

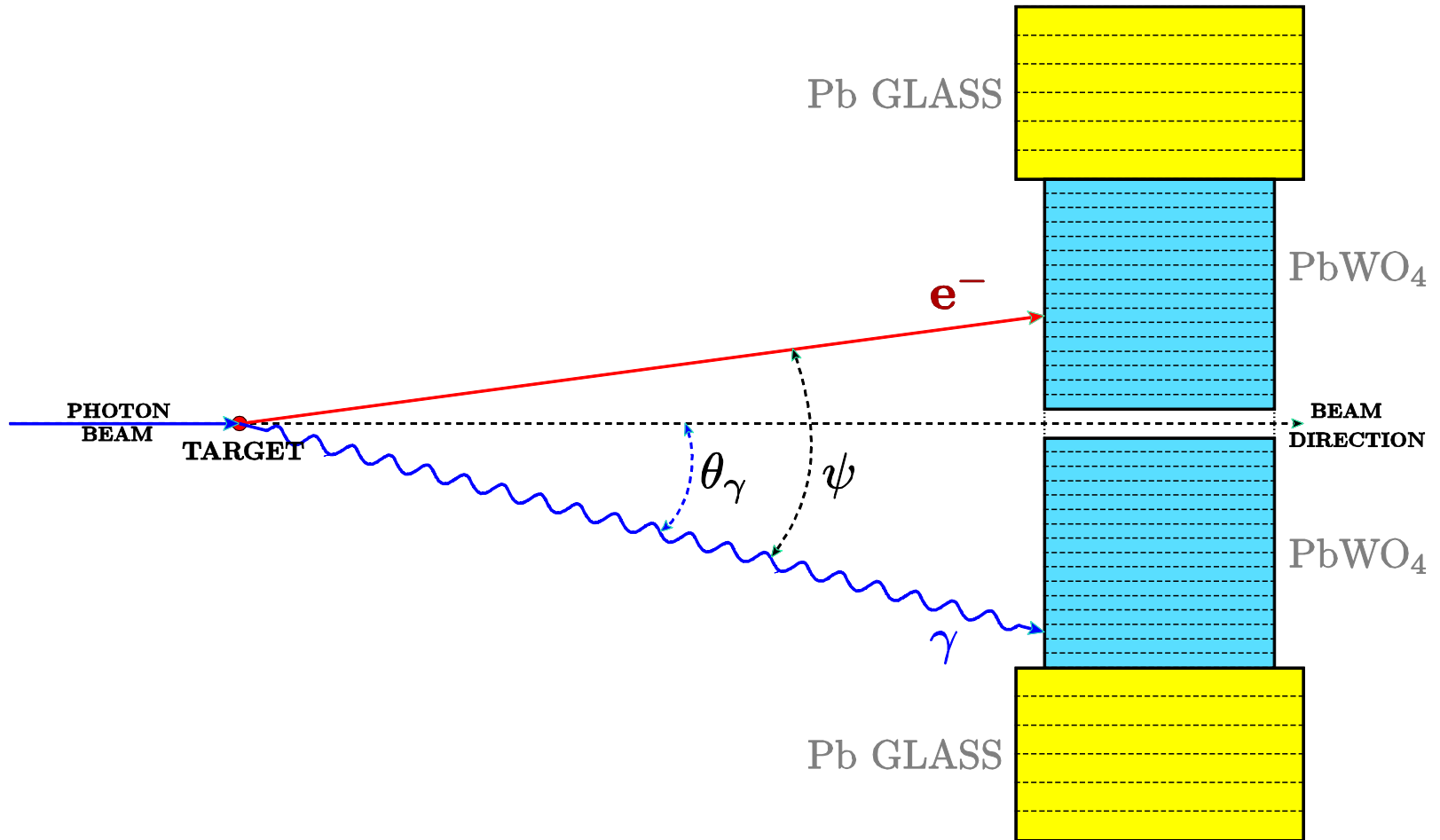
# COMPTON ANALYSIS REPORT

**PAWEL AMBROZEWICZ**  
**NC A&T**

## **OUTLINE:**

- **Extraction Procedure**
- **Uncertainties**
- **Summary**

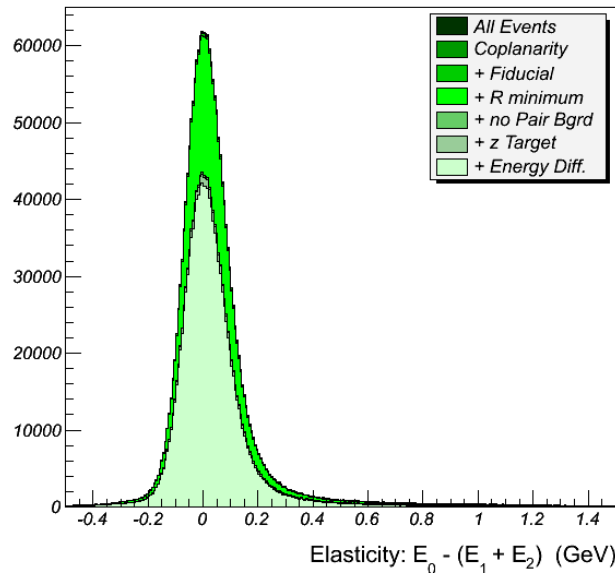
