Nishina Asia Award 2020年度候補者一覧

査読者（配布資料）

（敬称略）

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.20-1	Ying Jiang China	Boya Distinguished Professor International Center for Quantum Materials, School of Physics, Peking University, Beijing, China	For his seminal contributions to the understanding of structure and dynamics of interfacial water at the atomic scale.	Prof. Zhong-xian Zhao ,	伊藤，村尾，松田
No.20-2	Parameswaran Ajith Indian	nternational Centre for Theoretical Sciences (Tata Institute of Fundamental Research)	For his pioneering contributions to the development of phenomenological models of gravitational-wave signals from coalescing binary black holes.	Spenta R Wadia infosys Homi Bhabha Chair Professor and Founding Director,International Centre for Theoretical Sciences (ICTS-TIFR),	佐々木，田村
No.20-3	Sungjay Lee Korea	School of Physics Korea Institute for Advanced Study	Discovery of a new class of d=3 gauge theories, with M-theory applications, and pioneering works that revolutionized study of d=2, 3 gauge theories and their	Piljin Yi Professor of Physics & Vice President Korea Institute for Advanced Study	風間，福嶋
No.20-4	Jun Zhao China	Xie Xide Junior Chair Professor, Dept. of Physics, Fudan University, Shanghai, China	The elucidation of magnetic properties of iron-based superconductors.	Yuanbo Zhang Professor of Physics, Fudan University, China	松田，山内
No.20-5	NGUYEN QUANG HUNG Viatnamese	Institite of Research and Developmenrt,Duy Tan University	The award is given to Dr. Nguyen Quang Hung for his contributions in the field of nuclear structure theory, particularly for the description of level density	Nguyen Dinh Dang Quantum Hadron Physics Laboratory RIKEN Nishina Center for Accelerator-Based Science	福嶋，田村
No.20-6	Feng-Kun Guo China	Institute of Theoretical Physics, Chinese Academy of Sciences	For his outstanding theoretical contributions to understanding the nature of new hadrons discovered since 2003.	岡　眞 Advanced Science Research Center, Japan Atomic Energy Agency	福島，中家，磯
No.20-7	Bumjoon Kim Korea	Department of Physics Pohang University of Science and Technology	The discovery and experimental study of an unconventional Mott insulating state induced by relativistic spin-orbit	Soo-Bong Kim Professor of Physics Seoul National University	松田，伊藤
No.20-8	Le Duc Ninh Vietnamese	Institute For Interdisciplinary Research in Science and Education, International Center for Interdisciplinary Science and Education (ICISE)	For his contribution to the precision-physics program at the CERN Large Hadron Collider, which is important to search for new physics beyond the	Jean Tran Thanh Van Rencontres du Vietnam (ICISE)	山内，田村

No.20-9	Bohm-Jung Yang Korea	Department of Physics and Astronomy,Seoul National University	for his contribution to uncovering topolpgical of three-dimensional Dirac semimetals	Doochul Kim Professor Emeritus Seoul National University	押川，風間，福嶋
No.20-10	Han-Chun Wu China	Beijing Institute of Technology	For his outstanding contributions in the opening a charge transport gap and introducing spin degree into	Ching-Ray Chang, NTU-IBM Quantum Computer Hub National Taiwan	押川，永長
No.20-11	Wei Song China	Associate Prof. in Tsinghua University	Her outstanding contributions to holography in warped anti-de Sitter spaces	Tadashi Takayanagi（高柳 匡）Professor at Yukawa Institute for Theoretical Physics, Kyoto U.	磯，佐々木
No.20-12	Chen Fang China	Institute of Physics, Chinese Academy of Sciences	For developing the theory of topological classification and diagnosis for non-magnetic	Hongming WENG Institute of Physics, Chinese Academy of	永長，村尾，押川
No.20-13	Ssu-Yen Huang Taiwan	Department of Physics, National Taiwan University	For his semina l contributions in pure spin current phenomena, including intrinsic spin-dependent thermal transport, spin Seebeck effect, transport magnetic	Yuan Huei Chang Department of Physics, National Taiwan University	永長，押川
No.20-14	Chang-Ki Min Korea	Researcher, XFEL Division, Pohang Accelerator Laboratory, Pohang, Republic of Korea	His contribution to substantial improvements of temporal accuracy in femtosecond time-resolved studies using hard X-ray free	In Soo Ko Director, Pohang Accelerator Laboratory and Professor Emeritus, Pohang University of	中家，伊藤，山内

No.20-1

Nomination form for the 2020 Nishina Asia Award

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)
Ying Jiang, Boya Distinguished Professor International Center for Quantum Materials, School of Physics, Peking University, Beijing, China Phone: +86-10-62757177 Email: yjiang@pku.edu.cn **Nationality:** China **Education:** Ph.D. Physics. Institute of Physics, Chinese Academy of Sciences (July 2008) Thesis: "The controlled growth and quantum properties of low-dimensional metal systems" Advisor: Prof. Enge Wang B.S. Physics. Beijing Normal University, China (July 2003) **Appointments:** Assistant Professor, Associate Professor, Full Professor. International Center for Quantum Materials, School of Physics, Peking University, Beijing, China (Jan. 2010-present) Postdoctoral Research Associate. Department of Physics and Astronomy, University of California, Irvine, USA (Mar. 2008-Dec. 2009) Visiting Scholar. Institut für Festkörperforschung, Forschungszentrum Jülich GmbH, Germany (Nov. 2006-Jun. 2007) **Honors:** Fellow of the American Physical Society (APS), 2019 Top-ten Science Advances in China, Ministry of Science and technology of China, 2016 and 2018 Leading Innovative Talent in Science and Technology, Central Chinese Government, 2018 China-Youth Science and Technology Award, China Association for Science and Technology, 2018 Tan Kah Kee Young Scientist Award, Tan Kah Kee Science Award Foundation, 2018 Distinguished Young Scholars, National Science Foundation of China, 2017 Cheung Kong Young Scholar, Ministry of Education of China, 2017 Emerging Leaders, Journal of Physics: Condensed Matter (IOP), 2016

Citation for the Award (within 30 words)
For his seminal contributions to the understanding of structure and dynamics of interfacial water at the atomic scale.
Description of the work
In 1926, Schrödinger proposed an equation to describe the quantum behavior of microscopic particles. Unfortunately, it is impossible to solve this equation for realistic material systems due to the many-body problem. One year later, Born and Oppenheimer avoided this difficulty by adding an approximation to this equation that only the electrons are treated quantum mechanically while the heavy nuclei are considered as classical particles. The so-called Born-Oppenheimer approximation is very successful in understanding and predicting the physical properties of many materials. However, it is not accurate anymore or even invalid for light-element materials, where the nuclei can also exhibit prominent quantum effects. Water is probably the most noticeable archetype of such materials beyond the Born-Oppenheimer approximation. For this reason, many unusual properties of water still remain mysterious so far. The complexity of water mainly arises from the high-density hydrogen, which is extremely difficult to characterize in experiment due to its small size and mass. In order to overcome this grand challenge, Ying Jiang has pioneered the H-sensitive scanning probe microscopy (SPM) using a qPlus sensor relying on the weak high-order electrostatic force. On one hand, it was able to achieve the submolecular resolution of water molecules, which allows locating, in real space, the position of H atoms within the H-bonded network; On the other hand, the disturbance of the probe on fragile water structure was reduced to a nearly non-invasive level. Those innovations in SPM techniques have opened up a new era of water science and led to several seminal works (8 in Science/Nature journals). First, Jiang has made seminal contributions to the elucidation of Nuclear Quantum Effects (NQEs) [1]. His systematic works along this line have received worldwide recognitions. In 2015, he succeeded to track the proton dynamics in real time within a water cluster and observed quantum tunneling of multiple protons in a concerted fashion, which puts an end to a 20-years long debate. The concerted proton tunneling in water/ice has been confirmed afterward by many groups using different techniques; In 2016, he provided a smoking gun for how the quantum motion of H atoms affects the H-bonding interaction and arrived at a general picture that the zero-point motion of protons weakens the weak H bonds but strengthens the relatively strong ones. Those findings have profound implications for the understanding of water from a quantum mechanical view. In 2018, Jiang was also the first to achieve atomic-resolution imaging of ion hydrates, the textbook clusters formed by water-ion interaction [2]. His works provide new insights into many key issues that are still under debate in this important field, such as the water number and configuration in the hydration shells, the effect of hydrated ions on the water structure and dynamics, the microscopic factors that govern the transport of the hydrated ions, and so on. In particular, he unraveled the microscopic structures of Na^+ hydrates at interfaces

and discovered a magic-number effect on the transport of ion hydrate. He was the first to point out that the ion transport at interfaces is related to the hydration number of water molecules, which have attracted immediate attentions from an incredibly wide range of technologically and biologically relevant fields.

Most recently, Jiang has made an important breakthrough on ice, the crystalline form of water [3]. For the past nearly 100 years, massive experiments and theoretical calculations have led to the discovery of eighteen crystalline 3D phases. However, whether the ice can exist at 2D has been an open question, which received enormous attentions in recent years. Jiang successfully grew a 2D bilayer hexagonal ice on a hydrophobic Au surface and imaged the 2D ice growth at the edges with atomic resolution. This work confirms experimentally the existence of the first genuine 2D ice ("2D ice I" named by Jiang *et al.*) and opens the door to explore the large family of 2D ice phases, which were predicted to foster intriguing physical properties such as high T_c superconductivity and superionic state.

In summary, Dr. Jiang's creative approaches solved several most challenging puzzles in water science and can be further applied to other H-rich materials. He is the key player in shaping the new frontier of condensed matter physics: light-element materials physics beyond the Born-Oppenheimer approximation. Therefore, Dr. Ying Jiang well deserves the Nishina Asia Award.

Key references (up to 3 key publications*)

[1] J. Guo, J.-T. Lü, Y. Feng, J. Chen, J. Peng, Z. Lin, X. Meng, Z. Wang, X.-Z. Li†, E.-G. Wang†, and **Y. Jiang†**, "Nuclear quantum effects of hydrogen bonds probed by tip-enhanced inelastic electron tunneling", **Science** 352, 321 (2016).

[2] J. Peng, D. Cao, Z. He, J. Guo, P. Hapala, R. Ma, B. Cheng, J. Chen, W.-J. Xie, X.-Z. Li, P. Jelínek, L.-M. Xu†, Y.-Q. Gao†, E.-G Wang†, **Y. Jiang†**, "The effect of hydration number on the interfacial transport of sodium ions", **Nature** 557, 701 (2018).

[3] R. Ma, D. Cao, C. Zhu, Y. Tian, J. Peng, J. Guo, J. Chen, X.-Z., Li, J. S. Francisco, X. C. Zeng†, L.-M. Xu†, E.-G. Wang†, **Y. Jiang†**, "Atomic imaging of edge structure and growth of a two-dimensional hexagonal ice", **Nature** 577, 60 (2020).

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

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

Signature 赵忠贤 02 02 2020

Date

Nomination form for the 2020 Nishina Asia Award

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

Name: Parameswaran Ajith
Affiliation: International Centre for Theoretical Sciences (Tata Institute of Fundamental Research)
Date of the degree of PhD: Dec, 2007
Nationality: Indian
Address: ICTS-TIFR, Shivakote, Hesaraghatta Hobli, Bengaluru North 560089, India.
Curriculum vitae: Attached separately
E-mail: ajith@icts.res.in
Tel. +91 80 4653 6210, +91 91645 94474

Citation for the Award (within 30 words)

For his pioneering contributions to the development of phenomenological models of gravitational-wave signals from coalescing binary black holes.

