

CURRICULUM VITAE

Bei-Lok Bernard Hu
Professor of Physics

February, 2006

I. PERSONAL DATA

Date and Place of Birth: October 4, 1947, Chungking, China. Citizenship: U.S.A.

Permanent Address:

Department of Physics, University of Maryland,
College Park, Maryland 20742-4111
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II. EDUCATION

Date	School	Location	Major	Degree
1958-64	Pui Ching Middle School	Hong Kong	Science	High School
1964-67	University of California	Berkeley	Physics	A.B.
1967-69	Princeton University	Princeton	Physics	M.A.
1969-72	Princeton University	Princeton	Physics	Ph.D.

III. ACADEMIC EXPERIENCE

Date	Institution	Position
June 1972- Jan. 1973	Princeton University Princeton, N.J. 08540	Research Associate Physics Department
Jan. 1973- Aug. 1973	Institute for Advanced Study Princeton, N.J. 08540	Member School of Natural Science
Sept.1973- Aug. 1974	Stanford University Stanford, Calif. 94305	Research Associate Physics Department
Sept.1974- Jan. 1975	University of Maryland College Park, Md. 20742	Postdoctoral Fellow Physics & Astronomy
Jan. 1975- Sept.1976	University of California Berkeley, Calif. 94720	Research Mathematician Mathematics Department
Oct. 1976- May 1977	Institute for Space Studies NASA, New York, N.Y. 10025	Research Associate Astrophysics

June 1977- University of California Research Physicist
Aug. 1979 Santa Barbara, Calif. 93106 Physics Department

Aug 1980- University of Maryland Assist, Assoc. & Full
Now College Park, MD 20742 Professor of Physics

Visiting or Honorary Appointments:

Sept.1979- Harvard University Honorary Research Fellow
Aug. 1980 Cambridge, Mass. 02138 Lyman Lab. of Physics

Jan. 1987- Institute for Advanced Study Member
Aug. 1987 Princeton, New Jersey 08540 School of Natural Sciences

Jan. 1989- Cornell University Professor of Physics and Research Fellow
June 1990 Ithaca, New York 14853 Newman Lab. of Nuclear Studies

April-May Newton Institute for Math. Member
1994 Sciences, Cambridge Univ. Geometry and Physics Program

Sept.1994- Institute for Advanced Study Dyson Visiting Professor
Jan. 1995 Princeton, New Jersey 08540 School of Natural Sciences

Short-term Visitor or Lecturer:

July 1982 Nuffield Foundation, Participant and Speaker at the
Univ. of Cambridge Workshop on the Early Universe
Aug. 1982 Shanghai Normal Visiting Professor
University, China

Sept. 1984 Erice Int'l School, Italy Principal Lecturer
Nov. 1984 Raman Institute of Visiting Professor
Physics, India

July 1985 Academia Sinica, Visiting Professor
Beijing, China

Aug. 1985 Yukawa Institute, Visiting Professor
Kyoto, Japan

June 1986 Academia Sinica, Visiting Professor
Taipei, Taiwan

May 1989 Erice Int'l School, Italy Principal Lecturer
Dec. 1990 SILARG7, Mexico City Principal Lecturer

Spring 1992 Institute for Theor. Physics Principal Participant,
University of California Workshop on Phase Transition
Santa Barbara in the Early Universe (declined)