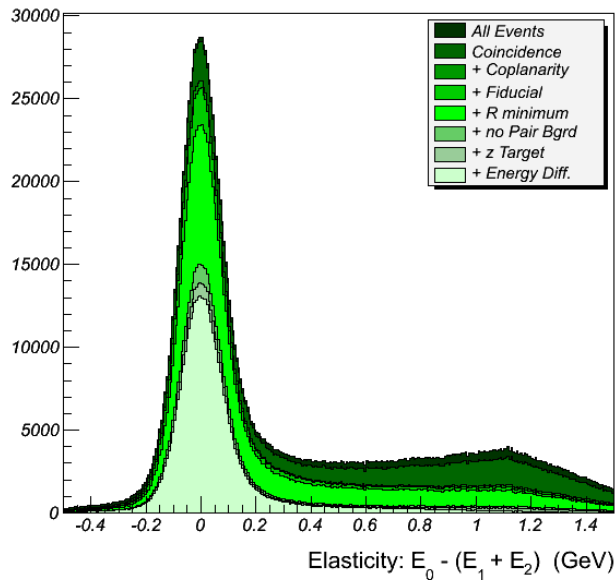
# COMPTON EVENT



# DATA REDUCTION

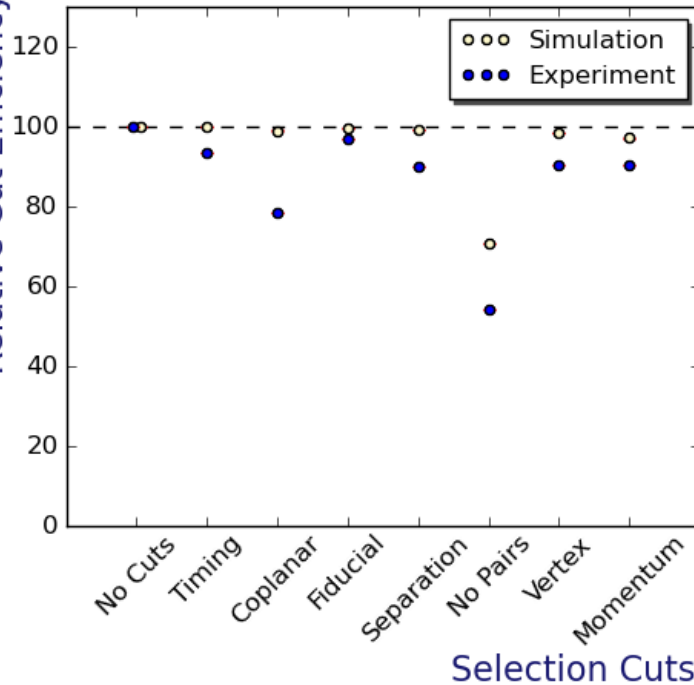
## STATISTICS:

- Initial - ~1.5M
- Compton - ~0.5M

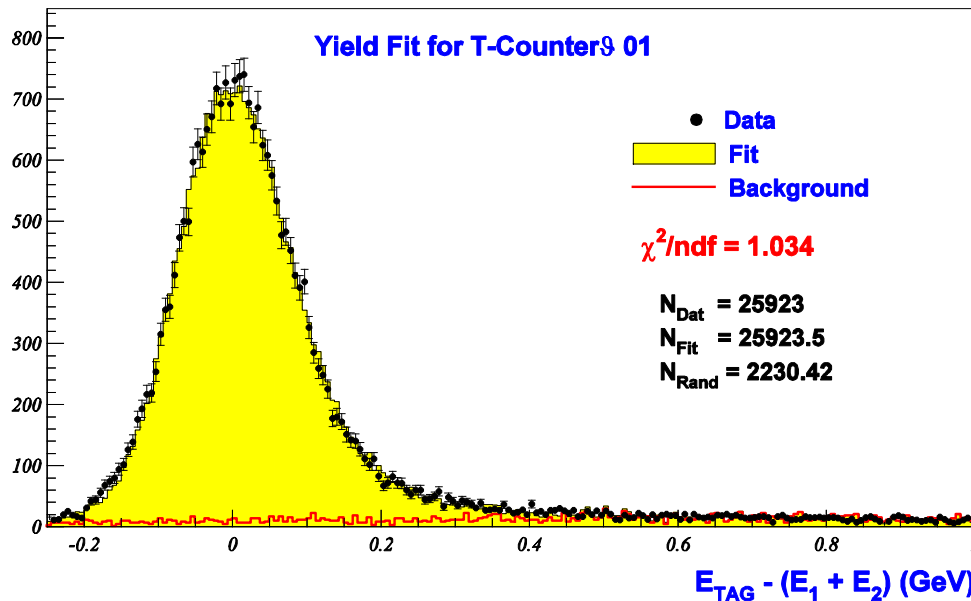


Relative Cut Efficiency (%)