Description of the work

The recent discovery of gravitational waves (GWs) confirms a major prediction of Einstein's general theory of relativity (GR) and opens a fundamentally new observational window onto the Universe. Parameswaran Ajith has done impactful work on several aspects of GW physics and astronomy – in particular, in the modelling of GWs from binary black holes by combining analytical and numerical relativity, and probes of strong gravity using GW observations.

The detection of GWs from binary black holes, and the extraction of source parameters are performed by comparing the data with theoretical templates of the expected signal waveforms. Thus, the calculation of accurate theoretical templates plays a vital role in GW astronomy. Ajith pioneered one of the two existing approaches (the *phenomenological* method) for constructing waveform templates describing the full inspiral, merger and ringdown of binary black holes by combining analytical calculations in GR with large-scale numerical-relativity simulations[1 2 3 4 5]. Waveforms constructed using this method are widely used to extract the source parameters from the LIGO-Virgo events[6 17] and for testing the consistency of the observed signal with GR[7 8]. By coherently describing the entire coalescence (inspiral, merger and ringdown), such templates have significantly increased the sensitivity of GW searches and the accuracy and the precision of the parameter estimation. The extreme computational efficiency of the phenomenological waveforms has made them the standard workhorses in LIGO-Virgo data analysis.

Ajith was among the first to theoretically demonstrate the advantages of using inspiral-merger-ringdown templates in GW detection[2], parameter estimation[9], and tests of GR[10]. In addition, his work directly contributed to the implementation of inspiral-merger-ringdown templates in GW searches: He demonstrated the effectualness of templates modeling only non-precessing spins in detecting a significant fraction of black hole binaries with generic spins and identified an *effective spin* parameter that is well measured by observations[4 11]. He contributed to the construction of *template banks* employing non-precessing waveforms [12], to the demonstration of the improved efficiency of such searches in LIGO data[13], and finally to the actual searches for binary black holes in data from Initial LIGO's fifth and sixth scientific runs[14 15]. This body of work impactful on the design of current GW searches, which made the first detections.

Ajith's group at the International Centre for Theoretical Sciences (ICTS) made several direct contributions to deciphering the discovery of GWs. They formulated, developed an implemented a test of GR based on the consistency between the inspiral, merger and ringdown parts of observed GW signals from a binary black holes[16]. This was one among the handful of tests used to establish the consistency of the first LIGO event with a binary black hole system predicted by GR[7] and was one of the first tests of GR in the highly relativistic, strong-field regime of gravity[17]. Ajith and collaborators also proposed and implemented a method to infer the mass and spin of the remnant black hole in a binary merger, making use of full inspiral, merger, ringdown waveforms and fitting formulas calibrated to numerical relativity simulations[18]. This was used to infer the mass and spin of the final black hole in the LIGO events[6 19]. These are some of the best measurements of black-hole spin among all astronomical observations.

Ajith's group is one of the world-leading groups in the probes of strong gravity using GW observations. Their recent work include a test of the "no-hair" nature of binary black holes (i.e., to see if a binary black hole system in quasi-circular orbits is completely described by the masses and spin angular momenta of the black holes, as suggested by the uniqueness theorems in GR)[20] and a method for constraining the parameter space of exotic compact objects ("black hole mimickers") as potential sources of the GW events discovered by LIGO and Virgo[21]. Now that GW observations are becoming precision probes of gravity and astrophysics, it is important to characterize the systematic effects in our GR-based waveform models. Ajith's group characterized the systematic errors due to neglecting the higher order modes of the gravitational radiation from binary black holes [22] and constructed accurate waveform templates that include the effect of higher order modes[23]. Another exciting frontier of their research is the gravitational lensing of GWs. They developed a method for identifying strongly lensed binary black hole merger events in the LIGO-Virgo data[24] and performed the first search for lensing signatures[25]. Although no detection of lensing signatures has been made so far, the first detection is expected in the next few years.

Ajith is a recipient of the *NR Sen Young Researcher Award* by the Indian Association for General Relativity and Gravitation (2019), *CIFAR Azrieli Global Scholarship* by the Canadian Institute for Advanced Research (2017-19), is the Head of the *Max Planck Partner Group in Astrophysical Relativity* at ICTS-TIFR (2015-20) supported by the Max Planck Society and the PI of the *Indo-US Centre for the Exploration of Extreme Gravity* funded by the Indo-US Science and Technology Forum (2017-19).

Key references (up to 3 key publications*)

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1. P.Ajith et al, *Inspiral-merger-ringdown gravitational-waveforms for black-hole binaries with non-precessing spins*, Phys. Rev. Lett. **106**, 241101 (2011).
2. P. Ajith, *Addressing the spin question in gravitational-wave searches: Waveform templates for inspiralling compact binaries with nonprecessing spins*, Phys. Rev. D **84** 084037 (2011).
3. Ab. Ghosh, Ar. Ghosh, N. K. Johnson-McDaniel, C. K. Mishra, P. Ajith, W. Del Pozzo, D. A. Nichols, Y. Chen, A. B. Nielsen, C. P. L. Berry, L. London, *Testing general relativity using golden black-hole binaries*, Phys. Rev. D **94**, 021101 (R) (2016).

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

Spenta R. Wadia
Infosys Homi Bhabha Chair Professor, Professor Emeritus & Founding Director
International Centre for Theoretical Sciences (Tata Institute of Fundamental Research)
Bengaluru North 560089, India
E-mail: spenta.wadia@icts.res.in
Tel: +91 80 4653 6010

Relation to the candidate: Senior colleague

Signature   Date: 3 March 2020

References:

[1] P Ajith *et al*, Class Quantum Grav. **24** (2007) S689.
[2] P Ajith *et al*, Phys Rev D **77** (2008) 104017.
[3] P Ajith, Class Quantum Grav **25** (2008) 114033.
[4] P Ajith *et al*, Phys Rev Lett **106** (2011) 241101.
[5] L. Santamaria *et al*, Phys. Rev. D **82**, 064016 (2010).
[6] B P Abbott *et al* (LIGO-Virgo Collaboration), Phys Rev Lett **116**, 241102 (2016).
[7] B P Abbott *et al* (LIGO-Virgo Collaboration), Phys Rev Lett **116**, 221101 (2016).
[8] B P Abbott *et al* (LIGO-Virgo Collaboration), Phys Rev X **6** 041015 (2016).
[9] P Ajith, S Bose, Phys. Rev. D **79** (2009) 084032.
[10] D Keppel, P Ajith, Phys. Rev. D **82** (2010) 122001.
[11] P Ajith, Phys Rev D **84** 084037 (2011).
[12] P Ajith *et al*, Phys. Rev. D **89** 084041 (2014); S. Roy *et al* Phys. Rev. D **99**, 024048 (2019).
[13] S Privitera *et al*, Phys. Rev. D **89** 024003 (2014).
[14] J. Abadie *et al* (LIGO-Virgo Collaboration), Phys. Rev. D **83**, 122005 (2011)
[15] J. Aasi *et al* (LIGO-Virgo Collaboration), Phys. Rev. D **87**, 022002 (2013)
[16] A Ghosh *et al*, Phys Rev D **94**, 021101(R) (2016); Class. Quantum Grav. **35** 014002 (2017).
[17] B. P. Abbott et al. (LIGO-Virgo Collaboration), Phys. Rev. D **100**, 104036 (2019).
[18] A Ghosh, W Del Pozzo, P Ajith, Phys Rev D **94**, 104070 (2016).
[19] B P Abbott *et al* (LIGO-Virgo Collaboration), Phys Rev Lett **116,** 241103 (2016); Phys. Rev. X **9**, 031040
[20] S. Dhanpal *et al*, Phys. Rev. D **99**, 104056 (2019); T. Islam *et al*, Phys. Rev. D **101**, 024032 (2020).
[21] N. K. Johnson-McDaniel et al, arXiv:1804.08026 [gr-qc]
[22] V.Varma *et al* , Phys. Rev. D **90**, 124004 (2014); V. Varma & P. Ajith, Phys. Rev. D**96** 124024 (2017).
[23] A. K. Mehta *et al*, Phys. Rev. D **96**, 124010 (2017; A. K. Mehta *et al*, Phys. Rev. D **100**, 024032 (2019).
[24] K. Haris *et al,* arXiv:1807.07062 [gr-qc]
[25] O.A. Hannuksela *et al*, Astrophys. J. Lett. **874** L2, 10 (2019).

Nomination form for the 20120Nishina Asia Award No.20-3

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

Nominee

Dr. Sungjay Lee
School of Physics
Korea Institute for Advanced Study
85 Hoegiro, Dongdaemun-Gu, Seoul 20455
Republic of Korea
Phone: +82-2-958-3708
E-mail: sjlee@kias.re.kr

Academic Employment

2015 - Present: Professor at Korea Institute for Advanced Study, Seoul, Korea
2013 - 2015: Enrico Fermi Fellow at Enrico Fermi Institute, Univ. of Chicago, Illinois, USA
2012 - 2015: STFC Ernest Rutherford Fellow at DAMTP, Univ. of Cambridge, United Kingdom
2010 - 2012: Research Associate at DAMTP, Univ. of Cambridge, United Kingdom
2010 - 2010: KIAS Assistant Professor at Korea Institute for Advanced Study, Seoul, Korea
2008 - 2010: Research Fellow at Korea Institute for Advanced Study, Seoul, Korea

Education and Qualifications Received

Ph.D., March 2004 – February 2008
Department of Physics and Astronomy, Seoul National University, Korea
Thesis: Studies on three dimensional superconformal theories and their gravity duals
M.S., March 2002 – February 2004
Department of Physics and Astronomy, Seoul National University, Korea
B.S., March 1998 – February 2002
School of Chemical Engineering / School of Physics, Seoul National University, Korea

Prizes and Awards

2017 Baekcheon Physics Prize, Korean Physical Society, Korea.
2016 Young Scientist Award (Presidential), Ministry of Science and ICT, Korea.
2016 Junior Fellowship, Fondation Science Mathematique de Paris, France.
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)

"Modular Constraints on (S)CFTs", East Asia Joint Workshop on Fields ad Strings 2018, November 6 (2018), Korea Institute for Advanced Study, Korea.

"Modular Constraints on (S)CFTs", Workshop on New Frontiers in String Theory, July 25 (2018), Yukawa Institute for Theoretical Physics, Japan.

"Modular Constraints on CFTs with Currents", Workshop on SCFTs in 6 and Lower Dimensions, January 16 (2018), Tsinghua Sanya International Mathematics Forum, China.

"Bootstrapping Pure Quantum Gravity," Strings and Fields 2016, August 12 (2016), Yukawa Institute for Theoretical Physics, Japan.

"Three-Charge Black Holes and Quarter BPS States in Little String Theory", Recent Developments in M-theory, February 16 (2016), CERN, Switzerland.

"Three-Charge Black Holes and Quarter BPS States in Little String Theory", KIAS-YITP Joint Workshop 2015, September 15 (2015), Korea Institute for Advanced Study, Korea.

"Ramond-Ramond Charges and the Gamma Class," Strings Conference 2014, June 25 (2014), Princeton University, United States.