June 1992 Univ., Buenos Aires, Argentina Visiting Professor

Aug. 1992 Waseda University, Senior Fellow,

	Tokyo Univ., and Yukawa Institute	Japan Society for the Promotion of Science
July. 1993	Instituto Superior Tecnico, Lisbon	Visiting Professor
Aug. 1993	CAP-NSERC, Summer Institute in Theoretical Physics, Banff, Canada	Principal Lecturer
Nov. 1994	Department of Physics University of Buenos Aires	Honorary Professor
Spring 1995	Dept. of Physics,	Visiting Professor
Spring 99,01	Hong Kong University of Science and Technology	
July 1995	Tubitak, Istanbul, Turkey	Visiting Professor
July 1995	University of Barcelona Barcelona, Spain	Visiting Professor
Aug. 1995	Department of Mathematics University of Sydney	Visiting Professor
Aug. 1995	Institute for Mathematical Physics, University of Adelaide	Visiting Professor
Sept. 1995	Erice International School, Italy	Principal Lecturer
June 1997	Dept. of Mathematics Hong Kong University of Science and Technology	Visiting Professor
July 1998	Albert Einstein Institute for Gravitation Theory, Potsdam, Germany	Visiting Professor Spring
Jan. 1999	Institute for Theor. Physics University of California Santa Barbara	Principal Participant, Workshop on Nonequilibrium Quantum Fields
Nov. 1999	Institute for Nuclear Theory University of Washington	Workshop on Quantum Field Nonequilibrium Processes
May 2001	Erice International School, Italy	Principal Lecturer
Jan 2004	University of Queensland University of New South Wales	Visitor
2004-2007	Institute of Physics, Academia Sinica, National Center for Theoretical Sciences, Taiwan	Visitor
Mar 2006	National University of Singapore	Visitor

IV. PROFESSIONAL ACTIVITIES

Fellow,	American Physical Society
Member,	International Society for General Relativity and Gravitation
Member,	New York Academy of Science
Trustee,	Association of Members of the Institute for Advanced Study (1984-1990)
Council,	Chinese Society on Gravitational Physics and Relativistic Astrophysics (1979-85)
Council,	Overseas Chinese Physics Association (1990-94, 98-)
Member,	International Advisory Committee for the Third Marcel Grossmann Meeting, Shanghai, China, 1983

- Member, International Advisory Committee for the Instructional Conference on Gauge Theory, Gravitation and the Early Universe, Bangalore, India, 1984
- Member, Local Organizing Committee of the 13th International Colloquium on Group Theoretical Methods in Physics, College Park, U.S.A., 1984
- Member, Local Organizing Committee of the First International Conference on the Physics of Phase Space, College Park, U.S.A., 1986.
- Member, Scientific Organizing Committee, International Conference on Gravitation and Cosmology, Goa, India, 1987.
- Member, International Advisory Committee for the Workshop on Thermal Field Theories and their Applications,
First Meeting: Cleveland, U.S.A., Oct., 1988;
Second Meeting: Tsukuba, Japan, July, 1990;
Third Meeting: Banff, Canada, August, 1993;
Fourth Meeting: Dalian, China, August 1995.
- Member, International Advisory Committee for the Peyresq Meetings on Quantum And Stochastic Gravity, Cosmology and Black Holes, France. 1999 – now
- Member, International Advisory Board for the DICE Meetings on Foundational Issues of Quantum Mechanics, Gravity, Cosmology & Quantum Information. Piombino, Italy. 2006 -
- Member, NSF Panel for the review of proposals for Centers of Creativity
NSF Panel for the review of proposals for gravitational physics
NASA Panel for the review of proposals for gravity and relativistic physics
- Chair, Scientific and Organizing Committees, International Symposium on Directions in General Relativity, College Park, USA, May, 1993
- Co-Chair, International Symposium on Quantum Classical Correspondence, Drexel University, Philadelphia, U.S.A., Sept., 1994
- Editor, International Journal of Modern Physics, A, D, Modern Physics Letters A
Quantum Information and Computation

V. HONORS AND AWARDS

- *Fellow, American Physical Society
- *Senior Fellow, Japan Society for the Promotion of Science
- * Dyson Visiting Professor (1994) Institute for Advanced Study, Princeton
- *General Research Board Award (1994, 2007) University of Maryland Graduate School
- *Teaching Excellence Award (1996) Univ. of Maryland, Dean for Undergraduate Studies
- * Princeton National Fellow (1967) Princeton University Graduate School
- *NSF Exceptional Undergraduate Traineeship (1965-67) Univ. of California, Berkeley
- * Biographic Listing in: American Man and Women of Science (USA)
 - Who's Who in Science and Engineering (USA)
 - Who's Who in Frontiers of Science and Technology (USA)
 - Who's Who in the World (USA)
 - Marquis Who's Who (USA)
 - Men of Achievement (UK)
 - Who's Who among Asian Americans (USA)
 - Huaxia Haiwai Keji Jingying (China)

Reference Asia (India)

