

References

- [Ab84] K. Abe *et al.*, Phys. Rev. Lett., **53**:751, 1984.
- [Ab85] K. Abe *et al.*, Phys. Rev., **D32**:2288, 1985.
- [Ab96] K. Abe *et al.* Phys. Rev. Lett. **76**, 587 (1996).
- [Ab97] K. Abe *et al.* [SLAC E154], Phys. Rev. Lett. **79**, 26 (1997).
- [Ab98] A. Abele *et al.* [Crystal Barrel Collaboration], Phys. Lett. **B423**, 175, (1998).
- [Ab98a] D. Abbott *et al.*, Phys. Rev. Lett. **80**, 5072 (1998).
- [Ab98b] K. Abe *et al.* [SLAC E143], Phys. Rev. D **58**, 112003 (1998).
- [Ab99] H. Abramowicz and A. Caldwell, Rev. Mod. Phys. **71**, 1275 (1999).
- [Ab99a] K. Abe *et al.* [SLAC E155], Phys. Lett. **B463**, 339 (1999).
- [Ab00] D. Abbott *et al.*, Phys. Rev. Lett. **84**, 5053 (2000).
- [Abpc] “A-B-SIMC”, SIMC Primer, by J. Arrington, Argonne National Lab, unpublished (2001). Available from http://www.jlab.org/~johna/SIMC_documents/simc.ps.
- [Ac98] K. Ackerstaff *et al.* [HERMES Collaboration], Phys. Rev. Lett. **81**, 5519 (1998).
- [Ac98a] M. Acciarri *et al.*, Phys. Lett. **B418**, 399 (1998).
- [Ac98c] P. Achenbach *et al.*, Nucl. Instr. and Meth. **A416** (1998) 357.
- [Ac99] K. Ackerstaff *et al.*, Phys. Lett. B **464**, 123 (1999).
- [Ac00] K. Ackerstaff *et al.*, hep-ex/0002016 (2000).
- [Acam] Details of the “F1” chip can be found at <http://www.acam.de>.
- [Ad93] B. Adeva *et al.*, Phys. Lett. **B302**, 533 (1993); D. Adams *et al.*, Phys. Lett. **B329**, 399 (1994); B. Adeva *et al.*, Phys. Lett. **B357**, 248 (1995).
- [Ad94] G. Adams, Workshop on CEBAF at Higher Energies, N. Isgur and P. Stoler, eds, CEBAF (1994), p. 65.
- [Ad94a] D. Adams *et al.* [SMC Collaboration], Phys. Lett. **B329**, 399 (1994).
- [Ad95] M. R. Adams *et al.* [E665 Collaboration], Phys. Rev. Lett. **74**, 1525 (1995).
- [Ad96] J. Adomeit *et al.* [Crystal Barrel Collaboration], Z. Phys. **C71**, 227 (1996).
- [Ad97] M. r. Adams *et al.* Zeit. Phys. **C74**, 237 (1997).

- [Ad98] G. S. Adams *et al.* [E852 Collaboration], Phys. Rev. Lett. **81**, 5760 (1998).
- [Ad01] C. Adloff, *et. al.* [H1 collaboration], Phys. Lett. B **517**, 47 (2001)
- [Ad02] G. Adams *et al.*, submitted to Nucl. Instr. and Meth., June (2002)
- [Af94] A. Afanasev, J. Gomez and S. Nanda, Workshop on CEBAF at Higher Energies, *op. cit.*, p. 184.
- [Af98] A. Afanasev and P. R. Page, Phys. Rev. D **57**, 6771 (1998).
- [Af99] A. Afanasev, hep-ph/9910565, “ Proceedings of the JALB-INT Workshop on Exclusive and Semi-Exclusive Processes at High Momentum Transfer”, C. Carlson and A. Radyushkin, World Scientific (200), May 1999.
- [Af00] A. Afanasev, C. E. Carlson, and C. Wahlquist, Phys. Rev. D **62**, 074011 (2000).
- [Af00a] A. Afanasev, C. E. Carlson, and C. Wahlquist, Phys. Rev. D **61**, 034014 (2000).
- [Af00b] I. R. Afnan *et al.*, Phys. Lett. B **493**, 36 (2000).
- [Af00c] A. V. Afanasev and A. P. Szczepaniak, Phys. Rev. D, **61**:114008, 2000.
- [Ah01] J. Ahrens *et al.* [The GDH and A2 Collaborations], Phys. Rev. Lett. **87**, 022003-1 (2001).
- [Ai00] A. Airapetian *et al.* Eur. Phys. J. **C17**, 389 (2000)
- [Ai01] A. Airapetian *et al.* [HERMES collaboration], Phys. Rev. Lett. **87**, 182001 (2001)
- [Ai01a] A. Airapetian *et al.*, Eur. Phys. J. **C20**(2001) 479-486.
- [Ai02] HERMES Collaboration: A. Airapetian, *et al.*, hep-ex/0209072.
- [Ai04] A. Airapetian *et al.* Phys. Rev. Lett. **92**, 012005 (2004).
- [Ak85] S. V. Akulinichev, S.A. Kulagin and G.M. Vagradov, Phys. Lett. **B158**, 485 (1985)
- [Al76] M. J. Alguard *et al.* [SLAC E80], Phys. Rev. Lett. **37**, 1261 (1976); **41**, 70 (1978).
- [Al88] D. Alde *et al.*, Phys. Lett., **B205**:397, 1988.
- [Al90] D. M. Alde *et al.*, Phys. Rev. Lett. **64**, 2479 (1990).
- [Al98] M. Alford, K. Rajagopal and F. Wilczek, Phys. Lett. **B422**, 247 (1998).
- [Al99] L. C. Alexa *et al.*, Phys. Rev. Lett. **82**, 1374 (1999); and references therein.
- [Al00] S. I. Alekhin and A. L. Kataev, Nucl. Phys. **A666-667**, 179 (2000); and references therein.
- [Am91] P. Amaudraz *et al.*, Phys. Rev. Lett. **66**, 2712 (1991).

- [Am94] A. Amroun *et al.*, Nucl. Phys. **A579**, 596 (1994); and references therein.
- [Am95] C. Amsler and F. E. Close, Phys. Lett. **B353**, 385 (1995).
- [Am96] C. Amsler and F. E. Close, Phys. Rev. D **53**, 295 (1996).
- [Am98] M. Ambrogiani *et al.*, Nucl. Phys. B **61**, 384 (1998).
- [Am01] M. Amarian *et al.*, Nucl. Instr. and Meth. **A460** (2001) 239.
- [Am02] M. Amarian *et al.* [the JLab E94-010 Collaboration], Phys. Rev. Lett. **89**, 242301-1 (2002).
- [An71] R. L. Anderson *et al.*, Phys. Rev. **D4**, 3245 (1971).
- [An76] R. L. Anderson *et al.*, Phys. Rev. **D14**, 679 (1976); G. White *et al.*, Phys. Rev. **D49**, 58 (1994)
- [An77] R. Anderson *et al.*, SLAC-PUB-1741, *Invited talk presented at Int. Conf. on Production of Particles with New Quantum Numbers, Wisconsin U., Madison, Apr. 22-24, 1976.*
- [An77b] R. L. Anderson *et al.*, Phys. Rev. Lett. **38**, 263 (1977).
- [An93] P. L. Anthony *et al.* [SLAC E142], Phys. Rev. Lett. **71**, 959 (1993).
- [An95] V. V. Anisovich *et al.*, Phys. Lett. **B323**, 233 (1994).
- [An96] A. V. Anisovich and H. Leutwyler, Phys. Lett. B375 (1996) 335.
- [An96a] M. Anghinolfi *et al.*, Nucl. Phys. **A602**, 405 (1996).
- [An96b] M. Antonelli, *et al.*, NIM, 558, **A409**,(1996).
- [An97] L. Anthony *et al.*, Phys. Rev. **D56**, 1373 (1997).
- [An98] M. Anselmino and F. Murgia, Phys. Lett. **B442** (1998) 470.
- [An03] P. L. Anthony *et al.* [E155 Collaboration], Phys. Lett. B **553**, 18 (2003).
- [An03a] B.D. Anderson *et al.*, Basic Instrumentation for Hall A Beamline preprint.
- [Ao93] H. Aoyagi *et al.*, Phys. Lett., **B314**, 1993.
- [Ap94] R. D. Appuhn *et al.*, Nucl. Instr. and Meth. **A350** (1994) 208.
- [Ar75] X. Artru *et al.*, Phys. Rev. D **12**, 1289 (1975).
- [Ar88] R. G. Arnold *et al.*, Phys. Rev. Lett. **61**, 806 (1988).
- [Ar97] R. Arnold and J. McCarthy, *A Proposal for Extension of E155 to Measure the Transverse Spin Structure Functions of the Proton and Deuteron* , SLAC E155x, September 1997.

- [Ar98] J. Arrington, Ph.D. thesis, California Institute of Technology, 1998.
- [Ar99] C. S. Armstrong *et al.*, Phys. Rev. D **60**, 052004 (1999).
- [Ar00] C. S. Armstrong *et al.*, submitted to Phys. Rev. D (2000).
- [As87] D. Aston *et al.*, *The LASS spectrometer*, Technical report, 1987, SLAC-Report-298.
- [As88] J. Ashman *et al.* [EMC Collaboration], Phys. Lett. **B206**, 364 (1988).
- [As89] J. Ashman *et al.* [EMC Collaboration], Nucl. Phys. **B328**, 1 (1989)
- [As89a] D. Aston *et al.*, SLAC-PUB-5145; Nucl. Phys. (Proc. Suppl.) **B8**, 32 (1989).
- [As95] D.M. Asner *et al.*, CLEO CONF95-24, EPS0188, 1995.
- [As99] D. Ashery [E791 Collaboration], Proceedings of the Int. Workshop on Physics with Electron Polarized Ion Colliders, Bloomington, 1999, p. 322.
- [At84] M. Atkinson *et al.* (The Omega Collaboration) Nucl. Phys., **B231**:15, 1984.
- [At84a] M. Atkinson *et al.* (The Omega Collaboration) Nucl. Phys., **B243**:1, 1984.
- [Au83] J. J. Aubert *et al.* [EMC Collaboration], *Phys. Lett.* **B123**, 275 (1983).
- [Au97] G. Audit *et al.*, Nucl. Phys. **A614**, (1997) 461
- [Av00] T. Averett, Proceedings of the HiX2000 workshop, J.P. Chen and Z.E. Meziani, eds.
- [Av02] H. Avakian Proceedings of SPIN 2002.
- [Av03] H. Avakian Proceedings of X-th Workshop on High Energy Spin Physics, Dubna 2003.
- [Ba73] W. Bartel *et al.*, Nucl. Phys. **B58**, 429 (1973).
- [Ba77] Exotic hybrids were apparently first described in a bag model context by T. Barnes, Ph.D. thesis, California Institute of Technology, 1977 (unpublished).
- [Ba82] “The Role of Electromagnetic Interactions in Nuclear Science”, a report of the DOE/NSF Nuclear Science Advisory Committee (1982).
- [Ba83] G. Baum *et al.*, [SLAC E130] Phys. Rev. Lett. **51**, 1135 (1983).
- [Ba90] I. Balitsky *et al.*, Phys. Lett. **B242**, 245 (1990); **B318**, 648 (1993) (Erratum).
- [Ba93] G. S. Bali *et al.*, Phys. Lett. B **309**, 378 (1993).
- [Ba94] A. Baldit *et al.*, Phys. Lett. B **332**, 244 (1994).
- [Ba95] T. Barnes, F. E. Close, and E. S. Swanson, Phys. Rev. D **52**, 5242 (1995).
- [Ba96] B. Baumbaugh *et al.*, IEEE Trans. Nucl. Sci. **43**, 1146, (1996).