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

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

More than 90 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. 4th, 2019)

Papers Published in SCI Journals:	**34**
Papers Cited More than 250 times:	**3**
Papers Cited More than 100 times:	**4**
Papers Cited More than 50 times:	**5**

Total Accumulated Citations: **2,250**
Citation for the Award (within 30 words)
Discovery of a new class of d=3 gauge theories, with M-theory applications, and pioneering works that revolutionized study of d=2, 3 gauge theories 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. 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 described by 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, S. Lee, J. Park), Sungjay managed to formulate 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. Let me emphasize that their construction in fact preceded that of ABJM. The most astounding of this story is that he was apparently a key contributor to this project despite that he was the youngest of the collaboration team.

Since then, Dr. Lee made several other crucial 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 A-model 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. This proposal was motivated by Sungjay's exact computations of S^2 partition functions a few months prior, to begin with, but Sungjay and Jaume came back to the problem and managed to find a very simple, intuitive, and convincing proof of the conjecture, closing the loop themselves. Of many exact computation of partition functions via the localization method during last ten years, this is probably the most significant result, thanks to which the entire subject of d=2 GLSM has come under new attentions of numerous string theorists and geometers.

Most recently, Sungjay has extended his scope to the (numerical) conformal bootstrap in various dimensions with emphasis on understanding generic features of quantum gravity. In particular, he has shown that any unitary two-dimensional CFT with global symmetry should contain a light charged state. This numerical study provides a nontrivial evidence toward a proof of the Weak Gravity Conjecture, which leads to a number of intriguing implications to cosmology and particle physics.

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 or higher 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 Results in D=2 Supersymmetric Gauge Theories
Nima Doroud, Jaume Gomis, Bruno Le Floch, Sungjay Lee
JHEP 1305 (2013) 093

** attached as the most significant paper

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

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

I served as Dr. Sungjay Lee's mentor during his postdoctoral stay at KIAS, right after his Ph.D. from Seoul National University.

Signature Piljin Yi Date 2019.03.14

Nomination form for the 2019 Nishina Asia Award   No.19-14

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)
Curriculum Vitae of ***Jun Zhao*** ***Citizenship***: China ***Current Appointments:*** Xie Xide Junior Chair Professor, Dept. of Physics, Fudan University, Shanghai, China (from 2014) ***Past Appointments:*** Professor, Dept. of Physics, Fudan University, Shanghai (2012-2014) Miller Research Fellow, University of California at Berkeley (2010-2012) ***Education:*** Dept. of Physics and Astronomy, the University of Tennessee, Knoxville (August 2005 - May 2010) Degree: Ph.D. in Physics (May, 2010) Thesis: Neutron Scattering Study of High Temperature Superconductors Advisor: Professor Pengcheng Dai Institute of Physics, Chinese Academy of Sciences, Beijing, China (September 2002 to July 2005) Degree: M.S. in Physics Advisor: Professor Zhongxian Zhao Physics Department, Tsinghua University, Beijing, China (September 1998 - July 2002) Degree: B. S. in Physics ***HONORS AND AWARDS:*** Sir Martin Wood China Prize (2018) Wanren Program Leading Scientist, Department of Organization, China (2018) Chang Jiang Distinguished Professor, Ministry of Education, China (2017) Qiushi Outstanding Young Scholar Award, Qiushi Foundations, Hong Kong (2014) Pujiang Scholar Award, City of Shanghai, China (2013) Thousand Young Talents Investigator Award, Department of Organization, China (2012) Miller Fellowship, University of California, Berkeley (2010-2012)

Outstanding Dissertation in Magnetism Award (for doctoral thesis of outstanding quality and achievements in magnetism), American Physical Society (2010)

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Publication Citations:
https://scholar.google.com/citations?hl=en&user=Ue1WSaYAAAAJ

Citation for the Award (within 30 words)

The elucidation of magnetic properties of iron-based superconductors.

Description of the work

The discovery of iron-based high temperature superconductors (iron pnictides and iron chalcogenides) opened a new avenue of research that could help to unravel one of the biggest mysteries in condensed matter physics—the mechanism of high temperature superconductivity. Prof. Jun Zhao has made outstanding contributions in understanding magnetic correlations and their relationship to high temperature superconductivity in iron-based materials.

Shortly after the discovery of the iron-based superconductors, Prof. Jun Zhao and his collaborators used neutron powder diffraction to study the magnetic and structural phase diagram for iron pnictides. They discovered that the electronic phase diagram of the iron pnictides is very similar to that of the cuprates. Like the cuprates, the parent compounds of the iron pnictides are antiferromagnets, where superconductivity arises from the proximity of the antiferromagnetic ground state through chemical doping. To understand the nature of the antiferromagnetic ground state of the parent compounds, Prof. Jun Zhao and collaborators used inelastic neutron scattering to map out the entire energy spectrum of spin wave excitations in the parent compounds of iron pnictides. They solved the effective magnetic exchange Hamiltonian and found that the magnetic interactions are anisotropic in the *ab* plane, which suggests the presence of magnetic nematicity; in addition, they found that the magnetism in iron pnictides has both local moment and conduction electron characters. Recently, Prof. Zhao's group also used inelastic neutron scattering to show that the structurally simplest iron-chalcogenide superconductor FeSe displays both spin fluctuations at two different wavevectors (□,0) and (□□□), both of which are coupled with nematicity, indicating that FeSe is a novel nematic quantum paramagnet. The elucidation of the interplay between spin fluctuations, nematicity and superconductivity in these materials are important for establishing the mechanism behind high temperature superconductivity.

In addition to the work described above, Prof. Zhao's group has been active in studying the magnetic correlations in complex magnetic materials, such as the spin liquids, hidden-order materials and heli-magnetic superconductors. Very recently, Prof. Zhao's group reported neutron scattering measurements that reveal continuous spinon excitations and hidden order quantum excitations in the triangular-lattice antiferromagnets $YbMgGaO_4$ and $TmMgGaO_4$, respectively. Moreover, Prof. Zhao's group discovered that, for the first time, a spin re-orientation transition coincides with the occurrence of superconductivity in the exotic heli-magnetic superconductor CrAs.

Prof Jun Zhao's works have had a large impact in the condensed matter physics community. I strongly recommend him for the Nishina Asia Award without any reservations.

Key references (up to 3 key publications*)

1. Structural and magnetic phase diagram of $CeFeAsO_{1-x}F_x$ and its relationship to high-temperature superconductivity
Jun Zhao, Q. Huang, C. de la Cruz, S. Li, J. W. Lynn, Y. Chen, M. A. Green, G. F. Chen, G. Li, Z. Li, J. L. Luo, N. L. Wang, Pengcheng Dai,
Nature Materials 75, 953-959 (2008)

2. Strong interplay between stripe spin fluctuations, nematicity and superconductivity in FeSe.
Qisi Wang, Yao Shen, Bingying Pan, Yiqing Hao, Mingwei Ma, Fang Zhou, P. Steffens, K. Schmalzl, T. R. Forrest, M. Abdel-Hafiez, Xiaojia Chen, D. A. Chareev, A. N. Vasiliev, P. Bourges, Y. Sidis, Huibo Cao and Jun Zhao.
Nature Materials 15, 159-163 (2016)

3. Magnetic ground state of FeSe
Qisi Wang, Yao Shen, Bingying Pan, Xiaowen Zhang, K. Ikeuchi, K. Iida, A. D. Christianson, H. C. Walker, D. T. Adroja, M. Abdel-Hafiez, Xiaojia Chen, D. A. Chareev, A. N. Vasiliev and Jun Zhao
Nature Communications 7, 12182 (2016)

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

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

Yuanbo Zhang
Professor of Physics, Fudan University, China
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Phone: +86-18616137929

Relation to the candidate: Colleague at Fudan University

Signature: ______________________ Date: 2019/03/29

Nomination form for the 2020 Nishina Asia Award No.20-5

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)
Name: NGUYEN QUANG HUNG (*) Date of birth: July 24, 1980 Nationality: Vietnamese Sex: male **Affiliation**: Institute of Fundamental and Applied Sciences (IFAS), Duy Tan University, 03 Quang Trung, Danang City, Vietnam **Position:** Associate Professor, Director of IFAS (*) Re-nominated for the fourth time. Previous nominations: 2013, 2017, 2018. Please see the materials of his nomination for the Nishina Asia Award 2018 (NAA 2018). The only revision here is the replacement of the Ref. 3 (in list of key references) with 3) **N. Quang Hung, N. Dinh Dang, and L.G. Moretto** *Pairing in excited nuclei: a review,* invited review to appear in Rep. Prog. Phys. in 2019. Abstract: The present review summarizes the recent studies on the thermodynamic properties of pairing in many-body systems including superconductors, metallic nanosized clusters and/or grains, solid-state materials, focusing on the excited nuclei, that is nuclei at finite temperature and/or angular momentum formed via heavy-ion fusion, alpha-induced fusion reactions, or inelastic scattering of light particles on heavy targets. Because of the finiteness of the systems, several interesting effects of pairing such as nonvanishing pairing gap, smoothing of superfluid-normal phase transition, first and second order phase transitions, pairing reentrance, etc., will be discussed in detail. Influences of exact and approximate thermal pairing on some nuclear properties such as temperature-dependent width of the giant dipole resonance, total level density, and radiative strength function of the gamma-rays emission will also be analyzed. Finally, the first experimental evidence of the pairing reentrance phenomenon in a ^{104}Pd nucleus as well as its solid-state counterpart of ferromagnets under strong magnetic field will be presented.
Citation for the Award (within 30 words)
Please see his nomination for NAA 2018.

Description of the work

Please see his nomination for NAA 2018.

Key references (up to 3 key publications*)

1) **N. Quang Hung, N. Dinh Dang, L.T. Quynh Huong,**
Simultaneous microscopic description of nuclear level density and radiative strength function, Phys. Rev. Lett. **118** (2017) 022502.

2) **N. Quang Hung and N. Dinh Dang,**
Thermodynamic properties of hot nuclei within the self-consistent quasiparticle random-phase approximation, Phys. Rev. C **82** (2010) 044316.

3) **N. Quang Hung, N. Dinh Dang, and L.G. Moretto**
Pairing in excited nuclei: a review, invited review to appear in Rep. Prog. Phys. in 2019.

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

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

Nguyen Dinh Dang

Nishina Center Research Scientist

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Signature Nguyen Dinh Dang Date 9 January 2019

Nomination form for the 2019 Nishina Asia Award

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)
Name: Feng-Kun Guo **Affiliation:** Institute of Theoretical Physics, Chinese Academy of Sciences **Nationality:** China **Address:** Institute of Theoretical Physics, CAS, Zhong Guan Cun East Street 55, Beijing 100190, China **Email:** fkguo@itp.ac.cn **Telephone:** +86-10-62648752 **Appointments:** ● 01.2019 – Professor, Institute of Theoretical Physics, CAS ● 09.2015 – 12.2018 Associate Professor, Institute of Theoretical Physics, CAS ● 10.2010 – 09.2015 Senior Research Fellow, University of Bonn ● 10.2007 – 09.2010 VIQCD Postdoctoral Fellow, Forschungszentrum Jülich **Education:** ● 09.2002 – 07.2007 Ph.D. in physics, Institute of High Energy Physics, CAS; Thesis: "Heavy Quarkonium $\pi\pi$ Transitions and New Hadronic States"; Advisor: Prof. Peng-Nian Shen ● 09.1998 – 07.2002 B.S. in physics, Shandong University **Honors**: ● 2018 Key Project, National Natural Science Foundation of China ● 2018 IoP Publishing Top Cited Author Award (China) ● 2017 Most Valued Reviewer for 2017 (Phys. Lett. B) ● 2017 EPJ Distinguished Referee in 2017 (nominated by Eur. Phys. J. A) ● 2017 Chin. Phys. C Top Reviewer Award ● 2015 EPJ Distinguished Referee in 2015 (nominated by Eur. Phys. J. C) ● 2015 The Thousand Talents Plan for Young Professionals
Citation for the Award (within 30 words)
For his outstanding theoretical contributions to understanding the nature of new hadrons discovered since 2003.

