A personal view on Gary’s accomplishments in physics

Jacques Soffer

Physics Department, Temple University, Philadelphia,PA, USA

Essential key words

- Meson Photoproduction
- Proton proton elastic scattering
- Proton deuteron elastic scattering
- Transversity frame
- Amplitude analysis
- Polarization in inclusive reactions
- Polarization properties of top quark
- Single quark polarization
- Transversity distribution
- Tensor charge
- Fragmentation function
- Exclusive meson electroproduction
- etc.......

Many collaborators

- K.C. Wali
- M. Moravcsik
- J. Owens
- R. Dalitz
- R. Jaffe
- X.D. Ji
- L. Gamberg
- S. Liuti
- etc......

EXCLUSIVE REACTIONS

Very relevant today at JLab

Nuclear Physics B80 (1974) 164 – 188, North-Holland Publishing Company

SPIN CORRELATION MEASUREMENTS
IN PSEUDOSCALAR MESON PHOTOPRODUCTION*

Gary R. GOLDSTEIN, Joseph F. OWENS III† and John P. RUTHERFOORD
Physics Department, Tufts University, Medford, Massachusetts 02155

Michael J. MORAVCSIK
Institute of Theoretical Physics, University of Oregon, Eugene, Oregon 97403

Received 2 October 1973
(Revised 30 April 1974)

Abstract: Because polarized photon beams and polarized proton targets have improved considerably and the techniques for measuring recoil baryon polarizations are continually improving, it is becoming feasible to measure double and triple spin correlations in pseudoscalar meson photoproduction. Of the large number of such experiments possible, only a few will add significantly new information to that already obtained from the existing cross section and limited polarization measurements. Using a simple, general, and transparent method, we shall show that all such measurements fall into three classes: (a) those which are equivalent to more simple measurements, (b) those which are highly bounded by previous measurements, and (c) those which yield truly new information.

Optimization

ANNALS OF PHYSICS **98**, 128–159 (1976)

Optimally Simple Connection between the Reaction Matrix and the Observables*

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AND

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Received September 1, 1975

A class of optimal formalisms is derived to describe in the simplest possible way the relationship between the amplitudes of an arbitrary four-particle reaction and the experimental observables for that reaction. Within the optimal class (which includes none of the currently used formalisms) there are an infinite number of realizations depending on coordinate systems and quantization axes. The matrix connecting the bilinear combinations of amplitudes and the experimental observables (the X-matrix) for the optimal class consists only of small submatrices along the main diagonal, the maximum sizes of which are independent of the values of the spins involved. Two examples are worked out in detail: $\frac{1}{2} + 0 \to \frac{1}{2} + 0$ and $1 + \frac{1}{2} \to 0 + \frac{1}{2}$, and it is shown that the optimal prescription in conjunction with quantization along the normal of the reaction plane gives an unprecedentedly simple X-matrix as well as constraints among the observables imposed by parity conservation, which are also maximally simple. The advantages of the new class of formalisms are enumerated for the purposes of studies of high energy and nuclear reactions.

Bicoms

quantities. In any formalism we have a linear relationship between the experimental measurements on the one hand and the bilinear combinations ("bicoms") of the amplitudes, on the other. In general, however, the matrix connecting the observables and the bicoms (the "X-matrix") will be far from diagonal, and hence, a given measurement will depend on many bicoms and vice versa. As a result, the relationship between the bicoms and the observables will be a rather involved one, thus, in a practical sense complicating the determination of the amplitudes from the measurements and the answering of the other questions asked above. Considering that the cost of a single experiment in high energy physics can easily exceed $1 million dollars, there is a very strong incentive to simplify this relationship as much as possible.

Don’t be afraid of summation!

The final density matrix is then

$$
\begin{aligned}
\rho_F(uv, UV) &= M\rho_I(uv, UV)\, M^\dagger \\
&= (M^{(13)} \otimes M^{(24)})[\rho_I(uv)\, \rho_I(UV)](M^{(13)\dagger} \otimes M^{(24)\dagger}) \\
&= \sum_{l}\sum_{\lambda}\sum_{l'}\sum_{\lambda'}\sum_{L}\sum_{\Lambda}\sum_{L'}\sum_{\Lambda'} D(\lambda l, \Lambda L)\, D^*(\lambda' l', \Lambda' L') \\
&\qquad \times (\mathscr{S}^{\lambda l})(\rho_I^{uv})(\mathscr{S}^{\lambda' l'})(\mathscr{S}^{\Lambda L})(\rho_I^{UV})(\mathscr{S}^{\Lambda' L'}),
\end{aligned}
\tag{2.25}
$$