### Data Reduction



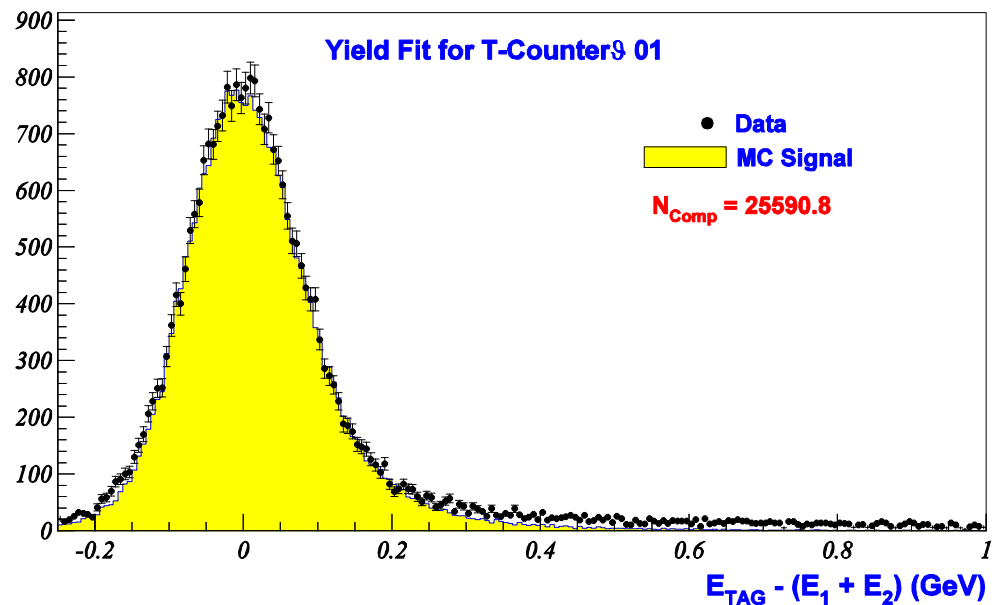
# LINE SHAPE YIELD FITS



- Excellent theory calculation
- Very good apparatus simulation
- Data background model
- Superior fitting procedure

Elasticity offers perfect features to carry out the fit:

- peaked distribution
- radiative effects signature



# CROSS SECTION EXTRACTION PROCEDURE

Unradiated Differential Cross Section

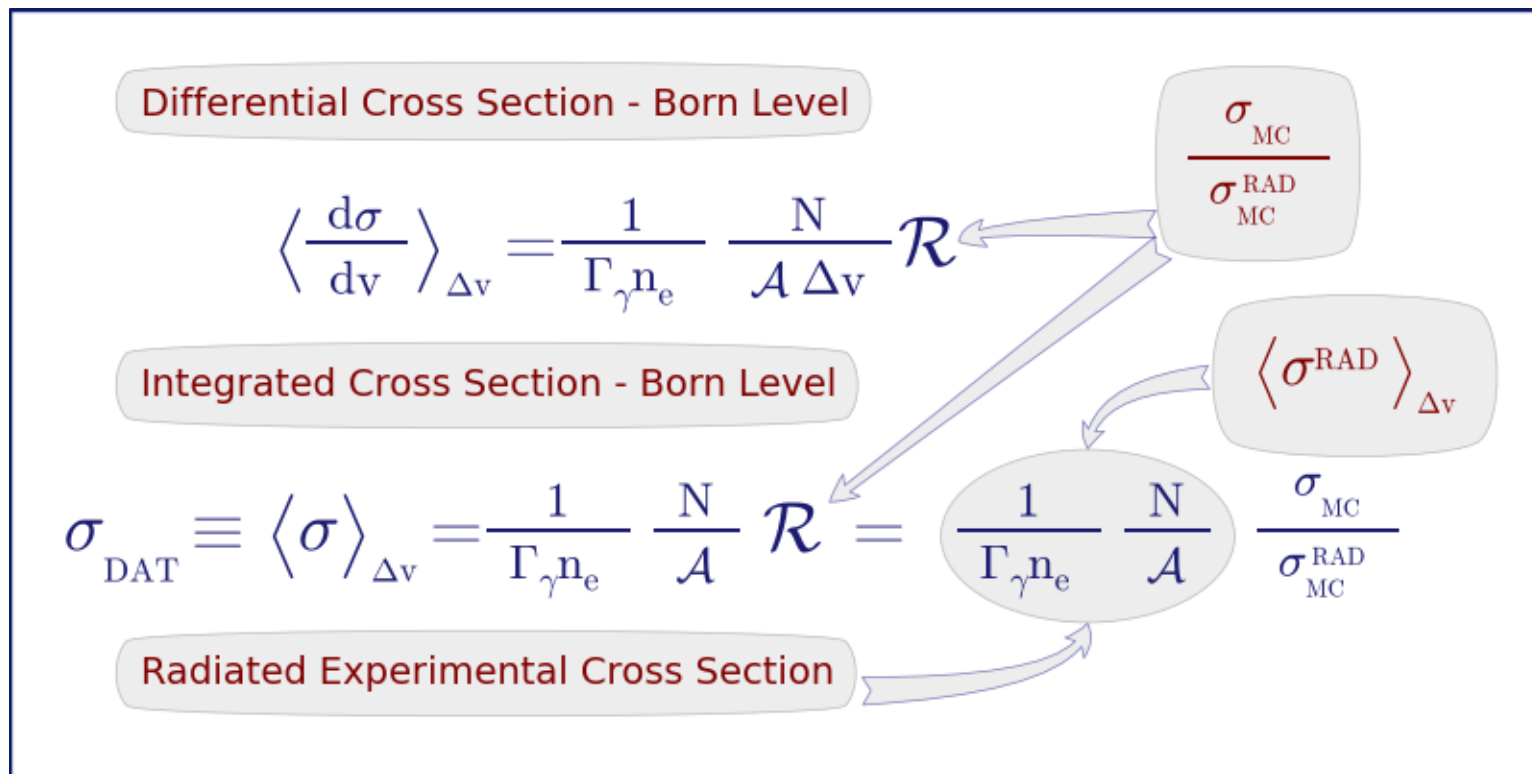
$$\left\langle \frac{d\sigma}{dv} \right\rangle = \frac{1}{\Gamma_\gamma n_e} \frac{N}{A \Delta v} \mathcal{R}$$

