EXPERIMENTS WITH A POLARIZED COHERENT BREMSSTRAHLUNG BEAM AT SLAC

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Representing the Real Photon Collaboration
E160/E161/E159 approved Nov. 2001

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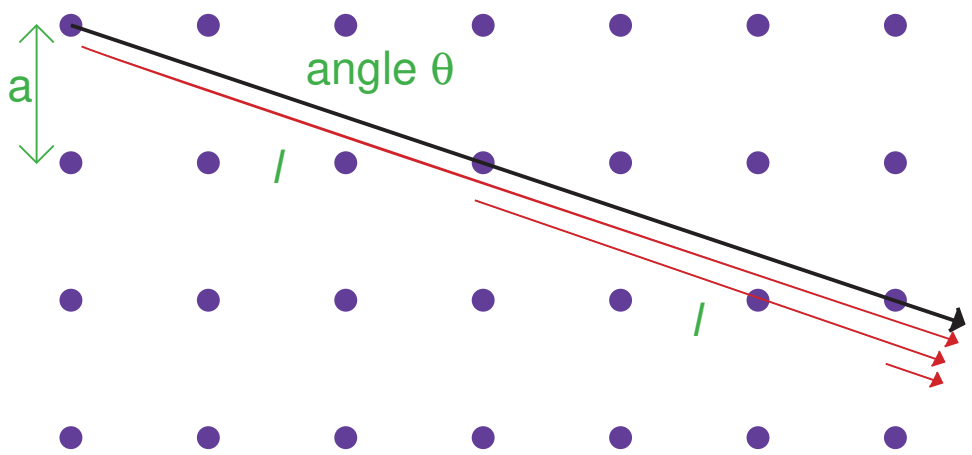
- Coherent Bremsstrahlung Beam
- A-Dependence of J/ψ Photoproduction
- Gluon Spin from Charm Photoproduction
- Gerasimov-Drell-Hearn Sum Rule

Real Photon Collaboration (65)

Aarhus Universitet (Denmark)
Brookhaven National Lab
University of California Los Angeles
University of Cape Town (South Africa)
Florida International University
Laboratori Nazionali di Frascati (Italy)
Jefferson Lab
University of Liverpool (England)
Los Alamos National Laboratory
Institut für Kernphysik Mainz (Germany)
University of Massachusetts
Mississippi State University
Old Dominion University
Ruhr-Universität Bochum (Germany)
Service de Physique Nucleaire, CEA Saclay (France)
Smith College
Stanford Linear Accelerator Center
University of Virginia
College of William and Mary
University of the Witwatersrand (South Africa)
Yerevan Physics Institute (Armenia)

Coherent Bremsstrahlung

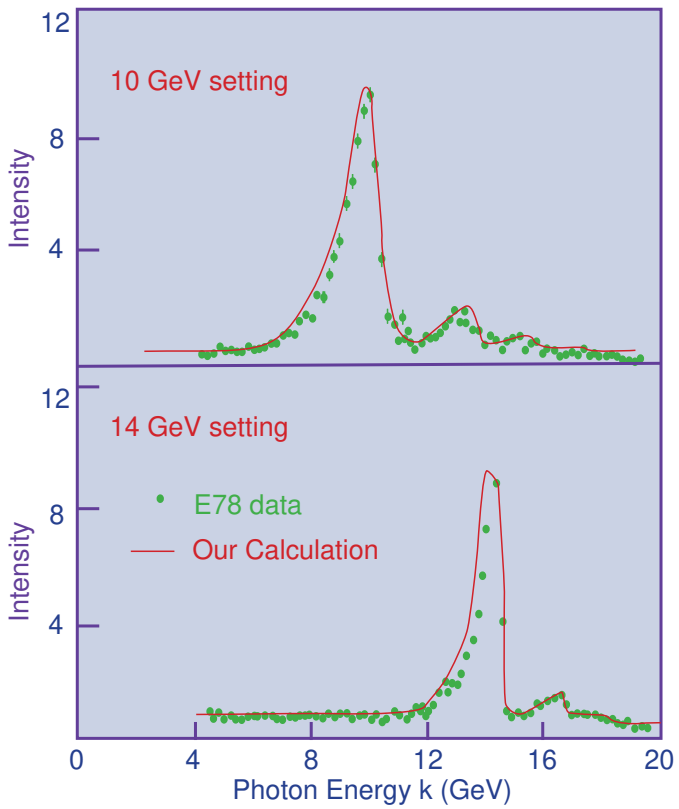


photon waves, velocity=1.
Want to be in phase.

