Chia-Ling Chien

Jacob L. Hain Professor of Physics
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Education:

1965	B.S.	Tunghai University, Taiwan (Physics)
1968	M.S.	Carnegie-Mellon University (Physics)
1972	Ph.D.	Carnegie-Mellon University (Physics) Thesis Advisor**:** Sergio DeBenedetti (deceased)

Experience:

1973-74	Research Associate, The Johns Hopkins University
1974-75	Associate Research Scientist, The Johns Hopkins University
1975-76	Visiting Assistant Professor of Physics, The Johns Hopkins University
1976-79	Assistant Professor of Physics, The Johns Hopkins University
1979-83	Associate Professor of Physics, The Johns Hopkins University
1983-present	Professor of Physics, The Johns Hopkins University
2007-present	Professor of Materials Science and Engineering

1980	IBM Yorktown Heights Research Center, Summer faculty position
1980-81	Member, International Advisory Committee, International Conference on Amorphous Systems Investigated by Nuclear Methods
1985-2011	Advisory Committee of Conference on Magnetism and Magnetic Materials
1986	Local Chairman, 31st Magnetism and Magnetic Materials Conference
1987	Co-organizer, Focused Session on Granular Materials, 1987 APS March Meeting
1989	Member, International Advisory Committee, International Conference On the Applications of the Mössbauer Effect, Budapest, Hungary
1991	Member, International Advisory Committee, International Conference On the Applications of the Mössbauer Effect, China
1991-95	Member, International Advisory Board of the *Journal of Materials, Chemistry and Physics*
1995	Program Co-Chairman, 40th Conference on Magnetism and Magnetic Materials
1996-2003	Advisory Committee, Hong Kong University of Science and Technology
1996-2002	Associate Editor, *"Methods in Materials Research : A Current Protocols Publication"* (Wiley)
1997-present	Director, Materials Research Science and Engineering Center (MRSEC) at Johns Hopkins University
1998	Co-organizer, Focused Session on magnetic nanostructures, 1998 APS Meeting
2002	General Chairman, Conference on Magnetism and Magnetic Materials (2002).
2002-present	Member, Advisory Committee, Institute of Physics, Academia Sinica, Taiwan.
2003	Chair, Advisory Committee, Conference on Magnetism and Magnetic Materials
2007	Member, Department of Physics and Astronomy Academic Performance Evaluation Committee, National Tsinghua University, Hsinchu Taiwan
2010-	Associate Editor, *"Methods in Materials Research: A Current Protocols Publication"* (Wiley)

2011(1-8) Distinguished Visiting Research Fellow, Institute of Physics, Academia Sinica
2011(1-8) Visiting Professor, Center for Condensed Matter Sciences, National Taiwan Univ.

Honors and Distinction:

Jacob L. Hain Professor of Physics
1989 Fellow (American Physical Society)
1996- Honorary Professor, Nanjing University, Nanjing, China
1996- Honorary Professor, Lanzhou University, Lanzhou, China
1998- Advisory Professor, Fudan University, Shanghai, China
2004 David Adler Award of American Physical Society
2005 IEEE Magnetics Society Distinguished Lecturer
2006- Honorary Chair Professor, National Tsinghua University, Taiwan
2007 Tunghai University Distinguished Alumnus Award
2010 Fellow of the American Association for the Advancement of Sciences (AAAS)
2012 First recipient of AUMS (Asian Union of Magnetics Societies) Award

Professional Activities:

Fellow: American Physical Society
Member: IEEE Magnetics Society
Member: Materials Research Society
Fellow: American Association for the Advancement of Science

Patents:

1. C. L. Chien, G. Xiao, and S. H. Liou, "Metal-Insulator Composites having Improved Properties and Method for Their Preparation," U.S. Patent No. 4,973,525 (Nov. 27, 1990).
2. C. L. Chien, P. C. Searson, and K. Liu. "Arrays of Semi-metallic Bi Nanowires and Fabrication Techniques Therefor," U.S. Patent No. 6,187,165 (February 13, 2001).
3. F. Y. Yang, K. Liu, C. L. Chien and P. C. Searson, "Bismuth Thin Films structure and Method of Construction," U. S. Patent No. 6,358,392 (March 19, 2002).
4. T. P. Weihs, R. C. Cammarata, C. L. Chien, and C. H. Shang, "High Performance Nanostructured Materials and Methods of Making the Same," US patent 6,596,101 (July 22, 2003)
5. F. Q. Zhu and C. L. Chien, "Ferromagnetic Nanorings, Mediums Embodying Same Including Devices and Methods Related Thereto," US patent 7,983,074 (July 19, 2011).

Pending Patents: 3

Publications: Over 390 papers and book chapters.
Invited Talks, Colloquia, and Seminars: Over 250.
Total Citations: 15,000+
Hirsch Citation Index: 61

1 publication with 1200+ citations
2 publications with 750+ citations

33 publications with 100+ citations

Graduate Students Supervised

J. H. Hsu (Professor, National Taiwan University)
K. M. Unruh (Professor, University of Delaware)
S. H. Liou (Professor, University of Nebraska)
G. Xiao (Professor, Brown University)
J. R. Childress (Hitachi Global Storage Technologies)
A. Gavrin (Associate Professor and Associate Dean, Indiana University at Indianapolis)
J. Q. Xiao (Professor, University of Delaware)
J. S. Jiang (Principal Physicist, Argonne National Lab)
T. Ambrose (Seagate Research Lab)
N. J. Gökemijer (Seagate Research Lab)
K. Liu (Professor, UC Davis)
F. Y. Yang (Associate Professor, Ohio State University)
Y. Ji (Assistant Professor, University of Delaware)
X. M. Cheng (Assistant Professor, Bryn Mawr College)
J. Valentine (US Patent and Trademark Office)
T. Y. Chen (Assistant Professor, Arizona State University)
F. Q. Zhu (Hitachi Global Storage Technologies)
D. L. Fan (Assistant Professor, University of Texas at Austin)

Post-Doctoral Advisees

G. Xiao (Professor, Brown University)
J. Q. Xiao (Professor, University of Delaware)
T. H. Kim (Associate Professor, Ewha University, Korea)
J. W. Cai (Professor, Physics Institute, China)
G. J. Strijkers (Associate Professor, Eindhoven Institute of Technology)
F. Y. Yang (Associate Professor, Ohio State University)
L. Sun (Associate Professor, University of Houston)
S. Urazhdin (Assistant Professor, Emory University)
W. L. Lee (Assistant Research Fellow, Institute Of Physics, Academia Sinica, Taiwan)
F. Q. Zhu (Hitachi Global Storage Technologies)
D. L. Fan (Assistant Professor, University of Texas at Austin)
T. Y. Chen (Assistant Professor, Arizona State University)
W. G. Wang (Assistant Professor, University of Arizona)

Recent Research Areas and Representative Publications (since 1992)

Giant Magnetoresistance in Granular Systems: After the discovery of giant magnetoresistance (GMR) by Fert and Grünberg (2007 Nobel Prize in Physics) in 1988, we have discovered GMR in granular systems in 1992 demonstrating that GMR is a general phenomena in magnetic nanostructures with a non-aligned spin structure for mediating spin-dependent scattering.