VII. TEACHING EXPERIENCE

1. **Regular courses** taught:

Freshman-Sophomore *Introductory Physics for Physical Sciences, Engineering and Biosciences Majors* (Physics 122, 262, 263, 270)
Introductory Physics for Physics Majors (Phys. 272/272H)

Junior-Senior Courses for Physics Majors:
Modern Physics (Physics 421-422)
Modern Physics for Engineering Majors (Physics 420)
Thermal Physics (404)

Undergraduate Physics Research: Physics 389

Independent Study Seminar: Physics 398

Graduate Physics *Core Course: Statistical Mechanics* (Physics 602)
Topical Courses: *General Relativity* (Physics 675/875)
Topical Courses: *Advanced Gravitation Theory* (Phys. 776)
Special Topics Courses (Physics 879: see below)
Interdisciplinary Courses (Physics 889: see below)
Seminar: *Gravitation Theory*: Physics 779A
Seminar: *Quantum Coherence and Information*: Physics 779B
Special Problems in Advanced Physics: Physics 798

Master's Thesis Research: Physics 799

Ph.D. Dissertation Research: Physics 899

2. Innovations: **New courses** designed and taught:

"*Quantum Processes in the Early Universe*" Physics 889 (Fall 1983)

"*Quantum Field Theory in Curved Spacetime*" Physics 879 (S'84, S'86, S'92)

"*Geometric Methods in Physics*" Physics 798B (S'88)

"*Particles and the Universe*" Physics 889 (S'88):
taught jointly with Professors Pati and Eichler

"*Statistical Field Theory: Problems in Gravitation Cosmology and Nuclear- Particle Physics*," Physics 889 (S'91, S'97)

"Advanced Gravitation Theory" Physics 776 Designed this new course
and taught (S'93, S'96, S'02 S'04)

"*Statistical Field Theory: Quantum and Atom Optics*", Physics 889 (S'98)

"*Black Holes and the Early Universe*", Physics 499G (S'99)

"*Nonequilibrium Quantum Field Theory: Dynamics of Bose Einstein Condensate and Advanced Topics*", Physics 889 (S'03)

"*Gravitational Wave Physics and New Cosmology*" Physics 776 (S '04)

3. Supervised **independent research** or reading course to undergraduates

1983-1986 Chairman of Physics Honors Committee
Spring 1983 Dallas Kennedy, David Wasson, Selman Herschfield
1993-1994 Steve Sabian
1995-1996 Veronika Hubeny
1999-2000 Nick Cummings

4. *Master of Science* Students

James T. Wheeler, May 1981
Liam M. Healy, December 1981
Joseph Shanks, May 1982
Laura Mersini, May 1997
Andrew Skinner, May 2005

5. *Doctor of Philosophy* Students

Tsung-Chen Shen, Oct. 1985
"Quantum Effects on Non-Maximally Symmetric Spaces"

Dennis Joseph O'Connor, Oct. 1985
"Quantum Field Theory in Curved Spacetime: Phase Transition and Finite Size Effect"

Christopher Rhodes Stephens (joint with Prof. Charles W. Misner), Oct. 1986
"On Some Aspects of the Relationship between Quantum Physics, Gravity and Thermodynamics"

Salman Habib, Sept. 1988
"Quantum Fields in Curved Spacetime: Kinetic Theory"

Yuhong Zhang, Dec. 1990
"Stochastic Properties of Interacting Quantum Fields"

Aris Stylianopoulos, Dec. 1990
"Finite Temperature Quantum Field Theory in Curved Spacetime"

Roberto Camporesi, May 1991
"Geometrical Representation of Propagators and Quantum Effects in Spacetimes with Symmetry"

Sukanya Sinha, May 1991 "Semiclassical Limit of Quantum Cosmology"

Andrew Matacz (joint with Prof. Paul Davies, Univ. of Adelaide), May 1994
"Quantum Statistical Processes in Cosmology and Gravity"

Alpan Raval, Dec. 1996

"Stochastic Properties of Particle Detector and Quantum Field Interactions"

Stephen A. Ramsey, Dec. 1997

"Nonequilibrium Dynamics of Quantum Fields in Inflationary Cosmology"

