Nishina Asia Award 2018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.18-1	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 and γ-ray strength function	Nguyen Dinh Dang Nishina Center Research Scientist Quantum Hadron Physics Laboratory （理研仁科加速器センター）	永宮、福嶋、山内
No.18-2	CHONG Yidong Singqpore	Nanyang Technological University, Singapore	Dr. Chong has pioneered two influential areas of research in photonics, topological photonics and coherent perfect absorption, which promise to have applications in optical devices with novel properties.	Leong Chuan Kwek,	家、前野
No.18-3 受賞	Yu-tin Huang Taiwan	Physics Department,National Taiwan University	For his contribution to uncoverring hidden symmetries and structures in the S-matrix of gauge and gravity theories in diverse dimensions.	Dr.Yuan-Huei Chang Professor and Chaiman Department of Physics National Taiwan University	磯、江口
No.18-4	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 coupling in iridates.	Soo-Bong Kim Professor of Physics Seoul National University	前野、押川
No.18-5 -1	Wang YAO China	Department of Physics, The University of Hong Kong	For pioneering contribution to Valleytronics in 2D semiconductors & van der Waals heterostructres	Fu-Chun Zhan Professor and Director Kavli Institute for Theoretical Sciences University of Chinese Academy of Sciences	家、前野
No.18-5 -2	Wang YAO Chinese	Department of Physics, The University of Hong Kong	For the prediction of the valley optical selection rule and the valley Hall effect as foundations of valley optoelectronics in 2D materials.	Hongming WENG Institute of Physics, Chinese Academy of Sciences	家、前野
No.18-6	Suvrat Raju India	International Centre for Theoretical Sciences,Tata Institute of Fundamental Reserch	For new on the information paradox and the interior of black holes and clarifying the nature of subtle non-loca effects in quantum gravity,	Spenta R Wadia infosys Homi Bhabha Chair Professor and Founding Director,International Centre for Theoretical Sciences (ICTS-TIFR), ata Institute of	磯、江口

No.18-7	Jianglai Liu China	Shanghai Jiao Tong University	For his seminal contribution in the PandaX experiment, resulting in a most sensitive direct search for the particle dark matter.	Xiangdong JI Distinguished University Professor,U.of Maryland Hongwen Chair Professor,Shanghai Jiao Tong University	梶田、山内、永宮
No.18-8	Sungdae Ji South Korea	Max Planck POSTECH Center	for the first time in measurement of quantum spin dynamics in Kitaev Quantum Spin Liquid phase by systematic investigations of both inelastic neutron scattering and thermodynamic measurements from ・	Yasuo Endoh, Professor Emeritus of Tohoku University & Diamond Fellow of KEK	押川、前野
No.18-9	Young Sul Cho South Korea	Department of Physics, Chonbuk National University	For contributions to modeling and uncovering underlying mechanism of discontinuous transitions in percolation and their applications, and cluster nchronization which attracted broad interest from the researchers in statistical physics	Professor Byungnam Kahng Affiliation: Department of Physics and Astronomy, Seoul National University	押川、福嶋
No.18-10	Ying Jiang China	Associate Professor Internaeional Center for Quantum Materials,School of Physics Peking Univerity,Beijing China	Unraveling nuclear quantum effects of water at atomic scale	Rui-Rui Du Chair Profesor of Physics Director of the International Center for Quantum Materials Peking Universty.Beijing China	三島
No.18-11	Jensen Li Chana	Department of Physics/Hong Kong Univ. of Science and Technology	For his seminal contribution to acoustic metamaterials. He proposed and realized acoustic metamaterials with "double-negativity", negative and extreme wave manipulation properties.	Professor Che Ting Chan Physics Department,Hong Kong University of Science and Technology	三島
No.18-12	Chao-Yang Lu China	Professor of Physics, Hefei National Laboratory for Physical Sciences at Microscale, University of Science and Technology of	For his outstanding contributions to quantum information science with single photons	Ruibao Tao Department of Physics,Fudan University	押川、前野
No.18-13	Gu Liyi China	RIKEN (The Institute of Physical and Chemical Research),	An Observational Discovery of Cosmological In-fall of Galaxies in Clusters	Kazuo Makishima (牧島一夫) RIKEN (The Institute of Physical and Chemical Research)	佐々木、磯

No.18-14	Huailiang Xu Chaina	Electronic Science and Engineering, Jilin University	Lasing in filamentation in air and ultrafast hydrogen migration in intense laser fields	Professor Kaoru Yamanouchi Department of Chemistry, School of Science, The University of Tokyo	永宮、山内

Nomination form for the 2018 Nishina Asia Award

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

Office address: Representative Office of Duy Tan University in Ho Chi Minh city, No 10C, Tran Nhat Duat street, No 1 district, Ho Chi Minh city, Vietnam

Tel: +84-903-255 294; Email: nqhungdtu@gmail.com

Position: Associate Professor, Director of IFAS

Home address: Room 06.05, Block A4, Hoang Anh Gold House Building, Nguyen Huu Tho street, Nha Be district, Ho Chi Minh city, Vietnam.

Education:

- Undergraduate: Department of Nuclear Physics, Faculty of Physics, Hanoi University of Science – Hanoi National University. *Date of university graduation*: September 2003;
- Master: Department of Nuclear Physics, Faculty of Physics, Hanoi University of Science, Hanoi National University. *Date of master degree*: November 2005;
- PhD: Heavy-Ion Nuclear Physics Laboratory, Nishina Center for Accelerator-Based Science, RIKEN and Institute of Physics – Vietnam Academy of Science and Technology. *Date of Ph.D. degree*: November 2009;
- Postdoc: Nishina Memorial Fellow at Nishina Center for Accelerator-Based Science, RIKEN, December 2009 – May 2010.

Employment records:

- 2009 – 2011: Contract Researcher, Center for Nuclear Physics, Hanoi Institute of Physics.
- 2011 – 2014: Assistant Professor, Head of Physics Department, School of Engineering, Tan Tao University.
- 2014 – 2015: Associate Professor, Vice Dean, School of Engineering, Tan Tao University.
- 2015 - present: Associate Professor, Head of Nuclear Theory Group and Director of IFAS, Duy Tan University.

Awards:

- Certificate of Merit for Excellent Research Achievement by Hanoi Institute of Physics (2010).
- Young Researcher Award by Vietnam Theoretical Physics Society (2012).
- Certificate of Merit for Excellent Contribution in Teaching and Research at Tan Tao University by President of People's Committee of Long An prefecture (2014).
- Chu Van An Award for Excellent Achievements in Teaching and Research by President of Tan Tao University (2015).

- Selected as one of 70 young scientists of Vietnam to attend the reception by Prime Minister Nguyen Tan Dung (2015). - Received the congratulation letter from Minister of Science and Technology of Vietnam for the paper published in Physical Review Letters (2017). - Selected as one of 9 members of the National Foundation for Science and Technology Development (NAFOSTED) Committee for Physics (term 2018-2020).
Citation for the Award (within 30 words)
The award is given to Prof. Nguyen Quang Hung for his contributions in the field of nuclear structure theory, particularly for the description of level density and gamma-ray strength function.
Description of the work (★)
This work has made a major step forward by proposing, for the very first time, a unified and consistent microscopic approach capable of describing simultaneously the nuclear level density and the emission probability of γ-rays from hot nuclei, which play essential roles in stellar nucleosynthesis. According to the rules of quantum mechanics, the atomic nucleus has discrete energy levels. As the excitation energy increases, the level spacing decreases rapidly so that the levels become densely crowded. In this condition dealing with individual nuclear levels becomes impractical. Instead, it is meaningful and convenient to consider the average properties of nuclear excitations in terms of the nuclear level density (NLD) and radiative strength function (RSF). The former, introduced by Hans Bethe 80 years ago, is the number of excited levels per unit of excitation energy. The latter, proposed by Blatt and Weisskopf 64 years ago, describes the emission probability of high-energy light quanta (γ-rays), which is expressed in terms of the average reduced partial radiation of g-rays per unit energy interval. These two quantities are indispensable ingredients in astrophysical nucleosynthesis, including the calculations of reaction rates in cosmos and production of elements, as well as in technology such as nuclear energy production and transmutation of nuclear waste. Therefore, the study of these quantities has been one of the most important topics in nuclear physics. This study has gained impetus in 2000 after the experimentalists of Oslo university proposed a method to simultaneously extract both the NLD and RSF from the primary γ-decay spectrum obtained in a single compound nuclear reaction experiment (Fig. 1). This method, however, suffers from the normalization uncertainties. Given the importance of the NLD and RSF, it is imperative to have a consistent theoretical basis to understand these quantities. Nonetheless, a unified theory capable of simultaneously and microscopically describing both the NLD and RSF has been absent so far.

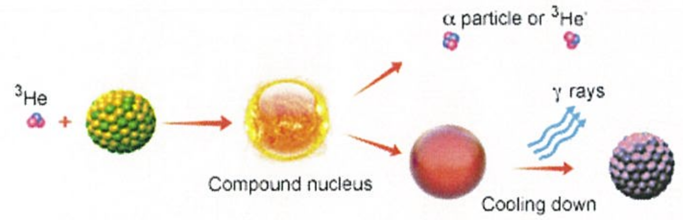

Fig. 1: *In reactions performed by using the Oslo method the light particles (e.g. ^{3}He) fuse with a heavy target creating a compound nucleus at a certain temperature (hot nucleus), which subsequently cools down by emitting light particles (e.g. α-particles in transfer reactions or ^{3}He' in inelastic scattering reactions) and γ-rays.*

In the present work, employing the mean fields of independent nucleons (protons and neutrons), the authors exactly solved the problem with superfluid interactions between nucleons. These exact solutions are employed to construct the partition function to calculate the NLD. To calculate the RSF, the exact neutron and proton pairing gaps as well as the related quantities, obtained from the same partition function, are included in the Phonon Damping Model, a microscopic model proposed by one of the authors, N. Dinh Dang of RIKEN Nishina Center for Accelerator-Based Science, in collaboration with A. Arima in 1998 to describe the damping of giant dipole resonance in highly excited nuclei.

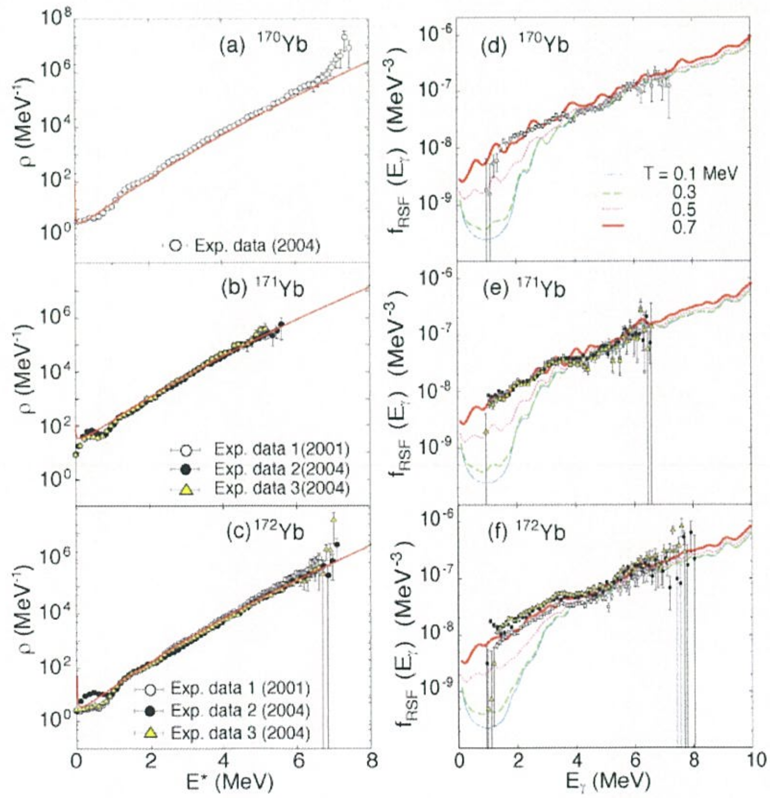

Fig. 2: *NLD [(a) - (c)] as functions of excitation energy and RSF [(d) - (f)] as functions of the γ-ray energy at different temperatures T, predicted by the present approach, in comparison with the experimental data for ytterbium isotopes $^{170, 171, 172}$Yb.*

The good agreement between the predictions by the present approach and experimental data (Fig. 2) indicates that the use of exact solutions for pairing, which conserve rigorously the particle numbers, is indeed very important for the consistent description of both NLD and RSF at low and intermediate excitation and γ-ray energies. It shows that the microscopic strength function with the temperature-dependent width, which was successful in the description of the damping of giant resonances in highly excited nuclei, turns out to be very important for the correct description of the RSF at low γ-ray energies as well. This finding invalidates the 60-year-old Brink-Axel hypothesis, which assumes that the giant dipole resonance built on an excited state should be the same as that built on the ground state. The explanation of the enhancement found of the RSF at low γ-ray energies is also a big plus of this approach as it does not requires a phenomenological introduction of pygmy dipole resonance to describe a group of additional dipole strengths appearing at the giant resonance's low-energy tail.