173. John Q. Xiao, J. Samuel Jiang, and C. L. Chien, "Giant Magnetoresistance in Non-Multilayer Magnetic Systems," *Phys. Rev. Lett.* ***68**, 3749 (1992).*
181. John Q. Xiao, J. Samuel Jiang, and C. L. Chien, "Giant Magnetoresistance in Granular Co-Ag System," *Phys. Rev.* ***B46**, 9266 (1992).*
185. P. Xiong, G. Xiao, J. Q. Wang, J. Q. Xiao, J. S. Jiang, and C. L. Chien, "Extraordinary Hall Effect and Giant Magnetoresistance in Granular Co-Ag System," *Phys. Rev. Lett.* ***69**, 3220 (1992).*
187. J. Samuel Jiang, John Q. Xiao, and C. L. Chien, "Magnetic Properties and Giant Magnetoresistance of Granular Permalloy in Silver," *Appl. Phys. Lett.* ***61**, 2362 (1992).*
194. L. Piraux, M. Cassart, J. Samuel Jiang, John Q. Xiao, and C. L. Chien, "Magneto-thermal Transport Properties of Granular Co-Ag," *Phys. Rev. (Rapid Commun.)* ***B48**, 638 (1993).*
209. C. L. Chien, "Magnetism and Giant Magneto-Transport Properties in Granular Solids," *Annual Review of Materials Science*, ***25**, 129 (1995).*

Arrays of Magnetic Nanowires: In 1993, they have pioneered arrays of magnetic nanowires fabricated by electrodeposition through nanopore templates [*Science*, *261, 1316 (1993)*]. These nanowires may be single-material or multi-segmented [*Phys. Rev. (Rapid Commun.) B* ***51**, 7381 (1995)*]. The magnetic nanowires exhibit unique magnetic properties dictated by the high aspect ratio and the small diameter in tens of nanometer. They exhibit a wide variety of conducting[*Phys. Rev. B* ***58** (Rapid Communications), 14681 (1998).*], magnetic properties [*Appl. Phys. Lett.* ***74**, 2803 (1999), Phys. Rev. B* ***61** (Rapid Commun). R6463 (2000), Appl. Phys. Lett.* ***79**, 4429 (2001), IBM J. Res. and Develp.,* ***49**, 79 (2005), Phys. Rev. B (Rap. Comm.)* ***71**, 012417 (2005).*]

196. T. M. Whitney, J. S. Jiang, P. C. Searson, and C. L. Chien, "Fabrication and Magnetic Properties of Arrays of Metallic Nanowires," *Science*, ***261**, 1316 (1993).*
210. K. Liu, K. Nagodawithana, P. C. Searson, and C. L. Chien, "Perpendicular Giant Magnetoresistance of Multilayered Co/Cu Nanowires," *Phys. Rev. (Rapid Commun.)* ***B51**, 7381 (1995).*
250. Kai Liu, C. L. Chien, and P. C. Searson, "Finite-Size Effects in Bismuth Nanowires," *Phys. Rev. B* ***58** (Rapid Communications), 14681 (1998).*
258. L. Sun, P. C. Searson, and C. L. Chien, "Electrochemical Deposition of Nickel Nanowire Arrays in Single Crystal Mica Films," *Appl. Phys. Lett.* ***74**, 2803 (1999).*
265. L. Sun, C. L. Chien and P. C. Searson, "Fabrication of Nanoporous Single Crystal Mica Templates for Electrochemical Deposition of Nanowire Arrays," J. *Materials Science,* ***35**, 1097-1103 (2000).*
267. L. Sun, P. C. Searson and C. L. Chien, "Finite-Size Effects in Nickel Nanowire Arrays," *Phys. Rev. B* ***61** (Rapid Commun). R6463 (2000).*
289. L. Sun, C. L. Chien, and P. C. Searson, "Magnetic Anisotropy in Prismatic Ni Nanowires," *Appl. Phys. Lett.* ***79**, 4429 (2001).*
334. L. Sun, Y. Hao, C. L. Chien. And P. C. Searson, "Tuning the properties of magnetic nanowires," *IBM J. Res. and Develp.,* ***49**, 79 (2005).*
335. L. Sun, P. C. Searson, and C. L. Chien, "Asymmetry of magnetic hysteresis in exchange-biased multilayers with out-of-plane applied field," *Phys. Rev. B (Rap. Comm.)* ***71**, 012417 (2005).*

Proximity Effects in Superconductor/Ferromagnet Multilayers: We have revealed the intriguing interactions occurring in the proximity of a superconductor and a ferromagnet [*Phys.*

Rev. Lett. ***76**, 1727 (1996)*], π-phase coupling [*Phys. Rev. Lett.* ***74**, 314 (1995)*], and interlayer coupling across a superconducting layer.

206. J. S. Jiang, D. Davidovic, D. H. Reich and C. L. Chien, "Oscillatory Superconducting Transition Temperature in Nb/Gd Multilayers," *Phys. Rev. Lett.* ***74**, 314 (1995).*
217. J. Q. Xiao and C. L. Chien, "Proximity Effects of Superconductor/Magnetic Semiconductor NbN/GdN Multilayers," *Phys. Rev. Lett.* ***76**, 1727 (1996).*
227. J. S. Jiang, D. Davidovic, D. H. Reich and C. L. Chien, "Superconducting Transition in Nb/Gd/Nb Trilayers," *Phys. Rev.* ***B 54**, 6119 (1996).*
260. C. L. Chien and D. H. Reich, "Proximity Effects in Superconducting/Magnetic Multilayers," *J. Mag. Mag. Mat.* ***200**, 83-94 (1999).*

Physics of Exchange Bias: Exchange bias occurring across the interface between a ferromagnet and an antiferromagnet is an intriguing phenomenon of scientific and technological importance. We have uncovered some of the rich physics of exchange bias, including the finite size effect in thin antiferromagnet [*Phys. Rev. Lett.* ***76**, 1743 (1996)*], exchange bias in the paramagnetic state [*Phys. Rev. Lett.* ***81**, 2795 (1998*], exchange across a spacer layer [*Phys. Rev. Lett.* ***79**, 4270 (1997)*], memory effect [*Phys. Rev. B* ***60**, 3033 (1999)*], spiraling spin structure [*Phys. Rev. Lett.,* ***85**, 2597 (2000)*], and oscillatory exchange bias [*Phys. Rev. Lett. 90, 147201 (2003)*], and antiferromagnet spin rotation [*Phys. Rev. B* ***71**, 220410 (Rapid Commun.) (2005)*], and the existence of exchange spring [*Phys. Rev. B* ***73**, 184428 (2006).*].

