

## SCHNITZER, HOWARD J.

Education:        1955 B.S.                Newark College of Engineering  
                      1960 Ph.D.                University of Rochester

### Professional

Record:            1960–61                Postdoctoral Research Associate, University of Rochester  
                      1961–62                Postdoctoral Research Associate, Brandeis University  
                      1962–65                Assistant Professor, Brandeis University  
                      1965–68                Associate Professor, Brandeis University  
                      1968–                    Professor, Brandeis University  
                      1969–70                Visiting Professor, Rockefeller University  
                      1974–75                Harvard University (on leave – fall)  
                      1976–77                Harvard University (on leave – spring)  
                      1978–80                Associate Editor, Physical Review Letters  
                      1981–83                Chairman, Physics Department, Brandeis University  
                      1983–84                Harvard University (on leave)  
                      1990–91                Harvard University (on leave – spring)  
                      1997–98                Harvard University (on leave – spring)  
                      2004–05                Harvard University (on leave – spring)  
                      2010–11                (on leave – spring)

### Academic

Honors:            1955–56, 1957–60    National Science Foundation Predoctoral Fellow  
                      1964–66                Alfred P. Sloan Foundation Fellow  
                      1972–                    Fellow of the American Physical Society  
                      1983–84                John S. Guggenheim Foundation Fellow  
                      1991–                    Gertrude and Edward Swartz Professor of Theoretical Physics

“D-Wave Effect on the Dispersion Equation Analysis of the  $\pi^-$ -Proton Scattering” (with G. Salzman), Bull. Am. Phys. Soc., Ser. II 2, 353 (1957).

“Discrepancy Between  $\pi^-$ -Proton Scattering and a Dispersion Relation” (with G. Salzman), Phys. Rev. 112, 1802 (1958).

“Alternative Method for Comparing Pion-Proton Scattering Data with Dispersion Equations” (with G. Salzman), Phys. Rev. 113, 1153 (1959).

“The  $I = 1/2$   $\pi$ -N Resonances and the  $\pi$ - $\pi$  Interaction” (with C. Goebel), Bull. Am. Phys. Soc., Ser. II 4, 50 (1959).

“Pion Production by Pions and the Second Pion Nucleon Resonance” (with C. Goebel), Proc. of the 1960 Ann. Conf. H. E. Phys., Rochester (Interscience Publishers, Inc., New York 1960) p. 298.

“Pion Production and the Second Pion-Nucleon Resonance” (with C. Goebel), Phys. Rev. 123, 2193 (1961).

“Quantum Mechanical Systems with Indefinite Metric II” (with E.C.G. Sudarshan), Phys. Rev. 123, 1059 (1962).

“Pion-Pion Scattering and Low-Energy Pion Production” Phys. Rev. 125, 1059 (1962). “Analytic Properties of Direct Interactions,” Nucl. Phys. 36, 505 (1962).

"Resonance Model for Photoproduction of K Mesons on Nucleons" (with S. Hatsukade), Bull. Am. Phys. Soc., Ser. II 7, 323 (1962).

"Resonance Model for Photoproduction of K Mesons on Nucleons" (with S. Hatsukade), Phys. Rev. 128, 468 (1962).

"Completeness Identity in Field Theory" (with O.W. Greenberg, E.C.G. Sudarshan), Nuovo Cimento 25, 461 (1962).

"Applications of Polology to Stripping Reactions" (With C. Dullemond), Proc. Intern'l Symp. Direct Interactions and Nucl. Reac. Mechanisms, Istituto di Fisica, Universita di Padua, Italy; (Gordon and Breach Publishers, 1963), p. 420.

"Application of Polology to Stripping Reactions" (with C. Dullemond), Phys. Rev. 129, 821 (1963).

"Higher Order Lagrangians" (with E.C.G. Sudarshan) Unpublished, 1962.

"Lehmann Ellipse for 3-Body Potential Scattering" (with M. Grisaru), unpublished, 1963.

"Inner Coulomb Corrections to Pion-Nucleon Scattering Phase Shifts," Nuovo Cimento 28, 752 (1963).

"Resonance Model for Photoproduction of K Mesons on Nucleons, II" (with S. Hatsukade), Phys. Rev. 132, 1301 (1963).

"Unitary Symmetry and Strange Baryon Electromagnetic Mass Splittings" (with S. Coleman), Postdeadline Paper, Meeting of Am. Phys. Soc. (April 1963).

"Mixing of Elementary Particles" (with S. Coleman), Phys. Rev. 134, B863 (1964).

"Departures from the Eightfold Way, II" (with S. Coleman), Phys. Rev. 136, B223 (1964).

"Concerning Space-Time and Symmetry Groups" (with M. E. Mayer, E. C.G. Sudarshan, R. Acharya and M. Y. Han), Phys. Rev. 135, B888 (1964).

"Electromagnetic Mass Differences of Strongly Interacting Particles" (with S. Coleman, S. L. Glashow, R. Socolow), Proc. Intern'l Conf. HE Phys., Dubna, USSR (August 5-15, 1965).

"Dispersion Relations and Direct Nuclear Reactions," Rev. of Mod. Phys. 37, 666 (1965).

"Charged Scalar Theory and Broken Charge Symmetry," Nuovo Cimento 39, 727 (1965).

"Weak and Strong D/F Ratios" (with S. Coleman), unpublished preprint, 1965.

"Current Algebras and Meson Systems," Phys. Rev. 141, 1484 (1966).

"SU(6) Predictions from Adler-Weisberger Sum Rules and the Johnson-Treiman Relations," Phys. Lett. 20, 539 (1966).

