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# PROTON POLARIZATION IN DEUTERON PHOTO-DISINTEGRATION TO $E_\gamma > 3$ GEV AT $\theta_{\rm cm} = 90^\circ$


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In experiment 89-019, we measured recoil proton polarization in deuteron photodisintegration at photon energies from 0.5 to 2.5 GeV. These data suggest that the meson-baryon picture of the reaction dynamics fails, as they provide evidence that there is essentially none of the contribution expected from baryon resonances other than from the $\Delta$ resonance. In contrast, the simple trends of the data appear to be justifiable from quark models. These surprising observations suggest the importance of extending the measurements with high precision to higher energies, to determine if indeed the trends continue over a much broader energy range. Also, in the past few years, additional nonperturbative quark models have appeared, such as the QCD rescattering model of Sargsian *et al.*, which calculates the deuteron photodisintegration as a convolution of the deuteron wave function, the hard photo-quark coupling, and the proton-neutron scattering amplitude. This calculation is nominally valid only for $-t > 2$ Gev$^2$ and $E_\gamma > 2.5$ GeV, just above our highest energy polarization data. This too suggests the importance of extending the energy range of the measurements. Here, we propose to continue the $\theta_{\rm cm} = 90^\circ$ deuteron photodisintegration polarization data up to energies of $E_\gamma \approx 3.2$ GeV with uncertainties about 0.05 - 0.1, in a 21 day measurement. These data will test generally whether the observed behavior continues to higher energies, as well as specifically testing predictions of the various reaction models.

## 1 Introduction and Motivation

One of the central goals of nuclear physics is to determine the role of quarks and gluons in nuclei and in nuclear reactions. Traditional nuclear models are based on effective nucleon-nucleon interactions, which are mediated by the exchange of mesons. These models have been extended into the GeV region by explicitly including excited nucleon states. At very high energies, the features of nuclear reactions are expected to become simple, yielding two distinct signatures for quantum chromodynamics (QCD) effects; these are scaling of the cross sections and hadronic helicity conservation. In the intermediate energy regime, nonperturbative QCD models, e.g. quark exchange, quark rescattering, and the quark-gluon string model may become valid.

This proposal continues our previous studies into the reaction mechanism for deuteron photodisintegration. Almost all investigations for photodisintegration, and for other reactions, focus on scaling of the cross sections. Photodisintegration cross sections at large four momentum transfers, $-t$ and $-u$ above about 1 (GeV/c)$^2$, generally follow the constituent counting rules [1], e.g., scale. These rules can be derived from perturbative QCD [2], but the applicability of pQCD to these data is controversial [3]. One surprising feature is that the apparent onset of scaling [4,5] comes at particularly low beam energies, near 1 GeV, for deuteron photodisintegration at $\theta_{\text{cm}} = 90^\circ$.

We have recently, in Jefferson Lab E89-019 [6], studied the recoil proton polarization for this reaction, to test the prediction of hadron helicity conservation, which also arises out of pQCD. This complementary prediction has been previously untested in any photoreaction at large $-t$ and $-u$. It leads to definite simple predictions for certain polarization observables. The data from E89-019 show that recoil proton polarization in deuteron photodisintegration largely follows perturbative expectations.

### *1.1 Deuteron Photodisintegration Polarization Data*

The induced polarization $p_y$, perpendicular to the scattering plane, is consistent with vanishing above 1 GeV - see Fig. 1. Previous data are from [7]. The data suggest the induced polarization is 0, and stays 0 at higher energies - although perhaps the highest energy data point indicates a nonzero polarization at higher energies. Further, the comparison with the Bonn calculation suggests that there are no resonant contributions other than the $\Delta(1232)$. One might expect at high energies, well above the resonance region, that there are many unresolved resonances, which would average to a more or less vanishing polarization. Starting from the Bonn calculation, which includes all the large, well established moderate mass resonances, this does not seem to be a reasonable extrapolation for beam energies of 1 to 2 GeV, for which discrete resonances are observed. Thus, these data suggest that this picture of the reaction mechanism has broken down. Clearly, these calculations are quite difficult and further theoretical study is needed. In contrast, from pQCD, the induced polarization is usually believed to doubly vanish, because of hadronic helicity conservation, and because the induced polarization is the imaginary part of an interference of largely real amplitudes.