219. T. Ambrose and C. L. Chien, "Finite-Size Effects and Uncompensated Magnetization in Thin Antiferromagnetic CoO Layers," *Phys. Rev. Lett.* ***76**, 1743 (1996).*
235. N. J. Gokemeijer, T. Ambrose, and C. L. Chien, "Long-Range Exchange Bias Across a Spacer Layer," *Phys. Rev. Lett.* ***79**, 4270 (1997).*
248. *X. W. Wu* and C. L. Chien, "Exchange Coupling in Ferromagnet/Antiferromagnet Bilayers with Comparable T_C and T_N," *Phys. Rev. Lett.* ***81**, 2795 (1998).*
249. S. M. Zhou, Kai Liu, and C. L. Chien, "Exchange Coupling and Macroscopic Domain Structure in a Wedged Permalloy/FeMn Bilayer," *Phys. Rev. B* ***58** (Rapid Communications) 14717 (1998).*
263. N. J. Gökemeijer, J. W. Cai, and C. L. Chien ,"Memory Effects of Exchange Coupling in Ferromagnet/Antiferromagnet Bilayers," *Phys. Rev. B* ***60**, 3033 (1999).*
264. V. I. Nikitenko, V. S. Gornakov, A. J. Shapiro, R. D. Shull, Kai Liu, S. M. Zhou, and C. L. Chien, "Asymmetry in the Elementary Events of Magnetization Reversal in Ferromagnetic/Antiferromagnetic Bilayers," *Phys. Rev. Lett.* ***84**, 765 (2000).*
274. F. Y. Yang and C. L. Chien, "Spiraling Spin Structure in an Exchange-Coupled Antiferromagnetic Layer," *Phys. Rev. Lett.,* ***85**, 2597 (2000).*
280. N. J. Gokemeijer, R. L. Penn, D. R. Veblen, and C. L. Chien, ":Exchange Coupling in Epitaxial CoO/NiFe Bilayers with Compensated and uncompensated Interfacial Spin Structures," *Phys. Rev. B* ***63**, 174422 (2001).*
313. F. Y. Yang and C. L. Chien, "Oscillatory Exchange Bias due to an Antiferromagnet with Incommensurate Spin Density wave," *Phys. Rev. Lett.* ***90**, 147201 (2003).*
340. S. Urazhdin and C. L. Chien, "Effects of anriferromagnetic spin rotation on the anisotropy of ferromagnetic/antiferromagnetic bilayers," *Phys. Rev. B* ***71**, 220410 (Rapid Commun.) (2005).*
354. V. S. Gornakov, Yu. P. Kabanov, O. A. Tikhomirov, V. I. Nikitenko, S. V. Urazhdin, F. Y. Yang, C. L. Chien, A. J. Shapiro, and R. D. Shull, "Experimental study of the microscopic mechanisms of magnetization reversal in FeNi/FeMn exchange-biased ferromagnet/antiferromagnet polycrystalline bilayers using the magneto-optical indicator film technique," *Phys. Rev. B* ***73**, 184428 (2006).*

Andreev Reflection Spectroscopy and Half-metals: Chien's group has been instrumental in establishing quantitative Andreef reflection spectroscopy (ARS) [*Phys. Rev. B* ***63****, 104510 (2001), Phys. Rev. B* ***81****, 214444 (2010).*], which is a ballistic transport phenomenon occurring at the interface between a metal and a superconductor. ARS can quantitatively measure the spin polarization of a metal as well as the superconducting gap of a superconductor. Since materials with high spin polarization (P) are essential for all spintronics devices, high P materials, especially half metals with P = 100%, are highly sort after and extensively searched. Chien's group has reported the P values of many highly spin-polarized materials including CrO_2, the first true half-metal a measured P of more than 99% [*Phys. Rev. Lett.* ***86****, 5585 (2001).*] as well as several others with exceptionally high spin polarization including $La_{0.7}Sr_{0.3}MnO_3$ and $La_{0.6}Sr_{0.4}MnO_3$ [*Phys. Rev. B* ***66,*** *12410 (2002)*], Co_2MnSi and NiMnSb [*Phys. Rev. B* ***68****, 104430 (2003)*], and $Co_{1-x}Fe_xS_2$ [*Phys. Rev. Lett.,* ***94****, 056602 (2005)*].

281. Y. Ji, G. J. Strijkers, F. Y. Yang, C. L. Chien, J. M. Byers, A. Anguelouch, G. Xiao, and A. Gupta, "Determination of the Spin Polarization of Half-Metallic CrO_2 by point Contact Andreev Reflection," *Phys. Rev. Lett.* ***86****, 5585 (2001).*
301. Y. Ji, C. L. Chien, Y. Tomioka and *Y.* Tokura, "Measurement of Spin Polarization of Single Crystals of $La_{0.7}Sr_{0.3}MnO_3$ and $La_{0.6}Sr_{0.4}MnO_3$" *Phys. Rev. B* ***66,*** *12410 (2002).*
305. Lance Ritchie, Gang Xiao, Y. Ji, T. Chen, C. L. Chien, M. Zhang, J. Chen, Z. Liu, G. Wu, and X. X. Zhang, "Magnetic, structural, and transport properties of Heusler alloys Co_2MnSi and NiMnSb," *Phys. Rev. B* ***68****, 104430 (2003).*
318. J. M. D. Coey and C. L. Chien, "Half-Metallic Ferromagnetic Oxides," in *Spin-Polarized Materials for Spintronics* in *MRS Bulletin* ***28*** *(no.10), 720 (October 2003).*
339. L. Wang, K. Umemoto, R. M. Wentzcovitch, T. Y. Chen, C. L. Chien, J. G. Checkelsky, J. C. Eckert, E. D. Dahlberg, and C. Leighton, "$Co_{1-x}Fe_xS_2$: a tunable source of highly spin polarized electrons," *Phys. Rev. Lett.,* ***94****, 056602 (2005).*
384. T. Y. Chen, S. X. Huang, and C. L. Chien, "Pronounced effects of additional resistance in Andreev reflection spectroscopy," *Phys. Rev. B* ***81****, 214444 (2010).*
400. T. Y. Chen, Z. Tesanovic, and C. L. Chien, "Unified formalism of Andreev reflection at a ferromagnet/superconductor interface," *Phys. Rev. Lett.* ***109****, 146602 (2012).*

Magneto-Transport Properties of Single-Crystal Bi Thin Films: Bi is a semimetal with unusual Fermi surfaces and electrons and holes of low effective mass and carrier density. We have accomplished in high quality Bi thin films enormous carrier mean path necessary for capturing extremely large magnetoresistance (400,000%) [*Science* ***284****, 1335 (1999), Phys. Rev. Lett.* ***82****, 3328 (1999)*], Shubnikov-de Haas oscillations [*Phys. Rev. B* ***61****, 6631 (2000).*], spin Hall effect, and quantum transport.

257. F. Y. Yang, Kai Liu, C. L. Chien, and P. C. Searson, "Large Magnetoresistance and Finite-Size Effects in Electrodeposited Single-Crystal Bi Thin Films," *Phys. Rev. Lett.* ***82****, 3328 (1999).*
261. F. Y. Yang, Kai Liu, Kimin Hong, D. H. Reich, P. C. Searson, and C. L. Chien, " Large Magnetoresistance of Electrodeposited Single-Crystal Bismuth Thin Films," *Science* ***284****, 1335 (1999).*
266. F. Y. Yang, Kai Liu, Kimin Hong, D. H. Reich, P. C. Searson, C. L. Chien, Y. Leprince-Wang, Kui Yu-Zhang, and Ke Han, "Shubnikov-de Haas Oscillations in Electrodeposited Single-Crystal Bismuth Films," *Phys. Rev. B* ***61****, 6631 (2000).*

Spin-Transfer Torque Effects: Spin transfer torque (STT) is the inverse effect of the GMR effect, where an electrical current alters the magnetic configuration without using a magnetic field. Due to the high current density required, STT switching can only be observed in nanostructures of nanopillars and point contacts with a small cross section. Using the point contact technique, we have observed STT switching in continuous trilayers [*Appl. Phys. Lett.* ***84**, 380 (2004)*.], and have discovered new STT effects. We have observed STT effect in a single exchange-biased ferromagnetic layer [*Phys. Rev. Lett.,* **90**, 106601(2003), *Phys. Rev. Lett.*, **93**, 026601 (2004)], which is the inverse effect of domain wall resistance (DMR). We have also observed that granular solids exhibit no STT effect at zero field but a huge effect of 400% under either a large external magnetic field or a large current density, which is essential for generating the all-important spin-polarized current [*Phys. Rev. Lett.* ***96**, 207203 (2006)*].

