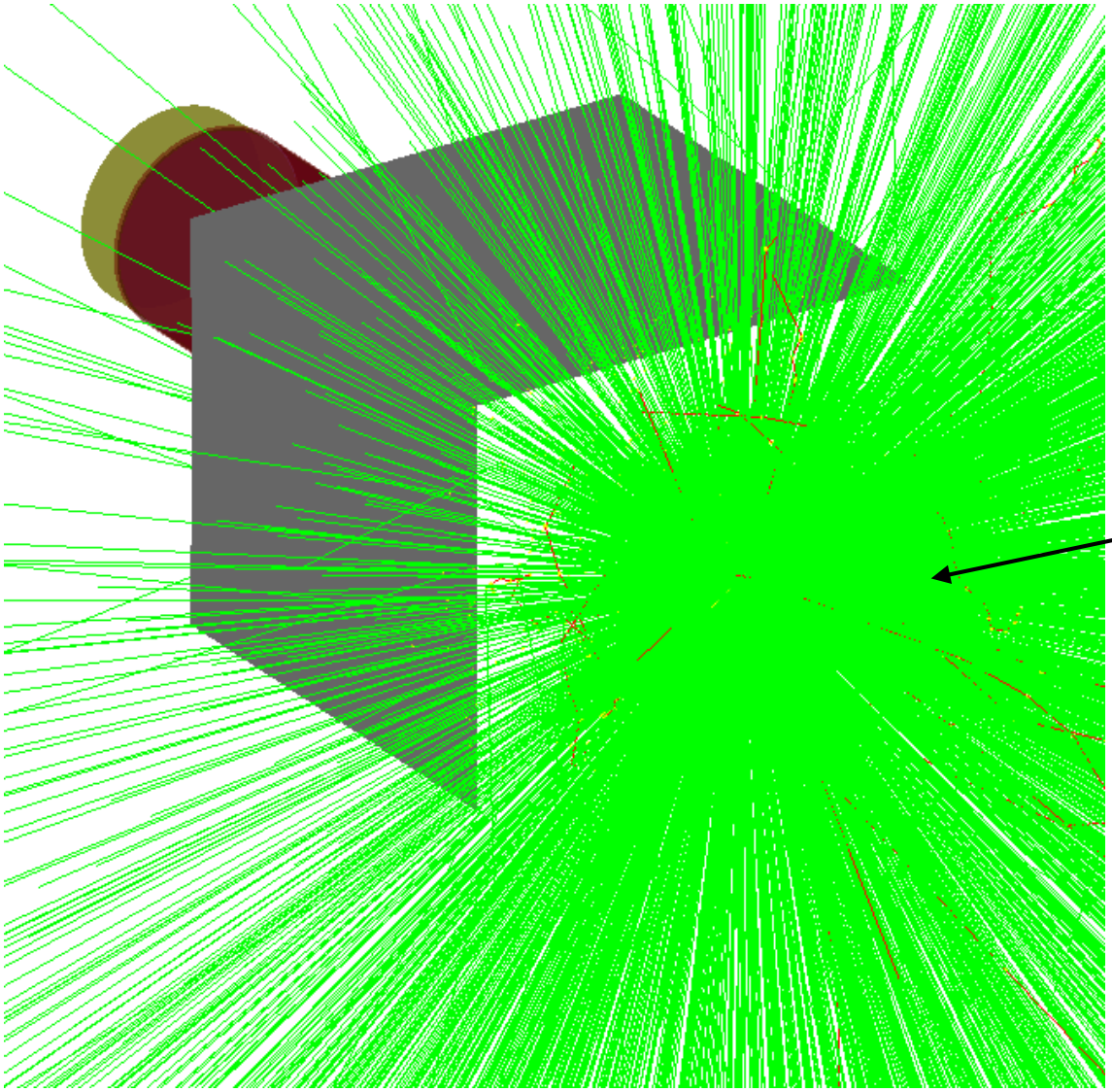
- **But we are interested with I, therefore**

