Nishina Asia Award 2015年度候補者一覧

ファイル番号	候補者	候補者所属	業績の題目	推薦者	論文査読者
NO.15-1 B	**Qihua Xiong** Singaporean	Nanyang Technological University	nanoscience and nanotechnology, particularly in the area of low dimensional nanomaterials, heterostructures, artificial nanostructures including the study and characterization of the optical and transport properties of nanomaterials	Leong-Chuan Kwek Center for Quantum Technologies, National University of Singapore	**前野、家、上田**
No.15-2 B	**Dong Qian** Born in Jan. 24th, 1977, China	Physics Department, Shanghai Jiao Tong University	the coexistence of superconductivity and topological state in topological insulator films, which is a breakthrough for the probing and manipulating of Majorana Fermions in topological insulators	Prof. Dr. Gui Lu Long (APS Fellow, IoP Fellow, Member of IUPAP C13 Commission) Department of Physics, Tsinghua University, Beijing 10084, China	**前野、家、西森、上田**
No.15-3 C	(Raymond) **Ooi Chong Heng** Malaysia	University of Malaya,	theoretical quantum optics, laser interactions and nonlinear photonics	Swee-Ping Chia High Impact Research, University of Malaya, Kuala Lumpur, Malaysia	**上田、西森**
No.15-4 A+	**Pengjie Zhang** China	Center for Astronomy and Astrophysics, Department of Physics and Astronomy, Shanghai Jiao Tong University	original E_g method to test gravity theories at cosmological scales, and rigorous proof of the Copernican principle	Yipeng Jing Center for Astronomy and Astrophysics, Department of Physics and Astronomy, Shanghai Jiao Tong University	**佐々木、江口**
	Dr. Sungjay Lee Korea	Enrico Fermi Institute University of Chicago	Discovery of a new class of d=3 gauge theories, with M-theory applications, and a pioneering work that	Piljin Yi Professor of Physics & Chair, School of Physics	

No.15-5 B			and a pioneering work that revolutionized study of d=2 gauged linear sigma models and their conformal limit	School of Physics Korea Institute for Advanced Study	江口、初田
No.15-6 B,C	**Ying Jiang** Chinese	International Center for Quantum Materials, School of Physics, Peking University, Beijing, China	Real-space observation and manipulation of quantum many-body effects	Zhongxian ZHAO , Institute of physics Chinese Academy of Sciences ,	三島、上田
No.15-7 B	**Liangjian Wen** Chinese	Instirute of High Energy Physics, Chinese Academy of Sciences, Beijing	the Daya Bay experiment which leads to the discovery of a new type of neutrino oscillation, denoted by a parameter called theta-13	Yifang Wang Instirute of High Energy Physics, Chinese Academy of Sciences, Beijing	永宮、梶田、山内
No.15-8 B	**Bowen Xiao** China	Central China Normal University	establishing an effective kt-factorization in dilute projectile-dense target collisions, explaining why there are two distinct gluon distributions, finding a new AdS5-gravity solution corresponding to uniformly accelerating particles	**Xiangdong Ji** Professor of Physics Department of Physics, University of Maryland, Department of Physics and Astronomy, Shanghai Jiao Tong University, Shanghai, **Alfred Mueller** Enrico Fermi Professor of Physics Department of Physics, Columbia University, **Feng Yuan** Senior Scientist Nuclear Science Division, Lawrence Berkeley National	初田、江口
No.15-9 ①	**Yong-il Shin** Korea	Citizen of the Republic of Korea School of Physics & Astronomy, Seoul National University	demonstration of atom interferometry with Bose-Einstein condensates using atom chips and trapping geometry, in-situ imaging method overcoming outstanding obstacle for exploring	Soo-Jong Rey Professor, School of Physics & Astronomy, Seoul National University, Director, Fields, Gravity &	上田、

No.15-9-① A-			outstanding obstacle for exploring strongly interacting Fermi gases, and observation of various topological excitations and Berezinskii-Kosterlitz-Thouless phase transition in quasi-2d Bose gas	Director, Fields, Gravity & String, Center for Theoretical Physics of the Universe, Institute of Basic Sciences, Daejon KOREA	西森、前野
No.15-9-② A-	**Yong-il Shin** Korea	Citizen of the Republic of Korea School of Physics & Astronomy, Seoul National University		Wolfgang Ketterle John D. MacArthur Professor of Physics Research Laboratory for Electronics, MIT-Harvard Center for Ultracold Atoms, and Department of Physics Massachusetts Institute of Technology	上田、西森、前野
No.15-10-① B	**Amer Iqbal** Pakistan	Department of Physics, LUMS School of Science and Engineering, Lahore PAKISTAN	understanding nonperturbative aspects in supersymmetric guage theories and string theories using the methods of D-branes and topological strings	Soo-Jong Rey Professor, School of Physics & Astronomy, Seoul National University, Director, Fields, Gravity & String, Center for Theoretical Physics of the Universe, Institute of Basic Sciences, Daejon KOREA	江口、初田
No.15-10-② B	**Amer Iqbal** Pakistan	Department of Physics, LUMS School of Science and Engineering, Lahore PAKISTAN		Cumrun Vafa Donner Professor of Science Harvard University	江口、初田
No.15-11 A-	**Jeng-Da Chai** Taiwan	Department of Physics, National Taiwan University	generally accurate density functional methods for nanoscale applications	Dr. Yuan-Huei Chang Professor and Chairman Department of Physics National Taiwan University	西森、初田
	Ke HE China NAA受賞	State Key Laboratory of LowState Key Laboratory of Low -Dimensional Quantum Physics, Department of Dimensional	the first experimental realization of the quantum anomalous Hall effect	Qi-Kun Xue State Key Laboratory of Low - Dimensional Quantum Physics	家、

No.15-12	NAA支員	Quantum Physics, Department of Tsinghua UniversityTsinghua University , CHINA,		Dimensional Quantum Physics, Department of Physics, Tsinghua University	前野、上田
No.15-13 A+	**Seok Kim** Korea	Seoul National University	pioneering exact computations of superconformal indices in maximally supersymmetric conformal field theories in three and six dimensions using the technique of supersymmetric localization	Shiraz Minwalla,	江口、佐々木
No.15-14 B	**Hongwei Zhao** China	Institute of Modern Physics(IMP),Chinese Academy of Sciences,Lanzhhou,China	development and demonstration of high performance highly-charged ECR(Electron Cyclotron Resonance) ion sources and accelerator technologies.	Wenlong Zhan Chinese Academy of Sciences(ZAS) Professor in Physics, Chinese Academician, Vice-president of CAS,	永宮、伊藤、山内

Nomination form for the 2015 Nishina Asia Award

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)
Name: Qihua Xiong Affiliation: Nanyang Technological University Year of PhD Awarded: 2006 Nationality: Singaporean Address: Division of Physics and Applied Physics School of Physical and Mathematical Sciences Nanyang Technological University 21 Nanyang Link, Singapore Email: qihua@ntu.edu.sg Telephone: +65-6513 8495
Citation for the Award (within 30 words)
For his important scientific contribution to nanoscience and nanotechnology, particularly in the area of low dimensional nanomaterials, heterostructures, artificial nanostructures including the study and characterization of the optical and transport properties of nanomaterials as well as laser cooling of solids.
Description of the work
Driven by the paradigm of “bottom-up” nanoscience and nanotechnology, Dr Xiong’s research covers rational synthesis of functional semiconductor nanomaterials, systematic investigations on their physical properties at quantum size regime and practical applications in nanoelectronics, nanophotonics and nanobiotechnology. His group is notable for his recent achievement in realizing Van der Waals epitaxy growth of non-planar semiconductor nanostructures, fundamental investigations of phonons, excitons and their interactions by optical spectroscopy, as well as demonstrating flexible metamaterials that resonate at visible wavelength as an excellent photonic device for strain and photonic and plasmonic nanolasers. IThe range of topics can be broadly defined as follows: • Develop novel approaches to synthesize (bottom-up) and fabricate (top-down) tunable low-dimensional metallic and semiconducting nanomaterials, heterostructures, and artificial nanostructures. • Investigate their fundamental properties as an outcome of confined geometry and anisotropy, especially by using optical spectroscopy (Raman, optical absorption and photoluminescence) and electrical transport measurement. • Explore the applications of nanomaterials and artificial nanostructures in nanoelectronics,

nanophotonics, energy harvesting, and defense technology.

- Build nano-bio interfaces, such as nanopore and plasmonic nanostructures for biosensing.

Key references (up to 3 key publications*)

1. Q. Zhang, G.Y. Li, X.F. Liu, F. Qian, Y. Li, T.C. Sum, C.M. Lieber and **Q.H. Xiong***, "A room temperature low-threshold ultraviolet plasmonic nanolaser", Naure Communications, 5, 10.1038/ncomms 5953 (2014)

2. J. Zhang, D.H. Li, R.J. Chen and **Q.H. Xiong***, "Laser cooling of a semiconductor by 40 Kelvin", *Nature* **493**, 504-508 (2013)

3. P. Xie, **Q.H. Xiong**, Y. Fang, Q. Qing and C.M. Lieber*, "Local electrical potential detection of DNA by nanowire–nanopore sensors", *Nature Nanotechnology* **7**, 119-125 (2012)

*) Copy of one most significant publication should be attached.

Nominator (name, affiliation, email, telephone and relation to the candidate)

Name: Leong- Chuan Kwek

Affiliation: Center for Quantum Technologies, National University of Singapore

Email: cqtklc@nus.edu.sg

Tel: +6590095232

Relation to Candidate: None

Signature Date Feb 24, 2015

Nomination form for the 2014 Nishina Asia Award

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)
NAME: Dong Qian AFFILIATION: Physics Department, Shanghai Jiao Tong University PERSONAL: Male, Born in Jan. 24th, 1977, P.R. China DEGREE: 1998.7 B.S. in Physics, Fudan University, Shanghai, China 2003.1 Ph.D. in Physics, Fudan University, Shanghai, China EDUCATION AND APPOINTMENTS: 1994.9-1998.7 Physics Department, Fudan University, China 1998.9-2003.6 Surface Physics Lab., Physics Department, Fudan University, China 2003.7-2006.7 Postdoctoral Research Associate, Physics Department, Princeton University, USA 2006.7-2009.3 Associate Research Scholar, Physics Department, Princeton University, USA 2009.5- Professor, Physics Department, Shanghai Jiao Tong University, China RESEARCH INTERESTS: Topological phases of matter, Strongly correlated electrons, Superconductivity, Magnetism, STM, Angle-Resolved Photoemission NATIONALITY: China ADDRESS: 800 Dongchuan Road, Physics Department, Shanghai, China 200240 EMAIL: dqian@sjtu.edu.cn TELEPHONE: 86-21-34203047
Citation for the Award (within 30 words)
Dr. Qian has achieved the coexistence of superconductivity and topological state in topological insulator films, which is a breakthrough for the probing and manipulating of Majorana Fermions in topological insulators.

Description of the work

Topological insulators (TIs) are a new quantum class of matters discovered recently and were considered as a "star materials" in science and technology. Dr. Qian made significant contributions in the experimental realization of three dimensional TIs (Nature 2008, Nature Physics 2009). He and his collaborators found the first 3D TI (BiSb alloy) and the TI with simplest surface band structures and largest bulk gap (Bi_2Se_3). TIs have nontrivial surface states with spin-momentum locking under the protection of time reversal symmetry, which make them promising for application in spintronics, fault-tolerant quantum computation and lots of other fields. Topologically ordered phase in TIs does not break any symmetry. Known from history, new sciences always comes out of the intermixing. The interplay of topological order and system breaking such as superconductivity can lead to new quantum phenomena such as time-reversal invariant topological superconductors and Majorana fermions. To exploring those new phenomena, the first and most important problem is how to introduce superconducting states into TI's surface states and whether topological surface states can host Cooper pairs. It remains a big challenge due to the extreme difficulty to get atomically sharp and electronic transparent TI/SC interface.

One proposed experimental way to introduce superconductivity to TI's surface is utilizing superconducting proximity effect between s-wave superconductor (SC) and TI's surface state. In 2012, Dr. Qian and his collaborators made a breakthrough in introducing superconductivity into TI's surface (Science 2012):

1) For the first time, they succeeded in growing single crystal Bi_2Se_3 thin films on superconducting $NbSe_2$ substrate with atomically sharp and electronic transparent interface.
2) Further, in this high quality TI/SC heterostructure, by *in situ* scanning tunneling spectroscopy they unambiguously observed that superconducting states are present at $Bi_2Se_3/NbSe_2$ at the surface and interface.
3) By angle-resolved photoemission spectroscopy, they confirmed the formation of topological surface states in the films in which Copper pairs present. The topological surface states can host Copper pairs.

The superconducting TI/SC heterostructure that Dr. Qian made provides excellent platform for feature experiments on the interplay of TI and SC. Those findings immediately lay the groundwork for detecting Majorana fermions in TI system. Majorana fermions are proposed to emerge as superconducting vortex core states on superconducting TI's surfaces. The thin film based geometry opens many possibilities for probing and manipulating Majorana fermions.

Key references (up to 3 key publications*)

1. The Coexistence of Superconductivity and Topological Order in the Bi2Se3 Thin Films

Mei-Xiao Wang, Canhua Liu, Jin-Peng Xu, Fang Yang, Lin Miao, Meng-Yu Yao, C. L. Gao, Chenyi Shen, Xucun Ma, X. Chen, Zhu-An Xu, Ying Liu, Shou-Cheng Zhang, **Dong Qian**, Jin-Feng Jia, Qi-Kun Xue, *Science* **336**, 52 (2012).

2. Observation of a large-gap topological-insulator class with a single Dirac cone on the surface

Y. Xia, **D. Qian**, D. Hsieh, L. Wray, A. Pal, H. Lin, A. Bansil, D. Grauer, Y.S. Hor, R.J. Cava, M.Z. Hasan, *Nature Physics*, **5**, 398 (2009).

3. A topological Dirac insulator in a quantum spin Hall phase

D. Hsieh, **D. Qian**, L. Wray, Y. Xia, Y. S. Hor, R.J. Cava and M.Z. Hasan, *Nature*, **452**, 970 (2008).

*) Copy of one most significant publication should be attached.

Nominator (name, affiliation, email, telephone and relation to the candidate)

Prof. Dr. Gui Lu Long (APS Fellow, IoP Fellow, Member of IUPAP C13 Commission)
Department of Physics, Tsinghua University, Beijing 10084, China
gllong@tsinghua.edu.cn;guilulong@gmail.com
Tel: +861062772692
Relation to candidate: colleague, fellow members of Chinese Physics Society. Dr Qian is a leading figure in the Chinese physics community. I have also invited President Jie Zhang of Shanghai Jiaotong University, Prof. Qikun Xue(who had worked in Tohoko University for many years), who is one of the leading world experts in topological insulator and superconductivity to write supporting letters to support my recommendation .

Signature  Date 30, December 30, 2012

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)

Name:

(Raymond) Ooi Chong Heng

Affiliation:

University of Malaya,

Nationality:

Malaysia

Address:

Department of Physics, Faculty of Science, University of Malaya,

50603 Kuala Lumpur, MALAYSIA

E-mail: rooi@um.edu.my

Tel: +60 (0)3-7967 4092

hp: +60 (0)11 26203832

Website: http://sites.google.com/site/qtmphoton/

Researcher ID: http://www.researcherid.com/rid/B-9461-2010

Nationality: Malaysian

CURRICULUM VITAE

Education:

- Dr. rer. nat. (Doctor of Natural Science): 1 March 2000 - 18 June 2003
  Universitaet Konstanz, Konstanz, Germany
- Master of Engineering (Photonics): October 1998 - November 1999
  Nanyang Technological University, Singapore
- Bachelor of Science, 2nd Upper Hons (Physics): July 1993-April 1997
  Universiti Sains Malaysia

Research Grants:

1. Exploratory Research Grant Scheme (ERGS) by MoHE: RM110,000 (24 Aug 2011-25 Aug 2013) – Quantum correlations of photons at high intensity for subwavelength resolution (as PI)
2. High Impact Research (HIR) by MoHE : RM2.7 million (4 Jul 2011-3 July2015)- Quantum and Laser Science (as PI)
3. High Impact Research (HIR) by MoHE : RM234,000 (15 Mar 2011) - Generation of Novel Light Sources by Nonlinear Frequency Conversions (as PI)
4. Fundamental Research Grant Scheme (FRGS) by MoHE: RM36,000 (1 Oct 2010-30 Sep 2012) - Generation of Nonclassical Light from Low Dimensional Structures (as PI)
5. University of Malaya Research Grant (UMRG): RM56k, RM26k (1 May 2010-30 Apr 2011-30 Apr 2012) - Novel Properties of Light in Photonic Structures (as PI)

6. Monash University internal (seeding) grant: RM23, 000 (June 2008- June 2009) - Novel Properties of Light in Artificially Engineered Structures(as PI)
7. Korean Research Foundation 2008 Junior Research Grant (KRW22 million) -Nonclassical Correlation of Photon Pairs at High Intensity (as PI)

Awards and Recognitions:

- Malaysia Toray Science Foundation (MTSF) Science & Technology Award 2013
- Distinguished Research Prize (March 2007): Department of Physics, KAIST.