Mathematically, the induced polarization results from the imaginary part of a sum of interference terms between pairs of helicity amplitudes. Each term could vanish independently if at least one of the amplitudes is zero (as expected from helicity conservation), or if both of the amplitudes have the same phase (as might be expected in a generalized parton distribution approach). Alternatively, the imaginary parts of the individual non-vanishing terms could add happen to add to 0.

As a further test, we measured the polarization transfers - see Fig. 2. The polarization transfers $C_x$ and $C_z$ lead to the proton spin being polarized in the scattering plane, perpendicular and parallel to the proton momentum

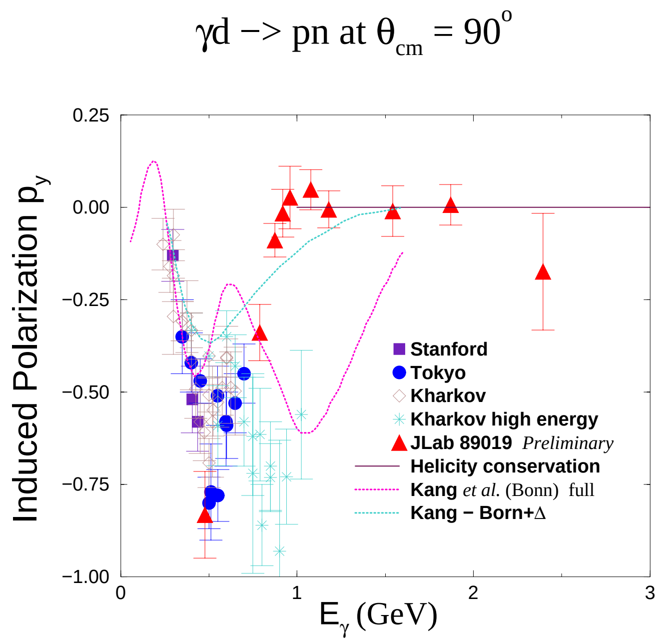


Figure 1: Deuteron photodisintegration induced polarization data from Jefferson Lab E89-019, along with previous data and theoretical estimates.

direction, respectively. The polarization transfer $C_x$ is the real part of the same interference of amplitudes as the induced polarization $p_y$. For these data, we see that the polarization transfers appear to be steadily decreasing above about 1 GeV beam energy. Note that we have no data point at about 1.1 GeV, because the beam for this energy was unpolarized. Although $C_x$ is decreasing, it is nonzero, which suggests that the vanishing of $p_y$ comes from the pairs of amplitudes having the same phase.

The polarization transfer $C_z$ shows a qualitatively similar decrease with energy as $C_x$, though the uncertainties are larger due to the spin transport through the spectrometer magnets. In particular, we report no point for $C_z$ at 2.4 GeV, because the nearly 180° spin rotation through the spectrometer dipole magnet makes the uncertainties on this point about $\pm 1$.

There are no meson-baryon calculations for these observables, and no previous data with which to compare. If we are approaching helicity conservation, one then expects $C_x$ to approach 0. In fact, the decrease of $C_x$ follows $1/-t$, consistent with the helicity-flip amplitudes decreasing faster than the helicity non-flip amplitudes by a power of $-t$, as one expects from simple perturbative arguments. While $C_z$ is not 0 from helicity conservation, further reasonable

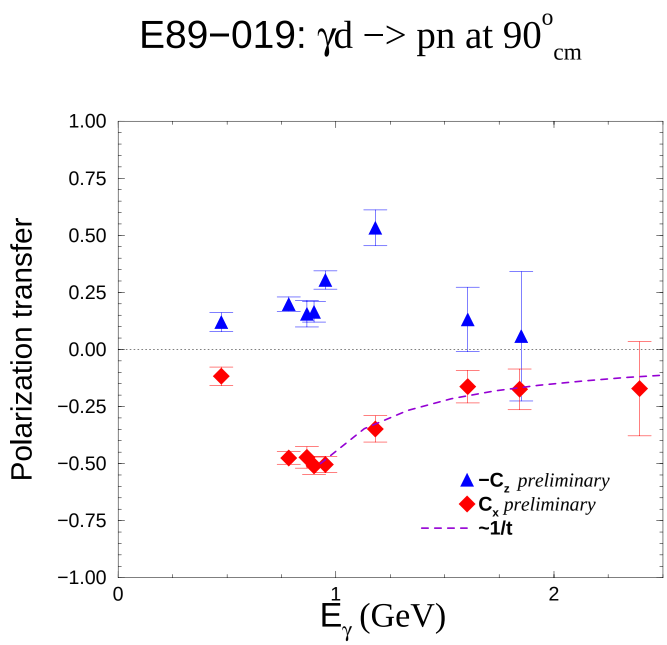


Figure 2: Deuteron photodisintegration polarization transfer data from Jefferson Lab E89-019.