"Low Energy Associated Production:  $\pi^- + p \rightarrow K^0 + \Lambda$ " (with H. Hoffman), Nucl. Phys. 76, 481 (1966).

"Symmetry Predictions from Sum Rules without Saturation" (with F. J. Gilman) Phys. Rev. 150, 1362 (1966).

“Current Algebra Determination of Low-Energy Pion-Nucleon Scattering,” *Phys. Rev.* 158, 1471 (1967).

“Sum Rules for the Spectral Functions of  $SU(3) \times SU(3)$ ” (with S.L. Glashow and S. Weinberg), *Phys. Rev. Lett.* 19, 139 (1967).

“Convergent Calculation of Nonleptonic K Decay in the Intermediate-Boson Model” (with S. L. Glashow and S. Weinberg), *Phys. Rev. Lett.* 19, 205 (1967).

“Pion Electromagnetic Mass Difference for Physical Pions” (with I. Gerstein, B. W. Lee, and H. T. Nieh), *Phys. Rev. Lett.* 19, 1064 (1967).

“Current Algebra Calculation of Hard Pion Processes:  $A_1 \rightarrow \rho\pi$  and  $\rho \rightarrow \pi\pi$ ” (with S. Weinberg), *Phys. Rev.* 164, 1828 (1967).

“Hard Pions and Pion Mass Difference” *Proc. 1967 Intern’l. Conf. Particles and Fields* (Interscience Publishers, New York, 1967), p. 538.

“Current Algebra and Ward Identities: Three and Four Point Functions” (with I. Gerstein), *Phys. Rev.* 170, 1638 (1968).

“Current Algebra, Ward Identities, and Space-Space Equal-Time Current Commutators” (with M. L. Wise), *Phys. Rev. Lett.* 21, 475 (1968).

“Structure of Three Point Functions from  $SU(3) \times SU(3)$  Algebra” (with S. Weinberg and I. Gerstein), *Phys. Rev.* 175, 1873 (1968).

“Chiral  $SU(3)$  Three Point Function: Single Particle Approximation” (with I. Gerstein), *Phys. Rev.* 175, 1876 (1968).

“Electromagnetic Mass Difference of Zero Mass Pions: 4th Order” (with I. Gerstein, T. Wong, G. Guralnik), *Phys. Rev. D1*, 3442 (1970).

“Current Algebra Determination of Low-Energy Pion-Nucleon Parameters,” *Proc. Conf. on  $\pi N$  Scattering at the Univ. of California, Irvine* (J. Wiley and Sons, Inc., New York, 1969), p. 155.

“Connections Between Ward Identities, Phenomenological Lagrangian, and Algebra of Fields (A View from the Bridge)” in *Lectures in Theoretical Physics*, K. T. Mahanthappa, W. E. Britten and A. O. Burut (editors) Gordon and Breach, New York, 1969, Vol. XIV, p. 65.

“The Veneziano Model and Current Algebra: PCAC,” *Phys. Rev. Lett.* 21, 1154 (1969).

“Hard Pions—A Phenomenological Approach to Current Algebra” *Proc. 1969 Erice (Sicily) Summer School*, (Academic Press, New York 1970), pp. 144-182.

“The Phenomenological Current Algebra Vertex” (with M. L. Wise), *Ann. Phys. (N.Y.)* 59, 129 (1970).

“Current Algebra and Unitarity,” *Phys. Rev. Lett.* 24, 1384 (1970).

“Current Algebra Beyond the Tree Approximation,” *Phys. Rev. D2*, 1621 (1970).

“Scale Transformation and Broken Chiral Symmetry,” *Phys. Rev. D3*, 1898 (1971).

“Dynamical and Kinematical Aspects of Corrections to Scaling Behavior,” Phys. Rev. D4, 1429 (1971).

“Current Algebra and Unitarity, II” (with P. Ford), Phys. Rev. D4, 2402 (1971).

“Sigma Term in Pion-Nucleon Scattering” Phys. Rev. D5, 1482 (1972); D6, 1801 (1972).

“Light-Cone Analysis of Virtual Processes” (with R. Jackiw), Phys. Rev. D5, 2008 (1972); Addenda, Phys. Rev. D7, 3116 (1973).

“Anomalies of Bilocal Operators,” Phys. Rev. D6, 2118 (1972).

“Constraints and Anomalies in Finite Quantum Electrodynamics,” Phys. Rev. D8, 385 (1973).

“The Reggeization of Yang–Mills Gauge Mesons in Theories with a Spontaneously Broken Symmetry” (with M. Grisaru and H.-S. Tsao), Phys. Rev. Lett. 20, 811 (1973).

“Reggeization of Non-Abelian Gauge Vector Mesons: S-Matrix Theory vs. Field Theory.” Proc. Conf. on Recent Advances in Elem. Particle Phys., 1973, Ann. NY Acad. Sci., 229, 45 (1974).

“Reggeization of Elementary Particles in Renormalizable Gauge Theories: Vectors and Spinors” (with M. Grisaru and H.-S. Tsao), Phys. Rev. D8, 4498 (1973).

“The Reggeization of Elementary Particles in Renormalizable Gauge Theories: Scalars” (with M. Grisaru and H.-S. Tsao), Phys. Rev. D9, 2864 (1974).

“Nonperturbative Effective Potential for  $O(N)$  Scalar Theory in the Many-Field Limit,” Phys. Rev. D10, 1800 (1974).

“The Hartree Approximation in Relativistic Field Theory,” Phys. Rev. D10, 2042 (1974).

“Quark Dynamics and Bound Charm,” unpublished Brandeis report, December, 1974.

