

UNIVERSITY OF MARYLAND
Department of Physics
College Park, Maryland 20742

Curriculum Vitae

YOUNG SUH KIM
Professor of Physics

I. Education:

B.S., Carnegie Institute of Technology, 1958
Ph.D., Princeton University, 1961

II. Experience in Higher Education:

1961 – 62 Postdoctoral Fellow, Princeton University
1962 – 68 Assistant Professor of Physics, Univ. of Maryland
1968 – 93 Associate Professor of Physics, Univ. of Maryland
1993 – Professor of Physics, Univ. of Maryland

1963 (Summer) Visitor, Brookhaven National Laboratory
1964 (Summer) Participants, Summer Inst. for Theoretical Physics,
Univ. of Wisconsin, Madison, Wisconsin
1969-70 Visiting Associate Professor, Wesleyan University
1985 (fall) Visiting Scientist, Goddard Space Flight Center

III. Experience other than Higher Education: None

IV. Publications: See attached list.

V. Professional Activities:

American Physical Society since 1959.
International Standing Committee of the International Colloquium
on Group Theoretical Methods in Physics since 1989.

VI. Honors and Awards:

Postdoctoral Fellow, Princeton University, 1961 – 62
Faculty Research Award from the General Research Board, 1964
Faculty Research Award from the General Research Board, 1973

Signature:

Date: March 12, 2003

A. Papers published in Refereed Journals (or accepted for publication)

1. Physics Research

- Ddispersion Relations for Production Amplitudes, Phys. Rev. Lett. **6**, 313 – 315 (1961).
- Dispersion Relations for Production Amplitudes I, Phys. Rev. **124**, 1241 – 1248 (1961).
- Dispersion Relations for Production Amplitudes II, Phys. Rev. **124**, 1632 – 1638 (1961).
- Pion Production in the Low-energy Limit, Phys. Rev. **125**, 1771 – 1777 (1962).
- Complex Angular Momentum in Two-channel Problems, with A. M. Jaffe, Phys. Rev. **127**, 2261 – 2266 (1962).
- Asymptotic Behavior of the S-matrix for high Angular Momentum, with A. M. Jaffe, Phys. Rev. **129**, 2818 – 2824 (1963).
- Anomalous Thresholds and Three-Particle Unitarity Integral, Phys. Rev. **132**, 927 – 929 (1963).
- Unitary Symmetry and Non-leptonic K-decay, with S. Oneda, Phys. Lett. **8**, 83 – 85 (1964).
- The $\omega - \phi$ Mixing Angle, with S. Oneda and J. C. Pati, Phys. Rev. **135B**, 1076 – 1079 (1964).
- Final-state Interactions in the η to 3π Decay, with S. Oneda and L. M. Kaplan, Nuovo Cimento **34**, 655 – 664 (1964).
- Three-Particle Unitarity Integral, Phys. Rev. **135B**, 454 – 458 (1964).
- SU(3) Symmetry and the Nonleptonic K-meson Processes, with S. Oneda and D. Korff, Phys. Rev. **136B**, 1064 – 1073 (1964).
- Beta-decay Coupling Constants, Nuovo Cimento **36**, 523 – 532 (1965).
- Analytic Property of Three-body Unitarity Integral, with J. N. Islam, Phys. Rev. **138B**, 1222 – 1230 (1965).
- Particle-mixture Theory and Apparent CP Violation in K-meson Decay, with H. Ezawa, S. Oneda and J. C. Pati, Phys. Rev. Lett. **14**, 673 – 676 (1965).
- Role of Partially Conserved Axial Vector current in π and K Decays, with S. Oneda, Prog. Theor. Phys., Special Issue Dedicated to Professor H. Yukawa, 238 – 249 (1965).

- Perturbed Bound-state Poles in Potential Scattering I, Phys. Rev. **142**, 1150 – 1153 (1966).
- Perturbed Bound-state Poles in Potential Scattering II, with K. V. Vasavada, Phys. Rev. **150**, 1259 – 1262 (1966).
- Radius of the Nucleon in a Bound-state Model, with K. V. Vasavada, Phys. Rev. **152**, 1259 – 1262 (1966).
- The Saturation of Equal-time Charge Commutation Relations in Perturbation Theory, with R. A. Brandt, Phys. Rev. **161**, 1473 – 1482 (1967).
- Analyticity Requirement for Regge Poles and Backward Unequal-mass Scattering, with M. Resnikoff, Phys. Rev. **169**, 1228 – 1293 (1968).
- Analyticity Requirement for Regge Poles and Backward Unequal-mass Scattering II, with K. J. Kim, Suppl. to New Physics **7**, 39 – 40 (1968).
- Spontaneously Broken SU(3) and Massive Vector Meson, with F. Landis Markley, Nuovo Cimento **63A**, 60 – 74 (1969).
- Lorentz Contraction of the Bethe-Salpeter Green's Function, with Roger Zaoui. Phys. Rev. D **4**, 1764 – 1769 (1971).
- Normalizable Wave Functions for Bound States and Resonances in S-matrix Theory, with K. V. Vasavada, Phys. Rev. D **5**, 1002 – 1011 (1972).
- Radial Excitations in the Symmetric Quark Model, with M. E. Noz, Nuovo Cimento **11A**, 513 – 522 (1972).
- Solutions of Bethe-Salpeter Equation in the Infinite-momentum Limit, with Triptesh De, Phys. Rev. D **6**, 3689 – 3695 (1972).
- Radial Effects in the Symmetric Quark Model, with Triptesh De and M. E. Noz, Nuovo Cimento **13A**, 1089 – 1101 (1973).
- Covariant Harmonic Oscillators and the Quark Model, with M. E. Noz, Phys. Rev. D **8**, 3521 – 3527 (1973).
- Radial Excitations in the Symmetric Quark Model II, with M. E. Noz, Nuovo Cimento **19A**, 657 – 665 (1974).
- S-matrix, Wave Functions, and Foundations of Quantum Mechanics, New Physics **15**, 46 – 54 (1975).
- Covariant Harmonic Oscillators and Diffractive Excitations, with M. E. Noz, Phys. Rev. D **12**, 122 – 128 (1975).
- Covariant Harmonic Oscillators and Excited Meson Decays, with M. E. Noz, Phys. Rev. D **12**, 129 – 138 (1975).