or in components

$$
\begin{aligned}
[\rho_F(uv; UV)]_{\alpha\beta,\Gamma\Delta} &= \sum_{l}\sum_{\lambda}\sum_{l'}\sum_{\lambda'}\sum_{L}\sum_{\Lambda}\sum_{L'}\sum_{\Lambda'} D(\lambda l, \Lambda L)\, D^*(\lambda' l', \Lambda' L') \\
&\qquad \times \sum_{a}\sum_{b}\sum_{A}\sum_{B} (\mathscr{S}^{\lambda l})_{\alpha a}\, (\rho_I^{uv})_{ab} \\
&\qquad \times (\mathscr{S}^{\lambda' l'})^*_{b\beta}\, (\mathscr{S}^{\Lambda L})_{\Gamma A}\, (\rho_I^{UV})_{AB}\, (\mathscr{S}^{\Lambda' L'})^*_{B\Delta},
\end{aligned}
\tag{2.26}
$$

and finally, the observables

$$
\begin{aligned}
\mathscr{L}(uv, UV; \xi\omega, \Xi\Omega) &= \sum_{l}\sum_{\lambda}\sum_{l'}\sum_{\lambda'}\sum_{L}\sum_{\Lambda}\sum_{L'}\sum_{\Lambda'} D(\lambda l, \Lambda L)\, D^*(\lambda' l', \Lambda' L') \\
&\qquad \times \sum_{a}\sum_{b}\sum_{A}\sum_{B}\sum_{\alpha}\sum_{\beta}\sum_{\Gamma}\sum_{\Delta} (Q^{\xi\omega})_{\beta\alpha}\, (\mathscr{S}^{\lambda l})_{\alpha a}\, (\rho_I^{uv})_{ab}\, (\mathscr{S}^{\lambda' l'})^*_{b\beta}
\end{aligned}
$$

Amplitude analysis in the transversity formalism

PHYSICAL REVIEW D VOLUME 28, NUMBER 5 1 SEPTEMBER 1983

Amplitude analysis of elastic *p*-*p* scattering at 6 GeV/*c* at all *t*'s

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Michael J. Moravcsik
Department of Physics and Institute of Theoretical Science, University of Oregon, Eugene, Oregon 97403
(Received 13 October 1982)

The extensive set of polarization data obtained at the Argonne Zero Gradient Synchrotron for elastic proton-proton scattering at 6 GeV/c at a full set of values of t is used to determine the five complex reaction amplitudes, using the optimal formalism. The determination is easiest in the transversity formalism, and from that the "planar" amplitudes (including the helicity amplitudes) are obtained. A complete determination is made at 20 different values of t, from -0.1 to -1.0 $(\mathrm{GeV}/c)^2$, using data interpolated in t. In addition, a less complete set of data permits the determination of the five magnitudes (but not of the four phases) in the range from $t=-1.0$ to $t=-2.0$ $(\mathrm{GeV}/c)^2$. The magnitudes of the five amplitudes can be obtained without any ambiguity, but for the four relative phases several distinct solutions exist, one of which is selected on the basis of continuity in t and minimum χ^2. There continues to be evidence that in the planar system in which the orientation axes are 90° from the helicity axes, all amplitudes tend to be either pure real or pure imaginary.