“Dynamics of Light and Heavy Bound Quarks” (with J. S. Kang), Phys. Rev. D12, 841 (1975).

“Is  $\chi(3700)$  a Radial Excitation of  $\chi(3100)$ ?” (with J. S. Kang), Phys. Rev. D12, 2791 (1975).

“Hyperfine Splitting of Ground-State Charmonium,” Phys. Rev. D13, 74 (1976).

“P States of Charmonium and the Forces that Confine Quarks,” Phys. Rev. Lett. 35, 1540 (1975).

“Bound States, Tachyons, and the Restoration of Symmetry in the  $1/N$  Expansion” (with L. F. Abbott, and J. S. Kang), Phys. Rev. D13, 2212 (1976).

“The  $1/N$  Expansion of Renormalizable and Non-Renormalizable Scalar Field Theories,” Nucl. Phys. B109, 297 (1976).

“Semiclassical Bound-State Methods in Four-Dimensional Field Theory: Trace Identities, Mode Sums, and Renormalization for Scalar Field Theories” (with L. F. Abbott), Phys. Rev. D14, 1977 (1976).

“The Spin Structure of Charmonium and the Quark-Gluon Effective Interaction,” Phys. Lett. 65B, 239 (1976).

“Are There Quasi-Stable Hadrons Containing Super-Heavy Quarks” (with E. Poggio), Phys. Rev.

D15, 1973 (1977).

“Meson Hyperfine Splittings and Asymptotic Freedom,” *Phys. Lett.* 69B, 477 (1977).

“What Have We Learned About Quark Forces from Charmonium?” in *Proc. 5th Intern’l. Conf. on Experimental Meson Spectroscopy*, Northeastern University Press, 1977, p. 81.

“Supercurrent Anomaly in a Supersymmetric Gauge Theory” (with L.F. Abbott and M.T. Grisaru), *Phys. Rev. D* 16, 2995 (1977).

“Possible Supersymmetry Breaking by Pseudoparticles” (with L.F. Abbott and M.T. Grisaru), *Phys. Rev. D* 16, 3002 (1977).

“Cancellation of the Supercurrent Anomaly in a Supersymmetric Gauge Theory” (with L. F. Abbott and M. T. Grisaru), *Phys. Lett.* 71B, 161 (1977).

“A Supercurrent Anomaly in Supergravity” (with L. F. Abbott and M. T. Grisaru), *Phys. Lett.* 73B, 71 (1978).

“Inverted Charmed Meson Multiplets as a Test for Scalar Confinement,” *Phys. Lett.* 76B, 461 (1978).

“Spin Structure in Meson Spectroscopy with an Effective Scalar Confinement of Quarks,” *Phys. Rev. D* 18, 3482 (1978).

“Vacuum Polarization at Long Distances and the Heavy Quark-Antiquark Potential” (with E. C. Poggio), *Phys. Rev. Lett.* 41, 1344 (1978).

“Vacuum Polarization Corrected Long Distance Static Quark-Antiquark Potential” (with E. C. Poggio), *Phys. Rev. D* 19, 1557 (1979).

“Quantum Chromodynamics and the Spin-Dependent Quark-Antiquark Forces,” *Phys. Rev. D* 19, 1566 (1979).

“Hadronic Corrections to the Annihilation Rate of Heavy Vector Mesons to Lepton Pairs” (with E. C. Poggio), *Phys. Rev. D* 20, 1175 (1979); Addendum *D* 21, 2034 (1980).

“Reggeization of Gauge Vector Mesons and Unified Theories” (with M.T. Grisaru), *Phys. Rev. D* 20, 784 (1979).

“Reggeization of Elementary Fermions in Arbitrary Renormalizable Gauge Theories” (with M.T. Grisaru), *Phys. Rev. D* 21, 1952 (1980).

“The Supersymmetry Ward Identity for the Supersymmetric Non-Abelian Gauge Theory” (with P. Majumdar and E. Poggio), *Phys. Rev. D* 21, 2203 (1980).

“Supersymmetric Regulators and Supercurrent Anomalies” (with P. Majumdar and E. Poggio), *Phys. Letters* 93B, 321 (1980).

“Decoupling Theorems and Effective Field Theories” (with B. Ovrut) *Proceedings of the 20th International Conference on High Energy Physics*, Madison, Wisc., July 1980, p. 445.

“A New Approach to Effective Field Theories” (with B. Ovrut), *Phys. Rev. D* 21, 3369 (1981).

“Decoupling Theorems and Effective Field Theories” (with B. Ovrut), Phys. Rev. D22, 2518 (1981)

“The Decoupling Theorem and Minimal Subtraction” (with B. Ovrut), Phys. Lett. B100, 403 (1981).

“Gauge Theories with Minimal Subtraction and the Decoupling Theorem” (with B. Ovrut), Nuclear Physics B179, 381 (1981).

“Low Energy and Threshold Calculations Using Effective Field Theory” (with B. Ovrut), Nuclear Physics B184, 109 (1981).

“Effective Field Theories and Higher Dimension Operators” (with B. Ovrut), Phys. Rev. D24, 1695 (1981).

“Radial and Regge Excitations in Unified, Grand Unified, and Subconstituent Models,” Nucl. Phys. B193, 195 (1981).

“Gauge Theory and Effective Lagrangians” (with B. Ovrut), Nucl. Phys. B189, 509 (1981).

“Spin Structure in Meson Spectroscopy,” Proceedings of the 16th Rencontre de Moriond, Vol. II, March 1981, p. 293.

“Closing Conference Summary Talk,” Proceedings of the 16th Rencontre de Moriond, Vol. II, March 1981, p. 649.