electron, velocity=β.
Lag by one photon wavelength over distance a/θ

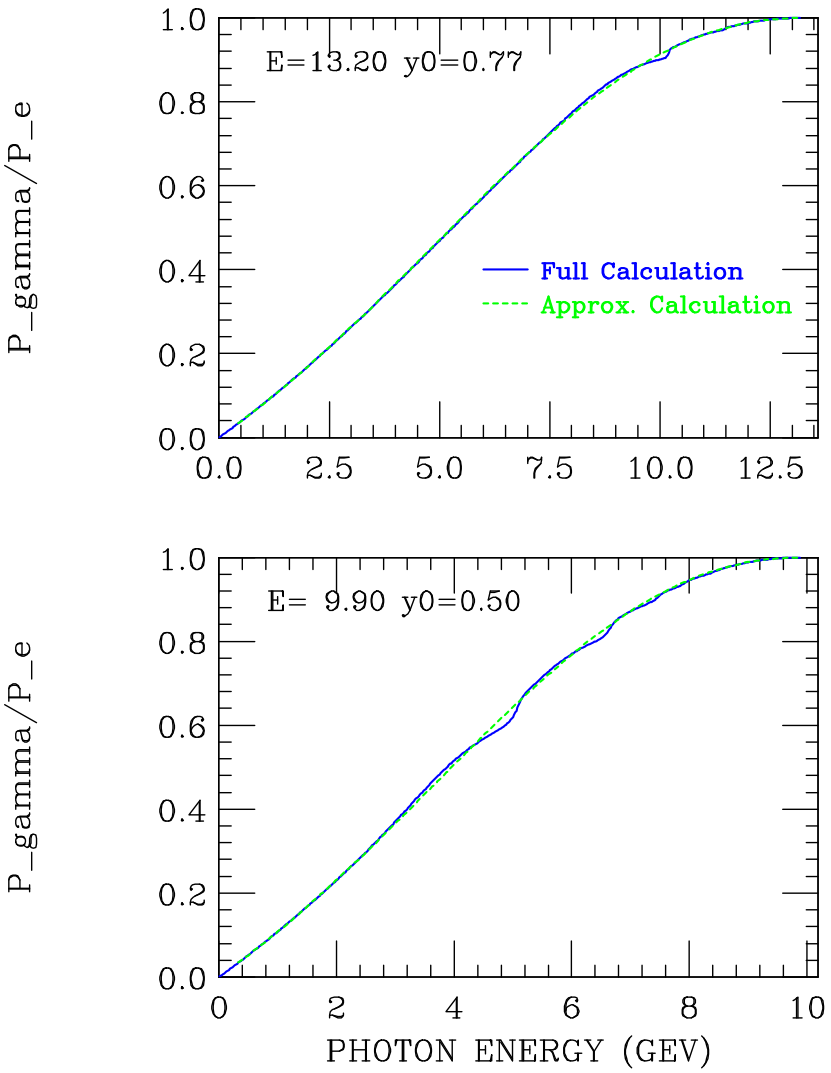
- High flux quasi-monoenergetic circularly polarized real photon beam.
- Thin diamond crystal radiators: low mosaic spread, low Z, small lattice spacing.
- Outperforms laser backscattering (emittance growth limits intensity) and tagging (rates are too low with 10^{-4} duty cycle).

Coherent Bremsstrahlung Spectra



- Calculations using formulas from Diambrini Palazzi, Rev. Mod. Phys. 40, 611 (1968).
- Data from SLAC E78, W. Kaune et al., Phys. Rev. D11, 478 (1975)
- Calculations are shown to be reliable for 19.7 GeV electron beams. Plotted is intensity—photon flux times energy.

