Nishina Asia Award 2016年度候補者一覧　　赤印　第2回選考候補者　　NAA候補者（配布資料）

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.16-1 受賞	**Seok Kim** Korea 1977.01.17	Associate Professor of Seoul National University	to the recent progress in quantum field theory and string theory with research papers full of sparkling and ingenious ideas.	Kimyeong Lee	江口、初田
NO.16-2	Chao-Yang LU China	Professor of Physics, Hefei National Laboratory for Physical Sciences at Microscale, University of Science and Technology of China	For his outstanding contributions to quantum information science with single photons	Zhongxian ZHAO , Institute of physics Chinese Academy of Sciences ,	西森
No.16-3	**Huailiang Xu** Chaina	Electronic Science and Engineering, Jilin University	Lasing in filamentation in air and ultrafast hydrogen migration in intense laser fields	志田　忠正　京都大学名誉教授 東京大学大学院理学研究科 山内　薫教授	三島、伊藤
No.16-4	Sungjay Lee Korea	School of Physics Korea Institute for Advanced Study	Discovery of a new class of d=3 gauge theories, with M-theory applications, and a pioneering work that revolutionized study of d=2 gauged linear sigma models and their conformal limit.	**Piljin Yi** Professor of Physics & Chair, School of Physics Korea Institute for Advanced Study	江口、初田
No.16-5	Liangjian Wen Chinese	Instirute of High Energy Physics, Chinese Academy of Sciences, Beijing	the Daya Bay experiment which leads to the discovery of a new type of neutrino oscillation, denoted by a parameter called theta-13	Yifang Wang Instirute of High Energy Physics, Chinese Academy of Sciences, Beijing	永宮、梶田、山内
No.16-6	Bedangadas Mohanty India	National Institute of Science Education and Research Bhubaneswar (NISER)	the study of the Quantum Chromodynamics phase diagram in high-energy nuclear collisions and for the discovery of the heaviest anti-matter nucleus.”	Spenta R Wadia International Centre for Theoretical Sciences (ICTS-TIFR), Tata Institute of Fundamental Research, Bangalore, India	初田

No.16-7	Hung, Ling-Yan China	Physics Department, Fudan University, 220 Handan Lu, Shanhai, China	Significant contributions to the fundamental problems at the junction of field theory, (quantum) gravity and condensed matter physics, these vastly different areas tied together by the ubiquitous role of many-body entanglement.	**Ruibao Tao,** Fudan University, Shanghai, China,	**江口、初田**
No,16-8	Hongming WENG Chinese	Institute of Physics, Chinese Academy of Sciences	For his outstanding contributions to the discovery of Weyl semimetals, in particular, the theoretical prediction of TaAs family compounds as candidates for Weyl semimetals.	**Lu Yu,** Institute of Physics, Chinese Academy of Sciences	**家、　前野**
No,16-9	**Pengjie Zhang** China	Center for Astronomy and Astrophysics, Department of Physics and Astronomy, Shanghai Jiao Tong University	original E_g method to test gravity theories at cosmological scales, and rigorous proof of the Copernican principle	Yipeng Jing Center for Astronomy and Astrophysics, Department of Physics and Astronomy, Shanghai Jiao Tong University	**佐々木**
No,16-10	Kai-Feng Chan Taiwan	Department of Physics,National Taiwan University	"his significant contributions to the measurement of the rarest Bs meson decays with the data from the Large Hadron Collider"	Professor Yuan-Huei Chang Department of Physics,National Taiwan University	**永宮、山内**
No,16-11	Bowen Xiao China	Central China Normal University	For establishing an effective kt-factorization in dilute projectile-dense target collisions, for explaining why there are two distinct gluon distributions, for finding a new AdS5-gravity solution corresponding to uniformly accelerating particles.	Yoshitaka Hatta (八田　佳孝) Associate Professor Yukawa Institute for Theoretical Physics, Kyoto University	**初田、永宮**
No,16-12	Haozhao Liang China	Quantum Hadron Physics Lab., RIKEN Nishina Center	For his outstanding contributions to the application of self-consistent covariant density functional theory for interdisciplinary studies on nuclear physics	Prof. Kenji Fukushima Department of Physics, The University of Tokyo	**初田**