(★) A RIKEN Press Release has been issued on this work on 13 January 2017 at http://www.riken.jp/en/pr/press/2017/20170113_1/

- This work is a milestone in the history of Vietnamese nuclear physics, when, for the first time, a paper in nuclear physics, whose all three coauthors are Vietnamese, has been published in Physical Review Letters. Therefore, this paper was mentioned, and its authors were interviewed in several big newspapers and on national TV in Vietnam.
- The minister of Science and Technology of Vietnam Chu Ngoc Anh has also sent a congratulation letter to the authors of this paper on 23 February 2017.

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 and N. Dinh Dang,**
Exact and approximate ensemble treatments of thermal pairing in a multilevel model, Phys. Rev. C 79 (2009) 054328.

*) 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 Quantum Hadron Physics Laboratory RIKEN Nishina Center for Accelerator-Based Science Main Research Bldg., R. 430 RIKEN, 2-1 Hirosawa, Wako city, 351-0198 Saitama, Japan Tel: 81-48-462-1111, Extension: 3447 Fax: 81-48-462-4698 Email: dang@riken.jp
Signature Đặng Date 17 January 2018

No.18-2

Nomination form for the 2018 Nishina Asia Award

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)
CHONG Yidong Nanyang Technological University, Singapore Nationality: Singapore Education History: PhD Physics, Massachusetts Institute of Technology, 2005-2008 BSc Physics, Stanford University, 1999-2003 Employment History: Nanyang Assistant Professor, Nanyang Technological University, 2011-present Postdoctoral Associate, Yale University, 2008-2011 Address: Division of Physics and Applied Physics School of Physical and Mathematical Sciences Nanyang Technological University SPMS-PAP-02-01, 21 Nanyang Link Singapore 637371, Singapore Tel: +65 6316 2967 (home) +65 9327 9319 (hp)
Citation for the Award (within 30 words)
Dr. Chong has pioneered two influential areas of research in photonics, topological photonics and coherent perfect absorption, which promise to have applications in optical devices with novel properties.
Description of the work

The new field of topological photonics deals with optical structures in which light takes the form of "topologically protected" electromagnetic waves analogous to electronic wavefunctions in the exotic quantum materials known as topological insulators. These "topological edge states" can bypass obstacles without back-scattering, with promising applications as robust waveguides and other devices, as well as allowing photonics to be a platform for studying fundamental the properties of "topological matter". Dr. Chong helped to pioneer this research field during his PhD work at MIT, when he helped to develop the first experimental realization of a microwave photonic crystal exhibiting topological edge states [*Nature* 461, 772 (2009)].

After joining Nanyang Technological University (NTU) in 2012, he further advanced the field by proposing a method for realizing a photonic analogue of a topological insulator at the technologically important optical frequency regime [*Physical Review Letters* 110, 203904 (2013)]. He has made numerous other theoretical and experimental breakthroughs, such as the first experimental demonstration (using microwaves) of a "Laughlin topological pump" for demonstrating the topological characteristics of an electromagnetic device [*Physical Review X* 5, 011012 (2015)], the design and implementation of three-dimensional optical structures with topological features ("Weyl points") [*Nature Physics* 13, 611 (2017)], and the theoretical prediction of moving topological solitons [*Physical Review Letters* 117, 143901 (2016)]. He also helped extend the idea of topological edge states into the field of acoustics [*Physical Review Letters* 114, 114301 (2015)], which is now the active new research area of "topological acoustics".

Another distinct contribution of Dr. Chong is in the field of non-Hermitian photonics: photonic structures with distinct properties arising from optical amplification and loss. He pioneered the concept of coherent perfect absorption, the complete absorption of an optical wave into an absorbing media (with no scattering or reflection) by simultaneous fine-tuning of the absorptivity and the incident wave-form [*Physical Review Letters* 105, 053901 (2010), *Science* 331, 889 (2011)]. In recent years, Dr. Chong has co-authored a comprehensive review article on coherent perfect absorption [*Nature Reviews Materials* 2, 17064 (2017)], and helped to non-Hermitian photonics to new areas such as the development of topological non-Hermitian photonic modes [*Physical Review Letters* 118, 040401 (2017)].

Key references (up to 3 key publications*)

1. W. Hu, J. C. Pillay, K. Wu, M. Pasek, P. P. Shum, and Y. D. Chong, "*Measurement of a Topological Edge Invariant in a Microwave Network.*" Physical Review X 5, 011012 (2015).

2. "Coherent Perfect Absorbers: Time-Reversed Lasers", Y. D. Chong, L. Ge, H. Cao, and A. D. Stone, Physical Review Letters 105, 053901 (2010).

3*. “Observation of Unidirectional Backscattering-immune Topological Electromagnetic States”, Z. Wang(**), Y. D. Chong(**), J. D. Joannopoulos, and M. Soljačić, Nature 461, 772 (2009). (** Equal contributions) *) Copy of one most significant publication should be attached.
Nominator (name, affiliation, email, telephone and relation to the candidate)
Signature ______________________________ Date ________________________

Nomination form for the 2018 Nishina Asia Award

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

Name: Yu-tin Huang
Nationality: Taiwan
Affiliation: Physics Department, National Taiwan University
Ph. D: May 2009 Stony Brook University
Address: No. 1, Section 4, Roosevelt Rd, Da'an District, Taipei City, 10617
E-Mail: , Tele: 886-2-3366-5194

Previous Affiliation:
2017-present Physics Department, National Taiwan University, Associate Professor
2014- 2017 Physics Department, National Taiwan University, Assistant Professor
2013-2014 Institute for Advanced Studies, Member
2012-2013 Michigan University Post Doc
2009-2012 UCLA Post Doc

Citation for the Award (within 30 words)

For his contribution to uncovering hidden symmetries and structures in the S-matrix of gauge and gravity theories in diverse dimensions.

Description of the work

As one of the leading experts in the world on the S-matrix for gauge and gravity theories, Yu-tin Huang is one of the few people who initiated, with amazing insight and endeavor, a series of surprising developments that have revolutionized our understanding about scattering amplitudes, and about field theory and gravity. Invited by Cambridge University Press, he and Elvang wrote the textbook titled "Scattering Amplitudes in Gauge Theory and Gravity", published in 2015. Its clarity and style are highly appreciated by the field theory community around the world. It is clear that it is becoming the standard reference on this topic and will influence a few generations.

Ref. [1] demonstrated how structures of the S-matrix could be completely hidden in the conventional Lagrangian of gauge and gravity theories. In particular, by augmenting the classical Lagrangian by terms that vanish through algebraic identities, a duality between the color structure of its scattering amplitude and its kinematic factor is revealed. This shows that the hidden structure for the S-matrix is present beyond the tree-level approximation. This realization led tremendous progress for loop level computations of quantum gravity amplitudes, where color kinematic duality was employed to obtain amplitudes of (super)gravity, leading to surprising results for the ultra-violet behavior of quantum gravity theory. A new layer of the amazing hidden connection between gauge theory and gravity is unraveled by this work.

Ref. [2] established the presence of dual-superconformal symmetry for N=6 to all orders in perturbation theory. Unlike the case of the N=4 super Yang-Mills, this symmetry was not expected from the dual string picture, and hence the establishment of its presence was an important field theory accomplishment, which led to high-multiplicity and loop-order computations of Chern-Simons matter theories.

Ref. [3] explored soft-theorems associated with spontaneous symmetry breaking. Most importantly, using the Akulov-Volkov theory, it demonstrated how spontaneously broken fermionic symmetries leave its fingerprint in the zero-momentum limit of Goldstone fermions in the S-matrix. Turning to supergravity, it was shown that similar soft theorems are present in the fermion sectors, which are not implied by supersymmetry, hinting at further hidden symmetries.

Recently in a series of collaborate effort with Nima Arkani-Hamed, Yu-tin has set out to draw out general constraints on interacting theories for massive particles and in the context of effective field theory from consistency conditions of its S-matrix. This has allowed them to deduce far reaching conclusions such as bounds on the spin for fundamental charged particle and new on-shell formalism for efficient computations of massive amplitudes. This has culminated in their recent work ``Scattering amplitudes for all masses and spin" arxiv.1409.04891.

Finally, since returning to Taiwan, Yu-tin Huang has made great effort in helping local students and young researchers, as well as offering services to the theory community. He organized *Amplitudes in Asia 2015*, as well as many other conferences and workshops. People in Taiwan could feel the clear difference due to his heart-warming effort. It is the common opinion of many senior physicists that Yu-tin Huang is the most promising theorist in Taiwan in the younger generation.

Key references (up to 3 key publications*)

[1] "Gravity as the Square of Gauge Theory", Zvi Bern, Tristan Dennen, Yu-tin Huang, Michael Keirmaier, **Phys.Rev. D82 (2010) 065003**

[2] "Tree-Level Recursion Relation and Dual Superconformal Theory of ABJM", Dongmin Gang, Yu-tin Huang, Eunkyung Koh, Sangmin Lee, Arthur Lipstein **JHEP 1103 (2011) 116**

[3] "New Fermionic Soft Theorems", Wei-Ming Chen, Yu-tin Huang, Congkao Wen, **Phys.Rev.Lett.**

115 (2015) no.2, 021603 *) Copy of one most significant publication should be attached.
Nominator (name, affiliation, email, telephone and relation to the candidate)
Relation to the candidate: colleague.
Signature Yuan Huei Chang Date 2018-03-07

No.18-4

Nomination form for the 2018 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

sbk@snu.ac.kr
+82-2-880-5755 (O), +82-10-3896-3530 (Mobile)
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 2018 Nishina Asia Award

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

Name YAO, Wang

Affiliation Department of Physics, The University of Hong Kong,
Email: wangyao@hku.hk; Phone: +852 2219 4809.

Nationality China

Birth date Dec. 1979 (in Jilin, China)

Education

2001 - 2006	Univ. of California, San Diego	PhD in Physics 2006
1997 - 2001	Peking University, Beijing, China	BSc 2001

Employment history

2017 -	Professor, Physics Department, The University of Hong Kong
2014 - 2017	Associate Professor, Physics Department, The University of Hong Kong
2008 - 2014	Assistant Professor, Physics Department, The University of Hong Kong
2006 - 2008	Postdoc Fellow, Univ. of Texas at Austin

Factual summary

Published 80+ peer-reviewed papers (26 in *Nature* journals, 3 in *Science* journals, 15 in Phys. Rev. Lett.). 26 papers cited >100 times (including 2 cited > 1000 times) on *Web of Science*, and 27 are classified as *Highly Cited Papers.*

Awards and Honors

Founding member, Young Academy of Sciences of Hong Kong (2017 - present)

OCPA Achievement in Asia Award (Robert T. Poe Prize), 2014.

Croucher Innovation Award, 2013.

Major professional activities

Associate editor, *2D Materials* (2013 - present)

Physical Sciences Panel member, Research Grants Council of HKSAR (2017 - present)

Vice president (2013-15), honorary secretary (2011-13), Physical Society of Hong Kong.