Description of the work

Quantum chromodynamics (QCD) is the fundamental theory for the strong interaction, which is the interaction generating the majority of the mass of the visible universe. The experimentally accessible strongly interacting particles are called hadrons composed of quarks and gluons, with the proton and neutron as two examples. However, because quarks and gluons are confined within hadrons, one has to understand hadron spectroscopy in order to understand how the strong interaction in the nonperturbative regime works. The central question in this aspect is thus: How is the emerging hadron spectrum organized? The potential quark model provided historically an answer to this question. However, dozens of new hadrons have been discovered since the year 2003 at high-energy experiments at the B factories (Belle, BESIII, CLEO) playing a central role. Their properties are at odds with the quark model expectations, and thus have inspired intensive theoretical and experimental investigations. Feng-Kun Guo has worked vigorously in this field, and produced a number of influential papers. Both experimental and theoretical developments in the field, with a special focus on hadronic molecules which are strongly interacting systems formed of two hadrons, have been summarized comprehensively in the recent review by him (coauthored with his collaborators) published in Rev. Mod. Phys. [1]. The review has become a standard reference in the field.

Among the very first new unusual hadrons are the charmed mesons with positive parity discovered in 2003. They exhibit several mysterious properties. In the pioneering work [2], Feng-Kun Guo studied these mesons by investigating the interactions between ground state charmed mesons and light mesons that are the Goldstone bosons of the spontaneous chiral symmetry breaking in QCD. Consequently, the positive-parity charmed mesons are dynamically generated as hadronic molecules. In his sequential works, combining chiral effective field theory with results from large-scale lattice QCD simulations and experimental results, he has shown that all the mysteries can be naturally resolved.

In addition to the charmed mesons, the other major groups of new hadrons were observed in the charmonium mass region, denoted as XYZ states due to their mysterious properties. Feng-Kun Guo showed that approximate symmetries of QCD for heavy quarks could provide invaluable insights into revealing the nature of these XYZ states, and made a series of predictions in [3] and other publications. These predictions have led to experimental investigations, and some of them have been verified such as the observation of the X(3872) in the radiative decay of the Y(4260) made by BESIII.

Prof. Guo continuously produces influential papers with insightful ideas, and his work has helped to understand the nature of these new hadrons and plays a major role in establishing a clearer pattern for them. Feng-Kun Guo has become a world leading scientist in this field, and clearly deserves the Nishina Asia Award. I strongly recommend him.

Key references (up to 3 key publications*)

[1] * Feng-Kun Guo, Christoph Hanhart, Ulf-G. Meißner, Qian Wang, Qiang Zhao, Bing-Song Zou, *Hadronic molecules*, **Rev. Mod. Phys. 90 (2018) 015004.**

[2] Feng-Kun Guo, Peng-Nian Shen, Huan-Ching, Chiang, Rong-Gang Ping, Bing-Song Zou, *Dynamically generated 0^+ heavy mesons in a heavy chiral unitary approach*, **Phys. Lett. B 641 (2006) 278**.

[3] Feng-Kun Guo, Carlos Hidalgo-Duque, Juan Nieves, Manuel Pavon Valderrama, *Consequences of heavy quark symmetries for hadronic molecules*, **Phys. Rev. D 88 (2013) 054007**.

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

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

Name: Makoto Oka

Affiliation: Advanced Science Research Center, Japan Atomic Energy Agency

Email: oka@post.j-parc.jp

Telephone: 029-282-5093

Relation to the candidate: I first met him in a conference in Spain and have known him for these 5 years. I invited him to a workshop at JAEA in 2018.

Signature M. Oka Date March, 29, 2019

No.20-7

Nomination form for the 2020 Nishina Asia Award

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)
Bumjoon Kim Department of Physics Pohang University of Science and Technology 77 Cheongam-Ro Nam-Gu Pohang Gyeongbuk Korea 37673 Tel: +82 (0)54 279 9882 Fax: +82 (0)52 279 9889 Mobile: +82 (0)10 5128 5122 Nationality: Korean Career history: December 2016 - present Associate Professor Pohang University of Science and Technology Department of Physics July 2013 - November 2016 Group Leader Max Planck Institute for Solid State Research Neutron Scattering Group, Solid State Spectroscopy Department September 2010 - June 2013 Assistant Physicist Argonne National Laboratory Materials Science Division February 2010 - September 2010 Postdoctoral Research Fellow Argonne National Laboratory Materials Science Division April 2008 - January 2010

Postdoctoral Research Fellow University of Michigan, Ann Arbor Prof. James W. Allen October 2006 - March 2008 Visiting scientist University of Tokyo Prof. Hidenori Takagi 08.2005 Ph. D. in physics New approach to angle-resolved photoemission spectroscopy using high photon energy Prof. Se-Jung Oh Seoul National University 02.2001 M. S. in physics Seoul National University 02.1999 B. A. in physics Korea Advanced Institute of Science and Technology Award: Brian R. Coles Prize 2013 30 Young Scientists of Korea (2016)
Citation for the Award (within 30 words)
The discovery and experimental study of the spin-orbit Mott insulating state induced by relativistic spin-orbit coupling in iridates.
Description of the work

B. J. Kim discovered a new phase of quantum matter in the 5d transition-metal oxide Sr_2IrO_4 now widely known as "spin-orbit Mott insulator". Using angle-resolved photoemission, x-ray absorption, and resonant x-ray diffraction, he established that the electronic ground state in this material has a highly nontrivial spin-orbit entangled structure with effective total angular momentum one-half (J_{eff}=1/2). These results were published in Physical Review Letters (2008) and Science (2009), which have a combined citation exceeding 1600 (as of 3/3/2018). The study of spin-orbit Mott insulator has now become one of the mainstreams in condensed matter physics.

The discovery of the J_{eff}=1/2 ground state is significant because it is parent to a plethora of unconventional electronic orders. One of the most exciting possibilities is the realization of the cuprate physics in a non-cuprate material; namely, spin-1/2 Mott insulator on a square lattice with J_{eff}=1/2 moments playing the role of spin-1/2 moments. Following the initial work, B. J. Kim showed that Sr_2IrO_4 exhibits spin dynamics in remarkable similarity with that in high temperature superconducting cuprates, heightening the prospect of finding a new high temperature superconductor. This work is also a major breakthrough in x-ray science because it is the first demonstration of using hard x-ray to probe momentum-resolved dynamic spin structure over the full Brillouin zone, which has previously been only accessible by inelastic neutron scattering.

B. J. Kim has further shown that the J_{eff}=1/2 state develops a high temperature pseudogap and a low-temperature d-wave gap upon carrier doping, reproducing the complete phenomenology of the cuprates. This work used surface sensitive techniques to dope the surface layer of Sr_2IrO_4 and at present whether the d-wave gap represents unconventional superconductivity remains an open question, but at the least it established a new material platform to study the elusive relationship between the pseudogap and the d-wave gap. Contributions from other groups have further strengthened the analogy to cuprates by showing the existence of competing symmetry broken phases in the pseudogap region of the phase diagram that are also very much reminiscent of the cuprate phase diagram. All the evidence collectively point to a high probability of finding high temperature superconductivity in iridate in the near future.

In another related material Na_2IrO_3, B. J. Kim showed that the J_{eff}=1/2 state leads to a strong magnetic frustration and a magnetic phase in close proximity to the Kitaev spin liquid.
This is first direct evidence that the Kitaev magnetic interaction can be realized in a condensed matter setting. This shows that J_{eff}=1/2 states can lead to very different types of magnetic interactions depending on the bonding and lattice geometry and thus can have wide applications beyond reproducing cuprate physics. Other interesting directions include topological phases of matter combining magnetism, for which pyrochlore iridates (also based on J_{eff}=1/2 states) are now under active discussions.

In summary, the discovery of the J_{eff}=1/2 ground state by B. J. Kim has opened a new field and had a broad impact in condensed matter physics in the last decade. Given the fact that the conventional Mott insulator since its discovery in 1930's has been a central paradigm of correlated electron physics for nearly a century, it is extremely interesting to see a new spin on the Mott insulators and the future it will bring.

Key references (up to 3 key publications*)

B. J. Kim et al., Novel J_{eff}=1/2 Mott insulator induced by relativistic spin-orbit coupling in Sr2IrO4, Physical Review Letters **101**, 076402 (2008).

B. J .Kim et al., Phase-sensitive observation of a spin-orbital Mott state in Sr2IrO4, Science **323**, 1329 (2009).

Y. K. Kim et al., Fermi arcs in a doped pseudospin-1/2 Heisenberg antiferromagnet, Science **345**, 187 (2014).

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

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

Soo-Bong Kim
Department of Physics and Astronomy
Seoul National University

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I know him by his impressive research achievements although he is in other University and other physics field.

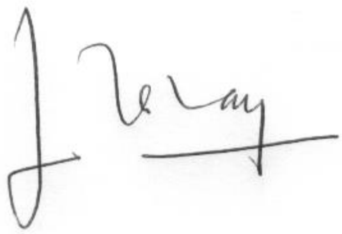
Signature Kim Soo Bong Date March 7. 2018

Nomination form for the 2020 Nishina Asia Award

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)
Dr. LE Duc Ninh (family name: LE, first name: Duc Ninh) Affiliation: Institute For Interdisciplinary Research in Science and Education, International Center for Interdisciplinary Science and Education (ICISE), Khu Vuc 2, Ghenh Rang, Quy Nhon, Vietnam Nationality: Vietnamese Email: ldninh@ifirse.icise.vn Telephone: +84 832754249 Curriculum Vitae: 07/2008: defended Ph.D thesis in Theoretical Physics, Laboratoire d'Annecy-le-Vieux de Physique Théorique and University of Savoie, Chambéry, France. Topic: One-Loop Yukawa Corrections to the Process p p --> b anti-b H in the Standard Model at the LHC: Landau Singularities. Grade: Très Honorable avec félicitations (Highest distinction). Research positions after Ph.D: Since October 2016: permanent researcher at ICISE, Quy Nhon, Vietnam. Head of Theoretical Physics Group. 2014-2016: Postdoctoral research fellow. Humboldt-Universität zu Berlin, Berlin, Germany. 2011-2014: Postdoctoral research fellow. Karlsruher Institut für Technologie, Karlsruhe, Germany. 2008-2011: Postdoctoral research fellow. Max-Planck-Institut für Physik, Munich, Germany.
Citation for the Award (within 30 words)
For his contribution to the precision-physics program at the CERN Large Hadron Collider, which is important to search for new physics beyond the Standard Model.