- A Model for Relativistic Bound-state Perturbation Theory, *Phys. Rev. D* **14**, 273 – 279 (1976).
- Lorentz-invariant Minimum Uncertainty Products, *J. Kor. Phys. Soc.* **9**, 54 – 58 (1976).
- Covariant Harmonic Oscillators and the Parton Picture, with M. E. Noz, *Phys. Rev. D* **15**, 335 – 338 (1977).
- Covariant Harmonic Oscillators and the Chiral Configuration Mixing, with M. E. Noz, *Phys. Rev. D* **15**, 2032 – 2035 (1977).
- Covariant Harmonic Oscillators and Excited Baryon Decays, with M. E. Noz, *Prog. Theor. Phys.* **57**, 1373 – 1386 (1977).
- Covariant Form of the Uncertainty Relations, *J. Kor. Phys. Soc.* **11**, 1 – 5 (1978).
- Quarks, Partons, and Lorentz-deformed Hadrons, with M. E. Noz, *Prog. Theor. Phys.* **60**, 801 – 816 (1978).
- Group Theory of Covariant Harmonic Oscillators, with M. E. Noz, *Am. J. Phys.* **46**, 480 – 483 (1978).
- Physical Basis for Minimal Time-energy Uncertainty Relation, with M. E. Noz, *Found. of Phys.* **9**, 375 – 387 (1979).
- Representation of the Poincaré Group for Relativistic Extended Hadrons, with M. E. Noz and S. H. Oh, *J. Math. Phys.* **20**, 1341 – 1344 (1979).
- Addendum to Representation of the Poincaré Group for Relativistic Extended Hadrons, with M. E. Noz and S. H. Oh, *AIP-PAPS, JMAPA* **20**, 1336 – 1347 (1979).
- Lorentz Deformation of the Bethe-Salpeter Wave Function, with M. E. Noz, *Hadronic J.* **2**, 460 – 480 (1979).
- Lorentz Deformation and the Jet Phenomenon, with M. E. Noz and S. H. Oh, *Found. of Phys.* **9**, 947 – 954 (1979).
- Lorentz Deformation and the Jet Phenomenon II: Explanation of the Nearly Constant Transverse Jet Phenomenon, with M. E. Noz and S. H. Oh, *Found. of Phys.* **10**, 635 – 639 (1980).
- Lorentz Deformation in the $O(4)$ and Light-cone Coordinate Systems, with M. E. Noz and S. H. Oh, *J. Math. Phys.* **21**, 1224 – 1228 (1980).
- Yukawa's Approach and Dirac's Approach to Relativistic Quantum Mechanics, with D. Han, *Prog. Theor. Phys.* **64**, 1852 – 1860 (1980).

- Three-Particle Symmetry Classifications according to the Method of Dirac, with P. E. Hussar and M. E. Noz, *Am. J. Phys.* **48**, 1038 – 1042 (1980).
- Dirac's Form of Relativistic Quantum Mechanics, with D. Han, *Am. J. Phys.* **49**, 1157 – 1161 (1981).
- Symplectic Formulation of Relativistic Quantum Mechanics, with M. E. Noz, *J. Math. Phys.* **22**, 2289 – 2293 (1981).
- Physical Principles in Quantum field Theory and Covariant Harmonic Oscillators, with D. Han and M. E. Noz, *Found. of Phys.* **11**, 895 – 903 (1981).
- the Little Group for Photons and Gauge Transformations, with D. Han, *Am. J. Phys.* **49**, 348 – 351 (1981).
- Photon Spin as a Rotation in Gauge Space, with D. Han and D. Son, *Phys. Rev. D* **25**, 461 – 463 (1982).
- Space-time Symmetries of Confined Quarks, with D. Han, M. E. Noz, and D. Son, *Phys. Rev. D* **25**, 1740 – 1743 (1982).
- E(2)-like Little Group for Massless Particles and Polarization of Neutrinos, with D. Han and D. Son, *Phys. Rev. D* **26**, 3717 – 3725 (1982).
- Massless Composite Particles and Space-time description of Gauge Transformation, with D. Han and D. Son, *Phys. Rev. D* **27**, 2348 – 2353 (1983).
- c-number Time-energy Uncertainty Relation in the Quark Model, *Phys. Rev. D* **27**, 3032 – 3035 (1983).
- Gauge Transformations as Lorentz-boosted Rotations, with D. Han and D. Son, *Phys. Lett.* **131B**, 327 – 329 (1983).
- Unitary Transformations of Photon Polarization Vectors, with D. Han and D. Son, *Phys. Rev. D* **31**, 328 – 330 (1985).
- Time-energy Uncertainty Relation and Lorentz covariance, with M. E. Noz, *Am. J. Phys.*, **53**, 142 – 147 (1985).
- Photons, Neutrinos, and Gauge Transformations, with D. Han, D. Son, *Am. J. Phys.* **54**, 818 – 821 (1986).
- Eulerian Parameterization of Wigner's Little Groups and Gauge Transformations as Rotations of Spin 1/2 Particles, with D. Han and D. Son, *J. Math. Phys.* **27**, 2228 – 2235 (1986).
- a New Dispersion Relation for Electron-atom Scattering, with A. Temkin and A. K. Bathia, *J. Phys. B* **19**, L701 – 706 (1986).

- Uncertainty Relations for Light Waves and the Concept of Photons, with D. Han and M. E. Noz, *Phys. Rev. A* **35**, 1682 – 1691 (1987).
- Cylindrical Group and Massless Particles, with E. P. Wigner, *J. Math. Phys.* **25**, 1175 – 1179 (1987).
- Covariant Phase Space Representation for Localized Light Waves, with E. P. Wigner, *Phys. Rev. A* **36**, 1293 – 1297 (1987).
- Decomposition of Lorentz Transformations, with D. Han and D. Son, *J. Math. Phys.* **28**, 2373 – 2378 (1987).
- Thomas Precession, Wigner Rotations, and Gauge Transformations, with D. Han and D. Son, *Class. and Quantum Grav.* **4**, 1777 – 1783 (1987).
- Linear Canonical Transformations of Coherent and Squeezed States in the Wigner Phase Space, with D. Han and M. E. Noz, *Phys. Rev. A* **37**, 807 – 814 (1988).
- Special Relativity and Interferometers, with D. Han, *Phys. Rev. A* **37**, 4494 – 4496 (1988).
- Covariant Phase-Space Representation for Harmonic Oscillators, with E. P. Wigner, *Phys. Rev. A* **38**, 1159 – 1167 (1988).
- Thomas Precession and Squeezed States of Light, with D. Han and E. E. Hardkopf, *Phys. Rev. A* **39**, 1269 – 1276 (1989).
- Covariant Phase-Space Representation and Overlapping Distribution Functions, with E. P. Wigner, *Phys. Rev. A* **39**, 2829 – 2834 (1989).
- Observable Gauge Transformations in the Parton Picture, *Phys. Rev. Lett.* **63**, 348 – 351 (1989).
- Squeezed States and Thermally Excited States in the Wigner Phase-Space Picture of Quantum Mechanics, with M. Li, *Phys. Lett. A* **139**, 445 – 448 (1989).
- Linear Canonical Transformations of Coherent and Squeezed States in the Wigner Phase Space II. Quantitative Analysis, with D. Han and M. E. Noz, *Phys. Rev. A* **40**, 902 – 912 (1989).
- Space-time Geometry of Relativistic Particles, with E. P. Wigner, *J. Math. Phys.* **31**, 55 – 60 (1990).
- Lorentz-Squeezed Hadrons and Hadronic Temperature, with D. Han and M. E. Noz, *Phys. Lett. A* **144**, 111 – 115 (1990).
- Linear Canonical Transformations of Coherent and Squeezed States in the Wigner Phase Space III. Two-mode States, with D. Han and M. E. Noz, *Phys. Rev. A* **41**, 6233 – 6244 (1990).