$$I = mR^{-1}$$

Simulation Geometry

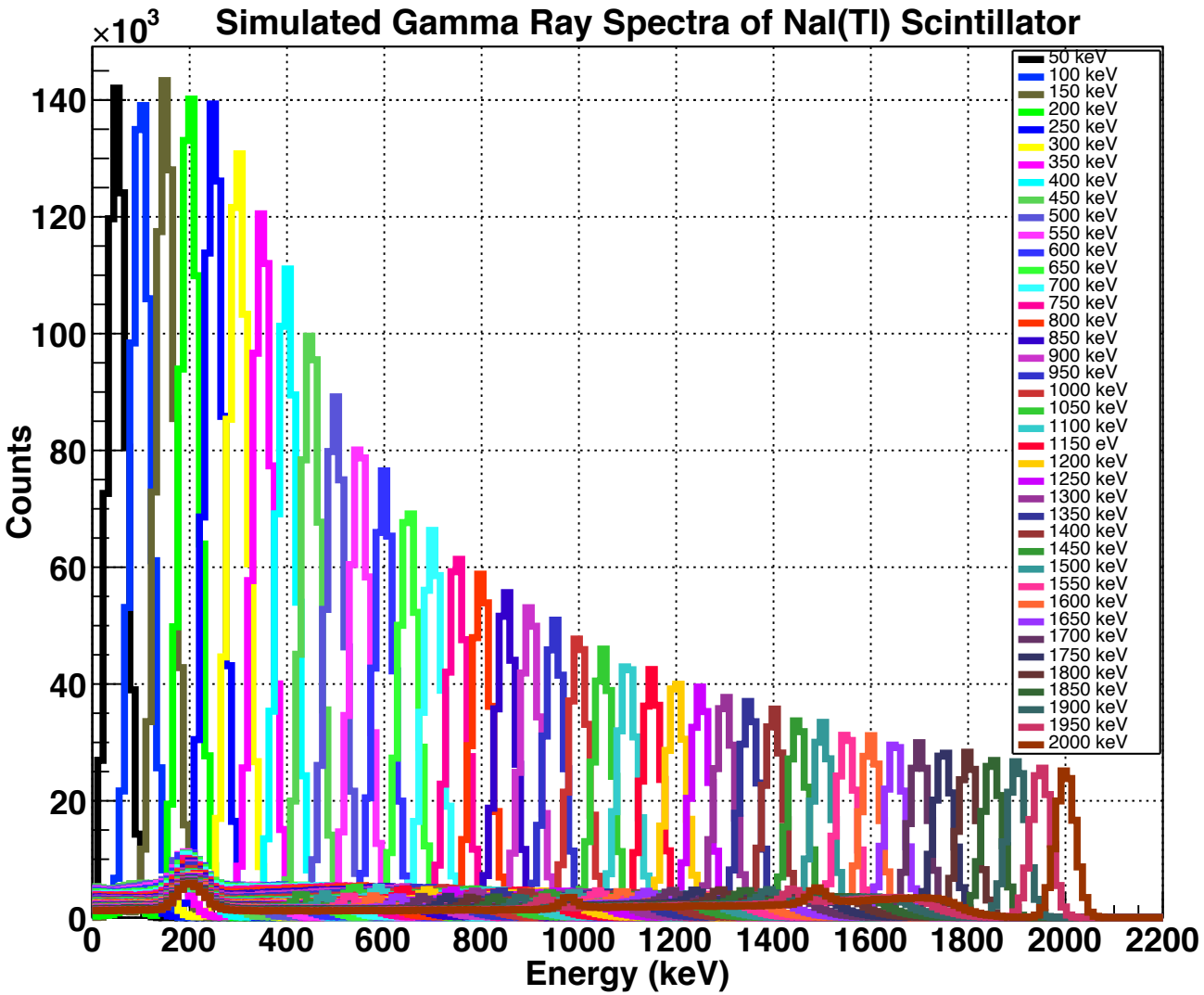


- **The distance from the source to the Pb block front surface is 3cm while the thickness of lead block to the surface of NaI(Tl) crystal is 3cm.**



