

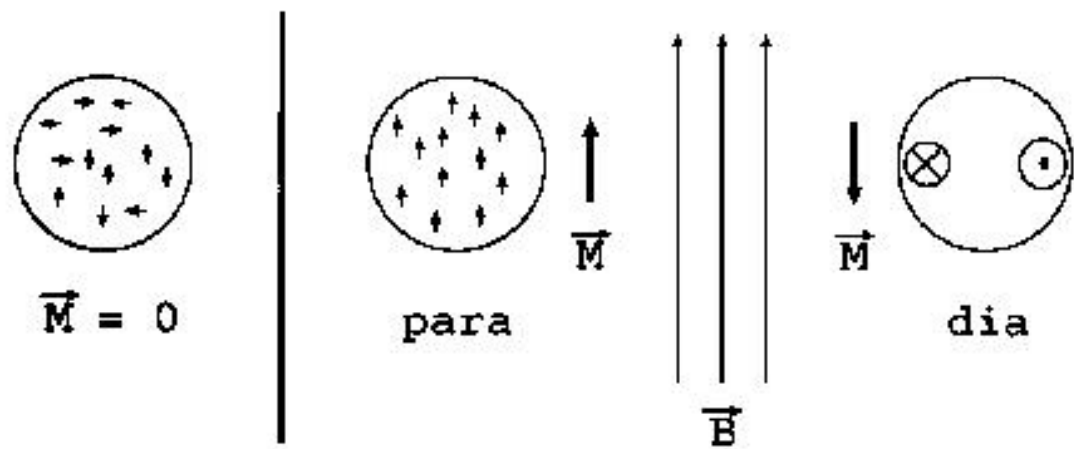
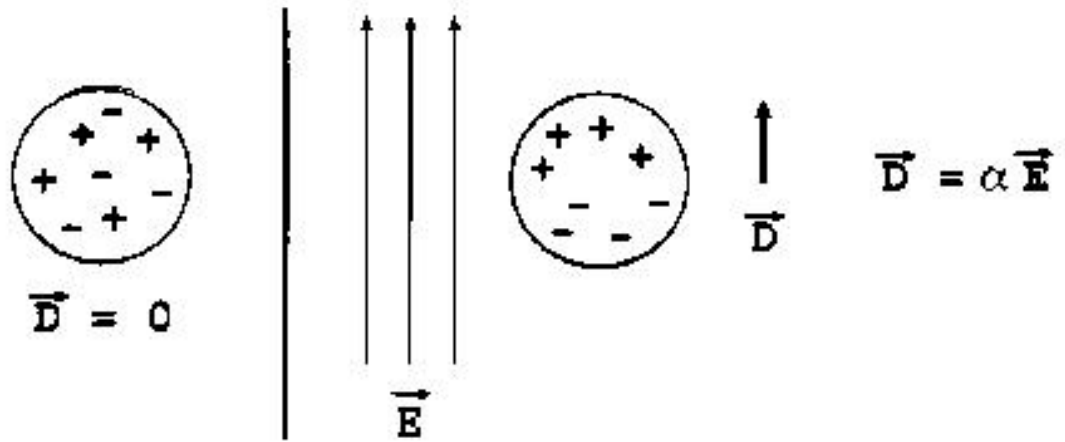
Compton Scattering from the Deuteron

Magnus Lundin
LOWq workshop
August 23-25, 2001



LUND UNIVERSITY

An experimentalist's view



$$\vec{M} = \beta \vec{B}$$

Dispersion sum rule

$$\bar{\alpha} + \beta = \frac{1}{2\pi} \int_{m_n}^{\infty} \frac{\sigma_{\gamma}(E)dE}{E^2}$$

$$\bar{\alpha}_p + \bar{\beta}_p = 14.2 \pm 0.5 \quad (14.0 \pm 0.5)$$

$$\bar{\alpha}_n - \bar{\beta}_n = 15.8 \pm 0.5 \quad (15.2 \pm 0.5)$$

(units 10^{-4} fm^3)