- Entropy and Lorentz Transformations, with E. P. Wigner, Phys. Lett. A **147**, 343 – 347 (1990).
- Space-time Geometry of Relativistic Particles in Four-Dimensional Phase Space, with Chang-Ho Kim, J. Math. Phys. **32**, 1998 – 2006 (1991).
- Time-dependent Mode Coupling and Generation of Two-mode Squeezed States, with V. I. Man'ko, Phys. Lett. A **157**, 226 – 228 (1991).
- E(2)-Symmetric Sheared States, with L. Yeh, J. Math. Phys. **33**, 1237 – 1246 (1992).
- O(2,1)-like Little Group for Space-like Momenta and Localized Light Waves in Continuous Media, with L. Yeh, J. Math. Phys. **33**, 3190 – 3196 (1992).
- Symmetries of Two-mode Squeezed States, with D. Han, M. E. Noz, and L. Yeh, J. Math. Phys. **34**, 5493 – 5508 (1993).
- Quantization of Electromagnetic Fields in Cavities and Spontaneous Emission, with K. Kakazu, Phys. Rev. A **50**, 1830 – 1839 (1994).
- Correspondence between the Classical and Quantum Canonical Transformation Groups from an Operator Formulation of the Wigner Function, with L. H. Yeh, Found. of Physics **24**, 873 – 882 (1994).
- O(3,3)-like Symmetry of Coupled Harmonic Oscillators, with D. Han and M. E. Noz, J. Math. Phys. **36**, 3940 – 3954 (1995).
- Wavelets, Windows, and Photons, with D. Han and M. E. Noz, Phys. Lett. A **206**, 299 – 304 (1995).
- Polarization Optics and Bilinear Representations of the Lorentz Group, with D. Han and M. E. Noz, Phys. Lett. A **219**, 26 – 32 (1996).
- Quantization and Spontaneous Emission in Circular Cylindrical Cavities, with K. Kakazu, Prog. of Theor. Phys. **96**, 883 – 899 (1996).
- (invited) Lorentz Boosts as Squeeze Transformations and the Parton Picture, J. Moscow Phys. Soc. **6**, 37 – 46 (1996)
- (invited) Group Contractions: Inonu, Wigner, and Einstein, Int. J. Mod. Phys. A **12**, 71 – 78 (1996).
- (invited) Wigner's Influence on Particle Physics: Unification of Spacetime Symmetries of Massive and Massless Particles, Acta Physica Polonica B **27**, 2741 – 2746 (1996).
- Jones-matrix Formalism as a Representation of the Lorentz Group, with D. Han, and M. E. Noz, J. Opt. Soc. Am. A **14**, 2290 – 2298 (1997).

- Stokes Parameters as a Minkowskian Four-vector, with D. Han and M. E. Noz, Phys. Rev. E **56**, 6065 – 6076 (1997).
- Little Groups and Maxwell-type Tensors for Massive and Massless Particles, with S. Baskal, Europhys. Lett. **40**, 375 – 380 (1997).
- (invited) Does Lorentz Boost Destroy Coherence?, Fortschr. der Physik, **46**, 713 – 724 (1998).
- Illustrative Example of Feynman’s Rest of the Universe, with D. Han and M. E. Noz, Am. J. Phys. **67** 61 – 66 (1999).
- Wigner Rotations and Iwasawa Decompositions in Polarization Optics, with D. Han and M. E. Noz, Phys. Rev. E **67**, 1036 – 1041 (1999).
- Interferometers and Decoherence Matrices, with D. Han and M. E. Noz, Phys. Rev. E **61**, 5907 (2000).
- Shear Representations of Beam Transfer Matrices, with S. Baskal, Phys. Rev. E **63** 056606,1-6 (2001).
- Iwasawa Effects in Multilayer Optics, with E. Georgieva, Phys. Rev. E **64** 026602,1-6 (2001).
- Wigner Rotations in Laser Cavities, with S. Baskal, Phys. Rev. E **66** 026604,1-6 (2002).
- Lens Optics as an Optical Computer for Group Contractions, Phys. Rev. E (to be published).

2. Instrumentation or Technique:

3. Review Papers:

- Relativistic Harmonic Oscillators and Hadronic Structures in the Quantum Mechanics Curriculum, with M. E. Noz, Am. J. Phys. **46**, 484 – 488 (1978).
- A Simple Method for Illustrating the Difference between the Homogeneous and Inhomogeneous Lorentz Groups, with M. E. Noz and S. H. Oh, Am. J. Phys. **47**, 892 – 897 (1979).
- Internal Space-time Symmetries of Massive and Massless Particles, with D. Han, M. E. Noz, and D. Son, Am. J. Phys. **52**, 1037 – 1043 (1984).
- Book Review: Group Theoretical Methods and Their Applications, by A. Fassler and E. Stifel (Birkhauser, Boston, 1992), Am. J. Phys. **61**, 476 (1993).
- Lorentz Group in Polarization Optics, J. Opt. B **2**, R1 - R5 (2000).

4. Teaching and Miscellaneous:

- Quark Model in the Quantum Mechanics Curriculum, with P. E. Hussar and M. E. Noz, *Am. J. Phys.* **48**, 1043 – 1049 (1980).
- Dirac's Light-cone Coordinate System, with M. E. Noz, *Am. J. Phys.* **50**, 721 – 724 (1982).
- Illustrative Examples of the Symplectic Group, with M. E. Noz, *Am. J. Phys.* **51**, 368 – 375 (1983).
- Canonical Transformations in Quantum Mechanics, with E. P. Wigner, *Am. J. Phys.* **58**, 439 – 448 (1990).