Citation for the Award (within 30 words)
For pioneering contribution to Valleytronics in 2D semiconductors & van der Waals heterostructures.

Description of the work
Yao's work has defined an important new research direction – valley optoelectronics in 2D semiconductors and their heterostructures. In many crystals the Bloch bands have degenerate but inequivalent energy extrema in momentum space, known as valleys. The notion of addressing and exploiting this internal quantum degree of freedom of carriers is referred to as valleytronics. Valleytronics has become a burgeoning field of research since the emergence of atomically thin 2D semiconductors (transition metal dichalcogenides etc.), where Yao has made groundbreaking advances that has enabled versatile control of valley, transforming valleytronics from a concept to an experimentally demonstrated reality. These advances have paved the way towards the exploitation of valley for versatile functionalities in future optoelectronics. Yao's theory papers made two fundamental predictions for the field of valleytronics: the valley optical selection rule; and the valley Hall effect, which have generated great excitement in the theoretical and experimental research communities. The valley optical selection rule predicted by Yao and collaborators makes the valley-selective optical transitions possible by circularly polarized light [1,2]. This intriguing phenomenon has driven the tremendous optoelectronic studies in the semiconducting TMDs, and has enabled a series of milestones in the experimental demonstration of optical valley control. The valley Hall effect, in which electrical field generates transverse valley current, was predicted by Yao and collaborators in gapped single & bilayer graphene [3] and in TMDs [1]. This topological valley transport phenomenon was subsequently observed in monolayer TMDs (McEuen group), graphene on hBN (Geim group), and biased graphene bilayer (Tarucha group & Zhang group independently), and has become another cornerstone for the rapidly growing field of valleytronics. The three key publications by Yao [1-3], in which he is corresponding author or first author, have 1802, 386, 808 citations respectively on Google Scholar. They have become the key components in the vast research field of 2D semiconductors. These work were the first of Yao's many major theory contributions to reveal the valley related phenomena in 2D materials, and the community is busy testing other predictions from his group including: the spin-layer-valley locking effect in bilayer TMDs (Nat Comm. 4, 2053, 13", cited 150 times on Google Scholar), the excitonic valley Hall effect (Nat Comm. 5, 3876, 14", cited 104 times), and anomalous valley optics of interlayer excitons (PRL 115, 187002, 15", cited 47 times). In addition to the theoretical works, Yao's impact on the field was greatly amplified by his important collaborative research with leading experimentalists, which has led to several milestones on the

experimental demonstration of valleytronic controls based on his theory predictions. Yao's influence has also overflown to the field of metamaterials, photonic and phononic crystals, where his valleytronics works have stimulated experimental and theoretical exploration of the analog in these artificial crystals. Yao is highly respected in the international science community, frequently asked to give invited talks at leading international conferences (e.g. APS March Meeting, 4 times in 2009, 2013, 2015, 2018).

Latest study of Yao's group has extended to the valley phenomena in heterostructures formed by van der Waals stacking of 2D materials. The feasibility to combine highly disparate 2D materials to create a wide range of functional heterostructures without the constraints of lattice matching is the most promising aspect of 2D materials research. Yao's group has discovered new manifestations of valley physics in the heterostructures, where the ubiquitous moiré pattern from lattice mismatch leads to nanoscale patterned optical and topological properties. Two theory papers from his group (Nature Phys 13, 356, 17"; Science Adv. 3, e1701696, 17") marked the beginning to understand this new physics in van der Waals stacked heterostructures.

In recognition of his achievements, Yao has received Croucher Innovation Award in 2013 and OCPA Achievement in Asia Award in 2014. The former is the most prestigious research award in Hong Kong, one to two winners annually, with competition from all fields of natural sciences, technology and medicine. The latter award is presented by the International Organization of Chinese Physicists and Astronomers (OCPA) annually to a physicist/astronomer under 50 years of age, or a team of Physicists/astronomers, of Chinese ethnicity working in Asia who has made outstanding contributions in physics or astronomy. Four past winners of the OCPA award have been the presidents of Peking University, Shanghai Jiao-Tung University, and Univ. of Science & Technology China.

Since establishing his own research group at University of Hong Kong in 2008, Yao has published 70 peer-reviewed journal articles including: 22 on Nature Physics, Nature Materials, Nature Communications, Nature Nanotechnology, Science Advances (8 as corresponding author); 9 on Physical Review Letters (4 as corresponding author, 1 as first author); 4 on Science, Nature (1 as co-first author). He has written invited review articles on Nature Physics, Chemical Society Review, Nature Reviews Materials, Advances in Physics; and invited news & view articles on Nature Physics, Nature Materials, NPG Asia Materials. His works have been cited for over 14000 times on Google Scholar, and the citation received in the year 2017 alone is over 4000 times.

Key references (up to 3 key publications*)

[1] D. Xiao#, Guibin Liu, W. Feng, X. Xu & Wang Yao#, "Coupled spin and valley physics in monolayers of MoS2 and other group Vi dichalcogenides", Phys. Rev. Lett. 108, 196802 (2012).
-- 1802 citations on Google Scholar, and 500 citations received in year 2017 alone.

[2] Wang Yao, Di Xiao & Qian Niu, "Valley-dependent Optoelectronics from Inversion Symmetry Breaking", Phys. Rev. B 77, 235406 (2008).
-- 386 citations on Google Scholar.

[3] Di Xiao#, Wang Yao#, Qian Niu, "Valley Contrasting Physics in Graphene: Magnetic Moment & Topological Transport", Phys. Rev. Lett. 99, 236809 (2007).
-- 808 citations on Google Scholar.

mark corresponding authors. Yao's major collaborators Di Xiao and Qian Niu on these three publications have been working in USA.

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

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

Nominator:
Fu-Chun Zhang, Professor and Director, Kavli Institute for Theoretical Sciences, University of Chinese Academy of Sciences, Beijing, 100190, China
e-mail: fuchun@ucas.ac.cn
Telephone No. +86 13906500437
Relation to the candidate:
The nominator is a senior colleague of the candidate in the University of Hong Kong. The nominator was a Chair Professor 2003-2013 and Head of Physics Department 2005-2012 at the University of Hong Kong. The nominator recruited Yao to the Univ. of Hong Kong and witnessed Yao's creative work and his rapid rise in the field of valleytronics.

Signature Fu-Chun Zhang Date March 15, 2018

Nomination form for the 2018 Nishina Asia Award

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

Name: Wang YAO

Date of Degree of Ph.D.: June 16, 2006

Affiliation: Department of Physics, The University of Hong Kong

Nationality: Chinese

Address: Department of Physics, The University of Hong Kong, Hong Kong SAR, China

Phone: +852-2219-4809

Fax: +852-2559-9152

Email: wangyao@hku.hk

Education:

- ✓ 1997 ~ 2001, Department of Physics, Peking University, Beijing, China
  B.S. in Physics
- ✓ 2001 ~ 2006, University of California, San Diego
  Ph.D. in Physics (supervisor: Prof. Lu Jeu Sham)

Employment History:

- ✓ 2017 ~ , Professor, Physics Department, The University of Hong Kong
- ✓ 2014 ~ 2017, Associate Professor, Physics Department, The University of Hong Kong
- ✓ 2008 ~ 2014, Assistant Professor, Physics Department, The University of Hong Kong
- ✓ 2006 ~ 2008, Postdoc Fellow, Univ. of Texas at Austin (supervisor: Prof. Qian Niu)

Honors and Awards:

- ✓ OCPA Achievement in Asia Award (Robert T. Poe Prize), 2014.
- ✓ Croucher Innovation Award, 2013.
- ✓ Outstanding Researcher Award, The University of Hong Kong, 2014 - 2015.
- ✓ Outstanding Young Researcher Award, The University of Hong Kong, 2012 - 2013.
- ✓ Research Output Prize (Faculty of Science), The University of Hong Kong, 2013 - 2014.

Factual summary:

Published 80+ peer-reviewed papers (26 in Nature journals, 3 in Science journals, 15 in Phys. Rev. Lett.). 26 papers cited >100 times (including 2 cited > 1000 times) on Web of Science, and 27 are classified as Highly Cited Papers.

Major Professional activities:

- ✓ Associate editor, 2D Materials (2013 - present)
- ✓ Physical Sciences Panel member, Research Grants Council of HKSAR (2017 - present)
- ✓ Founding member, Young Academy of Sciences of Hong Kong (2017 - present)
- ✓ Vice president (2013-15), honorary secretary (2011-13), Physical Society of Hong Kong.

Citation for the Award (within 30 words)
For the prediction of *the valley optical selection rule* and *the valley Hall effect* as foundations of valley optoelectronics in 2D materials.
Description of the work

In solid, it is a very common situation that the edge of the Bloch band is located at several degenerate points well separated in momentum space. These degenerate and inequivalent band extrema are labeled by an index known as "*valley*", constituting a quantum degree of freedom of carriers. The notion of addressing and exploiting the valley degree of freedom is referred to as valleytronics, in analogy to the more developed field of spintronics. Despite the general presence of valley in materials and its potential impact for electronics, the accessibility to this internal subspace of carriers had been very limited compared to what can be done on spin, which had far restricted the exploration of valley. This situation was changed along with the emergence of two-dimensional materials families, where the nominee has made groundbreaking contributions that enable versatile control of valley properties and phenomena.

The **prediction of *the valley optical selection rule*, and *the valley Hall effect*** by the nominee and his collaborators played a decisive role in creating the important research direction of valley optoelectronics in 2D materials.

Valley optical selection rule. -- The nominee's theory papers [1, 2] discovered that when inversion symmetry is broken, interband optical transition at a time-reversal pair of valleys can couple to light of opposite circular polarizations, and predicted this valley optical selection rule respectively in gapped graphene systems [1], and in monolayer transition metal dichalcogenides (TMDs) [2]. The prediction in TMDs was published in 2012 [2], and was immediately verified by many experimental groups in the same year. This intriguing valley optical property has been a major motivation on the tremendous studies on this class of 2D semiconductors. The valley optical selection rule has now become the standard mechanism for accessing valley and spin in the vast experimental studies in TMDs, enabling a series of milestones in the optical addressing of valley phenomena including:

- Optical pump of valley polarization (Heinz group & XD Cui group, both in Nature Nano 12"; Feng et al. Nat Comm 12");
- Optical generation of valley quantum coherence (XD Xu group, in Nature Nano 13");
- Valley pseudospin rotation controlled by optical pulses (Feng Wang group, in Science 14"; Gedik group, in Nature Mat. 15"; Heinz group, in Nature Phys 17");
- Valley light emitting diode (Iwasa group, in Science 14");
- Photo-induced valley Hall effect (McEuen group, Science 14");

- Kerr rotation probe of valley polarization (Mak & Shan group, in Nat Nano 15" & 16");
- Valley dependent magneto-optical effect (Xu group & Imamoglu group, both in Nature Phys 15"; Ralph group & Heinz group, both in PRL 15");
- Valley magnetoelectricity (Mak & Shan group, in Nature Mat 17").

The valley Hall effect predicted by the nominee and collaborators -- in gapped graphene in 2007 [3] and in TMDs in 2012 [2] -- is a topological transport phenomenon where carriers from different valleys pickup opposite transverse velocities when driven by electric field. This electrically generated topological valley current is another key component that drive the rapidly growing research field of valley electronics, and was first observed in TMDs (McEuen group, Science 14"), graphene on hBN (Geim group, Science 14"), and bilayer graphene (Yuanbo Zhang group & Tarucha group, both on Nat. Phys. 15").

With these theoretical advances that have transformed valleytronics from a concept to an experimentally demonstrated reality, the control of valley properties and phenomena in 2D materials is now an important new research direction pursued by a vast community, reflected by the citations received by the nominee's three key references (listed in the following).