$$\frac{N_1(v_{\text{det}})}{N_0(\Delta v)}$$

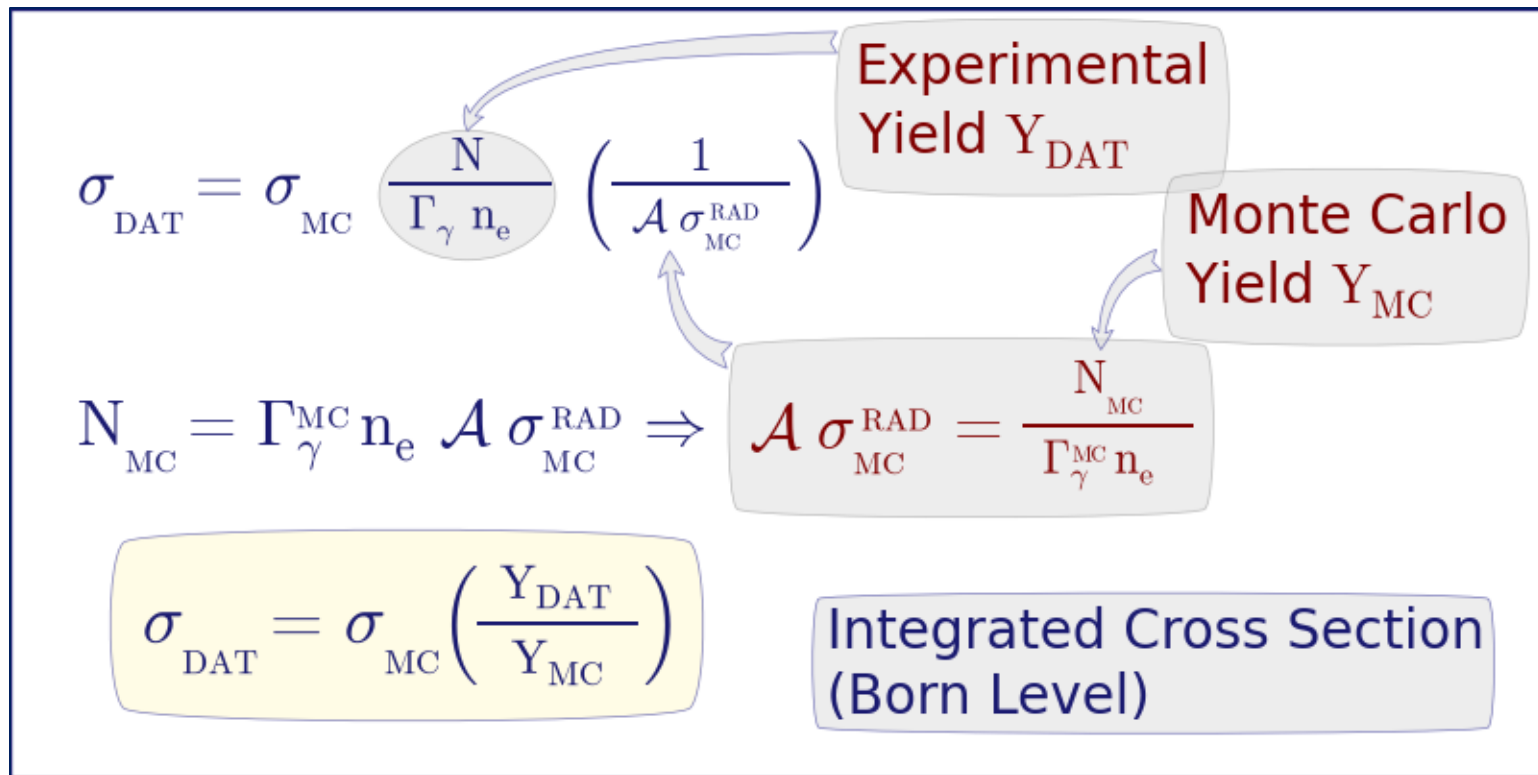
Radiative Correction Factor

$$\mathcal{R} \equiv \frac{\int_{\Delta\Omega} \frac{d\sigma}{d\Omega} d\Omega}{\int_{\Delta\Omega \times \Delta k''} \frac{d\sigma}{d\Omega dk''} d\Omega dk''} = \frac{\sigma_{\text{MC}}}{\sigma_{\text{MC}}^{\text{RAD}}}$$