B. Papers presented at Scientific Meetings:

1. Invited Papers:

- Group Contractions and the $E(2)$ -like Little Group for Massless Particles as an Infinite-momentum/Zero-mass Limit of the $O(3)$ -like Little Group for Massive Particles, presented at the 12th Int'l Colloquium on Group Theoretical Physics (Trieste, Italy, 1983)
- Decomposition of Lorentz Transformations, presented at the Workshop on Lorentz Transformations and Spacetime Geometry (College Park, Maryland, 1987).
- Covariant Phase-Space Representation of Quantum Mechanics, presented at the Workshop on Bell's Inequality (George Mason University, Fairfax, Virginia, 1988)
- Squeezed States of Hadrons and Squeezed States of Light, presented at the 18th International Colloquium on Group Theoretical Methods in Physics (Moscow, Russia, 1990).
- Neutrino Polarization as a Consequence of Gauge Invariance, presented at the Tallinn Symposium on Neutrino Physics (Tallinn, Estonia, 1990).
- Squeezed States, Time-energy Uncertainty Relation, and Feynman's Rest of the Universe, presented at the Workshop on Squeezed States and Uncertainty Relations (College Park, Maryland, 1991).
- Entropy in the Wigner Phase-Space Picture of Quantum Mechanics and Feynman's Rest of the Universe, presented at the First International Sakharov Conference (Moscow, 1991).
- Wigner Functions and Lorentz Transformations, presented at the Second International Wigner Symposium (Goslar, Germany, 1991).
- Symmetries of Two-mode Squeezed States, presented at the Workshop on Harmonic Oscillators (College Park, Maryland 1992).

- Wavelets and Spacetime Squeeze, presented at the Second Int'l Workshop on Squeezed States and Uncertainty Relations (Moscow, 1992).
- Wavelets and Photon Localization, presented at the Third International Wigner Symposium (Oxford, UK, 1993).
- Covariant Harmonic Oscillators and Coupled Harmonic Oscillators, presented at the Second International Workshop on Harmonic Oscillators (Cocoyoc, Mexico, 1994).
- Squeezed States and Relativistic Quantum Mechanics, presented at the Workshop on Quantum Systems (Minsk, Belarus, 1994).
- Squeezed Photons and Squeezed Hadrons, presented at the the Ettore Majorana Conference on Quantum-like Models and Coherent Effects (Erice, Italy, 1994).
- Quarks and Partons as Two Different Manifestations of One Covariant Entity, presented at the 8th Symposium on Symmetries in Science (Bregenz, Austria, 1994).
- Two Different Squeeze Transformations, presented at the Fourth International Conference on Squeezed States and Uncertainty Relations (Taiyuan, China, 1995).
- Wigner's Last Papers on Spacetime Symmetries, presented at the Fourth International Wigner Symposium (Guadalajara, Mexico, 1995)
- Wigner's Influence on Particle Physics: Unification of Spacetime Symmetries of Massive and Massless Particles, presented at the Second German-Polish Symposium on New Ideas in the Theory of Fundamental Interactions (Zakopane, Poland 1995).
- Lorentz Boosts as Squeeze Transformations and the Parton Picture, presented at the 1995 Annual Meeting of Particle and Nuclear Physics Division of Russian Academy of Science (Moscow, Russia, 1995).
- Neutrino Polarization as a Consequence of Gauge Transformation, presented at the Second Workshop on Quantum Systems (Minsk, Belarus, 1996)
- Group Contractions: Inonu, Wigner, and Einstein, 2nd Workshop on Classical and Quantum Integrable Systems (Dubna, Russia, 1996).
- Eugene Wigner and Translational Symmetries, presented at 4th International Workshop on Symmetry and Structural Properties of Condensed Matter (Zajaczkowo, Poland, 1996).
- Lorentz Group in Condensed Matter Physics, presented at the 4th International Workshop on Symmetry and Structural Properties of Condensed Matter (Zajaczkowo, Poland, 1996).

- Wavelets and Information-preserving Transformations, presented at the Third International Workshop on Quantum Communications (Fuji-Hakone Land, Japan, 1996).
- Does Lorentz Boost Destroy Coherence? presented at the Workshop on Fundamental Problems of Quantum Mechanics (Baltimore, Maryland, 1997)
- High-speed Contraction of Transverse Rotations to Gauge Transformations, presented at the Workshop on Quantum Groups, Deformations and Contractions (Istanbul, Turkey, 1997)
- Wigner's Photons, presented at 5th International Conference on Squeezed States and Uncertainty Relations (Lake Balatonfured, Hungary, 1997).
- Squeezed States as Representations of Symplectic Groups, presented at the Fifth International Conference on Squeezed States and Uncertainty Relations, Lake Balatonfured, Hungary (May, 1997).
- Representations of the Poincaré Group based on Four-dimensional Harmonic Oscillators and Their Applications to Hadronic Physics, presented at the Third International Workshop on Classical and Quantum Integrable Systems (Yerevan, Armenia, 1998).
- Decoherence Matrices, presented at the 6th International Conference of Squeezed States and Uncertainty Relations (Naples, Italy, 1999).
- Two-pearl Strings, presented at the 12th International Workshop on Fundamental Problems in High Energy Physics and Field Theory (Protvino, Russia, 1999).
- Wavelets, Squeezed States, and Entropy Problems, presented at the 3rd IMACS/IEEE Conference (Athens, Greece, 1999).
- Further Contents of Einstein's $E = mc^2$, presented at the 4th International Conference on Geometrization of Physics (Kazan, Russia, 1999).
- Feynman's Entropy and Decoherence Mechanism, presented at the 20th Maximum Entropy Conference (Paris, France, 2000).
- Symmetries of Massive and Massless Particles and Their Unification, International Conference dedicated to Prof. Dmitri Volkov's 75th Birthday (Kharkov, Ukraine, 2000).
- Symmetries shared by Particle Physics and Quantum Optics, presented at the 23rd International Colloquium on Group Theoretical Methods in Physics (Dubna, Russia, 2000).

