

## Lei Bao

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### Education

Ph.D., Physics, 1999, University of Maryland at College Park  
M.S., Physics, 1996, University of Maryland at College Park  
M.S., Electrical Engineering, 1992, SouthEast University, Nanjing, China  
B.S., Electrical Engineering, 1990, SouthEast University, Nanjing, China

### Appointments

10/2011 – present Professor, Department of Physics and School of Teaching and Learning, The Ohio State University  
10/2006 – 09/2011: Associate Professor, Department of Physics, The Ohio State University.  
Associate Professor (Courtesy appointment) School of Teaching and Learning, College of Education and Human Ecology, The Ohio State University.  
08/2000 – 09/2006: Assistant Professor, Department of Physics, The Ohio State University.  
08/1999 – 07/2000: Research Associate, Physics Department, Kansas State University.  
08/1994 – 07/1999: Graduate Research and Teaching Assistant, Physics Department, University of Maryland.

### Academic Affiliations

09/2010 – present: Guest Professor at NingXia University, YingChuan, China  
06/2010 – present: Guest Professor at South China Normal University, GuangZhou, China  
05/2009 – present: Guest Professor at Beijing Normal University, Beijing, China  
10/2008 – present: Guest Professor at Beijing JiaoTong University, Beijing, China  
09/2003 – present: Guest Professor at SouthEast University, Nanjing, China

Member of the OSU China Gateway Faculty Advisory Committee.  
Member and Science Education Co-coordinator, the Overseas Chinese Physics and Astronomy Association (OCPA)  
Member of American Association of Physics Teachers (AAPT)  
Past Chair of AAPT international education committee (2009.1-2011.1)  
Council member of the Chinese National Association of Research in Higher Education of Physics  
Editor of *Research in Education Assessment and Learning* (2009-present)  
Member of the Advisory Team of the Center for School Curriculum Research & Development, GuangXi Normal University, Guilin, China (2006-present)  
Member of the editorial board of “WuLiTongBao” (physics bulletin) published under the Chinese Physical Society.

### Research Interests and Fields

Inquiry based and technology assisted education methods and curriculum for science learning and scientific reasoning.  
Assessment instruments for assessing science content knowledge and scientific reasoning skills.

Measurement and assessment methods

- Model Analysis – multi-dimensional modeling for assessing learning.
- Dynamic models of learning and a unified probability framework for education measurement, which integrates Model Analysis, normalized gain and IRT under a single coherent theoretical frame.
- Development of quantitative assessment instruments and methods for assessing content knowledge, reasoning, and views and attitudes.
- Large scale quantitative assessment and targeted comparisons.
- International assessment data center.

Computational models of student learning processes such as neural network models

Experimental technology and methods for measuring and modeling behavioral data of student learning (e.g. automatic group dynamics analysis and eye-tracking analysis of human interactions with computer simulations).

Technologies in education (e.g. in-class polling, web based interactive learning modules, technology enhanced science inquiry, virtual reality experiments, learning games)

## Current and Past Grants (Current grants are marked with \*)

1. \**International Education and Assessment for the 21<sup>st</sup> Century*, IPERC Foundation, PI, \$100K/yr for 5 years.
2. \**Developing Scientific Reasoning Assessment Tools for STEM Education and Teacher Preparation*, NSF, PI, \$199,801, 2010~2014.
3. \**Mathematics Coaching Program* – Year Six funded by the Ohio Department of Education for \$2.6 million from 2013-2014. Share of Budget \$53,015.
4. \**Science Learning and Scientific Reasoning*, NIH, PI, \$998,658, 2009~2013.
5. *Developing Scientific Reasoning Abilities in Pre-service Teachers*, NSF, CCLI, Co-PI, \$125,000, 2010~2012.
6. *Virtual Experiments for Physics Labs*, NSF, CCLI, PI \$100,396, 2007~2011.
7. *Building a solid foundation for multidisciplinary STEM education research*, NSF, CCLI, Co-PI, \$148,711, 2008~2011.
8. *STEP: Gateway into first-year STEM curricula: A community college/university collaboration promoting retention and articulation*, NSF Subcontract, \$18,827, 2008~2010.
9. *Creating Research-based Single-Concept Question Sequences for In-class Polling Systems*, NSF CCLI, Co-PI, 2006~2010, \$489,999.
10. *Develop and Assess The Ohio State Standardized Clicker System*, OSU, Co-PI, 07/2005~06/2007, \$84,796.
11. *Scientific Misconceptions: From Cognitive Underpinnings to Educational Treatment*, CASL, US Department of Education, Collaborator (10%) 09/2005~08/2008, \$933,397.
12. *Context Cues, Associative Memory and Learning of Physics*. NSF (REC 0126070) PI. 01/2002 – 12/2005, \$269,305.
13. *Technology & Model-Based Conceptual Assessment*. NSF (REC 0087788) Co-PI. (Subcontract from Kansas State University – PI. at OSU) (01/2001 – 12/2004), \$241,947 at OSU.
14. Ohio State University Seed Grant PI 2001-02 \$9,000.

## Teaching

Physics 1250: Introductory Physics (Au 2013)  
Physics 1250: Introductory Physics (Au 2012)  
Physics 780.20: Project Based Learning in Physics Education (Sp 2012)  
Physics 880.20: Physics Education Research (Au 2011)  
Physics 107: Physics By Inquiry (Sp 2011)  
Physics 106: Physics By Inquiry (Wi 2010)  
Physics 131: Introductory Mechanics (Au 2009)  
Physics 107: Physics By Inquiry (Sp 2008)  
Physics 132I: Introductory E&M for Engineering Honors (Wi 2008)  
Physics 131J: Introductory Mechanics for Engineering Honors (Au 2007)  
Physics 133J: Introductory Modern Physics for Engineering Honors (Sp 2007)  
Physics 132J: Introductory E&M for Engineering Honors (Wi 2007)  
Physics 108: Physics By Inquiry (Au 2006)  
Physics 107: Physics By Inquiry (Sp 2006)  
Physics 132: Electricity and Magnetism (Wi 2006)  
Physics 131J: Introductory Mechanics for Engineering Honors (Au 2005)  
Physics 107: Physics By Inquiry (Sp 2005)  
Physics 106: Physics By Inquiry (Wi 2005)  
Physics 108: Physics By Inquiry (Au 2004)  
Physics 107: Physics By Inquiry (Sp 2004)  
Physics 106: Physics By Inquiry (Wi 2004)  
Physics 107: Physics By Inquiry (Sp 2003)  
Physics 131: Introductory Mechanics (Au 2002)  
Physics 133: Modern Physics (Sp 2002)  
Physics 131J: Introductory Mechanics for Engineering Honors (Au 2001)  
Physics 880.20: Theoretical Models and Advanced Mathematical Methods in Physics Education. (Sp 2001)  
Physics 780.20: Introductory to Physics Education Research. (Wi 2001)  
US Olympic Team: Lab Instructor for US Olympic Physics Team of 1997.  
TA for many versions of undergraduate courses at the University of Maryland. (09/1994 – 06/1999)

## Committee and Admin Services

OSU CUEE Center Director  
OSU Chinagateway Advisory Board  
OSU Chinagateway Developmental Grant Committee

#### Departmental Committee:

Colloquium (11-14)  
Graduate studies (12-13)  
Computer (10-12)  
Undergraduate Service Course (09-10)  
Undergrad Course (06-07)  
Public Relation (06-07)  
Personnel Resource Committee (03-04)  
Qualify Exam (02-04),  
Graduate Study (00-02)

### Graduate Students and Post-Docs

#### Current:

Joseph Fritchman (01/2011 ~ present) Scientific Reasoning and Science Inquiry  
Jarred Hudson (08/2014 ~ present) Science Inquiry and Education Technology

#### Post-Doc/Research Associate

Jing Han (05/2013 ~ present) Scientific Reasoning and Educational Assessment  
Zhao Fu (09/2011~present): Scientific Reasoning assessment and data analysis.

#### Past Students and Post-Docs:

Gyoungho Lee (Post-Doc 01/2001~09/2002, Assistant Professor at Seoul National University, Korea, and the secretary of the physics education division in the Korean Physical Society since 04/2005).  
YeounSoo Kim (Post-Doc 02/2004 ~ 02/2006) Students attitudes, motivations, cognitive conflicts and anxiety. Current position: Physics teacher at the most elite high school in South Korea.  
Lin Ding (Post-Doc 07/2007~08/2010), Assistant Professor, School of Teaching and Learning, The Ohio State University.