assumptions about the helicity conserving amplitudes at $\theta_{\rm cm} = 90^\circ$ lead to this observable also vanishing.

Thus, we observe that one can justify the *trends* of all the experimental observables for deuteron photodisintegration at $\theta_{\rm cm} = 90^\circ$ on the basis of quark models, including pQCD. This is quite surprising; while approximate scaling of the cross sections has been observed in many reactions, previous measurements of spin observables have tended to show that helicity conservation is not valid, although most of these measurements have been at modest four-momentum transfers, and for meson-baryon or for baryon-baryon reactions. These observations suggest both the importance of the independent scattering mechanism[8], and and further suggest that the point-like coupling of the photon probe in deuteron photodisintegration suppresses the independent scattering, allowing the effects of helicity conservation to appear.

For point particles, helicity conservation is a direct result of the electromagnetic coupling, which violates helicity conservation only at the level of $m/E$. Thus, helicity conservation for quarks is not unreasonable. However, in coupling the quarks to form a nucleon, orbital angular momentum may contribute, leading to the initial and final state hadrons having different helicity.

Large momentum transfer elastic $pp$ scattering is known to have non-vanishing polarizations, and thus hadron helicity non-conservation. As indicated above, one explanation for these data is the contribution of the independent scattering mechanism.[9]

### *1.2 Review of Cross Section Data and Theories*

In the past few years, we have performed several experiments[5,10,11] to study photodisintegration, to attempt to determine the onset of apparent scaling, and thus lead to an understanding of the reaction mechanism. We will show in a series of figures the published results of Hall C experiment 89-012[5], and previous data[4], compared to several predictions. It is clear from the data in Fig. 3 that the large-angle cross sections approximately scale, and also that the angular distribution goes from being about flat near 1 GeV to becoming increasingly forward peaked at the higher energies.

It was first suggested to us by Miller[12] that asymptotic meson baryon theory predictions of cross sections should approximately reduce to the pQCD scaling limit, $d\sigma/dt \propto s^{-11}$ for fixed center of mass angle. This results from phase space factors and from the nucleon form factors that are probed. This result is also approximately derived in the quark picture from both the reduced nuclear amplitudes[13] (RNA) approach to extending the pQCD calculations, and from Radyushkin's approach[14]. The RNA model attempts to account for soft physics and threshold factors by incorporating the nucleon form factors. Radyushkin argues that the reaction proceeds largely via the photon coupling to quarks exchanged between the nucleons. The cross section is given by a convolution of phase space factors, the nucleon form factors, and the short distance hard photo-quark coupling, which can be taken to be about constant, as its kinematic variation is much slower than that of the form factors. In Fig. 3, we compare the data, scaled by $s^{11}$ to the Radyushkin and RNA formulas. Radyushkin's approach appears to work well, being within a factor of two of all the data above 1 GeV, while the RNA approach works quite poorly. Also, Radyushkin's formula is normalized only to the datum at 90° and 1.6 GeV; putting in the kinematic variation of the hard photo-quark coupling might improve the agreement. The RNA approach is normalized separately to the 1.6 GeV datum for each angle. Algebraically, the difference between these two approaches comes largely from an additional factor of $1/p_T^2$ in the RNA approach.