- Internal Space-time Symmetries of Massive and Massless Particles and Their Unification, presented at the International Conference on Supersymmetry and Quantum Field Theory dedicated to the 75th Birthday Anniversary of Dmitriy V. Volkov (Kharkov, Ukraine, 2000).
- Lorentz Group applicable to Optical Instruments, presented at the 7th International Conference on Squeezed States and Uncertainty Relations (Boston, MA, 2001).
- Quark-Parton Phase Transition and the Entropy Problem in Quantum Mechanics, presented at the Akhiezer Memorial Conference on Quantum Electrodynamics and Statistical Physics (Kharkov, Ukraine, 2001).
- Dirac's Approach to Lorentz Covariance, presented at the 2001 Petrov School on Contemporary Problems in Theoretical Physics (Volga Beach, near Kazan, Russia, 2001).
- A soluble model in String Theory, presented at the 2001 Petrov School on Contemporary Problems in Theoretical Physics (Volga Beach, near Kazan, Russia, 2001).
- Wigner's Spins, Feynman's Partons, and Their Common Grounds, presented at the Advanced Study Institute on Symmetries and Spin (Prague, Czech Republic, 2001).
- Neutrino Polarization as a Consequence of Gauge Invariance, presented at the Advanced Study Institute on Symmetries and Spin (Prague, Czech Republic, 2001).
- Feynman's Decoherence, presented at the 9th International Conference on Quantum Optics (Minsk, Belarus, 2002)
- Einstein, Wigner, and Feynman, presented at the Wigner Centennial Conference (Pecs, Hungary, 2002)
- Is the Concept of Quantum Probability Consistent with Lorentz Covariance, presented at the 2nd International Conference on Foundations of Probability in Physics (Vaxjo, Sweden, 2002).
- Feynman's Decoherence and Feynman's Rest of the Universe, presented at the First Feynman Festival (College Park, 2002).

2. Seminars and Colloquia given at Institutions other than UMCP:

- Dispersion Relations and Symmetry Breaking, at College of William and Mary, February 1965.

- Bound-state Wave Functions in S-matrix Theory, at Wesleyan Univ., November 1968.
- Boundary conditions in S-matrix Theory, at Brown Univ, February 1970.
- Normalizable Wave Functions in S-matrix Theory, at Naval Research Laboratory, April 1971.
- Covariant Hadronic Wave Functions, at Purdue University, March 1976.
- Lorentz Transformation of Bound-state Wave Functions, at Univ. of Maryland Baltimore County, April 1978.
- Hadronic Geometry, at Queens College of CUNY, October 1979.
- Null-plane Dynamics, College of William and Mary, November 1983.
- Poincaré Symmetry of Relativistic Extended Hadrons, Simon Fraser University, March 1985.
- Kinematical Approach to the Poincaré Group, Concordia University, October 1985.
- Yukawa Strings, Baruch College of CUNY, February, 1988.
- Wigner's Little Groups and Covariant Harmonic Oscillators, Univ. of Mexico, July 1990.
- Group Contractions and Spacetime Geometry, Univ. of Mexico, July 1990
- Dirac's Form of Relativistic Quantum Mechanics and Lorentz-squeezed Oscillator Wave Functions, Univ. of Mexico, August 1990.
- Symmetry of Massless Particles, Univ. of Mexico, August 1990.
- Feynman's Parton picture and Form Factors, Univ. of Mexico, August 1990.
- Neutrino Polarization as a Consequence of Gauge Invariance, Joint Institute for Nuclear Research, Dubna, USSR, October 1990.
- Entropy and Lorentz Transformations, Lebedev Institute, Moscow, October 1990.
- Lorentz-squeezed Hadrons and Hadronic temperature, Univ. of California at Santa Cruz, January 1991.
- Further Contents of Einstein's $e = mc^2$, Drexel University, March 1991.
- Squeezed States and Uncertainty Relations, Baruch College of the City University of New York, November 1992.

- Further Contents of Einstein's $e = mc^2$, Univ. of Maryland Baltimore County, November 1993.
- Squeezed Oscillators, Nihon Univ. (Tokyo), September 1996.
- Maxwell and Wigner, Univ. of Zacatecas (Zacatecas, Mexico), October 1997.
- One-lens Optics as an Analogue Computer for Group Contractions, Adam Mickewics University (Poznan, Poland), November 2002.

3. Contributed papers:

- Estimate of the Multiple Lepton Number Conserving Coupling Constant, with C. Y. Chang, APS Spring Meeting in Washington: Bull. Am. Phys. Soc. 14, # 4, page 12 (1969).
- Space-time Geometry for Relativistic Extended Hadrons, with D. Han, APS Spring Meeting in Washington: Bull. Am. Phys. Soc. 25, 492 (1980).
- Poincaré Group, Symplectic Group, and Relativistic Extended Hadrons consisting of Spin 1/2 Quarks, with P. E. Hussar and M. E. Noz, 9th Int'l Colloquium on Group Theoretical Method in Physics, Cocoyoc, Mexico, 1980.
- Experimental Test of Quantum Mechanics and Special Relativity in High-energy Physics, with M. E. Noz, APS Winter Meeting in New York: Bull. Am. Phys. Soc. **26**, 47 (1981).
- Little Groups and Gauge Transformations, with D. Han and D. Son, APS Spring Meeting in Baltimore: Bull. Am. Phys. Soc. **26**, 575 (1981).
- Covariant Harmonic Oscillators and the Bethe-Salpeter Wave Functions, with M. E. Noz, APS Spring Meeting in Baltimore: Bull. Am. Phys. Soc. **26**, 596 (1981).
- Little Groups and the c-number Time-energy Uncertainty Relation, with D. Han, M. E. Noz, and D. Son, APS Spring Meeting in Baltimore: Bull. Am. Phys. Soc. **26**, 596 (1981).
- Little Groups, the Quark Model, and Gauge Transformations, with D. Han, M. E. Noz, D. Son, 10th Int'l Colloquium on Group Theoretical Methods in Physics (Canterbury, England, 1981).
- Phase Space Formulation of Relativistic Quantum Mechanics, with M. E. Noz, APS Spring Meeting in Washington: Bull. Am. Phys. Soc. **27**, 541 (1982).
- Forms of Gauge Transformation Matrices, with D. Han and D. Son, APS Spring Meeting in Washington: Bull. Am. Phys. Soc. **27**, 562 (1982).