Professional Profile:

- Professor: 1 July 2014-now
  University of Malaya, Malaysia
- Associate Professor: 8 Feb 2010-June 2014
  University of Malaya, Malaysia
- Visiting Prof/Fellow 2014, 2015
  NTU
- Visiting Research Scientist: 7 June-6 July 2011
  School of Physics, Peking University,
  State Key Laboratory for Artificial Microstructure & Mesoscopic Physics
- Visiting Research Scientist: Nov-Dec 2009
  Nanyang Technological University, Singapore
- Senior Lecturer (C1, top level): 2 January 2009-7 February 2010
  Monash University, Malaysia (Sunway Campus)
- Assistant Professor: 1 September 2007-1 January 2009
  Korea University
- Research Professor: 15 September 2006-31 August 2007
  Korea Advanced Institute of Science and Technology (KAIST)
- Postdoctoral Research Associate: 26 June 2003-25 June 2006
  Institute for Quantum Studies, Department of Physics, Texas A&M University, USA
- Visiting Scientist: summer 2004, 2005 and 12 July 2006-1 September 2006
  Max-Planck Institute for Quantum Optics, Garching, Germany
- Visiting Research Associate: 18 September 2003- 1 January 2004
  Frick Laboratory, Chemistry Department, Princeton University, USA
- Research Assistant (Mitarbeiter): March 2000-June 2003
  Universitaet Konstanz, Germany (Theoretical Quantum Optics Group)

Professional Membership:

- Member: Optical Society of America (OSA)
- Member: Institute of Physics, Malaysia (MIFM)
- Council Member: Institute of Physics, Malaysia (IFM)

Professional Services:

- Editor: Central European Journal of Physics (http://www.versita.com/science/physics/cejp/)
- Chief Editor of Jurnal Fizik Malaysia, Institute of Physics Malaysia: 2011-now
- Referee for Q1 journals-Applied Physics Letters, Physical Review Letter, Physical Review A, Physical Review B, Physical Review E, Journal of Optics
- Referee for Q2 and Q3 journals- IEEE, European Physical Journal D, Optics Communications

Citation (within 30 words)

Prof Dr Raymond Ooi leads the "Quantum and Laser Science" group has h-index11, produced more than 70 ISI papers (mostly in Q1 journals) and more than 20 invited/plenary conference papers, with more than 500 citations covering quantum optics, nonlinear optics and laser spectroscopy, electromagnetic field scattering, generation, interactions and propagation of intense laser fields, artificial optical structures (e.g. photonic crystals, metamaterials and plasmonics), and statistical physics of Bose-Einstein condensates.

Description of the work

Dr Raymond Ooi works on various topics of theoretical quantum optics, laser interactions and nonlinear photonics and has published in many high impact journals, like Physical Review. His research topics are state-of-the-art and the first of the kind in Malaysia. Raymond managed to solve several challenging problems.

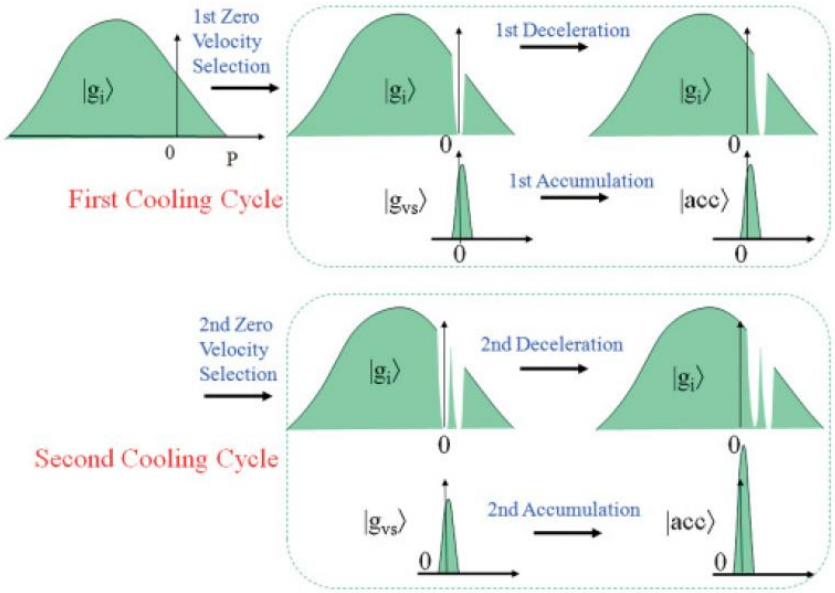
- Raymond introduced the first superconducting photonic bandgap structure. The superconducting-dielectric photonic bandgap structure opens up potential integration of superconducting electronics with optics (at microwave and far infrared regimes) into superconducting optoelectronics and sparks new possibilities in superconducting photonics and plasmonics.

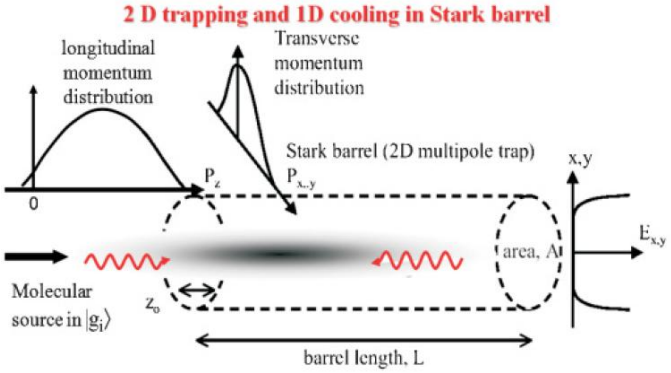
  1) C. H. Raymond Ooi and Au Yeung T. C., (1999) "Polariton gap in a superconductor–dielectric superlattice", Physics Letters A 259, 413.

  2) C. H. Raymond Ooi, Au Yeung T. C., Kam C. H. and Lim T. K., (2000) "Photonic band gap in a superconductor-dielectric superlattice", Physical Review B 61, 5920

  3) C. H. Raymond Ooi and Chan Hin Kam, (2010) "Echo and Ringing of Optical Pulse in Finite Photonic Crystal with Superconductor and Dispersive Dielectric", Journal of Optical Society of America B 27, 458.
- Laser cooling techniques for atoms, which led to the 1997 Nobel Prize in physics cannot be applied to molecules due to the many quantum levels. After exploring all existing laser cooling schemes for atoms during his PhD (2000-2003) and a lot of thinking Raymond found a laser cooling scheme for molecular gas using only a few lasers. It is a clever way that circumvents the need for many lasers on the many internal molecular levels. In 2010, Raymond proposed a more practical version of the laser cooling scheme. This work may lead to realization all-optical approach to achieve ultracold molecules and hence Bose-Einstein condensate of molecular gas,

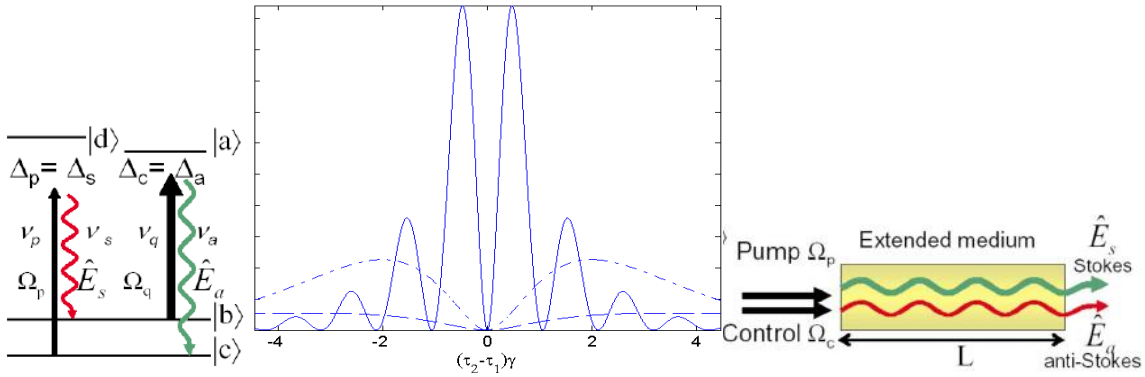
that is the holy grail of atomic and molecular physics.





1. C. H. Raymond Ooi, K.-P. Marzlin and J. Audretsch, (2002) "Momentum Spread of Spontaneously Decaying Cold Gas in Thermal Radiation", Physical Review A 66, 063413.
2. C. H. Raymond Ooi, K.-P. Marzlin, and J. Audretsch, (2003) "Laser Cooling of Molecules via Single Spontaneous Emission", European Physical Journal D 22, 259.
3. C. H. Raymond Ooi, (2003) "Rotational cooling of polar molecules by Stark-tuned cavity resonance", Physical Review A 68, 013410.

- Raymond co-discovered (with Marlan Scully) and developed the first controllable nonclassical correlation of photon pairs using a double Raman scheme. He proposed it for use in quantum microscopy and lithography. He has studied the scheme for two-atoms, extended medium and microparticle. Recent advances in plasmonics will bring this closer to develop technological applications with high resolution or subwavelength resolution using quantum light sources.



$$G^{(2)}(\vec{r}_1,t_1;\vec{r}_2,t_2)=\langle \hat{E}_S^-(\vec{r}_1,t_1)\hat{E}_{AS}^-(\vec{r}_2,t_2)\hat{E}_{AS}^+(\vec{r}_2,t_2)\hat{E}_S^+(\vec{r}_1,t_1)\rangle$$

1) M. O. Scully and C. H. Raymond Ooi, (2004) "Improving quantum microscopy and lithography via Raman photon pairs: II. Analysis", Journal of Optics B: Quantum Semiclassical Optics 6, S816. (becomes JOURNAL OF PHYSICS B-ATOMIC MOLECULAR AND OPTICAL PHYSICS)
2) C. H. Raymond Ooi, Qingqing Sun, M. Suhail Zubairy and Marlan O. Scully, (2007) "Correlation of Photon Pairs from Double Raman Amplifier: Generalized Analytical Quantum Langevin Theory", Physical Review A 75, 013820.
3) C. H. Raymond Ooi and M. Suhail Zubairy, (2007) "Role of noise operators on two-photon correlations in an extended coherent Raman medium", Physical Review A 75, 053822.

Key references (up to 3 key publications*)

1) C. H. Raymond Ooi, Au Yeung T. C., Kam C. H. and Lim T. K., (2000) "Photonic band gap in a superconductor-dielectric superlattice", Physical Review B 61, 5920
2) C. H. Raymond Ooi, (2010) "Laser Cooling of Molecules by Zero Velocity Selection and Single Spontaneous Emission", Physical Review A 82, 053408.
3) C. H. Raymond Ooi, Qingqing Sun, M. Suhail Zubairy and Marlan O. Scully, (2007) "Correlation of Photon Pairs from Double Raman Amplifier: Generalized Analytical Quantum Langevin Theory", Physical Review A 75, 013820

*) Copy of one most significant publication should be attached.

Nominator (name, affiliation, email, telephone and relation to the candidate)

Name: Swee-Ping Chia

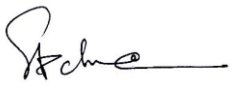
Affiliation: High Impact Research, University of Malaya, Kuala Lumpur, Malaysia

Email: spchia@um.edu.my

Telephone: +60-(0)3-78735843

Mobile: +60-(0)12-2175843

Relation to the candidate: Colleague



13 March 2015

Signature Date

Nomination form for the 2015 Nishina Asia Award

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)
Name: Pengjie Zhang Affiliation: Center for Astronomy and Astrophysics, Department of Physics and Astronomy, Shanghai Jiao Tong University CV: Research field: cosmology, the large scale structure of the universe and its applications in fundamental cosmological physics 2013-present, professor, Department of Physics and Astronomy, Shanghai Jiao Tong University 2005-2015, professor, Shanghai Astronomical Observatory, Chinese Academy of Sciences 2003-2005, postdoc, Fermilab 2003, Ph.D, University of Toronto 1975, year of birth Nationality: China Address: Center for Astronomy and Astrophysics, 955 Jianchuan Road, Shanghai, China Email: zhangpj@sjtu.edu.cn Telephone: 01186-21-67285628 (office), 01186-13472585276 (mobile)
Citation for the Award (within 30 words)
For his original E_g method to test gravity theories at cosmological scales, and for his rigorous proof of the Copernican principle at cosmological scales. Both works have significantly enhanced our understanding of the Universe.

Description of the work

Pengjie Zhang works on the statistics of the large scale structure (LSS) of the universe and using LSS to probe fundamental cosmological physics. He made significant contributions to testing General Relativity (GR) at cosmological scale and the Copernican principle, two fundamental principles of cosmological physics.

(1) The E_G method to test GR at cosmological scale (Zhang et al. 2007, PRL). Although GR has been rigorously tested in solar system, it is difficult to test at cosmological scales. Therefore the observed cosmic acceleration can be either caused by a mysterious dark energy, or modifications of GR at cosmological scale. A key to break this degeneracy is to test GR at cosmological scales independently. By combining weak lensing and redshift distortion, Zhang et al. (2007) proposed the E_G method which directly measures the capability of mass to distort space-time. Furthermore, by construction, it significantly reduces uncertainties from the otherwise troublesome galaxy bias and initial density fluctuation. It is therefore a highly discriminating probe of various gravity models such as GR, DGP, f(R) and TeVeS.
E_G has been widely accepted as a major method to test GR at cosmological scale (e.g. Clifton et al. 2012, review of modified gravity and cosmology on Physics Reports). It was applied in SDSS surveys and confirmed GR at z~0.3 and ~50 Mpc scales (Reyes et al. 2010). It has been adopted as an important scientific goal by stage IV dark energy surveys such as DESI and LSST. It is capable of testing GR at 1% accuracy at ~100 Mpc scale over the past 10 billion years.

(2) The "linear" kinetic SZ method which confirmed the Copernican Principle (Zhang & Stebbins, 2011, PRL). The Copernican Principle, a corner stone of modern cosmology, assumes that we do not live in a special region of the universe. However, it is extremely hard to verify, especially over billion light year radial scale and above. This leaves a major loophole in modern cosmology. For example, violations of the Copernican Principle along the radial direction (the LTB models in general and the void model to be specific), which are consistent with CMB, can explain supernovae data without resorting to cosmic acceleration and dark energy. It therefore challenges a major discovery of modern cosmology and physics. Zhang and Stebbins (2011) found that, violations of the Copernican Principle will inevitably cause a diffuse kinetic Sunyaev Zel'dovich (kSZ) effect with unique "linear" dependence on density fluctuation. Interesting void models, which can explain supernovae data without dark energy, cause a linear kSZ effect orders of magnitude larger than observation. Therefore this linear kSZ test was the most stringent test of the Copernican principle. It robustly ruled out the void models and confirmed the Copernican Principle at >1Gpc radial scale. Ethan Vishniac, the chief editor of ApJ and a leading expert on the kSZ effect, appraised this work as "hard to see any loopholes", during an interview by physicsworld.