Of course, realistic meson baryon calculations will not look quite like their expected asymptotic magnitudes, since they are based on fits to data that are not entirely asymptotic, and include, e.g., non-asymptotic baryon reso-

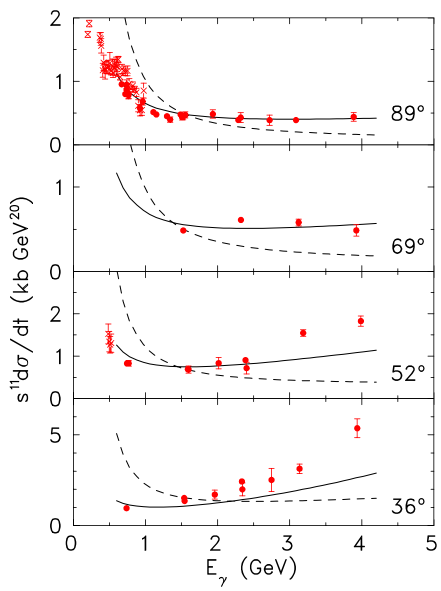


Figure 3: Deuteron photodisintegration data compared to reduced nuclear amplitudes (dash) and Radyushkin (solid) models. The cross sections are multiplied by $s^{11}$, so that pQCD quark-scaling behavior results in a constant value.

nances. In Fig. 4 we show calculations of this type, done by Lee [16], by Kang *et al.* (Bonn) [17], and by Nagornyi and Dieperink [18]. Calculations were also done by Laget [15], and others, but for energies below 1 GeV. The detailed choices of describing the nucleon-nucleon interaction and inclusion of mesons and resonances vary between the calculations. While Laget includes only the $\Delta$ resonance, both Lee and Nagornyi and Dieperink include the $\Delta$ and $N^*$, and the Bonn calculation attempts to include all well established resonances with mass less than 2 GeV and spin less than 5/2. The Nagornyi and Dieperink calculation hypothesizes that the deuteron form factor has both soft and hard parts, with the form of the hard part having the correct asymptotic behavior. The normalization is also fixed to reproduce the data at 1 GeV. Thus, in light of the discussion given above concerning Fig. 3, it is perhaps not too surprising that this calculation follows the data closely. (Note that the calculations shown here were sent to us by Nagornyi, and are slightly different those published [18].)

There are detailed disagreements between the calculations. For example, Lee underpredicts the cross section without final-state interactions (FSI), but overpredicts it when including FSI. Bonn underpredicts the cross section with

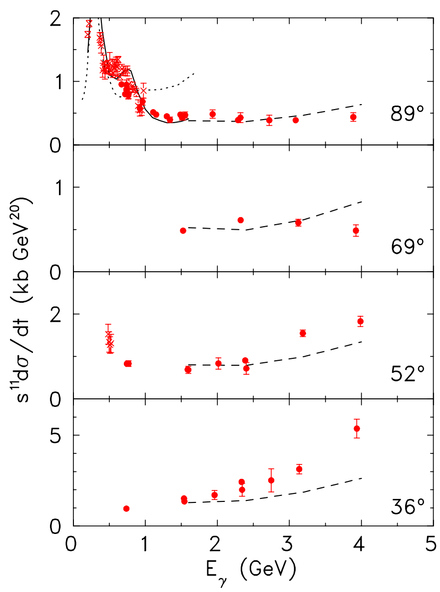


Figure 4: Deuteron photodisintegration data compared to meson-baryon calculations by Lee (solid) and Nagornyi and Dieperink (dash). The Bonn calculation (not shown) essentially overlaps the data points within its range, up to 1.6 GeV.

FSI, and reproduces it correctly through the inclusion of the baryon resonances.

The only polarization calculations are by Laget and by the Bonn group. The Bonn calculations were shown in Fig. 1; the Laget calculation included only the $\Delta$ resonance and was quite similar to the Bonn $\Delta$ + Born term calculation. As indicated above, although the Bonn $\Delta$ + Born term calculation qualitatively reproduces the induced polarization better than the full calculation, it underpredicts the cross section by roughly a factor of two near 1 GeV; thus, leaving out the higher mass resonances does not explain the data.

Two cross section calculations in quark models have also appeared recently - see Fig. 5. The QCD rescattering model of Sargsian *et al.* [19] calculates the deuteron photodisintegration as a convolution of the deuteron wave function, the hard photo-quark coupling, and the proton-neutron scattering amplitude. It takes as input the proton-neutron data, and thus predicts the range within which the photodisintegration data should lie, since there are uncertainties in the proton-neutron data and interpolations between data points are needed to match the photodisintegration kinematics. The model is qualitatively similar in approach to the idea of Radyushkin, but it goes beyond an estimation of