Amplitude analysis in the transversity formalism

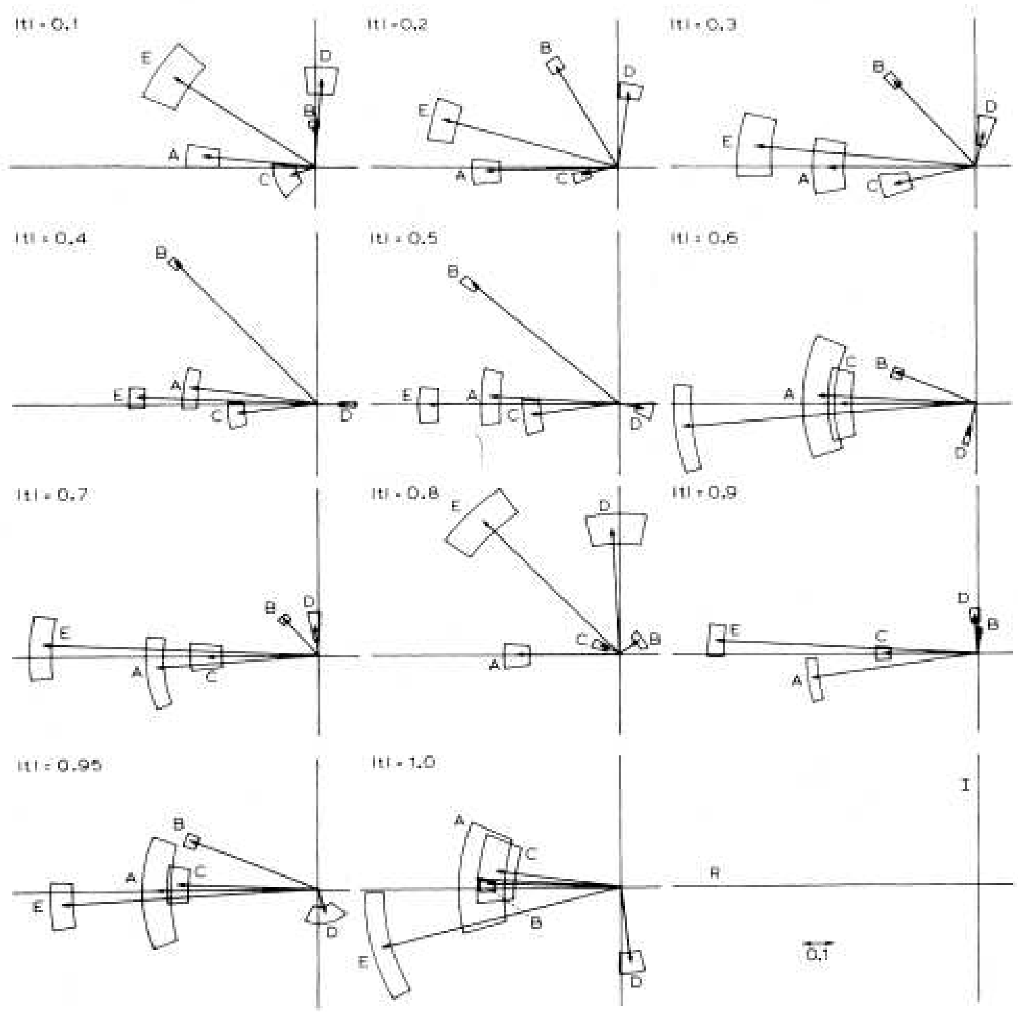

FIG. 2. 90° planar amplitudes for elastic *p-p* scattering at 6 GeV/*c* at various *t* values. The magnitudes are normalized so that the differential cross section is unity. The wedge-shaped figures at the ends of the amplitude vectors denote errors. For details of the procedure leading to these amplitudes, see the text.

Very relevant to study three-body forces (Riken)

ANNALS OF PHYSICS **171**, 205–232 (1986)

Polarization Measurements in *p–d* Elastic Scattering: The Structure of $\frac{1}{2} + 1 \rightarrow \frac{1}{2} + 1$

MICHAEL J. MORAVCSIK AND HUSSEIN M. SINKY

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AND

GARY R. GOLDSTEIN

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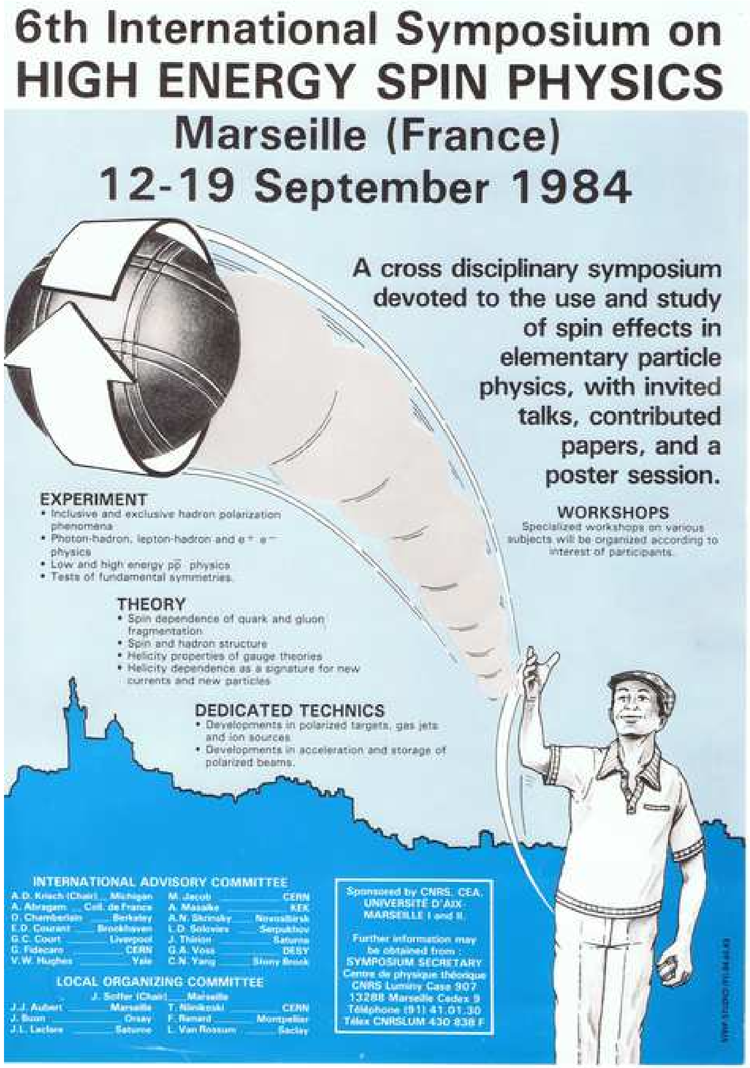
Received January 7, 1985