In addition to these theoretical works, the nominee also played key roles in achieving several **milestones on experimental demonstrations of valley controls** based on his theory predictions, where he worked with leading experimentalists in the field in the design and interpretation of experiments. These include:

- First experimental demonstration of optical pump of valley polarization (Nat Nano 7, 490, 12", **1287** cites), where the nominee conceived the project with experimental group;
- First experimental observation of valley quantum coherence (Nat Nano 8, 634, 13", **485** cites) where the nominee is a corresponding author;
- First demonstration of magnetic control of valley (Nat Phys 11, 148, 15", **167** cites), where the nominee is a corresponding author.

Other pioneering theory works from the nominee's group on valleytronic controls in 2D crystals include:

- Valley-spin-layer locking effects in bilayer TMDs (Nature Comm 4, 2053, 13", **108** cites);
- Massless Dirac excitons, and excitonic valley Hall effect in monolayer TMDs (Nature Comm 5, 3876, 14", **75** cites);
- Universal mechanisms for electric generation of valley current and polarizations in 2D

materials (PRL 113, 156603, 14"; PRL 118, 096602, 17").

These theory findings further point to new optoelectronic applications in 2D materials with versatile controllability exploiting carriers' valley degree of freedom, and are being busy tested by the community.

Latest study of the nominee's group has extended to the valley and spin phenomena in van der Waals heterostructures formed by stacking of different 2D materials. The van der Waals coupling between the 2D materials allows rich (and nearly unlimited) choices on stacking different building blocks from the rapidly growing 2D materials library (like *Lego*), to combine and extend the distinct properties of different building blocks. This is the most powerful and promising aspect of 2D materials research towards versatile designer quantum materials for device applications and fundamental physics. Focusing on a generic aspect of such heterostructures, i.e. the moiré pattern (i.e. periodic variation of local atomic registries) due to the inevitable lattice mismatch, the nominee's group has discovered new manifestations of the valley properties in the heterostructures, where the ubiquitous moiré leads to lateral modulations in the electronic, optical, and topological properties and controls of valley and spin not possible in the monolayers. Latest findings from the nominee's group that mark the beginning to understand this new physics include:

- *Topological mosaic in Moire superlattices of van der Waals heterobilayers,* Q. Tong, H. Yu, Q. Zhu, Y. Wang, X. Xu and Wang Yao*, **Nature Physics** 13, 356 (2017).
- *Moire excitons: from programmable quantum emitter arrays to spin-orbit coupled artificial lattices,* H. Yu, G. Liu, J. Tang, X. Xu and Wang Yao*, **Science Advances** 3, e1701696 (2017).

Key references (up to 3 key publications*)

[1] Wang Yao, Di Xiao & Qian Niu, *"Valley-dependent Optoelectronics from Inversion Symmetry Breaking",* Phys. Rev. B 77, 235406 (2008). ---- **276** cites on *Web of Science*;

[2] D. Xiao*, Guibin Liu, W. Feng, X. Xu & Wang Yao*, *"Coupled spin and valley physics in monolayers of MoS2 and other group Vi dichalcogenides"*, Phys. Rev. Lett. 108, 196802 (2012). (* Co-corresponding authors). ---- **1316** cites (**361** cites received in year 2017 alone);

[3] Di Xiao*, Wang Yao* & Qian Niu, *"Valley Contrasting Physics in Graphene: Magnetic Moment and Topological Transport",* Phys. Rev. Lett. 99, 236809 (2007). (* Co-corresponding authors), ---- **583** cites on *Web of Science*.

*) 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**: research peer
Signature____________________________________ Date______________________________

Nomination form for the 2018 Nishina Asia Award

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)
Name: Suvrat Raju Affiliation: International Centre for Theoretical Sciences, Tata Institute of Fundamental Research. Address: ICTS-TIFR, Shivakote, Hesaraghatta Hobli, Bangalore 560089 Email: suvrat@icts.res.in Telephone: +91-80-4653-6330 Cellphone: +91-9455999243 **Brief cv:** **Education** • B.Sc. (Hons) Physics, St. Stephen's College, University of Delhi, 2002. • A.M., Harvard University, 2003. • PhD, Harvard University, 2008. **Positions Held** • Postdoctoral fellow, Harish-Chandra Research Institute, 2008—10. • Ramanujan fellow, Harish-Chandra Research Institute, 2010—12. • Reader, International Centre for Theoretical Sciences, TIFR, 2012—2016 • Associate Professor, International Centre for Theoretical Sciences, TIFR, 2017—present. **Selected Awards:** • Swarnajayanti Fellowship, Department of Science and Technology, 2017 • Saraswathi Cowsik medal, TIFR, 2015. • Young Scientist Medal, Indian National Science Academy, 2013. • Young Scientist Platinum Jubilee Award, National Academy of Sciences of India, 2013. • Ramanujan fellowship, Department of Science and Technology, 2010. • St. Stephen's College centenary medal, 2002. (see c.v. attached for further details, including complete list of publications.)
Citation for the Award (within 30 words)
For new insights on the information paradox and the interior of black holes and for clarifying the nature of subtle non-local effects in quantum gravity.

Description of the work
The information paradox is a central problem in quantum gravity. During the course of his work on this problem in the past five years, the nominee (Suvrat Raju) has developed new insights on this problem. Raju's work has also led to the elucidation of an important physical effect— the subtle violation of locality in quantum gravity—which Raju has studied both using modern techniques of holography and older techniques of perturbative string theory. Raju first attempted to understand the information paradox in the context of the AdS/CFT conjecture. Here, In collaboration with Kyriakos Papadodimas, Raju showed that the information paradox was closely tied to whether one could represent the black-hole interior holographically. Raju and Papadodimas took an important step towards this goal by proposing such a representation for large AdS black holes. In their work, Raju and Papadodimas boldly proposed two new physical effects. One was that the map between local operator in the interior of the black hole and local operators in the boundary conformal field theory may depend on the *microstate* of the system. This is called state-dependence. In later work, Raju checked that state-dependence was consistent and would not lead to any observable departure from quantum mechanics for an infalling observer. More recently, substantial support for this hypothesis has accumulated from the work of Berenstein and Miller, Verlinde and Verlinde, and Jafferis. The construction of Raju and Papadodimas also suggested that local operators in the interior of the black hole were scrambled versions of operators in the exterior. This suggests that subtle non-local effects are important in preserving the unitarity of quantum mechanics in the interior of black holes. In later work, with Bryan and Banerjee, Raju and Papadodimas demonstrated how such nonlocal effects could be studied in a controlled setting—empty anti-de Sitter space. In work with his student, Sudip Ghosh, Raju showed how one signature of such nonlocal effects was the breakdown of perturbation theory. Motivated by this, Raju and Ghosh examined the breakdown of string perturbation theory in a novel limit—where the number of particles becomes large, but the energy per particle becomes small. Their work utilized novel techniques from the mathematical literature—including Mirzakhani and Zograf's analysis of the volumes of Weil-Petersson moduli spaces—which they combined with an extensive numerical analysis of string scattering. In recent work with Raju and Ghosh described how traditional quantum information measures can be generalized in the presence of these nonlocal effects. The work described here has had significant impact in the community and Raju was invited to

describe this work in Strings 2014 (Princeton), Strings 2015 (Bangalore) and Strings 2017 (Tel-Aviv).

Key references (up to 3 key publications*)

(each publication listed here involves a short version, published in **Phys. Rev. Lett.** and a more detailed version published in **Phys. Rev. D.**)

[1]. K. Papadodimas and S. Raju, "The Black Hole Interior in AdS/CFT and the Information Paradox", **Phys. Rev. Lett.**, 112 051301 (2014); " State-Dependent Bulk-Boundary Maps and Black Hole Complementarity", **Phys. Rev. D**, 89, 086010 (2014).

[2] K. Papadodimas and S. Raju, "Local Operators in the Eternal Black Hole", **Phys. Rev. Lett.**, 115, 211601(2015); "Remarks on the necessity and implications of state-dependence in the black hole interior", **Phys. Rev. D.**, 93, 084049 (2016).

[3] S. Ghosh and S. Raju, "Breakdown of String Perturbation Theory for Many External Particles", **Phys. Rev. Lett.** 118 (2017); "Loss of Locality in gravitational correlators with a large number of insertions", **Phys. Rev. D**. 96 (2017)

Copy of Publication [1] is attached.

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

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

Prof Spenta R. Wadia,

Infosys Homi Bhabha Chair Professor and Founding Director,

International Centre for Theoretical Sciences (ICTS-TIFR),

Tata Institute of Fundamental Research, Bangalore, India.

e-mail:

tel: +91 80 6730 6010

Signature Date 21 March 2018

Nomination form for the 2018 Nishina Asia Award

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)
Jianglai Liu, Shanghai Jiao Tong University (SJTU) Nationality: China Address: Physics Bldg. 317, School of Physics & Astronomy, SJTU Dongchuan Rd 800, Minhang District, Shanghai, China, 200240 Email: jianglai.liu@sjtu.edu.cn Phone: 86-21-3420-3040, 86-152-1433-3469 1998 B.S. Nanjing University 2006 Ph.D. University of Maryland at College Park 2006-2010 Postdoc/Senior Postdoc, Caltech 2010-Now SJTU, Associate Professor (10-15), Professor (15-Now) Dr. Jianglai Liu has worked on various experiments in the intersection of nuclear, particle, and astrophysics. He studied the strange form factors of the nucleon at the Thomas Jefferson National Accelerator Facility via parity-violating electron scattering (1999-2006), performed measurements of the axial-vector coupling constant using ultracold neutrons at the Los Alamos National Laboratory (2006-2010), and studied neutrino oscillation at the Daya Bay reactors (2006 – now). After joining SJTU in 2010, he started working on the PandaX dark matter direct search experiment at the China Jin-Ping Underground Laboratory, and is presently serving as the deputy spokesperson of the project. He is also the PI of the neutrino physics group at the SJTU, with the research emphasis now on the JUNO neutrino experiment, leading the level-II calibration group. Dr. Liu received the best Ph.D. dissertation prize from Jefferson Science Association in 2006. He was selected into the “1000 Junior Talent Program” in China in 2011 and received the “Distinguished Young Scholar” awards from NSFC in 2015.
Citation for the Award (within 30 words)
For his seminal contribution in the PandaX experiment, resulting in a most sensitive direct search for the particle dark matter.

Description of the work
Dark matter is an unknown but dominating matter within our universe, which does not participate in the electromagnetic and strong interactions. According to many theories beyond the Standard Model, the dark matter particles are likely to be a kind of "weakly interacting massive particles" (WIMPs), which then could be detected and studied in terrestrial particle physics laboratories. In the past 30 years, many experiments have been attempting to detect WIMPs in deep underground laboratories, but no convincing signal has emerged. The PandaX experiment in the China Jin-Ping underground Laboratory is the first liquid xenon dark matter search experiment in China, commenced in 2009. The first stage of the experiment (PandaX-I) with 120-kg xenon target was completed in late 2014, resulting into a competitive limit in WIMP-nucleon cross section at the low mass region. However, PandaX was facing fierce competitions from larger scale experiments such as LUX in the US and XENON1T in Europe. After a heroic effort, the upgraded experiment, PandaX-II with 580-kg of target xenon, started to take data in Mar. 2016. PandaX-II was the world largest running dark matter detector in 2016, with a record level of low background rate. The first three months of data were released in summer 2016, which set the most stringent limit on the dark matter-nucleon spin-independent scattering cross section, surpassing the previously the best limit from the LUX experiment. The lowest limit is found at 2.5×10^{-46} cm^2 for a dark matter mass of 40 GeV/c^2. The result was published as a cover article in Physical Review Letters (PRL), and was an Editor's Choice, accompanied by a Physics Viewpoint commentary (highest level recommendation of PRL, https://physics.aps.org/articles/v10/3). In summer 2017, PandaX-II released again the latest results, with a world largest 54-ton-day data set. The cross section limit was further lowered 2.5 times in comparison to the 2016 data. The result was published back-to-back on PRL in Nov. 2017 with the first result from XENON1T experiment, and represent the most sensitive search for WIMPs for a mass greater than 100 GeV/c^2. The papers were highlighted by another Physics "Viewpoint" commentary by Dan Hooper from FNAL, commenting that "... the latest results from two dark matter searches have further ruled out many theoretically attractive dark matter particle candidates ...", and "... representing the cutting edge in the search for dark matter ...". The recent rapid progress made by PandaX-II, LUX, and XENON1T has been selected by Physics as an annual highlight in 2017 (https://physics.aps.org/articles/v10/137). Dr. Jianglai Liu is de facto the leader of the PandaX-II experiment. He serves as the deputy spokesperson, in charge of the experiment construction (particularly the PMT system and data acquisition), commissioning, and lead the data analysis group. He is the corresponding author of all major physics publications of the experiment.