- [Ba96a] G. Bardin *et al.*, Conceptual Design Report of a Compton Polarimeter for Hall A at CEBAF, DAPNIA/CEA Report, <http://www.jlab.org/compton/Documentation/Technical/1996/proposal.ps>.
- [Ba97] G. Bali *et al.* [SESAM Collaboration], Nucl. Phys. Proc. Suppl. **63**, 209 (1997).
- [Ba98] G. Bali *et al.* (SESAM Collaboration) Nucl. Phys. Proc. Suppl., **63**:209, 1998.
- [Ba00] G. S. Bali *et al.* [SESAM/TCL Collaboration], Phys. Rev. D **62**, 054503 (2000).
- [Ba00] R. Baier, D. Schiff, and B. G. Zakharov, Annu. Rev. Nucl. Part. Sci. **50**, (2000) 37.
- [Ba01] S. D. Bass and A. De Roeck, Eur. Phys. J. **18**, 531 (2001).
- [Ba02] A. Bachetta *et al.*, Phys. Rev. D **65**, 94021 (2002).
- [Be67] H. A. Bethe, Ann. Rev. Nucl. Sci. **21**, 93 (1971).
- [Be69] J. S. Bell and R. Jaciw, Nuovo Cimento **60A**, 47 (1969); S. L. Adler, Phys. Rev. **177**, 2426 (1969).
- [Be70] G. Bellettini *et al.*, Il Nuovo Cimento, vol. 66, no. 1, (1970), 243.
- [Be75] C. J. Bebek *et al.*, Phys. Rev. Lett. **34**, 759 (1975); Phys. Rev. Lett. **37**, 1525 (1976); Phys. Rev. D **15**, 3085 (1977).
- [Be78] C. J. Bebek *et al.*, Phys. Rev. D **13**, 1693 (1978).
- [Be80] E. Berger, Z. Phys., **C 4**, 289 (1980).
- [Be82] B. Bengtson and M. Moszynski, Nuclear Inst. and Meth. **204**, 129, (1982).
- [Be84] E. L. Berger, F. Coester, and R. B. Wiringa, Phys. Rev. D **29**, 398 (1984).
- [Be89] D. Beck *et al.*, Nucl. Instr. Methods in Phys. Res. **A277**, 323 (1989).
- [Be91] H. J. Behrend *et al.*, Z. Phys. **C49**, 401 (1991).
- [Be93] G. M. Beladidze *et al.*, Phys. Lett., **B313**, 1993.
- [Be93a] V. Bernard, N. Kaiser, and Ulf-G. Meißner, Phys. Rev. D **48**, 3062 (1993); Int. J. Mod. Phys. **E4**, 193 (1995).
- [Be94] A. C. Benvenuti *et al.*, [BCDMS Collaboration], Z. Phys. **C 63**, 29 (1994).
- [Be95] V. M. Belyaev and A. Radyushkin, Phys. Lett. **B359**, 194 (1995).
- [Be96] O. Benhar, S. Fantoni, N. N. Nikolaev, J. Speth, A. A. Usmani and B. G. Zakharov, J. Exp. Theor. Phys. **83**, 1063 (1996);
- [Be97] C. Bernard *et al.* [MILC Collaboration], Phys. Rev. D **56**, 7039 (1997).

- [Be99] H. A. Bethe, Rev. Mod. Phys. **71**, S6 (1999).
- [Be99a] O. Benhar, V. R. Pandharipande, I. Sick, Phys. Lett. **B469**, 19 (1999).
- [Be99b] S. C. Bennett and C. E. Wieman, Phys. Rev. Lett. **82**, 2484 (1999).
- [Be00] O. Benhar, N. N. Nikolaev, J. Speth, A. A. Usmani and B. G. Zakharov, Nucl. Phys. **A673**, 241 (2000).
- [Be00a] P.Y. Bertin, C.E. Hyde-Wright, F. Sabatié (spokespersons), Experiment E-00-110.
- [Be01] A. Belitsky and D. Müller, Phys. Lett. B **153**, 349 (2001).
- [Be02] A. Belitsky and D. Müller, Nucl.Phys. **A711**, 118 (2002).
- [Be02a] A. V. Belitsky, D. Müller and A. Kirchner, Nucl. Phys. B **629**, 323 (2002) [arXiv:hep-ph/0112108]
- [Be02b] A. Belitsky and D. Müller, Nucl. Phys. A **711**, 118 (2002).
- [Be02c] D. Beck *et al.*, G0 Experiment, (http://www.jlab.org/exp_prog/generated/apphallc.html as viewed 26-JUN-2002)
- [Be02d] V. Bernard, T.R. Hemmert, and Ulf.-G. Meißner, hep-ph/0203167.
- [Be03] A. Belitsky, X. Ji and F. Yuan hep-ph/0208038.
- [Be03a] A. Belitsky, X. Ji, and F. Yuan, Phys.Rev.Lett. **91**, 092003 (2003).
- [Be04] A. Belitsky, X. Ji and F. Yuan, Phys. Rev. **D 69**, 074014 (2004).
- [Bepc] E. Beise, private communication
- [Bi83] A. Bialas and T. Chmaj, Phys. Lett. **133B** (1983) 241.
- [Bi88] J. Bijnens, A. Bramon and F. Cornet, Phys. Rev. Lett. **61**, 1453 (1988).
- [Bi89] R. P. Bickerstaff and A. W. Thomas, J. Phys. G **15**, 1523 (1989).
- [Bi95] A. Bianconi, S. Jeschonnek, N. N. Nikolaev, and B. G. Zakharov, Phys.Lett.**B343** (1995), 13.
- [Bi96] A. Bianconi, S. Jeschonnek, N. N. Nikolaev, and B. G. Zakharov, Nucl.Phys. **A608** (1996), 437.
- [Bi96a] A. Bianconi, S. Jeschonnek, N. N. Nikolaev, and B. G. Zakharov, Phys. Rev. C **53** (1996), 576.
- [Bi01] F. Bissey, A. W. Thomas and I. R. Afnan, Phys. Rev. C **64**, 024004 (2001); F. Bissey, V. Guzey, M. Strikman and A. W. Thomas, Phys. Rev. C **65**, 064317 (2002).

- [Bj66] J. D. Bjorken, Phys. Rev. **148**, 1467 (1966); Phys. Rev. D **1**, 465 (1970); Phys. Rev. D **1**, 1376 (1970).
- [Bl69] E. D. Bloom *et al.*, Phys. Rev. Lett. **23**, 930 (1969), and M. Briedenbach *et al.*, Phys. Rev. Lett. **23** 935 (1969)
- [Bl70] E. D. Bloom and F. J. Gilman, Phys. Rev. Lett. **25**, 1140 (1970); Phys. Rev. D **4**, 2901 (1971).
- [Bl97] G. R. Blackett *et al.* The Photoproduction of the $b_1(1235)\pi$ System, Technical report, August 1997. hep-ex/9708032.
- [BNL00] A. Leksanov *et al.* [E850 Collaboration], Proc. of 7th. Conf. CIPANP2000, Quebec, p. 306.
- [BNL98] Y. Mardor *et al.*, Phys. Rev. Lett. **81**, 5085 (1998).
- [Bo81] A. Bodek and J. L. Ritchie, Phys. Rev. D **23**, 1070 (1981).
- [Bo83] A. Bodek *et al.*, Phys. Rev. Lett. **50**, 1431 (1983).
- [Bo94] G. D. Bosveld, A. E. L. Dieperink and A. G. Tenner, Phys. Rev. C **49**, 2379 (1994).
- [Bo94a] P. Bosted, *et al.*, “DIS-Parity: Parity Violation in Deep Inelastic Electron Scattering”, SLAC-PROPOSAL-E-149 (1993) (unpublished).
- [Bo98] C. Bochna *et al.* [E89-012 Collaboration], Phys. Rev. Lett. **81**, 4576 (1998)
- [Bo00] P. Bosted, “Spin Structure Functions of the Nucleon Measured at SLAC”, *Circum-Pan-Pacific RIKEN Symposium on High Energy Spin Physics* (Wako, Japan, November 1999), RIKEN Review 28 (May, 2000) (No. 13); P. Bosted, private communication.
- [Bo03] “DIS-Parity: Search for New Physics through Parity Violation in Deep Inelastic Electron Scattering”, SLAC Letter of Intent (2003) (unpublished)
- [Br70] M. Branschweig, *et al.*, DESY preprint, 70/1.
- [Br73] S. J. Brodsky and G. R. Farrar, Phys. Rev. Lett. **31**, 1153 (1973); V. A. Matveev, R. M. Muradyan and A. N. Tavkhelidze, Lett. Nuovo Cimento **7**, 719 (1973).
- [Br74] A. Browman *et al.*, Phys. Rev. Letts., vol. 33, no. 23,(1974)1400
- [Br79] E. L. Berger and S. J. Brodsky, Phys. Rev. Lett. **42** (1979) 940.
- [Br79] S. J. Brodsky, C. E. Carlson, and H. Lipkin, Phys. Rev. D **20**, 2278 (1979).
- [Br79a] S. J. Brodsky and G. P. Lepage, Phys. Lett. **B87**, 359 (1979).
- [Br80] S. J. Brodsky and G. P. Lepage, Phys. Rev. D **22**, 2157 (1980).