The polarization structure of the reaction $\frac{1}{2} + 1 \rightarrow \frac{1}{2} + 1$ elastic scattering, with parity conservation and time reversal invariance, is exhibited in a very compact way using the optimal transversity frame. The relationship between observables and amplitude products is reduced to six small matrices. Sets of experiments are proposed which determine the amplitudes. It is shown that the presently available set of polarization measurements needs to be enlarged considerably for such an amplitude determination. It is illustrated how such analyses can greatly expedite and simplify the economical planning of programs of polarization experiments.

6th Int. Spin Symposium - Marseille 1984



6th Int. Spin Symposium - Marseille 1984

Samedi 15 septembre 1984 685 **marseille** Page CINQ **Le Méridional**

Neutrons et particules nucléaires...

200 savants internationaux réunis à la fac de pharmacie dans le cadre du 6e symposium sur la physique du SPIN à haute énergie

6th Int. Spin Symposium - Marseille 1984

6th Int. Spin Symposium - Marseille 1984

JOURNAL DE PHYSIQUE
Colloque C2, supplément au n°2, Tome 46, février 1985 page C2-231

EXPLORING DYNAMICS THROUGH POLARIZATION

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Department of Physics, Tufts University, Medford, Mass. 02155, U.S.A.
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Résumé - Nous présentons une revue du formalisme optimal qui est appliqué à la détermination de plusieurs amplitudes à partir des observables de la diffusion pp élastique. Un modèle de Regge élaboré ne réussit pas à expliquer ces amplitudes, mais le schéma OPE reste valable. On trouve une étonnante simplification dans le repère "de côté". Nous considérons la pertinence de QCD.

Abstract - The Optimal Formalism is reviewed and applied to determining various amplitudes from observables in pp elastic scattering. A sophisticated Regge model fails to explain these amplitudes, but OPE remains valid. Striking simplicity is found in the "sideways" frame. The relevance of QCD is considered.

JOURNAL DE PHYSIQUE
Colloque C2, supplément au n°2, Tome 46, février 1985 page C2-333

TESTS OF DYNAMICS THROUGH POLARIZATION EXPERIMENTS : THE CASE OF THE DIBARYON

G.R. Goldstein and M.J. Moravcsik*

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Résumé - Nous présentons une revue du formalisme optimal pour relier les amplitudes et les observables dans la diffusion à deux corps. Ce formalisme est appliqué au problème de la détermination complète d'ensembles non ambigüs d'amplitudes ; il conduit au fait que le vecteur polarisation est superflu pour déterminer les amplitudes du deuteron et au fait que des états dibaryon singlet et triplet sont plausibles dans la diffusion élastique p-p.

Abstract - The Optimal Formalism for relating amplitudes and observables in two-body scattering is reviewed. It is applied to : the problem of determining complete unambiguous sets of amplitudes ; the redundancy of vector polarization for determining deuteron amplitudes ; the plausibility of singlet and triplet dibaryon states in p-p elastic scattering.

A relevant question still unanswered

Volume 157B, number 2,3 PHYSICS LETTERS 11 July 1985

SHOULD WE EXPECT LARGE POLARIZATION EFFECTS AT HIGH ENERGIES?