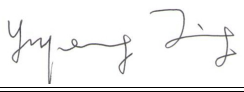
Key references (up to 3 key publications*)

1. Zhang, P., M. Liguori, R. Bean, and S. Dodelson, Probing Gravity at Cosmological Scales by Measurements which Test the Relationship between Gravitational Lensing and Matter Overdensity, 2007, Physical Review Letters, vol.~99, Issue 14, id.~141302, 99, 141302
2. Zhang, P. and A. Stebbins, Confirmation of the Copernican Principle at Gpc Radial Scale and above from the Kinetic Sunyaev-Zel'dovich Effect Power Spectrum, 2011, Physical Review Letters, vol.~107, Issue 4, id.~041301, 107, 041301

*) Copy of one most significant publication should be attached.

Nominator (name, affiliation, email, telephone and relation to the candidate)

Name: Yipeng Jing
Affiliation: Center for Astronomy and Astrophysics, Department of Physics and Astronomy, Shanghai Jiao Tong University
Email: ypjing@sjtu.edu.cn
Telephone: 0086-21-34203945 (o), 0086-13641754198 (mobile)
Relation to the candidate: the nominator is the vice dean for research of the department of physics and astronomy. He has been a colleague of the candidate for more than 10 years, and is working in the same research field.

Signature  Date 2015/3/14

Nomination form for the 2015 Nishina Asia Award

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)

Nominee

Dr. Sungjay Lee
Enrico Fermi Institute
University of Chicago
Chicago, Illinois 60637, USA
Phone: +1-773-744-5325
E-mail: sjlee79@uchicago.edu

Academic Employment

2013 - Present: Enrico Fermi Fellow at Enrico Fermi Institute, University of Chicago
2012 - Present: STFC Ernest Rutherford Fellow at DAMTP, University of Cambridge
2010 - 2012: Research Associate at DAMTP, University of Cambridge
2010 - 2010: KIAS Assistant Professor at Korea Institute for Advanced Study
2008 - 2010: Research Fellow at Korea Institute for Advanced Study

Education and Qualifications Received

Ph.D., March 2004 – February 2008
Department of Physics and Astronomy, Seoul National University,
Thesis: Studies on three dimensional superconformal theories and their gravity duals
B.S., March 2000 – February 2002
School of Chemical Engineering / School of Physics, Seoul National University

Prizes and Awards

2012 Ernest Rutherford Fellowship, Science and Technology Facilities Council, UK.
2012 Enrico Fermi Fellowship, University of Chicago.
2009 Research Excellence Award, Korea Institute for Advanced Study.

Recent Invited Talks (Selected)

"SUSY Partition Sums of (4,4) GLSMs,"
Workshop on Exact Results in SUSY Gauge Theories in Various Dimensions, CERN, August 19 (2014)

"Ramond-Ramond Charges and the Gamma Class," Strings Conference 2014, Princeton (US),

June 25 (2014)

"Sphere Partition Function and Its Applications,"
Strings Conference 2013, Seoul (Korea), June 25 (2013)

"Exact results in 2d SUSY theories and Applications,"
Workshop on Geometry and Physics of Gauged Linear Sigma Model, Michigan (US). March 07 (2013)

"Exact results in D=2 Supersymmetric Gauge Theories,"
Workshop on Exact Results in Gauge Theory and Their Applications, Aspen (US). July 13 (2012) ,

"Instanton: a Window into M5s,"
Conference on Maths of String and Gauge Theory, London (UK), May 5 (2012)
"Overview on 3d Partition Functions," Benasque String Theory Workshop, Benasque (Spain), July 13 (2011)

57 invited talks at universities and research centers in Belgium, Canada, France, Germany, Netherland, Italy, Japan, Korea, Spain, UK, and US.

Publication Statistics (InspireHEP database, as of Mar. 12th, 2015)

Papers Published in SCI Journals:	**27**
Papers Cited More than 100 times:	**4**
Papers Cited More than 50 times:	**4**
Total Accumulated Citations:	**1416**

Citation for the Award (within 30 words)

Discovery of a new class of d=3 gauge theories, with M-theory applications, and a pioneering work that revolutionized study of d=2 gauged linear sigma models and their conformal limit.

Description of the work

Dr. Sungjay Lee is the most prominent Ph.D. that emerged from the Korean high energy theory community during the last two decade or so, and belong to the very top echelon of young string theorists worldwide today. In less than seven years since graduation, he became a major player and a leader in supersymmetric gauge theories in low dimensions. Dr. Lee has either initiated, or contributed a key ingredient to, several new burgeoning research subjects repeatedly, including multi-M2-brane dynamics, ab initio Wall-Crossing for Seiberg-Witten theory, S-duality wall, S^3 partition functions of 3d CFT's, etc. One of the most recent and perhaps the most significant such contribution is computation of exact 2d GLSM partition functions on S^2 and understanding of how Gromov-Witten invariants are embedded in those partition functions. I know of not too many Ph.D.s in the 21st century era who has achieved so much so early in their career.

Dr. Lee made an impressive entrance to the worldwide string theory community in 2008 with a set of works in three dimensional conformal field theories. Since 2007, many string theorists began to take serious interests in multi-M2 brane worldvolume theory, which is now believed to be a Chern-Simons theory called Aharony-Bergman-Jafferis-Maldacena (ABJM). An important precursor of this was a study of N=4 superconformal Chern-Simons gauge theories with hypermultiplets by Gaiotto and Witten. Having worked on AdS4/CFT3 related issue in the previous year, Sungjay was motivated to study these systems, and at the end bridged the gap between Gaiotto-Witten theories and the M2 brane worldvolume theory. In a collaboration with four others (K. Hosomichi, K. Lee, Sangmin Lee, J. Park), Dr. Lee formulated the most general three-dimensional N=4,5,6 superconformal field theories of Chern-Simons type, where the crucial element was how to include the twisted hypermultiplets as well consistently.

This work, in particular, provided very simple prescriptions on how to construct all such N=4 theories, and thus produced ABJM model itself and many generalizations, including the symplectic and the orthogonal models with N=5 supersymmetries, for an analog of orientifold for multi-M2 branes. In my view, their contribution here represents the most significant progress for M2-brane physics, next to the Bagger-Lambert, the Gaiotto-Witten, and the ABJM proposal themselves. Let me emphasize that their construction in fact preceded that of ABJM. The most astounding of this story is that he was one of the key contributor to this project despite that he was the youngest of the collaboration team.

Since then, Dr. Lee made several seminal contributions for d=2 and d=3 supersymmetric gauge theories by computing their sphere partition functions and also unraveling their physical meaning. Until very recently, there has been little progress in our understanding of strongly interacting conformal field theories in d=3. This is related to the fact that there is no

efficient and systematic tool to control the long-distance behavior of the 3d theories such as 't Hooft anomaly matching condition in even-dimensional theories. S^3 SUSY partition functions, computed by Sungjay in collaboration with Hama and Hosomichi in 2010-2011, provided for the first time an efficient and systematic tool to study the strong infrared (IR) physics of the 3d (SUSY) gauge theories analytically: confirm detailed predictions of the AdS4/CFT3 correspondence and answer to a long-standing question of defining a measure counting the number of degrees of freedom in 3d, analogous to Zamolodchikov's theorems in 2d CFTs.

This work paved the way for his perhaps most important set of works, namely S^2 partition function of d=2 Gauged Linear Sigma Models and its interpretation via Gromov-Witten invariants for Calabi-Yau GLSM's. An exact computation of S^2 partition functions with several collaborators was followed by an even more important paper with Jaume Gomis, where the pair proved a conjecture that the S^2 partition function of D=2 (axial-anomaly-free) Gauge Linear Sigma Models computes the fully quantum corrected Kaehler potential of the corresponding Calabi-Yau manifold.

In more mathematical terms, these S^2 partition functions compute the famed Gromov-Witten invariants directly, without any help from the mirror symmetry. The conjecture that this might be true was actually suggested by David Morrison and company a few months earlier, which itself was motivated by Dr. Sungjay Lee's exact computations of S^2 partition functions to begin with. Sungjay and Jaume then managed to find a very simple, intuitive, and convincing proof of the conjecture, closing the loop themselves. Of many computation of partition functions in various dimensions, using localization method during last ten years, this is probably the most significant results, thanks to which the entire subject of d=2 GLSM came under attentions of numerous string theorists and geometers.

Dr. Sungjay Lee's contribution to d=3 and d=2 supersymmetric gauge theories since 2008 have been all class-leading and right at the forefront of the worldwide string theory community. In terms of his scientific contribution to the community, which has been singularly stellar among string theorists of Asian origin, I find very few comparable, say, under the age of forty. Prof. Yuji Tachikawa of Tokyo University is the only person I can think of, with comparable level of achievement at the similar stage of career.

Key references (up to 3 key publications*)

N=5,6 Superconformal Chern-Simons Theories and M2-branes on Orbifolds
Kazuo Hosomichi, Ki-Myeong Lee, Sangmin Lee, Sungjay Lee,Jaemo Park,
JHEP 0809 (2008) 002

SUSY Gauge Theories on Squashed Three-Spheres
Naofumi Hama, Kazuo Hosomichi, Sungjay Lee
JHEP 1105 (2011) 014

Exact Kahler Potential from Gauge Theory and Mirror Symmetry
Jaume Gomis, Sungjay Lee
JHEP 1304 (2013) 019

*) Copy of one most significant publication should be attached.

Nominator (name, affiliation, email, telephone and relation to the candidate)

Piljin Yi (piljin@kias.re.kr)
Professor of Physics & Chair, School of Physics
Korea Institute for Advanced Study
☎ 82-2-958-3757

Mentor during Dr. Sungjay Lee's stay at KIAS

Signature Piljin Yi  Date 2015.03.12

Nomination form for the 2015 Nishina Asia Award

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)
Ying Jiang, Associate Professor International Center for Quantum Materials, School of Physics, Peking University, Beijing, China Phone: +86-15811208489 Email: yjiang@pku.edu.cn Homepage: http://icqm.pku.edu.cn/LabJiangYing/Home.html **Nationality:** Chinese **Education:** Ph.D. Physics. Institute of Physics, Chinese Academy of Sciences (July 2008) Advisor: Prof. Enge Wang B.S. Physics. Beijing Normal University, China (July 2003) **Appointments:** Associate Professor. International Center for Quantum Materials, School of Physics, Peking University, Beijing, China (Feb. 2013-present) Assistant Professor. International Center for Quantum Materials, School of Physics, Peking University, Beijing, China (Jan. 2010-Jan. 2013) Postdoctoral Research Associate. Department of Physics and Astronomy, University of California, Irvine, USA (Mar. 2008-Dec. 2009) Co-advisor: Prof. Wilson Ho
Citation for the Award (within 30 words)
Real-space observation and manipulation of quantum many-body effects
Description of the work
Correlated many-body quantum effects lie in the core of condensed matter physics. Many-body effects arise from the collective behavior of large numbers of interacting particles, and the properties of such systems cannot be understood by only taking into account single or non-interacting particles. The conventional way to study such effects relies on various spectroscopic or transport techniques, which are all indirect and restricted to momentum- or energy-space. In the past five years, Ying Jiang has been devoted to attack the many-body problems from a completely new perspective. Using cryogenic scanning tunneling microscopes (STM), Dr. Jiang directly "images" in real space many-body quantum behaviors of electrons as well as nuclei with atomic precision. Those exotic real-space messages, which can never be accessed before, greatly advance our understanding of correlated many-body physics. During his postdoctoral research, Dr. Jiang has been focused on strongly correlated electron

systems. One remarkable example is Kondo lattice system, a chemically ordered arrangement of local moments that are spin-coupled to the host conduction electrons. The understanding of the many-body behaviors of Kondo lattice systems has challenged experimentalists and theorists for more than three decades without arriving at a cohesive picture. The origin of the complexity of Kondo lattice systems is believed to arise from the interplay between the single-site Kondo effect and inter-site correlations. By spatially mapping out the Kondo resonance, Dr. Jiang directly visualized the interplay between the inter-site coupling and the on-site Kondo screening in a two-dimensional O_2 (spin 1) lattice, which led to unexpected coexistence of both local and nonlocal Kondo screening at the atomic level [1]. This work provides an answer to Anderson's long-standing question of where the electrons will come from to compensate the moments in a Kondo lattice: the Kondo moments are collective, and where they near each other, they bind.

After joining Peking University as an independent PI, Dr. Jiang challenged himself by studying a new type of many-body system involving light nuclei: hydrogen-bonded network of water. It is well known that H nuclei (proton) can exhibit prominent quantum effects due to its small mass. Since the motion of protons is typically coupled through a network of hydrogen bonds, correlated many-proton quantum behaviors can be expected. However, there has been no clear evidence for such emergent phenomenon. To this end, Dr. Jiang developed a novel submolecular imaging technique [2], which allows locating in real space the position of protons within the hydrogen-bonded network. Based on this technique, Dr. Jiang succeeded to track the motion of protons in real time and discovered quasiparticle-like concerted proton tunneling within a cyclic water cluster [3]. With properly engineered STM tip, Dr. Jiang further demonstrated the possibility of controlling many-body proton tunneling, which constitutes a first step towards a more general approach to simultaneously manipulating several quantum particles in real space.

In short, Dr. Jiang's creative approaches and his remarkable findings provide substantially new insights into condensed matter physics and deserve the Nishina Asia Award.

Key references (up to 3 key publications*)

[1] Y. Jiang, J. X. Cao, Y. N. Zhang, R. Q. Wu, W. Ho, "Real-space imaging of Kondo Screening in a two-dimensional O_2 lattice", Science 333, 324 (2011). (A copy is attached)

[2] J. Guo, X. Z. Meng, J. Chen, J. B. Peng, J. M. Sheng, X. Z. Li, L. M. Xu, J. R. Shi, E. G. Wang, Y. Jiang, "Real-space imaging of interfacial water with submolecular resolution", Nature Materials 13, 184 (2014).

[3] X. Meng, J. Guo, J. Peng, J. Chen, Z. Wang, J. R. Shi, X. Z. Li, E. G. Wang, Y. Jiang, "Direct visualization of concerted proton tunnelling in a water nanocluster", Nature Physics 11, 235 (2015).

*) Copy of one most significant publication should be attached.

Nominator (name, affiliation, email, telephone and relation to the candidate)
Name: Zhongxian ZHAO , **Affiliation: Institute of physics Chinese Academy of Sciences ,** **Email: zhxzhao@aphy.iphy.ac.cn,** **Telephone: 86 10 82649190** **Relation to the candidate: No direct relation with the candidate. I know the candidate through his scientific report in conference and prize review in the committee which I charge of.**
 Signature Date March 18 2015

Nomination form for the 2015 Nishina Asia Award

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)
Candidate name: Dr. Liangjian Wen **Affiliation:** Institute of High Energy Physics, Chinese Academy of Sciences, Beijing ----------**Curriculum Vitae**---------- **Nationality:** Chinese **Address:** Experimental Physics Division, Yuquan Road 19B, Shijingshan District, Beijing, China, 100049 **Email:** wenlj@ihep.ac.cn **Telephone:** 86-10-88236768 **Career:** Jul 2012 – present, Associate Researcher at Institute of High Energy Physics Jan 2014 – Jul 2014, Visiting Scholar at Stanford University Oct 2012 – Dec 2013, Post-doc at Stanford University Jul 2010 – Apr 2012, Post-doc at Institute of High Energy Physics **Education:** Jul 2010, Ph.D. in Particle Physics and Nuclear Physics, Institute of High Energy Physics Jun 2005, Bachelor Degree in Applied Physics, University of Science and Technology of China (Hefei, China)
Citation for the Award (within 30 words)
For his key and innovative contributions to the Daya Bay experiment which leads to the discovery of a new type of neutrino oscillation, denoted by a parameter called theta-13.

Description of the work

The Daya bay collaboration announced in 2012 the discovery of a new type of neutrino oscillation, and the neutrino mixing angle θ_{13} measurement. This result was selected by the "Science" magazine as one of the 10 most important breakthroughs in 2012.