312. Y. Ji, C. L. Chien, and M. D. Stiles, "Current Induced Spin Wave Excitations in a Single Ferromagnetic Layer," *Phys. Rev. Lett.,* **90**, 106601(2003).
323. T. Y. Chen, Y. Ji, and C. L. Chien, "Reversible Switching in Continuous Films by Point Contact Spin Injection," *Appl. Phys. Lett.* ***84**, 380 (2004).*
324. T. Y. Chen, Y. Ji, C. L. Chien, and M. D. Stiles, "Current-driven switching in a single exchange-biased ferromagnetic layer," *Phys. Rev. Lett.*, **93**, 026601 (2004).
346. S. Urazhdin, C. L. Chien, K. Y. Guslienko, and L. Novozhilova, "Effects of current on the magnetic states of permalloy nanodiscs," *Phys., Rev. B* ***73**, 054416 (2006).*
351. T. Y. Chen, S. X. Huang, C. L. Chien and M. D. Stiles, "Enhanced magnetoresistance induced by spin transfer torque in granular films with a magnetic field," *Phys. Rev. Lett.* ***96**, 207203 (2006).*

Patterned Nanomagnets and Devices: While poles are synonymous to magnets as in the case of a macroscopic bar magnet, the magnetic configurations of a nanomagnet of sub-micron size are altogether different depending intricately on the geometrical shape and material. For example, a circular nanomagnet does not have a dipole configuration, but instead forms a vortex state of two chiralities with no poles, without a net magnetization nor stray magnetic field. However, a vortex core, lying at the disc center with spins pointing perpendicular to the disc, dominates the dynamics of circular nanomagnets [*Physics Today* ***60**, 40 (2007*]. Chien's group also pioneered magnetic nanorings that exhibit unique magnetic configurations. A few years ago with the nanosphere lithography, they have fabricated arrays of nanorings with the smallest diameter (100 nm), narrowest ring width (20 nm), largest number (10^9), and highest areal density (45 rings/μm^2), which are still records to date [*Adv. Mater.* ***16**, 2155 (2004)*]. They demonstrated the new configurations of "onion", "vortex", and "twisted" states and switching schemes of magnetic nanorings [*Phys. Rev. Lett.,* ***96**, 027203 (2006)*]. They have also fabricated the first nanoring magnetic tunnel junctions (MTJs) and demonstrated that in nanoring MTJs, unlike their counterparts in disc MTJs, magnetic field switching and spin torque switching can yield different states with potential for multilevel storage [*Phys. Rev. B.* ***77**, 224432 (2008)*.].

330. F. Q. Zhu, D. L. Fan, X. C. Zhu, J. G. Zhu, R. C. Cammarata, C. L. Chien, "Ultrahigh density arrays of ferromagnetic nanorings on a macroscopic area," *Adv. Mater.* ***16**, 2155 (2004).*
342. F. Q. Zhu, G. W. Chern, O. Tchernyshyov, X. C. Zhu, J. G. Zhu, and C. L. Chien, "Magnetic Bistability and Controllable Reversal of Asymmetric Ferromagnetic Nanorings," *Phys. Rev. Lett.,* ***96**, 027203 (2006).*
360. F. Q. Zhu, Z. Shang, D. Monet, and C. L. Chien, "Large enhancement of coercivity of magnetic Co/Pt nanodots with perpendicular anisotropy," *J. Appl. Phys.* ***101**, 09J101 (2007).*

363. C. L. Chien, F. Q. Zhu, and J. G. Zhu, "Patterned Nanomagnets," *Physics Today* ***60,*** *40 (2007); Japanese translation in Parity* ***23*** *(no.2) 10 (2008).*

371. H. X. Wei, F. Q. Zhu, X. F. Han, Z. C. Wen, and C. L. Chien, "Current-induced multiple spin structures in 100 nm ring magnetic tunnel junctions," *Phys. Rev. B.* ***77****, 224432 (2008).*

Development of Electric Tweezers and Cell Specific Drug Delivery: Optical tweezers and magnetic tweezers are well known techniques to only hold nanoparticles in suspension using laser beam and magnetic field gradients respectively. Since no net force is exerted, neither technique can manipulate small entities in suspension. We recently developed electric tweezers using AC and DC electric field to manipulate nanowires to execute translational and rotational motion with high precision of better than 150 nm. [*Appl. Phys. Lett.* ***85****, 4175 (2004), Phys. Rev. Lett.,* ***94****, 247208 (2005), Appl. Phys. Lett.* ***89****, 223115 (2006), Appl. Phys. Lett.* ***92****, 093115 (2008)*]. Electric tweezers is a new technique for a wide range of biomedical, MEMS, and fluid mechanics applications. In 2010, we have accomplished for the first time cell-specific drug delivery using electric tweezers to manipulate a single nanowire functionalized with a drug [*Nature Nanotechnology* ***5****, 545 (2010)*]

329. D. L. Fan, F. Q. Zhu. R. C. Cammarata, and C. L. Chien, "Manipulation of Nanowires in Suspension by AC Electric Fields," *Appl. Phys. Lett.* ***85****, 4175 (2004).*

341. D. L. Fan, F. Q. Zhu, R. C. Cammarata, and C. L. Chien, "Controllable High-Speed Rotation of Nanowires," *Phys. Rev. Lett.,* ***94****, 247208 (2005).*

356. D. L. Fan, F. Q. Zhu, R. C. Cammarata, and C. L. Chien, "Efficiency of assembling of nanowires in suspension by AC electric fields," *Appl. Phys. Lett.* ***89****, 223115 (2006).*

364. D. L. Fan, R. C. Cammarata, and C. L. Chien, "Precision transport and assembling of nanowires in suspension by electric field," *Appl. Phys. Lett.* ***92****, 093115 (2008).*

382. D. L. Fan, Z. Z. Yin, R. Cheong, F. Q. Zhu, R. C. Cammarata, C. L. Chien, and A. Levchenko, "Sub-cellular resolution delivery of a cytokine via precisely manipulated nanowires," *Nature Nanotechnology* ***5****, 545 (2010).* Featured story, "Nanowires have cells in their sights," *Nature Nanotechnology* ***5****, 481 (2010).*

391. D. L. Fan, F. Q. Zhu, R. C. Cammarata, and C. L. Chien, "Electric Tweezers," (invited) *Nanotoday* ***6****, 339 (2011).*

Materials with Perpendicular Magnetic Anisotropy Hybrids with Superconductors: While most ferromagnetic materials have in-plane anisotropy, a few materials, among them Co/Pt multilayers, exhibit perpendicular magnetic anisotropy, suitable for the studies of Bloch domain walls, the interplay in ferromagnet-superconductor hybrids, and with relevance to perpendicular magnetic recording. We have discovered antisymmetric instead of symmetric MR in materials with PMA due to the fact the domain walls aligns perpendicular to *both* magnetization and current, a situation exists only in materials with PMA [*Phys. Rev. Lett.,* ***94****, 017203 (2005)*]. We have also observed asymmetric domain nucleation where the reversal begins for one field direction only and characterized by an acute asymmetry of domain wall mobility for forward and backward domain motion [*Phys. Rev. Lett.,* ***98****, 117204 (2007)*] Recently, we show that the superconducting transition can be driven by the domain wall arrangement in the ferromagnet in ferromagnet/superconductor hybrids [*Phys. Rev. Lett.* ***101****, 017004 (2008)*].