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Received 26 November 1984; revised manuscript received 14 January 1985

It is demonstrated that while in reactions at very high energies polarization quantities in which the polarization of only one particle is specified are likely to be small, due to dynamics-independent factors, for many of the kinematic configurations of interest (and particularly at small t values), this is in no way indicative of other polarization quantities many of which could very well be far from the trivial values of 0 and 1. An example illustrates the statement.

INCLUSIVE REACTIONS

Polarization in inclusive reactions

Nuclear Physics B103 (1976) 145–171

POLARIZATION IN INCLUSIVE REACTIONS

Gary R. GOLDSTEIN
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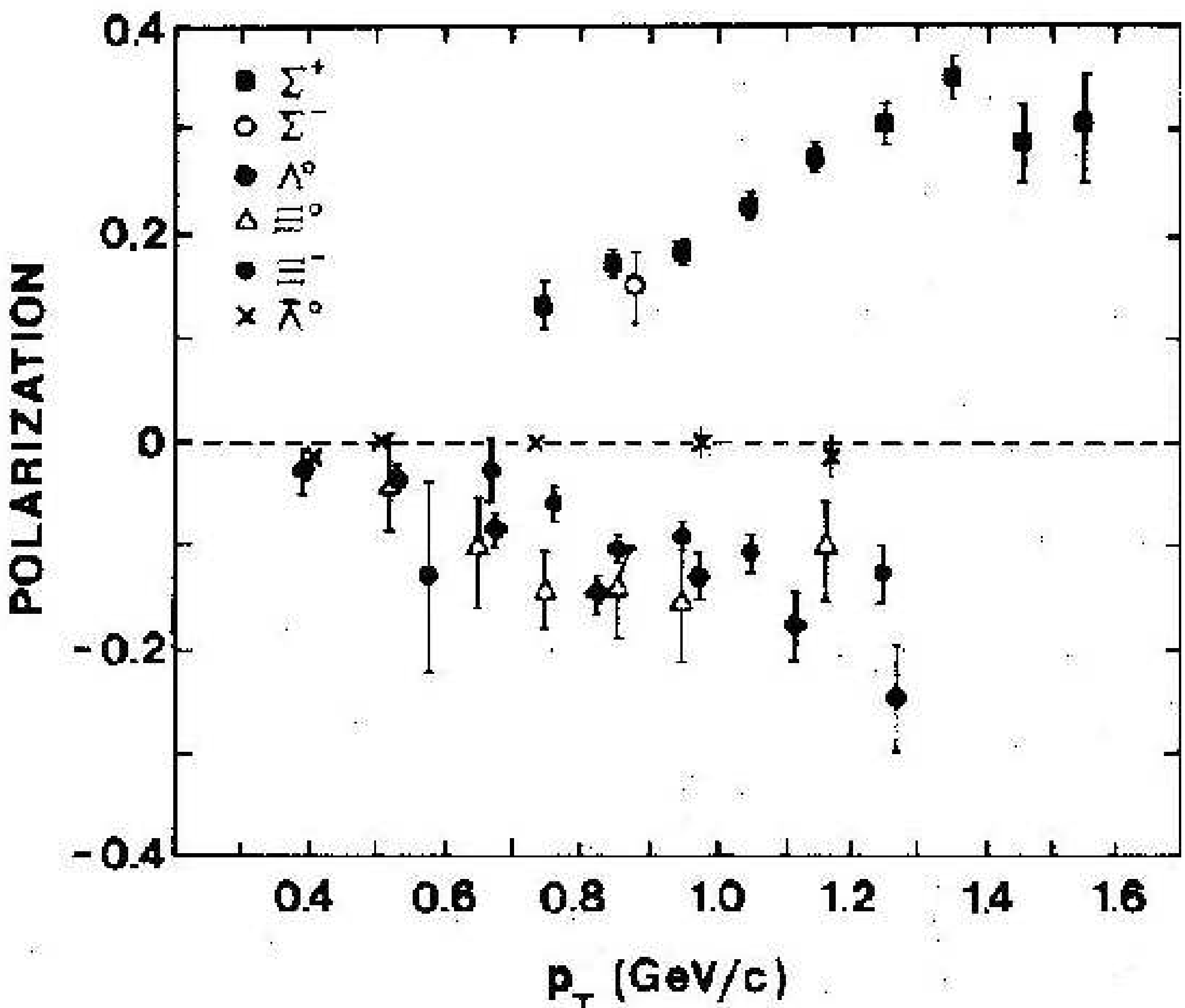
Joseph F. OWENS
Case Western Reserve University, Cleveland Ohio 44106

Received 18 August 1975

A formalism for discussing the spin dependence of inclusive reactions is presented. The role of various constraints following from conservation of parity and angular momentum conservation is discussed. Expressions for specific single and double polarization observables are presented. Predictions of the triple-Regge model for these observables are given.