- [Br80a] K. L. Brown, “TRANSPORT, A computer program for designing charged particle beam transport systems”, CERN 80-04, Geneva, 1980.
- [Br82] S. J. Brodsky, in *Proceedings of the Thirteenth Int’l Symposium on Multiparticle Dynamics*, ed. W. Kittel, W. Metzger and A. Stergiou (World Scientific, Singapore, 1982) 963.
- [Br83] S. J. Brodsky, C. Ji and G. P. Lepage, *Phys. Rev. Lett.* **51** (1983) 83.
- [Br83a] Brodsky S J and Hiller J R 1983 *Phys. Rev. C* **28** 475 ; 1984 *Phys. Rev. C* **30** 412(E) .
- [Br88] S. J. Brodsky, and G. F. de Teramond, *Phys. Rev. Lett.* **60**, 1924 (1988).
- [Br88a] S.J. Brodsky and A.H. Mueller, *Phys. Lett.* **B 206**, 685 (1988).
- [Br90] S. J. Brodsky, G. F. de Teramond and I. A. Schmidt, *Phys. Rev. Lett.* **64** (1990) 1924.
- [Br92] S. J. Brodsky *et al.*, *Nucl. Phys.* **B369** (1992) 519.
- [Br97] S. J. Brodsky and G. A. Miller, *Phys. Lett.* **B412**, 125 (1997).
- [Br99] S. J. Brodsky, M. Diehl, P. Hoyer, and S. Peigne, *Phys. Lett.* **B449**, 306 (1999); A. Afanasev, C. E. Carlson, and C. Wahlquist, *Phys. Rev. D* **58**, 054007 (1998) and *Phys. Lett.* **B398**, 393 (1997); C. E. Carlson and A. B. Wakely, *Phys. Rev. D* **48**, 2000 (1993).
- [Br99a] G.Braun *et al.* “F1 - An Eight Channel Time-to-Digital Converter Chip for High Rate Experiments”, hep-ex/9911009.
- [Br00] V. M. Braun, A. Khodjamirian, M. Maul, *Phys. Rev. D* **61**, 073004 (2000).
- [Br00a] V. M. Braun, A. Khodjamirian, M. Maul, *Phys. Rev. D* **61**, 073004 (2000).
- [Br00b] S. J. Brodsky, “Dynamical higher-twist and high x phenomena: A window to quark quark correlations in QCD”, hep-ph/0006310 (2000).
- [Br01] S. J. Brodsky, E. Chudakov, P. Hoyer and J.-M. Laget, *Phys. Lett.* **B498**, 23 (2001).
- [Br02] S. Brodsky *et al.*, *Phys.Lett. B* **530**, 99 (2002).
- [Br02a] S. Brodsky et.al, hep-ph/0206259.
- [Br03] S. Brodsky et al., hep-ph/0104291
- [Bu98] V. Burkert, “Physics with CLAS at Energies up to 12GeV”, in *Physics & Instrumentation with 6-12 GeV Beams*, a Thomas Jefferson National Accelerator Facility report, S. Dytman, H. Fenker and P. Roos, eds., June 1998, p. 407.
- [Bu98a] V. Burkert, “Electromagnetic Calorimeter Upgrade Possibilities for CLAS”, in *Physics & Instrumentation with 6-12 GeV Beams* (ibid.) p. 425.

- [Bu00] M. Burkardt, Phys. Rev. D **62**, 071503 (2000).
- [Bu01] V. Burkert, L. Elouadrhiri, M. Garcon, S. Stepanyan (spokespersons), Experiment E-01-113.
- [Bu02] M. Burkardt, Nucl. Phys. **A711**, 127 (2002).
- [Bu03] For a recent overview see: V. Burkert, hep-ph/0207149
- [Bu03a] M. Burkardt, hep-ph/02091179.
- [Ca75] U. Camerini *et al.*, Phys. Rev. Lett. **35** 483 (1975).
- [Ca75a] R. Carlitz, Phys. Lett. **B58**, 345 (1975).
- [Ca78] R. Cahn, Phys.Lett., **B78**, 269 (1978); Phys.Rev., **D 40**, 3107 (1989).
- [Ca78a] R. N. Cahn and F. J. Gilman, Phys. Rev. **D17**, 1313 (1978).
- [Ca83] C. E. Carlson and T. J. Havens, Phys. Rev. Lett. **51**, 261 (1983).
- [Ca85] P. Castorina and P. J. Mulders, Phys. Rev. **D31**, 2760 (1985).
- [Ca88] A. S. Carroll *et al.*, Phys. Rev. Lett. **61**,1698 (1988).
- [Ca90] C. E. Carlson and N. C. Mukhopadhyay, Phys. Rev. D **41**, 2343 (1990).
- [Ca91] C. E. Carlson, K. E. Lassila, and U. P. Sukhatme, Phys. Lett. **B263**, 377 (1991).
- [Ca91a] C. E. Carlson and N. C. Mukhopadhyay, Phys. Rev. Lett. **67**, 3745 (1991).
- [Ca92] C. E. Carlson, M. Chachkhunashvili, and F. Myhrer, Phys. Rev. D **46**, 2891 (1992).
- [Ca95] C. E. Carlson and K. E. Lassila, Phys. Rev. C **51**, 364 (1995).
- [Ca95a] C. E. Carlson and N. Mukhopadhyay, Phys. Rev. Lett. **74**, 1288 (1995).
- [Ca97] C. E. Carlson, J. R. Hiller, R. J. Holt, Ann. Rev. Nucl. and Part. Sci. **47**, 395 (1997); and references therein.
- [Ca97a] R. Carr, *et al.*, “A Precision measurement of the weak mixing angle in Moller scattering”, SLAC-PROPOSAL-E-158 (1997) (unpublished).
- [Ca98] J. Carlson and R. Schiavilla, Rev. Mod. Phys. **70**, 743 (1998); and references therein.
- [Ca00] D. Cassel, F. Close, J. Domingo, W. Dunwoodie, D. Geesaman, D. Hitlin, M. Olson and G. Young, *Review of the Jefferson Laboratory “Hall D Project”*, January 2000, (http://www.phys.cmu.edu/halld/halld_notes/Note_024/).
- [Ca00a] G. W. Carter and D. Diakonov, Nucl. Phys. B **582**, 571 (2000).

- [Ca00b] S. Catani *et al.*, hep-ph/0005025.
- [Ca01] R. Carlini, *et al.*, “The Q_{weak} Experiment: A Search for New Physics at the TeV Scale via a Measurement of the Proton’s Weak Charge”, JLab Proposal (2001) (unpublished).
- [Ca02] Jefferson Lab Experiment E02-013, G. Cates, K. McCormick, B. Reitz and B. Wojtsekhowski, spokespersons.
- [Ch77] V. L. Chernyak and A. R. Zhitnitsky, JETP Lett. **25**, 510 (1977); V. L. Chernyak, A. R. Zhitnitsky and V. G. Serbo, JETP Lett. **26**, 594 (1977).
- [Ch77a] V. L. Chernyak and A. R. Zhitnitsky, JETP Lett. **25**, 510 (1977).
- [Ch78] B. T. Chertok, Phys. Rev. Lett. **40**, 1429 (1978); S. J. Brodsky and B. T. Chertok, Phys. Rev. **D14**, 3003 (1976).
- [Ch96] E. Chen, M. Saulnier, W. Sun, and H. Yamamoto, *Tests of a high resolution time-of-flight system based on long and narrow scintillator*, hep-ex/9606007, (1996).
- [Ch99] E. Christova and E. Leader, Phys. Lett. **B468**, 299 (1999).
- [Ch01] E. Chudakov *et al.*, Letter of Intent for CEBAF12, JLab technical note: JLAB-TN-01-007, January 2001.
- [Ch04] Proposal PR04-114 to Jefferson Laboratory, J. -P. Chen, X. D. Jiang, J. C. Peng, and X. D. Jiang, spokespersons (unpublished).
- [Chpc] E. Chudakov, private communication
- [Ci89] C. Ciofi degli Atti and S. Liuti, Phys. Lett. **B225**, 215 (1989).
- [Ci90] C. Ciofi degli Atti and S. Liuti, Phys. Rev. C **41**, 1100 (1990).
- [Ci93] C. Ciofi degli Atti and S. Simula, Phys. Lett. B **319**, 23 (1993); Few-Body Systems **18**, 55 (1995); S. Simula, Phys. Lett. B **387**, 245 (1996); Few-Body Systems Suppl. **9**, 466 (1995).
- [Ci93a] C. Ciofi degli Atti, S. Scopetta, E. Pace and G. Salme, Phys. Rev. C **48**, 968 (1993).
- [Ci02] C. Ciofi degli Atti and B. Z. Kopeliovich, Eur. J.Phys. J. A **17**, 133 (2003); B. Z. Kopeliovich, J. Nemchik and E. Predazzi, in Proceedings of the *ELFE Summer School on Confinement Physics*, eds. S. D. Bass and P. A. M. Guichon, Editions Frontieres, 1995, p. 391, Gif-sur-Yvette, hep-ph/9511214.
- [Cl73] F. E. Close, Phys. Lett. **B43**, 422 (1973); Nucl. Phys. **B80**, 269 (1974).
- [Cl79] F. E. Close, *An Introduction to Quarks and Partons* (Academic Press, 1979).
- [Cl83] F. E. Close, R. G. Roberts, and G. G. Ross, Phys. Lett. **B129**, 346 (1983).

- [Cl88] F. E. Close and A. W. Thomas, Phys. Lett. **B212**, 227 (1988).
- [Cl95] F. E. Close and P. Page, Nucl. Phys. **B443**, 233 (1995).
- [Cl95a] F. E. Close, private communication, advocates using the *positive* term “strong QCD” instead of the negative “nonperturbative QCD”.
- [Cl00] F. E. Close and A. Kirk, Phys. Lett. B **483**, 345 (2000).
- [Cl00a] Proposal for CLAS Upgrade at High Energies.
- [Cl01] F. E. Close and A. Kirk, Eur. Phys. J., **C21**:531–543, 2001.
- [Cl01a] F. E. Close and N. Isgur, Phys. Lett. B **509**, 81 (2001).
- [CLAS03] CLAS Collaboration (H. Avakian et al.) hep-ex/0301005.
- [Co86] G.R. Court *et al.*, Phys. Rev. Lett. **57**, 507 (1986), T.S. Bhatia *et al.*, Phys. Rev. Lett. **49**, 1135 (1982), E.A. Crosbie *et al.*, Phys. Rev. D **23**, 600 (1981).
- [Co89] J. S. Conway *et al.*, Phys. Rev. D **39**, 92 (1989).
- [Co93] J. Collins, Nucl.Phys.B396, 161 (1993)
- [Co93a] G. T. Condo, T. Handler, W. M. Bugg, G. R. Blackett, M. Pisharody and K. A. Danyo, Phys. Rev., **D48**:3045, 1993.
- [CO96] COMPASS Collaboration, “Common Muon and Proton Apparatus for Structure and Spectroscopy” CERN/SPSLC 96-14.
- [Co97] J. C. Collins, L. Frankfurt, and M. Strikman, Phys. Rev. D **56**, 2982 (1997).
- [Co98] C. Coriano, H-N. Li, and C. Savkli, J. High En. Phys. 9807, 008 (1998).
- [Co99] COMPASS experiment at CERN: <http://wwwcompass.cern.ch>.
- [Co02] J. Collins, hep-ph/0204004 (2002)
- [CODA] JLab Data Acquisition Group, CODA, (<http://coda.jlab.org>)
- [COSY] M. Berz, COSY INFINITY Version 7 Reference Manual, MSUCL-977 (1996), Michigan State University, East Lansing, MI 48824
- [Cr75] J. W. Cronin *et al.*, Phys. Rev. **D11**, 3105 (1975).
- [Cr78] D. G. Crabb *et al.*, Phys. Rev. Lett. **41**, 1257 (1978).
- [Cr97] J. A. Crittenden [ZEUS Collaboration], presented at Photon '97, May 1997.
- [Cr98] R. R. Crittenden *et al.*, Nuclear Inst. and Meth. **387**, 377 (1998).