- Representation of the E(2) Group for Massless Particles, with D. Han and D. Son, APS Spring Meeting in Washington: Bull. Am. Phys. Soc. **27**, 562 (1982).
- Gauge Invariance and Neutrino Polarization, with D. Han and D. Son, APS Spring Meeting in Washington: Bull. Am. Phys. Soc. **27**, 563 (1982).
- Parton Phenomenon as a Consequence of Time-energy Uncertainty Relation, with P. E. Hussar and M. E. Noz, presented at 1982 DPF Meeting of APS (College Park, Maryland, October, 1982).
- Calculation of $\langle p_t \rangle$ and $\langle p_t^2 \rangle$ in a Random-walk Approximation, with M. E. Noz and S. H. Oh, APS New York Meeting (January, 1983); Bull. Am. Phys. Soc. **28**, 29 (1983).
- Representations of the E(2) Group for Gravitons, with D. Han and D. Son, APS Baltimore Meeting (April, 1983); Bull. Am. Phys. Soc. **28**, 676 (1983).
- Inonu-Wigner Group Contraction and Internal Space-time Symmetries of Massless Particles, with D. Han and D. Son, APS Baltimore Meeting (April, 1983); Bull. Am. Phys. Soc. **28**, 676 (1983).
- Causality and Time-energy Uncertainty Relation, with M. E. NOZ, APS Baltimore Meeting (April, 1983); Bull. Am. Phys. Soc. **28**, 722 (1983).
- Gauge Transformations as Rotations in the Infinite-momentum or Zero-mass Limit, with D. Han and D. Son, APS Baltimore Meeting (April, 1983); Bull. Am. Phys. Soc. **28**, 752 (1983).
- Covariant Harmonic Oscillators and Geometric Quantization, with M. E. Noz, APS Washington Meeting (April, 1984); Bull. Am. Phys. Soc. **29**, 657 (1984).
- Gauge Transformation Properties of Massless Particles with Spin 1/2, with D. Han and D. Son, APS Washington Meeting (April, 1984); Bull. Am. Phys. Soc. **29**, 684 (1984).
- Gauge Transformations and Thomas Precession are Brothers; their last name is Wigner's Little Group, with D. Han and D. Son, APS Washington Meeting (April, 1985); Bull. Am. Phys. Soc. **30**, 704 (1985).
- Rotations and Gauge Transformations, with D. Han and D. Son, presented at the First International Conference on the Physics of Phase Space (College Park, Maryland, 1986).
- Unitary Representations for Photon Polarization Vectors, with D. Han and D. Son, at the 15th International Colloquium on Group Theoretical Methods in Physics (Philadelphia, Pennsylvania, 1986).

- Coherent and Squeezed States in the Wigner Phase Space, presented at the International Symposium on Spacetime Symmetries (College Park, Maryland, 1988).
- New Physical Applications of the $O(3,2)$ deDitter Group, presented at the 21st Int'l Colloquium on Group Theoretical Methods in Physics (Salamanca, Spain, 1992).
- New Approach to the Photon Localization Problem, presented at the Third International Workshop on Squeezed States and Uncertainty Relations (Catonsville, Maryland, 1993).
- Lorentz Boosts as Squeeze Transformations and Coherence Problems, with D. Han, presented at the Fourth International Wigner Symposium (Guadalajara, Mexico, 1995).
- Lorentz Group in Optics, presented at the 21st International Colloquium on Group Theoretical Methods in Physics (Goslar, Germany, 1996).
- Jones Vectors and Stokes Parameters as Representations of the Lorentz Group, presented at the 5th International Wigner Symposium (Vienna, Austria, 1997).

C. Books or Contributions to Edited Books:

- Theory and Applications of the Poincaré Group, with M. E. Noz, (Reidel Publishing Co., Dordrecht, Holland, 1986).
- First International Conference on the Physics of Phase Space, Proceedings, edited by Y. S. Kim and W. W. Zachary (Springer-Verlag, Heidelberg, 1987).
- Special Relativity and Quantum Theory: a Collection of Papers on the Poincaré Group, with M. E. Noz (Kluwer Academic, Dordrecht, Holland, 1988).
- International symposium on Spacetime Symmetries, Proceedings, with Z. Z. Zachary (North Holland, Amsterdam, 1988).
- Phase Space picture of Quantum Mechanics, with M. E. Noz (World Scientific Publishing Co., 1991).
- Squeezed States and Uncertainty Relations, Proceedings of the Workshop, with D. Han and W. W. Zachary, NASA Conference Publication Series 3135 (1992).
- Harmonic Oscillators, Proceedings of the Workshop, with D. Han and W. W. Zachary, NASA Conference Publications Series 3197 (1993).
- Second International Workshop on Squeezed States and Uncertainty Relations, Proceedings, with D. Han and V. I. Man'ko, NASA Conference Publications Series 3219 (1993).

- Third International Workshop on Squeezed States and Uncertainty Relations, NASA Conference Publication No. 3270 (1994), edited by D. Han, Y. S. Kim, M. Rubin, Y. H. Shih, and W. W. Zachary.
- Fourth International Workshop on Squeezed States and Uncertainty Relations, NASA Conference Publication No. 3322 (1996), edited by D. Han, K. Peng, Y. S. Kim, V. I. Man'ko.
- Second Workshop on Quantum Systems: New Trends and Methods, edited by I. D. Feranchuk, A. Z. Gazizov, Y. S. Kim, and L. M. Tomilchik (World Scientific, Singapore, 1997)
- Covariant Model of Relativistic Extended Particles based on the Oscillator Representation of the Poincaré Group, contribution to the Edited Volume dedicated to Prof. Ta-You Wu, edited by J. P. Hsu and L. Hsu (World Scientific, 1998).
- Proceedings of the Fifth International Conference on Squeezed States and Uncertainty Relations, edited by D. Han, J. Janszky, Y. S. Kim, and V. I. Man'ko (NASA Conference Publications 206855, 1998).
- Lorentz Covariance of Internal Space-time Symmetries of Relativistic Extended Particles, in Lorentz Groups, edited by V. Dvoeglazov, Nova Scientific Publishers (Nova Scientific, Huntington, New York, 1999).
- Lorentz Group in Feynman's World, in Lorentz and Poincaré Invariance: 100 Years of Relativity, edited by J. P. Hsu and Y. Z. Zhang (World Scientific, Singapore, 2001).
- Journal of Optics B: Special Issue on Uncertainty Relations, Quantum Optics, Quantum Information, imaging and computing, edited by Y. S. Kim, M. A. Man'ko, and A. Sergienko, Journal of Optics B, Vol.4, No.3 (2002).

D. Papers submitted but not yet accepted for publication:

- Sliderule-like Property of Wigner's Little Groups and Cyclic S-matrices for Multilayer Optics, with E. Georgieva.