Dr. Jianglai Liu is an outstanding experimental particle/nuclear physicist, and is a well-known leader in the world neutrino and dark matter community. I recommend him for the 2018 Nishina Award in strongest possible term.

Key references (up to 3 key publications*)

(1) PandaX-II Collaboration (Xiangyi Cui et al., Jianglai Liu*), Dark Matter Results from 54-ton-day Exposure of PandaX-II Experiment, Phys. Rev. Lett. 119, 181302 (2017)
(2) PandaX-II Collaboration (Andi Tan et al., Jianglai Liu*), Dark Matter Results from First 98.7-day Data of PandaX-II Experiment, Phys. Rev. Lett. 117, 121303 (2016)
(3) PandaX Collaboration (Mengjiao Xiao et al., Jianglai Liu*), First Dark Matter Search Results from the PandaX-I Experiment, Sci China-Phys Mech Astron, 2014, 57(11): 2024-2030 (2014)

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

Xiangdong JI
Distinguished University Professor, U. of Maryland
Hongwen Chair Professor, Shanghai Jiao Tong University
Email: xdji@sjtu.edu.cn
Telephone: 17702116799
Relation to the candidate: colleague

Signature Date March, 25, 2018

No.18-8

Nomination form for the 2018 Nishina Asia Award

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)
Name: Sungdae Ji Nationality: South Korea Affiliation: Max Planck POSTECH Center Address: MPK, 77 Cheongam-ro, Nam-gu, Pohang, S. Korea. Email: jsungdae@mpk.or.kr Tel: +82-54-279-3793 Degrees: Ph. D in Physics, POSTECH, S. Korea (2007) M. S. in Physics, POSTECH, S. Korea (2001) B. S. in Physics, POSTECH, S. Korea (1999) Employments: Senior Researcher, Max-Planck POSTECH Center, S. Korea (2013 – present) Beamline Scientist, J-PARC, CROSS, Japan (2011 – 2013) Assistant Professor, WPI-AIMR, Tohoku University, Japan (2010 – 2011) Research Associate, University of Virginia, US (2007 – 2010)
Citation for the Award (within 30 words)
Dr. Sungdae Ji succeeded for the first time in measurement of quantum spin dynamics in Kitaev Quantum Spin Liquid phase by systematic investigations of both inelastic neutron scattering and thermodynamic measurements from α $RuCl_3$.
Description of the work

There's considerable interest in fundamental magnetism at present with the use of topological concepts (mathematical techniques) which is the citation of the 2016 Nobel Prize in Physics, allowing us to study anomalous phases, or states of matter. Quantum spin liquids (QSLs) are the topological state of matters whose magnetic spins do not settle into order even at absolute zero temperature, but instead have long-range topological entanglement emerging fractionalization of spin degree of freedom.

The Kitaev quantum spin liquid (QSL) model has fascinated condensed matter physicists for a decade due to the fact that it is exactly solvable and provides a variety of QSL phases. This model also implements the exchange frustration by bond-dependent Ising-like spin interaction on the ideal two-dimensional honeycomb lattice resulting in an exactly solvable topological QSL ground state and fractional spin excitations represented by noble Majorana fermions which can be utilized as a building block for the topological quantum computation. It was discussed on the relevance for some transition metal compounds such as irridates and ruthenates. Majorana Fermion itself currently becomes the hot issue in strongly correlated electron physics, though it has been considered long to be a constituent particle of neutrorino as Majorana theoretically proposed in 1937. Thus in the past decade, experimental observations of the Kitaev QSL model and Majorana quasiparticles have been eagerly pursued by leading groups in the world. Overcoming the competition, Dr. Sungdae Ji and his colleagues made achievement on direct observation of spin fractionalization in high-quality α-$RuCl_3$ single crystals. The combination of their extensive thermodynamic and inelastic neutron scattering experiments reveals unusual magnetic excitations: low-energy quasi-elastic excitations around the Brillouin zone center as well as an hour-glass-like magnetic continuum at high energies corresponding to respective localized magnetic fluxes and itinerant fermions, both of which are composed of Majorana fermions. In particular, they observed successive release of magnetic entropy and corresponding change of neutron spectra, which clearly prove theoretically proposed the central key of "thermal fractionalization" phenomena; that is, spin excitation is fractionalized into two distinguished Majorana fermions as a function of temperature. More importantly they clearly demonstrated that two characteristic crossovers observed at finite temperatures correspond to a two-stage release of magnetic entropy, first through itinerant fermions and then through localized Majorana fermions.

It should be mentioned here that this field is currently very competitive, and a similar experimental discovery has been made almost simultaneously by a few groups worldwide. In conclusion Dr Ji and his group complete the measurements including neutron magnetic scattering and data analysis which give rise to a crucial contribution to this exciting field in physics. For this reason, Dr. Ji's work is well suited for the Nishina Asia Award.

Key references (up to 3 key publications*)

"Majorana fermions in the Kitaev Quantum Spin System α-$RuCl_3$", Seung-Hwan Do, S.-Y. Park, Junki Yoshitake, Joji Nasu, Yukitoshi Motome, Y. S. Kwon, D. T. Adroja, D. Voneshen, Kyoo Kim, T.-H. Jang, J.-H. Park, Kwang-Yong Choi and Sungdae Ji, Nature Physics **13**, 1079 (2017)

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

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

Yasuo Endoh, Professor Emeritus of Tohoku University & Diamond Fellow of KEK

Email address hy_endoh@kcc.zaq.ne.jp

Telephone 090-5482-1639

Relation to the candidate :

Temporal scientific advisor through Kazuyoshi Yamada of the director general of IMSS, KEK.

Professor K. Yamada hired Dr, Sungdae Ji at WPI-AIMR, Tohoku University.

Signature Yasuo Endoh (遠藤康夫)

date 2018, 3, 26

Nomination form for the 2018 Nishina Asia Award

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)
Name: Professor Young Sul Cho Affiliation: Department of Physics, Chonbuk National University Nationality: Republic of Korea Address: Jeonju 54896, South Korea Email: yscho@jbnu.ac.kr Telephone: 82)632703334 Education: 2008. 02, B.S., Department of Physics and Astronomy, Seoul National University 2015. 02, Ph.D., Department of Physics and Astronomy, Seoul National University 2015. 03 – 07, Postdoctoral Fellow, Seoul National University 2015. 08 – 2016. 09, Postdoctoral Fellow, Northwestern University 2016. 10 – present, Assistant Professor, Department of Physics, Chonbuk National University
Citation for the Award (within 30 words)
For contributions to modeling and uncovering underlying mechanism of discontinuous transitions in percolation and their applications, and cluster synchronization which attracted broad interest from the researchers in statistical physics.
Description of the work
Percolation in cluster merging process has long served as a simple model that undergoes a geometrical phase transition in non-equilibrium disordered systems. As an occupation probability is increased beyond a transition point, a macroscopic-scale giant cluster emerges across the system. This percolation theory has been used for illustrating percolation-related diverse phenomena such as conductor-insulator transitions and the resilience of systems, for applications to memory chip devices, and for the formation of public opinion and the spread of disease in a population. More interestingly, it has served as a theoretical platform for understanding dynamics driven by contact processes such as rumor and epidemic disease propagation. The percolation transition is known to be generically continuous. Thus, it has been known as one of the most challenging problem in statistical physics to find a percolation model that exhibits a discontinuous transition. Moreover, recently many explosive or abrupt percolation transitions have been observed in complex systems. He introduced several types of explosive percolation models and explored features and underlying mechanism of them. One of the fascinating models he invented is the so-called spanning-cluster-avoiding model. This model contains the most essential factor, a global selection rule, which is naturally included in the notion of percolation in Euclidean space, but was ignored in random graphs. Thanks to the simplicity but essentiality of the rule, he was able to clarify the condition under which a discontinuous transition can occur. Thus, he solved the long-standing challenging problem. Moreover, modifying the so-called

half-restricted percolation, he completed the task of discovering the percolation model exhibiting a discontinuous percolation transition.

I believe that he has several strong talents for becoming a great physicist, among which I would like to emphasize that he has very intuitive ideas in physics. He always feel whatever he is doing in physics into his bones. On the basis of the feelings, he drives himself to achieve the final conclusion of a given task in a short time. He is good at numerical simulations and analytic calculations. Moreover, he has ability to understand a given problem quickly and modify it slightly to make it easier for calculations and simulations without changing the essence of physics. When he learned analytic methods related to cluster aggregation dynamics, he applied them to other problems very well. For instance, he obtained analytic solution of the half-restricted percolation model, which exhibits a hybrid percolation transition. The paper was published in Physical Review Letters in 2016.

He studied the cluster synchronization of chaotic oscillators during his postdoctoral course in Northwestern university. He demonstrated a general method to identify independently synchronizable cluster sets in an arbitrary pattern of clusters each of which is composed of synchronized chaotic oscillators. Using this method, he suggested a candidate for permanently maintaining chimera state which is the coexistence of coherent and incoherent subsets in a finite-size fully symmetric network. To find a permanent chimera state in finite-size system was a long-standing problem and he made a breakthrough in this topic.

I assure that he will be a central member in the Asian statistical physics community shortly. The Nishina Asia Award will be extremely helpful to accelerate his steps toward enhancing his status. Moreover, his tour in Japan as an awardee will be helpful to broaden his interests in various topics in physics.

Key references (up to 3 key publications*)

(1) Avoiding a spanning cluster in percolation models, *Science* **339**, 1185 (2013).

(2) Hybrid percolation transition in cluster merging processes: continuously varying exponents, *Physical Review Letters* **116**, 025701 (2016).

(3) Stable Chimeras and Independently Synchronizable Clusters, *Physical Review Letters* **119**, 084101 (2017).

