Overview

- E007 PAC approved, A- priority, January 2000
- Experimental goal: angular distribution for $\vec{\gamma} d \rightarrow \vec{p} n$, at $E_\gamma \approx 2$ GeV, measuring $C_{x'}$, p_y, and $C_{z'}$
- Motivation: reaction mechanism, quarks vs. hadronic degrees of freedom (d.o.f.)

- Put on schedule early September
- "Started" $\approx$ September 20
- Numerous problems: cryotarget, beam (tuning related to G0)
- ended October 15, run end party 42 days after experiment scheduled
- E007 goals achieved (E107 has some calibration data, lower energy point)

General Motivation

- Study the question of hadronic vs. quark degrees of freedom (d.o.f.) in the *transition region*, in which large s and large momentum transfer make quark-gluon d.o.f. seem the natural language in which theories should be formulated

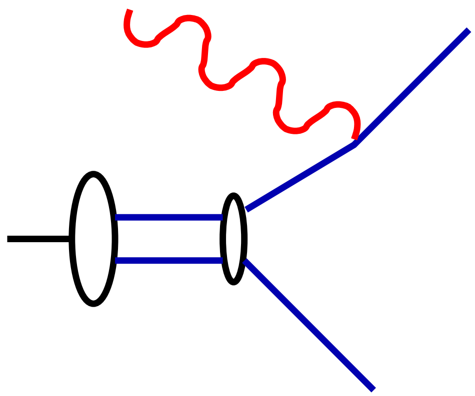
- Do hadronic d.o.f. "break down"?
- Is pQCD relevant?
- Are nonperturbative quark theories relevant?

- Previous cross section experiments SLAC NE8 and NE17, Hall C E89-012 and E96-003, Hall B E93-017, and Hall A E99-008.
- Previous polarization measurement[a] E89-012
- This experiment: Hall A E00-007
- One experiment "on the books", Hall A E00-107, a proposed extension of the $\theta_{\mathrm{c.m.}} = 90^\circ$ polarization data of E89-019 to ≈ 3 GeV

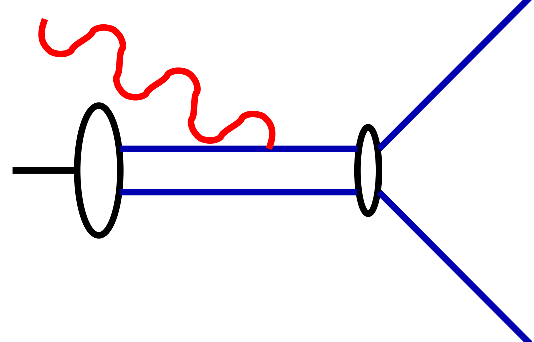
[a] About 60 previous experiments determined about 1400 data points over 40 years.

Reaction Mechanisms

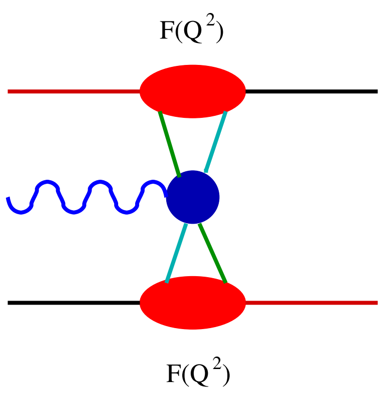
How are large transverse momentum protons produced?