333. X. M. Cheng, S. Urazhdin, O. Tchernyshyov, C.L. Chien, V.I. Nikitenko, A.J. Shapiro and R.D. Shull, "Antisymmetric magnetoresistance in magnetic multilayers with perpendicular anisotropy," *Phys. Rev. Lett.,* ***94****, 017203 (2005).*

358. Y. L. Iunin, Y. P. Kabanov, V. I. Nikitenko, X. M. Cheng, D. Clarke, O. A. Tretiakov, O. Tchernyshyov, A. J. Shapiro, R. D. Shull, and C. L. Chien, "Asymmetric domain nucleation and unusual magnetization reversal in ultrathin Co films with perpendicular anisotropy," *Phys. Rev. Lett.*, ***98**, 117204 (2007).*
372. L. Y. Zhu, T. Y. Chen, and C. L. Chien, "Altering the superconducting transition temperature by domain-wall arrangement in hybrid ferromagnet-superconductor structures," *Phys. Rev. Lett.* ***101**, 017004 (2008).*
385. L. Y. Zhu, M. Z. Cieplak, and C. L. Chien, "Tunable phase diagram and vortex pinning in ferromagnet-superconductor bilayer," *Phys. Rev. B (Rapid Commun.)* ***82**, 060503 (2010).*
390. M. Z. Cieplak, L. Y. Zhu, Z. Adamus, M. Konczykowski, and C. L. Chien, "Enhancement of vortex pinning in superconductor/ferromagnet bilayer via angled demagnetization," *Phys. Rev. B (Rapid Commun.)* ***84**, 020514(R) (2011).*

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118. **"Giant Magneto-Transport Properties in Granular Solids, Nanowires, and Amorphous Alloys,"** International Workshop on Spin Polarized Electron Transport, Miami, FL. (February 19 - 23, 1995).

119. **"Oscillatory Superconducting Transition Temperature in Gd/Nb Multilayers,"** International Workshop on Magnetism in Multilayered and Reduced Dimensional Systems, Argonne National Lab, Argonne, IL. (June 19 - 23, 1995).

120. **"Nanostructured Solids with 2D, 1D and 0D Entities,"** The Hong Kong University of Science and Technology Physics Summer School on Nanostructured and Granular Materials, Hong Kong (July 3- 14, 1995).

121. **"Giant Magneto-Transport Properties in Granular Solid, Nanowires, and Amorphous Alloys,"** The 3rd International Symposium on Physics of Magnetic Materials (ISPMM 95), Seoul Korea (August 21-25, 1995).

122. **"Magnetic Nanostructures,"** The 8th Chinese International Summer School of Physics-Beijing International Workshop on Modern Magnetism," Beijing, China (August 28 - September 7, 1995).

123. **"Giant Magnetoresistance in Magnetic Nanostructures,"** Colloquium, Department of Physics, Washington University, St. Louis, MO (October 18, 1995).

124. **"Fabrication, Magnetic Properties, and Giant Magnetoresistance in Arrays of Nanowire,"** International Symposium on the Science and Technology of Atomically Engineered Materials, Richmond, VA (October 30 - November 4, 1995).

125. **"Magnetic Nanostructures with 2D, 1D, and 0D Entities,"** Colloquium, Department of Physics, University of Connecticut, Storrs, CT (March 7, 1996)

126. **"Arrays of Nanowires,"** Fourth International Conference on Nanometer-Scale Science and Technology, Beijing, China (September 8-12, 1996).

127. **"Magnetic Nanostructures with 2D, 1D, and 0D Entities (I),"** Lectures for Honorary Professorship, Department of Physics, Nanjing University, Nanjing, China, (September 16, 1996).

128. **"Magnetic Nanostructures with 2D, 1D, and 0D Entities (II),"** Lectures for Honorary Professorship, Department of Physics, Nanjing University, Nanjing, China, (September 19, 1996).

129. **"Superconducting Nanostructures"** Lectures for Honorary Professorship, Department of Physics, Nanjing University, Nanjing, China, (September 23, 1996).

130. **"Magnetic and Superconducting Nanostructures,"** Department of Physics, Suzhou University, Suzhou, China, (September 27, 1996).

131. **"Magnetic Nanostructures (I),"** Lectures for Honorary Professorship, Department of Physics, Lanzhou University, Lanzhou, China, (October 2, 1996).

132. **"Magnetic Nanostructures (II),"** Lectures for Honorary Professorship, Department of Physics, Lanzhou University, Lanzhou, China, (October 3, 1996).

133. **"Superconductor/Ferromagnet Multilayers,"** Conference on Magnetism and Magnetic Materials, Atlanta, GA (November 12-15, 1996).

134. **"Superconducting Proximity Effects in Magnetic Materials,"** Department of Physics, University of Maryland, College Park, Maryland (April 24, 1997).

135. **"Magnetic Nanostructures with 2D and 1D Entities,"** American Vacuum Society 44th National Symposium and Topical Conferences, San Jose, California (October 20 - 24, 1997).

136. **"FM/AF Exchange Biasing and Arrays of Nanowires,"** Hewlett-Packard Research Lab, Palo Alto, California (October 25, 1997)

137. **"Recent Results in FM/AF Exchange Biasing and Arrays of Nanowires"** IBM Almaden Research Center, San Jose, California (October 27, 1997).

138. **"Magnetic Nanostructured Materials,"** AT&T Bell Labs Colloquium, Murray Hill, New Jersey, (December 9, 1997).

139. **"The Intriguing Physics of Exchange Coupling,"** Nanjing University Colloquium, Nanjing, China (October 13, 1998).

140. **"Magnetic Nanostructures,"** Fudan University Colloquium, Shanghai, China (October 15, 1998).

141. **"Magnetoresistive Sensors, the Role of Exchange Bias,"** Army Research Lab, Adelphi, MD (October 28, 1998).

142. **“Magnetic Nanostructures,”** Department of Physics, Penn State University, University Park, PA (November 2, 1998).

143. **“Magnetic Nanostructures,”** Department of Physics, Brown University, Providence RI (December 1, 1998).

144. **“Exchange Coupling in Magnetic Multilayers,”** American Physical Society Centennial March Meeting, Atlanta, GA (March 20-26, 1999).

145. **“Bi Nanowires and Single Crystal Bi Thin Films,” First GT Workshop on Exotic Multilayered Systems,”** Georgia Tech. Atlanta, GA (March 27, 1999).

146. **"Magnetic Nanostructures,"** Department de Physique, Universite de Marne La Vallee, France, (April 13, 1999).

147. **"New Features of Exchange Coupling in FM/AF Bilayers and Very Large MR in Single Crystal Bi Thin Films"**, Thomson-CSF, Orsay, France (April 14, 1999).