New surprises: Large A_N in hyperon inclusive production at FNAL in 1976

Many more puzzling single spin asymmetry data since then



QCD estimates

RAPID COMMUNICATIONS

PHYSICAL REVIEW D VOLUME 41, NUMBER 5 1 MARCH 1990

Gluon fusion as a source for massive-quark polarization

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(Received 20 October 1989)

It is well known that single-polarization asymmetries are large in hyperon production in contrast with naive QCD predictions. We have explored the possibility of polarization of quarks through "gluon fusion," assuming that the quark mass can be significant at energies of interest. The fourth-order contribution to the single-spin asymmetry in $g+g\rightarrow s+\bar{s}$ is calculated. Properties of the polarization of the strange quark in the hadron center-of-mass frame are discussed. A fit to the hyperon polarization is presented that reproduces the unique and striking kinematic dependence of the data. This is evidence that gluon fusion can be taken as a serious candidate for the "seed" of polarization.

QCD estimates

PHYSICAL REVIEW D VOLUME 53, NUMBER 3 1 FEBRUARY 1996

Single quark polarization in quantum chromodynamics subprocesses

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(Received 29 August 1995)

It is well known that the single-polarization asymmetries vanish in QCD with massless quarks. But, heavy quarks with a nonzero mass should be transversely polarized due to the breakdown of the helicity conservation. In this paper we give the exact fourth-order perturbative QCD predictions for the transverse polarization from all QCD subprocesses, $q+q' \to q+q'$, $q+g \to q+g$, $g+g \to q+\bar{q}$, and $q+\bar{q} \to q'+\bar{q}'$, which are significant for heavy quark production, with a description of the method of calculation. The kinematical dependence of the polarization is discussed. Top quark polarization from gluon fusion and quark annihilation processes, which are the important subprocesses at high energies, is estimated and its significance is discussed.

PACS number(s): 12.38.Bx, 13.88.+e

Dalitz-Goldstein 1992, before top discovery

PHYSICAL REVIEW D VOLUME 45, NUMBER 5 1 MARCH 1992

Decay and polarization properties of the top quark

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Gary R. Goldstein
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(Received 1 November 1991)

Polarization and angular distributions in the decay sequence $t \to bW^+, W^+ \to l^+\nu_l$ are discussed for the standard model. Top quarks from $e^+e^- \to t\bar{t}$ are predicted to have large polarization but, even if not, the parity-violating effects in this decay chain are large and will test closely the detailed spin structure of the electroweak interactions involving the top quark. A means of analyzing $\bar{t}t$ decays following $\bar{t}t$ production in hadronic interactions is developed, leading to an illuminating construction. Its application is illustrated by the analysis of the candidate for top-antitop pair creation in $\bar{p}p$ collisions found by the Collider Detector at Fermilab (CDF) at 1.8 TeV center-of-mass energy. If this is really $\bar{t}t$ production, then the top-quark mass would be 125^{+19}_{-11} GeV/c^2.

PACS number(s): 14.80.Dq, 13.20.Jf, 13.88.+e

Transversity distribution

PHYSICAL REVIEW D   VOLUME 52, NUMBER 9   1 NOVEMBER 1995

Soffer's inequality

Gary R. Goldstein
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(Received 13 January 1995)

Various issues surrounding a recently proposed inequality among twist-two quark distributions in the nucleon are discussed. We provide a rigorous derivation of the inequality in QCD, including radiative corrections and scale dependence. We also give a more heuristic, but more physical derivation, from which we show that a similar inequality does not exist among twist-three quark distributions. We demonstrate that the inequality does not constrain the nucleon's tensor charge. Finally we explore physical mechanisms for saturating the inequality, arguing it is unlikely to occur in nature.

PACS number(s): 13.88.+e, 12.39.Ki, 13.60.Hb

ACKNOWLEDGMENTS

We thank Jacques Soffer for discussions and a prepublication copy of Ref. [1]. This work is supported in part by funds provided by the U.S. Department of Energy (D.O.E.) under cooperative agreement No. DF-FC02-94ER40818 and No. DE-FG02-92ER40702.