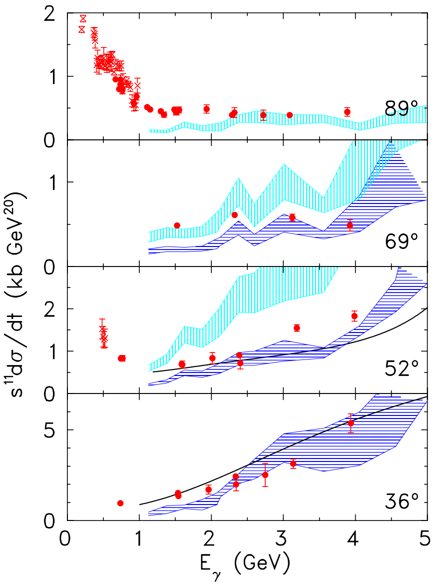


Figure 5: Deuteron photodisintegration data compared to the QCD rescattering model of Sargsian *et al.* with the scaling function $C = 1$ (vertical hatched region) and with the scaling function $C = (-t/s)/(1+t/s)$ (horizontal hatched region), and the quark gluon string model (solid line).

the approximate kinematic dependence. The model formally requires a beam energy above 2.5 GeV and four momentum transfer above 2 $\mathrm{GeV}^2$, but if a particular form for the unknown short distance scaling function is assumed, the model works beyond its nominal limits of validity, both to more forward angles and lower energies. Polarization calculations in this model are currently underway.

The quark gluon string calculations [20] attempt to describe the high energy but low momentum transfer limit of the quark picture, with a Regge theory approach. The QGS calculations are in good agreement with the cross section data at $36^\circ_{cm}$, but poorer agreement at larger angles. Polarization calculations in this model are also currently underway.

### *1.3 Motivation Summary*

We have shown above that the deuteron photodisintegration data at $\theta_{\rm cm} = 90^\circ$ are surprisingly in disagreement with meson-baryon picture expectations, but follow expectations from quark pictures of the reaction dynamics. It appears as if only the $\Delta$ resonance contributes to the reaction. Given the uniqueness of the trends of the data we have seen in the deuteron photodisintegration, it is clearly of high interest to attempt to extend these measurements, to the highest possible energy, to see if the observed trends continue.

If meson-baryon calculations fail, and if pQCD does not apply, then the underlying physics is likely some nonperturbative quark model. Several such models were discussed above. These models tend to follow the general trend of the constituent counting rules, and approximately explain the cross section data. Predictions of polarizations are now underway in these models, but generally our data from E89-019 are either too low in energy or too high in momentum transfer for these models, thus an extension is also important from the perspective of testing the reaction models. A successful approach of this type, that describes deuteron photodisintegration data over a wide range starting from quark degrees of freedom, would be an important step in trying to understand the transition between QCD and meson-baryon degrees of freedom in describing nuclei, one of the major goals for research at the Thomas Jefferson National Accelerator Facility (JLab).

## 2 The Experiment

We propose to measure recoil proton polarizations for deuteron photodisintegration at $\theta_{\mathrm{cm}} = 90^\circ$ for four beam energies, 1.8, 2.1, 2.7, and 3.2 GeV. The 1.8 and 2.1 GeV points are intended to fill in gaps in the E89-019 data, between the 1.67, 1.95 and 2.5 GeV data. The higher energy points provide good uncertainties to the highest possible energies. This choice of energies is also intended to ease scheduling difficulties somewhat. The 2.1 and 3.2 GeV energies can be run with 2 and 3 passes at about 1.1 GeV/pass. The 1.8 and 2.7 GeV energy can be run with 2 and 3 pass beam at about 0.9 GeV/pass. Each of these beam energies could be varied by about 0.1 GeV from the numbers that we give.

It is necessary to improve upon our techniques of E89-019, because we attempt to measure generally at higher energies, for which the cross sections and polarimeter figure of merit are lower. In E89-019, we obtained an uncertainty of $\Delta p_y \approx 0.13$ with a 10-day measurement at 2.5 GeV, with the standard analysis. The decrease in cross section and polarimeter figure of merit with increasing energy leads to prohibitively large time requirements, if the experimental technique is not improved.

### 2.1 E89-019 standard technique

The experimental technique in E89-019 was as follows. We used a 30 $\mu$A, ~70% polarized electron beam impinging on a 6% Cu radiator to generate the polarized photon beam. The mixed electron + photon beam then struck the Hall A 15-cm cryogenic deuterium target. The hadron spectrometer was used to detect protons corresponding to photon energies near the bremsstrahlung end point. Reconstructed target quantities were used to eliminate background events, and scattering of the protons in the polarimeter was used to determine the proton polarization.