No,16-13	Li-Sheng Geng China	School of Physics and Nuclear Energy Engineering, Beihang University,	For his contribution to the construction of the first complete nuclear mass table in the relativistic mean field theory and advancing the understanding of baryon magnetic moments and masses	Prof. Jie Meng School of Physics, Peking University	永宮、初田
No,16-14	Yilong Han Hong Kong, China	Physics Department, Hong Kong University of Science and Technology (HKUST)	For the outstanding contributions to our understanding of crystal melting, solid-solid transition and glass transition, especially their kinetics at the single-particle level through creative experimental investigations of colloids.	Prof. Michael Altman Head, Department of Physics Hong Kong University of Science and Technology	前野、家
No.16-15-①	BIJAYA KUMAR SAHOO Indian	Associate Professor at Theoretical Physics Division, Physical Research Laboratory (PRL),	For his central contributions in the development of Relativistic Coupled Cluster (RCC) method in many body system and in its applications to parity violation effect and time violation effect in atoms.	福山　武 Cooperative Researcher at RCNP, Osaka University Forner Professor at Ritsumeikan University	永宮、三島、山内
No,16-15-②	BIJAYA KUMAR SAHOO Indian	Theoretical Physics Division	For his groundbreaking work on the theory of parity and time-reversal violations in atoms and its applications to searches of physics beyond the Standard Model of particle interactions.	Koichiro Asahi Department of Physics, Graduate School of Science and Engineering, Tokyo Institute of Technology,	永宮、三島、山内
No,16-15-③	BIJAYA KUMAR SAHOO Indian	Theoretical Physics Division	The candidate have developed a novel many-body atomic theory in a relativistic coupled-cluster framework and performed most accurate calculation of the electron electric dipole moment of an atomic system.	Yasuhiro Sakemi	永宮、三島、山内
No,16-15-④	BIJAYA KUMAR SAHOO Indian	Theoretical Physics Division	groundbreaking works on theory aspects of atomic physics to guide exploration beyond the standard theory of particle physics such as party violation and search for EDM(electric dipole moment)of atoms	吉村　太彦　岡山大学理学部付属量子宇宙研究センター	永宮、三島、　山内

Nomination form for the 2016 Nishina Asia Award

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

Seok KIM: Associate Professor of Seoul National University

2013.09-: Associate Professor, Seoul National University, Korea

2012.09-2013.08: Visiting Professor, Perimeter Institute for Theoretical Physics, Canada

2009.09-2013.08: Assistant Professor in Seoul Natural University, Korea

2007.09-2009.08: Research Associate, Imperial College, London, England

2004.09-2007.08: Research Associate, Korea Institute for Advanced Study, Korea

1999.03-2004.08: M.S. and Ph.D. in Physics, Seoul National University, Korea

1995.03-1999.02: B.S. in Physics, Seoul National University, Korea

Nationality: Republic of Korea

Birthday: 1977.01.17

Address: Department of Physics and Astronomy & Center for Theoretical Physics
Seoul National University, Seoul 151-747, Korea

Email: ,

Phone: 82-2-880-1468

Citation for the Award (within 30 words)

Professor Kim has made some deep and exciting contributions to the recent progress in quantum field theory and string theory with research papers full of sparkling and ingenious ideas.

Description of the work

Professor Kim has been produced many very keen and deep papers on several topics in quantum field theory and string theory, bringing new insights to the topics regarded very difficult.
There are two fundamental objects in string/M-theory. They are so-called M2 and M5 branes. They are objects carrying electric and magnetic charges of the 3-form tensor field C_{MNP} of 11-dimensional supergravity. The understanding of the physics of these two objects have been a highly significant goal or stepping stone to achieve the ultimate theory of string/M theory, which is regarded as the unique consistent theory of quantum gravity. Professor Kim's works cited below have been pivotal in recent progress of our understanding of M2 and M5 brane physics.