- [Cz96] A. Czarnecki and W. Marciano, Phys. Rev. **D53**, 1066 (1996).
- [Da73] M. Davier *et al.*, Nucl. Phys., **B58**:31, 1973.
- [Da93] Jefferson Lab Experiment E93-026, D. Day, G. Warren and M. Zeier, spokespersons.
- [Da94] S. Dasu *et al.*, Phys. Rev. D **49**, 5641 (1994).
- [Da01] S. Davidson, S. Forte, P.Gambino, N. Rius, and A. Strumia, JHEP **02**, 37 (2002).
- [De79] E. Derman and W. J. Marciano, Ann. Phys. **121**, 147 (1979).
- [De00] D. Debruyne, J. Ryckebusch, W. Van Nespen, and S. Janssen, *Phys. Rev. C* **62**, 024611 (2000).
- [De01] W. Detmold, W. Melnitchouk, J. W. Negele, D. B. Renner and A. W. Thomas, Phys. Rev. Lett. **87**, 172001 (2001).
- [De02] W. Detmold, W. Melnitchouk and A. W. Thomas, Phys. Rev. D **66**, 054501 (2002), and references therein.
- [Di88] M. Diemoz *et al.*, Z. Phys. **C39**, 21 (1988).
- [Di89] H. Dijk and B. L. G. Bakker, Nucl. Phys. **A494**, 438 (1989); Z.-J. Cao and L. Kisslinger, Phys. Rev. C **41**, 647 (1990), and references therein.
- [Di97] D. Diakonov, V. Yu. Petrov, P. V. Pobylitsa, M. V. Polyakov and C. Weiss, Phys. Rev. D **56**, 4069 (1997).
- [Di99] M. Diehl, T. Feldmann, R. Jakob and P. Kroll, Eur. Phys. J. C **8** 409 (1999). M. Diehl, T. Feldmann, R. Jakob and P. Kroll, Phys. Lett. B **460**, 204, (1999).
- [Di02] M. Diehl, Eur. Phys. C **25**, 223 (2002)
- [Di02a] M. Diehl, hep-ph/0205208.
- [Do77] J. F. Donoghue and E. Golowich, Phys. Rev. D **15**, 3421 (1977).
- [Do92] J.F. Donoghue, E. Golowich, and B.R. Holstein, Dynamics of the Standard Model, Cambridge University Press (1992).
- [Do97] J. F. Donoghue and E. S. Na, Phys. Rev. D **56**, 7073 (1997).
- [Do02] A.G. Korotkov and W.D. Nowak, Nucl. Phys. A **711**, 175 (2002)
- [Dr66] S. D. Drell, and A. C. Hearn, Phys. Rev. Lett. **16**, 908 (1966).
- [Dr99] D. Drechsel, O. Hanstein, S.S. Kamalov and L. Tiator, Nucl. Phys. **A645**, 145 (1999).
- [Dr00] See, for example, D. Drechsel, S. S. Kamalov, and L. Tiator, Phys. Rev. D **63**, 114010 (2001).

- [Du85] G. V. Dunne and A. W. Thomas, Nucl. Phys. **A446**, 437c (1985).
- [Du91] M. Dueren and K. Rith, *Polarized Electron Nucleon Scattering at HERA: The HERMES Experiment*, in “Hamburg 1991, Proceedings, Physics at HERA, vol. 1” 427-445.
- [Du03] D Dutta *et al.* Phys. Rev. C **68**, 021001(r) (2003).
- [E01004] JLab experiment E01-004: The Charged Pion Form Factor, extension to E93-021.
- [E02104] “Quark Propagation through Cold QCD Matter,” W. Brooks, spokesperson. Jefferson Lab proposal E02-104, (2002).
- [E89044] JLab experiment e89-044, preliminary results (Contact: A. Saha).
- [Ef80] A. V. Efremov and A. V. Radyushkin, Theor. Math. Phys. **42**, 97 (1980).
- [Ef01] A. Efremov K. Goeke, P. Schweitzer Phys.Lett. **B552**, 37 (2001).
- [Eg94] K. S. Egiyan, L. L. Frankfurt, W. R. Greenberg, G. A. Miller, M. M. Sargsyan, M. I. Strikman, Nucl. Phys. **A580**, 365 (1994).
- [Eh95] B. Ehrnsperger and A. Schafer, Phys. Rev. D **52**, 2709 (1995).
- [Ei72] Y. Eisenberg *et al.*, Phys. Rev., **D5**:15, 1972.
- [Ei84] E. Eichten, I. Hinchliffe, K. Lane and C. Quigg, Rev. Mod. Phys. **56**, 579 (1984).
- [Ei99] M. Eides, L. Frankfurt, and M. Strikman, Phys. Rev. D **59**, 114025 (1999).
- [El74] J. Ellis and R. L. Jaffe, Phys. Rev. D **9**, 1444 (1974); Phys. Rev. D **10**, 1669 (1974).
- [En64] C.A. Engelbercht, Phys., Rev., **133**, B988 (1964).
- [En00] R. Ent, C. E. Keppel, and I. Niculescu, Phys. Rev. D. **62**, 73008 (2000).
- [En00a] R. Ent, H. Mkrtchyan, and G. Niculescu, JLAB Proposal E00-004 (2000).
- [Er83] M. Erikson and A. W. Thomas, Phys. Lett. **B128**, 112 (1983).
- [Erpc] J. Erler, private communication.
- [Fa75] G. R. Farrar and D. R. Jackson, Phys. Rev. Lett. **35**, 1416 (1975).
- [Fa79] G. R. Farrar and D. R. Jackson, Phys. Rev. Lett. **43**, 246 (1979); and D. R. Jackson, Thesis, CALTECH, 1977 (unpublished);
- [Fa81] C. Fabjan *et al.*, Nucl. Instrum. Meth. **185** (1981) 119.
- [Fa84] S. Fajfer and R. J. Oakes, Phys. Rev. **D30**, 1585 (1984).

- [Fa85] C. Fabjan, *Techniques and Concepts in High Energy Physics III*, T. Ferbel, ed, Plenum Pub.(1985).
- [Fa88] G. R. Farrar, H. Liu, L. L. Frankfurt and M. I. Strikman, *Phys. Rev. Lett.* **61**, 686 (1988).
- [Fe72] R. P. Feynman, *Photon Hadron Interactions* (Benjamin, Reading, Massachusetts, 1972).
- [Fi77] R. D. Field and R. P. Feynman, *Phys. Rev. D* **15**, 2590 (1977).
- [Fi01] B. Filippone and X. Ji, *Adv. Nucl. Phys.* **26**, 1 (2001).
- [Fo96] J. L. Forest, V. R. Pandharipande, S. C. Pieper, R. B. Wiringa, and R. Schiavilla, *Phys. Rev. C* **54**, 646 (1996).
- [Fr81] L. L. Frankfurt and M. I. Strikman, *Phys. Rep.* **76**, 215 (1981).
- [Fr83] B. L. Friman, V. R. Pandharipande, and R. B. Wiringa, *Phys. Rev. Lett.* **51**, 763 (1983)
- [Fr85] L. L. Frankfurt and M. I. Strikman, *Nucl. Phys.* **B250**, 1585 (1985).
- [Fr88] L. L. Frankfurt and M. I. Strikman, *Phys. Rep.* **160**, 235 (1988).
- [Fr90] J. L. Friar *et al.*, *Phys. Rev. C* **42**, 2310 (1990).
- [Fr91] L. L. Frankfurt and M. Strickman, *Prog. Part. Nucl. Phys.* **27**, 135 (1991).
- [Fr92] L. L. Frankfurt, G. A. Miller and M. I. Strikman, *Phys. Rev. Lett.* **68**, 17 (1992).
- [Fr92a] L. L. Frankfurt, G. A. Miller, and M. I. Strikman, *Comm. Nucl. Part. Phys.* **21**, 1 (1992).
- [Fr93] L. L. Frankfurt, G. A. Miller and M. Strikman, *Phys. Lett.* **B304**, 1 (1993)
- [Fr93a] L. L. Frankfurt, D. B. Day, M. M. Sargsian and M. I. Strikman, *Phys. Rev. C* **48**, 2451 (1993).
- [Fr94] L. L. Frankfurt *et al.*, in *Workshop on ‘CEBAF at Higher Energies’*, Eds. N. Isgur and P. Stoler, *Conf. Proc.* p. 499 (1994).
- [Fr94a] B. Frois and P. J. Mulders, *Workshop on CEBAF at Higher Energies*, Thomas Jefferson National Accelerator Facility, Eds. N. Isgur, P. Stoler, p. 309 (1994).
- [Fr95] L. L. Frankfurt, E. J. Moniz, M. M. Sargsyan, M. I. Strikman, *Phys. Rev. C* **51**, 3435 (1995).
- [Fr95b] L. L. Frankfurt, W. R. Greenberg, G. A. Miller, M. M. Sargsian and M. I. Strikman, *Z. Phys.* **A352**, 97 (1995).
- [Fr96] M. R. Frank, B. K. Jennings and G. A. Miller, *Phys. Rev. C* **54**, 920 (1996); B. K. Jennings and G. A. Miller, *Phys. Lett.* **B318**, 7 (1993).

