

# Compton scattering

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## I. INTRODUCTION

## II. THEORY

### II.1. Inelastic scattering of photon

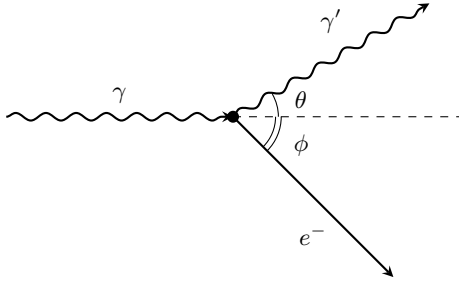


FIG. 1. Compton scattering of a photon by an electron.  $\gamma$  and  $\gamma'$  are the incident and scattered photons.  $e^-$  is the recoil electron initially at rest.  $\theta$  and  $\phi$  are the scattering and recoil angles, respectively.

Following relativistic kinematics, we treat photons as massless particles of energy  $E_\gamma = h\nu$ , where  $h$  is the Planck constant and  $\nu$  is the photon frequency. The energy of an electron is given by  $E_e = \sqrt{m_e^2 c^4 + p_e^2 c^2}$ , where  $m_e$  is the electron rest mass,  $p_e$  is the electron momentum, and  $c$  is the speed of light. By conservation of energy  $E$  and momentum  $\vec{p}$ , we have

$$E_\gamma + E_e = E'_\gamma + E'_e, \quad (1)$$

$$\vec{p}_\gamma + \vec{p}_e = \vec{p}'_\gamma + \vec{p}'_e, \quad (2)$$

where the prime denotes the final state. For simplicity, we take the initial electron energy as  $E_e = m_e c^2$ , that is the particle is initially at rest. Solving Equations (1) and (2), we obtain the energy of the scattered photon as

$$E'_\gamma = \frac{E_\gamma}{1 + \frac{E_\gamma}{m_e c^2} (1 - \cos \theta)}, \quad (3)$$

with  $\theta$  being the scattering angle, i.e. the angle between the initial and final photon momenta. The kinetic energy of the recoil electron is then approximated as  $E'_e = E_\gamma - E'_\gamma$ . The scattering scheme is illustrated in Figure 1.

$\theta$ [deg]	Counting Time [s]	Total Time [s]	Collection Date [YYYY-MM-DD]
0	964	1012	2025-03-04
30	1194	1224	2025-03-04
60	1619	1658	2025-03-04
90	1856	1900	2025-03-04
120	1706	1736	2025-03-04
15	1354	1522	2025-03-06
45	1333	1455	2025-03-06
75	1954	2058	2025-03-06
105	1645	1727	2025-03-06
135	1341	1431	2025-03-06

TABLE I.

### II.2. Differential cross section

### II.3. Total cross section & Attenuation

## III. EXPERIMENT SETUP

### III.1. Apparatus

### III.2. Data Collection

## IV. ANALYSIS & RESULTS

### IV.1. Energy-angle dependency

### IV.2. Scattering rate

## V. DISCUSSION & CONCLUSION

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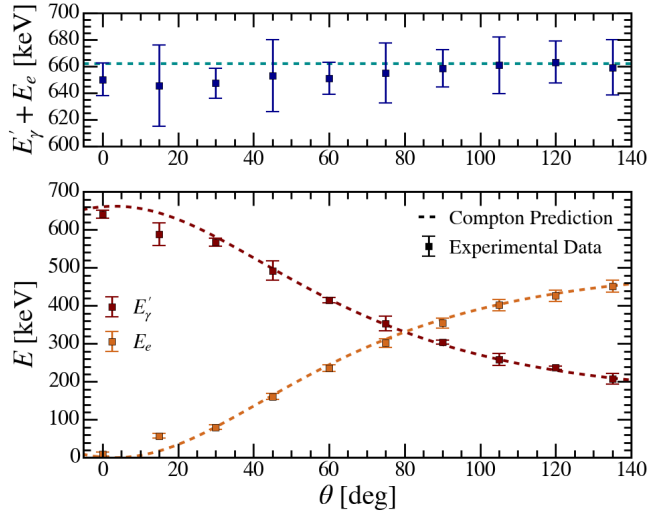


FIG. 2.

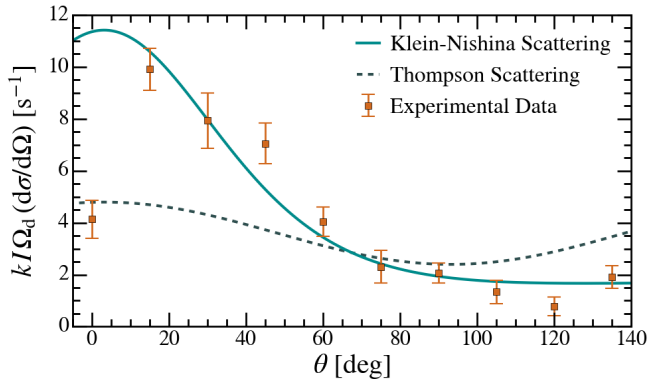


FIG. 3.

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## Appendix A: Energy Calibration

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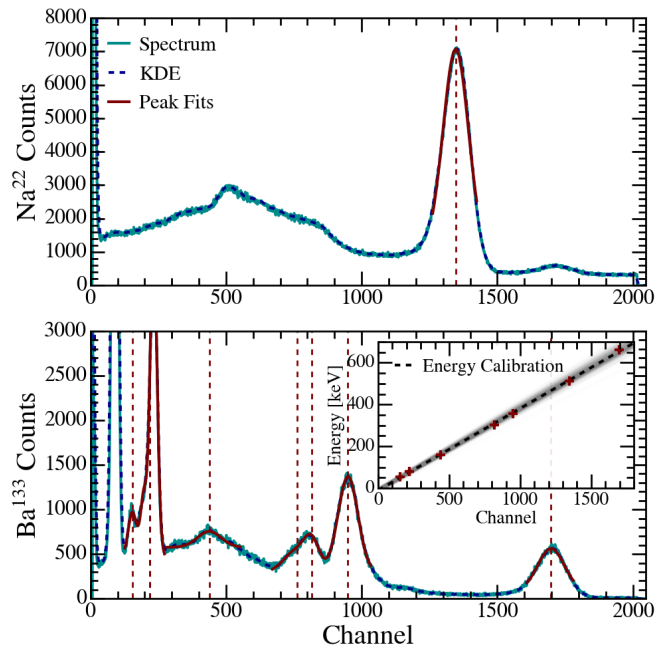


FIG. 4.