148. **"Large Magnetoresistance and Field-Sensing Characteristics of Single Crystal Bismuth Films,"** The 5th International Conference on Advanced Materials (IUMRS-ICAM'99), Beijing, China (June 13 - 18, 1999).

149. **“Magneto-Transport Properties of Bi Nanowires and Single Crystal Bi Thin Films,”** 5th International Conference on Electrical Transport and Optical Properties of Inhomogeneous Media (ETOPIM5), Hong Kong, China (June 21 - 25, 1999).

150. **“Intriguing Exchange Coupling in FM/AF Bilayers”** NIST, Gaithersburg, Maryland (August 11, 1999)

151. **"Nanostructures with Large Magneto-Transport Properties"** Workshop on "Magnetoelectronic Materials and Devices SUNY-Buffalo, Buffalo, New York (September 17 –18, 1999).

152. **“Large Magneto-Transport Properties in Bi Nanowires and Thin Films”**, Colloquium, Argonne National Lab, Argonne, IL (September 22, 1999).

153. “**Large Magnetoresistance in Magnetic Heterostructures, Nanowires and Single-Crystal Films of Bismuth”** Colloquium, Department of Physics, University of Minnesota, Minneapolis, MN (October 20, 1999).

154. **“Magneto-Transport Properties of Bi Nanowires and Single Crystal Bi Thin Films”** International Symposium on Cluster and Nanostructure Interfaces, Richmond, VA (October 25 –29, 1999).

155. “**Large Magnetoresistance in Magnetic Heterostructures, Nanowires and Single-Crystal Films of Bismuth”** Colloquium, Department of Physics, Florida State University, Tallahassee, Florida (November 4, 1999).

156. “**Very Large Magnetoresistance in Electrodeposited Single Crystal Bismuth Films”** 44th Annual Conference on Magnetism and Magnetic Materials, San Jose, California (November 15 – 18, 1999).

157. **“Overview of Magnetic Materials of Importance”** New Technology R & D Center, Philip Morris, Richmond, VA (November 23, 1999).

158. **“Magneto-Transport Properties of Electrodeposited Single-Crystal Bi Films”** International Workshop on Latest developments in Low-density and Low-dimensional electronic Systems $(LD)^3$, University of Florida, Gainesville, Florida (March 4 – 7, 2000).

159. **“Exchange Bias in FM/AF Bilayers”** Spallation Neutron Source Workshop on Magnetism, Argonne national Lab, Argonne, Illinois (April 27 – 28, 2000).

160. **“Exchange Bias in FM/AF Bilayers”** Synchrotron Radiation Research Center, Hsinchu, Taiwan, (May 31, 2000).

161. **“Large Magnetoresistance Effects in Magnetic Heterostructures, Nanowires and Single-Crystal Thin Films of Bismuth”** Institute of Physics, Academia Sinica, Taipei, Taiwan (June 1, 2000).

162. **Half-Metallic Ferromagnetic CrO_2”** Department of Physics, National Taiwan University, Taipei, Taiwan (June 2, 2000)

163. **“Magnetic Nanostructures”** Second Conference on Nanostructured Materials, Academia Sinica, Taipei, Taiwan (June 3, 2000).

164. **“Large Magneto-Transport Properties of Electrodeposited Single Crystal Bismuth Films”** International Conference on Magnetism (ICM2000), Recife, Brazil (August 6 – 11, 2000).

165. **"Spin-Dependent Transport and Magnetoelectronic Devices,"** Colloquium, Physics Department, Virginia Commonwealth University, Richmond, VA (Oct. 6, 2000).

166. “**Heterostructures and Spintronics,”** Colloquium, Applied Physics Laboratory, JHU, Laurel, MD (February 2, 2001).

167. **“Antiferromagnetic Spin Structure and Domains in Exchange-Coupled Multilayers,“** American Physical Society Centennial March Meeting, Seattle, WA (March 12-16, 2001).

168. “**Antiferromagnetic Spin Structure in Exchange-Coupled Multilayers and Determination of Spin Polarization in Half-Metallic Ferromagnets, “** Einhoven Institute of Technology, Einhoven, The Netherlands, (June 19, 2001).

169. **“Magnetic Nanowire Arrays and Manipulation of Isolated Magnetic Nanowires,”** International Workshop on Magnetic Wires, Sebastian, Spain (June 20 –23, 2001).

170. **“Highly Spin-Polarized Materials”,** International Conference on Novel Aspects of Spin-Polarized Transport and Dynamics (Spintronics 2001), Washington DC (August 9 – 11, 2001).

171. “**Magnetization Reversal in Bilayers with Exchange Anisotropy",** First Seeheim Conference on Magnetism, Seeheim, Germany (September 9-13, 2001).

172. **“The Central Roles of Antiferromagnetic Spin Structure and Domains in Exchange-Biased Multilayers,“** Michigan State University MRSEC workshop, East Lansing, MI (September 22, 2001).

173. **“Measurement of Spin Polarization using Point Contact,”** III Escola Brasileira de Magnetismo, Porto Alegre, Brazil (October 17-25, 2001)

174. **“Highly Spin-Polarized Materials”,** 48th International Symposium of the American Vacuum Society, IUVSTA 15th International Vacuum Congress, 11th International Congress on Solid Surfaces, San Francisco, CA (October 29 – November 2, 2001).

175. “**Bismuth Nanowires, Single-Crystal Thin Films, and Antidot Arrays,”** Colloquium, Department of Chemical Engineering and Materials Science, University of Minnesota, Minneapolis MN (Nov. 6, 2001).

176. “**Dynamic Spin Structure and Antiferromagnetic Domains in Exchange-Coupled Multilayers”,** Intermag Conference, Amsterdam, The Netherlands (April 28 – May 2, 2002)

177. **“Determination of Spin Polarization in Half-Metallic CrO_2,”** Gordon Research Conference on Magnetic Nanostructures, Barga, Italy (May 12 – 17, 2002).

178. **“Highly Spin Polarized Materials,”** Nanjing University Centennial Lecture, Nanjing, China (May 21, 2002).

179. “**Semi-Metallic and Half-Metallic Thin Films,”** Taiwan-Japan Joint Symposium on Fundamentals and Applications of Nano-Magnetic Thin Films and Particles, Tokyo, Japan (September 17-20, 2002).

180**.** **“Half-Metallic Ferromagnets,”** Materials Research Lecture Series, California Institute of Technology (October 9, 2002).

181. **“Measurement of Spin Polarization by Andreev Reflection,”** Materials Research Society Fall Meeting, Boston, MA (December 2-6, 2002).

182. **“Spin-Torque Effects in a Single Ferromagnetic Layer,”** FORC workshop, University of California at Davis, (April 25-27, 2003).

183. **“Spin-Transfer Torque in Magnetic Nanostructures,”** Invited talk, Annual National Physical Society Conference of Taiwan, Hsin-Chu, Taiwan (February 9-11, 2004).

184. **“Half-Metals and Nanorings,”** Plenary talk, Annual National Physical Society Conference of Taiwan, Hsin-Chu, Taiwan (February 9-11, 2004).

185. **“Bismuth Nanowires, Single-Crystal Films, and Antidot Arrays,”** Physics Department, Tunghai University, Taichung, Taiwan (February 12, 2004).