V. A. Petrun'kin, Sov. J. Part. Nucl. **12** (1981), p. 278

M. I. Levchuk and A. I. L'vov, Nucl. Phys. **A674**(2000), p. 449

Experimental approaches

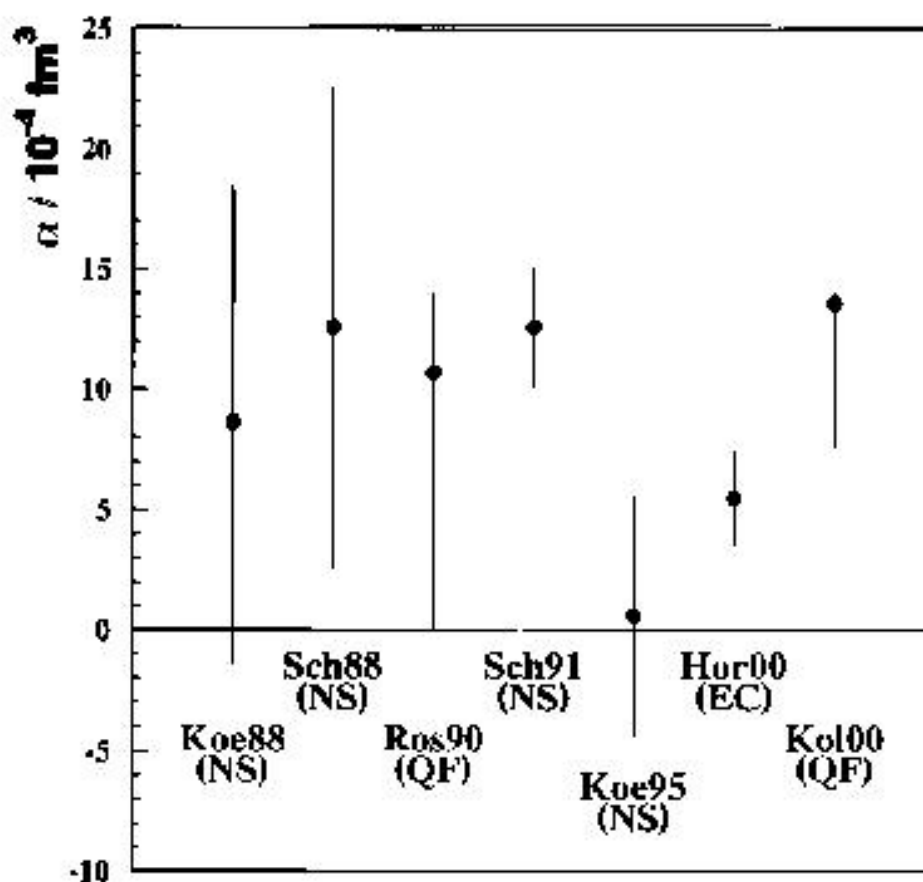
Proton

- Compton scattering

Neutron

- Neutron scattering
- Quasi-free Compton scattering from D
- Elastic Compton scattering from D