- [Fr97] L. L. Frankfurt, M. M. Sargsian and M. I. Strikman, Phys. Rev. C **56**, 1124 (1997)
- [Fr98] L. Frankfurt, G. Piller, M. Sargsian, and M. Strikman, Eur. Phys. J. **A2**, 301 (1998).
- [Fr98a] V. V. Frolov *et al.*, Phys. Rev. Lett. **82**, 45 (1998).
- [Fr99] L. Frankfurt *et al.*, Phys. Rev. **D60** 014010, (1999).
- [Fr99a] L. L. Frankfurt, V. Polyakov, M. Strikman and M. Vanderhaeghen, Phys. Rev. Lett. **84**, 2589 (2000).
- [Fr00] L. L. Frankfurt, G. A. Miller, M. M. Sargsian, and M. I. Strikman, Phys. Rev. Lett. **84**, 3045 (2000); and L. L. Frankfurt, G. A. Miller, M. M. Sargsian, and M. I. Strikman, Nucl. Phys. A **663**, 349 (2000); and Sargsian M M private communication.
- [Fr00a] L. Frankfurt, M. Poliakov, M. Strikman and, M. Vanderhaeghen, Phys. Rev. Lett., **84** 2589 (2000).
- [Fr01] A. Freund, M. McDermott, and M. Strikman, arXiv:hep-ph/0208160
- [Fr03] A. Freund, M. McDermott, and M. Strikman, arXiv:hep-ph/0208160
- [Ga71] S. Galster, H. Klein, J. Moritz, K.H. Schmidt, D. Wegener, Nucl. Phys. **B32**, 221 (1971).
- [Ga84] Rob Veenhof, *The GARFIELD Program, Simulation of Gaseous Detectors*, CERN, (1984),
- [Ga92] G. Garino *et al.*, Phys. Rev. C **45**, 780 (1992).
- [Ga96] H. Gao, R. J. Holt and V. R. Pandharipande, Phys. Rev. C. **54**,2779 1996), D. Dutta, H. Gao, private communication
- [Ga99] M. Garcon, M. Guidal, E. Smith (spokespersons), Experiment E-99-105
- [Ga00] A. Gasparian, Proceeding of the 10th international conference on the calorimeter, Pasadana, 2002.
- [Ga01] G. T. Garvey and J.-C. Peng, Prog. Part. Nucl. Phys. **47**, 203 (2001).
- [Ga02] K. Garrow *et al.*, Phys. Rev. C **66**, 044613 (2002).
- [Ge66] S. B. Gerasimov, Sov. J. of Nucl. Phys. **2**, 430 (1966).
- [Ge78] H. Georgi and H.D. Politzer, Phys.Rev.Lett., **40**, 3 (1978).
- [Ge92] C. Gerschel and J. Hufner, Z. Phys. **C56** (1992) 171.
- [Ge93] P. Geiger and N. Isgur, Phys. Rev. D **47**, 5050 (1993); D **44**, 799 (1991).
- [Ge95] D. F. Geesaman, K. Saito and A. W. Thomas, Ann. Rev. Nucl. and Part. Sci. **45**, 337 (1995).

- [Gi46] V. L. Ginzburg and I. M. Frank, JETP **16**, 15 (1946).
- [Gi75] B. Gittelman *et al.*, Phys. Rev. Lett. **35**, 1616 (1975).
- [Gi00] R. Gilman, Proceedings of the HiX2000 workshop, J.P. Chen and Z.E. Meziani, eds (ibid); P. Mulders, ibid; H. Gao, private communication
- [Gl97] W. Glöckle, proceedings of the “5th Workshop on Electromagnetically Induced Two-Hadron Emission”, Lund, Sweden, 2001.
- [Gl98] M. Glück, E. Reya, and A. Vogt, Eur. Phys. J. **C5**, 461 (1998).
- [Gl00] M. Gluck and E. Reya, Mod. Phys. Lett. A **15**, 883 (2000).
- [Go69] K. Gottfried and D. R. Yennie, Phys. Rev. **182** (1969) 1595.
- [Go94] J. Gomez *et al.*, Phys. Rev. D **49**, 4348 (1994).
- [Go01] K. Goeke, V. Polyakov and M. Vanderhaeghen, Prog. Part. Nucl. Phys. **47**, 401 (2001).
- [Go01a] M. Göckeler *at al.*, Phys. Rev. D **63**, 074506 (2001).
- [Go01b] K. Goeke, M. V. Polyakov, and M. Vanderhaeghen, Prog. Part. Nucl. Phys. **47**, 401 (2001).
- [Go02] J. L. Goity, A. M. Bernstein and B. R. Holstein, Phys. Rev. D **66** (2002) 076014.
- [Gr75] L. V. Gribov and L. Lipatov, Yad. Fiz. **20**, 181 (1975); G. Altarelli and G. Parisi, Nucl. Phys. **B126**, 298 (1977); Dokshitzer, Sov. Phys. JETP **46**, 641 (1977).
- [Gr94] W. R. Greenberg and G. A. Miller, *Phys. Rev. C* **49**, 2747 (1994).
- [Gr97] J. Gronberg *et al.* [CLEO Collaboration], Phys. Rev. D **57**, 33 (1998).
- [Gr98] J. Gronberg *et al.* [CLEO Collaboration], Phys. Rev. D **57**, 33 (1998).
- [Gr01] V. Yu. Grishina *et al.*, Euro. Journal of Phys. A **10**, 355 (2001).
- [Gu00] X. Guo, J.-W. Qiu, Phys. Rev. D **61**, 096003 (2000).
- [Gupc] M. Guidal “*Computer Code for DVCS and BH calculations*”, private communication.
- [GX02] The GLUEX Collaboration *The Gluonic Excitations experiment*, Design Report Version 4, September 2002, (http://www.phys.cmu.edu/halld/cdr_v4/).
- [Ha89] E. Hadjimichael and S. Fallieros, Phys. Rev. C, vol. 39, no. 4(1989) 1438.
- [Ha98] E. A. Hawker *et al.*, Phys. Rev. Lett. **80**, 3715 (1998); R. S. Towell *et al.*, Phys. Rev. D **64**, 052002 (2001).
- [Ha01] R. Hasty, *et al.*, Science **290**, 2117 (2000).

- [HallA] Hall A Operational Manual (2000).
- [HallD] Hall D PCDR.
- [HD99] The Hall D Collaboration, *Photoproduction of Unusual Mesons: The Hall D Project at Jefferson Lab*, Design Report version 2, August 1999, (<http://www.phys.cmu.edu/halld/cdr/>).
- [He90] D. W. Hertzog *et al.*, Nucl. Inst. and Meth., **A294**, 446 (1990).
- [He97] P. Herrera-Siklody, J. I. Latorre, P. Pascual and J. Taron, Nucl. Phys. **B497** (1997) 345, and Phys. Lett. **B419** (1998) 326.
- [Hi98] D.W. Higinbotham, Nucl. Instrum. Meth. A **414** (1998) 332-339. (<http://www.jlab.org/~doug/cherenkov>)
- [Ho55] R. Hofstadter and R. W. McAllister, Phys. Rev. **98**, 183 (1955).
- [Ho97] P. Hoyer, Nucl. Phys. **A622**, 284c (1997).
- [Ho98] E.P. Venugopal and B.R. Holstein, Phys. Rev D57 (1998) 4397.
- [Ho99] P. Hoodbhoy, X. Ji, and W. Lu, Phys. Rev. D **59**, 014013 (1999); **59**, 074010 (1999).
- [Hu90] E. Hummel and J. A. Tjon, Phys. Rev. Lett. **63**, 1788 (1989); Phys. Rev. C **42**, 423 (1990); J. W. Van Orden, N. Devine and F. Gross, Phys. Rev. Lett. **75**, 4369 (1995); D. R. Phillips, S. J. Wallace and N. K. Devine, Phys. Rev. C **58**, 2261 (1998); F. M. Lev, E. Pace and G. Salme, Phys. Rev. C **62**, 064004 (2000).
- [Hu98] J. Hufner and B. Kopelovich, Phys. Lett. **B426**, 154 (1998).
- [Hu00] H. W. Huang and P. Kroll, Eur. Phys. J. **C17**, 433 (2000); P. Kroll, hep-ph/0207118 (2002).
- [Hu03] H.W. Huang *et al.*, hep-ph/0309071.
- [In84] T. Inagaki *et al.*, Cryogenics **24**, 83 (1984).
- [Is81] N. Isgur, G. Karl, and D. W. L. Sprung, Phys. Rev. D **23**, 163 (1981).
- [Is84] N. Isgur and C. H. Llewellyn Smith, Phys. Rev. Lett. **52**, 1080 (1984); Phys. Lett. **B217**, 535 (1989); G. R. Farrar, K. Huleihel and H. Zhang, Phys. Rev. Lett. **74**, 650 (1995).
- [Is85] N. Isgur, and J. Paton, Phys. Rev. D **31**, 2910 (1985); N. Isgur, R. Kokoski and J. Paton, Phys. Rev. Lett. **54**, 869 (1985).
- [Is85a] N. Isgur, R. Kokoski, and J. Paton, Phys. Rev. Lett., **54**:869, 1985.
- [Is91] N. Isgur and M. B. Wise, Phys. Rev. D **43**, 819 (1991).

- [Is99] N. Isgur, Phys. Rev. D **59**, 034013 (1999).
- [Is99b] N. Isgur, Phys. Rev. D **60**, 114016 (1999).
- [Is01] N. Isgur, S. Jeschonnek, W. Melnitchouk, and J. W. Van Orden, Phys. Rev. D **64**, 054005 (2001); F. E. Close and N. Isgur, Phys. Lett. **B 509**, 81 (2001); S. Jeschonnek and J. W. Van Orden, Phys. Rev. D **65**, 094038 (2002); F. E. Close and Q. Zhao, Phys. Rev. D **66**, 054001 (2002).
- [It92] H. Ito, W. W. Buck, and F. Gross, Phys. Lett. **287B**, 23 (1992).
- [It97] H. Ito, S. E. Koonin and R. Seki, *Phys. Rev. C* **56**, 3231 (1997).
- [IUpc] Indiana University test results at
<http://dustbunny.physics.indiana.edu/~paul/hallDrd>.
- [Iv01] E.I. Ivanov *et al.* (E852 Collaboration) Phys. Rev. Lett., **86**:3977, 2001.
- [Ja84] R. L. Jaffe, F. E. Close, R. G. Roberts, and G. G. Ross, Phys. Lett. **B134**, 449 (1984).
- [Ja90] O. C. Jacob and L. S. Kisslinger, Phys. Lett. **243B**, 323 (1990).
- [Ja90] O. C. Jacob and L. S. Kisslinger, Phys. Lett. **243B**, 323 (1990).
- [Ja92] R.L. Jaffe and X. Ji Nucl.Phys. **B375** (1992) 527.
- [Ja93] R. Jakob and P. Kroll, Phys. Lett. **315B**, 463 (1993).
- [Ja02] P. Jain, B. Kundu, and J. Ralston, Phys. Rev. D **65**, 094027 (2002).
- [Je99] S. Jeschonnek and T. W. Donnelly, Phys. Rev. C **59** (1999), 2676.
- [Je00] S. Jeschonnek, N. Isgur, W. Melnitchouk, and J. W. Van Orden, to be submitted to Phys. Rev.
- [Ji94] X. Ji and P. Unrau, Phys. Lett. **B333**, 228 (1994).
- [Ji95] X. Ji, e-print hep-ph/9509288 (1995)
- [Ji95a] X. Ji and P. Unrau, Phys. Rev. D **52**, 72 (1995).
- [Ji97] X. Ji, Phys. Rev. Lett. **78**, 610 (1997); Phys. Rev. D **55**, 7114 (1997).
- [Ji97a] X. Ji, W. Melnitchouk, and X. Song, Phys. Rev. D **56**, 1 (1997).
- [Ji98] X. Ji, J. Phys. G **24**, 1181 (1998).
- [Ji00] X. Ji, C. Kao, and J. Osborne, Phys. Lett. **B 472**, 1 (2000).
- [Ji01] X. Ji and J. Osborne, J. Phys. G **27**, 127 (2001).