E. Technical Reports (not covered in any of the above categories):

- Preprint Library handbook, with W. S. Risk (1969).
- Bethe-Salpeter Equation in the Infinite-momentum Limit, with T. De, Univ. of Maryland CTP Tech. Rep. # 72 – 101 (1972).
- Forms of the Relativistic Quantum Mechanics, with S. H. Oh, Univ. of Maryland CPT Tech. Rep. # 77 – 007 (1976).

- Further Contents of Einstein's $e = mc^2$, Physics and astronomy Newsletter of the University of Maryland (March 1987).

F. Papers published in Proceedings of Scientific Meetings and Conferences:

- Brief Review of the Efforts to Reconcile Quantum Mechanics with the Principle of Relativity, Proc. of the 5th Int'l Conf. on Unity of Sciences, pages 927 – 933 (1976).
- Group Theoretical Interpretation of Relativistic Hadrons, with M. E. Noz, 7th Int'l Colloquium on Group Theoretical Methods in Physics, pages 345 – 345 (Springer-Verlag, 1979).
- Poincaré Group, Symplectic Group, and Relativistic Extended Hadrons Consisting of Spin 1/2 Quarks, with P. E. Hussar and M. E. Noz, 9th Int'l Colloquium on Group Theoretical Methods in Physics, pages 234 – 238 (Springer-Verlag, 1980).
- Little Groups, the Quark Model, and Gauge Transformations, with D. Han, M. E. Noz, D. Son, Proc. 10th Int'l Colloquium on Group Theoretical Methods in Physics (Physica 114A, 197 – 199, 1982).
- Group Contractions and the E(2)-like Little Group for Massless Particles as an Infinite-momentum/zero-mass Limit of the O(3)-like Little Group for Massive Particles, Proc. 12th Int'l Colloquium on Group Theoretical Methods in Physics, Lecture Note in Physics, # 201, pages 45 – 49 (Springer-Verlag, Berlin, 1984).
- Rotations and Gauge Transformations, with D. Han and D. Son, in the Proceedings of the First International Conference on the Physics of Phase Space, College Park, Maryland, Lecture Note in Physics, pages 420 – 422 (Springer-Verlag, Berlin, 1987).
- Unitary Representations for Photon Polarization Vectors, with D. Han and D. Son, 15th International Colloquium on Group Theoretical Methods in Physics, pages 558 – 562 (World Scientific, 1987).
- New Observable Effects of the Lorentz Group, with D. Han and E. E. Hardekopf, in the Proceedings of the International Symposium on Spacetime Symmetries, pages 321-326, North-Holland Publishers (1989).
- Uncertainty Relations in the Covariant Phase Space Representation of Quantum Mechanics, in the Proceedings of Bell's Inequality, Kluwer Academic Press (1989).
- Neutrino Polarization as a Consequence of Gauge Invariance, International Tallinn Symposium on Neutrino Physics, Proceedings, edited by I. Ots, L. Palgi, H. Uibo, and H. Oiglane, pages 147 – 154 (Estonian Academy of Sciences, 1991).

- Temporal Decoherence in Lorentz-Squeezed Hadrons, with M. E. Noz, Proceedings of 18th International Colloquium on Group Theoretical Methods in Physics, edited by V. Dodonov and V. Man'ko, pages 442 – 449 (Springer-Verlag, Berlin, 1991).
- Squeezed States, Time-Energy Uncertainty Relations, and Feynman's Rest of the Universe, with D. Han and M. E. Noz, edited by D. Han, Y. S. Kim, and W. W. Zachary, pages 269 – 282 (NASA Conference Publications 3135, 1992).
- Entropy in the Wigner Phase-Space Picture of Quantum Mechanics and Feynman's Rest of the Universe, First International Sakharov Conference, Proceedings edited by L. V. Keldysh and V. Ya. Fainberg, pages 229 – 236, Moscow, 1991.(Nova Science Publishers, 1992).
- New Physical Applications of the $O(3,2)$ deSitter Group, 21st Int'l Colloquium on Group Theoretical Methods in Physics, Proceedings, edited by M. A. Del Olmo, M. Santander, and J. Mateos Guilarte, pages 359 – 360 (Anales de Fisica. Monografias 1, Rea; Sociedad Espanola de Fisica, 1992).
- Wigner Functions and Lorentz Transformations, Second International Wigner Symposium, Proceedings, edited by H. Doebner and W. Scherer, pages 68 – 77 (World Scientific, 1993).
- Remarks about Massive and Massless Particles in Supersymmetry with S. Ketov, Workshop on Harmonic Oscillators, Proceedings, edited by D. Han, Y. S. Kim, and W. W. Zachary, pages 255 – 260 (NASA Conference Publications Series 3197, 1993).
- Symmetries of Coupled Harmonic Oscillators, with D. Han and M. E. Noz, Workshop on Harmonic Oscillators, Proceedings, edited by D. Han, Y. S. Kim, and W. W. Zachary, pages 53 – 66 (NASA Conference Publications Series 3197, 1993).
- Wavelets and Spacetime Squeeze, with D. Han and M. E. Noz, Second Int'l Workshop on Squeezed States and Uncertainty Relations, Proceedings, edited by D. Han, Y. S. Kim and V. I. Man'ko, pages 341 – 355 (NASA Conference Publications Series 3219, 1993).
- A New Approach to the Photon Localization Problem, with D. Han, Third International Workshop on Squeezed States and Uncertainty Relations, Proceedings, edited by D. Han, Y. S. Kim, M. Rubin, Y. H. Shih, and W. W. Zachary, pages 77 – 83 (NASA Conference Publication No. 3270, 1994).
- Squeezed States and Relativistic Quantum Mechanics, International Workshop on Quantum Systems, Proceedings, edited by A. O. Barut, I. D. Faranchuk, Ya. M. Shnir, and L. M. Tomil'chik, pages 281 – 292 (World Scientific, Singapore, 1995).