#### *Past Graduate Students:*

Keith Oliver (08/2003, Assistant Professor at Grand Valley State University, WI)  
Rasil Warnakulasooriy (08/2003, Post-doc in the physics department of MIT)  
Florin Bocaneala (06/2005, Thesis on computational modeling of learning process). Project Coordinator/Director of Physics/Astronomy Online Instruction for Present/Future Science Teachers at Fairmont State University, West Virginia. (06~present).  
Homeyra Sadaghiani (08/2005, Thesis on student learning in Quantum mechanics, Post-doc in the PER group at the University of Washington) (05~07). Assistant professor in the physics department at California State Polytechnic University in Pomona. (07~present).  
Dedra Demaree (09/2003 ~ 09/2006) Thesis "Toward Understanding Writing To Learn In Physics: Investigating Student Writing", Visiting assistant professor at College of the Holy Cross, Massachusetts (06~07). Assistant professor in the physics Department at Oregon State University. (07~present).  
Pengfei Li (09/2003 ~ 08/2007) Thesis on voting machine and problem solving, Assistant Professor in Physics Department at Savannah State University, Georgia. (07~present).  
Jing Wang (02/2004 ~ 2009) Thesis "Advanced Quantitative Measurement Methodology in Physics Education Research". Assistant professor in Eastern Kentucky University. (09~present).  
Albert Lee (07/2006 ~ 2009) Thesis "Development and Evaluation of Clicker Methodology for Introductory Physics Courses". Assistant professor in California State University, Los Angelis. (09~present).  
Amy Raplinger (09/2009 ~ 09/2011) Graduated with a Master Study on Scientific Reasoning and Science Inquiry  
Jing Han (08/2008 ~ 05/2013) Scientific Reasoning and Educational Assessment  
Aaron Adair (03/2011 ~ 12/2013) Science Inquiry and Project based Learning

#### Visiting Scholars:

Zhaolong Liu (11/2013~present), Professor, Beijing Institute of Technology, Beijing China.  
Qiaoping Zhu (09/2013~present), Associate Professor, Ningxia University, Yingchuan, China

#### *Past Visitors:*

Xiaohong Tang (11/2012~11/2013), Professor, Sichuan College of Education, Chengdu, Sichuan, China.  
Bei Sha (10/2012~03/2013), Associate Professor, QiLu Normal University, Shandong China.  
Yuhua Liu (03/2012~10/2012), Associate Professor, FoShan University, Guangdong, China  
Fengguo Li (03/2012 ~ 08/2012), Professor, South China Normal University, Guangzhou, China  
Yuan Pi (03/2012/ ~ 05/2012), Associate Professor, Central China Normal University, Wuhan, China

XiaoLi Wu (03/2011 ~ 03/2012), Professor, Beijing Institute of Technology, Beijing, China  
 Li Xie (02/2011 ~ 03/2012), Professor, Yangtze University, Jingzhou, Hubei, China  
 Shaona Zhou (09/2010~12/2011), Ph.D. student, South China Normal University, Guangzhou, China  
 Jiawu Fan (09/2010~09/2011), Ph.D. student, Beijing Normal University, Beijing, China  
 Li Cheng (08/2009 ~ 08/2011), Ph.D. student, South East University, Nanjing, China  
 Qiong Huang (11/2010~06/2011), Ph.D. student, Beijing Normal University, Beijing, China  
 Liangyu Peng (09/2010~03/2011), Professor, Hunan Normal University, Changsha, China  
 Xiaojun Wang (11/2010 ~ 12/2010), Professor, South China Normal University, Guangzhou, China  
 Guiqing, Xu (11/09 ~ 05/2010), Ph.D. student, Beijing Normal University, Beijing, China  
 Yibing Zhang (04/2009 ~ 07/2010), professor, Department of Physics, Ningxia University, Yingchuan, China  
 Xiumei Feng (09/2008 ~ 08/2009), assistant professor, Department of Physics, HuaZhong Normal University, Wuhan, China  
 TianFang Cai (09/2007~07/2008), associate professor, Department of Physics, Beijing JiaoTong University, Beijing, China  
 Kai Fang (04/2007~09/2007), assistant professor, Department of Physics, Tongji University, Shanghai, China  
 LiJia Yang (02/2007~10/2007), professor, Department of Physics, China National University of Defense Technology, Changsha, China

## Publications and Academic Activities

### Journal Articles:

#### Expected publications

1. Zhou, S., Bao, L., Koenig, K., Cai, T., Han, J., Pi, Y., Raplinger, A., Xiao, H. Assessment of Student Reasoning in Control of Variables. *American Journal of Physics* (Under the 3<sup>rd</sup> round of review, original paper submitted in 2012).
2. Bao, L., Chen, L. Han, J., Cai, T., Pi, Y., Zhou, S., Yan Tu, and Koenig, K., Dividing the Force Concept Inventory into Two Equivalent Half-Length Tests (Under the 3<sup>rd</sup> round of review, original paper submitted in 2012).
3. Han, J., Chen., L., Zhang, Y., Zhou, S., Bao, L. Seeing What Students See in Solving the Force Concept Inventory (Under the 2<sup>nd</sup> round of review, original paper submitted in 2012).

#### Published

1. Bao, L., Kim, Y., Raplinger, A., Han, J., & Koenig, K. (2013). Affective Factors in STEM Learning and Scientific Inquiry: Assessment of Cognitive Conflict and Anxiety, *Research in Education, Assessment, and Learning*, 4 (1), 1-52.
2. Koenig, K., Schen, M., & Bao, L., "Explicitly Targeting Pre-service Teacher Scientific Reasoning Abilities and Understanding of Nature of Science through an Introductory Science Course," *Science Educator*, 21, no. 2, 1-9 (2012).
3. Koenig, K., Schen, M., Edwards, M. & Bao, L., "Addressing STEM Retention through a Scientific Thought and Methods Course," *Journal Of College Science Teaching*, 41, no. 4, 23-29 (2012).
4. James Brogerg & Lei Bao, "The Impact of Assessment Format on Student and Evaluator Response in Physics Assessment," *Research in Education Assessment and Learning*, 3 (2), 57-68, (2012)
5. Aaron Adair and Lei Bao, "Project-Based Learning: Theory, Impact, and Effective Implementation," *Research in Education Assessment and Learning*, 3 (1), 6-21, (2012)
6. Li Chen, Jing Han, Jing Wang, Yan Tu, and Lei Bao, "Comparisons of Item Response Theory Algorithms on Force Concept Inventory," *Research in Education Assessment and Learning*, 2 (02), 26-34, (2011).
7. Shaona Zhou, Jing Han, Nathaniel Pelz, Xiaojun Wang, Liangyu Peng, Hua Xiao, Lei Bao, Inquiry Style Interactive Virtual Experiments: A Case on Circular Motion, *European Journal of Physics*, 32, 1597-1606, (2011).
8. Lin Ding, Neville Reay, Albert Lee, and Lei Bao, Exploring the role of conceptual scaffolding in solving synthesis problems, *Phys. Rev. ST Physics Ed. Research* 7, 020109 (2011).
9. Albert Lee, Lin Ding, N. W. Reay, and Lei Bao, "Single-Concept Clicker Question Sequences," *Physics Teacher*, 49 (6) p385-389, (2011) .
10. Jing Wang and Lei Bao, "Analyzing Force Concept Inventory with Item Response Theory," *Am. J. Phys.*, 78 (10), 1064-1070 (2010).
11. Lei Bao, Tianfan Cai, Kathy Koenig, Kai Fang, Jing Han, Jing Wang, Qing Liu, Lin Ding, Lili Cui, Ying Luo, Yufeng Wang, Lieming Li, Nianle Wu, "Learning and Scientific Reasoning", *Science*, Vol. 323. no. 5914, pp. 586 – 587 (2009).
12. Lei Bao, Kai Fang, Tianfang Cai, Jing Wang, Lijia Yang, Lili Cui, Jing Han, Lin Ding, and Ying Luo "Learning of Content Knowledge and Development of Scientific Reasoning Ability: A Cross Culture Comparison," *Am. J. Phys.*, 77 (12), 1118-1123 (2009).