- [Ji03] X. D. Ji, J. P. Ma, F. Yuan, hep-ph/0301141.
- [Ji03a] X. Ji, J.-P. Ma and F. Yuan, Nucl. Phys. **B652**, 383 (2003).
- [Ji03b] X. Ji, F. Yuan e-Print Archive: hep-ph/0206057.
- [Ji03c] X. Ji, hep-ph/0304037, to appear in Phys. Rev. Lett.
- [Ji04] X. Ji, J-P. Ma and F. Yuan, e-Print Archive: hep-ph/0404183.
- [Jo00] M. K. Jones *et al.*, Phys. Rev. Lett. **84**, 1398 (2000)); O. Gayou *et al.*, Phys. Rev. Lett. **88**, 092301 (2002). .
- [Jo02] K. Joo *et al.*, Phys. Rev. Lett. **88**, 122001 (2002).
- [Ju88] H. Jung and G. A. Miller, Phys. Lett. **B200**, 351 (1988).
- [Ju97] K. Juge, J. Kuti, and C. J. Morningstar, Nucl. Phys. Proc. Suppl. **63**, 326, (1997).
- [Ju99] K. J Juge, J. Kuti and C. J. Morningstar, Phys. Rev. Lett. **82**, 4400 (1999).
- [Ju02] K.J Juge, J. Kuti and C. Morningstar, hep-lat/0209109, to be published in Proceedings of Lattice 2002.
- [Ka75] W. Kaune, G. Miller, W. Oliver, R. W. Williams, and K. K. Young, Phys. Rev. D **11**, 478 (1975).
- [Ka90] L. P. Kaptari *et al.*, Nucl. Phys. **A512**, 684 (1990).
- [Ka93] Kang Y, Erbs P, Pfeil W, and Rollnik H 1990 *Abstracts of the Particle and Nuclear Intersections Conference*, (MIT, Cambridge, MA); Kang Y 1993 Ph.D. thesis Bonn.
- [Ka00] R. Kaiser and H. Leutwyler, Eur. Phys. J. **C17** (2000) 623.
- [Ko93] L. A. Kondratyuk *et al.*, Phys. Rev. C **48** 2491 (1993).
- [Ko95] A. Kotzinian, Nucl. Phys. **B 441** (1995) 234.
- [Ko96] A. M. Kotzinian and P. J. Mulders, Phys. Rev. **D54** (1996) 1229; Phys. Lett. **B406** (1997) 373.
- [Ko96a] A. M. Kotzinian and P. J. Mulders, Phys. Lett. **B406**, 373 (1997).
- [Ko97] N. I. Kochelev, *Proc. of Workshop on Physics with Polarized Protons at HERA*, 1997, Hamburg, p. 225, hep-ph/9711274.
- [Kop02] B. Z. Kopeliovich, J. Nemchik, A. Schaefer, and A. V. Tarasov, Phys. Rev. Lett. **88** (2002) 232303.
- [Kopc] N. Kochelev, private communication.

- [Kr98] Th. Feldmann and P. Kroll, Eur. Phys. J. **C5** (1998) 327.
Th. Feldmann, P. Kroll and B. Stech, Phys. Rev. **D58** (1998) 114006.
- [Kr99] D. Kharzeev, Eur. Phys. J. **C9**, 459 (1999).
- [Kr01] K. Wijesooriya, *et al.*, Phys. Rev. Lett. **86**, 2975 (2001).
- [Kr02] K. Wijesooriya *et al.*, Phys. Rev. C **66**, 034614 (2002).
- [Ku89] S. A. Kulagin, Nucl. Phys. **A500**, 653 (1989).
- [Ku94] S. A. Kulagin, G. Piller, and W. Weise, Phys. Rev. C **50**, 1154 (1994).
- [Ku98] S. Kumano, Phys. Rep. **303**, 183 (1998).
- [Ku00] S. Kuhlmann *et al.*, Phys. Lett. **B476**, 291 (2000).
- [Ku02] A. Kurylov, M. J. Ramsey-Musolf, and S. Su, “Parity-violating electron scattering as a probe of supersymmetry”, hep-ph/0205183 (2002).
- [La72] J.-M. Laget, Nucl. Phys. **A194**, 81 (1972).
- [La74] P. V. Landshoff, Phys. Rev. D **10**, 1024 (1974).
- [La88] J.M. Laget, J. Phys. G **14**, (1988) 1445.
- [La91] J.-M. Laget, in *Modern Topics in Electron Scattering*, edited by B. Frois and I. Sick (World Scientific, 1991) 290, and references therein.
- [La94] J.-M. Laget and R. Mendez-Galain, Nucl. Phys. **A581**, 397 (1995).
- [La94a] J.-M. Laget, Nucl.Phys. **579** (1994) 333.
- [La95] H. L. Lai *et al.* [CTEQ Collaboration], Phys. Rev. D **51**, 4763 (1995); H. L. Lai *et al.*, Eur. Phys. J. **C12**, 375 (2000).
- [La97] P. Lacock *et al.* [UKQCD Collaboration], Phys. Lett. **B401**, 308, (1997).
- [La98] J.-M. Laget, in *Proceedings of workshop on Jefferson Lab Physics & Instrumentations with 12 GeV Beams*, Newport News, 1998, p. 57.
- [La98a] J.-M. Laget, Proc. of the *Workshop on Color Transparency*, Grenoble (France), Edt. E. Voutier, (1998) 131 ; <http://isnwww.in2p3.fr/ct97>.
- [La00] B. Lampe and E. Reya, Phys. Rep. **332**, 1 (2000); S. D. Bass and A. W. Thomas, Prog. Part. Nucl. Phys. **33**, 449 (1994).
- [LAM10] Lambda/Ten Optics, 7A Stuart Road, Chelmsford, MA 01824.
- [Lan53] L. D. Landau, I. Y. Pomeranchuk, Dokl. Akad. Nauk SSSR **92**:535, 735 (1953).

- [Le80] G.P. Lepage, and S.J. Brodsky, Phys. Rev. D **22**, 2157 (1980).
- [Le92] Lee T-S H 1992 *Few Body Syst. Supplement* **6** 526 ; Lee T-S H 1991 *Argonne National Laboratory Preprint* PHY-6886-TH-91; Lee T-S H 1991 *Argonne National Laboratory Preprint* PHY-6843-TH-91.
- [Le96] H. Leutwyler, Phys. Lett. B378: 313-318, (1996).
- [Le02] G. Levman, J. Phys. G **28**, 1079 (2002).
- [Li00] S. Liuti, R. Ent, C. E. Keppel, and I. Niculescu, to be submitted to Phys. Rev. D.
- [Lu81] M. Luscher, Nucl. Phys. **B180**, 317 (1981).
- [Lu81a] T. Ludlam *et al.*, Nucl. Instrum. Meth. **180** (1981) 413.
- [Lu92] M. Luke, A. V. Manohar and M. J. Savage, Phys. Lett. **B288**, 355 (1992).
- [Lu93] A. Lung *et al.*, Phys. Rev. Lett. **70**, 718 (1993).
- [Ma91] A. V. Manohar, Phys. Rev. Lett. **66**, 289 (1991).
- [Ma93] Jefferson Lab Experiment E93-038, R. Madey and S. Kowalski, spokespersons.
- [Ma94] N. C. R. Makins *et al.*, Phys. Rev. Lett. **72**, 1986 (1994).
- [Ma94a] A. D. Martin, R. Roberts and W. J. Stirling, Phys. Rev. D **50**, 6734 (1994).
- [Ma98] A. D. Martin, R. G. Roberts, W. J. Stirling and R. S. Thorne, Eur. Phys. J. **C4**, 463 (1998).
- [Ma98a] Y. Mardor *et al.*, Phys. Rev. Lett. **81**, 5085 (1998); A. Leksanov *et al.*, Phys. Rev. Lett. **87**, 212301-1 (2001).
- [Ma00] P. Maris and P. C. Tandy, Phys. Rev. C **62**, 055204 (2000).
- [Ma00] P. Maris, P. C. Tandy, Phys. Rev. C **62**, 055204 (2000).
- [Ma02] Andrzej Czarnecki and William J. Marciano, Phys. Rev. D64, (2001), 013014.
- [Ma02a] A. D. Martin, R. G. Roberts, W. J. Stirling, and R. S. Thorne, “Uncertainties of predictions from parton distributions. I: Experimental errors”, hep-ph/0211080 (2002).
- [Me93] W. Melnitchouk and A. W. Thomas, Phys. Rev. D **47**, 3783 (1993).
- [Me94] W. Melnitchouk, A. W. Schreiber and A. W. Thomas, Phys. Rev. D **49**, 1183 (1994).
- [Me96] W. Melnitchouk and A. W. Thomas, Phys. Lett. **B377**, 11 (1996).
- [Me97] W. Melnitchouk, M. Sargsian, and M. I. Strikman, Z. Phys. **A359**, 359 (1997).