Experimental status of α_n



Neutron

NS : Neutron scattering

QF : Quasi-free Compton scattering

EC : Elastic Compton scattering

Koe88 : L. Koester *et al.*, *Z. Phys.* **A329**(1988), p. 229

Sch88 : J. Schmiedmayer *et al.*, *Phys. Rev. Lett.* **61**(1988), p. 1065

Ros90 : K. W. Rose *et al.*, *Nucl. Phys.* **A514**(1990), p. 621

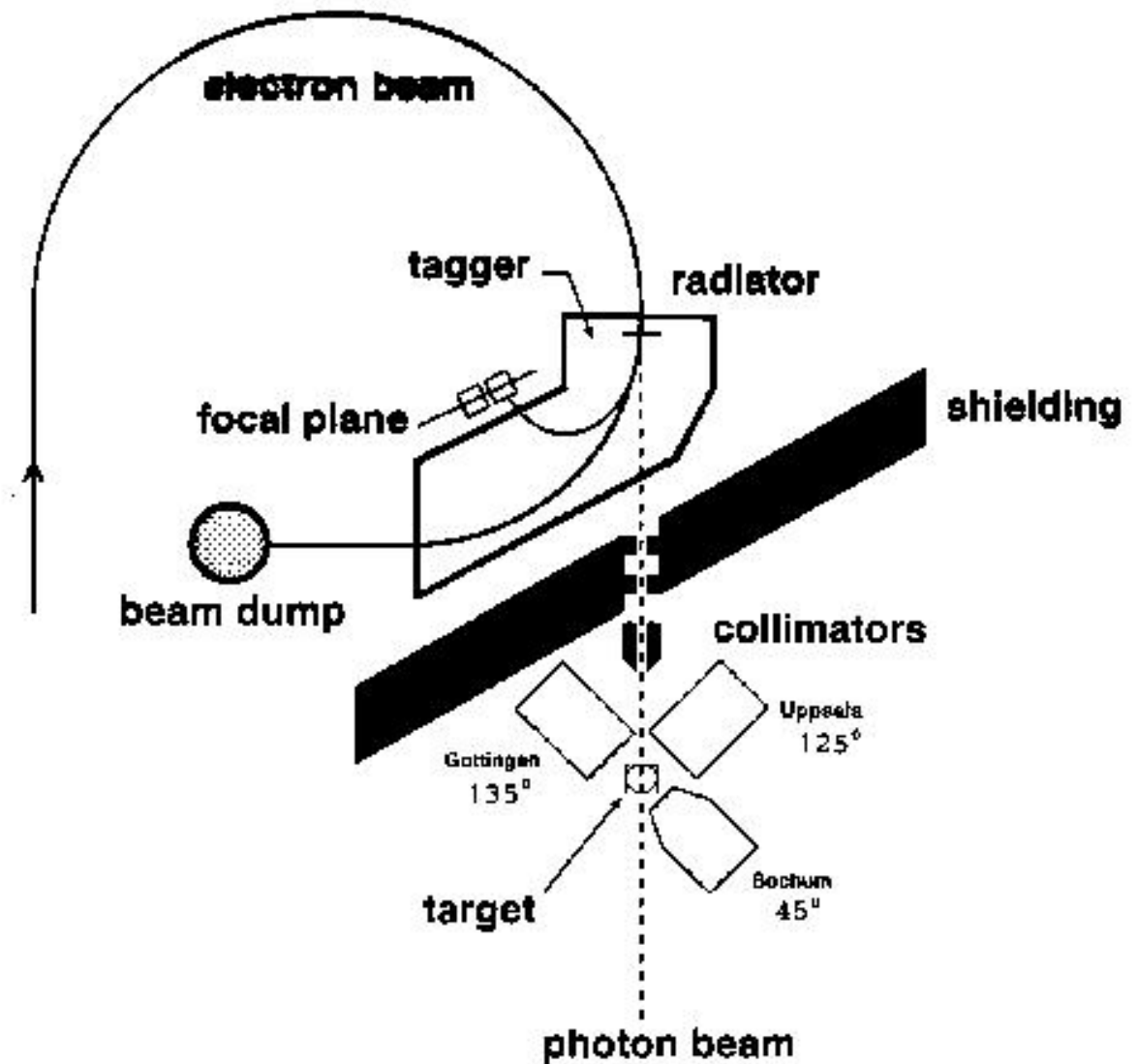
Sch91 : J. Schmiedmayer *et al.*, *Phys. Rev. Lett.* **66**(1991), p. 1015

Koe95 : L. Koester *et al.*, *Phys. Rev. C* **51**(1995), p. 3363

Hor00 : D. L. Hornidge *et al.*, *Phys. Rev. Lett.* **84**(2000), p. 2334

Kol00 : N. R. Kolh *et al.*, *Phys. Rev. Lett.* **85**(2000), p. 1388

Experimental setup and parameters



- $50 < E_\gamma < 70$ MeV, $\Delta E = 0.25$ MeV (64 detectors)
- 16 cm liquid D target
- 3 NaI detectors (10" x 10")
- 3 run periods spanning 1.5 years (7 weeks total)