“Spin-Dependence and Gluon Mixing in Ordinary Meson Spectroscopy,” unpublished preprint, May 1981.

“Dynamical Calculation of Bound-State Supermultiplets in N=8 Supergravity” (with M. T. Grisaru), Phys. Letters 107B, 196 (1981).

“Bound State Regge Trajectories in N=8 Supergravity” (with M.T. Grisaru), Proceedings of the 2nd Europhysics Study Conference on Unification of the Fundamental Interactions, Erice, Sicily, October 1981; and in Unification of the Fundamental Particle Interactions II, S. Ferrara and J. Ellis (eds.) (Plenum Press, New York, 1982), p. 169.

“Effective Field Theory in Background Field Gauge” (with B. Ovrut), Phys. Letters 110B, 139 (1982).

“Spin-Dependence and Glueball Mixing with  $\Theta(1640)$  in Ordinary Meson Spectroscopy,” Nucl. Phys. B207, 131 (1982).

“The Problem of the Displaced Scalar Meson States,” Phys. Lett. 117B, 96 (1982).

“Bound States in N=8 Supergravity and N=4 Supersymmetric Yang–Mills Theories” (with M. T. Grisaru), Nucl. Phys. B204, 267 (1982).

“Virtual Effects of Excited Quarks as Probes of a Possible New Hadronic Mass Scale” (with C. J. C. Burges), Nucl. Phys. B228, 464 (1983).

“Deep Inelastic Scattering as a Probe of New Hadronic Mass Scales” (with C.J.C. Burges), Phys. Lett. 134B, 329 (1984).

“Systematics of the Spin-Dependent Quarkonium Forces,” Phys. Lett. 134B, 253 (1984).

“The Soft-Pion Skyrmin Lagrangian and Strong CP-Violation,” Phys. Lett. 139B, 217 (1984).

“Systematics of Light Meson Spectroscopy,” Phys. Lett. 149B, 408 (1984).

“Supersymmetric Skyrmions in Four-Dimensions” (with E. Bergshoeff and R. Nepomechie), Nucl. Phys. B249, 93 (1985).

“Chiral Perturbation Theory for the Pion Skyrmin System,” Nucl. Phys. B261, 546 (1985).

“A (Nearly) Model Independent Description of the Spin-Dependent Interactions in Quarkonium,” Proceedings of the International Conference on Hadron Spectroscopy, University of Maryland, April 1985, p. 404, ed., S. Oneda, AIP.

“Meson Hyperfine Splitting,” Brandeis preprint 1985 (unpublished).

“The Polyakov String in  $O(N)$  or  $SU(N)$  Group Space” (with A. N. Redlich), Phys. Lett. 167B, 315 (1986); 193B, 536(E) (1987).

“Bose-Fermi Equivalence on the Two-Dimensional Torus for Simply-Laced Groups” (with A. N. Redlich and K. Tsokos), Nucl. Phys. B289, 397 (1987).

“Skyrme Model Predictions for Weak Radiative Decays of Baryons” (with W.F. Kao), Phys. Lett. 183B, 361 (1987).

“Partition Functions and Fermi-Bose Equivalence for Simply-Laced Groups on Compact Riemann Surfaces” (with K. Tsokos), Nucl. Phys. B291, 429 (1987).

“Two-Dimensional Non-Abelian Bosonization in the Presence of External Gauge Fields and Gravity” (with A. N. Redlich), Phys. Lett. 193B, 471 (1987).

“Weak Radiative Baryon Decays of the Skyrme Model” (with W. F. Kao), Phys. Rev. D37, 1912 (1988).

“Low-Energy Effective Action for Closed Bosonic Strings on Group Manifolds” (with D. Karabali and K. Tsokos), Nucl. Phys. B294, 412 (1987).

“Gauge Symmetry Enlargement and Accidental Massless Spectrum of String Models on Group Manifolds” (with D. Karabali), Nucl. Phys. B299, 548 (1988).

“Low-Energy Effective Action, to Two-Loop Order, for Strings on a Group Manifold, from Compactification of Closed Bose Strings” (with W.F. Kao and Q-Han Park), Phys. Lett. 200B, 53 (1988).

“Non-Abelian Bose-Fermi Equivalence in the Background of Kaluza-Klein Scalars and Compactification of Closed Bosonic Strings” (with D. Karabali and Q-Han Park), Phys. Lett. B205, 267 (1988).

“A GKO Construction Based on a Path Integral Formulation of Gauged Wess-Zumino-Witten Actions” (with D. Karabali, Q-Han Park, and Z. Yang), *Phys. Lett.* B216, 307 (1989).

“A Path Integral Construction of Superconformal Field Theories from a Gauged Supersymmetric Wess-Zumino-Witten Action,” *Nucl. Phys.* B324, 572 (1989).

“Thirring Interactions, Non-Abelian Bose-Fermi Equivalences and Conformal Invariance” (with D. Karabali and Q-Han Park), *Nucl. Phys.* B323, 572 (1989).

“BRST Quantization of the Gauged WZW Action and Coset Conformal Field Theories” (with D. Karabali), *Nucl. Phys.* B329, 649 (1989).

“Where Are the Inverted Multiplets of Meson Spectroscopy?” *Phys. Lett.* B226, 171 (1989).

“Gauged WZW Models and the Coset Construction,” *Proceedings of the Europhysics Conference on High-Energy Physics, Madrid, Spain*, edited by F. Banneiro and C. Lopez, *Nuclear Physics B, (Proceedings Supplements)* 16, 610 (1990).

“Constructive Methods for Higher-Genus Correlation Functions of Level-One Simply-Laced WZW Models” (with S. Naculich), *Nucl. Phys.* B332, 583 (1990).