Professor Kim have calculated the full index function on M2 branes (key reference 1) by the localization method of the path integral of the Aharony-Bergman-Jafferis-Maldacena's theory od M2 branes on S^1 x S^2. The BPS magnetic monopole operators in these theories are all included and the resulting index function matches exactly what obtained from AdS_4xCP^3 calculation. This work has significant influence in the further development of the subject.

Especially all subsequent works on the 3-dim supersymmetric theories like the various generalization to the less supersymmetric M2 brane physics, 3-d Mirror symmetry have been influenced. All index function calculations of higher dimensional superconformal field theories have been also influenced very much by this insightful and powerful work. This work shows that Prof. Kim's research independence, keen and deep insights to the subject, superb analytic skill and passion.

On the index function of the dyonic instantons in 5-dim N=2 supersymmetric Yang-Mills theories (key reference 2), he has shown what kinds of the ¼ BPS dyonic instantons appear quantum mechanically in the Coulomb phase. In the 5d theory, electric charge (W-bosons) and instantons (D0-branes here) are marginally bounded and the counting of the quantum degeneracy is highly nontrivial. In this work where the Nekrasov's calculation is adapted and improved, he has shown how it is done and has provided the interpretation of this result as the physics of the M5 brane wrapping on a circle. This calculation has shown how additional quantum states appear and how they can be grouped to the N^3 degrees of freedom. This index calculation was also expanded in this work to the DLCQ index calculation of the corresponding 6-dim (2,0) theories. This is the first detailed paper on the DLCQ of the (2,0) theory since the initial papers by Seiberg et.al. 15 years ago. This work gave a very concrete and strong support for the idea that the maximally supersymmetric 5-dimensional Yang-Mills theory captures the 6-dimensional (2,0) superconformal field theories living on M5-branes. The analytic results in this paper are highly nontrivial and have been influential in all further developments of M5-brane physics. Prof. Kim has shown in this work the mastery of fresh new topics, highly nontrivial calculations, and the strong drive. He has slowly have emerged as a young leader in this difficult subject of M5 brane physics.

In his third work (key-reference 3) he have wrote down the partition function of the 5d super Yang-Mills theory on S^5 and calculated it perturbatively and non-perturbatively. He has interpreted this as the index function on M5 branes. This is the first field theoretic calculation of the index function. The 6-dim (2,0) superconformal field theory on M5 branes is a notoriously difficult theory whose exact nature is not known yet. It is very hard to approach the problem directly and Prof. Kim's approach via the 5-dim Yang-Mills theory on S^5 is novel and refreshing. Two key results from this work have been quite influential. One is he calculation of the vacuum Casimir energy of N^3 behavior, which is the scaling behavior of the degrees of freedom on N M5 branes. This result is the first direct confirmation of the result obtained from the AdS-CFT correspondence sometime ago. Another is the W-algebra obtained by certain ½ BPS operators. This result has been confirmed recently in rather different approach. This work will have an ever-lasting impact on the development of this difficult subject.

Prof. Kim is a young string theorist in Korea who has shown deep insights, tenacious energy and enthusiasm, and keen eyes for new angles. He has made some very significant contributions to the field. His scientific standard is very high and demanding. Besides the papers mentioned above, he has been producing insightful, powerful and deep research works. This nominator thinks that Prof. Kim will continue to contribute serious insights to quantum field theory and string/M theory, making the subject vibrant, and recommends Prof. Kim to the Nishina Asia Award very highly.