Circular Polarization



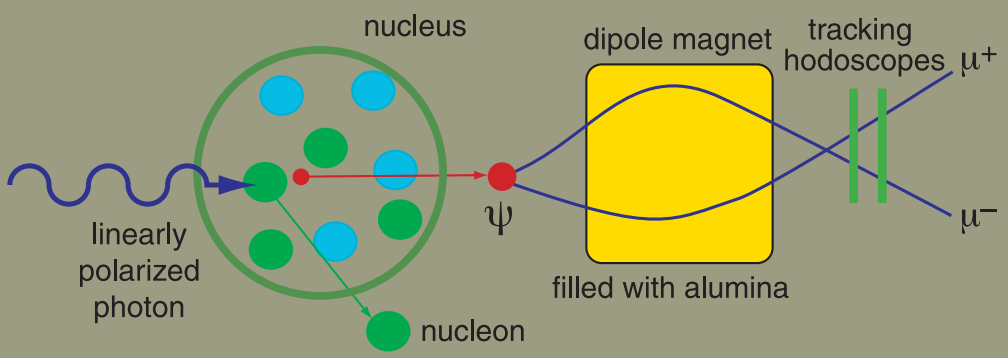
E160

Measurement of the A-Dependence of J/ψ(1S) and ψ(2S) Photoproduction

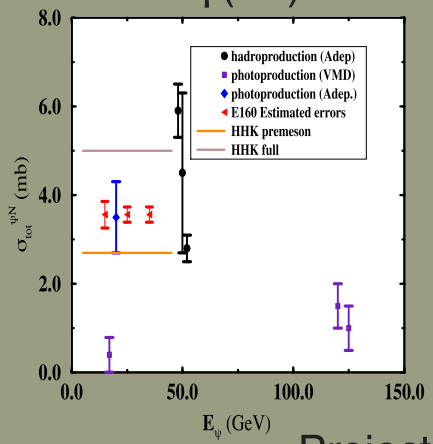
Goals

1) Study production and interaction of charmonium in nuclei from Be to Au at energies from 15 to 35 GeV.

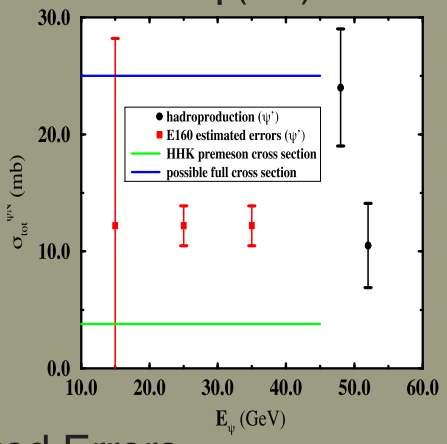
2) Constrain causes for charmonium suppression in heavy ion collisions.



J/ψ(1S)



ψ(2S)