13. Lin Ding, Neville W. Reay, Albert Lee and Lei Bao, "Are we asking the right questions? Validating clicker question sequences through student interviews," *Am. J. Phys.*, 77 (7), 643-650 (2009).
14. L. Bao, S. Stonebraker, and H. Sadaghiani, "A Flexible Homework System," *Am. J. Phys.*, 76 (9), 878-881 (2008).
15. Lin Ding, Neville W. Reay, Albert Lee and Lei Bao, "The effects of testing conditions on conceptual survey results," *Phys. Rev. ST Phys. Educ. Res.* 4, 010112 (2008).
16. David E. Pritchard, Young-Jin Lee and Lei Bao, "Mathematical learning models that depend on prior knowledge and instructional strategies," *Phys. Rev. ST Phys. Educ. Res.* 4, 010109 (2008)
17. N.W. Reay, P. Li, and L. Bao, "Testing a New Voting Machine Methodology," *Am. J. Phys.* 76 (2) 171-178 (2008).
18. L. Bao and E. F. Redish, "Model Analysis: Assessing the Dynamics of Student Learning," *Phys. Rev. ST Phys. Educ. Res.* 2, 010103 (2006).
19. L. Bao, "Theoretical Comparison of Average Normalized Gain Calculations," *Am. J. Phys.* 74 (10) 917-922 (2006).
20. Gyoungho Lee, Jongho Shin, Jiyeon Park, Sangho Song, Yeonsoo Kim, Lei Bao, "An Integrated Theoretical Structure of Mental Models in Science Education: Students' ideas of the circular motion," *J. Korea Assoc Res. Sci. Edu.* 25-6, 698-709 (2005).
21. M. C. Wittmann, J. T. Morgan, and L. Bao, "Addressing student models of energy loss in quantum tunneling," *Eur. J. Phys.* 26 939-950 (2005). Chosen for "Highlights of 2005" by the journal.
22. N. W. Reay, L. Bao, P. Li, R. Warnakulasooriya and G. Baugh, "Toward an effective use of voting machines in physics lectures," *Am. J. Phys.* 73, 554 (2005)
23. L. Bao and E. F. Redish, "Understanding probabilistic interpretations of physical systems: A pre-requisite to learning quantum physics", *Am. J. Phys.* 70 (3), 210-217, (2002)
24. L. Bao, K. Hogg, and D. Zollman, "Model Analysis of Fine Structures of Student Models: An Example with Newton's Third Law," *Am. J. Phys.* 70 (7), 766-778 (2002).
25. L. Bao and E. F. Redish, "Concentration Analysis: A Quantitative Assessment of Student States," *PERS of Am. J. Phys.* 69 (7), S45-53, (2001).

#### **Selected Media and News Coverage:**

Nature Physics: Science education: Lessons to be learned, Vol.6, 6, 2010.  
 Science News: Feature: Think Like a Scientist, Vol.175 #13 (p. 20), 06/20, 2009.  
 NPR: Can Scientific Reasoning Be Taught? 1/30, 2009  
 NPR Science Friday: Learning Facts vs. Learning to Reason. 1/30, 2009  
 The Columbus Dispatch: Study: Chinese students know more science facts than U.S. counterparts, 1/29, 2009.  
 China Daily: Science students lack ability to reason 1/30, 2009.  
 Inside Higher Ed: Blinding Them with Science 1/30, 2009

#### **Book/Chapters (Peer Reviewed):**

1. L. Bao and E. F. Redish, "Educational Assessment and Underlying Models of Cognition" In *The Scholarship Of Teaching And Learning In Higher Education: The Contributions Of Research Universities*, Ed. William E. Becker & Moya L. Andrews, pp 221-264, Indiana University Press, 2004.

#### **Peer Reviewed Conference Proceedings:**

1. Koenig, K. & Bao, L. (April 2013). Impacting the Scientific Reasoning Abilities of STEM Majors through an Introductory Physics Laboratory Course. Proceedings of the Annual Meeting of the National Association for Research in Science Teaching, Puerto Rico.
2. Liangyu peng, Lei Bao, Manchi Huan. Research of Generalized Lorenz System Family and Chua's Circuit Based on Simulink. 2011 International Conference on Computers, Communications, Control and Automation (CCCA 2011). Hong Kong, China, February 20-21, 2011. Volume I: 417-420. (IEEE publication)
3. Liangyu peng, Lei Bao, Manchi Huan. The Study of Removing Image Noise with Median Filter and Wavelet Transform. 2011 International Conference on Computers, Communications, Control and Automation (CCCA 2011). Hong Kong, China, February 20-21, 2011. Volume I: 421-424. (IEEE publication)
4. Liangyu peng, Lei Bao. Application of Matlab/Simulink and Orcad/PSpice Software in Theory of Circuits. 2010 International Conference on Broadcast Technology and Multimedia Communication (BTMC 2010), 2010 Second Pacific-Asia Conference on Knowledge Engineering and Software Engineering (KESE 2010). Chongqing, China, December 13-14, 2010. Volume III: 514-517. (IEEE publication)
5. Scott Zollinger, Patti Brosnan, Diana B. Erchick, and Lei Bao, "Mathematics Coaching: Impact on Student Proficiency Levels After One Year of Participation", North American Chapter of the International Group for the Psychology of Mathematics Education (PME-NA), (2010).

6. L. Ding, N. W. Reay, A. Heckler, and L. Bao, "Sustained effects of solving conceptually-scaffolded synthesis problems", *PERC Proceedings* (2010).
7. Lin Ding, Neville Reay, Albert Lee and Lei Bao, "Using Conceptual Scaffolding to Foster Effective Problem Solving" *PERC proceedings* (2009).
8. Homeyra R. Sadaghiani and Lei Bao, "Student Difficulties in Understanding Probability in Quantum Mechanics" *PERC proceedings* (Aug. 2005).
9. Yeounsoo Kim, Lei Bao and Omer Acar, "Students' Cognitive Conflict and Conceptual Change in a PBI Class," *PERC proceedings* (Aug. 2005).
10. Yeounsoo Kim and Lei Bao, "Development of an Instrument for Evaluating Anxiety Caused by Cognitive Conflict," *PERC proceedings* (Aug. 2004).
11. Gyoungho Lee, Jiyeon Park, Yeounsoo Kim and Lei Bao, "Alternative Conceptions, Memory & Mental Model in Physics Education," *PERC proceedings* (Aug. 2004).
12. Dedra Demaree, Stephen Stonebraker, Wenhui Zhao and Lei Bao, "Virtual Reality Experiments in Introductory Physics Laboratories," *PERC proceedings* (Aug. 2004).
13. Rasil Warnakulasooriya and Lei Bao, "Procedural Rules in Students' Reasoning," *PERC proceedings* July 2003.
14. Neville W. Reay, Lei Bao, Gordon Baugh and Rasil Warnakulasooriya, "Business-Style" Group Work in a Freshman Engineering Honors Class," *PERC proceedings* July 2003.
15. Florin Bocaneala and Lei Bao, "Neural Network Modeling for Physics Learning: A Case on E&M," *PERC proceedings* July 2003.
16. Homeyra Sadaghiani and Lei Bao, "Lecture Demonstrations in Modern Physics: Quality vs. Quantity," *PERC proceedings* July 2003.
17. Homeyra R. Sadaghiani and Lei Bao, "Immediate Informative Feedback Using a New Homework System," *PERC proceedings* Aug. 2002.
18. Keith Oliver and Lei Bao, "Student Resources in Quantum Mechanics, or Why Students Need Meta Resources," *PERC proceedings* Aug. 2002.
19. Gyoungho Lee and Lei Bao, "Context Map: A Method to Represent The Interactions Between Students' Learning and Multiple Context Factors," *PERC proceedings* Aug. 2002.
20. Rasil Warnakulasooriya and Lei Bao, "Toward a Model-Based Diagnostic Instrument in Electricity and Magnetism - An Example," *PERC proceedings* Aug. 2002.
21. Gyoungho Lee and L. Bao, "Graduate and undergraduate students' views on learning and teaching physics," *PERC proceedings*, July 2001.
22. R. Warnakulasooriya and L. Bao, "Students' understanding of Electricity and Magnetism for the development of a model based diagnostic test," *PERC proceedings*, July 2001.
23. Richard N. Steinberg., Michael. C. Wittmann, Lei Bao, and Edward F. Redish, "The Influence of Student Understanding of Classical Physics When Learning Quantum Mechanics," Research on the Teaching and Learning of Quantum Science, NARST Annual Meeting, Boston, March, 1999. <http://www.phys.ksu.edu/perg/paper/narst/>.
24. Zhonghan Woo, Lei Bao, Wang Ling and Yuan Chunwei, "AFM Analysis on the Bioelectric Property of Fish Scale Plates," The Eighth Symposium on Electrets, Paris, Sept., 1994.
25. Zhonghan Woo, Lei Bao, et al, "Electrostatic Technology and Clean Engineering," International Conference on Air and Water Cleaning Technology, China, June, 1993.
26. Lei Bao, Yiming Ling, "Ozone Synthesis with UV and Silent Discharge," The Asia-Pacific Conference on Plasmas Science and Technology, China, Sept. 1992.