186. **“Bismuth Nanowires, Single-Crystal Films, and Antidot Arrays,”** Physics Department, National Central University, Chungli, Taiwan (February 13, 2004).

187. **Half-Metals, Spin Torque, and Nanorings,”** David Adler Award talk, APS March Meeting, Montreal, Canada (March 22- 26, 2004).

188. **“Spin-Transfer Torque in Magnetic Nanostructures,”** Invited talk, Indo-US Workshop 2004, Puri, India (April 5-8, 2004).

189. **“Spin-Transfer Torque in Magnetic Nanostructures,”** Colloquium, Physics Department, University of North Carolina, Chapel Hill, NC(April 12, 2004).

190. **“Spin-Transfer Torque in Magnetic Nanostructures,”** Seminar, Faculté des Science, Université de Reims, Reims, France (July12, 2004).

191. **“Intriguing exchange bias – the role of antiferromagnetic spin structure,”** Ultrabias Summer School, Anglet, France (Sept. 12-16, 2004).

192. **“Spin transfer torque in magnetic nanostructure,”** Ultrabias Summer School, Anglet, France (Sept. 12-16, 2004).

193. **“Spin Torque and Nanorings,”** Workshop on Nanomagnetism using X-ray Techniques, Lake Geneva, WI (August 29 - September 3, 2004).

194. **“Spin Torque and Nanorings,”** Keynote Speaker, 5th Annual Nanoscience and Nanotechnology Forum, Vanderbilt University, Nashville, TN (October 6, 2004).

195. **“Spin Torque and Nanorings,”** Colloquium, Department of Physics and Astronomy, Johns Hopkins University, Baltimore, MD (October 26, 2004).

196. **“Spin Torque and Nanorings,”** Seminar, San Jose Research Center, San Jose, CA, (February 15, 2005).

197. **“Spin Torque and Nanorings,”** IEEE Distinguished Lecture, Komag Auditorium, San Jose, CA, (February 15, 2005).

198. **“Spin Torque and Nanorings,”** IEEE Distinguished Lecture, Center for Magnetic Recording Research, University of California at San Diego, CA (March 1, 2005).

199. **“Spin Torque and Nanorings,”** IEEE Distinguished Lecture, Colloquium, Department of Physics, Colorado State University, Fort Collins, CO (March 28, 2005).

200. **“Spin Torque and Nanorings,”** IEEE Distinguished Lecture, Colloquium, Seagate Research Center, Pittsburgh, PA (March 31, 2005).

201. **“Spin Torque and Nanorings,”** IEEE Distinguished Lecture, Colloquium, Department of Computer and Electrical Engineering, Carnegie-Mellon University, Pittsburgh, PA (April 1, 2005).

202. **“Spin Torque and Nanorings,”** IEEE Distinguished Lecture, Colloquium, Department of Computer and Electrical Engineering, University of Minnesota, Minneapolis, MN (April 19, 2005).

203. **“Spin Torque and Nanorings,”** IEEE Distinguished Lecture, Colloquium, NIST, Boulder, CO (April 20, 2005).

204. **“Spin Torque and Nanorings,”** IEEE Distinguished Lecture, Colloquium, Department of Computer and Electrical Engineering, Georgetown University, Washington DC (April 27, 2005).

205. **“Manipulation of nanowires, patterning and rotation,”** US-Spain Workshop, Segovia, Spain (Sept. 19-22, 2005).

206. **“Spin Torque and Nanorings,”** IEEE Distinguished Lecture, Department of Physics, University of York, York, UK (September 26, 2005).

207. **“Spin Torque and Nanorings,”** IEEE Distinguished Lecture, Department of Physics, University of Glasgow, Glasgow, UK (September 27, 2005).

208. **“Spin Torque and Nanorings,”** IEEE Distinguished Lecture, Department of Physics, University of Exeter, Exeter, UK (September 29, 2005).

209. **“Spin Torque and Nanorings,”** IEEE Distinguished Lecture, Department of Materials Science and Engineering, Stanford University, Palo Alto, CA (November 4, 2005).

210. **“Magnetic Nanostructures, Intricate Science and Technology,”** IEEE Distinguished Lecture, Department of Physics, Taiwan University, Taipei, Taiwan, Chien (November 12, 2005).

211. **“Spin Torque and Nanorings,”** Department of Physics, Fudan University, Shanghai. China (November 15, 2005).

212. **“Spin Torque and Nanorings,”** Department of Physics, Nanjing University, Nanjing, Chien (November 16, 2005).

213. **“Spin Torque and Nanorings,”** IEEE Distinguished Lecture, Korean Magnetics Society Meeting, Yongpyong, Korea (December 9, 2005).

214. **“Manipulation of Nanoentities by AC Electric Field,”** Annual Hopkins Biology Symposium on “Mining the Biology-Physics Interface” (January 25, 2006).

215. **“Magnetic Nanorings and Manipulation of Nanowires,”** American Physical Society March Meeting, Baltimore, MD (March 13-17, 2006).

216. **“Magnetic Nanoring,”** 5th International Workshop on Surfaces, Interfaces, and Thin Film Physics, Shanghai, China, (Mary 27-30, 2006).

217. **“Manipulation of Nanorings and of Nanowires,”** Zhongguancun Forum in Institute Of Physics, Chinese Academy of Sciences, Beijing, China (June 2, 2006).

218. **“Spin Transfer Torque Effect in Magnetic Nanostructures,” Invited** lecturer Ultrasmooth Network Summer School, Durham Castle, UK (July 9 – 14. 2006).

219. **“Spin Transfer Torque Effect in Magnetic Nanostructures,”** Department of Physics, University of Cambridge, Cambridge UK (July 17, 2006).

220. **“Manipulation of Nanoentities in Suspension,”** 2006 Ta-You Wu Science Camp, Taiwan (July 31 – August 5, 2006).

221. **“Spin Electronics,”** 2006 Ta-You Wu Science Camp, Taiwan (July 31 – August 5, 2006).

222. “**Spin Torque and Nanorings**,” Colloquium, Department of Physics, UC Riverside, (Oct. 13, 2006).

223. “**Manipulation of Nanoentities in Suspension**,” Colloquium, Department of Physics, National Tsing Hwa University, Hscinchu, Taiwan (January 2, 2007).

224. **“Nanomagnets: Poles or No Poles”** Colloquium, Department of Physics, Penn State University, State College, PA (September 6, 2007).

225. **“Patterned Nanomagnets,”** School of Nanofabrication, Rio de Janeiro, Brazil (September 17 –20, 2007).

226. **“Controlled Manipulation of Nanoentities in Suspension,”** European Science Foundation/European Molecular Biology organization Symposium on Biomagnetism and magnetic biosystems based on molecular recognition processes,” Sant Feliu de Guixols, Spain (September 22-27, 2007)

227. **“Nanomagnets: Poles or No Poles”** Department of Physics, Universitat Autonoma de Barcelona, Barcelona, Spain (Sept.27, 2007)

228. **“Controlled Manipulation of Nanoentities in Suspension,”** Colloquium, Department of Mechanical Engineering, Johns Hopkins University, (October 3, 2007).

229. **“Patterned Nanomagnets,”** Colloquium, Department of Physics, University of Hong Kong, and Hong Kong Physical Society, Hong Kong (October 15, 2007).

