Real Photons

- **Gerasimov-Drell-Hearn sum rule**
  MAMI, ELSA, and LEGS data ($W < 3\,\mathrm{GeV}$) show that sum rule is fulfilled within error bar ($< 10\%$ for proton, $< 20\%$ for neutron).

Real Photons

- **Gerasimov-Drell-Hearn sum rule**
  MAMI, ELSA, and LEGS data ($W < 3\,\mathrm{GeV}$) show that sum rule is fulfilled within error bar ($< 10\%$ for proton, $< 20\%$ for neutron).
- **Forward spin polarizability**
  Delicate cancelation of contributions from $\Delta(1232)$ excitation and pion S-wave production near threshold (-2+1=-1).
  Published ChPT results scatter between -4 and 4.

Real Photons

- **Gerasimov-Drell-Hearn sum rule**
  MAMI, ELSA, and LEGS data ($W < 3\,\mathrm{GeV}$) show that sum rule is fulfilled within error bar ($< 10\%$ for proton, $< 20\%$ for neutron).
- **Forward spin polarizability**
  Delicate cancelation of contributions from $\Delta(1232)$ excitation and pion S-wave production near threshold (-2+1=-1).
  Published ChPT results scatter between -4 and 4.
- **List of things desired**
  Check whether the photon is "helicity blind" at 40 GeV.

Real Photons

- **Gerasimov-Drell-Hearn sum rule**
  MAMI, ELSA, and LEGS data ($W < 3\,\mathrm{GeV}$) show that sum rule is fulfilled within error bar ($< 10\%$ for proton, $< 20\%$ for neutron).
- **Forward spin polarizability**
  Delicate cancelation of contributions from $\Delta(1232)$ excitation and pion S-wave production near threshold (-2+1=-1).
  Published ChPT results scatter between -4 and 4.
- **List of things desired**
  Check whether the photon is "helicity blind" at 40 GeV.
  Give quantitative information on nuclear contributions to helicity asymmetry of neutron targets, such as $\gamma + d \rightarrow p + n$ and $\gamma + d \rightarrow d + \pi^0$.

Real Photons

- **Gerasimov-Drell-Hearn sum rule**
  MAMI, ELSA, and LEGS data ($W < 3\,\mathrm{GeV}$) show that sum rule is fulfilled within error bar ($< 10\%$ for proton, $< 20\%$ for neutron).
- **Forward spin polarizability**
  Delicate cancelation of contributions from $\Delta(1232)$ excitation and pion S-wave production near threshold (-2+1=-1).
  Published ChPT results scatter between -4 and 4.
- **List of things desired**
  Check whether the photon is "helicity blind" at 40 GeV.
  Give quantitative information on nuclear contributions to helicity asymmetry of neutron targets, such as $\gamma + d \to p + n$ and $\gamma + d \to d + \pi^0$.
  Evaluate higher polarizabilities and compare with MAID, SAID. Power series expansion of Compton amplitude about $\nu = 0$.

Virtual Photons

- **Spin structure at long distance**
  Unprecedented new precision data from Halls A, B, C, covering transverse and longitudinal polarization as well as proton and neutron targets over a wide range ($0.01 < Q^2 < 6\,\mathrm{GeV}^2$), $W < 3\,\mathrm{GeV}$. Soon available: complete information on the spin structure functions (g_1, g_2 or σ_{TT}, σ_{LT}).

Virtual Photons

- **Spin structure at long distance**
  Unprecedented new precision data from Halls A, B, C, covering transverse and longitudinal polarization as well as proton and neutron targets over a wide range ($0.01 < Q^2 < 6\,\mathrm{GeV}^2$), $W < 3\,\mathrm{GeV}$. Soon available: complete information on the spin structure functions (g_1, g_2 or σ_{TT}, σ_{LT}).
- **GDH-like integrals, I_1 and I_{TT}**
  Visualize the transition from "coherent" processes (resonances, meson cloud) to "incoherent" scattering off partons (DIS). Characterized by a rapid variation with Q^2 and a sign change at $Q^2 \approx 0.2\,\mathrm{GeV}^2$ for the proton. Bridge the gap between GDH sum rule and Bjorken sum rule.
  ChPT: loops are functions of Q^2/m_π^2, convergent up to which Q^2 value?
  Combine ChPT and Lattice QCD (pion mass extrapolation, determination of LECs from QCD).

Virtual Photons, continued

- **Burkhard-Cottingham sum rule, I_2**
  Fascinating prediction: integral over full excitation spectrum related to ground state properties at any given Q^2, i.e., at all distances. Spectacular data.

Virtual Photons, continued

- **Burkhard-Cottingham sum rule, I_2**
  Fascinating prediction: integral over full excitation spectrum related to ground state properties at any given Q^2, i.e., at all distances. Spectacular data.
- **Spin polarizability γ_{TT}**
  Delicate cancelation between $\Delta(1232)$ and pion S-wave production near threshold.
  Both contributions drop fast with Q^2, but certainly not with same form factor. Delicacy more delicate.
  Asymptotically rapid decrease like $1/Q^6$. Because of weight factor $1/\nu^3$, high energies contribute little.

Virtual Photons, continued

- **Burkhard-Cottingham sum rule, I_2**
  Fascinating prediction: integral over full excitation spectrum related to ground state properties at any given Q^2, i.e., at all distances. Spectacular data.
- **Spin polarizability γ_{TT}**
  Delicate cancelation between $\Delta(1232)$ and pion S-wave production near threshold.
  Both contributions drop fast with Q^2, but certainly not with same form factor. Delicacy more delicate.
  Asymptotically rapid decrease like $1/Q^6$. Because of weight factor $1/\nu^3$, high energies contribute little.
- **Spin polarizability δ_{LT}**
  $\Delta(1232)$ contribution suppressed by an order of magnitude, dominant term $S_{0^+}^* E_{0^+}$. Asymptotically rapid decrease like $1/Q^6$. Because of weight factor $1/\nu^3$, high energies contribute little. Why is this observable not well described by ChPT?

Virtual Photons, List of Things Desired

- Please provide proton data for the Q^2 dependence of BC sum rule and δ_{LT} (my personal request to Santa Claus this year).

Virtual Photons, List of Things Desired

- Please provide proton data for the Q^2 dependence of BC sum rule and δ_{LT} (my personal request to Santa Claus this year).
- Do not forget to publish information on "neutron targets" below pion threshold, nuclear physicists may love it.

Virtual Photons, List of Things Desired

- Please provide proton data for the Q^2 dependence of BC sum rule and δ_{LT} (my personal request to Santa Claus this year).
- Do not forget to publish information on "neutron targets" below pion threshold, nuclear physicists may love it.
- Evaluate higher polarizabilities, maybe also higher twists?

Virtual Photons, List of Things Desired

- Please provide proton data for the Q^2 dependence of BC sum rule and δ_{LT} (my personal request to Santa Claus this year).
- Do not forget to publish information on "neutron targets" below pion threshold, nuclear physicists may love it.
- Evaluate higher polarizabilities, maybe also higher twists?
- Dear members of CLAS: We want more of your precision data for single-pion electroproduction above 1.6 GeV.
  We are tired of fitting our phenomenological codes to the old DESY data.