# CROSS SECTION EXTRACTION PROCEDURE



# CROSS SECTION EXTRACTION PROCEDURE



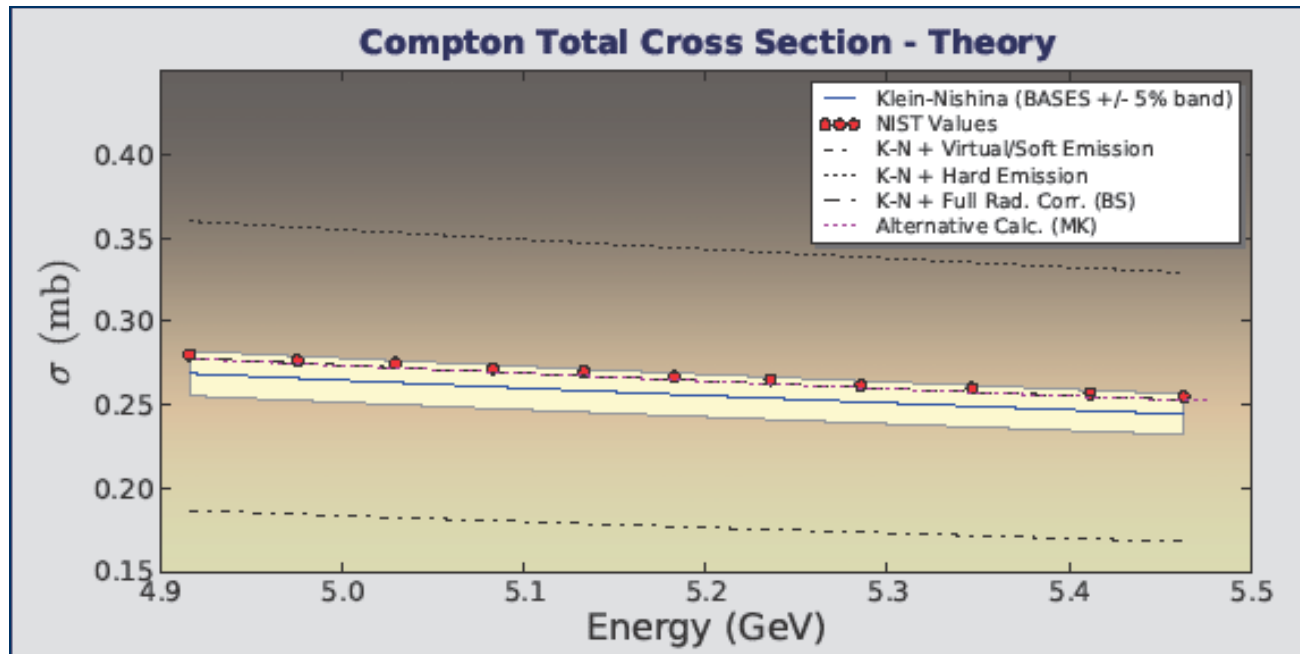
# CROSS SECTION EXTRACTION PROCEDURE

## TOTAL CROSS SECTION

$$\left\langle \frac{d\sigma}{dv} \right\rangle = \frac{1}{n_e \Gamma_\gamma \mathcal{A}_{exp}} \frac{N}{\Delta v}$$

## FORWARD SOLID ANGLE CROSS SECTION

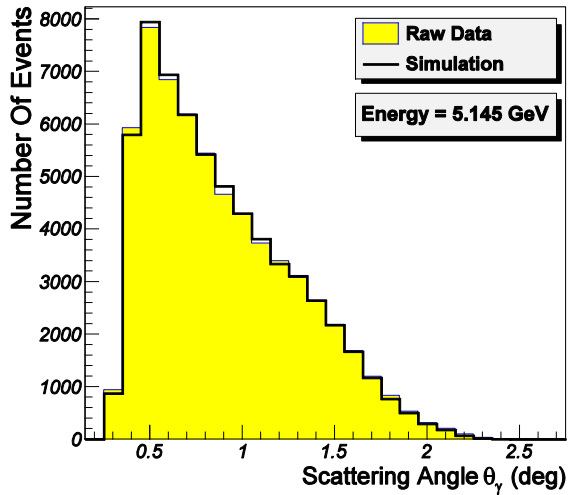
$$\sigma_{DAT} = \sigma_{KN} \frac{Y_{DAT}}{Y_{MC}}$$