- Quarks and Partons as Two Different Manifestations of One Covariant Entity, Symmetries in Science VII, edited by B. Gruber (Plenum, New York, 1995).
- Squeezed Photons and Squeezed Hadrons, in Quantum-like Models and Coherent Effects, edited by F. Fedele and P. K. Shukla (World Scientific, Singapore, 1995)
- Two Different Squeeze Transformations, 4th International Workshop on Squeezed States and Uncertainty Relations, edited by D. Han, K. Peng, Y. S. Kim. and V. I. Man'ko, pages 35 – 40 (NASA Conference Publications No. 3322. 1996).
- Wigner's Last Papers on Spacetime Symmetries, The 4th International Wigner Symposium, edited by N. M. Atakishiev, K. B. Wolf, and T. H. Seligman (World Scientific, Singapore, 1996).
- Lorentz Boosts as Squeeze Transformations and Coherence Problems, with D. Han, The 4th International Wigner Symposium, edited by N. M. Atakishiev, K. B. Wolf, and T. H. Seligman (World Scientific, Singapore, 1996).
- Wigner's Sisters, The 4th International Wigner Symposium, edited by N. M. Atakishiev, K. B. Wolf, and T. H. Seligman (World Scientific, Singapore, 1996).
- Wavelets and Information-preserving Transformations, Quantum Communication, Computing, and Measurement, Proceedings of the 3rd International Conference, edited by O. Hirota, A. S. Holevo, and C. M. Caves (Plenum, New York, 1997).
- Neutrino Polarization as a Consequence of Gauge Invariance, Quantum Systems: New Trends and Methods, Proceedings of the 2nd Workshop, edited by I. D. Feranchuk, A. Z. Gazizov, Y. S. Kim, and L. M. Tomilchik (World Scientific, Singapore, 1997)
- Lorentz Group in Polarization Optics, Group21, Proc. of the 21st International Colloquium on Group Theoretical Methods in Physics, edited by H. D. Doebner, W. Scherer, and C. Schulte (World Scientific, Singapore, 1997).
- Wigner's Photons, 5th International Conference on Squeezed States and Uncertainty Relations, Proceedings of the Fifth International Conference on Squeezed States and Uncertainty Relations, edited by D. Han, J. Janszky, Y. S. Kim, and V. I. Man'ko (NASA Conference Publications 206855, 1998).
- Jones Matrices and Stokes Parameters as Representations of the Lorentz group, Proc. of the 5th Wigner Symposium, edited by P. Kasperkovitz (World Scientific, 1998)
- Squeezed States as Representations of Symplectic Groups, with D. Han, Proceedings of the Fifth International Conference on Squeezed States and Uncertainty Relations, edited by D. Han, J. Janszky, Y. S. Kim, and V. I. Man'ko (NASA Conference Publications 206855, 1998).

- Gauge Transformations on Spin-1/2 Particles and Neutrino Polarizations as a Consequence of Gauge Transformations, in Proc. of the International Workshop on the Lorentz Group, CTP and Neutrinos, edited A. E. Chubuklo, V. V. Dvoeglazov, D. Ernst, V. G. Kadyshevsky, and Y. S. Kim (World Scientific, Singapore, 2000).
- Decoherence Matrices, Proc. of the 6th International Conference on Squeezed States and Uncertainty Relations, edited by D. Han, Y. S. Kim, and S. Solimeno, (NASA Conference Publications 209899, 2000).
- Feynman's Entropy and Decoherence Mechanism, Proceedings of the 20th International Workshop on Bayesian Inference and Maximum Entropy Methods in Science and Engineering, edited by Ali Mohammad-Djafari (AIP Conference Proceedings, Vol. 568, 2001). pages 409 – 417.
- Internal Space-time Symmetries of Massive and Massless Particles and Their Unification, Supersymmetry and Quantum Field Theory, Proceedings of the International Conference on Supersymmetry and Quantum Field Theory dedicated to the 75th Birthday Anniversary of Dmitriy V. Volkov, edited by Dmitri Sorokin (Nuclear Physics B, Proceedings Supplement, No. 102 and 103, 2001). pages 369 – 376.
- Quark-Parton Phase Transition and the Entropy Problem in Quantum Mechanics, presented at the Akhiezer Memorial Conference on Quantum Electrodynamics and Statistical Physics (Kharkov, Ukraine, 2001), Problems of Atomic Science and Technology, Special Issue dedicated to the 90th Birthday Anniversary of A. I. Akhiezer, No. 6 (1), 149 – 153 (2001).
- Neutrino Polarization as a Consequence of Gauge Invariance, presented at the Advanced Study Institute on Symmetries and Spin (Prague, Czech Republic), Czechoslovakia J. of Physics **53**, C353 – 364 (2002).
- Wigner's Spins, Feynman's Partons, and Their Common Grounds, presented at the Advanced Study Institute on Symmetries and Spin (Prague, Czech Republic), Czechoslovakia J. of Physics **52**, C433 – 442 (2002).

G. Contracts and Grants:

- Part of the NSF Contract (P.I.: Greenberg and Oneda) until 1974.
- Largely responsible for the NSF grant for the 18th Eastern Theoretical Physics Conference (P.I.: Ferrell): \$ 4950 (1979 – 80).
- Worked closely with G. A. Snow in obtaining a \$ 10,000 grant from DOE and a Contribution of \$ 2,500 from DPF of APS for the 1982 meeting of the Division of Particles and Fields of the American Physical Society hosted by the University of Maryland.

- Contribution of \$ 4,000 from IUPAP (International Union of Pure and Applied Physics) for the 13th Int'l Colloquium on Group Theoretical Methods in Physics, May, 1984 (co-chaired with A. J. Dragt).
- \$ 5,000, \$ 5,000, and \$ 3,000 respectively from NSF, ONR, and AFOSR for the 13th Int'l Colloquium on Group Theoretical Methods in Physics, May, 1984 (co-chaired with A. J. Dragt).
- \$ 4,000, \$ 4,000 and \$ 5,000 respectively from IUPAP (International Union of Pure and Applied Physics), NSF and ONR for the operation of the First International Conference on the Physics of Phase Space, May 1986 (co-chaired with W. W. Zachary).
- \$ 30,000 from SDIO for the operation of the International Symposium for the International Symposium on Spacetime Symmetries (1988). \$ 4,000 and \$ 12,000 from DOE and private corporations respectively for the same purpose.
- \$ 37,000 (direct support from the Goddard Space Flight Center) for the Workshop on Squeezed States and Uncertainty Relations (1991).
- \$ 5,000 from the Office of Naval Research for the operation of the Workshop on Squeezed States and Uncertainty Relations (1991).
- \$ 41,000 (direct support from the Goddard Space Flight Center) for the operation of the Workshop on Harmonic Oscillators (1992).

H. Students Advised:

1. Master's Degrees:

- Virginia Kalb, in Applied Math. (1976)

2. Ph.D. degrees:

- K. V. Vasavada, jointly with J. Sucher (1964)
- M. C. Li, jointly with G. A. Snow (1965)
- M. L. Tapper (1969)
- T. De (1973)
- T. J. Karr (1976)
- M. J. Ruiz (1978)
- P. E. Hussar (1983)
- M. J. Haberman (1984)