Key references (up to 3 key publications*)

S. Kim, The complete superconformal index for N=6 Chern-Simons theory, Nucl. Phys. B821 (2009) 241, [arXiv:0903.4172]

H. Kim, **S.Kim**, E. Koh, K. Lee, S. Lee, On instantons as Kaluza-Klein modes of M5-branes, JHEP 1112 (2011) 031, [arXiv:1110.2175]

H. Kim, **S. Kim**, M5-branes from gauge theories on the 5-sphere, JHEP 1305, 144 (2013) http://inspirehep.net/record/1120171

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

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

Kimyeong Lee

Professor in School of Physics,

Vice-President

Korea Institute for Advanced Study

klee@kias.re.kr

82-1-958-3729

82-10-9917-9753

Collaborator

KimyeongLee

Signature Date 2016.02.09

Nomination form for the 2016 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

Advisor: Prof. Mete Atatüre

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

Degree: Master of Science

Thesis: Quantum computing with multiphoton entanglement

Advisor: Prof. Jian-Wei Pan

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

Degree: Bachelor of Science

Honors and Awards:

2015	IOP Physics World "Breakthrough of the Year"
2015	National Natural Science First Prize
2015	National Natural Science Fund for Exceptional Young Scholars
2014	CAS International Cooperation Award for Young Scientists
2014	Hong Kong Qiu Shi Outstanding Young Scholar
2013	Shanghai Thousand Talent
2013	Young Faculty Career Award
2012	National Natural Science Fund for Outstanding Young Scholars
2011	National Youth Thousand Talent
2011	Fellow of Churchill College, University of Cambridge
2009	CAS President Graduate Student Prize
2008	Overseas Research Studentship, UK
2008	Cambridge Overseas Trust Bursary, Cambridge

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

Quantum information science exploits the unique properties of quantum mechanics such as superposition and entanglement for new ways of information processing, which in principle enables unconditionally secure communications and parallel quantum computation. Single photons are a promising candidate as quantum bits for quantum information processing tasks. Chao-Yang Lu has pioneered the field of optical quantum information science, making a wide range of fundamental contributions to the creation of quantum light sources, photonic quantum computing and quantum teleportation.

The experimental creation of large entangled states among multiple quantum particles in the laboratory is not only a fundamental scientific endeavor in itself with intimate connection to the paradox of Schrödinger's cat and quantum-classical transition, but is also the enabling technology for quantum information. Lu has been leading in developing methods to generate, manipulate, and measure Schrödinger-cat-like quantum states with increasing number of entangled photons. He was responsible for the first experimental realizations of six-photon Schrödinger cat state and cluster state (Nature Physics, 2007), five-photon ten-qubit hyper-entanglement with two degrees of freedom (Nature Physics, 2010), and eight-photon entanglement (Nature Photonics, 2012); refreshing world's record on quantum entanglement for three times, and holding the record until now.

One of the most intriguing applications of quantum entanglement 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".

These foundational experiments gave rise to new technologies for realizing quantum computers. Lu systematically performed proof-of-principle demonstrations of fundamental concepts in optical quantum computation, including the first demonstrations of Shor's algorithm (PRL, 2007), loss-tolerant quantum coding (PNAS, 2008), emulation of anyons in Kitaev model (PRL, 2009), solving linear equations systems (PRL, 2013), and entanglement-based machine learning (PRL, 2015), pioneering in the field of optical quantum computing. Together with his colleagues, Lu was invited to write a comprehensive review article on the topic of quantum information processing with single photons, published in Reviews of Modern Physics 84, 777-838 (2012).

Lu strives to significantly increase the number of experimentally controllable photonic quantum bits for future practically useful quantum technologies. To this end, he expanded his research to a new realm: quantum photonics in artificial semiconductor nanostructures. Remarkable, Lu was the first to develop spin-resolved resonance fluorescence in single InAs/GaAs quantum dots (Nature, 2010) to emit single photons that are both deterministic and highly indistinguishable (Nature Nanotechnology, 2013). Further, by combining with microcavities, recently he managed to simultaneously achieve near-perfect single-photon purity, indistinguishability, and efficiency (PRL, 2016), which settled the 15-year-long sought-after goal in the field of single-photon source, and paved the way to creating entanglement of tens of photons. Lu also pioneered in observing photon antibunching —indicating highly non-classical single-photon emission—in semiconductor monolayers (Nature Nanotechnology, 2015), opening a new line of research on quantum optics with two-dimension materials.

To conclude, Lu's research work are among the most significant breakthroughs in the field of quantum information science in recent years. Prof. Lu's pioneering and systematic contributions to these remarkable achievements deserves the Nishina Asian Award.