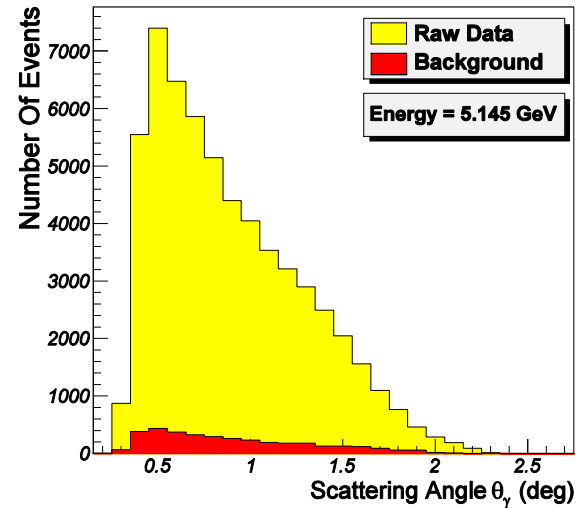


# DIFFERENTIAL CROSS SECTION

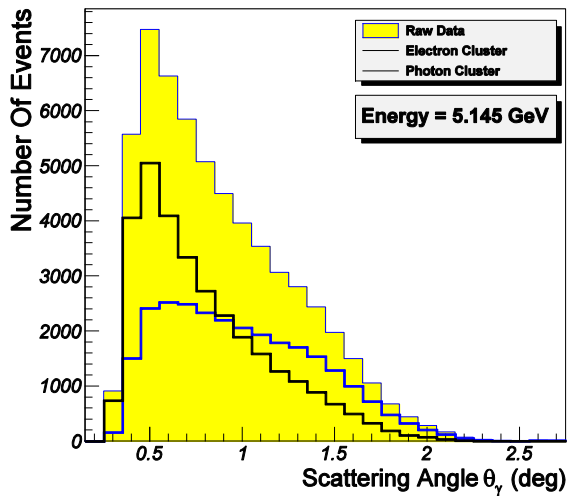
Two Cluster Angular Distributions



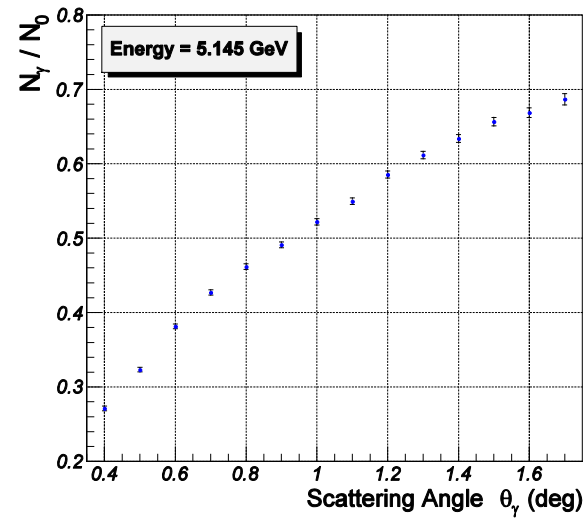
Signal/Background Distributions - Data



Electron And Photon Angular Distributions

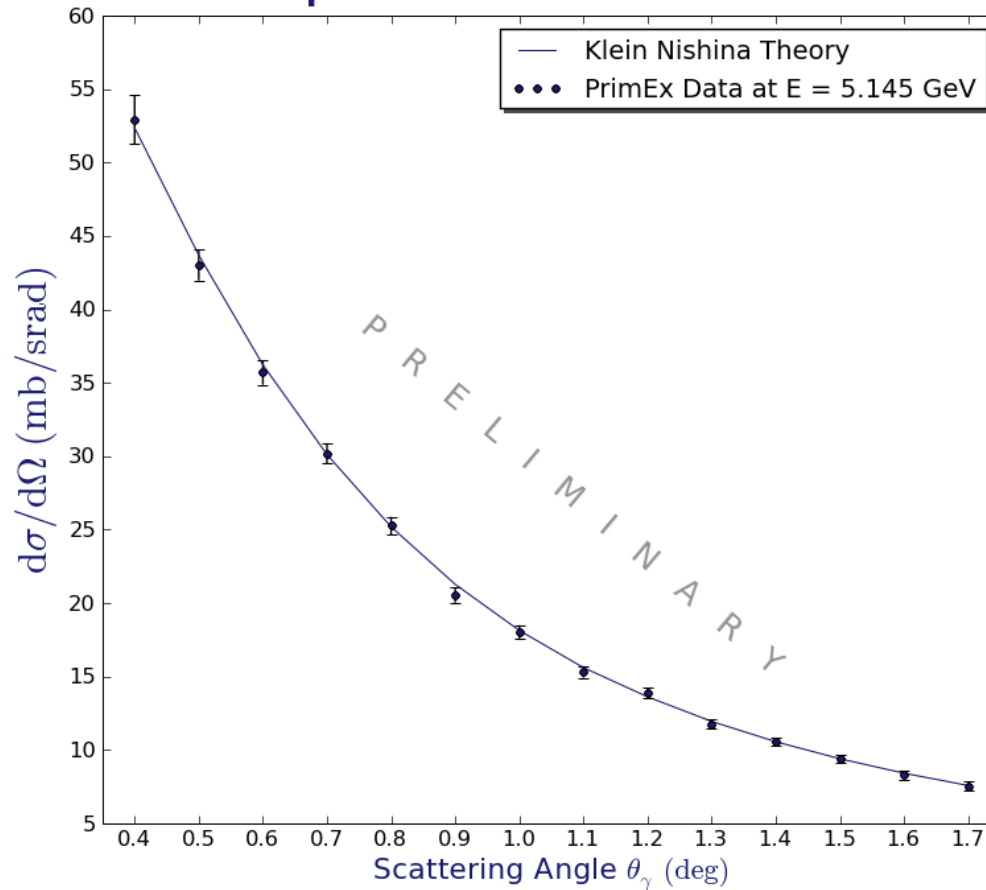


Relative Number Of  $\gamma$ 's Per  $\theta_\gamma$  Bin



# DIFFERENTIAL CROSS SECTION

## Compton Differential Cross Section



# UNCERTAINTIES

TCtr	Flux	Tgt	Selection Cuts					Fit	HyCal	Errors		
			$\Delta T_{coin}$	$\Delta\phi$	Rad. Tail	Sg/Bg	Geom.		Res.Fn.	Syst.	Stat.	Total
<b>1</b>	1.0	0.05	0.09	0.07	0.045	0.81	0.64	0.063	0.5	<b>1.53</b>	<b>0.88</b>	<b>1.77</b>
<b>2</b>	1.0	0.05	0.01	0.08	0.045	0.68	0.67	0.063	0.5	<b>1.47</b>	<b>0.82</b>	<b>1.68</b>