Liangjian played the most important role in this work. Liangjian and another student proposed an energy calibration scheme which led to an unprecedented energy scale uncertainty. He led the data analysis effort to select neutrinos, study backgrounds and systematic errors. He invented a simple cut to remove completely bad flasher PMTs, much better than other experiments. His event selection scheme soon becomes the standard of the collaboration. He invented a time-since-last-muon method that can deal with high muon rate, to determine 8He/9Li background when he was an undergraduate. Since we have only two months of data, this method is limited by statistics and he then invented a new method by reducing non-interacting-muons to improve the precision. His initiatives and innovations actually appear everywhere, from efficiency calculation for the time-correlated muon veto cut, the random coincidence background calculation, to the determination of fast neutron backgrounds, etc. He seems to know everything and almost everyone relies on him for unknowns. His analysis becomes the official one of the collaboration reported at journals without any dispute.

Liangjian developed a maximum likelihood method to reconstruction the energy and the event vertex in the liquid scintillator without bias and with the best possible energy and vertex resolution. This innovative work is published at Nucl. Instrum. and Meth. A 629 (2011) 296-302.

Liangjian also worked at the EXO and JUNO and has a number of publications.

Key references (up to 3 key publications*)

F. P. An et al (Daya Bay Collaboration), Observation of electron-antineutrino disappearance at Daya Bay, Phys. Rev. Lett. 108 (2012) 171803

Petr Vogel, Liangjian Wen, Chao Zhang, Neutrino Oscillation Studies with Reactors, arXiv:1503.01059, submitted to Nature Communication

L.J. Wen, et al., Nucl. Instrum. and Meth. A 564 (2006) 471-474.

*) Copy of one most significant publication should be attached.

Nominator (name, affiliation, email, telephone and relation to the candidate)

Yifang Wang

Institute of High Energy Physics, Chinese academy of Sciences, Beijing

yfwang@ihep.ac.cn

+86-10-88597198

Supervisor

Signature  Date MAY. 23. 2015

Nomination form for the 2015 Nishina Asia Award

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)
Bowen Xiao, Central China Normal University Nationality: China Address: Institute of Particle Physics, Central China Normal University, Wuhan, 430079 China Date of Birth: June 1981 B.S. Physics, Peking University, China, 2003. M. Phil. Physics, Columbia University, USA, 2003-2006, Ph.D. Physics, Columbia University, USA, 2003-2008 ((PhD adviser: Prof. Alfred H. Mueller) Postdoctoral Fellow, Lawrence Berkeley National Laboratory, USA, 2008 – 2010 Postdoctoral Fellow, Pennsylvania State University, USA, 2010-2012 Professor and Young 1000-plan Scientist, Central China Normal University, 2012 – Honors and Awards: Honorable Mention, Chinese Physics Olympiad, 1998 Freshman Scholarship, Peking University, 1999 Honorable Mention, the Chinese Mathematical Contest in Modeling, 2000 Chun-Tsung Scholar Fellowship, Peking University 2001 Young 1000-Plan Scholar, China, 2012
Citation for the Award (within 30 words)
For establishing an effective kt-factorization in dilute projectile-dense target collisions, for explaining why there are two distinct gluon distributions, for finding a new AdS5-gravity solution corresponding to uniformly accelerating particles.
Description of the work

We write to enthusiastically nominate Professor Bowen Xiao of China Central Normal University for the Nishina Asia Award. Bowen is an exceptional young theorist and has made ground-breaking contributions in a number of research directions. He has a bright career ahead of him in theoretical physics.

Bowen got his Ph.D. from Columbia University in 2008. He spent two years each at Lawrence Berkeley Laboratory and Penn State University as a postdoctoral Research Associate, before he accepted a tenured faculty position at China Central Normal University in Wuhan, China. Bowen is unusually broad in his interest, worked on many contemporary topics in high energy particle and nuclear physics, including small-x physics, hard probes in heavy-ion collisions, proton spin physics and theoretical problems based on conformal symmetry and the AdS/CFT correspondence. Less than six years after his Ph.D., Bowen has already published around 40 influential papers, including six as a main contributor in top physics journal Physical Review Letters. He has established himself as one of rare intellectual leaders of his generation in the theory of strong interactions.

While still a student he wrote an important paper with F. Dominguez, C. Marquet, A. Mueller and B. Wu, studying the similarities and differences between perturbative QCD and strong coupling N=4 SYM theory in a variety of quantities including jet energy loss and transverse momentum broadening in heavy-ion collisions ([3]). This paper has become a classical reference for the theoretical understanding of these topics.

One of the remarkable advances that emerged through the above work is solving the problem of creating “bare” jets in the AdS context similar to quark jets, created without their gluon cloud, in electron-position annihilation. One way of creating bare jets in the string context is to use a heavy quark-antiquark pair at the bottom of a D(7) brane and near the boundary of AdS(5) space. Initially the quark and antiquark are at the same spatial position before undergoing a uniform acceleration, in opposite directions, corresponding to the jet pair creation time in the QCD case. Bowen discovered ingeniously the exact analytical solution to the oppositely uniformly accelerating quark-antiquark pair and published it ([2]). He found an exact analytic formula for the shape and position of the string connecting the quark and antiquark as the string falls into the fifth dimension of AdS(5). Bowen’s solution has some fantastic features. There are two world-sheet horizons which he was able to identify as the separation points of the radiation field from the fields, giving the quark and antiquark their masses. He was further able to identify the position of the world sheet horizons with a temperature for the radiation in a manner exactly analogous to what Unruh did in Minkowski space. His solution has been quoted in the “firewall” debates about the black hole information paradox and has generated considerable interest in the string theory community.

With Y. Hatta and other collaborators, Bowen has used the AdS/CFT correspondence to study the proton’s spin-dependent structure functions and used conformal symmetry to find interesting solutions to the equations of relativistic hydrodynamics. In the spin-dependent structure function study, they found that the so-called

Burkhard-Cottongham sum rule is satisfied in the strong coupling limit of N=4 SYM, while in the study on hydrodynamics they were able to find classes of exact solutions to second-order conformal hydrodynamics. In particular they have found an exact and well-behaved solution to the second-order hydrodynamic equations of Baier, Romatschke, Son, Starinets and Stephanov and have used this solution to check the accuracy of the second-order viscous hydro codes which are necessary to accurately describe heavy ion collisions. In both of these studies great technical skill is used to better understand interesting and topical physics problems and this is Bowen's unique style of doing theoretical physics.

In collaborating with F. Dominguez, C. Marquet and F. Yuan, he has established successfully an effective kt-factorization for dijet production in various processes in which a dilute projectile scatters on a dense target ([1]). Factorization is an important property of QCD involving many scales and a fundamental ingredient for high-energy scattering phenomenology. Recent developments, however, have shown that the naïve kt-factorization is violated in dijet production in proton-proton collisions. On the other hand Bowen and his collaborators have been able to establish an effective kt-factorization for dilute-dense collisions. Although kt-dependent parton distributions are different in different processes, they can be related fundamentally and thus the predictive power of QCD is restored. With the complete results for these dijet processes, one has a firm basis for interpreting the recent STAR and PHENIX data on the azimuthal angular correlations of two forward hadrons in dA collisions at RHIC, as well as two forward jet correlations which should soon be available at the LHC.

More importantly, in their calculations Bowen found the processes can be used to probe the unintegrated (kt-dependent) gluon distribution at small-x. In 1994 McLerran and Venugopalan proposed a promising method to calculate the gluon distribution in large nuclei and at small-x by solving the classical Yang-Mills equations. This method has developed into a systematic procedure for calculations at small-x, leading to an effective theory called the color glass condensate. One of the original predictions of this theory is that the gluon number density in big nuclei exhibits a kind of nonabelian Weizsacker-Williams distribution. However, it has long been believed that this gluon number distribution could not be probed in a physical process. In recent publications Bowen and his collaborators have identified the key process for measuring this gluon distribution as quark-antiquark dijet correlations in deep inelastic lepton-nucleus scattering. This result has stimulated much interest, and the process has been designated as one of the "golden" measurements for the future electron-ion collider (EIC) now being widely discussed. There is much work yet to be done here and Bowen is one of the key leaders in this effort. For example, the energy evolution of the Weizsacker-Williams gluon distribution has not been widely studied compared to the great effort which has gone into understanding and evaluating the dipole gluon distribution. Although the evolution of both of these gluon distributions follows from the general Balitsky-Kovchegov-(BK)-Jalilian-Marian-Iancu-McLerran-Weigert-Leonidov-Kovner(JIMWLK) formalism, it is only recently that, due to Bowen's work, the importance of getting a deeper understanding of the Weizsacker-Williams gluon

distribution has been appreciated.

Professor Bowen Xiao has a strong physics intuition for novel experimental phenomena and an ingenious capability of doing challenging theoretical calculations. He has used his formidable technical skills to solve many important theoretical problems in hadronic physics. He has demonstrated crucial leadership role in various collaborative projects. He is among the top internationally recognized young researchers in the field of strong interactions, with the unique distinction of broad interest and un-matched mathematical skills. We strongly believe that he would be an excellent choice for the 2015 Nishina Asia Award.

Key references (up to 3 key publications*)

[1] F. Dominguez, C. Marquet, Bo-Wen Xiao and F. Yuan, Universality of Unintegrated Gluon Dis- tributions at small x, Phys. Rev. D83:105005, (2011).

[2] B. Xiao, On the exact solution of the accelerating string in AdS(5) space, Phys. Lett. B 665, 173 (2008).

[3] F. Dominguez, C. Marquet, A. H. Mueller, B. Wu and B.W. Xiao, Comparing energy loss and p-perpendicular - broadening in perturbative QCD with strong coupling N = 4 SYM theory, Nucl. Phys. A 811, 197 (2008).

*) Copy of one most significant publication should be attached.

Nominator (name, affiliation, email, telephone and relation to the candidate)

Xiangdong Ji
Professor of Physics
Department of Physics, University of Maryland, College Park, MD 20742, USA
Department of Physics and Astronomy, Shanghai Jiao Tong University, Shanghai, 200240, P. R. China
xji@physics.umd.edu, (001)301-405-7277

Alfred Mueller
Enrico Fermi Professor of Physics

Department of Physics, Columbia University, New York, NY 10027, USA
amh@phys.columbia.edu, (001)212-854-3338

Feng Yuan
Senior Scientist
Nuclear Science Division, Lawrence Berkeley National Laboratory, Berkeley, CA 94720, USA
fyuan@lbl.gov, (001)510-486-5626

Signature Date March 24, 2015

Nomination form for the 2015 Nishina Asia Award

Candidate
Yong-il Shin Citizen of the Republic of Korea School of Physics & Astronomy, Seoul National University, Seoul 151-747 KOREA Phone: +82 2 880 4226 Web: http://phya.snu.ac.kr/yishin, Email: yishin@snu.ac.kr **Professional Experience** 2011.03 – present Associate Professor, School of Physics & Astronomy, Seoul National University, Seoul 151-747 KOREA 2009.09. – 2011.02. World Class University Assistant Professor, School of Physics & Astronomy, Seoul National University, Seoul 151-747 KOREA 2008.07. – 2009.08. Research Scientist, 2006.01. – 2008.07. Postdoctoral Associate, Both at MIT-Harvard Center for Ultracold Atoms (strongly interacting Fermi gases and novel optical lattice emulator) 2001.08. – 2005.12. Research Assistant Research Laboratory of Electronics, MIT, USA (Bose-Einstein condensate interferometry and atom chips for strongly interacting Fermi gases) **Education** 2001.08 – 2006.02, Ph.D. in Physics Massachusetts Institute of Technology, Cambridge MA USA **Awards, Honors and Fellowships** 2013 Korean Physical Society Young Career Physicist Award 2011 TJ Park Science Faculty Fellowship 2006 Finalist in the competition for the American Physical Society award for Outstanding Doctoral Thesis Research in Atomic, Molecular and Optical Physics (2006) 2005 Martin Deutsch Award for Excellence in Experimental Physics, MIT 2005 Guinness World Record as Lowest Man-made Temperature, 450 pico-Kelvin, based on the publication Science **301,** 1513 (2003) 1995-2000 Fellow of the Korea Foundation for Advanced Studies 1994 Bronze Medal, 25th International Physics Olympiad, Beijing, China
Citation for the Award (within 30 words)
for his ingenious demonstration of atom interferometry with Bose-Einstein condensates using atom chips and trapping geometry, in-situ imaging method overcoming outstanding obstacle for exploring strongly interacting Fermi gases, and observation of various topological excitations and Berezinskii-Kosterlitz-Thouless phase transition in quasi-2d Bose gas.

Description of the work

Shin started his major research career at MIT under the supervision of Wolfgang Ketterle and David Pritchard. He persistently focused on atom interferometry with Bose-Einstein condensate (BEC) using atom chips and successfully demonstrated it in a trapping geometry for the first time. For this achievement, he received in 2005 the prestigious Martin Deutsch Award for Excellence in Experimental Physics at MIT and was a finalist in 2006 in the competition for the APS award for Outstanding Doctoral Thesis Research in Atomic, Molecular and Optical Physics.

With all momentum built at MIT, Shin continued postdoctoral research there and carried out 2 major research programs – experimental study of unitary Fermi gas and also of DARPA Optical Lattice Emulator. He is the first achiever of so-called in-situ imaging method for the study of thermodynamic properties of strongly interacting Fermi gas. It provided a new way to circumvent the inhomogeneous density broadening effect that is an intrinsic problem in experiments with trapped samples, thus enabled to make significant progress worldwide in our understanding of strongly interacting Fermi gases.

During this relatively short period, Shin achieved direct observation of phase separation of a superfield and a normal phase, quantitative determiniation of the phase diagram of a unitary Fermi gas, and determination of the equation of state of a polarized Fermi gas at unitarity.

Since 2009, Shin vigorously developed his own research program in Korea. Within a year, he succeeded in making BEC of neutral atoms first time in Korea. He ambitiously studied topological excitations (2d skyrmions and half-quantum vortices) in spinor BEC and Berezinski-Kosterlitz-Thouless (BKT) phase transition in quasi-2d Bose gases. It should be stressed how he managed to achieve all these despite intrinsic obstacles pervading in Korean research environment. There was no prior research infrastructure, nor any experienced researchers in the field. Despite this, Shin managed brilliantly how to train new generation of young researchers and at the same time achieve the highest quality of research accomplishment.

In a short career less than a decade, Shin has built solid and remarkable reputation among colleagues in Korea and around the world as the most creative and the most audacious researcher in the field of low-temperature atomic physics. His understanding on physics, even in the field of quantum field theory and cosmology, both theory and experiments, is truly impressive. For the last 5 years, I always end up tossing physics with him most frequently and I always leave with fully charged ideas and enthusiasm. I believe it is only a matter of time that he will surprise all of us with a chain of new discoveries in the realm where our imagination indicated otherwise so far.

Key references (up to 3 key publications*)

1. Atom interferometry with Bose-Einstein condensates in a double-well potential, Physical Review Letters 92, 050405 (2004) 270 citations
2. Observation of phase separation in a strongly interacting imbalanced Fermi gas, Physical Review Letters 97, 030401 (2006) 256 citations
3. Phase diagram of a two-component Fermi gas with resonant interactions, Nature 451, 689

(2008) 176 citations

*) Copy of the first paper is attached.