\**PERC proceeding is an AIP publication that currently publishes one issue annually. The acceptance rate is about 50%.*

#### **Invited Review Papers:**

1. Lei Bao and ZuRen Wu, "Physics Education in China: From Past to Future," *AAPT Interactions*, 38 (1), 24-25, (2008).

#### **Peer Reviewed Papers in Non-English Journals:**

1. Ying Luo and Lei Bao, "Implications from the comparison of scientific reasoning abilities between Chinese and US college students," *Journal of Education in China*, 10, 20, 2009 (in Chinese)
2. Kai Fang, Lijia Yang, Tianfang Cai, Jing Wang, and Lei Bao, "Assessment of Physics Education Research," *College Physics*, 2009, (in Chinese).
3. Kai Fang, Lijia Yang, Tianfang Cai, Jing Wang, and Lei Bao, "Review of Physics Education Research," *College Physics*, 2009, (in Chinese).

### Invited Talks / Seminars:

1. L. Bao, "21st Century Education: Developing and Assessing Student Critical Thinking and Scientific Reasoning," Plenary Talk, Global Chinese Conference on Science Education, GuangZhou, China, July, 2013.
2. L. Bao, "Research and Best Practices to Improve Student Learning," Plenary Talk, Workshop on Research based STEM Education, STEM Learning Center, Beijing Jiaotong University, Beijing, China, July, 2013.
3. L. Bao, "Research and Best Practices to Improve Student Learning," Plenary Talk, Teacher Workshop on STEM Education, South China Normal University, GuanZhou, China, July, 2013.
4. L. Bao, "Developing and Assessing Student Ability," Colloquium, Sichuan Normal University, Chengdu, China, June, 2013.
5. L. Bao, "Developing Effective Scientific Reasoning and Problem Solving Skills," Colloquium, University of Cincinnati, Department of Physics and FUSION science education center, October, 2012.
6. L. Bao, "Developing and Assessing Student Ability: 21st Century Skills and 21st Century Education," Plenary Talk, China Physical Society, China-US Advanced Forum on Physics Education, Tsinghua University, Beijing China, August, 2012.
7. L. Bao, "Scientific Reasoning and Problem Solving Skills," Colloquium, ChangJiang University, JingZhou, China, August, 2012.
8. L. Bao, "Developing Effective Problem Solving Skills," Plenary Talk and Workshop, Strengthening Teaching and Learning in the STEM Fields, LASPAU, Harvard University, June, 2012.
9. L. Bao, "Learning, Reasoning, and Science Inquiry," Colloquium, Harvard University, School of Engineering and Applied Sciences, Cambridge, MA, April, 2012.
10. L. Bao, "Jobs, Physics, and Education Reforms," Invited Conference Speech, Annual Meeting of The Physical Society of Republic of China, National Chung Cheng University, Taiwan, January, 2012.
11. L. Bao, "STEM Education: US-China Comparison," Plenary Talk, Advanced Workshop on Investigative Learning, Nanjing, China, August, 2011.
12. L. Bao, "Technology in Physics Education," Hong Kong Institute of Education, Hong Kong, August, 2011.
13. L. Bao, "Scientific Reasoning and Science Education," Plenary Talk, OCPA7 Biannual Meeting, Kaohsiung, Taiwan, August, 2011.
14. L. Bao, "STEM Learning and Scientific Reasoning," NARST Annual Meeting, Orlando, FL, April, 2011.
15. L. Bao, "Assessment of Advanced Ability in Chinese College Admission Test," AAPT Winter Meeting, Jacksonville FL, January, 2011.
16. L. Bao, "Science Learning and Scientific Reasoning," Indiana University Purdue University Indianapolis, October, 2010.
17. L. Bao, "Advanced Methods in Education Assessment," Beijing Education Testing Center, Beijing, September, 2010.
18. L. Bao, "Current Trends in Physics Education Research," Beijing University of Posts and Telecommunications, Beijing, September, 2010.
19. L. Bao, "Introductory to Physics Education Research," Beijing Institute of Technology, Beijing, September, 2010.
20. L. Bao, "Interactive Classrooms for Fostering Student General Abilities," Central China Normal University, WuHan, September, 2010.
21. L. Bao, "Physics Education and Training of Scientific Reasoning," South China Normal University, GuangZhou, August, 2010.
22. L. Bao, "Physics Education Research: A Research based Framework for Education Reform," Hunan Normal University, ChangSha, August, 2010.
23. L. Bao, "Recent Development in Physics Education Research," Plenary Speech, Annual Meeting of the Chinese National Association of Research in Higher Education of Physics, YunNan Normal University, KunMing, August, 2010.
24. L. Bao, "Developing Interactive Classroom Environments," TongJi University, ShangHai, August, 2010.
25. L. Bao, "Assessment Methods and Instrument Design," Beijing Normal University, Beijing, August, 2010.
26. L. Bao, "Physics Education Research Around the World," 2010 International Physics and Science Education Research Forum, the Annual Meeting of Chinese Society of Education, Physics Education Committee, August, 2010.
27. L. Bao, "Current Trends in Physics Education Research: Methodology and Development," Plenary Speech, Annual Meeting of the Education Committee of the Chinese Physical Society, Beijing, July, 2010.
28. L. Bao, J. Han, and K. Koenig, "Assessment of Scientific Reasoning: A Case in Proportional Reasoning," AAPT-PERC, Portland, OR, July, 2010.
29. L. Bao, "Learning and Scientific Reasoning," University at Buffalo (SUNY), July, 2010.
30. L. Bao, "Learning to Teach and Teaching to Learn," APS/AAPT Winter Meeting, Washington DC, February, 2010.
31. L. Bao, "Learning and Scientific Reasoning" OSU Physics Colloquium, OSU, January, 2010.
32. L. Bao, "Establishing a Productive Global Collaboration," OSU Research Symposium on Research and the Global University, OSU, November, 2009.
33. L. Bao, "Assessment of Learning and Reasoning," AAPT Summer Meeting, Ann Arbor, July, 2009.