“Duality Relations Between  $SU(N)_k$  and  $SU(k)_N$  WZW Models and their Braid Matrices” (with S. Naculich), *Phys. Lett.* 244B, 235 (1990).

“Duality Between  $SU(N)_k$  and  $SU(k)_N$  WZW Models” (with S. Naculich), *Nucl. Phys. B* 347, 687 (1990).

“Group-Level Duality in WZW Models and Chern-Simons Theory” (with S. Naculich and H. Riggs), *Phys. Lett.* 246B, 417 (1990).

“Group-Level Duality of WZW Fusion Coefficients and Chern-Simons Link Observables” (with E. Mlawer, S. Naculich, and H. Riggs), *Nucl. Phys.* B352, 863 (1991).

“A Quantum Generated Symmetry: Group-Level Duality in Conformal and Topological Field Theory” (with S. Naculich and H. Riggs), in “Quarks, Symmetries, and Strings” World Scientific Publishers (1991), M. Kaku, A. Jevicki, and K. Kikkawa (Eds.), p. 294.

“Concerning the Electric Dipole Moment of the Neutron in the Skyrme Model,” *Phys. Lett.* 253B, 465 (1991).

“A Quantum Generated Symmetry of Conformal and Topological Field Theory” (with S. Naculich, H. Riggs, and E. Mlawer), *Proceedings of the NATO Workshop on Quantum Field Theory, Statistical Mechanics, Quantum Groups, and Topology*, World Scientific Publishers (1992), T. Curtright, L. Mezincescu, and R. Nepomechie (Eds.), p. 218.

“The Quasi-Rational Fusion Structure of  $SU(m|n)$  Chern-Simons and WZW Theories,” (with M. Bourdeau, E. Mlawer, and H. Riggs), *Nucl. Phys.* B372, 303 (1992).

“Topological Landau-Ginsburg Matter from  $Sp(N)_k$  Fusion Rings” (M. Bourdeau, E. Mlawer, and H. Riggs), *hep-th/9111020*, *Mod. Phys. Lett.* A7, 689 (1992).

“Concerning the Double Scaling Limit in the  $O(N)$  Vector Model in Four-Dimensions,” *hep-th/9206045*, *Mod. Phys. Lett.* A7, 2449 (1992).

“Simple-Current Symmetries, Rank-Level Duality, and Linear Skein Relations for Chern-Simons



Groups" (with S. Naculich and H. Riggs), hep-th/9205082, Nucl. Phys. B394, 445 (1993).

"CP-Violating Yukawa Couplings in the Skyrme Model and the Neutron Electric Dipole Moment" (with H. Riggs), hep-ph/9212273, Phys. Lett. B305, 252 (1993).

"Two-Dimensional Yang–Mills Theories are String Theories" (with S. Naculich and H. Riggs), hep-th/9305097, Mod. Phys. Lett. A8, 2223 (1993).

"Twist-Points as Branch Points for the QCD<sub>2</sub> String" (with S. Naculich and H. Riggs), hep-th/9310105, Phys. Lett. B319, 466 (1993).

"Integrable N=2 Landau–Ginzburg Theories from Quotients of Fusion Rings" (with E. Mlawer and H. Riggs), hep-th/9310082, Nucl. Phys. B418, 603 (1994).

"The Cutoff  $\lambda\phi^4$  O(N) Model in the Large N Limit" (with J. Nunes), hep-th/9311319, Int. Journal of Mod. Phys. A10, 719 (1995).

"The String Calculation of Wilson Loops in SO(N) and Sp(N) 2-D Yang–Mills Theory" (with S. Naculich and H. Riggs), hep-th/9406100, Int. Journal of Mod. Phys. A10, 719 (1995).

"Universal Aspects of Two-Dimensional Yang–Mills Theory at Large N" (with M. Crescimanno), hep-th/9501099, Int. Journal Mod. Phys. A11, 1733 (1996).

"Large N Universality of the Two-Dimensional Yang–Mills String" (with M. Crescimanno and S. Naculich), hep-th/9503020, Nucl. Phys. B446, 3 (1995).

"Evaluation of the Free Energy of Two-Dimensional Yang–Mills Theory" (with M. Crescimanno and S. Naculich), hep-th/9601104, Phys. Rev. D54, 1809 (1996).

"BF Theories and Group-Level Duality" (with J. Isidro and J. Nunes), hep-th/9510064, Nucl. Phys. B465, 315 (1996).

"Field Strength Correlators for Two-Dimensional Yang–Mills Theories Over Riemann Surfaces" (with J. Nunes), hep-th/9510154, Int. Journal of Mod. Phys. A12, 4743 (1997).

"The Master Field for 2D QCD on the Sphere" (with J. Nunes), hep-th/9510155, Phys. Lett. B377, 117 (1996).

"The Gauged Vector Model in Four-Dimensions: Resolution of an Old Problem?" (with D. Olmsted), hep-th/9602069, Nucl. Phys. B512, 237 (1998).

"The Quantum Field Theory of Physics and of Mathematics," physics/9703005, published in the Proceedings of the Conference on "Conceptual Foundations of Quantum Field Theory," Cambridge U. Press, 1999 (T.Y. Cao, editor), p. 161.

"A New Derivation of the Picard–Fuchs Equations for Effective N=2 Super Yang–Mills Theories" (with J.M. Isidro, A. Mukherjee, and J.P. Nunes), hep-th/9609116, Nucl. Phys. B492, 647 (1997).