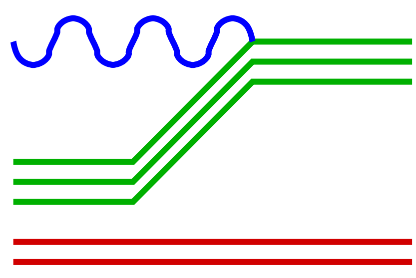
Initial State Correlations



Final State Interactions

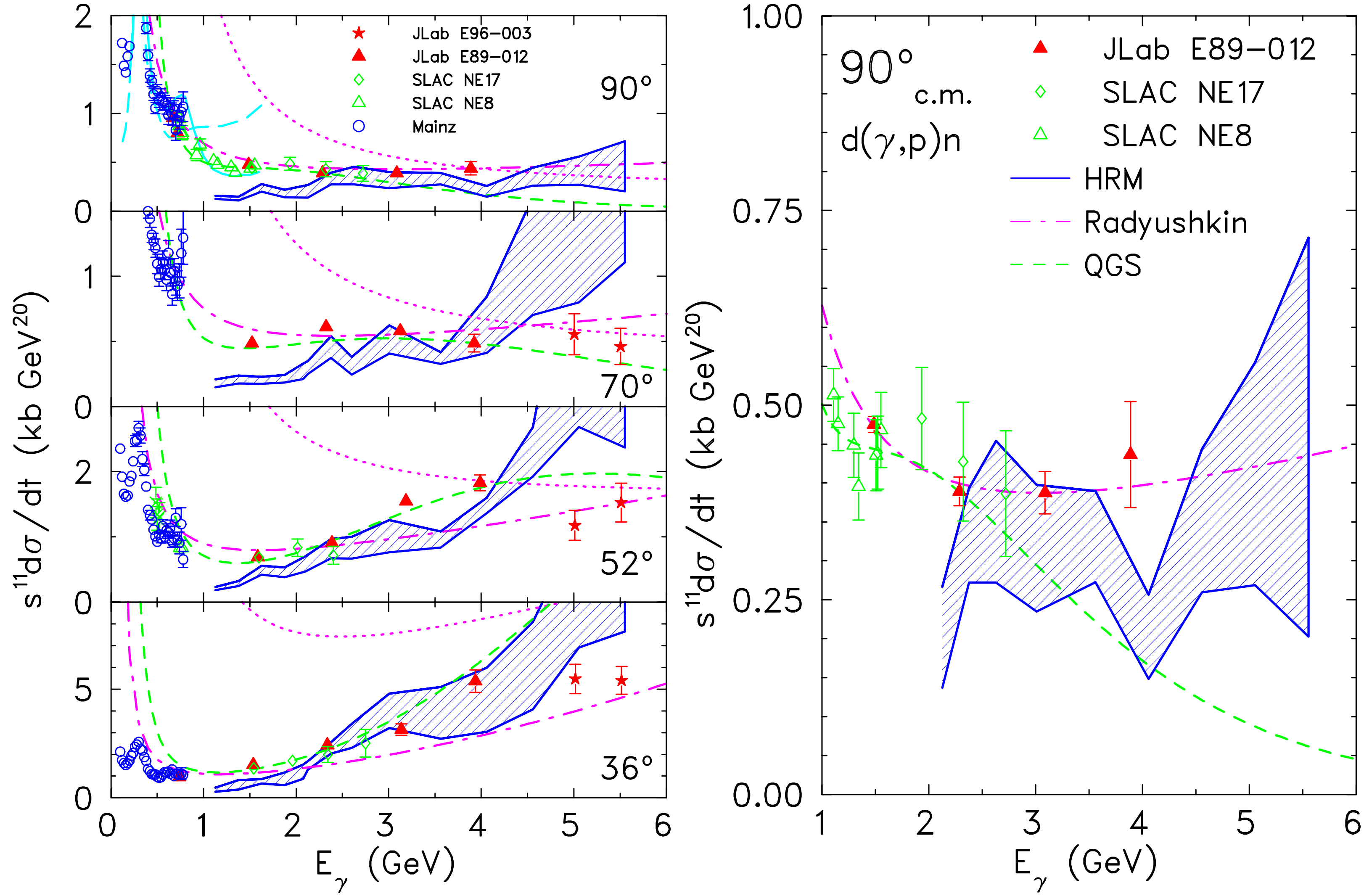


Photon absorbed
on exchanged quarks
or meson

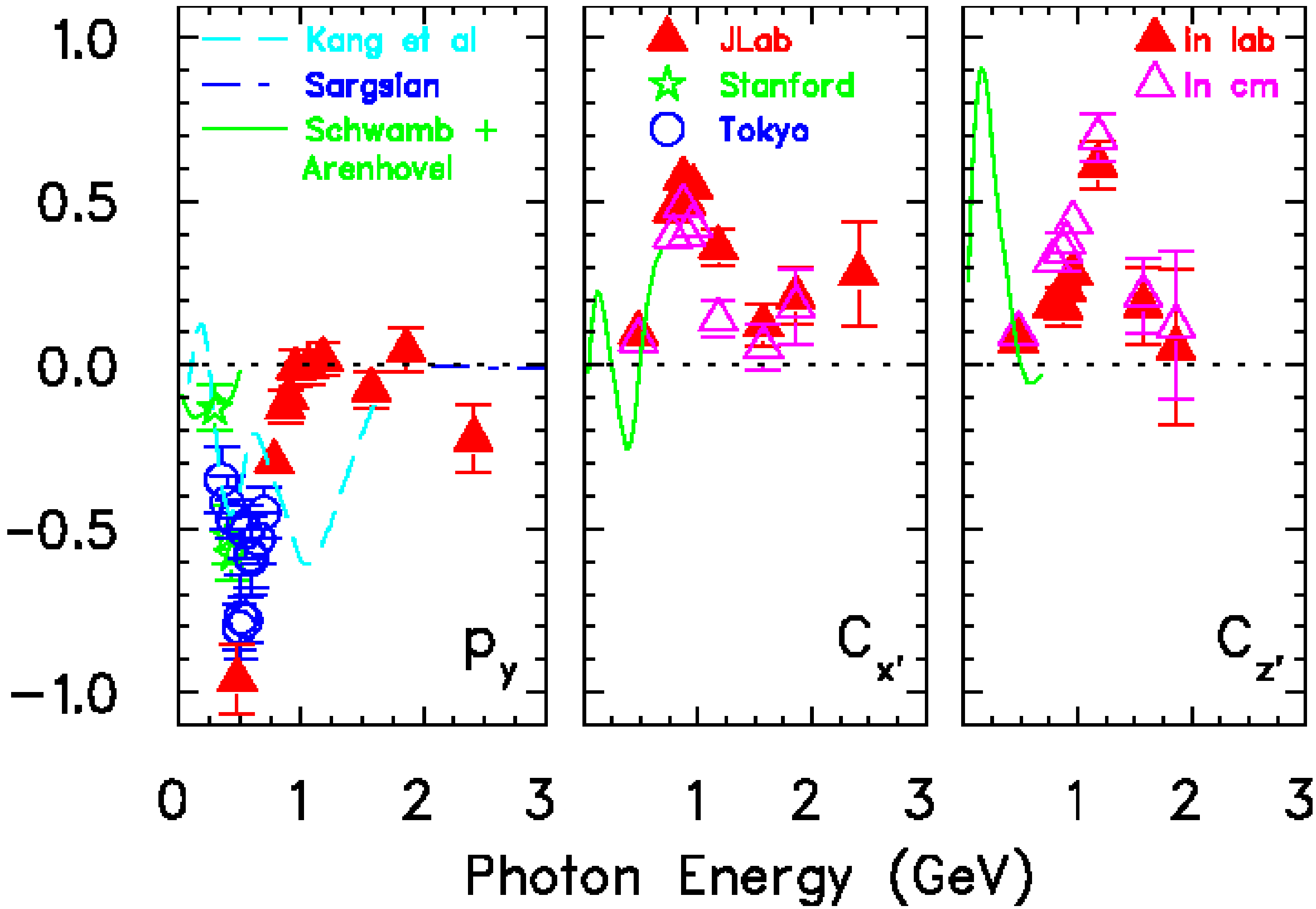


Quark Gluon String
(QGS) model

Deuteron Photodisintegration Cross Sections



Deuteron Photodisintegration Polarizations

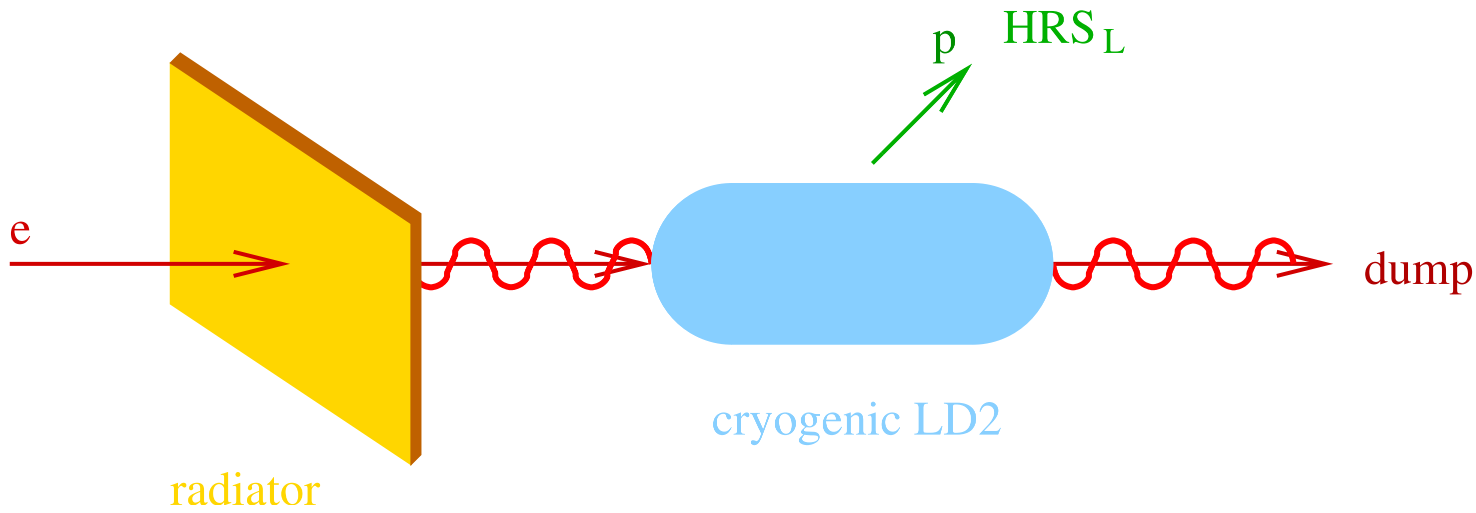


An Interpretation of Deuteron Photodisintegration

- Experimental observations:
  - Cross section scaling for $p_T > 1.3$ GeV
  - Recoil polarizations small
- Conventional hadronic calculations are difficult to formulate, crude, and unsatisfactory