To cleanly determine the polarization for $\gamma d$ events, it is needed to determine the electrodisintregration and target cell wall contributions to the data. Measurements were performed for $ed$ events, with the radiator out, and for $\gamma p$ and $ep$ events, with a hydrogen target, rather than an empty target, in place of the deuterium to obtain similar target energy loss effects. Single interactions with hydrogen nuclei lead to protons of low momentum, compared to $\gamma d \to pn$, that are not in the spectrometer momentum acceptance.

The relative rates for these four types of runs were typically 100:30:10:1 for $\gamma d$:$ed$:$\gamma p$:$ep$ run types, and were approximately independent of energy. If one measures and subtracts these backgrounds, keeping total time fixed, the $ed$ background increases the uncertainty by about a factor of 2, while the $\gamma p$ background increases the uncertainty by about a factor of 1.5. The two backgrounds together lead to a factor of 3 increase in the uncertainty. (The $ep$ measurement is to correct for over subtraction, takes little time, and has little effect.)

### 2.2 Improved technique

We have identified three ways to improve the experiment so that we can make measurements at a higher energy, while still performing a singles measurement of $d(\gamma, p)n$.

1. Improve the FPP analyzer.

2. Increase the event rate.

3. Decrease the background.

We propose to improve the FPP analyzer by using the $CH_2$ analyzer being developed for E99-007, which extends $G_E^p$ measurements [21] to higher $Q^2$, and is tentatively scheduled for late fall 2000. The experiment will install a thick $CH_2$ analyzer with higher figure of merit in the polarimeter. At the higher proton energies of this proposal, the $CH_2$ analyzer has about twice the analyzing power, and the same efficiency, as the carbon analyzer, leading to a factor of four reduction in the beam time needed. Installation and removal of the thicker analyzer are difficult tasks; we assume that this experiment can be scheduled along with other experiments that use the modified analyzer to reduce overhead.

We propose to increase the event rate by operating at higher beam current. We previously limited the beam current to 30 $\mu$A, to limit site boundary radiation. For this measurement, we propose to increase the current so that we run with 50 $\mu$A of beam of polarization 75% . This current is consistent with recent experimental experience with the strained GaAs polarized source. We expect that this will require installation of some local shielding near the radiator to reduce site boundary radiation. (At this point, results for site boundary radiation during the conditions of E89-019 have not been analyzed, so it is not clear how much reduction is needed.) The additional heating of the radiator foil at the higher currents is not a problem.

We also propose to decrease backgrounds in the experiment. The main point here is a straightforward change in the analysis, rather than an actual decrease in the background. There is no simple way to decrease the number of electrodisintegration events, as long as the electron beam goes through the target. These events have essentially the same kinematics as photon production in the radiator followed by photodisintegration. There is also no simple way to decrease the number of events from the target cell walls. Tighter cuts to reduce the tail of the wall contributions also reduces the events of interest.

As part of the analysis of E89-019, we investigated the proton polarizations for the different beam and target conditions, radiator in / out and deuterium / hydrogen targets, as described above. Our expectation, based on the work of Tiator and Wright[22], was that the electrodisintegration events near the photon endpoint would be dominated by the transverse response, leading to the same proton polarizations as for the photodisintegration events. We found this idea to be generally true, with no statistically significant differences between the electro- and photo-disintegration polarizations in the data points above 1 GeV. For this experiment, we plan to make measurements of the electrodisintegration polarizations to check that this remains the case at higher energies. If no significant discrepancies are found, these data sets will be added so that the statistical uncertainty is reduced, rather than subtracted, which would increase the statistical uncertainty.

The data we showed previously for the photodisintegration polarizations have uncertainties approximately doubled by the electrodisintegration subtraction, with essentially no change in the centroid of the data point. Thus, avoiding the subtraction roughly halves our uncertainties, reducing the time needed by a factor of four. One could assume that the photo- and electro-polarizations are the same, and not measure the electrodisintegration background. The additional statistics then obtained in the extra beam time with $\gamma d$ and $\gamma p$ runs then leads to a further reduction in the statistical uncertainties of $\approx$20 %. Our preference is to measure the electrodisintegration for the more precise, lower energy points of this proposal - leading to the increased uncertainty - but to assume the equality of the photo- and electro-disintegration polarizations for the highest energy point, as this point is less precise and the time saved is significant.