Kazutomu Shiokawa, May 1998

"Coherence in Quantum Chaos, Stochastic Spacetimes and Collective Phenomena"

Nicholas G. Phillips, May 1999

"Fluctuations of the Quantum Stress Tensor in Curved Spacetimes via Generalized Zeta Functions and Point Separation"

Philip Johnson, Dec. 1999

"Nonequilibrium Dynamics of Particle Field Interaction"

Gregory Stephens, Aug. 2000

"Nonequilibrium Dynamics of Defect Formation in the Early Universe"

Sanjiv Shresta, Oct. 2003

"Coherent Quantum Dynamics of Atom- Quantum Field Interaction"

Ana Maria Rey, Dec. 2004 (with Theodore Kirkpatrick, IPST, and Charles Clark, NIST) "Ultra-cold Bosonic Atoms in an Optical Lattices"

Guido Pupillo, Aug. 2005 (with Carl Williams, NIST)

Confined Ultracold Bosons in One Dimensional Optical Lattices

Chad Galley, 2006 (expected)

"Stochastic Field Theory Approach to Gravitational Radiation Reaction"

Ardeshir Eftekharzadeh 2006 (expected)

"Topics in Gravitational Radiation Reaction and Black Hole Fluctuations"

Andrew Skinner 2006

"Quantum Decoherence and Entanglement in Spin-Chain Models for Quantum Computers"

Nick Cummings, 2007 (expected)

"Quantum Entanglement, Back-Action and Control: Basic Issues and Applications"

Chris Fleming, 2008 (expected)

"Macroscopic Quantum Phenomena: Basic Issues and Applications"

Anzi Hu, 2009 (expected)

Chad Sprouse 2009 (expected)

VIII. INVITED TALKS AT INTERNATIONAL MEETINGS (since 2000)

Speaker or Chairman at International Meetings or Visits (*indicates invited talks or lectures, - indicates invited participants, + indicates chairman of sessions,)

- 2000 *Fifth Peyresq Meeting on **Stochastic Gravity and Quantum Cosmology**, Peyresq, France, June 2000
*International Conference in Honor of E. Fradkin, Moscow, June 2000 (declined)
*International Conference on **Mechanisms of Decoherence**, Utrecht, Netherland, June 2000 (declined)
*Minisymposium in Honor of Leonard Parker, Oakland University, Oct. 2000
*Second International Workshop on **Quantum Aspects of Beam Physics**, Capri, Italy, Oct. 2000
- 2001 * Lectures on **Quantum and Gravity Physics** at the Erice International School, Italy; May 2001.
***Black Holes III: Theory and Mathematical Aspects**, Banff, Canada, May, 2001
*Sixth Peyresq Meeting on **Quantum and Stochastic Gravity, String and Brane Cosmology**. Peyresq, France, June 2001
* Workshop on **Mechanisms for Decoherence**-Theory and Applications to Nanotechnology and Quantum Information Science held at IC2, University of Texas, Austin, October 2001
- 2002 + Session on New Approaches to Quantum Gravity in the Workshop on **New Directions in the Foundations of Physics** May 3-5, 2002. AIP, College Park
* IXth International Conference on **Quantum Optics** Raubichi, BELARUS, May 14-17, 2002. ICQO'2002 (declined)
* Third International **Sakharov Conference** on Physics, Lebedev Institute Moscow June 24-28. (declined)
*Seventh Peyresq Meeting on Quantum and Stochastic Gravity, **Brane and String Cosmology** Peyresq, France, June 23-28, 2002
*Santa Fe **Cosmology Summer Workshop**, July 8-27, 2002
*Dynamics Days Asia-Pacific: Second International Conference on **Nonlinear Science** (DDAP2) Hangzhou, China. August 8-12, 2002. (declined)
*Workshop on **Quantum Control** at MIT, October 14-18, 2002
- 2003 *International Workshop on **Quantum Aspects of Beam Physics**. Hiroshima, January 2003 (declined)
*APS Topical Group: **Analog Models of Gravity**, Philadelphia, April 2003 (paper presented by co-author E. Calzetta)
+2nd annual New Directions in the **Foundations of Physics**. AIP, U Maryland, College Park. May 2-4, 2003