Description of the work
The work of Dr. LE Duc Ninh (LDN) has been mostly on the calculation of electroweak (EW) and QCD radiative corrections to multi-gauge-boson production at the CERN Large Hadron Collider (LHC). It is well known that the study of multi-gauge-boson production at the LHC has been classified into different channels: diboson (VV), triboson (VVV), and diboson production in association with two jets (VVjj). The work of LDN has contributed significantly to all of these channels. The diboson production is sensitive to triple-gauge-boson couplings. In Ref. [1], the authors have provided the first complete next-to-leading order (NLO) EW + QCD calculation of the production of pairs of on-shell WW, WZ, and ZZ at the LHC in the Standard Model (SM). In this work, for the first time, the importance of the photon-quark induced process is pointed out. They have shown that this correction, which is proportional to the density of photons in the proton, is not negligible as one usually expects. Even though the photon density is very small, the photon-quark induced correction is found to be large in the region where the transverse momentum (p_T) of the gauge boson is large, reaching about +60% when p_T(W-) = 700 GeV in the WZ channel (see Fig. 10 of [1]). They have also provided analytical results for the leading-logarithmic contribution. This result enabled them to provide an explanation for the long-standing puzzle of QCD corrections to diboson production, namely why the NLO QCD corrections to the WW channel are so different from the corrections to the ZZ channel, as posed by Ohnemus in Phys.Rev. D50 (1994) 1931. Nowadays, the photon density in the proton is recognized as an important ingredient in the precision-physics program at the LHC and is provided by many parton-distribution-function (PDF) collaborations including CTEQ, NNPDF, LUXqed, … It is a matter of fact that the study in [1] has been recognized in the community and has an impact on the recognition of the importance of the photon PDF in the proton at the LHC. Recently, LDN together with Julien Baglio have performed another comprehensive study of the polarization of a massive gauge boson produced in the diboson WZ channel in Ref. [2]. Their calculation is performed at the NLO QCD+EW correction level. With their detailed and systematic calculation, they have pointed out that it may be better to define polarization observables using the projection method (which they called fiducial polarization observables) rather than using the traditional template-fit method, which has been widely used by ATLAS and CMS in their measurements. The other VVV and VVjj channels are sensitive to quartic-gauge-boson couplings which have never been directly tested prior to the LHC. For the VVV case, together with his collaborators, LDN has performed a full calculation of the NLO QCD+EW corrections to the on-shell WWZ production in Dao Thi Nhung, Le Duc Ninh, Marcus M. Weber, JHEP 1312 (2013) 096. Technically, this calculation is much more complicated than the above VV calculation due to a larger number of Feynman diagrams in the EW corrections and a more complicated phase space. However, the most complicated calculation he has performed is the calculation of NLO QCD corrections to the QCD-induced WZjj channel published in Ref. [3]. This process is the most important background to the WZ vector boson scattering at the LHC. Nowadays, these calculations can be done using automated computer programs such as MadGraph5, but these tools were not available back in 2013. The work produced by LDN and his collaborators has contributed not only to the physical understanding of those important processes but also to the development of the automated tools. The work [3] was not only a state-of-the-art calculation at the time, it is also the first paper in a series of works for the class of VVjj processes (VV = WZ, same-sign WW, ZZ, W gamma, Z gamma, diphoton) that LDN has produced together with his collaborators. These calculations have been implemented in the computer program VBFNLO (arXiv:1404.3940), which has been being used by

ATLAS and CMS in their measurements.
Key references (up to 3 key publications*)
[1] Julien Baglio, Le Duc Ninh, Marcus M. Weber, Massive gauge boson pair production at the LHC: a next-to-leading order story, Phys.Rev. D88 (2013) 113005, Erratum: Phys.Rev. D94 (2016) no.9, 099902 [2] Julien Baglio, Le Duc Ninh, Fiducial polarization observables in hadronic WZ production: A next-to-leading order QCD+EW study, JHEP 1904 (2019) 065 [3] Francisco Campanario, Matthias Kerner, Le Duc Ninh, Dieter Zeppenfeld, WZ Production in Association with Two Jets at Next-to-Leading Order in QCD, Phys. Rev. Lett. 111 (2013) no.5, 052003. *) Copy of one most significant publication should be attached.
Nominator (name, affiliation, email, telephone and relation to the candidate)
Jean TRAN THANH VAN Affiliation : Rencontres du Vietnam, ICISE Email : jtrantv@gmail.com Phone : 00 33 629 851 976 Relation to the candidate : I am the Director of the Institute in which Dr Le Duc Ninh is working as head of the theoretical group.



Signature Date March 17, 2020

Nomination form for the 2019 Nishina Asia Award

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)
✓ Name : Bohm-Jung Yang ✓ Affiliation: Department of Physics and Astronomy, Seoul National University ✓ Nationality: Republic of Korea ✓ Address: Department of Physics and Astronomy, 56-526, Seoul National University, 1 Gwanak-ro, Gwanak-gu, Seoul, Korea ✓ Telephone : 82-2-880-6604 ✓ Email:bjyang@snu.ac.kr ✓ Research Experience ① August 2008: Doctor of Philosophy in Physics, Seoul National University (Seoul, Korea; Advisor: Prof. Jaejun Yu) ② October 2008 – June 2010: Postdoctoral Researcher, Department of Physics, University of Toronto (Toronto, Canada; Advisor: Prof. Yong Baek Kim and Prof. Hae-Young Kee) ③ July 2010 – March 2015: Postdoctoral Researcher, RIKEN Center for Emergent Matter Science (Saitama, Japan; Advisor: Prof. Naoto Nagaosa) ④ April 2015 – August 2015: Research Scientist, RIKEN Center for Emergent Matter Science (Saitama, Japan; Advisor: Prof. Naoto Nagaosa) ⑤ September 2015 – present: Assistant Professor, Department of Physics, Seoul National University (Seoul, Korea)
Citation for the Award (within 30 words)
For his contribution to uncovering topological properties of three-dimensional Dirac semimetals

Description of the work
Prof. Bohm-Jung Yang has published a series of important papers about topological semimetals. In particular, he made a significant contribution to uncovering topological properties of three-dimensional (3D) Dirac semimetals. In certain condensed matter systems, the low energy electronic excitations can be described by massless Dirac fermions with relativistic energy dispersion. Graphene and the surface of topological insulators are the representative systems possessing two-dimensional (2D) massless Dirac fermions. Because of this characteristic energy band structure, 2D Dirac materials can exhibit various novel physical properties. On the other hand, 3D massless Dirac fermions have been considered more unstable than its 2D counterpart, and its discovery is achieved only very recently. Na3Bi and Cd3As2 are the first materials in which 3D massless Dirac fermions are predicted by first-principle calculations and experimentally confirmed after that. At that time, although there were few theories proposing the symmetry protection of 3D massless Dirac fermions, a general theoretical framework describing stable 3D Dirac semimetals and their topological properties were absent. Prof. Yang conceived the idea that a unified theoretical description of 3D Dirac semimetals can be achieved by investigating the relation between the band topology and symmetry eigenvalues of symmorphic and non-symmorphic rotations. In collaboration with Prof. Naoto Nagaosa, Prof. Yang successfully constructed a general theoretical framework describing stable 3D Dirac semimetals with nontrivial topological properties, which is reported in Ref.[1]. In this paper, Prof. Yang explained how crystalline symmetries, stable Dirac points, and band topology are related to each other, and classified stable 3D Dirac semimetals into two distinct classes, class I and class II, protected by symmorphic and nonsymmorphic rotation symmetries, respectively. This paper has provided a fundamental theoretical basis for describing 3D topological Dirac semimetals, and has been considered as one of the most influential papers in the study of 3D Dirac semimetals. According to Ref.[1], a 3D Dirac semimetal system has to satisfy time-reversal (T), inversion (P) symmetries in the presence of spin-orbit coupling. For further generalization of the theory to embrace wider classes of 3D Dirac materials, it is essential to understand the influence of P, T symmetry breaking and the effect of weak spin orbit coupling. In Ref.[2], Prof. Yang and his student studied the topological properties of PT symmetric Dirac semimetal systems with negligible spin orbit coupling in which electrons can be described by spinless fermions and a Dirac point can be deformed to a nodal line. In this paper, Prof. Yang showed that the band topology of spinless PT symmetric systems is endowed with the characteristic mathematical structure, so-called the Stiefel Whitney class. When a Dirac point or a

nodal line carries nontrivial Stiefel Whitney numbers, a single node has topological stability and nodal line pairs develop linking structure with other nodal lines below the Fermi level. The idea of Stiefel Whitney classes is extended further to 2D insulators, based on which Prof. Yang proposed a new 2D topological insulator, dubbed a 2D Stiefel Whitney insulator. Ref.[2] is the first work in which novel topological phases associated with Stiefel Whitney classes are proposed in condensed matter systems. Considering the tremendous impact of the notion of Chern classes defined by complex wave functions to condensed matter physics, the notion of Stiefel Whitney classes defined by real wave functions proposed in Ref.[2] is expected to play a critical role in the future study of topological states.

Finally, Prof. Yang also examined the influence of time-reversal symmetry breaking on PT symmetric Dirac semimetals. In particular, focusing on a van der Waals ferromagnet Fe3GeTe2, Prof. Yang and his student performed careful theoretical analysis. It is shown that when spin orbit coupling is neglected, this material can be considered as a PT symmetric Dirac semimetal with stable nodal lines. Introduction of ferromagnetic ordering opens a tiny gap along nodal lines, which significantly enhances the anomalous Hall conductivity in Fe3GeTe2 as shown in Ref.[3]. In collaboration with experimental groups, Prof. Yang successfully identified Fe3GeTe2 as the first example of ferromagnetic nodal line semimetals in which the interplay between the symmetry protected nodal structure and ferromagnetism gives rise to novel topological responses of magnetic topological Dirac materials.

To sum up, Prof. Yang constructed a general theoretical framework to understand stable 3D Dirac semimetals and unveiled the fundamental relationship between crystalline symmetry and band topology of Dirac semimetals [1]. Also, his study of PT symmetric Dirac semimetals in spinless fermion systems has established the central role of Stiefel Whitney classes on new topological phenomena in condensed matter systems [2]. Moreover, his study of a magnetic Dirac semimetal system Fe3GeTe2 showed that the interplay of ferromagnetism and band topology can induce new topological magnetic state, leading to the first discovery of a ferromagnetic topological nodal line semimetal [3]. Considering his contribution to uncovering novel topological properties of 3D Dirac materials, I believe that Prof. Yang deserves to be the winner of the Nishina Asia Award in 2019.

Key references (up to 3 key publications*)

1. **Bohm-Jung Yang*** and Naoto Nagaosa, "Classification of stable three-dimensional Dirac semimetals with nontrivial topology", Nature Communications 5, 4898 (Sep. 2014).

2. J. Ahn, D. W. Kim, Y.K.Kim and **Bohm-Jung Yang***, "Band topology and linking structure of nodal line semimetals with Z2 monopole charges", Phys. Rev. Lett. 121, 106403 (2018).

3. Kyoo Kim, Junho Seo, Eunwoo Lee, K.-T. Ko, B. S. Kim, Bo Gyu Jang, Jong Mok Ok, Jinwon Lee, Youn Jung Jo, Woun Kang, Ji Hoon Shim, C. Kim, Han Woong Yeom, Byung Il Min, **Bohm-Jung Yang*** & Jun Sung Kim* "Large anomalous Hall current induced by topological nodal lines in a ferromagnetic van der Waals semimetal", Nature Materials. 17, 794-799 (2018).