34. L. Bao, "Assessment and training in scientific reasoning," IPERC Summer Workshop, Columbus, Ohio, July, 2009
35. L. Bao, "Connections between Science Content, Instruction, and Development of Scientific Reasoning: Developing a Research Based Framework for Sustainable Education Improvement," Forum for School Science, AAAS Annual Meeting, Chicago, February, 2009.
36. L. Bao, "Physics Education Research Methods and Current Development," China Eastern Normal University, ShangHai, November, 2008.
37. L. Bao, "Methods and Current Development in Science Education and Education Research," Southeast University, Nanjing, November, 2008
38. L. Bao, "Physics Education Research: A Research Based Framework for Sustainable Education Improvement," Higher Education Forum, TongJi University, ShangHai, November, 2008
39. L. Bao, "K-12 Science Education and Education Research," BoYa Colloquium, HuaZhong Normal University, Wuhan, November, 2008.
40. L. Bao, "Physics Education Research," Annual Meeting of the Education Committee of the Chinese Physical Society, Peking University, Beijing, November, 2008.
41. L. Bao, "Science Education and Education Research," Forum on Physics Education and Teacher Training, Beijing Normal University, Beijing, November, 2008.
42. L. Bao, "Assessment of Learning: Review on Methodology," IPERC Workshop, Beijing Jiaotong University, Beijing, November, 2008.
43. L. Bao, "Assessment of Scientific Reasoning," Center for Research on College Science Teaching and Learning, Michigan State University, September, 2008.
44. L. Bao, "Cross Culture Comparison of Student Content Knowledge and Reasoning Ability," AAPT Summer Meeting 2008.
45. L. Bao, "Student Learning/Reasoning Ability and Content Knowledge," Wright State University, March 2008.
46. L. Bao, "Understanding Quantitative Assessment: Probability Frames and Methods," University of Maryland, November, 2007.
47. L. Bao, Plenary Talk -- "Measurement and Cognitive Modeling," Biennial Meeting for Foundations and Frontiers of Physics Education Research, Bar Harbor, Maine, 2007.
48. L. Bao, "Comparing the probabilistic frameworks of popular quantitative education measurement methods," AAPT Summer Meeting 2007.
49. L. Bao, "Cognitive Modeling and Measurement in Education Research," Center for Learning Science, Southeast University, Nanjing, China, July, 2007
50. L. Bao, "Research and Measurement Methodology in Physics Education," GuangXi Normal University, Guilin, China, July, 2007
51. L. Bao, "Modeling Quantitative Assessment Data," Tsinghua University, Beijing, China, June, 2007
52. L. Bao, "Physics Education Research and Quantitative Assessment," BeiJing Normal University, Beijing, China, June, 2007
53. L. Bao, "Physics Education Research: An Interdisciplinary Field of Research," BeiJing JiaoTong University, Beijing, China, June, 2007
54. L. Bao, "Model Analysis: Representing and Assessing the Dynamics of Student Learning," APS April Meeting, Jacksonville Florida, April 15-17, 2007
55. L. Bao, "Theoretical Analysis of Models and Methods for Quantitative Assessment," AAPT Summer Meeting 2006.
56. L. Bao, "Introduction to Model Analysis," University of Toledo, Oct. 2005.
57. L. Bao, "Physics Education Research at The Ohio State University," Tsinghua University, Beijing China, Aug. 2005.
58. L. Bao, "Research in Physics Education: An Overview," Nanjing University, Nanjing China, Aug. 2005.
59. L. Bao, "Research and Development in Physics Education," China-Japan-US Symposium on Physics Education and Experiment in University, Hangzhou China, Aug. 2005.
60. L. Bao, "Physics Principles in Modeling Education Assessment," AAPT Summer Meeting, 2005
61. L. Bao, N. Reay, and L. Pengfei "Formative Use of In-Class Polling Technology in Physics Lectures," AAPT Summer Meeting, 2005
62. L. Bao, "Theoretical and Experimental Approaches in Physics Education Research," Invited Seminar, University of Washington, May 2005.
63. L. Bao, "Formative Use of In-class Polling Technology in Physics Lectures," Invited Seminar, Rutgers University, April 2005.
64. L. Bao, "Model Analysis: a Framework for Cognitive Representation and Educational Assessment," Physics Colloquium, North Carolina State University, Nov. 2004.
65. L. Bao, "Model Analysis as a Method for Cognitive Representation and Measurement," *AAPT Announcer* 34 (2) 90 (Aug. 2004).
66. L. Bao, "Recent Advancement in Physics Education Research," Symposium on Physics Research and Education, Nanjing, China, Aug. 2004.



67. L. Bao, "Formative Assessment: Theory, Methodology and Applications," Fifth National Competition of Multi-Media and Internet Materials for Physics Education, ShiJiaZhuang, China, Aug. 2004. Keynote Speech.
68. L. Bao, "Internet and Virtual Reality Technology for Teaching Science," Rainbow Education Research Institute, ShuZhou, China, Aug. 2004.
69. L. Bao, "Education Research in US," Department of Education, ShengZheng BaoShang District, China, Aug. 2004.
70. L. Bao, "Computational Modeling of the Learning Process: A neural net simulation of students' learning of charge distribution and polarization," University of Maryland, Oct. 2003.
71. L. Bao, "Virtual Reality in the Teaching and Learning of Physics," China Physics Society (CPS) Autumn Annual Meeting, HeFei, China, Sept. 2003.
72. L. Bao, "Recent Advancement in Physics Education Research: Theories and Experiments," Physics Colloquium, SouthEast University, Nanjing, China, Aug. 2003.
73. L. Bao, "Current Research Issues and Advancement in Physics Education Research," International Conference on Physics Education Research and Reform, JiAn, China, Aug. 2003. Keynote Speech.
74. L. Bao, "Model Analysis and Education Assessment," *AAPT Announcer* 33 (2) 90 (Aug. 2003).
75. L. Bao, "Cognitive Representations: Philosophy and Design of Measurement," *AAPT Announcer* 32 (2) 143 (Aug. 2002).
76. L. Bao, "States and Perturbations of Cognitive Processes in Learning Quantum Mechanics," Gordon Research Conferences, June, 2002, *Physics Research And Education: Quantum Mechanics*.
77. L. Bao, "Quantum Cognition: Are we ready?," AAPT National Conference, January, 2002, *Announcer* 31 (4) 67.
78. L. Bao, "Research on Physics Education," International Conference on Physics Education Research and Reform, Hangzhou, China, April 1997.
79. L. Bao, "Physics of Flash Memory and Applications in Instruction of Quantum Mechanics", University of Maryland, September 2000.
80. L. Bao, "Introduction to Model Analysis," University of Washington, November 1999.
81. L. Bao, "Dynamics of Student Modeling and Assessment Method," Rutgers University, October 1999.
82. L. Bao, "Model Analysis: A Quantitative Approach to Study Student Understandings of Physics," Syracuse University, May 1999.

#### **Contributed Conference Presentations:**

1. Nianle Wu, Tianfangcai, Lei Bao, "Teaching and Learning of Relativity," OCPA 8, Singapore (2014).
2. Kathleen Koenig, Larry Bortner, Carol Fabby, Lei Bao, "Promoting Scientific Reasoning Abilities in the Introductory Physics Lab Course" AAPT Winter Meeting, New Orleans, Louisiana (2013).
3. Lei Bao, Shaona Zhou, Jing Han, Amy Raplinger, and Kathleen Koenig, "Assessment of Student Reasoning in Control of Variables," NARST Annual Meeting, Indianapolis, Indiana (2012).
4. Kathleen Koenig, Lei Bao, Melissa Schen, "Using Specialized Instruction to Develop Scientific Reasoning Abilities in Teacher Candidates," NARST Annual Meeting, Indianapolis, Indiana (2012).
5. Lei Bao & Aaron M. Adair, "Probing the Origins of Students' Naïve Preconceptions: Force and Motion" AAPT 2012 Summer Meeting, Philadelphia, Pennsylvania (2012)
6. Aaron M. Adair & Lei Bao, "Project Based Learning: A Review and an Implementation" AAPT 2012 Summer Meeting, Philadelphia, Pennsylvania (2012)
7. Aaron M. Adair, Jing Han & Lei Bao, "Using a Roller Coaster to Teach Physics: A PBL Implementation" AAPT 2012 Summer Meeting, Philadelphia, Pennsylvania (2012)
8. Carol Fabby, Kathleen Koenig & Lei Bao, "Reforming the Introductory Physics Laboratory to Impact Scientific Reasoning Abilities" AAPT 2012 Summer Meeting, Philadelphia, Pennsylvania (2012)
9. Kathleen Koenig, Carol Fabby, Lei Bao, "Importance of Scientific Reasoning Abilities: Should this Influence Our Teaching?" AAPT Winter Meeting, Ontario, California (2012)
10. Shaona Zhou, Hua Xiao, Jing Han, Yuan Pi, Lei Bao, "Students' Understanding of the Concept of Sampling" AAPT Summer Meeting: Omaha, Nebraska (2011)
11. Li Chen, Jing Han, Liangyu Peng, Yan Tu, Lei Bao, "The impact of sample size in using IRT with FCI," AAPT Summer Meeting: Omaha, Nebraska (2011).
12. Jiawu Fan, Shaona Zhou, Chunhui Du, Jing Han, Lei Bao, "The Impact of Virtual Experiments on Students' Reasoning in Physics" AAPT Summer Meeting: Omaha, Nebraska (2011).
13. Jiawu Fan, Shaona Zhou, Chunhui Du, Jing Han, Lei Bao, "Using virtual experiments to help student reasoning in physics" AAPT Summer Meeting: Omaha, Nebraska (2011)
14. Lei Bao, Jing Han, Kathy Koenig, and Tianfang Cai, "Assessment of Scientific Reasoning: A Case in Probabilistic Reasoning," AAPT Winter Meeting: Jacksonville, FL (2011).
15. Li Chen, Jing Han, Jing Wang, Yan Tu, Lei Bao, "Comparison of Item Response Theory Methods," AAPT Winter Meeting: Jacksonville, FL (2011).
16. Li Chen, Jing Han, Jing Wang, Yan Tu, Lei Bao, "Item Response Theory: A Comparison of Algorithms," AAPT Winter Meeting: Jacksonville, FL (2011).

