Compton Scattering at HIGS – EM Polarizabilities

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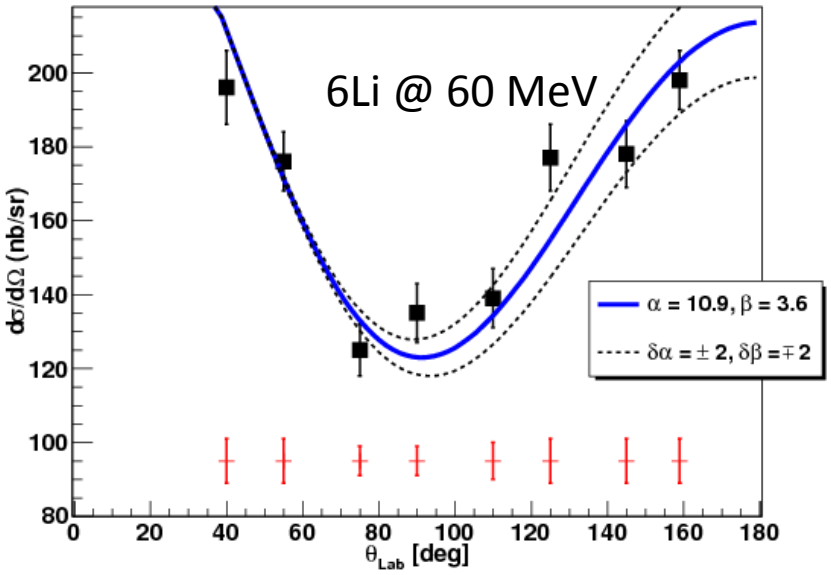
[From the Last LRP, QCD and the Structure of Hadrons, p 29]

Polarizabilities. Another important property of the nucleon is its electromagnetic polarizability—the ability of its internal constituents to orient themselves in response to external electric and magnetic fields. The most direct method of determining such polarizabilities is Compton scattering, the direct scattering of a photon from the nucleon. This provides stringent tests of calculations that link the effective low-energy description of nucleons to QCD. As with the nucleon electromagnetic distributions, the formalism to describe the polarizabilities can be extended to probe differing distance scales, using the technique of virtual Compton scattering. Collectively, the results indicate that the nucleon's paramagnetic (or intrinsic) polarizability is of opposite sign to its diamagnetic (or induced) response. The next generation of such experiments will be carried out at the HIγS facility.



- **^{6}Li at 60 MeV**, L. S. Myers, et al., **Phys. Rev. C 86**, 044614 (2012), **^{6}Li at 86 MeV,** L. S. Myers, et al.**, Phys. Rev. C 90, 027603 (2014)**

Duke U (H. Gao, H. R. Weller, C. R. Howell), GWU (W. Briscoe, E. Downie, G. Feldman, H. Griesshammer), UMass(R. Miskimen), UVa(B. Norum, D. Crabb), UKy(M. Kovash), JMU(S. Whisant),USask (R. Pywell), MTA(D. Hornidge)

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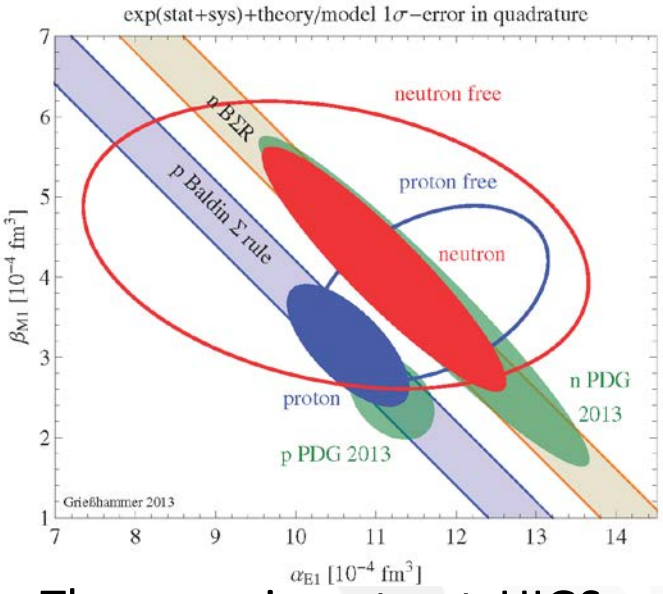
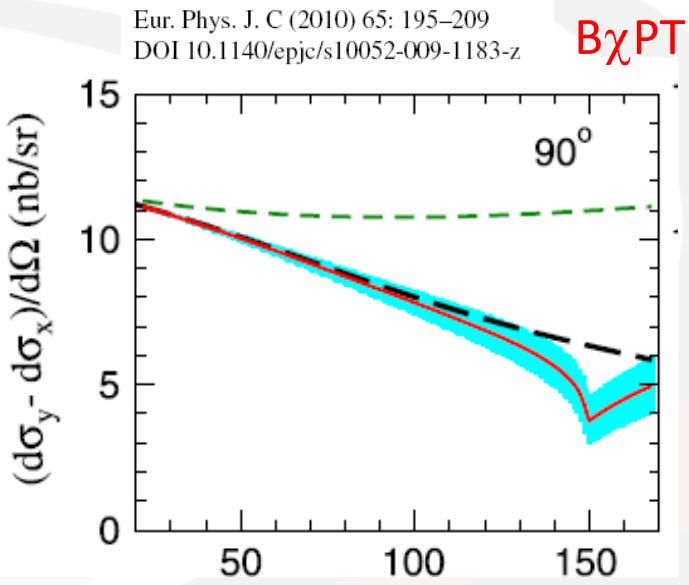
EM Polarizabilities Extractions & Errors