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

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

Nominator: Doochul Kim,
President, Institute for Basic Science, Daejeon, Korea, dkim@ibs.re.kr,
Professor Emeritus, Seoul National University, Seoul, Korea, dkim@snu.ac.kr
Tel: +82-10-4221-7155
Relation: The candidate was a graduate student while I was at Department of Physics and Astronomy, Seoul National University. The candidate's Ph.D. supervisor, Prof. Jaejun Yu, and the postdoc advisor, Prof. Yong Baek Kim are my long time colleagues and strong supporters of the candidate.

Signature Date March, 22, 2019

Nomination form for the 2020 Nishina Asia Award

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)
Name: Han-Chun Wu **Affiliation**: Beijing Institute of Technology **Nationality:** China **Address:** School of Physics, Beijing Institute of Technology Beijing, 10086 China **Email:** wuhc@bit.edu.cn **Telephone**: +86 18600362730 **Professional Experience** 2014 – Present Full Professor, Beijing Institute of Technology, Beijing 100081, China 2013 – 2014 Invited Professor, King Saud University, Riyadh 11451, Saudi Arabia 2008 – 2013 Postdoctoral Research Fellow, Trinity College Dublin, Dublin 2, Ireland **Education Background** 2008 Ph.D. in Physics, Trinity College Dublin, Dublin 2, Ireland
Citation for the Award (within 30 words)
For his outstanding contributions in the opening a charge transport gap and introducing spin degree into graphene
Description of the work
Graphene is a single-atom-thick carbon sheet with extraordinary properties unrivaled by any other known material, which will likely lead to a revolution in many areas of technology. It hosts massless Dirac fermions which obey the relativistic Dirac equation. Andre Geim and Konstantin Novoselov succeeded in mechanically exfoliation micrometer-scale graphene samples and investigated their unique electronic properties. For their groundbreaking experiments regarding graphene, Geim and Novoselov were awarded the 2010 Nobel Prize in Physics. Graphene has extremely high mobility, making it a good candidate for transistors vastly faster than what is achievable today with silicon. However, graphene does not naturally have a bandgap, which presents an impasse for its implementation within conventional transistor architectures. It was theoretically predicted that depending on the structure of sheet grain boundaries, there are

two distinct transport behaviors: either high transparency or the opening a charge transport gap over a large energy range. Dr. Han-Chun Wu and his collaborators beautifully verified this using self-aligned periodic grain boundaries. A charge transport gap of at least 1.3 eV was opened and a current on-off ratio of 10^4 was achieved [1].

Graphene also has the capacity for room-temperature spin transport, with propagation diffusion lengths of several micrometers, making it a highly promising material for spintronics. Indeed, several graphene-based spin-logic devices have been proposed. However, pristine graphene is diamagnetic and carbon does not possess d or f electrons. This means that inducing magnetic moments in graphene is non-trivial. Dr. Han-Chun Wu and his collaborators beautifully added the spin degree of freedom to graphene using inherent grain boundaries that sandwich zig-zag structures between adjacent ripples of large curvature, and proposed all carbon spin filter [2].

As presented, Dr. Wu has made many breakthroughs in opening a band gap and introducing a spin degree into graphene, and has been instrumental in establishing Asian leadership of the global field of graphene science. Besides these representative accomplishments, Dr. Wu has made significant contributions to the broader field, coauthoring numerous papers which address the key problems for the application of 2D materials. For these reasons, Dr. Wu strongly deserves the Nishina Asia Award.

Key references (up to 3 key publications*)

1. Han-Chun Wu*, Alexander N. Chaika*, Tsung-Wei Huang, Askar Syrlybeko, Mourad Abid, Victor Yu. Aristov, Olga V. Molodtsova, Sergey V. Babenkov, Dmitry Marchenko, Jaime Sánchez-Barriga, Partha S. Mandal, Andrei Varykhalov, Yuran Niu, Barry E. Murphy, Sergey A. Krasnikov, Olaf Lübben, Jing-Jing Wang, Huajun Liu, Li Yang, Hong-Zhou Zhang, Mohamed Abid, Ching-Ray Chang, and Igor V. Shvets, Transport Gap Opening and High On-Off Current Ratio in Trilayer Graphene with Self-Aligned Nanodomain Boundaries, ACS Nano 9, 8967 (2015)

2. Han-Chun Wu*, Alexander N. Chaika*, Ming-Chien Hsu, Tsung-Wei Huang, Mourad Abid, Mohamed Abid, Victor Yu. Aristov, Olga V. Molodtsova, Sergey V. Babenkov, Yuran Niu, Barry E. Murphy, Sergey A. Krasnikov, Olaf Lübben, Huajun Liu, Byong Sun Chun, Yahya T. Janabi, Sergei N. Molotkov, Igor V. Shvets, Alexander I. Lichtenstein, Mikhail I. Katsnelson, and Ching-Ray Chang*, Large Positive In-Plane Magnetoresistance Induced by Localized States at Nanodomain Boundaries in Graphene, Nature Communications 8, 14453 (2017)

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

Nominator (name, affiliation, email, telephone and relation to the candidate)
Prof. Ching-Ray Chang National Taiwan University, Taiwan Email: crchang@phys.ntu.edu.tw Telephone: +88 02 3366-5176 Relation to the candidate: Collaborator
Signature ______________ Date ____March 24, 2020_______________

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Nomination form for the 2020 Nishina Asia Award

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)
Name: Wei Song Affiliation: Associate Prof. at Tsinghua University, Beijing, China Date of Birth: April 14, 1983 Nationality: Chinese Email: wsong2014@mail.tsinghua.edu.cn Phone: +86 13641040458 Address: Jing Zhai 309, Tsinghua University, Hai Dian District, Beijing, 100084, China Date of the degree of Ph.D: July 4, 2009 (Thesis Title: Quantum Gravity in Three Dimensions) Biography: 2000-2004 : Bachelor of Science, Nanjing University, Nanjing, China 2004-2009: PhD, The Institute of Theoretical Physics, Chinese Academy of Sciences (Advisor: Prof. Miao Li) 2009-2013: Junior Fellow, Harvard University 2013-2014: Postdoc Associate, Princeton University 2014-present: Associate Professor, Tsinghua University (also 2019-2020: Tsinghua-IAS Fellow, Institute for Advanced Study, USA)
Citation for the Award (within 30 words)
Her outstanding contributions to holography in warped anti-de Sitter spaces
Description of the work
Prof. Wei Song is one of a few extremely outstanding Asian young researchers in high energy theory and she is the best female young researcher in string theory not only in Asian but also in the world, as far as I know. She has published 40 papers and has earned totally more than 2500 citations until now (based on INSPIRE database, which is also applied all citation counts in my letter below). She wrote three papers which have more than 250 citations. With these remarkable research achievements, she has now been a very responsible leader of the Chinese string theory community. For example, she was virtually the main organizer of the strings 2016 conference held in Tsinghua University. Strings conference is the annual largest event in string theory community. Prof. Wei Song has contributed to string theory tremendously in the subject of holography or gauge/gravity correspondence. The holography in string theory tells us that a gravitational theory (or string theory) in d+1 dimensional spacetime is equivalent to a d dimensional non-gravitational theory such as quantum field theories. The most standard example of holography is AdS/CFT, where gravitational theories on anti-de Sitter (AdS) spaces are equivalent to conformal field theories (CFTs). In particular, Prof. Wei Song is very famous for pioneering a deformed version of AdS/CFT where a part of conformal symmetry (a half of Virasoro symmetries) was broken, which has numerous important applications. First of all, she wrote extremely famous paper of Kerr/CFT correspondence based on

collaborations with Prof. Strominger and others (ref.[1]). This paper argues that Kerr black holes are equivalent to certain two dimensional chiral CFTs and they gave a microscopic derivation of Kerr black hole entropy. This paper, which has been cited 630 times, gave a huge impact to string theory researchers partly because it extends the validity of the AdS/CFT to astrophysical objects.

The idea of breaking a half of Virasoro symmetry expands holographic dualities further and she discovered a new class of holography, called warped AdS (WAdS) duality, with Prof. Strominger and others (ref.[2]). They found that a gravity on warped AdS is equivalent to the warped conformal field theories (WCFT), which is a novel non-relativistic quantum field theory with SL(2;R)×U(1) symmetry as the global symmetry. This duality has attracted much attention and this paper has been cited more than 280 times.

The warped AdS holography, which Prof. Wei Song pioneered, has recently attracts much attention in the context of integrable irrelevant deformations of CFTs. By combining with the recently technique, she and her post-doc recently identified the precise WCFT which is equivalent to string theory in WAdS (ref.[3]). They confirmed that the spectrum and entropy perfectly agree between WAdS and WCFT. She has often been invited to important conferences in this field. For example, she was a guest speaker in the KITP conference: Geometry from the Quantum, at Santa Barbara in Jan.2020 and in Solvay Workshop on Holography, Brussels in May 2018. Obviously, Prof. Wei Song is the top researcher in the worlds on this important aspect of holography.
Due to the above reasons I recommend Prof. Wei Song for Nishina Asia Award in my strongest way.

Key references (up to 3 key publications*)

[1] M. Guica, T. Hartman, W. Song and A. Strominger, ``The Kerr/CFT Correspondence,'' Phys. Rev. D 80 (2009) 124008 [arXiv:0809.4266 [hep-th]].
[2] D. Anninos, W. Li, M. Padi, W. Song and A. Strominger, ``Warped AdS(3) Black Holes,'' JHEP 0903 (2009) 130 [arXiv:0807.3040 [hep-th]].
[3] L. Apolo and W. Song,``Strings on warped AdS3 via TJbar deformations,'' JHEP 1810 (2018) 165 [arXiv:1806.10127 [hep-th]].

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

Name: Tadashi Takayanagi
Affiliation: Professor, Yukawa Institute for Theoretical Physics, Kyoto University
Email: takayana@yukawa.kyoto-u.ac.jp
Phone: 090-3041-5054
Relation to the candidate: The nominator has been working on subjects closely related to those of candidates. The nominator has often discussed physics with the candidates in various conferences and workshops abroad. Last year the nominator invited the candidate to a conference hosted in YITP, Kyoto, ``String Theory and Quantum Information”, where she gave a beautiful plenary invited talk on ref. [3] and its developments in the presence of more than 200 participants.

高柳匡

Signature Date Mar.23, 2020

Nomination form for the 2020 Nishina Asia Award

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)
Name Chen Fang Affiliation Institute of Physics, Chinese Academy of Sciences Contact 8 Zhongguancun South 3rd St., Beijing 100190, China +86-1082649073 cfang@iphy.ac.cn Citizenship China Education Oct. 2011 Ph.D. Purdue University (USA)
Citation for the Award (within 30 words)
For developing the theory of topological classification and diagnosis for non-magnetic materials.
Description of the work
The research on topological materials is one of the major topics in condensed matter physics. These materials are known to host interesting phenomena such as the negative linear magnetoresistance in the bulk of topological semimetals, and the robust, gapless modes on the surface of topological insulators. The nominee and his group have solved two important problems in this field, the problems of "classification" and "diagnosis". A key concept in this field is the "topological invariant", a global quantum number that distinguishes topological materials from non-topological ones, and distinguishes different types of topological materials. In fact, all topology-related phenomena in a material are fully determined by this quantum number(s). The types and forms of all topological invariants depend and only depend on two factors: symmetry and dimensionality. Identifying all invariants for a given dimension and symmetry group of interest is, therefore, an important mission for theorists, known as the "classification problem". The nominee's recent work in Ref.[1,2] for the first time identifies four new Z_2 topological invariants in 3D for the following spatial symmetries: rotation, screw rotation, roto-reflection and inversion. These new invariants in hand and, using a theoretical tool called "layer construction", in Ref.[2] they list all independent topological invariants when the symmetry is time reversal plus any one of the 230 space groups in 3D, solving the classification problem for the cases that are most relevant in condensed matter physics. In Ref.[1], the nominee also for the first time proposes the presence of "high-order" topological states in 3D, now a new and thriving direction in this

field.