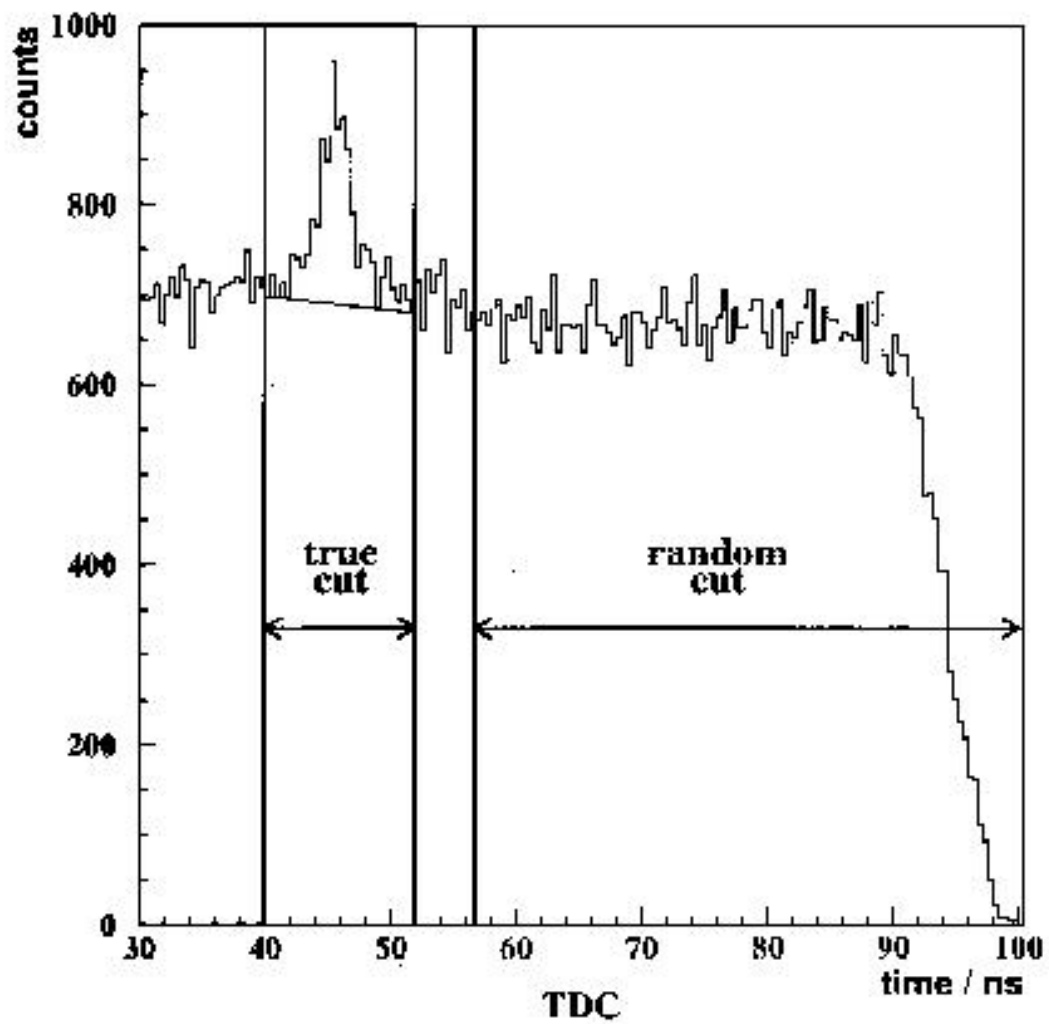
3 run periods

3 NaI detectors