17. Lei Bao, Jing Han, Guiqing Xu, Yibing Zhang, and Kathleen M. Koenig, "Large Scale Assessment of Scientific Reasoning," AAPT Summer Meeting: Portland, Oregon (2010).
18. Jing Han, Guiqing Xu, Li Chen, Kathleen M. Koenig and Lei Bao, "Developing Assessment Instruments on Scientific Reasoning," AAPT Summer Meeting: Portland, Oregon (2010).
19. Kathleen M. Koenig and Lei Bao, "Developing Scientific Reasoning in Middle School Students", AAPT Summer Meeting: Portland, Oregon (2010).
20. Kathleen M. Koenig, Michael Edwards, Lei Bao, "Motivating First-Year College Students to Continue as a Science Major," AAPT Summer Meeting: Portland, Oregon (2010).
21. Lin Ding, Neville W. Reay, Lei Bao, and Albert H. Lee, "The Role of Conceptual Scaffolding in Students' Solving Synthesis Problems," AAPT Summer Meeting: Portland, Oregon (2010).
22. Nathaniel Caldwell, Jing Han, Lei Bao, "Interactive Tutorial for Developing Scientific Reasoning," AAPT Summer Meeting: Portland, Oregon (2010).
23. Tom Carter, Albert H. Lee, Lin Ding, Neville W. Reay, and Lei Bao, "Clicker Question Exchange for Introductory Physics Classes", AAPT Summer Meeting: Portland, Oregon (2010).
24. Kathy Koenig, Melissa Schen, Sachiko Tosa, and Lei Bao, "The Development of Scientific Reasoning Abilities in Pre-service Teachers," AAPT Winter Meeting: Washington DC (2010)
25. Kathleen M. Koenig, Michael Edwards, Douglas Bradley-Hutchison, and Lei Bao, "Using an Innovative Skills-based Course To Improve First Year Retention," AAPT Winter Meeting: Washington DC (2010)
26. Jing Han, Tianfang Cai, Kathy Koenig, Jing Wang, Lei Bao, "Exploring the Effects of Cultural Backgrounds on Student Attitudes on Learning" AAPT Summer Meeting: Ann Arbor, Michigan (2009)
27. Jing Han, Tianfang Cai, Kathy Koenig,, Jing Wang,, Lei Bao, "Cross Cultural Comparison of Students' Attitudes on Learning" AAPT Summer Meeting: Ann Arbor, Michigan (2009)
28. Jing Wang, Tianfang Cai, Kathy Koenig, Jing Han, Lei Bao, "The Developmental Trend of Scientific Reasoning Skills" AAPT Summer Meeting: Ann Arbor, Michigan (2009)
29. Lin Ding Neville Reay, Albert Lee, Lei Bao, "Why Don't We Bring into Play Diverse Problems?" AAPT Summer Meeting: Ann Arbor, Michigan (2009)
30. Young-Jin Lee, Lei Bao, David E Pritchard, "Modeling How Pre/Post Gain Depends on Prior Knowledge" AAPT Summer Meeting: Ann Arbor, Michigan (2009)
31. Mark Schober, Hugh Ross, Kathleen Koenig, Lei Bao, " Correlation Analysis of High School Students' Coursework and Reasoning" AAPT Summer Meeting: Ann Arbor, Michigan (2009)
32. Xiumei Feng, Tianfang Cai, Ying Luo, Kathy Koenig, Lei Bao, "Item Analysis of Gender Difference on Scientific Reasoning Test" AAPT Summer Meeting: Ann Arbor, Michigan (2009)
33. Albert H. Lee, Lin Ding, Neville W. Reay, Lei Bao, Tom Carter, "Exchange of Clicker Questions for Your Introductory Physics Classes" AAPT Summer Meeting: Ann Arbor, Michigan (2009)
34. Neville W. Reay, Lin Ding, Albert Lee, Lei Bao, "Developing, Validating and Evaluating Clicker Question Sequences" AAPT Summer Meeting: Ann Arbor, Michigan (2009)
35. Lin Ding, Neville Reay, Albert Lee, Lei Bao, "From Conceptual Understanding to Problem Solving" AAPT Summer Meeting: Ann Arbor, Michigan (2009)
36. Tianfang Cai, Jing Wang, Jing Han, Kathy Koenig, Lei Bao, "Development of Standardized Instruments for Assessment of Scientific Reasoning" AAPT Summer Meeting: Ann Arbor, Michigan (2009)
37. Jing Wang, Tianfang Cai, Kathy Koenig, Jing Han, Lei Bao, "Developmental Convergence of Scientific Reasoning Skills" AAPT Summer Meeting: Ann Arbor, Michigan (2009)
38. Xiumei Feng, Ying Luo, Tianfang Cai, Kathy Koenig, Lei Bao, "Comparing Gender Differences in Introductory Physics Between U.S. and China" AAPT Summer Meeting: Ann Arbor, Michigan (2009)
39. Lei Bao, Tianfang Cai, Jing Wang, Jing Han, Kathy Koenig, "Cross Culture Comparison of Assessment Results in Scientific Reasoning," AAPT Winter Meeting 2009.
40. Jing Han, Tianfang Cai, Xiumei Feng, Kathy Koenig, Lei Bao, "Teachers' Views on Science Learning and Reasoning," AAPT Winter Meeting 2009.
41. Jing Han, Tianfang Cai, Jing Wang, Kathy Koenig, Lei Bao, "Survey of Views on Science Learning and Reasoning," AAPT Winter Meeting 2009.
42. Tianfang Cai, Jing Han, Jing Wang, Xiumei Feng, Lei Bao, "Item and Skill Dimension Analysis of Scientific Reasoning Assessment Instruments," AAPT Winter Meeting 2009.
43. Jing Wang, Jing Han, Xiumei Feng, Kathy Koenig, Lei Bao, "Statistical analysis of developmental data of scientific reasoning ability," AAPT Winter Meeting 2009.
44. Jing Wang, Jing Han, Xiumei Feng, Kathy Koenig, Lei Bao, "Validity and reliability of Lawson's classroom test of scientific reasoning," AAPT Winter Meeting 2009.
45. Kathy Koenig, Tianfang Cai, Jing Wang, Jing Han, Lei Bao, "Lawson Classroom Test of Scientific Reasoning Scores and Student Background," AAPT Winter Meeting 2009.
46. Kathy Koenig, Tianfang Cai, Jing Wang, Jing Han, Lei Bao, "Connections between student backgrounds and scientific reasoning scores," AAPT Winter Meeting 2009.