- [Me98] W. Melnitchouk, J. Speth and A. W. Thomas, Phys. Lett. B **435**, 420 (1998).
- [Me99] W. Melnitchouk, J. Speth and A.W. Thomas, Phys. Rev. D **59**, 014033 (1999).
- [Me00] K. Mengel, R. Novotny, R. Beck, *et al.*, "Detection of Monochromatic Photons Between 50 and 790 MeV with a PbWO₄ - Scintillator Array", to be published (1999).
- [Me00] Z.-E. Meziani, *Proceedings of the HiX2000 Workshop*, J.P. Chen and Z.-E. Meziani, eds.
- [Mi56] A. B. Migdal, Phys. Rev. **103**:1811 (1956).
- [Mi00] J. Mitchell, *Proceedings of the HiX2000 Workshop*, J.-P. Chen and Z.-E. Meziani, eds.
- [Mi02] G. A. Miller, Phys. Rev. C **66**, 032201 (2002).
- [Mi02a] A. Miller (HERMES Collaboration) Proceedings of SPIN2002 BNL, Upton NY 2002.
- [Mi02b] G. A. Miller and A. W. Thomas, "Comment on 'A precise determination of electroweak parameters in neutrino nucleon scattering'", hep-ex/0204007 (2002)
- [Mi02c] A. I. Milstein, O. P. Sushkov, and I. S. Terekhov, "Calculation of radiative corrections to the effect of parity nonconservation in heavy atoms", hep-ph/0212072 (2002).
- [Mkpc] H. Mkrtchyan *et al.*, JLab test run results, 1999 (private communication).
- [ML00] *Assessment of the MEGA/LASS Magnet at LANL, 20 March, 2000*, (http://www.phys.cmu.edu/halld/halld_notes/Note_026/).
- [Mo70] M. Morpurgo *et al.*, Particle Accelerators **1**, 255 (1970).
- [Mo79] M. Moszynski and B. Bengston, Nucl. Inst. and Meth., **158**, 1 (1979).
- [Mo79a] M. Morpurgo *et al.*, Cryogenics **19**, 411 (1979).
- [Mo95] B. Moussallam, Phys. Rev. **D51** (1995) 4939.
B. Ananthanarayan and B. Moussallam, hep-ph/02052702.
- [Mo97] C. J. Morningstar and M. Peardon, Phys. Rev. D **56**, 4043 (1997).
- [Mo99] H. Morita, C. Ciofi degli Atti, and D. Treleani, Phys. Rev. C **60**, 034603 (1999).
- [Mo99a] R. Mohring, Ph.D. thesis, University of Maryland, 1999.
- [Mopc] M. Morlet and J. Van de Wiele, private communication.
- [Mu82] A. H. Mueller, in *Proceedings of the Seventeenth Rencontres de Moriond*, ed. J. Tran Thanh Van (Editions Frontieres, Gif-sur-Yvette, France, 1982) **Vol. I** 13.

- [Mu83] A. H. Mueller, in *Proceedings of the Seventeenth Rencontre de Moriond Conference on Elementary Particle Physics*, Les Arcs, France, 1982, edited by J. Tran Thanh Van (Editions Frontieres, Gif-sur-Yvette, France, 1982); S. J. Brodsky, in *Proceedings of the Thirteenth International Symposium on Multiparticle Dynamics*, Volendam, The Netherlands, 1982, edited by W. Kittel *et al.* (World Scientific, Singapore, 1983).
- [Mu94] D. Müller *et al.*, Fortschr.Phys.42,101 (1994)
- [Mu94] D. Müller *et al.*, Fortschr.Phys. **42**, 101 (1994)
- [Mu95] C. R. Munz *et al.*, Phys. Rev. C **52**, 2110 (1995).
- [Mu96] P.J. Mulders and R.D. Tangerman, Nucl.Phys.B461, 197(1996)
- [Mu01] V. Muccifora, hep-ex/0106088, (2001).
- [Mu02] A. Mukherjee, I.V. Musatov, H. C. Pauli, A. V. Radyushkin, hep-ph/0205315.
- [Na70] Y. Nambu, Univ. of Chicago Report No. 70-70 (1970) (unpublished); lectures at the Copenhagen Summer Symposium (1970) (unpublished).
- [Na84] O. Nachtmann and H. J. Pirner, Z. Phys. **C21**, 277 (1984).
- [Na88] J. Napolitano *et al.*, Phys. Rev. Lett. **61**, 2530 (1988); S.J. Freedman *et al.*, Phys. Rev. C **48**, 1864 (1993); J.E. Belz *et al.*, Phys. Rev. Lett. **74**, 646 (1995).
- [NA99] *Nuclear Physics: The Core of Matter, The Fuel of Stars*, The Committee on Nuclear Physics of the Board on Physics and Astronomy of the Commission on Physical Sciences, Mathematics, and Applications of the National Research Council, National Academy Press, Washington, D.C. (1999).
- [Na02] A. Nathan (for the RCS Collaboration), *Workshop Proceeding for Exclusive Processes at High Momentum Transfer*, A. Radyushkin and P. Stoler , eds, World Scientific (2002), 225.
- [Na02a] Paul van der Nat, “Hadronization at 12 GeV,” Master’s thesis, vrije Universiteit Amsterdam/Nikhef, July 2002.
- [Ne77] R. Nieman *et al.*, IEEE Trans. on Magn., **13**, 632 (1977).
- [Ne95] T. G. O’Neill *et al.*, Phys. Lett. **B351**, 87 (1995).
- [Ne00] Lattice Hadron Physics Collaboration proposal, “*Nuclear Theory with Lattice QCD*”, J.W. Negele and N. Isgur principal investigators, <ftp://www-ctp.mit.edu/pub/negele/LatProp/>.
- [Ni94] N. N. Nikolaev, A. Szczurek, J. Speth, J. Wambach, B. G. Zakharov and V. R. Zoller, Phys. Rev. C **50**, 1296 (1994).

- [Ni99] I. Niculescu, C. Keppel, S. Liuti, and G. Niculescu, Phys. Rev. D **60**, 094001 (1999).
- [Ni00] I. Niculescu *et al.*, Phys. Rev. Lett. **85**, 1186 (2000).
- [Ni00a] I. Niculescu *et al.*, Phys. Rev. Lett. **85**, 1182 (2000).
- [NS96] “Nuclear Science: A Long Range Plan”, a report by the DOE/NSF Nuclear Science Advisory Committee, February, 1996.
- [NS02] “Opportunities in Nuclear Science: A Long-Range Plan for the Next Decade”, a report by the DOE/NSF Nuclear Science Advisory Committee, April, 2002.
- [Os99] M. Ostrick *et al.*, Phys. Rev. Lett. **83**, 276 (1999). C. Herberg *et al.*, Eur. Phys. J. A **5**, 131 (1999).
- [Pa97] V. R. Pandharipande, I. Sick, and P. K. A. deWitt Huberts, Rev. Mod. Phys. **69**, 981 (1997).
- [Pa99] I. Passchier *et al.*, Phys. Rev. Lett. **82**, 4988 (1999).
- [Pa00] E. Pace, G. Salme and S. Scopetta, to appear in *Proceedings of the XVII-th European Few-Body Conference*, Evora, Portugal (2000).
- [Pa01] E. Pace, G. Salme and S. Scopetta, Nucl. Phys. A **689**, 453 (2001); E. Pace, G. Salme, S. Scopetta and A. Kievsky, Phys. Rev. C **64**, 055203 (2001).
- [PDB] Particle Data Book, Phys. Rev., D66, (2002),01001.
- [Pe89] M. D. Petroff and M. Atac, IEEE Trans. Nucl. Sci. **NS-36**, 163 (1989).
- [Pe98] J.-C. Peng *et al.*, Phys. Rev. D **58**, 092004 (1998).
- [Pe00] G. Petratos, *Proceedings of the HiX2000 Workshop*, J.-P. Chen and Z.-E. Meziani, eds.
- [Pe00a] V. Petrov *et al.*, Phys. Rev. D **57**, 4325 (1998); M. Penttinen, M. V. Polyakov, and K. Goeke, Phys. Rev. D **62**, 014024 (2000).
- [PHOT] Photonis Imaging Systems, www.photonis.com.
- [Pi01] S.C. Pieper, R.B. Wiringa, Ann. Rev. Nucl. Part. Sci. **51**, 53 (2001).
- [Po99] M. V. Polyakov and C. Weiss, Phys. Rev. D **60**, 114017 (1999).
- [Po02] P. V. Pobylitsa, Phys. Rev. D **66**, 094002 (2002).
- [Po03] M.V. Polyakov and A.G. Shuvaev. hep-ph/0207153
- [Pr78] C. Y. Prescott, *et al.*, Phys. Lett. **B77**, 347 (1978).
- [Pr79] C. Y. Prescott, *et al.*, Phys. Lett. **B84**, 524 (1979).

- [Pu02] J. Pumplin, *et al.*, JHEP **7**, 12 (2002).
- [Ra77] A. V. Radyushkin, JINR report P2-10717, Dubna, 1977 (unpublished).
- [Ra79] J. Ralston and D. Soper, Nucl. Phys. **B152**, 109 (1979)
- [Ra88] J. P. Ralston and B. Pire, Phys. Rev. Lett. **61**, 1823 (1988).
- [Ra90] J. P. Ralston and B. Pire, Phys. Rev. Lett. **65**, 2343 (1990); B. Kundu, J. Samuelsson, P. Jain and J. P. Ralston, Phys. Rev. D **62**, 113009 (2000).
- [Ra91] V. A. Nesterenko and A. V. Radyushkin, Phys. Lett. B **115**, 410 (1982); and A. V. Radyushkin, Nucl. Phys. A **532** 141c (1991).
- [Ra92] J. P. Ralston and B. Pire, Phys. Rev. Lett. **61**, 1823 (1988); C. E. Carlson, M. Chachkhunashvili, and F. Myhrer, Phys. Rev. D **46**, 2891 (1992).
- [Ra96] A. V. Radyushkin, Phys. Lett. **B380**, 417 (1996); Phys. Lett. **B385**, 333 (1996); Phys. Rev. D **56**, 5524 (1997).
- [Ra97] A. Radyushkin, Phys.Lett.B380.417 (1996); Phys. Rev. D **56**, 5524 (1997).
- [Ra98] R. Rapp, T. Schafer, E. V. Shuryak and M. Velkovsky, Phys. Rev. Lett. **81**, 53 (1998)
- [Ra98a] A. V. Radyushkin, Phys. Rev. D **58**, 114008 (1998).
- [Ra99] A. V. Radyushkin, Phys.Rev.D **59**, 014030 (1999).
- [Ra99a] M. J. Ramsey-Musolf, Phys. Rev. **C60**, 015501 (1999).
- [Ra01] A. V. Radyushkin, in *At the frontier of particle physics/Handbook of QCD*, vol. 2, ed. M. Shifman, World Scientific (2001).
- [Ra01a] Radyushkin A (private communication).
- [Ra02] J.P. Ralston and B. Pire, Phys. Rev. D **66**, 111501 (2002)
- [Ra03] J. P. Ralston and P. Jain, hep-ph/0302043.
- [Rapc] Radyushkin A (private communication).
- [Ri98] G. Ricco *et al.*, Phys. Rev. C **57**, 356 (1998).
- [Ro79] D. A. Ross and C. T. Sachrajda, Nucl. Phys. **B149**, 497 (1979).
- [Ro82] S. Rock *et al.*, Phys. Rev. Lett. **49**, 1139 (1982).
- [Ro99] D. Rohe *et al.*, Phys. Rev. Lett. **83**, 4257 (1999).
- [Ru75] A. de Rújula, H. Georgi and H.D. Politzer, Ann. Phys. **103**, 315 (1975).