The hydrogen target data measured interactions with the aluminum cell walls, which, in our simple expectation, would average over many kinematics for Al($\gamma$,p)X, leading to small polarizations. However, the $\gamma p$ polarizations were not consistently zero. Thus this background must be measured and subtracted.

Putting all of these factors together, *these high energy data require over an order of magnitude less time to measure* as compared to measurements using just the standard technique from E89-019. The 2.5 GeV datum from E89-019 is improved by the changed analysis from an uncertainty of 0.16 (in 10 days) to 0.08. The $CH_2$ analyzer and higher beam current would have given a further improvement to $\Delta p_y = 0.03$, in the same time.

### *2.3 Parasitic Cross Section Measurements*

While the focus of this proposal is the recoil proton polarization at $\theta_{\rm cm} = 90°$, this measurement requires only a single spectrometer arm. During the same time we are measuring proton polarizations with the hadron arm, it is possible to measure photodisintegration cross sections with the electron spectrometer set for positively charged particles. We note that the PAC approved our experiment 99-008 to take such measurements during the running of E89-019, and the data were successfully obtained. The time of the polarization measurements is sufficient to do a complete angular distribution, at center of mass angles of 37°, 53°, 69°, 90°, 111°, 127°, and 143°. We plan to do such measurements at each of the beam energies of this proposal, except 1.8 GeV. (Given the short time at 1.8 GeV, the additional measurements would be too distracting.)

The point of these data is that the forward - backward cross section ratio varies dramatically between different meson-baryon and quark models of deuteron photodisintegration; thus these data provide a further constraint on the reaction dynamics. For example, in Radyushkin's model, the kinematic dependence of the short distance photo-quark absorption process is unknown, assumed to be a slow function of kinematics, and taken to be unity. Thus, in this model, the difference between the measured and predicted angular distribution provides information on the unknown short distance physics. In Radyushkin's model, the angular distribution is expected to be largely symmetric, and thus one might expect the large angle cross sections to also be slightly underpredicted.

These cross section measurements can be done parasitically with no additional time required. The event rates are sufficiently small that all singles events from both spectrometers can be read out with only a few percent dead time. The hadron spectrometer will measure between 40 and 300 thousand photodisintegration events at each beam energy. At the same time, we can measure a similar number of events in the electron arm, to be divided between the several electron arm angles, to determine the cross sections.

### *2.4 Time Estimate*

The kinematics now accessible with the improvements of this experiment are shown in Table 1. These estimates make standard assumptions for the spectrometer acceptance, about 5 msr for an extended target, for the beam current, 50 $\mu$A, and for the liquid deuterium target length, 15 cm. Also included are the dipole approximation to the spin transport, which leads to increased uncertainties for $C_z$, and 75% polarization of the electron beam. The $CH_2$ analyzer figure of merit is estimated with a Monte Carlo simulation. As indicated above, we measure the electrodisintegration for the three more precise, lower energy data points, but not for the point at 3.2 GeV. (Note that an extension to 4 GeV would require over 100 days for uncertainties of 0.2 on $p_y$; this is clearly excessive.)

In Figs. 6 and 7, we repeat the existing data for $p_y$ and $C_x$, along with the proposed measurements of this proposal set to arbitrary values, but with the expected statistical uncertainties. The analysis of E89-019 shows that systematic uncertainties are generally below 0.05; we anticipate similar systematic uncertainties for these measurements.

An additional two days are needed for elastic *ep* scattering to calibrate the polarimeter; these measurements can all be done at 3.2 GeV, the highest beam energy at which we measure photodisintegration data. The total time required would be 19 days for the physics measurements, plus 2 days for the calibrations, for a total of 21 days.