Nucleon tensor charge

VOLUME 87, NUMBER 24 PHYSICAL REVIEW LETTERS 10 DECEMBER 2001

Flavor-Spin Symmetry Estimate of the Nucleon Tensor Charge

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(Received 5 July 2001; published 19 November 2001)

The axial vector and tensor charge, defined as the first moments of the forward nucleon matrix elements of corresponding quark currents, are essential for characterizing the spin structure of the nucleon. There are no definitive theoretical predictions for the tensor charge, aside from several model-dependent calculations. We present a new approach that exploits the approximate mass degeneracy of the light axial vector mesons [$a_1(1260)$, $b_1(1235)$, and $h_1(1170)$] and uses pole dominance to calculate the tensor charge. The result is simple in form. It depends on the decay constants of the axial vector mesons and their couplings to the nucleons.

DOI: 10.1103/PhysRevLett.87.242001 PACS numbers: 12.40.Vv, 11.30.Ly, 11.40.Ha, 14.40.Cs

Nucleon transversity properties

RAPID COMMUNICATIONS

PHYSICAL REVIEW D **67**, 071504(R) (2003)

Novel transversity properties in semi-inclusive deep inelastic scattering

Leonard P. Gamberg
Division of Science, Penn State-Berks Lehigh Valley College, Reading, Pennsylvania 19610

Gary R. Goldstein
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(Received 12 January 2003; revised manuscript received 4 February 2003; published 29 April 2003)

The T-odd distribution functions contributing to the transversity properties of the nucleon and their role in fueling nontrivial contributions to azimuthal asymmetries in semi-inclusive deep inelastic scattering are investigated. We use a dynamical model to evaluate these quantities in terms of HERMES kinematics.

DOI: 10.1103/PhysRevD.67.071504 PACS number(s): 12.38.−t, 13.60.−r, 13.85.Hd, 13.88.+e

T-odd effects

Available online at www.sciencedirect.com

ScienceDirect

PHYSICS LETTERS B

ELSEVIER

Physics Letters B 650 (2007) 362–368

www.elsevier.com/locate/physletb

"T-odd effects" in unpolarized Drell–Yan scattering

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[b] *Department of Physics and Astronomy, Tufts University, Medford, MA 02155, USA*

Received 16 June 2006; received in revised form 2 May 2007; accepted 7 May 2007

Available online 26 May 2007

Editor: W. Haxton

Abstract

We consider the leading twist "T-odd" contributions as the dominant source of the $\cos 2\phi$ azimuthal asymmetry in unpolarized $p\bar{p} \to \mu^- \mu^+ X$ di-lepton production in Drell–Yan scattering. This asymmetry contains information on the distribution of quark transverse spin in an unpolarized proton. In a parton-spectator framework we estimate these asymmetries at 50 GeV center of mass energy. This azimuthal asymmetry is interesting in light of proposed experiments at GSI, where an anti-proton beam is ideal for studying the transversity properties of quarks due to the dominance of *valence* quark effects.

Transverse quark spin effects

Available online at www.sciencedirect.com
ScienceDirect
Physics Letters B 659 (2008) 234–243
PHYSICS LETTERS B
www.elsevier.com/locate/physletb

Collins fragmentation function for pions and kaons in a spectator model

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[b] *Department of Physics, Penn State University, Berks, Reading, PA 19610, USA*
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Received 27 July 2007; received in revised form 12 September 2007; accepted 13 September 2007

Available online 5 December 2007

Editor: A. Ringwald

Abstract

We calculate the Collins fragmentation function in the framework of a spectator model with pseudoscalar pion–quark coupling and a Gaussian form factor at the vertex. We determine the model parameters by fitting the unpolarized fragmentation function for pions and kaons. We show that the Collins function for the pions in this model is in reasonable agreement with recent parametrizations obtained by fits of the available data. In addition, we compute for the first time the Collins function for the kaons.