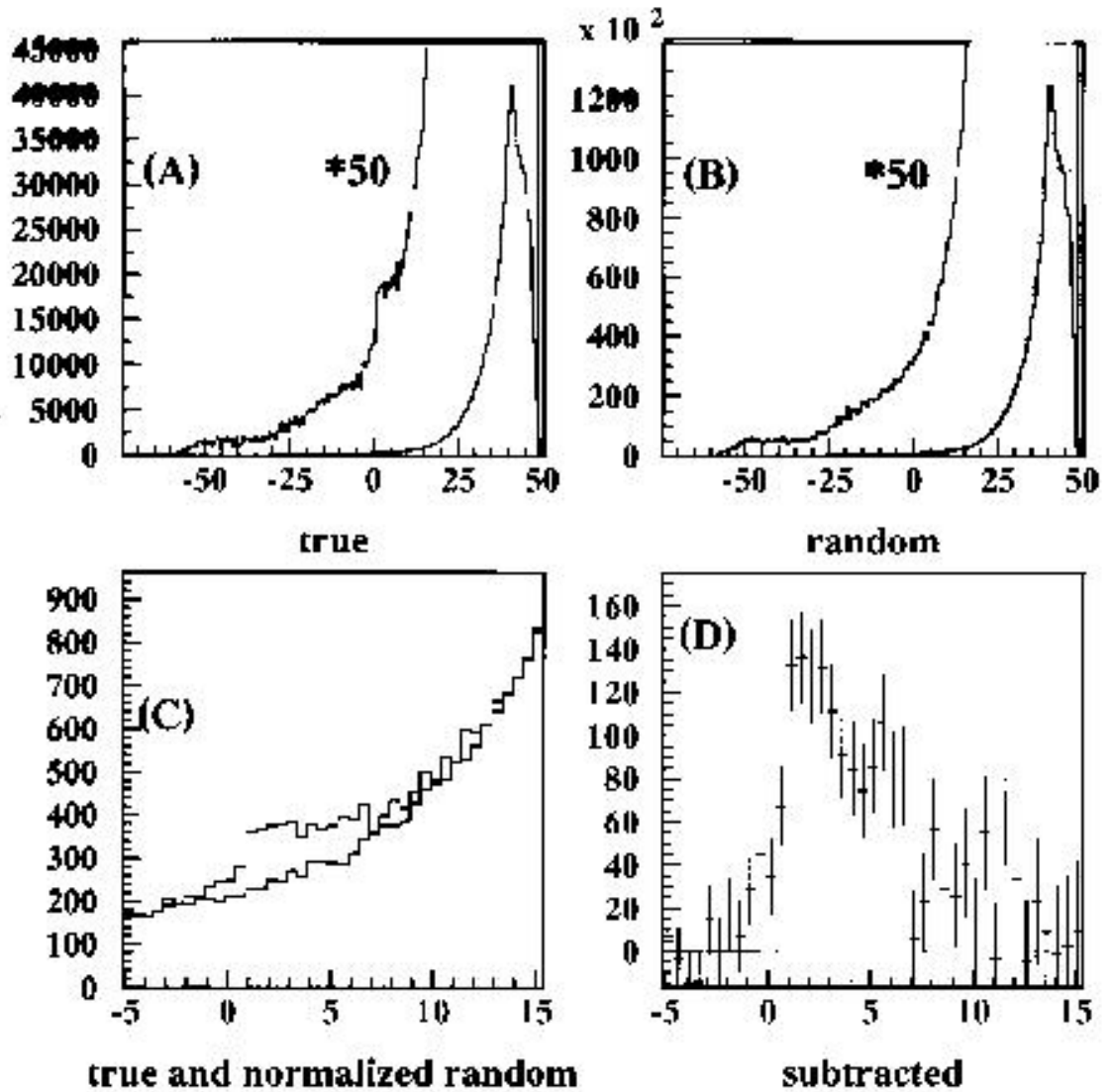
2 energy bins (50 - 60 and 60 - 70 MeV)