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

Name: Professor Byungnam Kahng

Affiliation: Department of Physics and Astronomy, Seoul National University

Email: bkahng@snu.ac.kr

Telephone: 82)2-880-1326

Relation to the candidate: Supervisor of Ph.D thesis

Signature Date March 27, 2018

Nomination form for the 2017 Nishina Asia Award

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)
Ying Jiang, Associate Professor International Center for Quantum Materials, School of Physics, Peking University, Beijing, China Phone: +86-10-62757177 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:** Associate Professor (tenured). International Center for Quantum Materials, School of Physics, Peking University, Beijing, China (Feb. 2016-present) Associate Professor. International Center for Quantum Materials, School of Physics, Peking University, Beijing, China (Feb. 2013-Jan. 2016) Assistant Professor. International Center for Quantum Materials, School of Physics, Peking University, Beijing, China (Jan. 2010-Jan. 2013) Postdoctoral Research Associate. Department of Physics and Astronomy, University of California, Irvine, USA (Mar. 2008-Dec. 2009) **Honors:** Cheung Kong Young Scholar (Ministry of Education of China, 2016) Outstanding Young Scientist (Organization Department of the CPC Central Committee, 2012) Director Awards for excellent research (Chinese Academy of Sciences, 2007)
Citation for the Award (within 30 words)
Unraveling nuclear quantum effects of water at atomic scale

Description of the work
For most of quantum materials, their properties are dictated by the quantum behavior of electrons, while the nuclei are only treated as classical particles. However, light nuclei like H^+ (proton) can exhibit prominent quantum effects due to the small mass, in terms of tunneling and zero-point motion. The so-called nuclear quantum effects (NQEs) are responsible for many abnormal properties of light-element materials such as water. Unfortunately, the accurate and quantitative description of NQEs is very challenging in experiments, since the quantum states of nuclei are much more fragile than those of electrons and are extremely sensitive to the atomic-scale environments. To this end, Dr. Jiang has developed state-of-art scanning tunneling microscopy/spectroscopy (STM/S), which allows the access to the quantum degree of freedom of protons with atomic precision. Combined with *ab initio* path integral molecular dynamics (PIMD) simulations, Dr. Jiang and his collaborators have made groundbreaking steps towards understanding the NQEs of water/ice. In his first work, Dr. Jiang developed a novel submolecular imaging technique [1], which allows locating in real space the position of protons. Based on this technique, Dr. Jiang succeeded to track the proton transfer in real time within a water nanocluster and observed quantum tunneling of multiple protons in a concerted fashion [2]. It is striking that such a collective proton tunneling can readily occur even near the zero temperature. This work puts an end to a 20-years long debate whether the collective proton tunneling exists or not and provides an answer to the well-known puzzle: non-zero entropy of ice at zero temperature. The concerted proton tunneling in water/ice has been confirmed afterwards by many groups (both theoretical and experimental) using different techniques. Another fundamental question of NQEs is how the zero-point motion of proton affects the H-bond interaction. Dr. Jiang provided a smoking gun for this question using a new technique called tip-enhanced inelastic electron tunneling spectroscopy [3]. He and his collaborators unraveled quantitatively, for the first time, the quantum component of a single H bond at a water-solid interface and arrived at a general picture that the zero-point motion of protons weakens the weak H bonds but strengthens the relatively strong ones. This work yields a cohesive picture for the quantum nature of H bonds. Those findings may completely renovate our understanding of water and provide answers to many weirdness of water from a quantum mechanical view. Furthermore, it is helpful for understanding exotic quantum behaviors of other H-bonded materials such as the high-temperature superconducting phase of H_2S. Dr. Jiang's creative approaches and his remarkable findings provide substantially new insights into quantum matters. His work opens up a new frontier of condensed matter physics, thus well deserves the Nishina Asia Award.
Key references (up to 3 key publications*)

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

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

[3] 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).

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

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

Rui-Rui Du
Chair Professor of Physics
Director of the International Center for Quantum Materials
Peking University, Beijing, China
Email: rrd@rice.edu
Telephone: 010-13520388312

No mentoring or collaboration relation to the candidate

Signature Rui-Rui Du Date 02/10/2017

Nomination form for the 2018 Nishina Asia Award

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

Jensen Li
Associate Professor
Department of Physics
Hong Kong University of Science and Technology
jensenli@ust.hk TEL: (852) 2358 7471
Nationality: Hong Kong, China

Academic qualifications:

1995 – 1998 B.Eng., The University of Hong Kong (First Class Honors)
1998 – 2000 M.Phil., Hong Kong University of Science and Technology
2000 – 2004 Ph.D., Hong Kong University of Science and Technology
Ph. D. certificate at 12 Nov 2004

Previous academic positions held (with dates):

- 08/2017 – 09/2017 Reader in Photonics, University of Birmingham
- 03/2013 – 07/2017 Senior Lecturer, University of Birmingham
- 09/2009 – 02/2013 Assistant Professor, City University of Hong Kong
- 11/2007 – 08/2009 Post-doctoral Fellow, University of California, Berkeley, USA
- 09/2005 – 08/2007 Post-doctoral Fellow, Imperial College, UK

Jensen obtained his PhD in 2004 from Hong Kong University of Science and Technology. He then spent two years in the Imperial College London with a postdoctoral fellowship from the Croucher Foundation and two years in University of California, Berkeley. Prior to his joining the University of Birmingham as a senior lecturer in 2013, he was an assistant professor at the City University of Hong Kong. He joined Hong Kong University of Science and Technology as an Associate Professor from Oct 2017. He and his research group have been active in metamaterials and transformation optics research. He is best known for his work in carpet cloak, and has authored 3 book chapters and 68 research articles in journals including 2 Nature Materials, 3 Nature Communications, 10 Physical Review Letters, 2 Advanced Materials and a Small article, with total citations over 5800 (Scopus, with h-index 29). He has received research grants from Research Grants Council of Hong Kong (RGC-HK), and has been supported by a grant from Marie Curie Foundation of the European Union. As well as these grants for his work in pure science, his success in applied science has been recognized by two industrial grants from Samsung Electronics.

Awards: Global Research Outreach winner proposal in Material & Device, Samsung Advanced Institute of Technology, Korea, 2011 Croucher Foundation Postdoctoral Fellowship 2005 – 2007 Sir Edward Youde Memorial Fellowship, 1999 Professional service: Editorial Board Member: Scientific Reports Associate Editor: EPJ Applied Metamaterials, Optics Express, New Journal of Physics CV can be obtained from: http://jensenli.people.ust.hk/assets/files/Li_Jensen-CV.pdf
Citation for the Award (within 30 words)
For his seminal contributions to acoustic metamaterials. He proposed and realized acoustic metamaterials with "double-negativity", negative refraction and extreme wave manipulation properties.
Description of the work
Metamaterials consist of arrays of artificially designed atoms with electromagnetic or acoustic properties on-demand. These materials came with the promises for wave manipulation capabilities that go beyond those of natural materials, including negative refractive indices for refraction in negative angles, super-resolution imaging beating the diffraction limit and invisibility cloaking. However, these novel functionalities are often bundled with extreme requirements in material designs and difficulties in experimental realizations. Li's work has been instrumental in taking the notion of metamaterials from theory to practice by inventing several simple and yet efficient schemes that demonstrated the extraordinary physics of metamaterials and at the same time paving the way for applications. For example, he invented the scheme of "carpet cloak" which is the first operationally feasible scheme to achieve invisibility cloaking at the optical regime, and he pioneered acoustic imaging with subwavelength resolution via a magnifying hyperlens structure. The success of metamaterials in the electromagnetic domain has made researchers wonder whether the same philosophy of making artificial atoms makes sense in acoustics. Li is recognized internationally as the pioneer who established acoustic metamaterial as a new area of applications. His seminal contribution includes a series of papers in developing "double-negative" acoustic metamaterials, which become highly influential in the field [**Error! Reference source not**

found., **Error! Reference source not found.**]. He made the first proposal that a negative acoustic refractive index is actually possible through double negativity in acoustics. While split-rings and wires are the common basic units in constructing the electromagnetic counterpart in giving double negativity in permittivity and permeability, a different strategy is required for acoustics. In that period of time, it was not even clear whether double negativity: density and bulk modulus being negative, is the required condition and is physically meaningful at all. Li discovered the double negativity can be implemented using resonating response from acoustic structural units. In 2012, he simplified and proposed the "space-coiling" approach to construct such an acoustic metamaterial [**Error! Reference source not found.**]. In his scheme, air channels are curled and are networked to force the sound waves to meander around elongated paths packed in unit cells of subwavelength dimensions. The propagation phase and impedance can be tuned by length and width of the curled air channels. Negative refraction and other extreme wave properties follow naturally. A Dirac-cone like dispersion (similar to that in graphene) with near-zero refractive index allows highly efficient tunneling through narrow channels. As the wave propagation path is elongated, broadband refractive indices with values larger than one become realizable. This is in contrary to conventional composite approach: an index much larger than one for airborne sound was viewed as impossible as sound waves always travel faster in solids than in air.

The impact of Li's work lies on the practical realization scheme of acoustic metamaterials and the promises of the interesting wave properties from metamaterials hence become a reachable target. Before the new scheme, the developments of acoustic artificial materials were usually relying on either the diffraction regime, i.e. the phononic crystal route, or in the effective medium regime (metamaterials) but working only in a single direction, i.e. 1D acoustic metamaterial. These structures are usually resonating and with complicated physical mechanisms. The demonstrated possibility and practical scheme in this work is certainly a milestone in the field and has been promoting the field of acoustic metamaterials up to the current date. The design has adopted and was experimentally realized by other groups and by Li's own group [3]. It opened up a new design route in acoustic metamaterials. The design strategy using space-coiling has then triggered a series of work to have phase gradient metasurfaces in controlling acoustic wavefronts. The work is influential not only in the concept but also in the way that the design is used in a wide range of applications, from negative refraction, beam steering, acoustic holograms, sound absorption, artificial Mie resonances, surface wave coupler, etc.

In a broader context, Li is continuing to utilize metamaterials as a platform for demonstrating extraordinary physics, emphasizing on the simplicity of metamaterial designs. His group is pursuing the use of geometric phase elements to construct optical metasurfaces, which only consists of a single type of metamaterial atom with designer orientation profile. It gives polarization tunable functionalities on both near and far field control. His group uses metamaterials to demonstrate Parity-time phase transition of optical properties. He has also recently extended the space-coiling approach to elastic waves on a solid plate, allowing demonstration of illusion effect (Phys. Rev. Lett. 2017). Such an extension paves the way to chip-scale applications, which uses guided elastic waves, such as the SAW devices. His groundbreaking contributions in the field of metamaterials, with many ideas originating from his work done in Hong Kong, make him a deserving candidate for the prestigious Nishina Asia award.

Key references (up to 3 key publications*)

1. Z. Liang and Jensen Li, "Extreme Acoustic Metamaterial by Coiling Up Space", Phys. Rev. Lett. 108, 114301 (2012) (Featured in APS Physics, Editor's Suggestion, cited 224 times).
2. J. Li, C. T. Chan, "Double-negative acoustic metamaterial", Phys. Rev. E 70, 055602 (2004). (cited more than 400 times)
3. Z. Liang, T. Feng, S. Lok, F. Liu, K. B. Ng, C. H. Chan, J. Wang, S. Han, S. Lee, and Jensen Li, "Space-coiling metamaterials with double negativity and conical dispersion", Sci. Rep. 3, 1614 (2013). (cited 61 times)

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

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

Professor Che Ting Chan

Physics Department, Hong Kong University of Science and Technology

Clear Water Bay, Hong Kong

phchan@ust.hk

852-23587487

Relation to the candidate: Colleague in the same department and former collaborator

Signature Chan Ch Ting Date 2018-03-29

Nomination form for the 2018 Nishina Asia Award

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

Chao-Yang Lu

Citizenship: China

Current Appointments:

Professor of Physics, Hefei National Laboratory for Physical Sciences at Microscale, University of Science and Technology of China (from June 2011)

Education:

Cavendish Laboratory, University of Cambridge, UK (January 2008 – March 2011)
Degree: PhD in Physics
Thesis: Quantum dot resonance fluorescence and spin dynamics

University of Science and Technology of China (September 2004 – December 2007)
Degree: Master of Science

University of Science and Technology of China (September 2000 – July 2004)
Degree: Bachelor of Science

Honors and Awards:

2017	TR35 (35 Innovators under 35) China, MIT Technology Review
2017	"Optics in 2017", *Optics & Photonics News*, OSA
2017	Fresnel Prize, European Physical Society
2016	"Optics in 2016", *Optics & Photonics News*, OSA
2016	Fellow of Optical Society of American (OSA)
2016	Top Ten Science Star of China, *Nature*
2015	IOP *Physics World* "Breakthrough of the Year"
2015	National Natural Science Award for Exceptional Young Scholars
2015	National Natural Science First Prize
2014	International Cooperation Award for Young Scientists
2014	Hong Kong Qiu Shi Outstanding Young Scholar Award
2011	National Youth Thousand Talent Professorship
2011	Fellow of Churchill College, University of Cambridge

Citation for the Award (within 30 words)
For his outstanding contributions to quantum information science with single photons

Description of the work

Representing a wide community of quantum scientists, I am pleased to nominate Dr. Chao-Yang Lu for the 2018 Nishina Asia Award recognizing his outstanding contributions to quantum photonics. My short appraisal is that Dr. Lu is a young and super-star in the field of quantum information sciences, especially on solid-state quantum light sources, quantum entanglement, quantum teleportation, and optical quantum computing. My assessment is well reinforced by the fact that Dr. Lu has won the 2017 Fresnel Prize from European Physical Society (although Dr. Lu is locating in Asia), was selected by *Nature* as "top-ten science star of China" and named by Anton Zeilinger, 2010 Wolf Prize winner in Physics, as "a wizard of entangled photons" (see *Nature* **534**, 461 (2016)), and is serving as the Chair of the Quantum Computing and Communication Technical Group of Optical Society of American (OSA).