PACS: 13.60.Le; 13.87.Fh; 12.39.Fe

Transverse quark spin effects

PHYSICAL REVIEW D **77**, 094016 (2008)

Transverse quark spin effects and the flavor dependence of the Boer-Mulders function

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[1]*Division of Science, Penn State Berks, Reading, Pennsylvania 19610, USA*
[2]*Department of Physics and Astronomy, Tufts University, Medford, Massachusetts 02155, USA*
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(Received 1 October 2007; published 21 May 2008)

The naive time-reversal-odd ("T-odd") parton distribution $h_1^\perp$, the so-called Boer-Mulders function, for both up (u) and down (d) quarks is considered in the diquark spectator model. While the results of different articles in the literature suggest that the signs of the Boer-Mulders function in semi-inclusive deep inelastic scattering (SIDIS) for both flavors u and d are the same and negative, a previous calculation in the diquark spectator model found that $h_1^{\perp(u)}$ and $h_1^{\perp(d)}$ have different signs. The flavor dependence is of significance for the analysis of the azimuthal $\cos(2\phi)$ asymmetries in unpolarized SIDIS and Drell-Yan processes, as well as for the overall physical understanding of the distribution of transversely polarized quarks in unpolarized nucleons. We find substantial differences with previous work. In particular, we obtain half and first moments of the Boer-Mulders function that are negative over the full range in Bjorken x for both the u and d quarks. In conjunction with the Collins function, we then predict the $\cos(2\phi)$ azimuthal asymmetry for π^+ and π^- in this framework. We also find that the Sivers u and d quarks are negative and positive, respectively. As a by-product of the formalism, we calculate the chiral-odd but "T-even" function $h_{1L}^\perp$, which allows us to present a prediction for the single-spin asymmetry $A_{UL}^{\sin(2\phi)}$ for a longitudinally polarized target in SIDIS.

DOI: 10.1103/PhysRevD.77.094016 PACS numbers: 12.38.−t, 13.60.−r, 13.88.+e

Exclusive meson electroproduction

Exclusive Meson Electroproduction: GPDs, Regge and Dispersion Relations

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†University of Virginia, Department of Physics, Charlottesville, VA 22901, USA.

Abstract. Exclusive pi0 electroproduction from nucleons at large photon virtuality can be described in terms of Generalized Parton Distributions, particularly the chiral odd subset. Chiral odd GPDs are related to transversity and can be accessed experimentally for various special choices of observables. This is accomplished by choosing C-parity odd and chiral odd combinations of t-channel exchange quantum numbers. These GPDs are calculated in a spectator model, and are constrained by boundary functions. Alternatively, the production amplitudes correspond to C-odd Regge exchanges with final state interactions. The helicity structure of the virtual photoproduction amplitudes provides relations between the partonic description via GPDs and the hadronic, Regge description of C-odd processes, all via quark helicity flip. GPDs, in general, are analytic functions of energy variables. Their integrals over unobservable parton momenta thereby satisfy Dispersion Relations (DR). Using DR's could allow the real part of the amplitudes, the integrated GPDs, to be extracted from the more easily measured imaginary parts. However, at non-zero momentum transfer DRs require integration over unphysical regions of the variables. We show that the relevant unphysical region of the non-forward DRs is considerable. This will vitiate the efforts to avoid the actual measurement of the real parts more directly.

Keywords: exclusive, electroproduction, GPD, Regge, dispersion relation
PACS: 11.55.Fv, 12.40.Nn, 13.60.-r, 13.88.+e

Exclusive meson electroproduction

PHYSICAL REVIEW D **79**, 054014 (2009)

Nucleon tensor charge from exclusive π^0 electroproduction

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(Received 5 November 2008; published 25 March 2009)

Exclusive π^o electroproduction from nucleons is suggested for extracting the tensor charge and other quantities related to transversity from experimental data. This process isolates C-parity odd and chiral-odd combinations of t-channel exchange quantum numbers. In a hadronic picture it connects the meson production amplitudes to C-odd Regge exchanges with final state interactions. In a description based on partonic degrees of freedom, the helicity structure for this C-odd process relates to the quark helicity flip, or chiral-odd generalized parton distributions. This differs markedly from deeply virtual Compton scattering, and both vector meson and charged π electroproduction, where the axial charge can enter the amplitudes. Contrarily, the tensor charge enters the π^o process. The connection through the helicity description of the process to both the partonic and hadronic perspectives is studied and exploited in model calculations to indicate how the tensor charge and other transversity parameters can be related to cross section and spin asymmetry measurements over a broad range of kinematics.

DOI: 10.1103/PhysRevD.79.054014 PACS numbers: 13.88.+e, 12.39.St, 12.40.Nn, 13.60.-r

Final Words

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There are TWO major differences between

a Tribute in Memory and a Birthday Fest

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In the second case

- 1 - You are still there to appreciate or to disagree
- 2 - You can still add new achievements

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VERY HAPPY BIRTHDAY DEAR GARY:

We all look forward to your future achievements