230. **“Nanomagnets: Poles or No Poles,”** Colloquium, Department of Physics, University of Science and Technology of China, Hefei, China (October 23, 2007).

231. **“Controlled Manipulation of Nanoentities in Suspension**,” MRSEC/NSEC seminar, Columbia University, New York, (December 5, 2007).

232. **“Nanomagnets: poles or no poles,”** Colloquium, Argonne National Laboratory, Argonne, IL (December 7, 2007).

233. **“Nanomagnets: poles or no poles,”** Colloquium, Department of Materials Science and Engineering, University of Texas at Arlington, Arlington, TX (April 18, 2008)

234. **“Nanomagnets: poles or no poles,”** Nanoscience Symposium, Brown University, Providence RI (May 5-7, 2008).

235. **“Iron Superconductors,”** Department of Physics and Astronomy, Johns Hopkins University, (May 15, 2008).

236. **“Iron Superconductors,”** Department of Physics and Astronomy, National Tsing Hua University, Hsinchu, Taiwan (June 3, 2008).

237. **“Iron Superconductors,”** Institute of Physics, Academia Sinica, Taipei, Taiwan (June 4, 2008).

238. **“Nanomagnets: poles or no poles,”** Department of Electrophysics, National Chiao Tung University, Hsinchu, Taiwan (June 5, 2008).

239. **“Iron Superconductors,”** Department of Physics, National Taiwan University, Taipei, Taiwan (June 6, 2008).

240. **“Ballistic transport through nanocontacts,”** 7^{th} International Workshop on Surface, Interface, and Thin Film Physics Shanghai, China (June 17-19, 2008).

241. **“Mind the Gap of Iron Superconductor,”** International Workshop on Strongly Correlated Systems, Hefei, China (June 20 – 22, 2008).

242. **“Mind the Gap of Iron Superconductor,”** Taiwan International Conference on Superconductivity (TIC08) HuiSun Forrest Station, Taiwan (July 7-10, 2008).

243. **“Nanomagnets: poles or no poles,”** Department of Physics, Nanjing University, Nanjing, Chien (September 10, 2008).

244. **“Mind the Gap of Iron Superconductor,”** Department of Physics, Nanjing University, Nanjing, Chien (September 12, 2008).

245. **“Mind the Gap of Iron Superconductor,”** National High Magnetic Field Lab, Tallahassee, Florida (October 3, 2008).

246. **“Mind the Gap of Iron Superconductor,”** Colloquium, Department of Physics, West Virginia University, Morgantown, WV (October 9, 2008).

247. **“Mind the Gap of Iron Superconductor,”** Department of Physics, UC Berkeley, Berkeley, CA (October 20, 2008).

248. **“Gap and Pseudogap of Fe-pnictide Superconductors,”** ICAM Workshop on Fe-pnictide and related superconductors, College Park, MD (Nov. 16-17, 2008).

249. **“Mind the Gap of Iron Superconductor,”** Keynote speaker, Howard University Nanotechnology Symposium, Washington DC (Nov. 20-21, 2008).

250. **“Superconducting gap of Fe superconductors,”** Materials Research Society Fall meeting, Boston, MA (Dec. 1-5, 2008).

251. **“Andreev reflection spectroscopy of iron superconductors,”** American Physical Society March Meeting, Pittsburgh, PA (March 16-20, 2009).

252. **“Nanomagnets: poles or no poles,”** Department of Physics, Fudan University, Shanghai, Chien (June 19, 2009).

253. **“Controlled manipulation of nanoentities in suspension by electric tweezers,”** in 2009 Workshop of “Investigation and manipulation of quantum discipline of correlated electron systems” and Summer School of “Advanced Functional Materials” University of Science and Technology of China,. Hefei, China (June 26 – 29, 2009)

254. **“Nanomagnets: poles or no poles,”** Keynote speaker at International Conference on Materials for Advanced Technologies 2009 (ICAME-2009) and International Union of Materials Research Society-International Conference in Asia 2009 (IUMRS-ICA 2009), Singapore (June 28 – July 3, 2009)

255. **“Gap and Pseudogap of Fe-pnictide Superconductors,”** OCPA06, Lanzhou, China (August 3-7, 2009).

256. **“Mind the Gap of Iron Superconductor,”** Colloquium, University of Delaware, Newark, DE, (Dec. 2, 2009).

257. **“Ballistic heat transport,”** Ninth International Workshop on Surface, Interface and Thin Film Physics, Shanghai, China, June 16-19, 2010.

258. **“Ballistic heat transport,”** International Workshop on Strongly Correlated Electron Systems 2010 (IWSCES-2010), Taiping Lake, Anhui, China, June 24-28 (2010)

259. **“Ballistic transport of spin and heat,”** Keynote, 2010 International Symposium on Spintronics and Devices, Beijing, China, October 21-22 (2010).

260. **“Nanomagnets: poles or no poles,”** Colloquium, Institute of Physics, Academia Sinica March 8, (2011).

261. **“Nanomagnets: poles or no poles,”** Academia Sinica Institute of Astronomy and Astrophysics (ASIAA)/Center of Condensed Matter Science (CCMS)/National Taiwan University(NTU) Joint Colloquium, March 15, (2011).

262. **“Ballistic transport of spin and heat in nanocontacts”** Intermag 2011. Taipei, Taiwan, April 25-29, (2011).

263. **“Ballistic transport in nanocontacts”** Department of Physics, Hong Kong University of Science and Technology, Clear Water Bay, Hong Kong May 23, (2011).

264. **“Spintronics and Spin Caloritronics in Magnetic Nanostructures,”** Plenary Presentation, Chinese Physical Society Annual Meeting, Hangzhou, China, September 16 (2011).

265. **“Spintronics, Spin Hall, and Spin Caloritronics,”** Colloquium, Department of Physics, Arizona State University, Tempe, Arizona (January 26, 2012).

266. **“Intrinsic Spin-Dependent Thermal Transport,”** American Physical Society March Meeting, Boston MA (February 27 – March 2, 2012).

267. **“Intrinsic Spin-Dependent Thermal Transport,”** 3^{rd} International Conference on Superconductivity and Magnetism – ICSM2012 April 29 – May 4, 2012 Istanbul, Turkey.

268. **“Spin Seebeck effect in the midst of Anomalous Nernst effect,”** Spin Caloritronics 4, Sendai, Japan, (June 2-5, 2012).

269. **“Spin Seebeck effect,”** Institute of Physics, Chinese Academy of Sciences, Beijing, China (June 7, 2012).

270. **“Spin Seebeck Effect,”** Department of Physics, Fudan University, Shanghai. China (June 21, 2012).

271. **“Electric Tweezers,”** Department of Physics, Yunan University, Kunming. China (June 28, 2012).

272. **“Electric Tweezers,”** Department of Physics, Fudan University, Shanghai. China (July 3, 2012).

273. **“Entanglement of Spin Seebeck Effect and Anomalous Nernst Effect,”** International Conference on Magnetism, Busan, Korea (July 8-13, 2012).

274. **"Entanglement of Spin Seebeck Effect and Anomalous Nernst Effect,"** 21th International Colloquium on Magnetic Films and Surfaces, Shanghai China (September 24-28, 2012).

275. **"Spintronics, Spin Caloritronics, and Skyrmion"** International Conference of Asian Union of Magnetics Societies," Nara Japan (October 2-5, 2012).