- *First International Conference on **Noise and Fluctuations in Photonics and Quantum Optics**", Santa Fe, USA, 1-4 June (Program committee and Invited speaker)
 - *Workshop on "The **Early Universe, Inflation and CMB Fluctuations**"
Peyresq, France June 22-26, 2003
 - *Santa Fe **Cosmology Summer Workshop**, July 7-25, 2003 (declined)
 - *Sixth International Workshop on **Quantum Field Theory** under the Influence of External Conditions (QFEXT03), University of Oklahoma, Norman, Sept. 15-19, 2003
- 2004
- +3rd annual New Directions in the Foundations of Physics conference, AIP, Univ. Maryland, College Park. April 30 - May 2, 2004
 - *Second International Conference on **Noise and Fluctuations**, Canary Islands, May 26-28. Program committee member and Invited speaker in **Photonics and Quantum Optics** (declined)
 - *7th Capra Meeting on **Gravitational Radiation Reaction**, Brownsville, Texas May 29-31, 2004 (declined)
 - *Biennial conference of the International Association for **Relativistic Dynamics**, Saas Fee, Switzerland 12-19 June 2004
 - *Workshop on "**Macro and Micro Structures of Spacetime**" Peyresq, France June 22-26
 - *Second International Workshop (DICE 2004) on **Decoherence, Gravity, Cosmology and Extensions of Quantum Theory**, Tuscany, Italy. Sept. 1-4
 - International Workshop on RHIC physics. Brookhaven National Laboratory. Dec. 16-17, 2004
- 2005
- *International Conference on **Theoretical Physics** dedicated to the **70th Anniversary of the Tamm Theory** Department, Lebedev Institute, Moscow, April 11-16 (declined)
 - ***Quantum Physics of Nature** (QUPON), Vienna, Austria, May 22-26
 - *10th Peyresq Workshop on "**Macro and Micro Structures of Spacetime II**", Peyresq, France, June 18-24
 - *Santa Fe **Cosmology Summer Workshop**, Santa Fe, New Mexico. July 5-23 (declined)
 - Quantum Control** Summer School, Caltech, Pasadena, Aug. 8-14 (declined)
 - ***Quark-Gluon-Plasma** Thermalization, Vienna, Austria, August 10-12, 2005 (declined)
 - *14th International Conference on **Fluid Dynamics in Complex Systems**. Kyoto University, Japan, Aug. 22-26 (declined)
 - 6th International Conference **Renormalization Group 2005** (RG2005) at the University of Helsinki, August 30 - September 3, 2005 (declined)
 - *Seventh International Workshop on **Quantum Field Theory** under the Influence of **External Conditions** (QFEXT03), Barcelona, Spain Sept. 5-9 (declined)
 - *Constrained Dynamics and **Quantum Gravity** Cala Gonone, Sardinia, Italy Sep 12-16 (declined)

*Asia-Pacific Conference on **Gravitation and Cosmology** – in celebration of the 90th anniversary of the publication of the Theory of General Relativity, National Central University, Taiwan. Nov 23-26.

- 2006 *Winter School on **Quantum Information Science**, National Cheng Kung University, Sun Moon Lake, Taiwan, Jan 5-7
- *National University of Singapore, Physics Department and Center for **Quantum Information Science**, March 30-April 3
- *National Center for Theoretical Science, Taiwan April 6-8
- *Institute of Physics, Academia Sinica, Taiwan May 13-23
- * International Conference on **Nonlinear Science**, Hong Kong May 24-26
- **Quantum Entanglement & Geometry**, Toruń, Poland June 4-7, 2006
- *11th Peyresq Workshop on "**Macro and Micro Structures of Spacetime III**", Peyresq, France, June 17-23
- *Workshop on **Quantum - Classical Transition and Quantum Information**, June 18-30 Benasque
- Santa Fe **Cosmology Summer Workshop**, Santa Fe, New Mexico. July 3-21
- *Unruh-Wald Fest University of British Columbia Vancouver Aug 18-20
- * DICE2006 International Workshop: **Quantum Mechanics between Decoherence and Determinism**: new aspects from particle physics to cosmology Castello di Piombino (Tuscany) Italy, September 11-15, 2006

IX. RESEARCH SCOPES

Publication List available upon request
Publication No.