Nominator (name, affiliation, email, telephone and relation to the candidate)

Soo-Jong Rey

Professor, School of Physics & Astronomy, Seoul National University, Seoul 151-747 KOREA

Director, Fields, Gravity & String, Center for Theoretical Physics of the Universe, Institute of Basic Sciences, Daejon KOREA

Email: sjrey @ snu.ac.kr, Phone: + 82 2 884 6233 (Office) +82 10 9677 1701 (mobile)

Relation to candidate: both belong to the faculty of School of Physics at Seoul National University

Signature *Soo-Jong Rey* Date March 30, 2015

Nomination form for the 2015 Nishina Asia Award

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)
Amer Iqbal Department of Physics, LUMS School of Science and Engineering, Lahore PAKISTAN Email: amer.iqbal @ lums.edu.pk Phone: + 92 42 3560 8130 Webpage: http://strings.lums.edu.pk **Career and Research** 2015.01. – 2015.04. Cheng Visiting Fellow, Harvard University, USA 2009.08. – present, Associate professor of Physics, LUMS School of Science & Engineering 2011.09. – 2012.01, Visiting Scholar, Simons Center for Geometry & Physics, USA 2005.09. – 2009.06, Assistant professor of Physics, University of Washington, Seattle USA 2004.09. – 2005.08. HEC Foreign Faculty, Abdus Salam School of Sciences, PAKISTAN 2002.09 – 2004.08. Postdoctoral Fellow, Harvard University, USA 2000.09 – 2002.08. Postdoctoral Fellow, University of Texas – Austin, USA 1996.09 – 2000.08. Research Assistant, MIT, USA **Education** 2000.08. Ph.D. in physics Massachusetts Institute of Technology, USA **Awards and Fellowships** 2009, Salam Prize for Physics 2015, Cheng Visiting Fellow
Citation for the Award (within 30 words)
for his fundamental contribution in understanding nonperturbative aspects in supersymmetric guage theories and string theories using the methods of D-branes and topological strings.
Description of the work

Iqbal is a rare theoretical physicist from native Pakistan. His early research at MIT focused on understanding novel nonperturbative aspects of that arise in certain D-brane background in string theory. Afterward, his interest extended to the so-called BPS states in string theory, which is best captured by the topological string theory. In this subject, he made fundamental contributions, especially for the proof of mirror symmetry using D-branes in collaboration with Hori at Tokyo University and Vafa at Harvard University, and also for the refined version of the topological string theory.

He returned from USA to Pakistan with strong intent to contribute to the science of his homeland. He continued to flourish in research as well as in educating young minds at Pakistan. Although teaching burden was severe, he managed to keep producing top-flight research. In collaboration with him in recent years, I was convinced that Iqbal is a truly original and creative theorist, who will continue achieving the top quality research for years to come. Given that he is conducting research and teaching in a very deserted and unfavorable circumstances and social environment, I believe suitable encouragement through award like Nishina Asia award would be most appropriate.

Key references (up to 3 key publications*)

* The refined topological index, Journal of High Energy Physics, 0910, 069 (2009)

* Quantum foam and topological strings, Journal of High Energy Physics 0804, 011 (2008)

* Matrix models, geometrical engineering, elliptic genera, Journal of High Energy Physics 0803, 069 (2008)

*) Copy of one most significant publication should be attached.

Nominator (name, affiliation, email, telephone and relation to the candidate)

Soo-Jong Rey

Professor, School of Physics, Seoul National University, KOREA

Director, Center for Theoretical Physics of the Universe, Institute for Basic Sciences, KOREA

Email: sjrey @ snu.ac.kr, Phone: + 82 2 884 6233 (office), + 82 10 9677 1701 (mobile)

Relation to candidate: collaborator in the most recent publication

Signature  Date 2015.03.30.

Nomination form for the 2015 Nishina Asia Award

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)

1. General Information:

(1) Name: Jeng-Da Chai
(2) Chinese Name: 蔡政達
(3) Affiliation: Department of Physics, National Taiwan University
(4) Address: No. 1, Sec. 4, Roosevelt Road, Taipei 10617, Taiwan
(5) Date of the degree of Ph.D. (MM/DD/YYYY): 12/21/2005
(6) Date of birth (MM/DD/YYYY): 06/30/1975
(7) Gender: Male
(8) Nationality: Taiwan
(9) E-mail: jdchai@phys.ntu.edu.tw
(10) Telephone: +886-2-3366-5586
(11) Fax: +886-2-2363-9984
(12) Website: http://web.phys.ntu.edu.tw/jdchai/

2. Professional Experience:

(1) Associate Professor, August 2013 ~ present
Department of Physics, National Taiwan University, Taipei, Taiwan
Research: Kohn-Sham Density Functional Theory, Orbital-Free Density Functional Theory, Time-Dependent Density Functional Theory, Materials for New Energy

(2) Center Scientist, January 2014 ~ December 2014
Physics Division, National Center for Theoretical Sciences (North), Taipei, Taiwan
Research: Kohn-Sham Density Functional Theory, Time-Dependent Density Functional Theory, Materials for New Energy

(3) Assistant Professor, August 2009 ~ July 2013
Department of Physics, National Taiwan University, Taipei, Taiwan
Research: Kohn-Sham Density Functional Theory, Time-Dependent Density Functional Theory, Materials for New Energy

(4) Postdoctoral Fellow, January 2006 ~ June 2009
Department of Chemistry, University of California, Berkeley, California, USA
Research: Kohn-Sham Density Functional Theory, Time-Dependent Density Functional Theory

3. Education:

(1) Ph.D. in Chemical Physics, July 2002 ~ December 2005

Institute for Physical Science and Technology, University of Maryland, College Park, Maryland, USA
Research: Orbital-Free Density Functional Theory

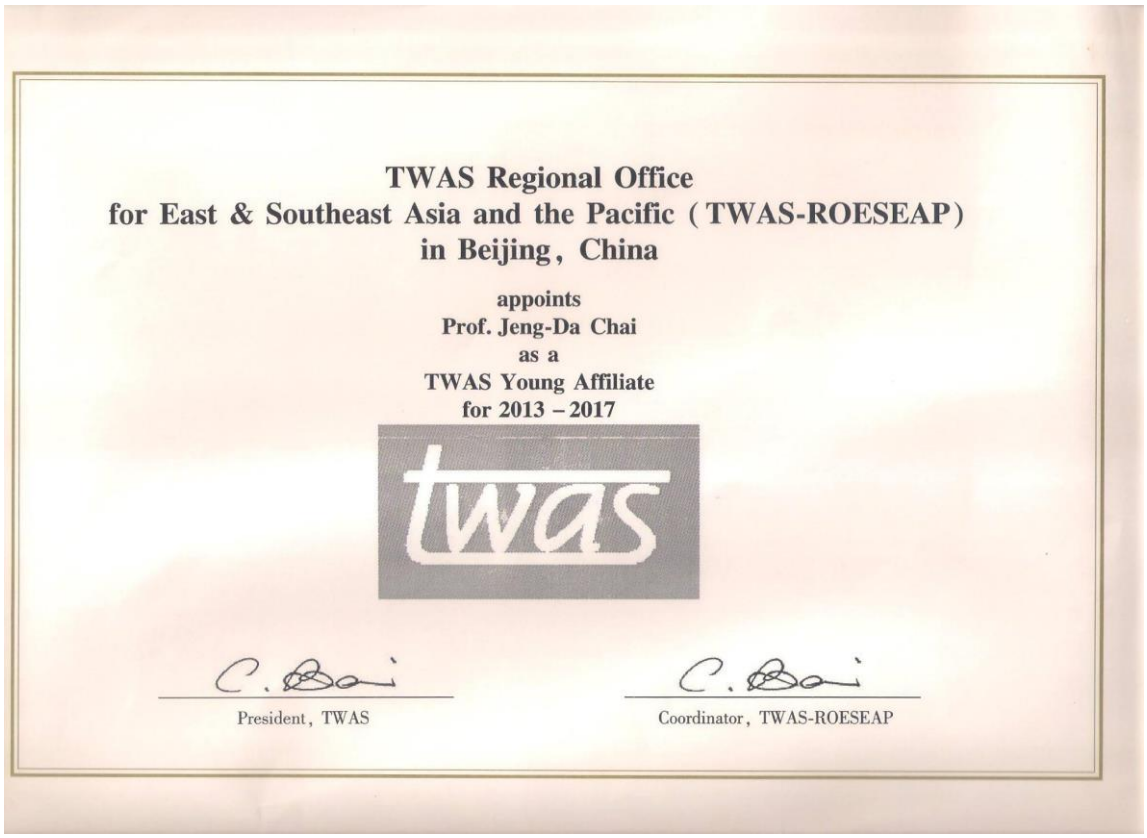
(2) M.S. in Physics (Ph.D. Candidate), September 1999 ~ June 2002
Department of Physics, The Ohio State University, Columbus, Ohio, USA
Research: *Ab Initio* Molecular Dynamics Simulations, High-Temperature Superconductors

(3) B.S. in Physics (with a minor in Mathematics), September 1993 ~ June 1997
Department of Physics, National Taiwan University, Taipei, Taiwan

4. Awards and Honors:

(1) Youth Medal, China Youth Corps, Taiwan (2015). [Honored by Taiwan President Ma Ying-jeou on March 26, 2015]

(2) TWAS Young Affiliate, The World Academy of Sciences (TWAS) - for the advancement of science in developing countries (2013 ~ 2017).



TWAS Regional Office
for East & Southeast Asia and the Pacific (TWAS-ROESEAP)
in Beijing, China

appoints
Prof. Jeng-Da Chai
as a
TWAS Young Affiliate
for 2013 – 2017

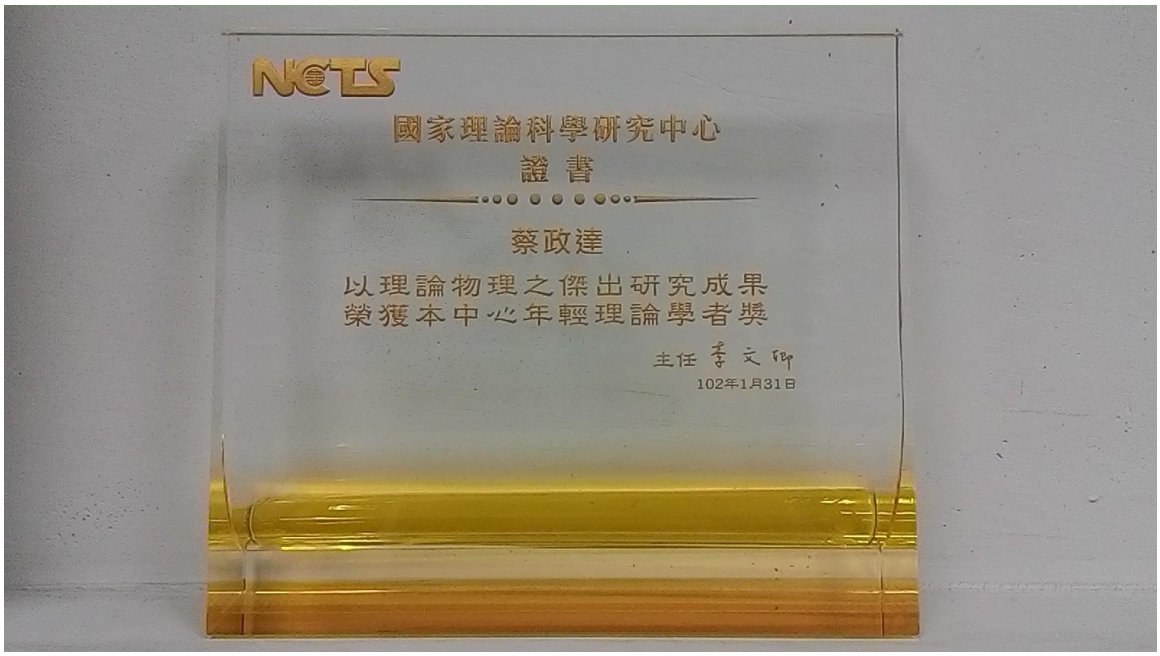
twas

C. Bai
President, TWAS

C. Bai
Coordinator, TWAS-ROESEAP

(3) Career Development Award, National Taiwan University, Taiwan (2013 ~ 2015).

(4) Young Theorist Award, National Center for Theoretical Sciences, Taiwan (2012).



NCTS
國家理論科學研究中心
證書

蔡政達
以理論物理之傑出研究成果
榮獲本中心年輕理論學者獎

主任 李文卿
102年1月31日

(5) EPSON Scholarship, The International Society for Theoretical Chemical Physics (2011).

CERTIFICATE OF

EPSON SCHOLARSHIP

This is to certificate that

Dr. Jeng-Da Chai

has been awarded EPSON Scholarship
in the 7th Congress of the International Society for Theoretical Chemical Physics
(ISTCP-VII), Waseda University, Tokyo, Japan, September 2-8, 2011.

Professor Hiromi Nakai
Chair of ISTCP-VII

June 1st, 2011
Awarded Date

(6) Excellent Journal Paper Award, National Taiwan University, Taiwan (2010, 2013, 2014).

(7) Have published two ***renowned*** (500+ citations) first-author papers.

5. **Software Development:**

(1) Co-developer of the famous Q-Chem software (2008 ~ present).

6. Journal Editors/Editorial Boards:

(1) Editorial Board, AASCIT Physics (December 2014 ~ present)

(2) Editorial Board, AASCIT Chemistry (December 2014 ~ present)

(3) Editorial Board, American Journal of Engineering and Applied Sciences (December 2014 ~ present)

(4) Editorial Board, Progress in Chemical Engineering (July 2013 ~ present)

(5) Editorial Board, Journal of Theoretical Chemistry (January 2013 ~ present)

(6) Editorial Board, Dataset Papers in Science (April 2012 ~ present)

(7) Editorial Board, Open Journal of Physical Chemistry (March 2011 ~ present)

(8) Lead Guest Editor, for a Special Issue on "Density Functional Theory and Its Applications", The Scientific World Journal (September 2012 ~ June 2013)

7. Journal Referees:

Journal of Chemical Physics, Journal of Chemical Theory and Computation, Physical Chemistry Chemical Physics, Journal of Physical Chemistry, RSC Advances, Theoretical Chemistry Accounts, Molecular Physics, International Journal of Quantum Chemistry,

Bulletin of the Chemical Society of Japan, Chinese Journal of Physics, Journal of Theoretical and Computational Chemistry.

8. Selected Recent Publications (2008 ~ present):

[Citation information taken from Web of Science on March 29, 2015]
[With two ***renowned*** (500+ citations) papers and two ***well-known*** (50~99 citations) papers]
(*: Corresponding Authors)

(1) **Jeng-Da Chai** and Martin Head-Gordon*, "Systematic Optimization of Long-Range Corrected Hybrid Density Functionals", Journal of Chemical Physics **128**, 084106 (2008). [Impact Factor: 3.122, Times Cited: **630**]

(2) **Jeng-Da Chai** and Martin Head-Gordon*, "Long-Range Corrected Hybrid Density Functionals with Damped Atom-Atom Dispersion Corrections", Physical Chemistry Chemical Physics **10**, 6615 (2008). [Impact Factor: 4.198, Times Cited: **1425**]

(3) **Jeng-Da Chai*** and Martin Head-Gordon, "Optimal Operators for Hartree-Fock Exchange from Long-Range Corrected Hybrid Density Functionals", Chemical Physics Letters **467**, 176 (2008). [Impact Factor: 1.991, Times Cited: 31]

(4) Tobias Benighaus, Robert A. DiStasio, Jr., Rohini C. Lochan, **Jeng-Da Chai**, and Martin Head-Gordon*, "Semiempirical Double-Hybrid Density Functional with Improved Description of Long-Range Correlation", Journal of Physical Chemistry A **112**, 2702 (2008). [Impact Factor: 2.775, Times Cited: **63**]

(5) **Jeng-Da Chai** and Martin Head-Gordon*, "Long-Range Corrected Double-Hybrid Density Functionals", Journal of Chemical Physics **131**, 174105 (2009). [Impact Factor: 3.122, Times Cited: **84**]

(6) **Jeng-Da Chai**, Vincent L. Lignères, Gregory Ho, Emily A. Carter, and John D. Weeks*, "Orbital-Free Density Functional Theory: Linear Scaling Methods for Kinetic Potentials, and Applications to Solid Al and Si", Chemical Physics Letters **473**, 263 (2009). [Impact Factor: 1.991, Times Cited: 4]

(7) John A. Parkhill, **Jeng-Da Chai**, Anthony D. Dutoi, and Martin Head-Gordon*, "The Exchange Energy of a Uniform Electron Gas Experiencing a New, Flexible Range Separation", Chemical Physics Letters **478**, 283 (2009). [Impact Factor: 1.991, Times Cited: 4]

(8) Jian-Hao Li, **Jeng-Da Chai***, Guang-Yu Guo, and Michitoshi Hayashi*, "The Quantified NTO Analysis for the Electronic Excitations of Molecular Many-Body Systems", Chemical Physics Letters **514**, 362 (2011). [Impact Factor: 1.991, Times Cited: 2]