While classification is a purely theoretical topic, the "diagnosis problem" is more concerned with realistic materials: it asks for a given real material what are the actual values of the above invariants, based on first-principle calculations. Direct computation of topological invariants is notoriously difficult in many real materials, and this difficulty has so far been hindering the discovery of more topological materials. In Ref.[2], nominee and his group develop a new method that greatly simplifies the calculation, by which people can extract most information on topology only from the symmetry eigenvalues of the bands at several high-symmetry momenta in the Brillouin zone. Based on this method, they in Ref.[3] design an automated diagnosis process that automatically and efficiently finds all topological properties for any given non-magnetic material. This process is then applied to ~40000 materials in a materials database in Ref.[3], and they predict ~8000 materials to be topological semimetals and insulators, exceeding by an order of magnitude the total number of such materials theoretically discovered in the past ten years. The work does not fully solve the diagnosis problem and the method has its limits, but it still marks so far the biggest step forward in this direction.

Key references (up to 3 key publications*)

1. Z. Song, Z. Fang and C. Fang, "*(d-2)-Dimensional Edge States of Rotation Symmetry Protected Topological States*", Phys. Rev. Lett. **119**, 246402 (2017).
2. Z. Song, T. Zhang, Z. Fang and C. Fang, "*Quantitative mappings between symmetry and topology in solids*", Nature Communications **9**, 3530 (2018).
3. T. Zhang, Y. Jiang, Z. Song, H. Huang, Y. He, Z. Fang, H. Weng and C. Fang, "*Catalogue of Topological Electronic Materials*", Nature **566**, 475 (2019).

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

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

Name: Hongming WENG

Affiliation: Institute of Physics, Chinese Academy of Sciences

Address: Institute of Physics, Chinese Academy of Sciences P.O.Box 603, Beijing 100190, China

Phone: +86-10-6284-9941 (office); +86-138-1157-0964(cell)

Fax: +86-10-6255-3698

Email: hmweng@iphy.ac.cn

Relation to the candidate: colleague

Signature ______________________ Date ______________________

Nomination form for the 2020 Nishina Asia Award

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

Ssu-Yen Huang

CURRENT EMPLOYMENT

Associate Professor (2018-present)

Department of Physics, National Taiwan University

1, Sec. 4, Roosevelt Road, Taipei 10617, Taiwan

+886-2-3366-5179;

EDUCATION

Ph.D. (2003-2009) Electrophysics, National Chiao Tung University, Hsinchu, Taiwan.

M. S. (1999-2001) Physics, Fu Jen Catholic University, Taipei County, Taiwan

B. S. (1995-1999) Physics, Tamkang University, Taipei County, Taiwan

RESEARCH EXPERIENCE

2014-2018	Assistant Professor National Taiwan University
2013-2014	Postdoctoral Research Associate Johns Hopkins University
2011-2013	Postdoctoral Research Associate Dragon Gate Program at National Tsing Hua University, Taiwan and Johns Hopkins University.
2010-2011	Postdoctoral Research Associate Massachusetts Institute of Technology
2009-2010	Postdoctoral Research Associate Institute of Physics, Academia Sinica, Taipei, Taiwan

AWARDS

2018 Ta-You Wu Memorial Award

2018 and 2016 Outstanding Faculty Teaching Award

2018 Academia Sinica Junior Research Investigators Award.

2018 Research Achievement Award, Taiwan Association for Magnetic Technology.

2017 Ministry of Science and Technology "Excellent Young Scholar Research Program"

2015 Golden Jade Fellowship

2014 Asian Union of Magnetics Societies (AUMS) Young Researcher Award

2010 Ph. D. Dissertation award, The Physical Society of ROC

2009 Best Ph. D. dissertation award, Taiwan Association for Magnetic Technology.

Citation for the Award (within 30 words)
For his seminal contributions in pure spin current phenomena, including intrinsic spin-dependent thermal transport, spin Seebeck effect, transport magnetic proximity effect, inverse spin Hall effect, and spin-orbit torque in (anti)ferromagnets.

Description of the work

Energy dissipation is one of the toughest challenges for high-density electronic devices and a paramount issue in many emerging technologies. The recent advent of pure spin current with the attributes of maximal spin angular momentum and minimal charge current, thus least Joule heating, offers promising solutions to these problems. In the past years, Dr. Huang has been devoted to manipulating the polarized and pure spin currents associated with the spin caloritronic effects, such as the anomalous Nernst effect, spin Seebeck effect, and thermal Hall effect. He also has important contributions in studying the ferromagnetic resonance driven spin pumping, light-induced magnonic spin current, and current-induced *zero-field* spin-orbit torque effect in antiferromagnets. He has made many outstanding contributions and discoveries in this newly invigorated field, including one book chapter, 8 PRL, 14 PRB, 2 PRA, 1 PRM, 2APL, etc., which are cited more than 1900 times and lead to more than 25 invited talks in the important scientific conferences. Their impacts are briefly described as follows:

Spin Seebeck Effect: Spin caloritronics encompasses new effects that explore pure spin current phenomena and devices. Of those, the spin Seebeck effect (SSE) is one of the most important but inadequately established effects to generate pure spin current. The SSE exists in two configurations: transverse and longitudinal configurations with in-plane and out-of-plane temperature gradient, respectively. The first observations of the transverse SSE used thin ferromagnetic metals, semiconductors, and insulators deposited on thick substrates. Huang and his collaborators demonstrated experimentally that in such transverse SSE geometry, there is an unintentional temperature gradient perpendicular to the thin film due to the overwhelming thermal conduction through the substrate. As a result, the actual characteristics of the spin-dependent thermal transport are dominated by the anomalous Nernst effect (ANE) in ferromagnetic metals. This problem plagued many previous reports of the transverse SSE. Huang used substrate-free samples to demonstrate the intrinsic spin-dependent thermal transport in ferromagnets [Phys. Rev. Lett. **107**, 216604 (2011)], which has been *highlighted on Physics Synopsis* by the editor of Physical Review Letters. The longitudinal SSE geometry with an out-of-plane temperature gradient is applicable in generating spin current from ferromagnetic (FM) insulators such as yttrium iron garnet (YIG), and a nonmagnetic metal Pt on the FM insulator as in Pt/YIG is used as a spin current detector. Their results [Phys. Rev. Lett. **109**, 107204 (2012)] showed that although the temperature gradient $\nabla_z T$ is unequivocally out-of-plane, one encounters another issue of magnetic proximity effects (MPE) when Pt is in contact with an FM material. The magneto-transport measurements, both electrical and thermal, and evidences from x-ray magnetic circular dichroism results [Phys. Rev. Lett. **110**, 147207 (2013)], conclusively demonstrated the existence of MPE in Pt. Furthermore, Huang and his collaborators demonstrated a new type of magnetoresistance (MR) in Pt when it is in contact with an FM material. The new MR is distinctively different from all previous known MR effects, as described in [Phys. Rev. B **87** 220409(R) (2013)]. They showed different mechanisms that contribute to the new MR [Phys. Rev. Lett. **112**, 236601 (2014)], impacting the theoretical proposals for this MR. Most importantly, although many complications exist in the SSE systems, they demonstrated intrinsic longitudinal SSE without any appreciable MPE in Au/YIG [Phys. Rev. Lett. **110**, 067206 (2013)]. Their results have attracted a lot of attention. A more complete account of the SSE is in their book chapter [Solid State Physics **64**, 53 (2013)]. Beyond the YIG based system, they recently reported the first observation of SSE in highly spin-polarized ferromagnetic half metal LaSrMnO, which could be an important material for metal-based spin caloritronic devices in addition to FM insulators [Phys. Rev. B **96**, 00402(R) (2017)].

Spin Hall Materials: The most important quantity in pure spin current phenomena is the spin Hall angle (θ_{SH}), which measures the efficiency of charge/spin current conversion. There are several methods to determine θ_{SH}, including lateral spin valve, spin pumping, spin Hall switching and etc.. But each method has different complexities. The disparity in the values of θ_{SH} for the same material is one of the most outstanding issues in spin current phenomena. Huang and collaborators demonstrated a new and self-consistent method to determine θ_{SH} by employing a simple geometry of a metal/ferromagnetic insulator structure under a longitudinal thermal gradient and performed full spin current analyses of the inverse spin Hall voltage [Phys. Rev. B **89**, 140407(R) (2014)]. Huang further showed that this method, which uses the SSE to generate spin current, is robust and does not depend on the crystallinity of the spin current generator YIG [Phys. Rev. Materials **1**, 031401(R) (2017)]. While the spin Hall property is intrinsic for given material, recently, they showed that both the θ_{SH} and spin Hall conductivity in AuTa alloy exhibit a quasilinear dependence on its composition, demonstrating the importance of conduction electrons over band structures in determining the θ_{SH} for binary alloys [Phys. Rev. B **97**, 024402 (2018)]. In addition, they achieved utilizing the spin current to probe the spin frustrations and spin fluctuations in spin glass $Cu_{1-x}Mn_x$ alloys [Phys. Rev. B **101**, 104413 (2020)]. And they observed that spin current can be significantly enhanced during the spin-freezing process. Their results provide important guidance in materials engineering for future spintronic devices.

Spin Hall effect and Spin-Orbit Torque in Ferromagnet and antiferromagnet: Inverse spin Hall effect has been established only in non-magnetic metals (e.g., Pt, W) with strong spin-orbit coupling (SOT) for a long time. Huang and collaborators reported the first observation of the inverse spin Hall effect in a 3*d ferromagnetic* metal of permalloy (Py) [Phys. Rev. Lett. **111**, 066602 (2013)]. This is the inverse effect of the well-known anomalous Hall effect in ferromagnetic metals. Ferromagnetic materials not only can generate spin-polarized current but also can be used to detect pure spin current. The large θ_{SH} in Py indicates that many other ferromagnetic metals can be exploited for pure spin current applications. These important results have been selected as the *Editors' suggestion* in Physical Review Letters. Besides ferromagnets, Huang and collaborator also found that chromium (Cr), which is a *3d* spin-density wave antiferromagnetic metal, has a large inverse spin Hall effect below and above its phase transition temperature [Phys. Rev. B. **92**, 020418 (R) (2015)]. This result leads to another important breakthrough, *field-free spin-orbit torque (SOT) switching* in heavy-metal-free Cr-based heterostructures [Phys. Rev. Applied **11**, 061005 (2019) (Letter)]. Moreover, they demonstrated the high-entropy alloy can also generate sizable spin-orbit torques for FM switching [Phys. Rev. Applied **8**, 044005 (2017)]. Very recently, Huang made an important contribution to the SOT antiferromagnetic (AFM) Néel vector switching. Antiferromagnet with zero net magnetization has several unique advantages, including ultrafast dynamics in the terahertz frequencies, robustness against field perturbation, and negligible stray field. Recently, there have been numerous reports of electrical switching of AFM Néel vector via SOT, attracting worldwide attention. By applying a writing current in the AFM layer or the normal metal (NM)/AFM bilayer, in a patterned multiterminal device, the measured resistance exhibited recurring signals due to the supposedly electrical switching of the AFM Néel vector. However, Huang showed that under a large writing current density beyond the Ohmic regime, the multiterminal devices generate unintended anisotropic thermal gradients and voltages [Phys. Rev. Lett. **123**, 227203 (2019)]. Thus, this widely held switching signal may not be the conclusive evidence of SOT switching of AFM but the thermal artifacts of patterned metal structures on substrates. Similar signals can be observed in such patterned structures, with and without the AFM layer. Consequently, the strength of the signal is greatly affected by the thermal conductivity of the substrates. This important observation is *highlighted by Physic Review Letters' Editors* as *Editors' suggestion and Featured in Physics* with a "Viewpoint: The heat in antiferromagnetic switching".