1. Laser Physics and Molecular Kinetic A1
2. General Relativity: homogeneous anisotropic cosmology, group-theoretical methods in perturbation theory, wave A2, 3, 6

equations in curved space

3. Relativistic Cosmology and Astrophysics: galaxy formation
Gravitational wave physics, radiation reaction A8, 11, 17, 58
A95, 109, 111, 112
4. Thermodynamics and Cosmology: noise, fluctuation,
irreversibility and structure B26, 27, 29, 31
5. Particle Physics and Cosmology, Cosmology as
'Condensed Matter' Physics, Semi-classical gravity and
mesoscopic physics, general relativity as hydrodynamics B2, 15, 18, 24, 34, 37
6. Quantum Field Theory in Curved Spacetime:
a) Canonical Formalism: canonical quantization,
adiabatic regularization, trace anomaly A4, 5, 7, 12, 13
b) Path-integral Formalism: Feynman propagator
in curved space, effective action method, interacting
field theory, renormalization group equations, quasi-
local approximation, closed-time path formalism A14,15,35, 65
7. Quantum Effects in the Early Universe:
particle creation in cosmological spacetimes and
backreaction on the structure and dynamics of the
early universe A9,10,14,16
18,31,37
B1,17,19,25
8. Symmetry Breaking of Quantum Systems in
Curved Spacetime: effects of spacetime curvature,
topology and field coupling on the symmetry
behavior; finite size effect and dimensional
reduction, infrared behavior and phase transition A23,25,34,38,39,40
B7,9,12
9. Inflationary Cosmology and Phase Transition in the Early
Universe: phase transitions and reheating, thermal and
quantum gravitational effects on Planck scale process A27,28,47,66,68
B10,11,12,13,16
10. Quantum Cosmology and Semiclassical Gravity:
Validity of minisuperspace approximation; Noise,
decoherence and backreaction, Fluctuations and
validity of semi-classical gravity A43, 45,52,55
B14, 21,24,25
11. Higher-Dimensional Unified Theories, Propagators in
Symmetric Spaces: Kaluza-Klein theory and cosmology,
classical and quantum dynamical effects, vacuum stability,
gauge coupling constants A6,29
12. Finite Temperature Quantum Field Theory in Curved A18,19,22,26,32,40

Spacetime: criteria for thermal equilibrium and finite temperature theories in curved spacetimes, real and imaginary time thermal Green function, adiabatic expansion, quasi-local effective Lagrangian	B3,4,5,7
13. Statistical Thermodynamics of Quantum Fields in Gravitational Systems: entropy of fields, subdynamics analysis, entropy generation in quantum cosmological processes, vacuum viscosity, gravitational entropy	A20,21,30,33,41,70 B6,26, C
14. Non-Equilibrium Statistical and Kinetic Field Theories in Curved Spacetime: effective action methods in quantum statistical theory, Wigner function and quantum kinetic theory, dissipation in semiclassical theories, transport phenomena	A35,36,43,72,77,78 B14
15. Quantum Open Systems and Stochastic Field Theory 52,56,57,63,64,82 quantum Brownian motion, influence functional method, coarse-grained effective action, decoherence and quantum to classical transition, uncertainty principle and squeezed states, quantum dynamics of correlations, applications to atomic physics, quantum optics and mesoscopic systems	A46,49- B26-34
16. Effective Field Theory	A61
17. Stochastic Semiclassical Gravity	A53, 54, 55, 69,74,79,80,81,85; B54
18. Structure and Defect Formation in the Early Universe	A58, 71,83
19. Black Hole Fluctuations and Backreaction, Phase Transitions	A64, 73, C4
20. Stochastic Theory of Accelerated Detectors, Black Holes and Cosmology	A59-62,67
21. Relativistic Particles Moving in a Quantum Fields	A84, B50,51,52
22. Atom-Field Interaction, Bose Einstein Condensation	A75,76,86, 90-92, 98
23. Quantum Coherence Phenomena and Quantum Information	A96, 97,102, 103