47. Xiumei Feng, Tianfang Cai, Jing Wang, Kathy Koenig, Lei Bao, "A Developmental Scale of Gender Difference in Scientific Reasoning," AAPT Winter Meeting 2009.
48. Tianfang Cai, Xiumei Feng, Jing Han, Kathy Koenig, Lei Bao, "Dimensional Analysis of Gender Difference in Scientific Reasoning," AAPT Winter Meeting 2009.
49. Lei Bao, Tianfang Cai, Jing Wang, Jing Han, and Kathy Koenig, "On the Measurement of Scientific Reasoning Ability: A Developmental Perspective," AAPT Summer Meeting 2008.
50. Lei Bao, Tianfang Cai, Jing Wang, Jing Han, and Kathy Koenig, "Assessing Scientific Reasoning Ability: Analysis of Skill Dimensions," AAPT Summer Meeting 2008.
51. Kathleen M. Koenig, Tianfang Cai, Jing Han, Jing Wang, and Lei Bao, "Assessing Middle School, High School, and College Students' Reasoning Ability," AAPT Summer Meeting 2008.
52. Kathleen M. Koenig, Tianfang Cai, Jing Han, Jing Wang, and Lei Bao, "Student Scientific Reasoning Ability and Academic Performance," AAPT Summer Meeting 2008.
53. Albert H. Lee, Lin Ding, Neville W. Reay, and Lei Bao, "Do Experts See What Students See in Clicker Sequences? Validation I," AAPT Summer Meeting 2008.
54. Lin Ding, Albert H. Lee, Neville W. Reay, and Lei Bao, "Content, Context and Representation in Clicker Sequences: Validation II," AAPT Summer Meeting 2008.
55. Lin Ding, Albert H. Lee, Neville W. Reay, and Lei Bao, "Students' Perceptions and Interpretations of Clicker Questions," AAPT Summer Meeting 2008.
56. Neville W. Reay, Lin Ding, Albert H. Lee, and Lei Bao, "The Effects of Testing Conditions on Pre-Post Test Results," AAPT Summer Meeting 2008.
57. Neville W. Reay, Lin Ding, Albert Lee, and Lei Bao, "Studying the Impact of Testing Conditions on Conceptual Survey Results," AAPT Summer Meeting 2008.
58. Lei Bao, Jing Wang, "Flipping the mind: switch effect as a tool for measurement," AAPT Summer Meeting 2007.
59. David Pritchard, Young-Jin Lee, Lei Bao, "How Prior Knowledge Affects Learning: Common Learning Theories Lead to Different Learning Models," AAPT Summer Meeting 2007.
60. Stephen Stonebraker, Lei Bao, "Studying Fine Structures of Mixed Mental Model States," AAPT Summer Meeting 2007.
61. Jing Wang, Lei Bao, "An item response analysis of existing concept surveys," AAPT Summer Meeting 2007.
62. Albert Lee, Lei Bao, Pengfei Li, Neville Reay, Jing Wang, "Gender Differences in Using Voting Machine in Introductory Physics Courses," AAPT Summer Meeting 2007.
63. Dedra Demaree, Gordon Aubrecht, Lei Bao, "Does feedback improve scientific writing quality independent of grade motivation?" AAPT Summer Meeting 2007.
64. Neville Reay, Lei Bao, Albert Lee, Pengfei Li, "A new clicker methodology for Introductory Physics Lectures," AAPT Summer Meeting 2007.
65. Pengfei Li, Neville Reay, Albert Lee, Lei Bao, "Designs and evaluations of two types of clicker question sequences," AAPT Summer Meeting 2007.
66. Lili Cui, Eric Anderson, Lei Bao, "Using Online Forum to Foster Interaction Outside Classroom," AAPT Summer Meeting 2007.
67. Kai Fang, Tianfang Cai, Jing Wang, Lili Cui, Lei Bao, "Cross culture comparison of results from physics concept tests," AAPT Summer Meeting 2007.
68. Stephen Stonebraker, Jing Wang, Lili Cui, Lei Bao, "Observations of implicit and explicit mixed mental model states," AAPT Summer Meeting 2007.
69. Neville Reay, Lei Bao, Albert Lee, Pengfei Li, "A new clicker methodology for Introductory Physics Lectures," AAPT Summer Meeting 2007.
70. Jing Wang, Lei Bao, "Switch effect: underlying mechanism and inferences," AAPT Summer Meeting 2007.
71. Jing Wang, Lei Bao, "Application of item response theory in physics education research," AAPT Summer Meeting 2007.
72. Lei Bao, Jing Wang, Jake Mayer, Albert Lee, Neville Reay, "Cross comparison of VM questions, conceptual surveys and common exams," AAPT Summer Meeting 2007.
73. Albert Lee, Lei Bao, Pengfei Li, Neville Reay, Jing Wang, "Testing Voting Machine in Algebra-based Introductory E&M Course," AAPT Summer Meeting 2007.
74. Lei Bao, Jing Wang, "A Switch Effect in Concept Test Questions," AAPT Summer Meeting 2006.
75. Jing Wang, Lei Bao, "Conceptual Priming in Multiple Choice Questions," AAPT Summer Meeting 2006.
76. Stephen Stonebraker, Lei Bao, "Toward a Model of Inconsistencies in Student Responses," AAPT Summer Meeting 2006.
77. Dedra Demaree, Lei Bao, Scott Franklin, Gordon Aubrecht, Wenhui Zhao, "Using a Tracking Tool to Analyze Student Writing and Revising," AAPT Summer Meeting 2006.
78. Pengfei Li, Neville Reay, Lei Bao, "Assessment of Using the Clickers," AAPT Summer Meeting 2006.
79. Rebecca Lindell, Lei Bao, Andrew Heckler, "A Mixed-Method Approach to Discovering Conceptual Learning Hierarchies," AAPT Summer Meeting 2006.
80. Neville Reay, Lei Bao, Pengfei Li, "Toward an Effective Use of Clickers in Lectures," AAPT Summer Meeting 2006.
81. Lei Bao, Jing Wang, "Switch Effect in Concept Test: Designs and Applications," AAPT Summer Meeting 2006.
82. Jing Wang, Lei Bao, "Transfer or Not: Depends on the Question," AAPT Summer Meeting 2006.

83. Neville Reay, Lei Bao, Pengfei Li, "Using Clickers in Classes with Different Instructional Methodologies," AAPT Summer Meeting 2006.
84. Stephen Stonebraker, Lei Bao, "Case Studies of Inconsistencies in Student Problem Solving," AAPT Summer Meeting 2006.
85. Lei Bao, Andrew Heckler, Rebecca Lindell, "Data Modeling of Results from the Lunar Phase Concept Inventory," AAPT Summer Meeting 2006.
86. Pengfei Li, Neville Reay, Lei Bao, "Assessment of In-class Polling System in Lectures," AAPT Summer Meeting 2006.
87. Dedra Demaree, Gordon Aubrecht, Lei Bao, Scott Franklin, Lisa Hermsen, "Towards a Quantitative Analysis of Writing and Revision Structure," AAPT Summer Meeting 2006.
88. Dedra Demaree, Lei Bao, Wenhui Zhao, Gordon Aubrecht, Scott Franklin, "A New Tool for Tracking Student Writing and Revision," AAPT Summer Meeting 2006.
89. Yeounsoo Kim, Lei Bao, Investigating the Relationship Between Epistemological Beliefs and Cognitive Conflicts, AAPT Winter Meeting 2006.
90. Pengfei Li, Neville Reay, Assessment of Using an In-Class Polling System in Lectures, AAPT Winter Meeting 2006.
91. Jing Wang and Lei Bao, Using Question Sequences To Probe Ontology Shift, AAPT Winter Meeting 2006.
92. Pengfei Li, Neville Reay, Lei Bao Assessment of Using the Clickers, AAPT Winter Meeting 2006.
93. Lei Bao, Pengfei Li, Neville Reay, "Formative Use of In-Class Polling Technology in Physics Lectures," AAPT Summer Meeting 2005
94. Homeyra Sadaghiani and Lei Bao, "Mathematical Tools Needed To Understand Quantum Mechanics Concepts," AAPT Summer Meeting 2005
95. Pengfei Li, Lei Bao, Neville Reay, Jing Wang, "New-Information Problem," AAPT Summer Meeting 2005.
96. Lei Bao, "Physics Principles in Modeling Education Assessment," AAPT Winter Meeting 2005.
97. Stephen Stonebraker, Jing Wang, Lei Bao, "Can Voting Machines Bring the Back of the Room Forward?" AAPT Summer Meeting 2005.
98. Pengfei Li, Lei Bao, Neville Reay, "Formative Use of the electronic Voting System," AAPT Summer Meeting 2005.
99. Yeounsoo Kim, Lei Bao, "Using the iCARE for Monitoring Cognitive Conflicts and Anxiety," AAPT Summer Meeting 2005.
100. Yeounsoo Kim, Lei Bao, "Students' Cognitive Conflicts and Conceptual Change in PBI Classes," AAPT Summer Meeting 2005.
101. Yeounsoo Kim, Lei Bao, "Investigating the Relationship Between Prior Knowledge and Cognitive Conflict," AAPT Summer Meeting 2005.
102. Homeyra Sadaghiani, Lei Bao, "Students' Understanding of Symmetry in Mathematics and Quantum Mechanics," AAPT Summer Meeting 2005.
103. Homeyra Sadaghiani, Lei Bao, "A Three-Year Investigation on Teaching and Learning Quantum Mechanics," AAPT Summer Meeting 2005.
104. Dedra Demaree, Lei Bao, "Student Difficulties with Wave Representations and their Applications," AAPT Summer Meeting 2005.
105. Dedra Demaree, Stephen Stonebraker, Wenhui Zhao, Lei Bao, "Outside the Box: An Unexpected Application for Virtual Reality Simulations," AAPT Summer Meeting 2005.
106. Pengfei Li, Lei Bao, Neville Reay, Jing Wang, "Statistical Analysis of Students' Voting Data in an E&M Course," AAPT Summer Meeting 2005.
107. Stephen Stonebraker, Jing Wang, Lei Bao, "Influences of Seating Position and Voting Machines on Course Performance," AAPT Summer Meeting 2005
108. Stephen Stonebraker, Dedra Demaree, Lei Bao, "Comparing Simulation-Based and Equipment-Based Lab Activities," AAPT Summer Meeting 2005.
109. Lei Bao, Florin Bocaneala, Jing Wang, "Computational Cognitive Analysis of Student Learning in Electric Charge Distribution," AAPT Summer Meeting 2005.
110. Lei Bao, Florin Bocaneala and Jing Wang "Measurement and Modeling of Student Group Learning Behaviors," AAPT Winter Meeting 2005. Stephen Stonebraker and Lei Bao, "The Choosing Function: Modeling How Students Pick Homework Problems," AAPT Winter Meeting 2005.
111. Yeounsoo Kim and Lei Bao, "Using the ICAE for Facilitating Conceptual Change in PBI Classes," AAPT Winter Meeting 2005.
112. Yeounsoo Kim and Lei Bao, "Applying Strategies for Helping Students Manage Conflicts in PBI Classes," AAPT Winter Meeting 2005.
113. Dedra N. Demaree and Lei Bao, "Students' Understanding and Use of Simple Graphical Representations for Waves," AAPT Winter Meeting 2005.
114. Dedra N. Demaree and Lei Bao, "Using ISLE Laboratories to Enhance a Traditional Lecture-Based Course Meeting," AAPT Winter Meeting 2005.
115. Homeyra Sadaghiani and Lei Bao, "Understanding of Phase and Phase Difference in a Variety of Contexts," AAPT Winter Meeting 2005.