"A Note on the Picard–Fuchs Equations for N=2 Seiberg–Witten Theories" (with J.M. Isidro, A. Mukherjee, and J.P. Nunes), hep-th/9703176, Int. Journal of Mod. Phys. A13, 233 (1998).

"On the Picard–Fuchs Equations for Massive N=2 Seiberg–Witten Theories" (with J.M. Isidro, A. Mukherjee, and J.P. Nunes), hep-th/9704174, Nucl. Phys. B502, 363 (1997).

"Superconformal Coset Equivalence from Level-Rank Duality" (with S. Naculich), hep-th/9705149,

Nucl. Phys. B505, 727 (1997).

“One-Instanton Test of a Seiberg–Witten Curve from M-Theory: the Antisymmetric Representation of  $SU(N)$ ” (with S. Naculich and H. Rhedin), hep-th/9804105, Nucl. Phys. B533, 275 (1998).

“The Non-Abelian Coulomb Phase of the Gauged Vector Model at Large  $N$ ” (with H. Rhedin), hep-th/9804008, Nucl. Phys. B537, 516 (1999).

“One-Instanton Predictions of a Seiberg–Witten Curve from M-Theory: the Symmetric Representation of  $SU(N)$ ” (with I. Ennes, S. Naculich and H. Rhedin), hep-th/9804151, Int. Journal of Mod. Phys. A14, 301 (1999).

“One-Instanton Predictions for Non-hyperelliptic Curves Derived from M-Theory” (with I. Ennes, S. Naculich and H. Rhedin), hep-th/9806144, Nucl. Phys. B536, 245 (1999).

“One-Instanton Predictions of Seiberg–Witten Curves for Product Groups” (with I. Ennes, S. Naculich and H. Rhedin), hep-th/9901124, Phys. Lett. B452, 260 (1999).

“Two Antisymmetric Hypermultiplets in  $N=2$   $SU(N)$  Gauge Theory: Seiberg–Witten Curve and M-theory Interpretation” (with I. Ennes, S. Naculich and H. Rhedin), hep-th/9904078, Nucl. Phys. B558, 41 (1999).

“Tests of M-Theory from  $N=2$  Seiberg–Witten Theory” (with I. Ennes, C. Lozano, S. Naculich and H. Rhedin), hep-th/9911022, lectures in the Proceedings of the Advanced School of Supersymmetry, in the Theories of Fields, Strings, and Branes, Santiago de Compostela, Spain, July 1999.

“Elliptic Models and M-Theory” (with I. Ennes, C. Lozano and S. Naculich), hep-th/9912133, Nucl. Phys. B576, 313 (2000).

“Elliptic Models, Type IIB Orientifolds, and the AdS/CFT Correspondence” (with I. Ennes, C. Lozano and S. Naculich), hep-th/0006140, Nucl. Phys. B591, 195 (2000)

“Vacuum States of  $N=1^*$  Mass Deformations of  $N=4$  and  $N=2$  Conformal Gauge Theories and their Brane Interpretations” (with S. Naculich and N. Wyllard) hep-th/0103047, Nucl. Phys. B609, 283 (2001).

“M-Theory Tested by  $N=2$  Seiberg–Witten Theory” (with I. Ennes, C. Lozano, S. Naculich and H. Rhedin), hep-th/0006141, in Mirror Symmetry IV, Advanced Studies in Mathematics, vol. 33, American Math. Society and International Press (2002), p. 113–126.

“Seiberg–Witten Curves for Elliptic Models” (with I. Ennes, C. Lozano and S. Naculich), hep-th/0007133, in Mirror Symmetry IV, Advanced Studies in Mathematics, vol. 33, American Math. Society and International Press (2002), p. 127–138.

“ $N=2$  Seiberg–Witten Theory and Non-hyperelliptic Curves” (with S. Naculich), Concise Encyclopedia of Supersymmetry, Kluwer Academic Press.

“ $1/N$  Corrections to Anomalies and the AdS/CFT Correspondence for Orientifolded  $N=2$  Orbifold and  $N=1$  Conifold Models” (with S. Naculich and N. Wyllard) hep-th/0106020, Int. Journal of Mod. Phys. A17, 2567 (2002).

“A Cascading  $N=1$   $Sp(2N+2M) \times Sp(2N)$  Gauge Theory” (with S. Naculich and N. Wyllard),

hep-th/0204023, Nucl. Phys. B638, 41 (2002). "An Orientifold of  $AdS_5 \times T^{11}$  with D7-branes and their  $\alpha'^2$ -corrections in the dual  $N=1$   $Sp(2N+2M) \times Sp(2N)$  gauge theory" (with N. Wyllard), hep-th/0206071, JHEP 0208, 012 (2002).

"pp-wave limits and orientifolds" (with S. Naculich and N. Wyllard), hep-th/0206094, Nucl. Phys. B650, 43-74 (2003).

"The  $N=2$  gauge theory prepotential and periods from a perturbative matrix model calculation" (with S. Naculich and N. Wyllard), hep-th/0211123, Nucl. Phys. B651, 106-124 (2003).

"Matrix model approach to the  $N=2$   $U(N)$  gauge theory with matter in the fundamental representation" (with S. Naculich and N. Wyllard), hep-th/0211254, JHEP 0301, 015 (2003).

"Cubic curves from matrix models and generalized Konishi anomalies" (with S. Naculich and N. Wyllard), hep-th/0303268, JHEP 0308, 021 (2003).

"Matrix model description of  $N=2$  gauge theories with non-hyperelliptic Seiberg–Witten curves" (with S. Naculich and N. Wyllard), hep-th/0305263, Nucl. Phys. B674, 37–79 (2003).

"Gauged vector models and higher-spin representations in  $AdS_5$ ," hep-th/0310210, Nucl. Phys. B695, 283 (2004).