(9) **Jeng-Da Chai***, "Density Functional Theory with Fractional Orbital Occupations", Journal of

Chemical Physics **136**, 154104 (2012). [Impact Factor: 3.122, Times Cited: 11]

(10) You-Sheng Lin, Chen-Wei Tsai, Guan-De Li, and **Jeng-Da Chai***, "Long-Range Corrected Hybrid Meta-Generalized-Gradient Approximations with Dispersion Corrections", Journal of Chemical Physics **136**, 154109 (2012). [Impact Factor: 3.122, Times Cited: 16]

(11) **Jeng-Da Chai*** and Shan-Ping Mao, "Seeking for Reliable Double-Hybrid Density Functionals without Fitting Parameters: The PBE0-2 Functional", Chemical Physics Letters **538**, 121 (2012). [Impact Factor: 1.991, Times Cited: 20]

(12) Piin-Ruey Pan, You-Sheng Lin, Ming-Kang Tsai, Jer-Lai Kuo*, and **Jeng-Da Chai***, "Assessment of Density Functional Approximations for the Hemibonded Structure of the Water Dimer Radical Cation", Physical Chemistry Chemical Physics **14**, 10705 (2012). [Impact Factor: 4.198, Times Cited: 13]

(13) Jian-Hao Li, **Jeng-Da Chai***, Guang-Yu Guo, and Michitoshi Hayashi*, "Significant Role of the DNA Backbone in Mediating the Transition Origin of Electronic Excitations of B-DNA — Implication from Long Range Corrected TDDFT and Quantified NTO Analysis", Physical Chemistry Chemical Physics **14**, 9092 (2012). [Impact Factor: 4.198, Times Cited: 1]

(14) **Jeng-Da Chai*** and Po-Ta Chen, "Restoration of the Derivative Discontinuity in Kohn-Sham Density Functional Theory: An Efficient Scheme for Energy Gap Correction", Physical Review Letters **110**, 033002 (2013). [Impact Factor: **7.728**, Times Cited: 10]

(15) You-Sheng Lin, Guan-De Li, Shan-Ping Mao, and **Jeng-Da Chai***, "Long-Range Corrected Hybrid Density Functionals with Improved Dispersion Corrections", Journal of Chemical Theory and Computation **9**, 263 (2013). [Impact Factor: 5.310, Times Cited: 15]

(16) Chen-Wei Tsai, Yu-Chuan Su, Guan-De Li, and **Jeng-Da Chai***, "Assessment of Density Functional Methods with Correct Asymptotic Behavior", Physical Chemistry Chemical Physics **15**, 8352 (2013). [Impact Factor: 4.198, Times Cited: 8]

(17) Chi-Ruei Pan, Po-Tung Fang, and **Jeng-Da Chai***, "Asymptotic Correction Schemes for Semilocal Exchange-Correlation Functionals", Physical Review A **87**, 052510 (2013). [Impact Factor: 2.991, Times Cited: 3]

(18) Kenji Sumida, David Stuck, Lorenzo Mino, **Jeng-Da Chai**, Eric D. Bloch, Olena Zavorotynska, Leslie J. Murray, Mircea Dinca, Sachin Chavan, Silvia Bordiga*, Martin Head-Gordon*, and Jeffrey R. Long*, "Impact of Metal and Anion Substitutions on the Hydrogen Storage Properties of M-BTT Metal-Organic Frameworks", Journal of the American Chemical Society **135**, 1083 (2013). [Impact Factor: **11.444**, Times Cited: 29]

(19) **Jeng-Da Chai***, "Thermally-Assisted-Occupation Density Functional Theory with Generalized-Gradient Approximations", Journal of Chemical Physics **140**, 18A521 (2014). [Impact Factor: 3.122, Times Cited: 1]

(20) Wei-Tao Peng and **Jeng-Da Chai***, "Assessment of Asymptotically Corrected Model Potentials for Charge-Transfer-Like Excitations in Oligoacenes", Physical Chemistry Chemical Physics **16**, 21564 (2014). [Impact Factor: 4.198, Times Cited: 0]

(21) Hsueh-Chien Li, **Jeng-Da Chai***, and Ming-Kang Tsai*, "Assessment of Dispersion-Improved Exchange-Correlation Functionals for the Simulation of CO_2 Binding by Alcoholamines", International Journal of Quantum Chemistry **114**, 805 (2014). [Impact Factor: 1.166, Times Cited: 1]

(22) Yihan Shao, Zhengting Gan, Evgeny Epifanovsky, Andrew T. B. Gilbert, Michael Wormit, Joerg Kussmann, Adrian W. Lange, Andrew Behn, Jia Deng, Xintian Feng, Debashree Ghosh, Matthew Goldey, Paul R. Horn, Leif D. Jacobson, Ilya Kaliman, Rustam Z. Khaliullin, Tomasz Kus, Arie Landau, Jie Liu, Emil I. Proynov, Young Min Rhee, Ryan M. Richard, Mary A. Rohrdanz, Ryan P. Steele, Eric J. Sundstrom, H. Lee Woodcock III, Paul M. Zimmerman, Dmitry Zuev, Ben Albrecht, Ethan Alguire, Brian Austin, Gregory J. O. Beran, Yves A. Bernard, Eric Berquist, Kai Brandhorst, Ksenia B. Bravaya, Shawn T. Brown, David Casanova, Chung-Min Chang, Yunquing Chen, Siu Hung Chien, Kristina D. Closser, Deborah L. Crittenden, Michael Diedenhofen, Robert A. DiStasio Jr., Hainam Do, Anthony D. Dutoi, Richard G. Edgar, Shervin Fatehi, Laszlo Fusti-Molnar, An Ghysels, Anna Golubeva-Zadorozhnaya, Joseph Gomes, Magnus W. D. Hanson-Heine, Philipp H. P. Harbach, Andreas W. Hauser, Edward G. Hohenstein, Zachary C. Holden, Thomas-C. Jagau, Hyunjun Ji, Benjamin Kaduk, Kirill Khistyaev, Jaehoon Kim, Jihan Kim, Rollin A. King, Phil Klunzinger, Dmytro Kosenkov, Tim Kowalczyk, Caroline M. Krauter, Ka Un Lao, Adele Laurent, Keith V. Lawler, Sergey V. Levchenko, Ching Yeh Lin, Fenglai Liu, Ester Livshits, Rohini C. Lochan, Arne Luenser, Prashant Manohar, Samuel F. Manzer, Shan-Ping Mao, Narbe Mardirossian, Aleksandr V. Marenich, Simon A. Maurer, Nicholas J. Mayhall, Eric Neuscamman, C. Melania Oana, Roberto Olivares-Amaya, Darragh P. O'Neill, John A. Parkhill, Trilisa M. Perrine, Roberto Peverati, Alexander Prociuk, Dirk R. Rehn, Edina Rosta, Nicholas J. Russ, Shaama M. Sharada, Sandeep Sharma, David W. Small, Alexander Sodt, Tamar Stein, David Stuck, Yu-Chuan Su, Alex J. W. Thom, Takashi Tsuchimochi, Vitalii Vanovschi, Leslie Vogt, Oleg Vydrov, Tao Wang, Mark A. Watson, Jan Wenzel, Alec White, Christopher F. Williams, Jun Yang, Sina Yeganeh, Shane R. Yost, Zhi-Qiang You, Igor Ying Zhang, Xing Zhang, Yan Zhao, Bernard R. Brooks, Garnet K. L. Chan, Daniel M. Chipman, Christopher J. Cramer, William A. Goddard III, Mark S. Gordon, Warren J. Hehre, Andreas Klamt, Henry F. Schaefer III, Michael W. Schmidt, C. David Sherrill, Donald G. Truhlar, Arieh Warshel, Xin Xu, Alan Aspuru-Guzik, Roi Baer, Alexis T. Bell, Nicholas A. Besley, **Jeng-Da Chai**, Andreas Dreuw, Barry D. Dunietz, Thomas R. Furlani, Steven R. Gwaltney, Chao-Ping Hsu, Yousung Jung, Jing Kong, Daniel S. Lambrecht, WanZhen Liang, Christian Ochsenfeld, Vitaly A. Rassolov, Lyudmila V. Slipchenko, Joseph E. Subotnik, Troy Van Voorhis, John M. Herbert, Anna I. Krylov, Peter M. W. Gill, and Martin Head-Gordon*,

"Advances in Molecular Quantum Chemistry Contained in the Q-Chem 4 Program Package", Molecular Physics **113**, 184 (2015). [Impact Factor: 1.642, Times Cited: 9]

(23) Chun-Shian Wu and **Jeng-Da Chai***, "Electronic Properties of Zigzag Graphene Nanoribbons Studied by TAO-DFT", Journal of Chemical Theory and Computation, DOI: 10.1021/ct500999m, in press (2015). [Impact Factor: 5.310, Times Cited: 0]

9. Selected Recent Invited Talks (2010 ~ present):

(1) "Thermally-Assisted-Occupation Density Functional Theory" presented at the 2nd Conference on New Advances in Condensed Matter Physics (NACMP 2015), Shanghai, China, February 1, 2015.

(2) "Thermally-Assisted-Occupation Density Functional Theory" presented at Annual Meeting of Physical Society of R.O.C., National Tsing Hua University, Hsinchu, Taiwan, January 29, 2015.

(3) "Thermally-Assisted-Occupation Density Functional Theory" presented at the 6th Cross-Strait Theoretical and Computational Chemistry Conference (CTCC-6), National Chung Cheng University, Chiayi, Taiwan, January 27, 2015.

(4) "Thermally-Assisted-Occupation Density Functional Theory" presented at the 9th International Conference on Computational Physics (ICCP9), National University of Singapore, Singapore, January 7, 2015.

(5) "Thermally-Assisted-Occupation Density Functional Theory" presented at the EITA-International Conference on New Materials, Nanotechnology and New Green Energy 2014 (EITA-New Materials 2014), National Cheng Kung University, Tainan, Taiwan, November 23, 2014.

(6) "Thermally-Assisted-Occupation Density Functional Theory" presented at the TWAS (The World Academy of Sciences - for the advancement of science in developing countries) 25th General Meeting, Muscat, Sultanate of Oman, October 28, 2014.

(7) "Thermally-Assisted-Occupation Density Functional Theory" presented at the 12th National Conference of Quantum Chemistry, Taiyuan, China, June 13, 2014.

(8) "Electronic Properties of Zigzag-Edged Graphene Nanoribbons" presented at BIT's 3rd Annual World Congress of Advanced Materials-2014 (WCAM-2014), Chongqing, China, June 6, 2014.

(9) "Thermally-Assisted-Occupation Density Functional Theory" presented at the 2014 EMN East Meeting (Energy Materials Nanotechnology), Beijing, China, May 14, 2014.

(10) "Thermally-Assisted-Occupation Density Functional Theory" presented at the 2014 Spring World Congress on Engineering and Technology (SCET 2014), Shanghai, China, April 17, 2014.

(11) "Energy Gap Correction and Asymptotic Correction Scheme in Density Functional

Theory" presented at Hong Kong Spring School on Quantum Simulation Methods, The University of Hong Kong, Hong Kong, April 9, 2014.

(12) "Restoration of the Derivative Discontinuity in Kohn-Sham Density Functional Theory: An Efficient Scheme for Energy Gap Correction" presented at the 12th International Conference on Nanoscience and Technology, Chengdu, China, October 30, 2013.

(13) "Restoration of the Derivative Discontinuity in Kohn-Sham Density Functional Theory: An Efficient Scheme for Energy Gap Correction" presented at the First International Workshop on Computational Science and Engineering (IWCSE 2013), National Taiwan University, Taipei, Taiwan, October 15, 2013.

(14) "Restoration of the Derivative Discontinuity in Kohn-Sham Density Functional Theory: An Efficient Scheme for Energy Gap Correction" presented at the 2013 Conference on Biophysics and Biochemistry (BPBC 2013), Beijing, China, September 19, 2013.

(15) "Restoration of the Derivative Discontinuity in Kohn-Sham Density Functional Theory: An Efficient Scheme for Energy Gap Correction" presented at the 8th Congress of the International Society for Theoretical Chemical Physics (ISTCP-VIII), Budapest, Hungary, August 27, 2013.

(16) "Restoration of the Derivative Discontinuity in Kohn-Sham Density Functional Theory: An Efficient Scheme for Energy Gap Correction" presented at the 6th Worldwide Chinese Theoretical and Computational Chemistry Conference (6th-WCTCC), Tamkang University, New Taipei, Taiwan, June 26, 2013.

(17) "Restoration of the Derivative Discontinuity in Kohn-Sham Density Functional Theory: An Efficient Scheme for Energy Gap Correction" presented at BIT's 2nd Annual World Congress of Advanced Materials-2013 (WCAM-2013), Suzhou, China, June 6, 2013.

(18) "Density Functional Theory with Fractional Orbital Occupations" presented at Annual Meeting of Physical Society of R.O.C., National Dong Hwa University, Hualien, Taiwan, January 31, 2013.

(19) "Density functional theory with fractional orbital occupations" presented at the 7th Singapore International Chemistry Conference (SICC-7), National University of Singapore, Singapore, December 18, 2012.

(20) "Density functional theory with fractional orbital occupations" presented at the 10th Asian International Seminar on Atomic and Molecular Physics (AISAMP10), Department of Physics, National Dong Hwa University, Hualien, Taiwan, October 29, 2012.

(21) "Density functional theory with fractional orbital occupations" presented at the 1st International Conference on Emerging Advanced Nanomaterials (ICEAN-2012), Brisbane, Australia, October 24, 2012.

(22) "Restoration of the Derivative Discontinuity in Kohn-Sham Density Functional Theory: An Efficient Scheme for Energy Gap Correction" presented at the 4th Annual

International Conference on Computational and Systems Biology (ICCSB2012), Shanghai Jiao Tong University, Shanghai, China, October 13, 2012.

(23) "Asymptotic Correction Schemes for Semilocal Exchange-Correlation Functionals" presented at the 2012 1st International Conference on Material Chemistry: Theoretical, Computational and Experimental Perspectives, Chinese Culture University, Taipei, Taiwan, September 21, 2012.

(24) "Restoration of the Derivative Discontinuity in Kohn-Sham Density Functional Theory: An Efficient Scheme for Energy Gap Correction" presented at the 5th Cross-Strait Theoretical and Computational Chemistry Conference (CTCC-5), Shaanxi Normal University, Xi'an, China, August 8, 2012.

(25) "Density functional theory with fractional orbital occupations" presented at the 3rd CQSE International Workshop on Atomic, Molecular, and Optical Science and Frontier Technology, Center for Quantum Science and Engineering (CQSE), National Taiwan University, Taipei, Taiwan, January 8, 2012.

(26) "Advances in Density Functional Theory" presented at the 2011 1st Q-Chem Workshop in Taiwan, National Center for High-Performance Computing, Hsinchu, Taiwan, November 21, 2011.

(27) "Density functional theory with fractional occupations" presented at the 11th National Conference of Quantum Chemistry, University of Science and Technology of China, Hefei, China, May 28, 2011.

(28) "Strong electron correlations via a new formulation of density functional theory" presented at Annual Meeting of Physical Society of R.O.C., National Taiwan Normal University, Taipei, Taiwan, January 26, 2011.

(29) "Recent Development of Density Functional Theory" presented at the 4th Cross-Strait Theoretical and Computational Chemistry Conference (CTCC-4), National Quemoy University, Kinmen, Taiwan, January 12, 2011.

(30) "Recent Development of Density Functional Theory" presented at the 13th Asian Workshop on First-Principles Electronic Structure Calculations, Pohang University of Science and Technology (POSTECH), Pohang, Korea, November 1, 2010.

(31) "Advances in Long-Range Corrected Double-Hybrid Density Functionals" presented at the 2nd International Workshop on Atomic, Molecular, and Optical Science and Frontier Technology, Center for Quantum Science and Engineering (CQSE), National Taiwan University, Taipei, Taiwan, May 1, 2010.