Table 1: Kinematics and polarization statistical uncertainties for $d(\gamma,p)n$ at $\theta_{cm} = 90°$.

| Quantity | Units | | | | |
|---|---|---|---|---|---|
| $E_e$ | (GeV) | 1.8 | 2.1 | 2.7 | 3.2 |
| $\theta_{lab}$ | (deg) | 56.0 | 53.9 | 50.2 | 47.7 |
| $p_p$ | (GeV/c) | 1.52 | 1.70 | 2.03 | 2.30 |
| $p_T$ | (GeV/c) | 1.3 | 1.4 | 1.6 | 1.7 |
| $-t$ | $(\mathrm{GeV/c})^2$ | 2.4 | 2.9 | 4.1 | 5.0 |
| rate | (cts/hr) | 12000 | 4400 | 700 | 200 |
| time | (days) | 1 | 3 | 7 | 8 |
| $\Delta p_y$ | (abs) | 0.05 | 0.05 | 0.05 | 0.10 |
| $\Delta C_z$ | (abs) | 0.13 | 0.24 | 0.41 | 0.23 |
| $\Delta C_x$ | (abs) | 0.06 | 0.07 | 0.07 | 0.12 |

## 3 Summary

During fall 1999, this collaboration measured recoil proton polarization in deuteron photodisintegration. The results, quite surprisingly, largely agree with quark model expectations, and imply that the meson baryon picture breaks down. It is clearly of interest to extend these data to higher energies, to see if these trends continue. Further, recently developed quark models, such as the QCD rescattering model, require for testing beam energies at the limit of, and above, our previous measurements. With improvements in the experimental technique, we are able to make such precise measurements up to 3.2 GeV. We request 21 days to measure 4 data points plus calibrations.

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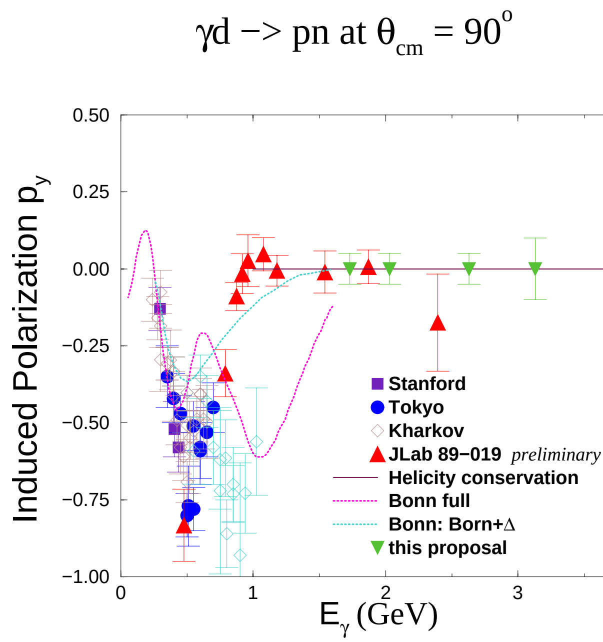


Figure 6: Deuteron photodisintegration induced polarization data, including the proposed points of this measurement. See text.

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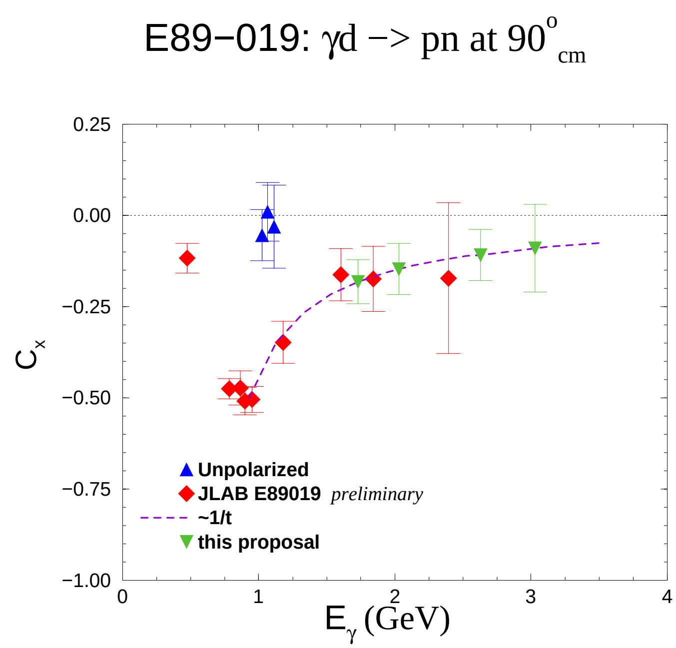


Figure 7: Deuteron photodisintegration polarization transfer data, including the proposed points of this measurement. See text.

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