Projected Errors

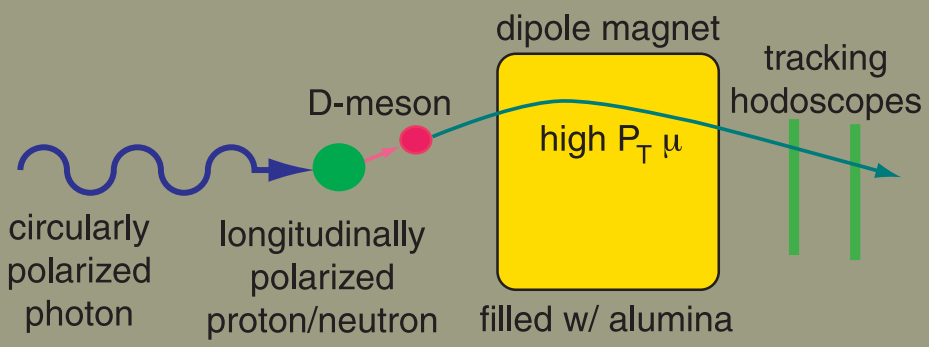
www.slac.stanford.edu/exp/e160

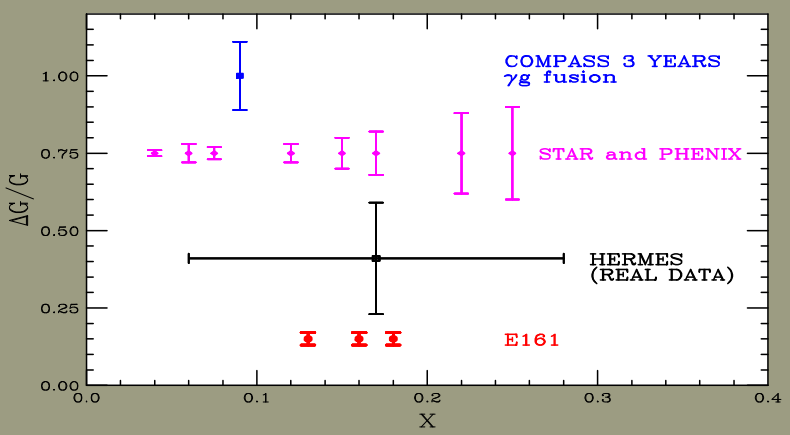
E161

Gluon Spin in Nucleons Using Polarized Open Charm Photoproduction

Goal

Find gluon contribution to the nucleon "Spin Puzzle" using photoproduction of open charm (dominated by photon-gluon fusion diagram). Complementary to measurements at RHIC-Spin and COMPASS.





Projected Errors

www.slac.stanford.edu/exp/e161

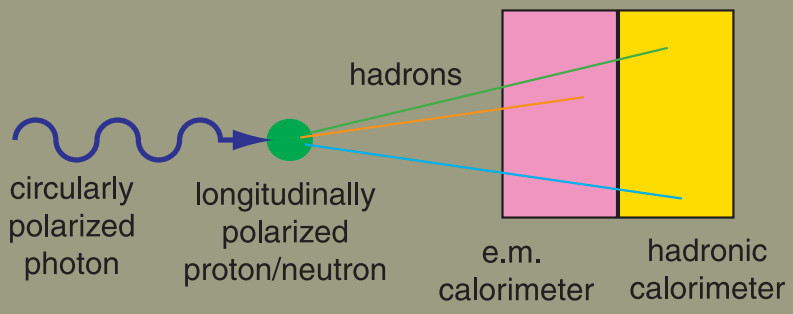
E159

Measurement of $\Delta\sigma(k)$ and the High Energy Contribution to the GDH Sum

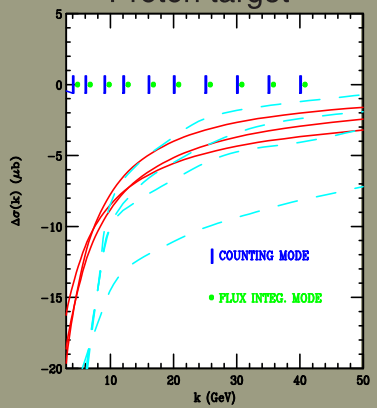
Goals

1) Measure helicity dependence of cross section to absorb circularly polarized photons on polarized nucleons in the energy range 5 to 45 GeV.

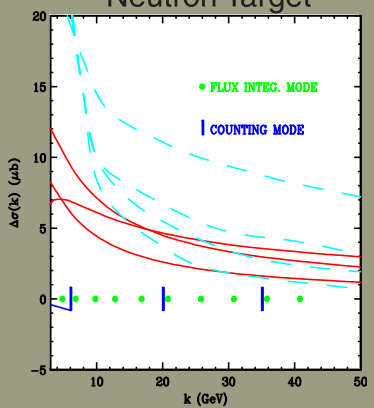
2) Test the fundamental GDH Sum Rule.



Proton target



Neutron Target



Projected Errors

www.slac.stanford.edu/exp/e159

Real Photon Program Summary

- Fundamental physics of hadron spin structure and dynamics.
- Builds on 20 years of nucleon structure and quark spin at SLAC.
- Requires unique SLAC facilities: linac, beamlines, ESA.
- Requires high intensity, high energy, polarized e^- and γ beams available only at SLAC.
- Fits into SLAC program with modest impact and cost.
- Provides important data for interdisciplinary questions:
  - J/ψ signal for quark-gluon plasma
  - gluon spin
  - Gerasimov-Drell-Hearn sum rule
- First experiment (E160) originally to run in early 2003. Delayed by one year...now a second year by budget problems.