Citation for the Award (within 30 words)

For "his outstanding contributions to the development of generally accurate density functional methods for nanoscale applications."

Description of the work

As the problem of finding an exact solution to the Schrödinger equation for a many-electron system quickly becomes intractable as the system size increases, the development of efficient and accurate electronic structure methods for large systems, continues being the subject of intense current interest. Over the past two decades, Kohn-Sham density functional theory (KS-DFT) has become one of the most popular theoretical approaches for calculations of electronic properties of large ground-state systems (up to a few thousand electrons), due to its favorable balance between cost and performance. Recently, its time-dependent extension, time-dependent density functional theory (TDDFT), has also been actively developed for the study of excited-state and time-dependent properties of large systems with considerable success. Consequently, Prof. Walter Kohn, one of the main developers of KS-DFT, was awarded the Nobel Prize in Chemistry in 1998 for his accomplishment.

However, the essential ingredient of KS-DFT, the exact exchange-correlation (XC) energy functional $E_{xc}[\rho]$, remains unknown and needs to be approximated. Functionals based on the conventional density functional approximations (DFAs), such as the local density approximation (LDA) and generalized gradient approximations (GGAs), are reliably accurate for properties governed by short-range XC effects, and are computationally efficient for nanoscale systems. Nevertheless, KS-DFAs can produce erroneous results in situations where the nonlocal XC effects are pronounced. Therefore, resolving the qualitative failures of KS-DFAs at a reasonable computational cost is tremendously important for nanoscale applications.

To meet the challenge, Dr. Jeng-Da Chai, who performed his postdoctoral research in Prof. Martin Head-Gordon's group at the University of California, Berkeley, developed a family of accurate long-range corrected (LC) hybrid density functionals (ωB97 [1], ωB97X [1], ωB97X-D [2], and ωB97X-2 [3]) for general applications. The main feature of the LC hybrid functionals is that the long-range part of exchange is treated exactly by the Hartree-Fock theory, while the short-range counterpart is treated approximately by DFAs. Before 2008, as existing LC hybrid functionals were not as accurate as B3LYP (the most popular hybrid density functional in 1990s and 2000s) for properties insensitive to the asymptote problems, LC hybrid functionals were not widely adopted for general applications. In 2008, Chai and Head-Gordon first proposed a systematic optimization procedure to model LC hybrid functionals, greatly improving the overall accuracy of LC hybrid functionals [1]. The resulting LC hybrid functionals [1], ωB97 and ωB97X, were shown to outperform B3LYP and many other well-known density functionals for a very wide range of applications. Since then, this seminal work has opened up a new direction in the development of generally accurate density functionals for nanoscale applications.

To accurately describe noncovalent interactions, Chai and Head-Gordon extended ωB97X to include atom-atom dispersion corrections. The resulting ωB97X-D functional [2] (cited more than 1,400 times), has been one of the most popular density functionals in atomic, molecular, and chemical physics, and quantum chemistry. In 2009, Chai and Head-Gordon also proposed a LC double-hybrid functional, ωB97X-2 [3], which is a LC hybrid functional (based on ωB97X) with a nonlocal description of electron correlation (inspired by second-order Møller–Plesset perturbation theory). Since 2008, the four LC hybrid functionals (ωB97 [1], ωB97X [1], ωB97X-D [2], and ωB97X-2 [3]) developed by Chai and Head-Gordon, have been recognized worldwide (cited more than 2,100 times). In addition, Chai and Head-Gordon also argued that the fine details of

Hartree-Fock operators adopted in LC hybrid functionals could be responsible to the accuracy of LC hybrid functionals [4].

Since August 2009, Dr. Chai has joined the faculty of the Department of Physics at National Taiwan University, and has made several significant contributions to the development of generally accurate density functional methods for nanoscale applications. For examples, Dr. Chai and his students developed three accurate LC hybrid density functionals (ωM05-D [5], ωM06-D3 [6], and ωB97X-D3 [6]). In particular, they emphasized the importance of kinetic energy density in ωM05-D and ωM06-D3. This unique combination was found to provide supreme performance for a very wide range of applications, including thermochemistry, kinetics, noncovalent interactions, frontier orbital energies, fundamental gaps, and long-range charge-transfer excitations. Relative to ωB97X-D, the three LC hybrid functionals were shown to be superior for general applications.

To avoid the use of orbital-dependent functionals (for computational efficiency), Dr. Chai and his students devised asymptotic correction schemes (e.g., a "pure" density functional whose functional derivative has the correct asymptote), such as LFA-PBE, RILFA-PBE, and LFAs-PBE, which were shown to be accurate for properties sensitive to the asymptote problems [7]. Besides, Dr. Chai and his student also developed a non-empirical double-hybrid density functional (PBE0-2) for general applications. The qualitative failures of conventional KS-DFAs, such as self-interaction error and noncovalent interaction error, are significantly reduced by PBE0-2 [8].

In addition, Dr. Chai and co-workers provided a comprehensive comparison of density functional methods with correct asymptotic behavior, such as LC hybrid functionals and asymptotically corrected (AC) model potentials [9–14]. The LC hybrid scheme was shown to consistently outperform the AC model potential scheme for the ground-state, excited-state, and time-dependent properties of a wide range of systems.

For the collaborative projects with international groups, Dr. Chai collaborated with Prof. Martin Head-Gordon and Prof. Jefffery Long's groups (U.C. Berkley) for a combined computational and experimental approach to the design and synthesis of new frameworks for hydrogen storage applications [15] (published in the Journal of American Chemical Society, one of the most prestigious journals in chemistry).

In 2013, Dr. Chai and his student proposed a systematic procedure for the evaluation of the derivative discontinuity (DD) of exchange-correlation density functional in KS-DFT, wherein the fundamental gap can be accurately and efficiently predicted by adding the estimated DD to the KS energy gap [16]. In addition, they showed that the fundamental gap of a system can be exactly evaluated by the KS orbitals and their energies for the system, which is a nontrivial result. The validity and accuracy of their perturbation schemes have been demonstrated for a wide variety of atoms and molecules, extending the applicability of KS-DFT to an area long believed to be beyond its reach. As this work resolved a very challenging and important subject in KS-DFT, it was published in one of the most prestigious journals in physics, Physical Review Letters.

Aiming to study the ground-state properties of large systems with strong static correlation effects, Dr. Chai proposed thermally-assisted-occupation density functional theory (TAO-DFT) [17], a density functional theory with fractional orbital occupations given by the Fermi-Dirac distribution (controlled by a fictitious temperature). Due to its significance, this work has been internationally recognized for being highlighted in the "Top 20 Most Read Articles of the Journal

of Chemical Physics in April 2012". In 2014, Dr. Chai further extended TAO-DFT to include GGA XC density functionals [18]. Relative to his previous TAO-LDA (i.e., the LDA to TAO-DFT), the resulting TAO-GGAs were shown to be significantly superior for a wide range of applications, such as thermochemistry, kinetics, and reaction energies. For noncovalent interactions, TAO-GGAs with empirical dispersion corrections were shown to yield excellent performance. Due to their computational efficiency for systems with strong static correlation effects, TAO-LDA and TAO-GGAs were applied to study the electronic properties of acenes with different number of linearly fused benzene rings (up to 100), which is very challenging for conventional electronic structure methods. Very recently, Dr. Chai and his student applied TAO-DFT to study the electronic properties of zigzag graphene nanoribbons (i.e., very important and challenging systems) [19].

In summary, Dr. Jeng-Da Chai's research at National Taiwan University has mainly focused on the development of generally accurate density functional methods suitable for the study of electronic and optical properties of nanoscale systems. This is a research area tremendously important for atomic, molecular and solid-state physics, quantum chemistry, and materials science. However, only very few researchers, who are living and working in developing countries, are working in this challenging research area, when compared with those living and working in developed countries, such as Japan, the United States, and European countries. In view of his outstanding contributions to the development of generally accurate density functional methods for nanoscale applications, Dr. Jeng-Da Chai deserves the Nishina Asia Award to recognize and encourage his research achievements.

References:

(*: Corresponding Authors)

[1] **Jeng-Da Chai** and Martin Head-Gordon*, "Systematic Optimization of Long-Range Corrected Hybrid Density Functionals", Journal of Chemical Physics **128**, 084106 (2008).

[2] **Jeng-Da Chai** and Martin Head-Gordon*, "Long-Range Corrected Hybrid Density Functionals with Damped Atom-Atom Dispersion Corrections", Physical Chemistry Chemical Physics **10**, 6615 (2008).

[3] **Jeng-Da Chai** and Martin Head-Gordon*, "Long-Range Corrected Double-Hybrid Density Functionals", Journal of Chemical Physics **131**, 174105 (2009).

[4] **Jeng-Da Chai*** and Martin Head-Gordon, "Optimal Operators for Hartree-Fock Exchange from Long-Range Corrected Hybrid Density Functionals", Chemical Physics Letters **467**, 176 (2008).

[5] You-Sheng Lin, Chen-Wei Tsai, Guan-De Li, and **Jeng-Da Chai***, "Long-Range Corrected Hybrid Meta-Generalized-Gradient Approximations with Dispersion Corrections", Journal of Chemical Physics **136**, 154109 (2012).

[6] You-Sheng Lin, Guan-De Li, Shan-Ping Mao, and **Jeng-Da Chai***, "Long-Range Corrected Hybrid Density Functionals with Improved Dispersion Corrections", Journal of Chemical

Theory and Computation **9**, 263 (2013).

[7] Chi-Ruei Pan, Po-Tung Fang, and **Jeng-Da Chai***, "Asymptotic Correction Schemes for Semilocal Exchange-Correlation Functionals", Physical Review A **87**, 052510 (2013).

[8] **Jeng-Da Chai*** and Shan-Ping Mao, "Seeking for Reliable Double-Hybrid Density Functionals without Fitting Parameters: The PBE0-2 Functional", Chemical Physics Letters **538**, 121 (2012).

[9] Piin-Ruey Pan, You-Sheng Lin, Ming-Kang Tsai, Jer-Lai Kuo*, and **Jeng-Da Chai***, "Assessment of Density Functional Approximations for the Hemibonded Structure of the Water Dimer Radical Cation", Physical Chemistry Chemical Physics **14**, 10705 (2012).

[10] Chen-Wei Tsai, Yu-Chuan Su, Guan-De Li, and **Jeng-Da Chai***, "Assessment of Density Functional Methods with Correct Asymptotic Behavior", Physical Chemistry Chemical Physics **15**, 8352 (2013).

[11] Wei-Tao Peng and **Jeng-Da Chai***, "Assessment of Asymptotically Corrected Model Potentials for Charge-Transfer-Like Excitations in Oligoacenes", Physical Chemistry Chemical Physics **16**, 21564 (2014).

[12] Hsueh-Chien Li, **Jeng-Da Chai***, and Ming-Kang Tsai*, "Assessment of Dispersion-Improved Exchange-Correlation Functionals for the Simulation of CO_2 Binding by Alcoholamines", International Journal of Quantum Chemistry **114**, 805 (2014).

[13] Jian-Hao Li, **Jeng-Da Chai***, Guang-Yu Guo, and Michitoshi Hayashi*, "The Quantified NTO Analysis for the Electronic Excitations of Molecular Many-Body Systems", Chemical Physics Letters **514**, 362 (2011).

[14] Jian-Hao Li, **Jeng-Da Chai***, Guang-Yu Guo, and Michitoshi Hayashi*, "Significant Role of the DNA Backbone in Mediating the Transition Origin of Electronic Excitations of B-DNA — Implication from Long Range Corrected TDDFT and Quantified NTO Analysis", Physical Chemistry Chemical Physics **14**, 9092 (2012).

[15] Kenji Sumida, David Stuck, Lorenzo Mino, **Jeng-Da Chai**, Eric D. Bloch, Olena Zavorotynska, Leslie J. Murray, Mircea Dinca, Sachin Chavan, Silvia Bordiga*, Martin Head-Gordon*, and Jeffrey R. Long*, "Impact of Metal and Anion Substitutions on the Hydrogen Storage Properties of M-BTT Metal-Organic Frameworks", Journal of the American Chemical Society **135**, 1083 (2013).

[16] **Jeng-Da Chai*** and Po-Ta Chen, "Restoration of the Derivative Discontinuity in Kohn-Sham Density Functional Theory: An Efficient Scheme for Energy Gap Correction", Physical Review Letters **110**, 033002 (2013).

[17] **Jeng-Da Chai***, "Density Functional Theory with Fractional Orbital Occupations", Journal of

Chemical Physics **136**, 154104 (2012).

[18] **Jeng-Da Chai***, "Thermally-Assisted-Occupation Density Functional Theory with Generalized-Gradient Approximations", Journal of Chemical Physics **140**, 18A521 (2014).

[19] Chun-Shian Wu and **Jeng-Da Chai***, "Electronic Properties of Zigzag Graphene Nanoribbons Studied by TAO-DFT", Journal of Chemical Theory and Computation, DOI: 10.1021/ct500999m, in press (2015).

Key references (up to 3 key publications*)

[Citation information taken from Web of Science on March 29, 2015]

(1) **Jeng-Da Chai** and Martin Head-Gordon, "Systematic Optimization of Long-Range Corrected Hybrid Density Functionals", Journal of Chemical Physics **128**, 084106 (2008). [Impact Factor: 3.122, Times Cited: **630**] (Most Significant Publication)

(2) **Jeng-Da Chai** and Martin Head-Gordon, "Long-Range Corrected Hybrid Density Functionals with Damped Atom-Atom Dispersion Corrections", Physical Chemistry Chemical Physics **10**, 6615 (2008). [Impact Factor: 4.198, Times Cited: **1425**]

(3) **Jeng-Da Chai** and Martin Head-Gordon, "Long-Range Corrected Double-Hybrid Density Functionals", Journal of Chemical Physics **131**, 174105 (2009). [Impact Factor: 3.122, Times Cited: **84**]

*) Copy of one most significant publication should be attached.

Nominator (name, affiliation, email, telephone and relation to the candidate)

Signature Date

Nomination form for the 2015 Nishina Asia Award

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)

Name: Ke HE

Affiliation: State Key Laboratory of Low-Dimensional Quantum Physics, Department of Physics, Tsinghua University, CHINA

Education:

Sep. 2000 ~ Mar. 2006 Ph.D. Institute of Physics, Chinese Academy of Sciences
The date of the degree of Ph.D.: 25 March 2006

Sept. 1996 ~ Jul. 2000 B.S. Department of Physics, Shandong University

Employment:

Sep. 2013 ~ Present	Assoc. Prof.	Department of Physics, Tsinghua University
Apr. 2009 ~ Sep. 2013	Assoc. Prof.	Institute of Physics, Chinese Academy of Sciences
Apr. 2007 ~ Mar.2009	Postdoc.	Institute for Solid State Physics, the University of Tokyo
Apr. 2006 ~ Mar.2007	Postdoc.	Department of Physics, the University of Tokyo

Nationality: Chinese

Address: Department of Physics, Tsinghua University, Beijing 100084, China

Email: kehe@tsinghua.edu.cn; Telephone: +86-10-62771704

Citation for the Award (within 30 words)

The outstanding contributions to the first experimental realization of the quantum anomalous Hall effect

Description of the work

Quantum anomalous Hall effect is a quantum Hall effect that occurs at zero magnetic field. This effect is crucial for applications of quantum Hall physics in low-energy-dissipation electronic devices. It was theoretically predicted in 1988. In spite of extensive investigation since then, there is no experimental success. From 2009, Dr. Ke He and his collaborators have carried out a systematic study on the material preparation and electronic properties of topological insulators, aiming to experimentally realize the quantum anomalous Hall effect. As an expert in molecular beam epitaxy, angle-resolved photoemission spectroscopy and scanning tunneling microscopy, Dr. He was mainly responsible for growth and band-engineering of topological insulator materials in

this project. He obtained thin films of Bi_2Se_3 family topological insulators with well-controlled composition, thickness and quality, and for the first time, established the evolution of the electronic structure of a three-dimensional topological insulator in the two-dimensional limit (Key Ref. 1). He discovered the magnetic topological insulator material system for the quantum anomalous Hall effect and clarified the relation between magnetism, band structure and topological properties in magnetic topological insulators (Key Ref. 2). These progresses laid the foundation for the discovery of quantum anomalous Hall effect and are among the most influential works in the field of topological insulators.