Lu has made many groundbreaking contributions already at such an early stage of his career, starting from the experimental generation of multi-photon entanglement (*Nature Physics*, 2007; 2010) in Schrödinger-cat-like state and the single-shot single-spin readout (*Nature*, 2010) when he was a graduate student in Hefei, China, and Cambridge, UK, to his recent important contributions to the recent quantum science satellite (*Science*, 2017; *Nature*, 2017, 2017) that will be central to the future global quantum internet. Rather than going through the long list, let me concentrate on two of my favorites from Dr. Lu's group: quantum teleportation and quantum computing.

One of the most fascinating applications of quantum physics is quantum teleportation; a "disembodied" way to transfer quantum states from one objective to another at a distant location, without actual transmission of the object itself. Since the first demonstration of teleportation of a single degree of freedom of a single photon, for 18 years it remained a fundamental open challenge to teleport multiple degrees of freedom simultaneously, which is necessary to describe a quantum particle fully and, therefore, to teleport it intact. To this end, by developing an ingenious method for seeing a single photon but without destroying it, Lu was the first to achieve the simultaneous teleportation of two inherent properties of a fundamental particle (*Nature*, 2015). This work was named by the IOP Physics World 2015 "**Breakthrough of the Year**".

Dr. Lu's foundational experiments gave rise to new technologies for realizing quantum computers. Lu and his team developed the cleanest way to produce on-demand single photons with near-unity indistinguishability (*Nature Nanotechnology*, 2013; so far the most cifed single-photon paper since 2013). By designing extreme cavity-QED systems, Lu and his team create the first single-photon source that simultaneously combines near-perfect single-photon purity, indistinguishability, and high efficiency—the three most important criteria for scalable quantum photonics (*PRL*, 2016; among the ten most cited papers published in PRL on the same year, and selected as "Optics in 2016" by OSA). Exploiting his state-of-the-art single-photons sources, he and his team realized Boson sampling, an intermediate model of quantum computing, with up to five photons and efficiencies five orders of magnitude (a huge leap forward!) higher than in all previous work (*Nature Photonics*, 2017; selected as "Optics in 2017" by OSA). This is the first single-photon quantum device which reaches a computational complexity that can beat early classical computers such as ENIAC and TRADIC, and laid out a blueprint for demonstrating quantum computational advantage over classical computer.

Due to his systematic contributions, Lu has been invited to write a comprehensive review article on quantum photonics (*Rev. Mod. Phys.* 84, 777-838 (2012)), and he was recently commissioned for a new article reviewing the most recent developments for the same journal. It is clear to the community that Dr. Lu's work is at the very forefront of optical quantum information science, and honestly, I think that future development will rely substantially on his efforts. I rank Dr. Lu as the most talented young scientist I have known in the past decade, and I wholeheartedly support his nomination for the Nishina Asian Award in the strongest term.

Key references (up to 3 key publications*)

1. X.-L. Wang, X.-D. Cai, Z.-E. Su, M.-C. Chen, D. Wu, L. Li, N.-L. Liu, **C.-Y. Lu***, and J.-W. Pan, Quantum teleportation of multiple properties of a single quantum particle, *Nature* **518**, 516-519 (2015)

2. H. Wang, Y. He, Y.-H. Li, Z. Su, X. Ding, Y.-M. He, J. Qin, H.-L. Huang, C. Wang, C. Schneider, M. Kamp, S. Höfling, **C.-Y. Lu***, J.-W. Pan, High-efficiency multi-photon boson sampling, Nature Photonics **11**, 361-365 (2017)

3. Y.-M. He, Y. He, Y.-J. Wei, D. Wu, M. Atature, C. Schneider, S. Hofling, M. Kamp, **C.-Y. Lu***, J.-W. Pan, On-demand semiconductor single-photon source with near-unity indistinguishability, *Nature Nanotechnology* **8**, 213-217 (2013).

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

Nominator (name, affiliation, email, telephone and relation to the candidate)
Prof. Ruibao Tao Affiliation: Fudan University Email: rbtao@fudan.edu.cn Telephone: 008618930576922 Without any relationship to the candidate
Signature Ruibao Tao Date 29 Mar, 2018

Nomination form for the 2018 Nishina Asia Award

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)
Name: **Gu Liyi (顧 力意)** Affiliation: RIKEN (The Institute of Physical and Chemical Research), Japan Curriculum Vitae: 1983 June 30 : Born in China 2010 June 26 : Obtained PhD degree from Shanghai Jiao-Tong University 2011 Apr. – 2013 Mar. : JSPS Postdoctoral Overseas Researcher, hosted by Department of Physics, the University of Tokyo 2013 Apr. – Sept. : PD Researcher, Research Center for the Early Universe, Univ. Tokyo 2013 Oct. – 2017 Jun. : PD Researcher, Netherlands Institute for Space Research, Utrecht 2017 July – present : Special Postdoctoral Researcher at RIKEN Nationality : China Address: Tamagawa High-Energy Astrophysics Laboratory, Nishina Center, RIKEN, 2-1 Hirosawa, Wako, Saitama, Japan 351-0198 E-mail: hellogreenling@gmail.com Telephone: 048-467-9333
Citation for the Award (within 30 words)
An **Observational Discovery of Cosmological In-fall of Galaxies in Clusters**
Description of the work

[Summary] The candidate, Dr. Gu Liyi, has been working in observational high-energy astrophysics. In collaboration with several researchers in Japan (including me) and China, he has discovered a very simple but novel phenomenon; over the past 7 billion years (about half the age of the Universe), galaxies in each cluster of galaxies gradually fell to the cluster's gravitational bottom, as they move through the X-ray emitting hot plasma and receive a drag force [1,2].

[Research background] Hundreds of billions of stars assemble through gravity into a galaxy, and hundreds of galaxies form a cluster of galaxies. Clusters are thus the most dominant class of objects in the cosmic hierarchy. In a cluster, however, only ~5% of its total mass is carried by galaxies. A larger fraction (~ 10%) is in the form of hot (~10^8 K) plasmas, called Intra-Cluster Medium (ICM), and the remaining 85% is attributed to Dark Matter. In the deep gravitational potential of a cluster, the ICM is trapped hydrostatically, within which galaxies keep moving.

[Our hypothesis] Since the discovery of ICM in the 1970's through its X-ray emission, most of astronomers believed that galaxies belonging to a cluster are swimming freely through the ICM. However, based on observations with the Japanese X-ray satellite *ASCA*, I and co-workers came to propose that the galaxies must receive considerable drag force from the ICM, and transfer their dynamical energies to it (Makishima *et al.* 2001). This hypothesis predicts that the galaxies must have been falling, over cosmological time scales, to the gravitational bottoms (centers) of their host clusters. Then, how to observationally prove this prediction remained a key research goal.

[How I came to know the candidate] I first met the candidate, Dr. Gu (still Mr. Gu at that time), in 2006 at a conference in Kyoto, when he accompanied his supervisor, Prof. Haiguan Xu (徐海光) of Shanghai Jiao-Tong University, as the "best graduate student of the group". Indeed, just talking to Mr. Gu was enough for me to perceive his excellence. After he obtained his PhD degree, I hence invited him to our group at the University of Tokyo, based on the JSPS Postdoctoral Overseas fellowship. He immediately understood the importance of our conjecture, and agreed to work on it.

[The candidate's achievement] In Japan, Dr. Gu analyzed, with an amazing speed, optical imaging data of 34 clusters of various redshifts (distances), which my colleagues had already acquired. He also analyzed archival X-ray data of the same clusters, taken with the *Chandra* Observatory. He has the highest expertise in the data treatment of both optical and X-ray wavelength, which we lacked. As a result, he has securely shown that the galaxies in clusters at a redshift of z~1 (half as young as the nearby ones) are distributed up to the edge of the ICM sphere [3]. This makes a contrast to nearby (present-day, older) clusters, wherein the galaxies are known to be radially much concentrated than the ICM. Therefore, over the past ~7 billion years (half the age of the Universe), the galaxies must have been falling to the centers of the ICM sphere. He examined these results with the greatest care, and removed all possible artifacts and systematic errors. He really knows what the research is.

[Further confirmation] Although the above result [3] covered a wide redshift range (z=0~1), the sample comprised of only 34 clusters. As a complementary attempt, Dr. Gu next collaborated with his Chinese colleagues, and analyzed 340 clusters from the Sloan Digital Sky Survey covering a shallower redshift range of z=0~0.5, together with X-ray archives. He completed this laborious work again with an amazing speed, and nicely reconfirmed and reinforced [2] the first result. He has also shown that the galaxies have been falling relative to Dark Matter as well.

[Implications] The galaxy in-fall scenario is a simple but totally novel paradigm that has never been considered before. Although it was first proposed by Makishima *et al.* (2001), it would have remained a mere conjecture if Dr. Gu had not joined us as the young ace scientist. Now, he is literally leading the new paradigm, and expanding its frontier under his superb scientific perspective. An example is a new interpretation of the ICM turbulence measurements with *Hitomi* (the short-lived Japanese X-ray mission) [1]. Finally, these results can be said to be of truly Asian origin, based on a close Japan-China collaboration; actually, things started in the mid 1990s when Professor Xu joined my group, based on Japan-China Joint PhD Support Program (文部省日中合作博士育成計画). This nomination would perfectly fit to the scope of the Nishina Asia Award.

Key references (up to 3 key publications*)

[1] The *Hitomi* collaboration (total 214 co-authors in alphabetical order, incl. Gu, L. and Makishima, K.): "The quiescent intracluster medium in the core of the Perseus cluster", *Nature*, **535**, 117-121 (2016)

[2] Gu, L., Wen, Z., Gandhi, P., Inada, N., Kawaharada, M., Kodama, T., Konami, S., Nakazawa, K., Xu, H., & Makishima, K.: "Galaxy Infall by Interacting with Its Environment: A Comprehensive Study of 340 Galaxy Clusters", *Astrophysical Journal,* **826**, id.72, 21 pp. (2016)

[3] Gu, L., Gandhi, P., Inada, N., Kawaharada, M., Kodama, T., Konami, S., Nakazawa, K., Shimasaku, K., Xu, H., & Makishima, K.: "Probing of the Interactions between the Hot Plasmas and Galaxies in Clusters from $z = 0.1$ to 0.9", *Astrophysical Journal,* **767**, id.157, 30 pp. (2013)

*) A copy of [2] is attached in pdf form

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

Name: **Kazuo Makishima (牧島一夫)**

Affiliation: RIKEN (The Institute of Physical and Chemical Research)

E-mail: maxima@riken.jp

Telephone: 090-9309-8961

Relation to the candidate: Host researcher while the candidate stayed in Japan as a JSPS Postdoctoral Overseas Researcher (2011 April – 2013 March), at Department of Physic, the University of Tokyo

Signature  Date March 31, 2018

Nomination form for the 2018 Nishina Asia Award

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

Name: Professor Huailiang Xu

Nationality: China

Address: College of Electronic Science and Engineering, Jilin University, Changchun, 130012, China

Email: huailiang@jlu.edu.cn

Telephone: +86 139 4489 9066

Education:

05/2002-12/2004	**Ph.D.**, Department of Physics, Lund University, **Sweden** Thesis title: *Radiative Properties of Rare Earth Elements - Free and Bound in Crystals* Supervisors: Professor Sune Svanberg and Professor Stefan Kröll Date of the Ph.D. degree: **December 17, 2004**
09/1998-05/2002	**Graduate student**, Department of Physics, Jilin University, **China** Supervisor: Professor Zhankui Jiang
09/1994-07/1998	**B.S.**, Department of Physics, Jilin University, **China** Supervisor: Professor Zhankui Jiang

Experience:

09/2009-**present**	**Professor**, College of Electronic Science and Engineering, Jilin University, Changchun, **China**
01/2008-10/2010	**Assistant Professor**, Department of Chemistry, The University of Tokyo, Tokyo, **Japan** Collaborator: Professor Kaoru Yamanouchi
01/2005-01/2008	**Postdoc.**, Department of Physics, Laval University, Québec, **Canada** Supervisor: Professor See Leang Chin
12/2013-02/2014	**Visiting Professor**, Department of Chemistry, The University of Tokyo, **Japan** Host and Collaborator: Professor Kaoru Yamanouchi
06/2013-06/2013	**Guest Researcher**, Institute of Photonics, Vienna University of Technology, **Austria** (4 weeks) Host: Professor Andrius Baltuška
08/2012-08/2012	**Visiting Professor**, Department of Chemistry, The University of Tokyo, **Japan** (4 weeks) Host and Collaborator: Professor Kaoru Yamanouchi
12/2011-05/2012	**Guest researcher**, Institute of Photonics, Vienna University of Technology, **Austria**

	Host: Professor Andrius Baltuška
05/2011-07/2011	**Visiting Professor**, Department of Chemistry, The University of Tokyo, **Japan**
	Host and Collaborator: Professor Kaoru Yamanouchi
07/2011-08/2011	**Visiting Professor**, Department of Physics, Laval University, **Canada**
	Host and Collaborator: Professor See-Leang Chin

Citation for the Award (within 30 words)

Lasing in filamentation in air and ultrafast hydrogen migration in intense laser fields

Description of the work

Professor Xu is a young but already well-recognized researcher who have been contributing largely in this decade to the developing a new and interdisciplinary research fields called ultrafast intense laser science, which is an emerging research field in atomic, molecular and optical physics and laser chemistry. Prof. Xu is famous for his pioneering studies with high originality on "air lasing" and "hydrogen migration" induced by a femtosecond intense laser field.