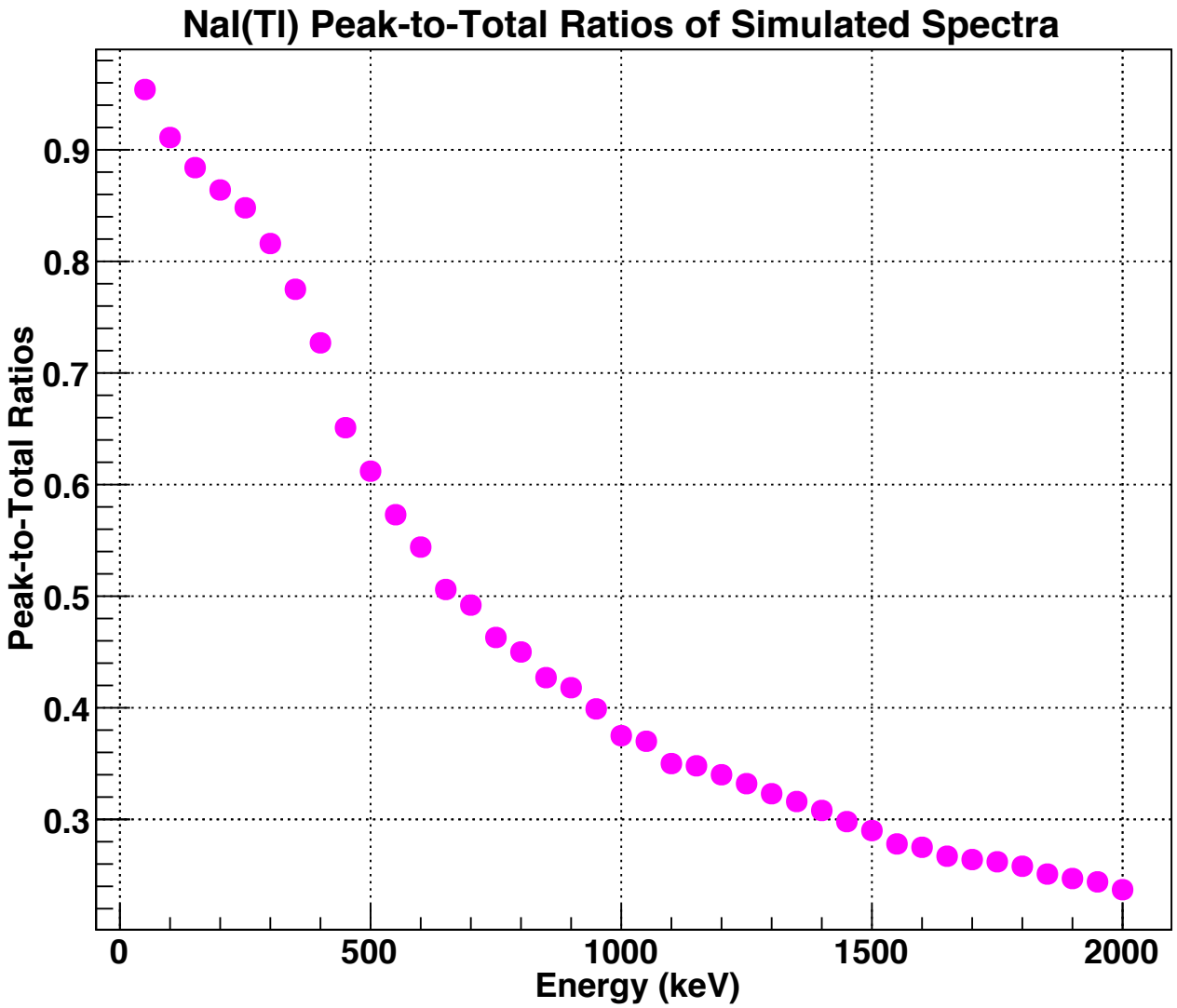
- **The figure display the real events display from Geant4 simulation**

Results and Discussions



chi square fit

- **Gamma ray from 50 keV to 2000 keV in the interval of 50 keV was used to reproduced photo-peaks.**



- **The P/T curve describes the probability a photon energy K', when detected, is completely absorbed.**
- **P/T ratio gives the diagonal element of the response matrix.**

Response matrix and Inverse response matrix

- **The response matrix elements.**

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# MATRIX M

4x4 matrix is as follows

     |      0    |      1    |      2    |      3    |
-------------------------------------------------------
   0 |      0.954           0           0           0
   1 |      0.126       0.911           0           0
   2 |      0.009       0.082       0.884           0
   3 |      0.004       0.019       0.112       0.864

###
# MATRIX Minv

4x4 matrix is as follows

     |      0    |      1    |      2    |      3    |
-------------------------------------------------------
   0 |      1.048          -0          -0          -0
   1 |     -0.145       1.098          -0          -0
   2 |   0.002776     -0.1018       1.131          -0
   3 |  -0.002025    -0.01094     -0.1466       1.157
```

- **The matrix describes the probability a photon of energy K' that reached the detector is detected as having an energy K.**

Summary

- **Incorrect physical data are obtained from an analysis of recorded gamma-ray spectra, without application of unfolding methods.**
- **Analysis of data obtained in the experiments requires accurate knowledge of the shapes of the response functions for a range of gamma ray energies.**
- **In this context, the conversion of observed measured distribution to a true photon energy spectrum is essentially required.**