- [Sa69] J. J. Sakurai, Phys. Rev. Lett. **22**, 981 (1969).
- [Sa01] M. M. Sargsian, S. Simula and M. I. Strikman, Phys. Rev. C **66**, 024001 (2002).
- [Sa03] P.R. Saull [ZEUS collaboration] arXiv:hep-ex/0003030
- [Sa03a] M. Sargsian, L. Farnkfurt and M. Strikman in progress.
- [Sapc] M. M. Sargsian, private communication.
- [Sc91] R. Schiavilla and D. O. Riska, Phys. Rev. C **43**, 437 (1991); R. Schiavilla, V. R. Pandharipande and D. O. Riska, Phys. Rev. C **41**, 309 (1990); and references therein.
- [Sc93] R. W. Schulze and P. U. Sauer, Phys. Rev. C **48**, 38 (1993).
- [Sc01] E.C. Schulte, *et al.*, Phys. Rev. Lett. **87**, 102302 (2001).
- [Se95] J. Sexton *et al.* [IBM Collaboration], Phys. Rev. Lett. **75**, 4563 (1995).
- [Sh79] M.A. Shifman, A.I. Vainshtein, V.I. Zakharov, Nucl. Phys. **B147**, 385 (1979).
- [Sh79a] M. A. Shupe *et al.*, Phys. Rev. D **19**, 1921 (1979).
- [Sh01] M. Shifman, Handbook of QCD, Volume 3, 1451, World Scientific (2001)
- [Si91] D.Sivers, Phys.Rev. **D43**, 261 (1991).
- [Si93] A. F. Sill *et al.*, Phys. Rev. D **48**, 29 (1993).
- [Si01] N. Simicevic, "Design of a Čerenkov Counter for the Q-Weak Experiment", LATECH-CAPS-01-03A, March 12, 2001. Available in Public Access Papers area of <http://www.jlab.org/qweak/>.
- [Sl88] T. Sloan, G. Smadja, and R. Voss, Phys. Rep. **162**, 45 (1988).
- [Sm91] E. S. Smith and R. Jacobs, "Photomultiplier Tests for the CLAS TOF," CLAS-NOTE 91-003, Feb 1, 1991.
- [Sm99] G. I. Smirnov, Eur. Phys. J. C **10**, 239 (1999); V. V. Burov, A. V. Molochkov, G. I. Smirnov, Phys. Lett. **B466**, 1 (1999).
- [Sm99a] E. S. Smith *et al.*, Nucl. Instr. and Meth. **A432** (1999) 265.
- [Sm02] J. R. Smith and G. A. Miller, Phys. Rev. C **65**, 055206 (2002).
- [Sm02a] E. S. Smith, "CLAS TOF Rates in an Electron Beam," CLAS-NOTE 2002-004, Mar 8, 2002.
- [So96] X. Song, Phys. Rev. D **54**, 1955 (1996).
- [So99] L. Sorrel, E155 Technical note 81. SLAC. 1999

- [So00] P. Souder, *Proceedings of the HiX2000 Workshop*, J.-P. Chen and Z.-E. Meziani, eds.
- [Sp98] J. Speth and A. W. Thomas, *Adv. Nucl. Phys.* **24**, 83 (1998).
- [Spt] Signal Processing Technologies: <http://www.spt.com>.
- [St93] P. Stoler, *Phys. Rep.* **226**, 103 (1993).
- [St93a] M. Stratmann, *Z. Phys* **C60**, 763 (1993).
- [St95] E. Stein *et al.*, *Phys. Lett.* **B343**, 369 (1995).
- [St97] F. M. Steffens and A. W. Thomas, *Phys. Rev. C* **55**, 900 (1997).
- [St00] N.G. Stefanis, W. Schroers and H.-Ch. Kim, *Phys. Lett. B* **449**, 299 (1999); and *Eur. Phys. J. C* **18**, 137 (2000).
- [St01] S. Stepanyan, et al. [CLAS collaboration], *Phys. Rev. Lett.* **87**, 182002-1 (2001)
- [St02] F. M. Steffens, *Phys. Lett. B* **541**, 346 (2002).
- [St03] P. Stoler, e-Print Archive: hep-ph/0307162
- [STARpc] The STAR TOF Working Group, "Proposal for a Large Area Time of Flight System for STAR, STAR-TOF," May 15, 2002.
- [Sz01] A. P. Szczepaniak and M. Swat, *Phys. Lett.*, **B516**:72, 2001.
- [Ta96] L. Tao *et al.*, *Z. Phys. C* **70**, 387 (1996).
- [tH76] G. 't Hooft, *Phys. Rev. Lett.* **37**, 8 (1976); and *Phys. Rev. D* **14**, 3432 (1976).
- [Th84] A. W. Thomas, *Adv. Nucl. Phys.* **13**, 1 (1984).
- [Th97] D. R. Thompson *et al.* (E852 Collaboration) *Phys. Rev. Lett.*, **79**:1630, 1997.
- [Th97] D. R. Thompson *et al.*, *Phys. Rev. Lett.* **81**, 5760, (1997).
- [Th00] A. W. Thomas, W. Melnitchouk and F. M. Steffens, *Phys. Rev. Lett.* **85**, 2892 (2000).
- [Th01] R. Thompson *et al.*, *Phys. Rev. Lett.* **86**, 1702 (2001).
- [Ti92] P. C. Tiemeijer and J. A. Tjon, *Phys. Lett.* **277B**, 38 (1992).
- [Ti92] P. C. Tiemeijer and J. A. Tjon, *Phys. Lett.* **277B**, 38 (1992).
- [TOSCA] 3-D Non-linear magnetostatics computer program, SCARPIA pre-processor and OPERA post-processor, Vector Fields, Oxford, U.K.
- [Uc88] T. Uchiyama and K. Saito, *Phys. Rev. C* **38**, 2245 (1988).

- [Ulpc] “MCEEP — Monte Carlo for Electro-Nuclear Coincidence Experiments”, User Manual, version 3.6, by P.E. Ulmer, Old Dominion University, unpublished (2001). Available from <http://www.physics.odu.edu/~ulmer/mceep/mceep.html>.
- [Va00] M. Vakili *et al.*, [CCFR Collaboration], Phys. Rev. D **61**, 052003 (2000).
- [Va98] M. Vanderhaeghen, M. Guidal, J.-M. Laget, Phys. Rev. C **57**, 1454 (1998).
- [Va99] M. Vanderhaeghen, P. A. M. Guichon, and M. Guidal, Phys. Rev. D **60**, 094017 (1999).
- [Vapc] M. Vanderhaeghen, private communication. The calculations were done using the double distribution of Radyushkin [Ra99] with and without the D -term of Polyakov and Weiss [Po99].
- [Ve87] P. Vernin, RPAC (II), CEBAF, January 1987, p. 615.
- [Vi92] M. Virchaux and A. Milzstajn, Phys. Lett. **74B**, 221 (1992).
- [Vo88] M. B. Voloshin and M. A. Shifman, Sov. J. Nucl. Phys. **47**, 511 (1988); N. Isgur, Phys. Rev. D **40**, 101 (1989); Phys. Lett. **B448**, 111 (1999).
- [Vo01] J. Volmer *et al.*, Phys. Rev. Lett. **86**, 1713 (2001).
- [Wa77] S. Wandzura and F. Wilczek, Phys. Lett. **B72**, 195 (1977).
- [Wa80] S. T. Wang *et al.*, Adv. in Cryogenics Engineering **25**, 19 (1980).
- [Wa82] S. T. Wang *et al.*, Cryogenics **22**, 335 (1982).
- [Wa91] D. A. Wasson, Phys. Rev. Lett. **67**, 2237 (1991).
- [Wa95] X.-N. Wang, M. Gyulassy, and M. Plumer, Phys. Rev. D **51**, 3436 (1995).
- [Wa97] M. R. Wayne, Nucl. Inst. and Meth. **A386**, 278 (1997).
- [Wa03] G. Warren *et al.*, “Spin Asymmetries on the Nucleon Experiment (SANE)”, Jefferson Lab Proposal P03-002.
- [We71] G. B. West, Phys. Lett. **B37**, 509 (1971); W. B. Atwood and G. B. West, Phys. Rev. D **7**, 773 (1973).
- [We94] D. Weingarten, Nucl. Phys. **B34** (Proc Suppl.), 29 (1994).
- [We96] G. West, hep-ph/9612403.
- [We97] H. Weigel *et al.*, Phys. Rev. D **55**, 6910 (1997).
- [We02] J. Wendland [HERMES Collaboration], <http://www-hermes.desy.de/notes/pub/trans-public-index.html> .

- [We02a] L.B. Weinstein and R. Niyazov, proceedings of the conference ‘Electron-Nucleus Scattering VII’, Elba, June 26, 2002. nucl-ex/0209014.
- [Wh92] L. Whitlow *et al.*, Phys. Lett. **B282**, 475 (1992).
- [Wi00] R. Wigmans, Calorimetry, Oxford Science Pub. (2000).
- [Wo81] R. C. Wolgast *et al.*, IEEE Trans. on Magn. **17**, 195 (1981).
- [Wo89] R. M. Woloshyn, Nucl. Phys. **A496**, 749 (1989).
- [Wo97] C. S. Wood, *et al.*, Science **275**, 1759 (1997).
- [Wopc] B. Wojtsekhowski and C. Hyde-Wright, private communication; K. Abe *et al.*, Phys. Lett. **B404**, 404 (1997); P. L. Anthony *et al.*, Phys. Lett. **B458**, 529 (1999).
- [WP01] “The Science Driving the 12 GeV Upgrade of CEBAF”, an internal report of the Thomas Jefferson National Accelerator Facility, Newport News, VA (2001)
- [Xiln] Xilinx: <http://www.xilinx.com>.
- [Yu95] Yu. Prokoshkin, S. A. Sadoyski, Phys. Atom. Nucl., **58**:606, 1995.
- [Za01] B. Zaroukian, J. Kaditz, C. A. Meyer and P. Eugenio, *A Study of leakage in Partial Wave Analysis for the HallD Detector at Jefferson Lab*, July 2001, (http://www.phys.cmu.edu/halld/halld_notes/Note_051/).
- [Ze01] G. P. Zeller, *et al.*, Phys. Rev. Lett. **88**, 091802 (2002).
- [Zepc] Z. Li, Brookhaven National Laboratory, private communications (2002)
- [Zh01] H. Zhu *et al.*, Phys. Rev. Lett. **87**, 081801 (2001).
- [Zh01a] L.Y. Zhu, Hall A data analysis workshop, Dec. 11-12, 2001. (<http://www.jlab.org/~lyzhu/work/dec01.ps.gz>)
- [Zh03] Q. Zhao and F. Close, private communication.
- [Zh03a] L.Y. Zhu *et al.*, Phys. Rev. Lett. **91**, 022003 (2003).

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