- EFT Extractions (Neutron) – HWG, JAM, DRP, GF, PPNP, 67 (2012) 841-897
- (Proton) – JAM, DRP, HWG, EJP, A 49 (2013) 12





BχPT with Δ

I. The experiments at HIGS will make *model independent* measurements of the electromagnetic polarizabilities for the proton (bring the blue open circle at the same level of errors as the filled ellipse), and

II. reduce the error in the neutron magnetic polarizability (filled red ellipse) to one-half of its current value.

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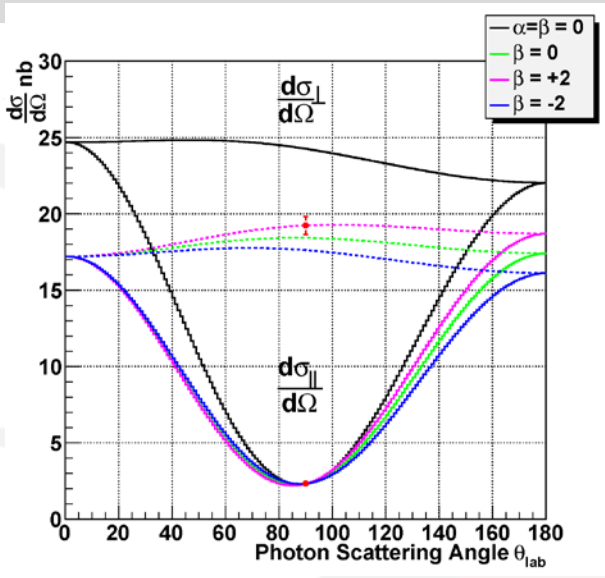
Dissecting deuteron Compton scattering I: The observables with polarised initial states, Harald Griesshammer, Eur. Phys. J. A (2013) 49: 100

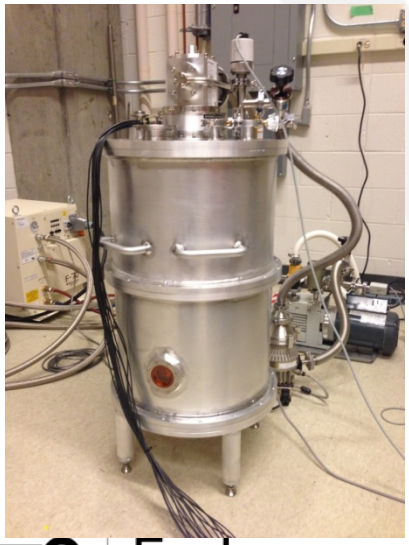
Making use of polarization sensitivity in Linear Polairzed CS

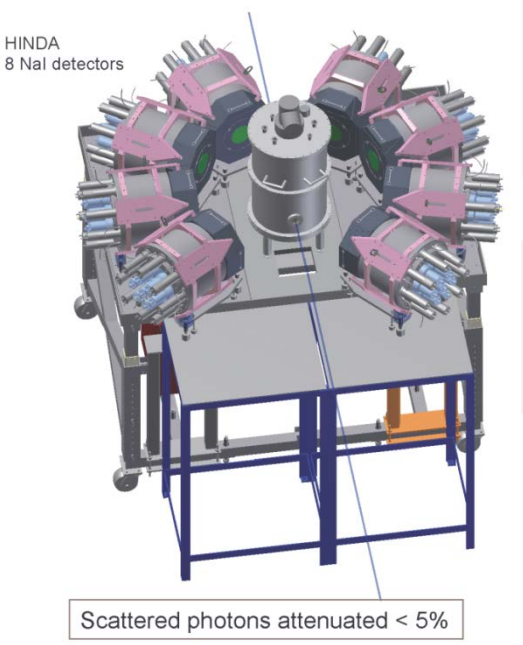
Proton: First such series of measurements of alpha and beta separately using linearly polarized gamma rays (HIGS and MAMI)

Quantity	Polarization	Eγ	% Err
α_p	Linear	85 MeV	2.5 %
β_p	Linear	85 MeV	<10%

Neutron: The 65 and 100 MeV measurements will reduce the error in βn from ~ 50% to ~20 %







- ❖ Cryo-Cooler
- ❖ Cooling Power: 1.5 W @ 4.2 K
- ❖ Base T = 3.5 K
- ❖ L = 20 cm, V = 0.24 Lit
- ❖ D/H/cm^2 = 10^{24}

- HIGS NaI Detector Array, (HINDA), 8-large NaI Core detectors with active shields

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