⇒ 18 data points

TDC spectrum

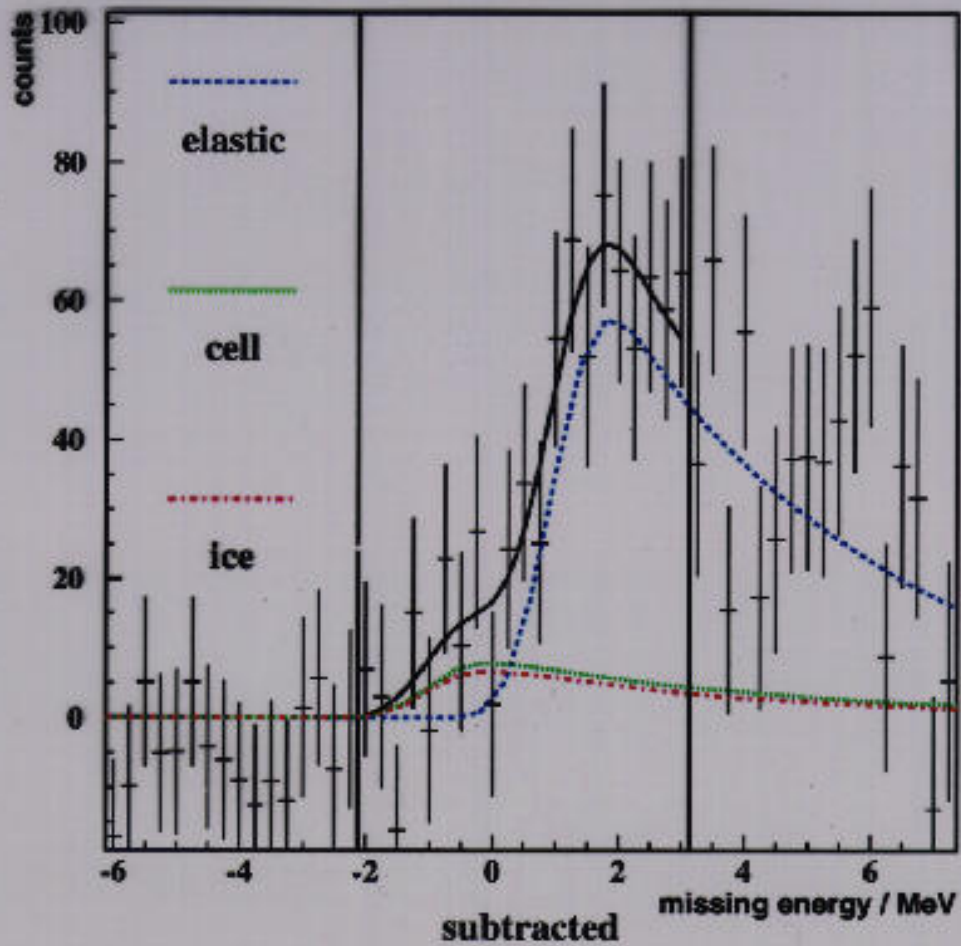


Missing energy

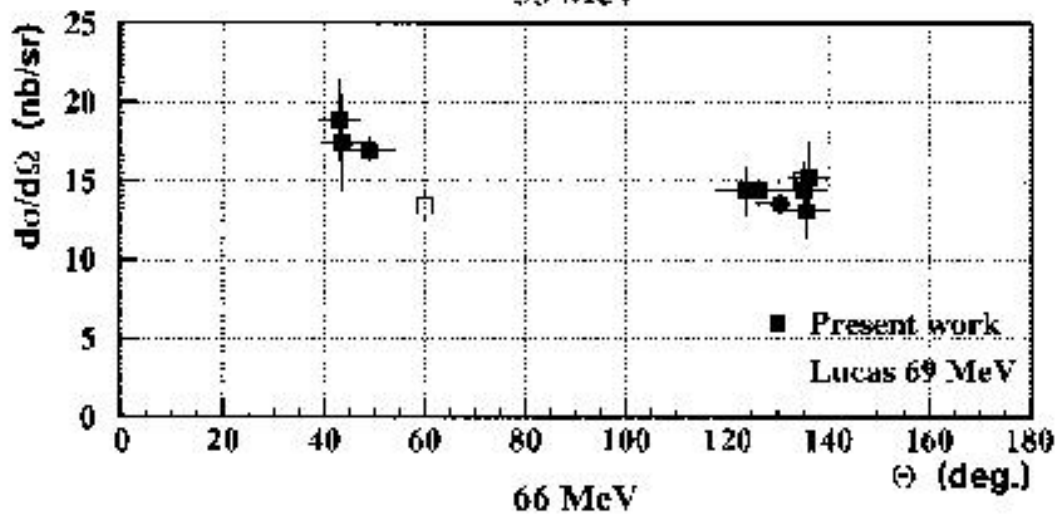
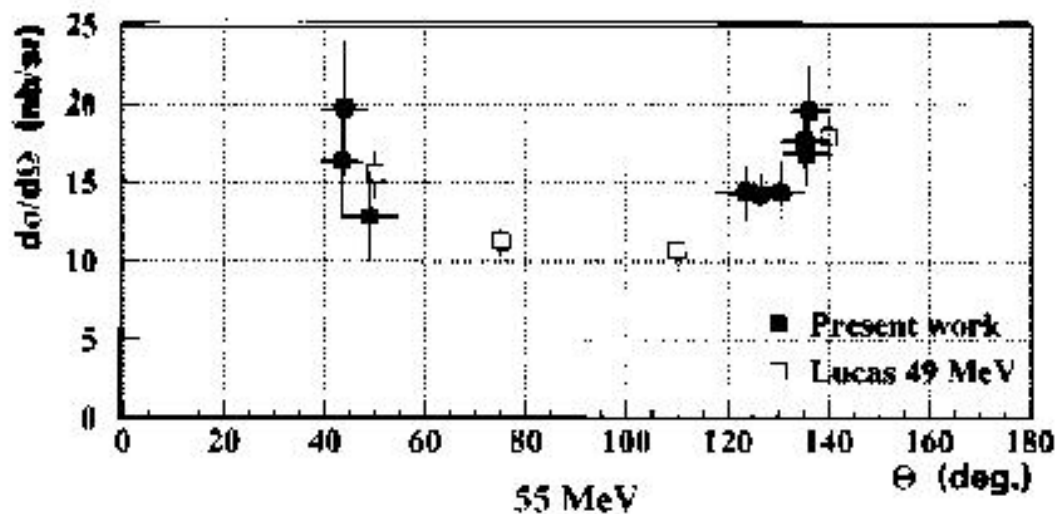