"String theory: a theory in search of an experiment," physics/0311047.

"Matrix models and  $N=2$  gauge theory" (with S. Naculich and N. Wyllard), hep-th/0401108, Proceedings of the 3rd Symposium on Quantum Theory and Supersymmetry, Cincinnati, Ohio, September 2003, World Scientific.

"Confinement/deconfinement transition of large  $N$  gauge theories with  $N_f$  fundamentals:  $N_f/N$  finite," hep-th/0402219, Nucl. Phys. B695, 267 (2004).

"Improved matrix-model calculation of the  $N=2$  prepotential" (with M. Gómez-Reino and S. Naculich), hep-th/0403129, JHEP 0404, 033 (2004).

"Thermodynamics of the localized D2-D6 system" (with M. Gómez-Reino and S. Naculich), hep-th/0412015, Nucl. Phys. B713, 263 (2005).

"More pendants for Polya: Two-loops in the  $SU(2)$  sector" (with M. Gómez-Reino and S. Naculich), hep-th/0504222, JHEP 0507, 055 (2005).

"Many roads lead to Seiberg–Witten theory" (with S. Naculich), hep-th/0407179, DeserFest: A Celebration of the Life and Works of Stanley Deser, James T. Liu, Michael J. Duff, Kellogg S. Stelle and Richard P. Woodard, eds. (World Scientific Publishers, 2006).

"Multipole radiation in Lorentz gauge," physics/0509122.

"Level-rank duality of D-branes on the  $SU(N)$  group manifold" (with S. Naculich), hep-th/0511083, Nucl. Phys. B740, 181 (2006).

"Level-rank duality of untwisted and twisted D-branes" (with S. Naculich), hep-th/0601175, Nucl. Phys. B742, 295 (2006).

"Twisted D-branes of the  $SU(N)_K$  WZW model and level-rank duality" (with S. Naculich), hep-th/0606147, Nucl. Phys. B755, 164 (2006).

"Confinement/Deconfinement Transition of Large  $N$  Gauge Theories in Perturbation

Theory with  $N_f/N$  Finite”, hep-th/0612099.

“Level-rank duality of the  $U(N)$  WZW model, Chern-Simons theory, and 2D of qYM theory” (with S. Naculich), hep-th/0703089, JHEP 0706, 023 (2007).

“Reggeization of  $N=8$  Supergravity and  $N=4$  Yang-Mills Theory”,

hep-th/0701217. “Reggeization of  $N=8$  Supergravity and  $N=4$  Yang-Mills Theory, II” arXiv: 0706.0917 [hep-th].

“Regge behavior of gluon scattering amplitudes in  $N=4$  SYM theory” (with S. Naculich), arXiv: 0708.3069 [hep-th], Nucl. Phys. B 794, 189 (2008).

“Implications of multi-Regge limits for the Bern-Dixon-Smirnov conjecture” (with R. C. Brower, H. Nastase, and C-I Tan), arXiv:0801.3891; Nucl. Phys. B 814, 293 (2009).

“Two-loop graviton scattering relations and IR behavior in  $N=8$  supergravity” (with S. G. Naculich and H. Nastase), arXiv:0805.2347; Nucl. Phys. B 805, 40 (2008)

“Analyticity for Multi-Regge Limits of the Bern-Dixon-Smirnov Amplitudes” (with R. C. Brower, H. Nastase, and C-I Tan), arXiv:0809.1632, Nucl. Phys. B 822, 301 (2009)

“Subleading-color contributions to gluon-gluon scattering in  $N=4$  SYM theory and relations to  $N=8$  supergravity” (with S. G. Naculich and H. Nastase), arXiv:0809.0376; JHEP 0811, 018 (2008).

“IR divergences and Regge limits of subleading-color contributions to the four-gluon amplitude in  $N=4$  SYM Theory” (with S. G. Naculich), JHEP 0910, 048 (2009), arXiv: 0907.1895.

“Higgs-regularized three-loop four-gluon amplitude in  $N=4$  SYM: exponentiation and Regge limits” H.J.Schnitzer (with J. Henn, S. G. Naculich, and M.Spradlin). JHEP 1004:038, (2010) (45 pages) arXiv 1001.1358 (2010).

“More loops and legs in Higgs-regulated  $N=4$  SYM amplitudes” (with J. Henn, S. G. Naculich, and M.Spradlin). ) JHEP 1008.002 (2010) (34 pages), arXiv: 1004.5381.

“On KLT and SYM-supergravity relations from 5-point 1-loop amplitudes” (with H. Nastase). JHEP 1101:048, (2011) (18 pages) arXiv:1011.2487.

“Eikonal methods applied to gravitational scattering amplitudes” (with S. G. Naculich) (2011) JHEP 1105:087 (2011) ( 16 pages ) arXiv:1101.1524,

“Twistor and Polytope Interpretations for Subleading Color One-Loop Amplitudes” (with H. Nastase) , Nuclear Physics B 855:901(1012) (29 pages) arXiv: 1104.2752

“Disagreeing on Everything” (with S. Deser and A. Lawrence) Letters, Scientific American, 8, April 2011

“Applications of Subleading Color Amplitudes in  $N=4$  SYM Theory (with S.G. Naculich and H. Nastase) , Advances in High Energy Physics 2011 , article ID 190587 (39 pages) arXiv:1105.3718.