<b>3</b>	1.0	0.05	0.01	0.09	0.045	0.82	0.59	0.063	0.5	<b>1.51</b>	<b>0.71</b>	<b>1.67</b>
<b>4</b>	1.0	0.05	0.03	0.08	0.045	0.69	0.62	0.063	0.5	<b>1.46</b>	<b>0.89</b>	<b>1.71</b>
<b>5</b>	1.0	0.05	0.13	0.10	0.045	0.72	0.76	0.063	0.5	<b>1.54</b>	<b>0.84</b>	<b>1.76</b>
<b>6</b>	1.0	0.05	0.08	0.07	0.045	0.66	0.53	0.063	0.5	<b>1.41</b>	<b>0.83</b>	<b>1.64</b>
<b>7</b>	1.0	0.05	0.03	0.07	0.045	0.70	0.65	0.063	0.5	<b>1.48</b>	<b>0.85</b>	<b>1.70</b>
<b>8</b>	1.0	0.05	0.03	0.06	0.045	0.62	0.66	0.063	0.5	<b>1.44</b>	<b>0.84</b>	<b>1.67</b>
<b>9</b>	1.0	0.05	0.08	0.07	0.045	0.76	0.40	0.063	0.5	<b>1.42</b>	<b>0.78</b>	<b>1.62</b>
<b>10</b>	1.0	0.05	0.03	0.08	0.045	0.77	0.57	0.063	0.5	<b>1.48</b>	<b>0.77</b>	<b>1.67</b>
<b>11</b>	1.0	0.05	0.06	0.09	0.045	0.63	0.59	0.063	0.5	<b>1.42</b>	<b>0.72</b>	<b>1.59</b>