Determination of the yield

- empty target : calculated (cell)
- ice : fit
- no inelastics : narrow fit region



- simulated response functions (Geant)
- $\chi^2 = 0.5$

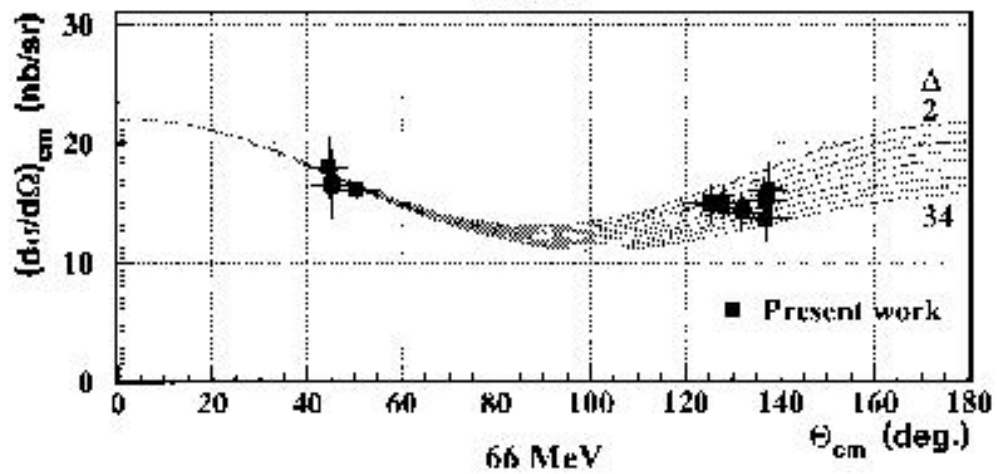
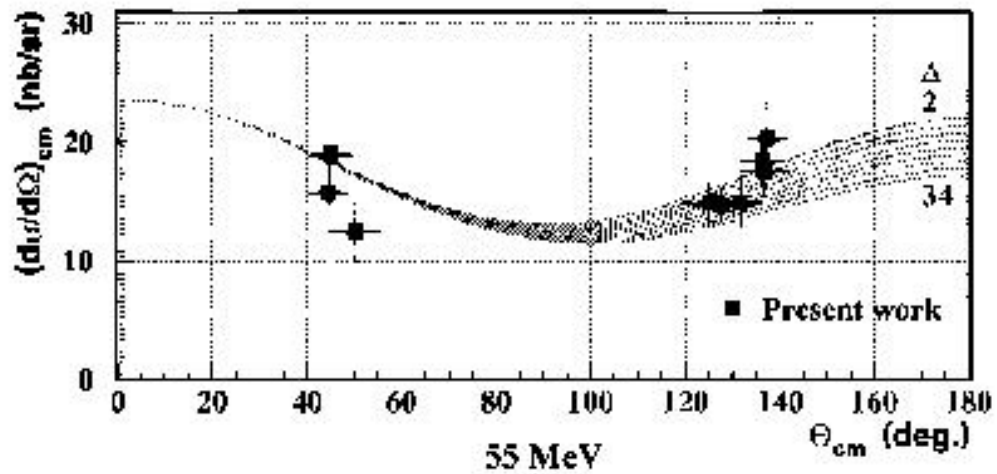


M. A. Lucas, Ph.D. thesis, University of Illinois, 1994

The model

Levchuk and L'vov

- Diagrammatic approach
- Bonn OBE potential
- Free parameter $\Delta = \bar{\alpha}_p - \bar{\beta}_p - \bar{\alpha}_n - \bar{\beta}_n$



$$\chi^2 \Rightarrow \Delta = 15.6 \pm 4.2$$

M. I. Levchuk and A. I. L'vov, Nucl. Phys. **A674**(2000), p. 449

M. I. Levchuk and A. I. L'vov, Nucl. Phys. **A684**(2001), p. 490c

Results

Sum rule (Levchuk and L'vov)

$$\alpha_p + \bar{\beta}_p = 14.0 \pm 0.5$$

$$\bar{\alpha}_n - \beta_n = 15.2 \pm 0.5$$

Proton Compton scattering (MacGibbon *et al.*)

$$\bar{\alpha}_p - \bar{\beta}_p = 10.0 \pm 1.5$$

Present experiment

$$\bar{\alpha}_p - \bar{\beta}_p + \bar{\alpha}_n - \bar{\beta}_n = 15.6 \pm 4.2$$

$$\Rightarrow \begin{aligned} \bar{\alpha}_n &= 10.4 \pm 2.3 \\ \bar{\beta}_n &= 4.8 \mp 2.3 \end{aligned}$$