In 2013, the quantum anomalous Hall effect was finally experimentally observed in thin films of Cr-doped $(Bi_xSb_{1-x})_2Te_3$ topological insulator by Dr. He and his collaborators (Key Ref. 3). Growth of such four-element thin films exhibiting the quantum anomalous Hall effect is extremely challenging and **is the most difficult part of this experiment**. Therefore, the contribution by Dr. He is crucial for the successful observation of quantized anomalous Hall effect. This discovery not only concludes the 25-year-long search for the quantum Hall effect without magnetic field, but also paves the road to many other novel quantum phenomena such as axion magnetoelectric effect and chiral topological superconductivity. This work represents one of the most important experimental breakthroughs of condensed matter physics in recent years worldwide. Dr. He well qualifies for the prestigious Nishina Asia Award regarding his outstanding achievements mentioned above.

.

Key references (up to 3 key publications*)

[1] Zhang, Y.; **He, K.**; Chang, C.-Z.; Song, C.-L.; Wang, L.-L.; Chen, X.; Jia, J.-F.; Fang, Z.; Dai, X.; Shan, W.-Y.; Shen, S.-Q.; Niu, Q.; Qi, X.-L.; Zhang, S.-C.; Ma, X.-C.; Xue, Q.-K., "Crossover of the three-dimensional topological insulator Bi_2Se_3 to the two-dimensional limit", *Nature Physics* **6**, 584 (2010).

[2] Zhang, J.; Chang, C.-Z.; Tang, P.; Zhang, Z.; Feng, X.; Li, K.; Wang, L.-l.; Chen, X.; Liu, C.; Duan, W.; **He, K**.; Xue, Q.-K.; Ma, X.; Wang, Y., "Topology-driven magnetic quantum phase transition in topological insulators", *Science* **339**, 1582 (2013).

[3] Chang, C.-Z.; Zhang, J.; Feng, X.; Shen, J.; Zhang, Z.; Guo, M.; Li, K.; Ou, Y.; Wei, P.; Wang, L.-L.; Ji, Z.-Q.; Feng, Y.; Ji, S.; Chen, X.; Jia, J.; Dai, X.; Fang, Z.; Zhang, S.-C.; **He, K.**; Wang, Y.; Lu, L.; Ma, X.-C.; Xue, Q.-K., "Experimental observation of the quantum anomalous Hall effect in a magnetic topological insulator", *Science* **340**, 167 (2013).*****

Dr. Ke He is a corresponding author of all the three papers.

***** Copy of the publication is attached.

Nominator (name, affiliation, email, telephone and relation to the candidate)
Name： Qi-Kun Xue Affiliation: State Key Laboratory of Low-Dimensional Quantum Physics, Department of Physics, Tsinghua University Email: qkxue@mail.tsinghua.edu.cn; Telephone: +86-10-62795618 Relation to the candidate: Ph.D. supervisor and group leader
Signature:  Date 31 March 2015

Nomination form for the 2015 Nishina Asia Award

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)
Seok Kim, Seoul National University. See attached cv for all other details.
Citation for the Award (within 30 words)
For pioneering exact computations of superconformal indices in maximally supersymmetric conformal field theories in three and six dimensions using the techniques of supersymmetric localization.
Description of the work

Seok Kim has made pioneering contributions to the study of supersymmetric observables - in particular the exact computation of superconformal indices - in highly supersymmetric quantum field theories.

Seok's first really major result was his evaluation of the superconformal index of the so called ABJM theories. ABJM theories are ${\cal N}=6$ theories in three dimensions. These theories are Chern Simons theories based on the gauge group $U(N)_k \times U(N)_{-k}$ (subscripts denote the Chern Simons level). These theories are ${\cal N}=6$ supersymmetric at general k, but enjoy enhanced ${\cal N}=8$ supersymmetry when $k=1,2$. These theories have been intensively studied since 2008 when Aharony, Bergmann, Jafferis and Maldacena conjectured that they admit a dual description in terms of M theory on $AdS_4 \times S^7/Z_k$. The case $k=1$ is particularly interesting; in this case the field theory is believed to describe the IR dynamics of a collection of N M2 branes in M theory, and has an enhanced $SO(8)$ R symmetry.

The superconformal index is a signed partition function over the states of a supeconforrmal field theory on a sphere (or equivalently, by the state operator map, the operators of that theory) weighted by a fugacity for energy (scaling dimension) and various chemical potentials. This quantity captures a great deal of exact information about the exact spectrum of supersymmetric operators. Seok was able to employ the technique of supersymmetric localization to find an exact formula for the superconformal index of ABJM theories for all N and k. In order to obtain these exact results, Seok was obliged to include an integral over supersymmetric configurations involving monopole fluxes into his analysis. Seok's careful treatment of monopole operators was crucial to obtaining the contribution of states that see the 11 circle in M theory (previous analysis of the index applied only to the large k limit and so were only sensitive to dual modes in string theory, obtained by compactifying M theory on a circle). Seok's results agree with those from AdS/CFT in the large N (but not necessarily large k) limit.

Seok's second major result was the exact computation of the superconformal index in the 6 dimensional (0,2) theory. The (0,2) theory is an intriguing theory from several points of view. Firstly, it is a maximally supersymmetric non gravavitational theory. Secondly it lives in six dimensions, the highest dimension in which the superconformal algebra exists. Third, upon compactification on a circle, its IR description is given by maximally supersymmetric Yang Mills theory in 5 dimensions.

Fourth, as demonstrated by Gaiotto, the compactification of this theory on Reimann surfaces yields four dimensional theories which flow in the IR to four dimensional gauge theories. Almost all known ${\cal N}=2$ gauge theories can be obtained in this manner. In other words a very large fraction of known consistent gauge theories in 4 dimensions can be obtained from an appropriate compactification of this theory. Clearly the (0,2) theory plays in special role in the space of quantum field theories.

There is no known Lagrangian for the 0$(0,2)$ theory. Nonetheless Seok and collaborators were able to compute the exact index of this theory using the method of supersymmetric localization. They did this by performing their computations in 5 dimensional Yang Mills theories obtained from the circle compactification of the $(0,2)$ theory. While 5d Yang Mills is presumably incomplete, it appears to be complete enough to contain all the supersymmetric configurations of the (0,2) theory (susy Kalutza Klein modes on the S^1 are caputured as instantons in the 5 d description). Using this phylosophy, Seok and collaborators were able to find explict formulas for the superconformal index of the (0,2) theory. This is a major and surprising result – thanks to which we know have a detailed understanding of the spectrum of operators of this theory, even in the absence of a Lagrangian.

In addition to the two results I have described Seok has obtained many other very interesting exact results in supersymmetric field theories. For instance he recently found a gauge theory that flows to the `worldsheet' theory of the E strings (membranes between M5 and M9 branes) of M theory and used his description to compute the eliptic genus of E strings. By computing the Witten Index, he cleared up a puzzle in the matching of vacuua of mass deformed ABJM theory between the boundary and the bulk. Seok has also written high qualityt papers on compcatifications and consistent trunctations of supergravity, and the construction of gravity duals of field theories that exhibit the non relativistic Schrodinger symmetry.

In summary I find several of Seok's papers excellent, and his work on the superconformal indies of maximally supersymmetric field theories in 3 and 6 dimensions simply outstanding. He is a brilliant young Korean physicist; an international leader in his area of speciality, and is, to my mind, ideally suited for the Nishina Award.

Key references (up to 3 key publications*)

The Complete superconformal index for N=6 Chern-Simons theory

Seok Kim (Imperial Coll., London).

Published in **Nucl.Phys. B821 (2009) 241-284, Erratum-ibid. B864 (2012) 884**

e-Print: **arXiv:0903.4172** [hep-th] | PDF

M5-branes from gauge theories on the 5-sphere

Hee-Cheol Kim (Korea Inst. Advanced Study, Seoul), Seok Kim (Seoul Natl. U.).

Published in **JHEP 1305 (2013) 144**

e-Print: **arXiv:1206.6339**

*) Copy of one most significant publication should be attached.

Nominator (name, affiliation, email, telephone and relation to the candidate)

Prof. Shiraz Minwalla
Tata Institute of Fundamental Research.
minwalla@theory.tifr.res.in

Signature Steinvalla Date March 31 2015

Nomination form for the 2015 Nishina Asia Award

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)

Name: Hongwei Zhao
Gender: Male
Date of birth: Jan. 13, 1966
Affiliation: Institute of Modern Physics (IMP), Chinese Academy of Sciences, Lanzhou, China

Curriculum vitae

Hongwei Zhao
Address: Institute of Modern Physics (IMP), CAS
Nanchang Road No.509, Lanzhou, 730000.
E-mail: zhaohw@impcas.ac.cn
Telephone: 86 931 4969210, cell phone: 13893616458
Citizenship: China

Current Appointments:
Research-professor, accelerator division, Institute of Modern Physics (IMP) since Nov. 1997.
Deputy Director, Institute of Modern Physics (IMP) since March 2008.
Past Appointments:
Associate research-professor, accelerator division, Institute of Modern Physics (IMP) (August 1995- Nov. 1997).
Junior researcher, accelerator division, Institute of Modern Physics (IMP) (July 1991- Nov. 1992).
Junior researcher, accelerator division of FLNR, Joint Institute for Nuclear Research, Dubna, Russia (Nov. 1992-Aug. 1995)

Education:
Joint Institute for Nuclear Research, Dubna, Russia (Nov. 1992-Aug.1995)
Degree: Russian PH.D in sciences and technologies
Thesis: Highly-charged ECR Ion Source physics and Technology
Advisor: Dr. V. B. Kutner
Institute of Modern Physics, CAS (Sept. 1991-July 1996)
Degree: Chinese PH.D in Physics
Thesis: Highly-charged ECR Ion Source physics and Technology
Advisor: Prof. Baowen Wei
Institute of Modern Physics, CAS (Sept. 1988-June 1991)
Degree: Chinese Master in Physics
Thesis: Beam physics and beam diagnostics
Advisor: Prof. Baowen Wei
Sichuan University, China (Sept.1984-July 1988)
Degree: B.S. in Physics.

Honors and Award:
1. **National Prize** for Advancement in Science and Technology, China (2012). For HIRFL-CSR project.
2. **Brightness Award** in ion source community. Awarded at 13th International Conference on Ion Sources held at Gatlinburg USA, September, 2009. For SECRAL ECR ion source achievements.
3. **The highest achievement prize** in Chinese Academy of Sciences (CAS) (2009). For contribution to HIRFL-CSR project.
4. **National Prize** for Advancement in Science and Technology, China (2008). For SECRAL ECR ion source achievements
5. **CAS Prize** for Advancement in Science and Technology, China (2000). For ECR ion source achievements.
6. **National Scientific Prize** for Young Scientist in China (1998). For ECR ion source research.
7. **The First Prize** for Scientific Achievements in Joint Institute of Nuclear Research, Dubna, Russia (1996). For research on ECR ion source.
8. **Flerov Fellowship**, awarded in 1993 by Joint Institute of Nuclear Research, Dubna, Russia (1993-1995).

Citation for the Award (within 30 words)

In recognition of his outstanding contribution to development and demonstration of high performance highly-charged ECR (Electron Cyclotron Resonance) ion sources and accelerator technologies.

Description of the work

ECR (Electron Cyclotron Resonance) ion source is a plasma device to produce intense highly-charged ion beams which have found applications in accelerator, nuclear physics, atomic physics, and ion-beam industry. A successful design, construction and operation of a highly-charged ECR ion source is strongly related to plasma physics, atomic physics, surface physics, ion beam optics, magnet engineering, microwave engineering and so on.

In the past 15 years, Dr. Hongwei Zhao and his group at IMP, have been developing 4 sorts of high performance highly-charged ECR ion sources with technologies of normal-conductor magnet, permanent magnet, evaporation-cooling magnet and superconducting magnet. Particularly Dr. Zhao and his group have led the way in conceiving and developing the first implementations of an innovative superconducting-magnet ECR ion source well known as SECRAL. SECRAL is one of the world best performance third-generation ECR ion sources for intense beam production of highly-charged ions. The most important breakthrough in the SECRAL development is its novel magnetic structure and those record CW beam currents for highly-charged ions such as $^{40}Ar^{12+}$ 1.5 mA, $^{129}Xe^{27+}$ 1.0 mA, $^{209}Bi^{30+}$ 0.7 mA, $^{209}Bi^{50+}$ 10 e μ A and so on. Those record beam currents created and updated steadily by SECRAL have been increased by a factor 3-5 in the past few years. SECRAL is the world first third-generation ECR ion source in operation to deliver more than 15000 hours for an accelerator. The SECRAL source performance has demonstrated it to be the highest output high charge state ECR source in the world. SECRAL has been pointing a new way to develop a compact, more reliable and high performance ECR ion source. The SECRAL world-leading level of demonstrated source performance together with other third-generation ECR ion source such as LBNL VENUS and RIKEN SC-ECRIS may provide the corresponding new research opportunities at the world-wide heavy ion facilities such as IMP HIRFL, RIKEN RIBF, MSU FRIB and GSI FAIR. The outstanding achievements and the significant contributions that Dr.Zhao has made in design, construction and operation of SECRAL have been highly recognized by the world ion source community. Dr.Zhao shared the "Brightness Award" with Dan Zuqi Xie, Claude Lyneis and Daniela Leitner (LBNL,USA) in 2009. The purpose of the "Brightness Award" is to "recognize and encourage innovative and significant recent achievements and breakthrough in the fields of ion source physics and technology".

The four sorts of highly-charged ECR ion sources developed by Dr. Zhao and his group have being operated for HIRFL accelerator facility (the biggest heavy ion accelerator in China) at IMP for 8-15 years. Those highly charged ion beams such as $^{26}Mg^{8+}$,$^{40}Ca^{11+}$,$^{58}Ni^{19+}$,$^{112}Sn^{26+}$, $^{208}Pb^{27+}$,$^{209}Bi^{31+}$,$^{238}U^{32+}$ delivered by the ECR ion sources to HIRFL accelerator, have played a significant role for Chinese nuclear physicists to synthesize more than 20 new isotopes and conduct precision mass-measurements of 16 short-lived nuclides for the first time.

Besides these outstanding accomplishments in the field of ECR ion source, through collaboration with BINP in Russia Dr. Zhao and his group built a new generation and also one of the world best performance electron-cooling devices which have played a significant role in beam commissioning and operation of the heavy ion cooling storage ring at IMP.

More recently, Dr. Zhao and his group have demonstrated successfully a prototype of ADS (Accelerator Driven Subcritical-reactor System) proton superconducting linac with beam energy 2.55 MeV, CW proton beam current 11 mA and CW beam power up to 28 kW, which is the world highest beam power presently achieved by a CW proton superconducting linac.

Key references (up to 3 key publications*)

1. H.W.Zhao, L.T.Sun, W.Lu, et.al, "New development of advanced superconducting Electron Cyclotron Resonance ion source SECRAL", Review of Scientific Instruments, ,Vol.81,02A201, (2010).
2. H.W.Zhao. "World-wide developments of superconducting ECR ion sources", invited talk at IPAC10. Proceedings of the first International Particle Accelerator Conference held in Kyoto, Japan in May 2010, p.31.
3. H.W.Zhao. "China ADS Linac R&D Progress", invited talk at LINAC14. The 27th International Conference on Linear Accelerator held in Geneva, Switzerland in September 2014.

*) Copy of one most significant publication should be attached.

Nominator (name, affiliation, email, telephone and relation to the candidate)

Name: Wenlong Zhan

Affiliation: Chinese Academy of Sciences (CAS)

Position: Professor in Physics, Chinese Academician, Vice-president of CAS.

E-mail: wlzhan@cashq.ac.cn

Telephone: 86 10 68526149, cell phone: 13910670282

Relation to the candidate: Hongwei Zhao is my former staff and subordinate at IMP. I was director in general of IMP (1998-2008).

Signature Date 2015/3/30