Thermal spin current to explore surface magnetization: Huang showed that the thermal measurement with a vertical temperature gradient could be an important tool for detecting magnetization structure with high sensitivity [Phys. Rev. B. **94**, 024405 (2016)]. By using thermal spin current and highly sensitive micro-magneto-optic Kerr effect (MOKE) measurements, he conclusively showed that the peculiar field dependence of the thermal voltage is due to the noncollinear magnetization between the surface and bulk YIG. Huang further experimentally demonstrated that the contributions of the interfacial and bulk temperature gradients in spin caloritronics can be revealed by the light excited thermal spin current measurement [Phys. Rev. B **99**, 094426 (2019)]. By flipping the direction of the incident light, the interfacial and bulk contributions to the transverse spin accumulation he can be qualitatively distinguished for the first time. Huang showed that the derived interfacial and bulk spin Seebeck coefficient is intrinsic and frequency-independent. Thus, unlike conventional electrical heating, light offers distinct heating mechanism to develop spintronic and spin caloritronic devices.

Thermal excited spin-polarized current: Huang designed several unique measurement configurations to distinguish the contributions of the spin-dependent thermal voltages from the thermal Hall effect (THE), the anomalous Nernst effect (ANE), and the spin Seebeck effect (SSE) in [Phys. Rev. Lett. **117**, 247201 (2016)]. Although recent theoretical researches indicate that the THE can compromise the legitimacy of all thermal related spin physics effects in spin caloritronics, Huang experimentally demonstrated that these speculations are false. He confirmed that ANE and SSE are indispensable tools to explore thermal spin current. Moreover, they showed in [Phys. Rev. B **96**, 174406 (2017)] that the ANE is thickness dependent. They found that the magnitude and even sign of the ANE exhibit nontrivial thickness-dependent behaviors in conventional FMs, including Fe, Co, Ni, and Py. Most importantly, the conversion efficiency of the spin signals generated by heat flows can be significantly enhanced to one order of magnitude in ultra-thin films. They demonstrated that this enhancement is dominated by the intrinsic Berry curvature and side-jump mechanisms. These findings also reveal various potential applications of spin-based thermoelectrics for energy harvesting.

Incoherent spin pumping: Although the spin pumping (SP) and the SSE, two of the most common methods for generating pure spin currents from ferromagnetic insulators, are considered to share similar physical mechanisms, Huang showed that while the SP is significantly reduced in a polycrystalline yttrium iron garnet (YIG), the SSE is insensitive to the crystalline structures [Phys. Rev. Materials **1**, 031401(R) (2017)]. This discovery offers new insights into the mechanisms between the coherently driven SP and the non-coherently excited SSE. This work is *highlighted by Physical Review Editors* and introduced by editors of Nature publisher as a research *highlight article* in *Nature Nanotechnology* [Nat. Nanotech. **12**, 936 (2017)]. Very recently, they further showed that the evidence is absent for coherent spin pumping in Pt/YIG [Phys. Rev. B **99**, 220402 (R) (2019)]. When YIG samples of an appropriate thickness has been used, all the spin wave resonance modes can be resolved and their temperature dependence and that of coherent spin pumping can be separately followed. They showed that there is *no* evidence of coherent spin pumping, which was expected to prevail at low temperatures. These are some of the most essential questions in pure spin current phenomena to date.

Dr. Huang and his collaborators' works have a profound and high impact on both fundamental physics and applications of spin-based phenomena in the emerging field of spin caloritronics and spintronics. Their papers have been heavily cited and thus far have led to 25 invited talks in the important scientific meetings. Dr. Huang has been awarded the Ta-You Wu Memorial Award and Academia Sinica Junior Research Investigators Award in 2018, Golden Jade Fellowship in 2015, AUMS Young Researcher Award in 2014. He is distinctly qualified for the 2020 Nishina Asia Award.

Key references (up to 3 key publications*)

1. C. C. Chiang, S. Y. Huang*, D. Qu, P. H. Wu, C. L. Chien, "*Absence of evidence of electrical switching of the antiferromagnetic Néel vector*", Phys. Rev. Lett., **123**, 227203 (2019) (Editors' suggestion and Featured in Physics). Viewpoint on Physics: The heat in antiferromagnetic switching.
2. S. Y. Huang*, X. Fan, D. Qu, Y. P. Chen, W. G. Wang, J. Wu, T. Y. Chen, J. Q. Xiao and C. L. Chien, *Transport magnetic proximity effects in platinum*, Phys. Rev. Lett. **109**, 107204 (2012).
3. S. Y. Huang*, W. G. Wang, S. F. Lee, J. Kwo, and C. L. Chien, *Intrinsic spin-dependent thermal transport*, (2011) Phys. Rev. Lett. **107**, 216604. *Editor highlights* on Physics Synopsis.

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

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

Prof. Yuan-Huei Chang

Department of Physics, National Taiwan University

Email: yhchang@phys.ntu.edu.tw

Relation to the candidate: colleague and former department chair

Signature Yuan Huei Chang Date 2020-03-30

Nomination form for the 2020 Nishina Asia Award

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

Chang-Ki Min

Nationality : Republic of Korea

Affiliation : Researcher, XFEL Division, Pohang Accelerator Laboratory, Pohang, Republic of Korea (Sep. 2011~)

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Education

Ph. D. (Physical Chemistry), 2001~2006, POSTECH, Republic of Korea

M. S. (Physical Chemistry), 1999~2001, POSTECH, Republic of Korea

B. S. (Chemistry), 1995~1999, POSTECH, Republic of Korea

Past Appointments

Post doctoral researcher, Univ. of Illinois at Urbana-Champaign (Nov. 2007 ~ Aug. 2011)

Post doctoral researcher, Korea Res. Inst. of Standards and Sci. (Mar. 2006~Aug. 2007)

Citation for the Award (within 30 words)

His contribution to substantial improvements of temporal accuracy in femtosecond time-resolved studies using hard X-ray free electron lasers

Description of the work

Dr. Chang-Ki Min got his Ph.D in the field of physical chemistry from POSTEH in 2006, and worked at Univ. of Illinois at Urbana-Champaign as a post Doc for four years from 2007. He joined the PAL-XFEL (Pohang Accelerator Laboratory X-ray Free Electron Laser) construction project in 2011 as a laser scientist for the 10-GeV electron linac of the PAL-XFEL. He was in charge of the laser system for a photocathode RF-gun and developed a reference timing system for the linear accelerator and optical lasers for the beamlines.

The PAL-XFEL is a hard X-ray FEL facility starting the user service operation from 2017 as the third operating facility in the world. It provides femto-seconds long XFEL with an unprecedented intensity to users as do other XFEL facilities (LCLS-1 in USA, SACLA in Japan, European XFEL in Germany, and SwissFEL in Switzerland). The XFEL intensity is high enough to enable a femtosecond pump-femtosecond probe (FPFP) experiment for femtosecond time-resolved studies to observe phenomena taking place within a time scale down to a few tens of femto-second ever available before for chemistry, biology, and others. The timing jitter between an optical laser as a pump and a XFEL as a probe determines the accuracy of FPFP experiment. To achieve the highest experimental time resolution, the timing jitter between the XFEL and the optical laser should be minimized as low as possible.

Dr. Min, who has a deep understanding of laser and RF technology, designed the 1 km long reference RF system from the injector to the beamlines using a state of the art technology as well as a well-developed conventional technology. He decided to use a coaxial cable for the RF reference line instead of the optical-based reference line that was regarded as the only solution for the XFEL's FPFP experiment. His idea was that the slow timing drift existing in the coaxial cable can be well compensated by the electron beam-based feedback control and the high frequency jitter only needs to be minimized. It was realized by using low noise devices for all timing devices and a balanced optical and microwave phase detector (BOMPD) built in-house based on a Sagnac interferometer which is used for the cavity-length feedback of the Ti:sapphire oscillators. All laser systems in the PAL-XFEL are locked with the reference timing stem with a timing jitter better than 10 fs in rms. Other devices for the PAL-XFEL such as a low-level RF control for the 10-GeV electron linac also followed his ideas.

His contribution is so remarkable that PAL-XFEL is able to provide an unprecedented timing jitter (between the XFEL and the optical laser) of better than 20 fs, outperforming other XFEL facilities. Thus, the PAL-XFEL becomes a world-leading facility in femtosecond time-resolved studies. He has played a big role in achieving a substantial improvement of accelerator technology. This is why I recommend Dr. Min for your prestigious Nishina Asia Award in 2020.

Key references (up to 3 key publications*)

1. Hard X-ray free-electron laser with femtosecond-scale timing jitter, H.-S. Kang, C.-K. Min, H. Heo, C. Kim, H. Yang, G. Kim, I. Nam, S. Y. Baek, H.-J. Choi, G. Mun, B. R. Park, Y. J. Suh, D. C. Shin, J. Hu, J. Hong, S. Jung, S.-H. Kim, K. Kim, D. Na, S. S. Park, Y. J. Park, J.-H. Han, Y. G. Jung, S. H. Jeong, H. G. Lee, S. Lee, S. Lee, W.-W. Lee, B. Oh, H. S. Suh, Y. W. Parc, S.-J. Park, M. H. Kim, N.-S. Jung, Y.-C. Kim, M.-S. Lee, B.-H. Lee, C.-W. Sung, I.-S. Mok, J.-M. Yang, C.-S. Lee, H. Shin, J. H. Kim, Y. Kim, J. H. Lee, S.-Y. Park, J. Kim, J. Park, I. Eom, S. Rah, S. Kim, K. H. Nam, J. Park, J. Park, S. Kim, S. Kwon, S. H. Park, K. S. Kim, H. Hyun,

S. N. Kim, S. Kim, S. Hwang, M. J. Kim, C. Lim, C.-J. Yu, B.-S. Kim, T.-H. Kang, K.-W. Kim, S.-H. Kim, H.-S. Lee, H.-S. Lee, K.-H. Park, T.-Y. Koo, D.-E. Kim & I. S. Ko, Nature Photonics 11, 708-713 (2017)

2. Laser systems for time-resolved experiments at the Pohang Accelerator Laboratory X-ray Free-Electron Laser beamlines, M. Kim, C.-K. Min & I. Eom, Journal of Synchrotron Radiation 26, 868-873 (2019)

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

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

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Dr. Min is a staff scientist of PAL and I am PAL Director. Dr. Min was a member of PAL-XFEL construction project, and I was the PAL-XFEL Project Director from 2011 to 2016.

Signature In Soo Ko Date March 30, 2020