116. Homeyra Sadaghiani and Lei Bao, "Tutorials on Quantum Probability and Wave Function in Different Potential Wells," AAPT Winter Meeting 2005.
117. Yeounsoo Kim and Lei Bao, "Developing Strategies for Helping Students Manage Conflicts in PBI Classes," AAPT Winter Meeting 2005.
118. Dedra N. Demaree and Lei Bao, "Using ISLE Laboratories to Enhance a Traditional Lecture-Based Course," AAPT Winter Meeting 2005.
119. Gyoungho Lee Jongho Shin, Jiyeon Park, Yeounsoo Kim, and Lei Bao, "Mental Models for Physics Education Research: Structure, Process, & Time," AAPT Winter Meeting 2005.
120. Homeyra Sadaghiani and Lei Bao, "Addressing Student Difficulties in Understanding Phase and Phase Difference," AAPT Winter Meeting 2005.
121. Stephen Stonebraker and Lei Bao, "Student Decision-Making About Homework in an Increased-Freedom Environment," AAPT Winter Meeting 2005.
122. Jing Wang, Pengfei Li, Homeyra Sadaghiani, Neville W Reay, and Lei Bao, "Developing Voting Machine Questions for Introductory Physics Courses," AAPT Winter Meeting 2005.
123. Lei Bao, and Florin Bocaneala, "Efforts in Experimental and Computational Modeling of the Learning Environment," AAPT Announcer, Vol. 34, No. 2, pp. 91, (Aug. 2004).
124. Lei Bao, Yeounsoo Kim and Florin Bocaneala, "The Development of an Instrument to Monitor Student Affective Status," AAPT Announcer, Vol. 34, No. 2, pp. 132, (Aug. 2004).
125. Neville Reay, Pengfei Li, and Lei Bao, "Use of Voting Machine in a Freshman Physics Course," AAPT Announcer, Vol. 34, No. 2, pp. 124, (Aug. 2004).
126. Neville Reay, Pengfei Li, and Lei Bao, "Use of Voting Machine to Teach Freshman Physics," AAPT Announcer, Vol. 34, No. 2, pp. 133, (Aug. 2004).
127. Pengfei Li, Neville Reay, and Lei Bao, "Model-Based Analysis of In-Class Polling Data," AAPT Announcer, Vol. 34, No. 2, pp. 124, (Aug. 2004).
128. Pengfei Li, Neville Reay, and Lei Bao, "Effects of In-Class Polling on Student Performance in Learning Physics," AAPT Announcer, Vol. 34, No. 2, pp. 133, (Aug. 2004).
129. Yeounsoo Kim and Lei Bao, "Developing Instruments for Evaluating Anxiety Caused by Cognitive Conflict," AAPT Announcer, Vol. 34, No. 2, pp. 126, (Aug. 2004).
130. Yeounsoo Kim and Lei Bao, "Student Anxiety Types in Cognitive Conflict Situations and Conceptual change," AAPT Announcer, Vol. 34, No. 2, pp. 133, (Aug. 2004).
131. Yeounsoo Kim, Yongheon Cho, Sangwoo Shin, Jaesool Kwon and Lei Bao, "Anxiety Types in Cognitive Conflict at Action and Reaction Task," AAPT Announcer, Vol. 34, No. 2, pp. 132, (Aug. 2004).
132. Yeounsoo Kim, Gyoungho Lee, Jiyeon Park and Lei Bao, "Students' Mental Models and Beliefs about Circular Motion," AAPT Announcer, Vol. 34, No. 2, pp. 132, (Aug. 2004).
133. Homeyra R. Sadaghiani and Lei Bao, "Student Learning of Quantum Mechanics," AAPT Announcer 34 (2) P 172 (Aug. 2004).
134. Homeyra R. Sadaghiani and Lei Bao, "Student Understanding of Fourier Analysis," AAPT Announcer 34 (2) P 133 (Aug. 2004).
135. Homeyra R. Sadaghiani and Lei Bao, "Student Understanding of Probability-Wave Distribution and Measurement Uncertainty," AAPT Announcer 34 (2) P 133 (Aug. 2004).
136. Homeyra R. Sadaghiani and Lei Bao, "Enhancing Engagement in High School Physics Classes Using Virtual Reality," AAPT Announcer 34 (2) P 97 (Aug. 2004).
137. Dedra Demaree, Stephen Stonebraker and Lei Bao, "Virtual Reality Experiments in Introductory Physics Laboratories," AAPT Announcer, Vol. 34, N. 2, pp. 136, (Aug. 2004).
138. Dedra Demaree, Stephen Stonebraker and Lei Bao, "Virtual Reality Experiments in Introductory Physics Laboratories," PERC Program, pp. 24, (Aug. 2004).
139. Dedra Demaree and Lei Bao, "Assessing Student Understanding of Wave Amplitude and Intensity," PERC Program, pp. 21, (Aug. 2004).
140. Dedra Demaree, Stephen Stonebraker, Wenhui Zhao and Lei Bao, "An Example of Virtual Reality Experiments in Introductory Physics Laboratories," AAPT Announcer, Vol. 24, N. 2, pp. 131, (Aug. 2004).
141. Dedra Demaree and Lei Bao, "Student Attitudes Towards Laboratory Quizzes," AAPT Announcer, Vol. 24, N. 2, pp. 131, (Aug. 2004).
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### Workshops:

1. L. Bao, "Science Inquiry and the 21<sup>st</sup> Century Education," Beijing Jiaotong University, Beijing, China, June, 2013.
2. L. Bao, "Developing Effective Scientific Reasoning and Problem Solving Skills," Strengthening Teaching and Learning in the STEM Fields, LASPAU, Harvard University, June, 2012.



3. L. Bao, "Interactive Classroom Environment and Inquiry Based Learning," 2010 International Physics and Science Education Research Forum, the Annual Meeting of Chinese Society of Education, Physics Education Committee, August, 2010.
4. L. Bao, "Research in Physics Education: Theory and Methodology," 4-day workshop presented at the Science Education Institute of GuangXi Normal University, Guilin, China, July, 2007.
5. Lei Bao and Neville Reay, "Model Analysis: Theoretical Basis and Methodology for Developing Effective Assessment," AAPT-PERC Summer Meeting, 2005.
6. Lei Bao, "Using Voting Machine Systems as a Tool for In-class Formative Assessment," SouthEast University, Nanjing, China, Aug. 2004.
7. Lei Bao and Edward F. Redish, "Model Analysis: Theoretical Basis and Methodology for Developing Effective Assessment," *AAPT Announcer* 33 (2) 60 (Aug. 2003).
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9. "Visual Quantum Mechanics and Quantum Tutorials", AAPT Workshop, July 2000.
10. "Physics Education Research and Instruction in Modern Physics / Quantum Mechanics", CSAAPT Workshop, UMBC, May 1998.
11. "Tutorials on Teaching Waves in Introductory Physics", CSAAPT Workshop, UVA, Nov. 1998.
12. "Tutorials in Teaching Introductory Physics," Workshops at Dickinson College for the Summer Seminar on Teaching Introductory Physics Using Interactive Methods and Computers, June 1995, June 1996 and June 1997.