" One-loop SYM-supergravity relation for five-point amplitudes " ( with S.G. Naculich), JHEP 1111:001 (2011) , (47 pages) , arXiv: 1108.6326

" Linear relations between  $N \geq 4$  supergravity and subleading color SYM amplitudes" ( with S.G. Naculich and H. Nastase), JHEP 1201: 041 (21 pages) , arXiv:1111.1675

" The Multi-Regge limit of NMHV Amplitudes in  $N=4$  SYM Theory"( with L. Lipatov and A. Prygarin ) , JHEP 01(2013) 068 , ( 28 pages) , arXiv: 1205.0186

" All - loop infrared-divergent behavior of most-subleading-color gauge-theory amplitudes" ( with S.G. Naculich ) , JHEP 04 (2013 ) 068 , (23 pages ) , arXiv: 1301.2234

" Wilson line approach to gravity in the high energy limit " ( with S. Melville, S.G. Naculich, and C. D. White ) , Phys. Rev. D 89, 025009 ( 2014 ) , (33 pages ) , arXiv: 1306. 6019 .

" The a-theorem for the four-dimensional gauged vector model " ( with Ida G. Zadeh), ( 18 pages ) , arXiv:1405.0261 .

" The a-theorem for the four-dimensional vector model " ( 9 pages ) , arXiv: 1405.7347 .

" Mutual Renyi information for two disjoint compound systems " (11 pages ) , arXiv:1406.1161 .

" Holographic Mutual information at small separations " ( with Cesar A. Agon ) , (14 pages ) , arXiv: 1501.03775 .

" Large distance expansion of Mutual information for disjoint disks in a free scalar theory " ( with C.A. Agon and I. Cohen-Abbo ) ( 16 pages ) , arXiv:1505.03757

" Left-Right Entanglement Entropy, D-Branes, and Level-rank duality " arXiv: 1505.07070 ( 16 pages )

" Renyi Entropy for the  $SU(N)_1$  WZW model on the torus " arXiv: 1510.0599 ( 18 pages)

BOOK REVIEW

"Supersymmetry and Supergravity," by J. Wess and J. Bagger in Classical and Quantum Gravity 10, 2448 (1993).

#### INVITED TALKS AT CONFERENCES

"Applications of Polology to Stripping Reactions," Padua Conference on Direct Interactions and Nuclear Reaction Mechanisms, Padua, Italy, September 1962.

"Dispersion Relations and Direct Nuclear Reactions," Gordon Conference on Nuclear Reaction Mechanisms: Direct Reactions, Colby Junior College, N.H., September 1964.

"Hard Pions and Pion Mass Difference," International Conference on Particles and Fields, Rochester, New York, September 1967.

"Current Algebra Determination of Low-Energy Pion-Nucleon Parameters," Conference on  $\pi$  N Scattering, University of California (Irvine), December 1967.

"Current Algebra for Hard Pions," Boston meeting of the American Physical Society, February 1968.

"Connections Between Ward Identities, Phenomenological Lagrangians, and Algebra of Fields (A View from the Bridge)," Lectures at the 1968 Boulder Summer School.

"Hard Pions – A Phenomenological Approach to Current Algebra," Lectures at the 1969 Erice (Sicily) Summer School.

"Reggeization of Non-Abelian Gauge Vector Mesons: S-Matrix Theory vs. Field Theory," NY Acad. Sci. Conf. on Recent Advances in Elementary Particle Phys. (New York, New York, March

1973).

“Reggeization of Yang–Mills Gauge Vector Mesons,” Berkeley Meeting of the American Physical Society, December 1973.

“What Have We Learned About Quark Forces from Charmonium?” Fifth International Conference on Experimental Meson Spectroscopy, Boston, Mass. April 1977.

“Decoupling Theorems and Effective Field Theories,” 20th International Conference on High Energy Physics, Madison, Wisconsin, July 1980.

“Spin Structure in Meson Spectroscopy,” 16th Rencontre de Moriond, France, March 1981.

“Closing Conference Summary,” 16th Rencontre de Moriond, France, March 1981.

“Radial and Regge Excitations in Unified and Subconstituent Models,” Spring Meeting of the American Physical Society, Baltimore, MD. April 1981.

“Virtual Effects of Excited Quarks and Flavor Changing Neutral Currents,” Theoretical Symposium on Intense Medium Energy Sources of Strangeness, University of California (Santa Cruz), March 1983.

“Deep Inelastic Scattering as a Probe of New Mass Scales,” Workshop on Composite Models in Particle Physics, University of California (Irvine), November 1984.

“The Unity of the Spin-Dependent Forces in Meson Spectroscopy,” International Conference on Hadron Physics, University of Maryland, April 1985.

“Gauged WZW Models and the Coset Construction,” Europhysics Conference on High-Energy Physics, Madrid, Spain, September 1989.

“A Quantum Generated Symmetry of Conformal and Topological Field Theory,” NATO Workshop on Quantum Field Theory, Statistical Mechanics, Quantum Groups, and Topology, University of Miami, January 1991.

“The Quantum Field Theory of Physics and of Mathematics,” Conference on the Conceptual Foundations of Quantum Field Theory, Boston University, March 1996.

“Tests of M-theory from Non-hyperelliptic Curves in Seiberg–Witten Theories,” Lecture series at the Advanced School on Supersymmetry of Fields, Strings, and Branes, Santiago de Compostela, Spain, July 1999.

“M-Theory Tested by Means of  $N = 2$  Seiberg–Witten Theory” Workshop on Strings, Duality, and Geometry, Université de Montréal, March 2000.

“String Theory: a theory in search of an experiment,” at Symposium in honor of Professor S. Schweber, Dabner Institute of MIT, October 2003.

“Many roads lead to Seiberg–Witten theory,” at Deserfest, a Symposium in honor of Professor S. Deser, University of Michigan, April 2004.