When an intense laser pulse propagates in air, a thin plasma channel called a laser-induced filament is generated. This filamentation process has been an attractive research target in these decade because the emission in the visible and ultraviolet wavelength range from such a filament vary sensitively depending of the laser pulse characteristics and the amplification of the intensity of carrier laser pulses can be realized automatically. Professor Xu performed systematic investigation of the filamentation processes, and after his well-designed and elaborated measurements of the filamentation in air, he proposed the mechanism of the air lasing and proved it experimentally and theoretically. His proposed mechanism is now being accepted in our research community as the most plausible mechanism of lasing in air in the filamentation process.

It has been known that, when hydrocarbon molecules are exposed to an intense laser field, a characteristic process called hydrogen migration proceed, in which hydrogen atoms move very rapidly with in a hydrocarbon molecule. However, until Professor Xu performed his time-resolved measurements the mechanism of the ultrafast migration processes had not been understood well. He investigated this hydrogen migration process by a technique called pump-probe coincidence momentum imaging, and revealed that there are two distinct time scales in the hydrogen migration processes, by which we were able to deepen our understanding of fundamental mechanisms of the ultrafast hydrogen migration.

Professor Xu's pioneering achievements can by summarized as blow:

I. Fluorescence emission from filaments and its application to remote sensing

Professor Xu investigated systematically the formation processes of filamentation in air by femtosecond intense laser pulses (Fig. 1), and identified that fluorescence emission from the filament exhibits characteristic spectral profiles depending on media in which a filament is generated such as gaseous media, aerosols, and solid bio-samples. He also demonstrated that the spectral measurement of the fluorescence is one of the most efficient techniques for remote sensing of atmosphere (Fig. 2). Prof. Xu also discovered that there are two different fundamental processes contributing to the fluorescence emission from nitrogen molecules and a trace amount of chemical species in a filament in air, that is, (i) 'ultrafast' optical interactions of molecules with femtosecond laser pulses and (ii) 'slow' collision processes among electrons, molecular ions, and neutral molecules in a filament.

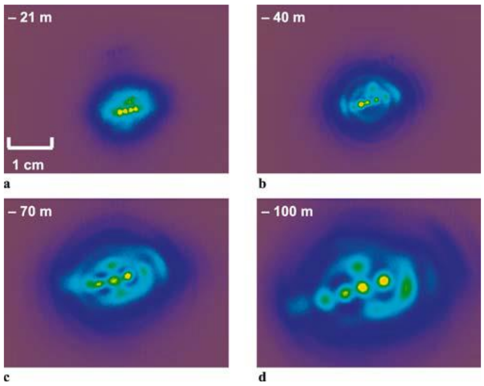

Fig.1. 2D cross sections of the laser-induced filament recorded by a CCD camera at the distances of (a) 21 m, (b) 40 m, (c) 70 m and (d) 100 m measured from the position of an output of the laser system.

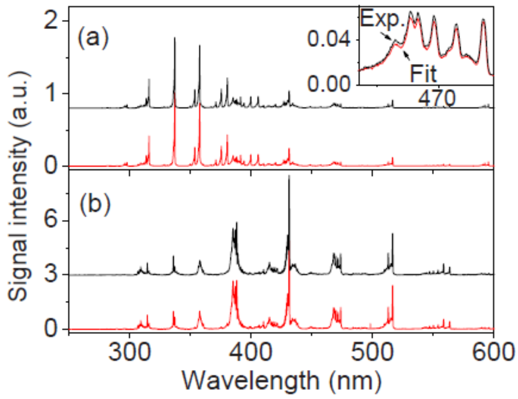

Fig.2. Filament-induced spectra of air containing 1316 ppm of C_2H_2 and 5263 ppm of CH_4 measured (black) and simulated (red) with different time delays of (a) –7 ns and (b) +7 ns with respect to the arrival time of laser pulses at the detector. The inset shows the higher resolution spectra with the delay time of –7 ns.

II. Lasing in filamentation

Professor Xu discovered a new phenomenon called free-space lasing in filamentation in optical media, and showed that harmonics or white-light generated by intense femtosecond laser pulses plays a role as seed light in the lasing action (Fig. 3). He also showed that the lasing is realized by the three sequential events covering in the different time scales; (i) tunnel/multiphoton ionization of the molecules occurring on the attosecond time scale, (ii) the population-inversion achieved in the molecular ions occurring on the femtosecond time scale, and (iii) the amplification of the seed pulses in the medium of molecular ions on the picosecond time scale. Prof. Xu further proved by experiment using few-cycle laser pulses and by theoretical calculations that the population inversion in lasing in air is realized within around 5 fs by the optical coupling among the three electronic states of nitrogen molecular ions (Fig. 4).

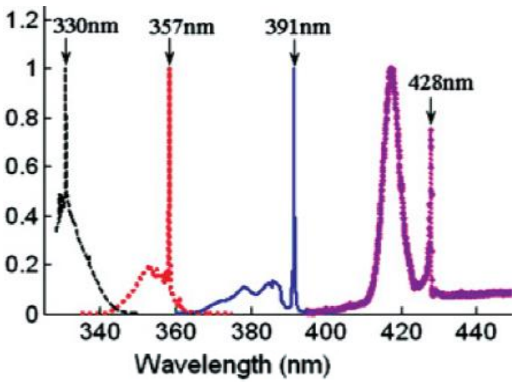

Fig.3. Lasing at 428, 391, 357, and 330 nm achieved in air with different pump laser wavelengths of 2050, 1920, 1760, and 1682 nm, respectively.

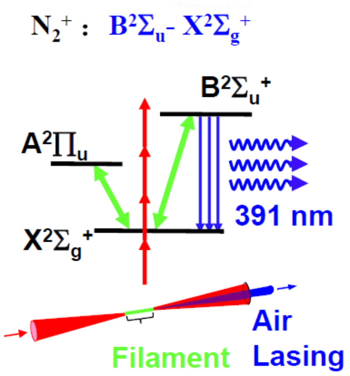

Fig.4. Scheme of population inversion for lasing in air through the optical couplings among the three different electronic states.

III. Coulomb explosion imaging

Professor Xu investigated ultrafast chemical bond rearrangement processes in hydrocarbon molecules called hydrogen migration induced by femtosecond intense laser fields by the method called pump-probe coincidence momentum imaging, and revealed for methanol (CH_3OH) that there are two distinct time scales in the migration of protons within dications CH_3OH^{2+} (see Fig. 5); (i) the instantaneous transfer of a proton from methyl group to hydroxyl group occurring within ~30 fs and (ii) the slower isomerization process occurring after the light-matter interaction on the time scale of the order of 100 fs.

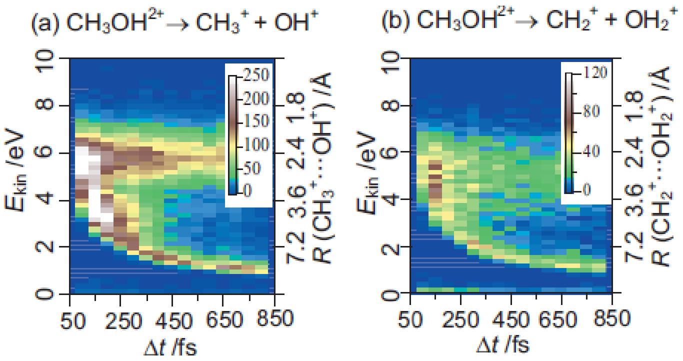

Fig.5. The contour plots of the kinetic energy E_{kin} versus the delay time t for the two fragmentation pathways of CH_3OH^{2+}, induced by intense laser fields in the pump-probe coincidence momentum imaging experiment: (i) non-migration pathway and (ii) migration pathway.

Prof. Xu also demonstrated that chemical bond breaking within a hydrocarbon molecule can be controlled by manipulating the hydrogen migrations by his pioneering studies on acetylene and butadiene (Fig. 6) and allene, which paved the way for bond selective reaction chemistry using tailored intense ultrashort laser pulses.

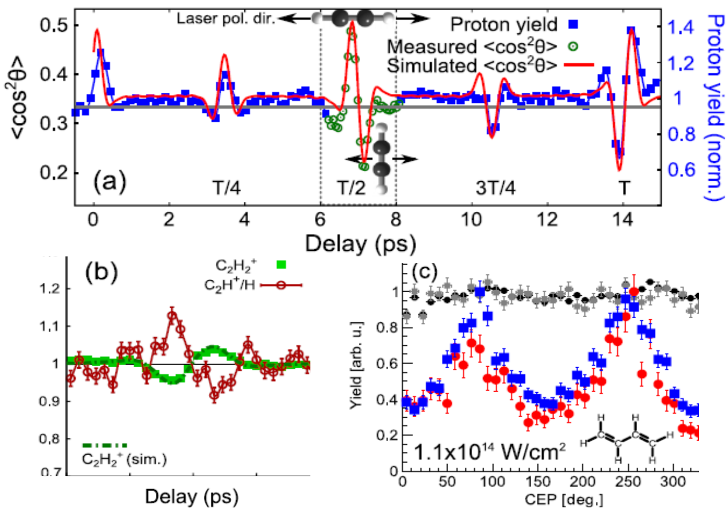

Fig.6. Efficient control of chemical reactions of hydrocarbons in intense laser fields by tailoring the laser pulse. (a) measured and simulated <cos$^2\theta$> and (b) fragments yields over the pump-probe delay; (c) the fragment yield versus the CEP of the laser pulse.

Key references (up to 3 key publications*)

1. **H.L. Xu**, E. Lötstedt, T. Ando, A. Iwasaki, K. Yamanouchi, "*Alignment-dependent population inversion in N_2^+ in intense few-cycle laser fields,*" **Phys. Rev. A 96**, 041401 (2017).
2. **H.L. Xu**, E. Lotstedt, A. Iwasaki, K. Yamanouchi, "*Sub-10-fs population inversion in N_2^+ in air lasing through multiple state coupling*", **Nature Communications 6**, 8347 (2015).
3. **H.L. Xu**, C. Maceau, K. Nakai, T. Okino, S.L. Chin, K. Yamanouchi, "*Two stages of ultrafast hydrogen migration in methanol studied by pump-probe coincidence momentum imaging*," **Journal of Chemical Physics 133**, 071103 (2010).

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

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