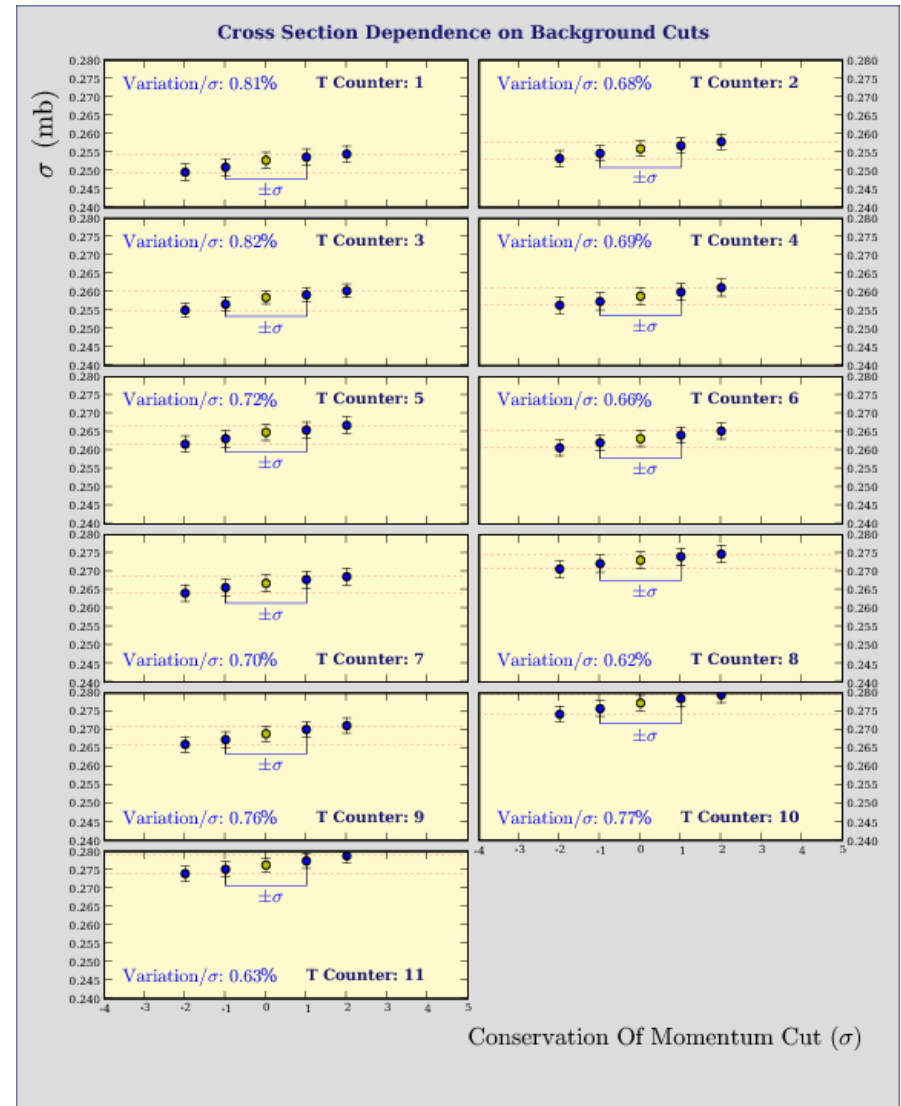
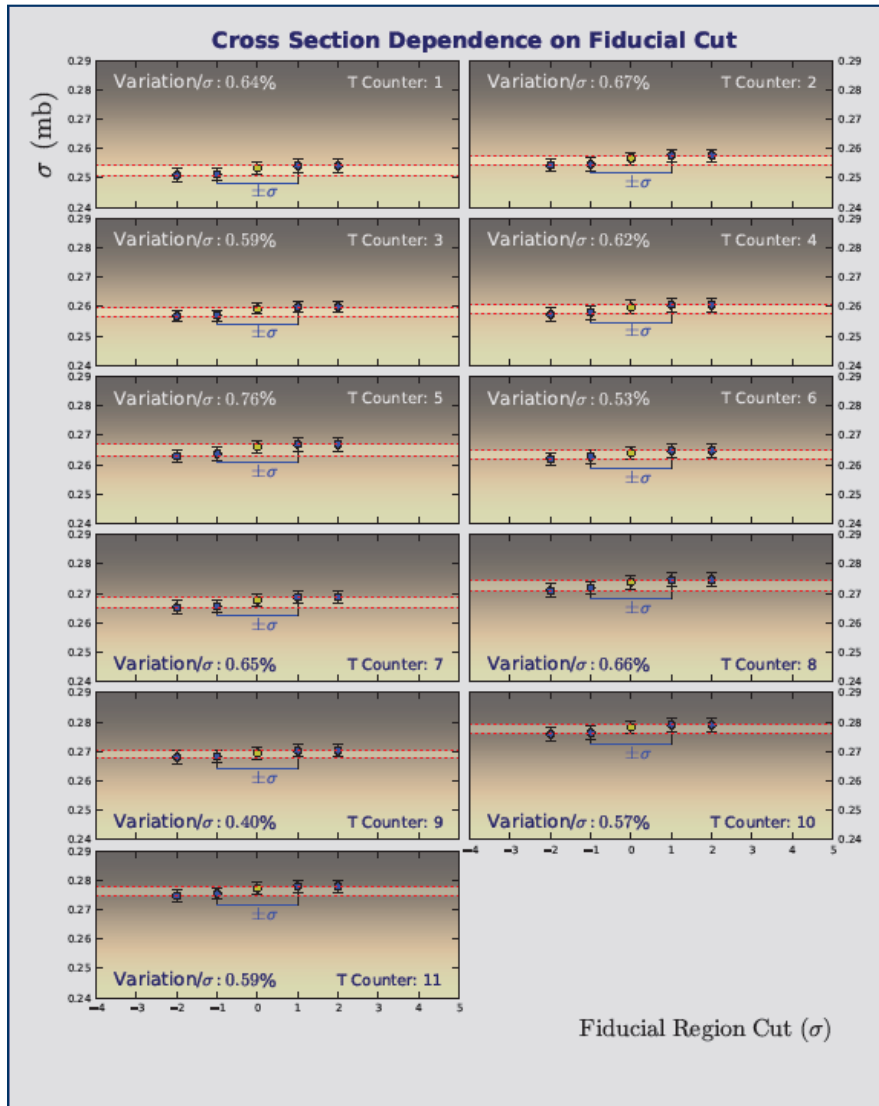
Table 4.1: Systematic uncertainties. All values are in %. Statistical error accounts for yield and photon flux fluctuations.

# UNCERTAINTIES

TCtr	Flux	Tgt	Selection Cuts					Fit	HyCal Res.Fn.	Errors		
			$\Delta T_{min}$	$\Delta\phi$	RC Tail	Sg/Bg	Geom.			Syst.	Stat.	Total
<b>1-2</b>	1.0	0.05	0.03	0.065	0.098	0.91	0.46	0.063	0.5	<b>1.52</b>	<b>0.61</b>	<b>1.64</b>
<b>3-4</b>	1.0	0.05	0.03	0.065	0.098	0.68	0.42	0.063	0.5	<b>1.38</b>	<b>0.57</b>	<b>1.50</b>
<b>5-6</b>	1.0	0.05	0.03	0.065	0.098	0.46	0.40	0.063	0.5	<b>1.28</b>	<b>0.60</b>	<b>1.42</b>
<b>7-8</b>	1.0	0.05	0.03	0.065	0.098	0.33	0.37	0.063	0.5	<b>1.23</b>	<b>0.61</b>	<b>1.37</b>
<b>10-11</b>	1.0	0.05	0.03	0.065	0.098	0.85	0.36	0.063	0.5	<b>1.46</b>	<b>0.54</b>	<b>1.55</b>

Table 4.2: Experimental uncertainties. All values are in %. Statistical error accounts for yield and photon flux fluctuations.

# UNCERTAINTIES



# SUMMARY

## This excellent data set provided:

- **Good control of systematics**
- **Wide range of results:**
  - **Total cross sections for 11 energy bins**
  - **HyCal Solid Angle cross sections (11 energy bins)**
  - **Differential cross sections**
    - 15 angle bins for each energy**
- **Results that compare very well with theory**
- **Results that helped securing PAC approval for**  
**PrimEx-II**