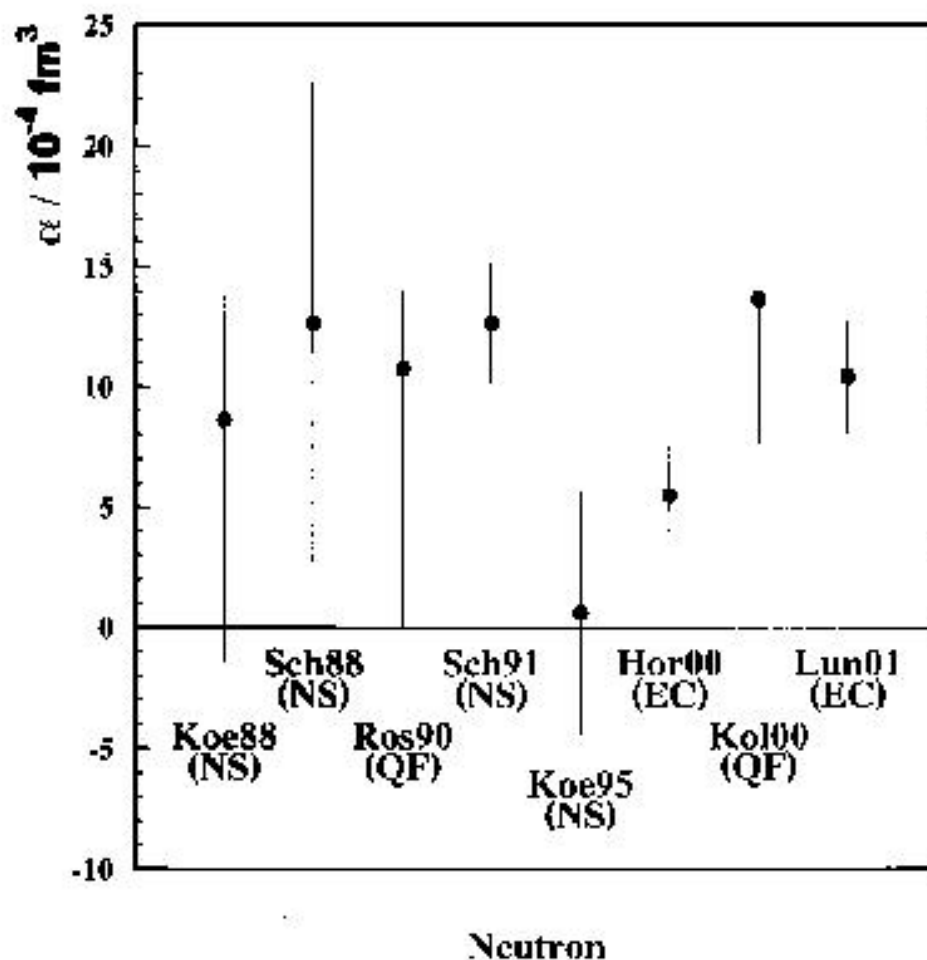
The proton (Sum rule and MacGibbon *et al.*)

$$\bar{\alpha}_p = 12.0 \pm 0.8$$

$$\bar{\beta}_p = 2.0 \mp 0.8$$

B. E. MacGibbon *et al.*, Phys. Rev. C 52(1995), p. 2097

Updated Experimental status



NS : Neutron scattering

QF : Quasi-free Compton scattering

EC : Elastic Compton scattering

Koe88 : L. Koester *et al.*, *Z. Phys.* **A329**(1988), p. 229

Sch88 : J. Schmiedmayer *et al.*, *Phys. Rev. Lett.* **61**(1988), p. 1065

Ros90 : K. W. Rose *et al.*, *Nucl. Phys.* **A514**(1990), p. 621

Sch91 : J. Schmiedmayer *et al.*, *Phys. Rev. Lett.* **66**(1991), p. 1015

Koe95 : L. Koester *et al.*, *Phys. Rev. C* **51**(1995), p. 3363

Hor00 : D. L. Hornidge *et al.*, *Phys. Rev. Lett.* **84**(2000), p. 2334

Kol00 : N. R. Kolb *et al.*, *Phys. Rev. Lett.* **85**(2000), p. 1388