- Some attempts to formulate hybrid hadron + quark models
- Generally believed that soft physics is important – while pQCD $\Rightarrow$ scaling, scaling $\not\Rightarrow$ pQCD
- Some nonperturbative quark models agree sufficiently well with data to merit further testing
  - Frankfurt, Miller, Strikman, Sargsian Hard Rescattering Model (HRM)
  - Kondratyuk *et al.* Quark Gluon String (QGS) Regge Model
  - Radyushkin quark exchange model

Experimental Overview

- $E_e = 4.056$ GeV for ep elastic dual-analyzer FPP calibrations at
  - $p_p = 2.4$, 2.2, 2.0, and 1.7 GeV/c
- $E_e = 2.056$ GeV for photodisintegration data, $E_\gamma \approx 2$ GeV
- $\theta_{\mathrm{c.m.}} = 37^\circ$, 53°, 70°, 90°, and 110°



Run Summary

- "New" cryotarget failure mode found, two weeks to fix
- Beam current low, $\approx$ 20 μA, not 50 μA, until laser replaced for last four days of experiment (possible confusion about 15 vs. 50)
- Problems finding optics target, solved by Dave Meekins
- Rates slightly higher than expected
- Cryotarget found to be skewed relative to beam

- In the end, we used up our PAC approved hours / luminosity
- Online estimated statistical uncertainties 0.05 - 0.10 – $C_{z'}$ worse due to spin precession near 2 GeV/c

Predictions

- Hard Rescattering Model – M. Sargsian *et al.* (private communication)
  - $C_{x'}$ small, but measureably positive
  - p_y small, not really measureably nonzero
  - $C_{z'}$ essentially 0
- Quark-Gluon String Model – Kondratyuk *et al.* (from email 28 Sep 02)

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Now I have with me only our old calculations of P_y at different
angles from 60 deg. to 120 deg. at c.m.s. and for energies from 1
till 6 GeV. For 2 GeV it grows from -0.2 till - 0.06 for angles from
60 deg. till 85 deg. Then changes sign at 90 deg. and grows from 0.06
at 95 deg. till 0.25 for 110-120 Deg...
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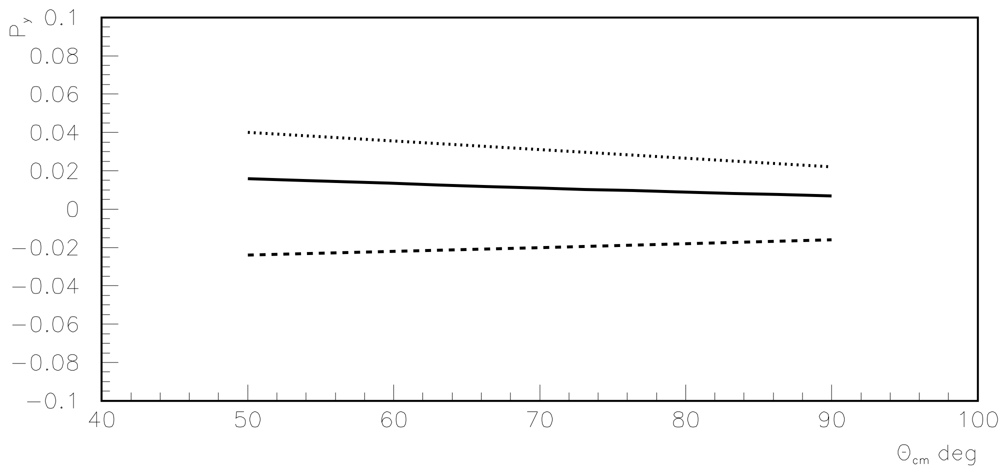
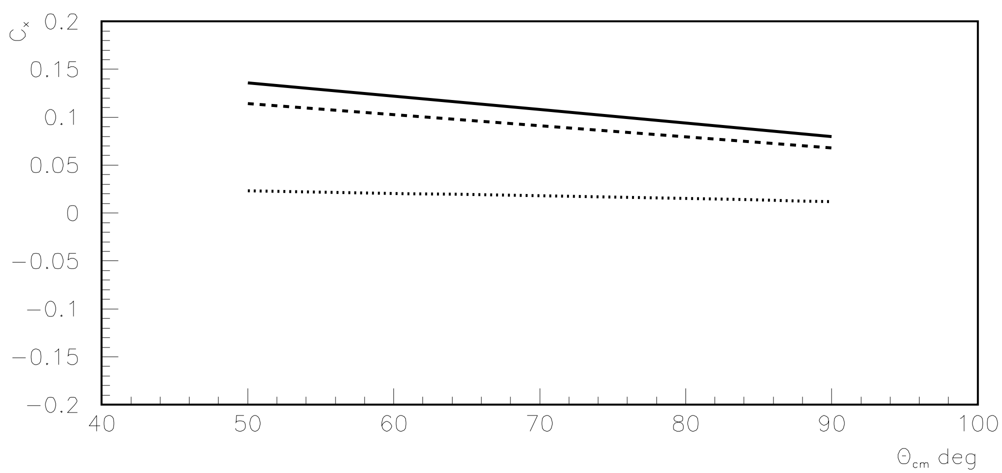
M. Sargsian HRM Prediction
Private Communication – Not for Reproduction





dashed line: ϕ_5 real, dotted line: ϕ_5 imaginary, solid line: ϕ_5 complex, with same phase as ϕ_1, ϕ_3, ϕ_4