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. Y.-M. He, G. Clark, J.R. Schaibley, Y. He, M.-C. Chen, Y.-J. Wei, X. Ding, Q. Zhang, W. Yao, X. Xu, **C.-Y. Lu***, and J.-W. Pan, Single Quantum Emitters in Monolayer Semiconductors, *Nature Nanotechnology* **10**, 497-502 (2015).

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. Zhong-Xian Zhao

Affiliation: Institute of Physics Beijing, Chinese Academy of Sciences

Email: zhxzhao@aphy.iphy.ac.cn

Telephone: 010-82649190

no relation to the candidate

Signature Date 2016/2/20

Nomination form for the 2016 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.

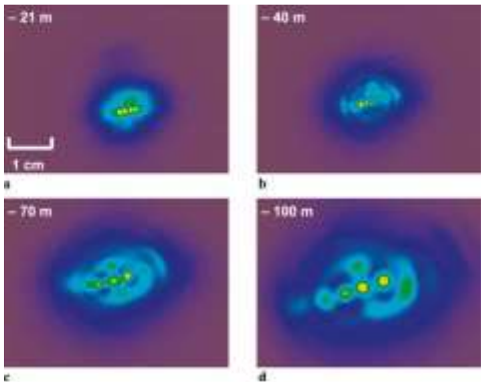


Fig.1. 2D cross sections of the laser-induced filament recorded by a CCD camera at the distances of (a) 21 m, (b) 40 m, (c) 70 m and (d) 100 m measured from the position of an output of the laser system.

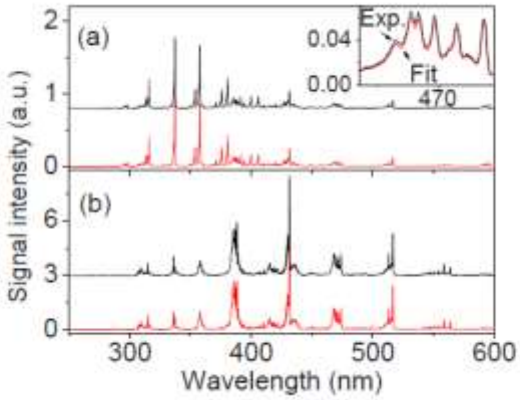


Fig.2. Filament-induced spectra of air containing 1316 ppm of C_2H_2 and 5263 ppm of CH_4 measured (black) and simulated (red) with different time delays of (a) –7 ns and (b) +7 ns with respect to the arrival time of laser pulses at the detector. The inset shows the higher resolution spectra with the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

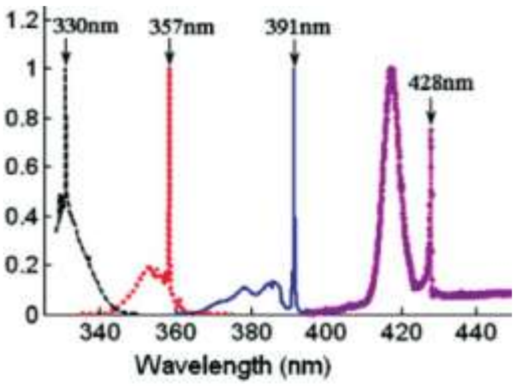


Fig.3. Lasing at 428, 391, 357, and 330 nm achieved in air with different pump laser wavelengths of 2050, 1920, 1760, and 1682 nm, respectively.

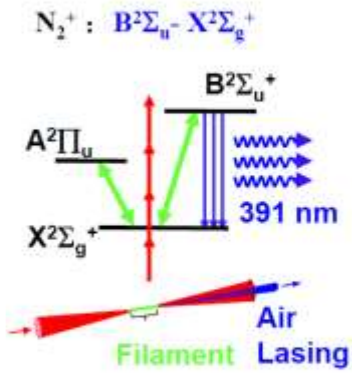


Fig.4. Scheme of population inversion for lasing in air through the optical couplings among the three different electronic states.

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.

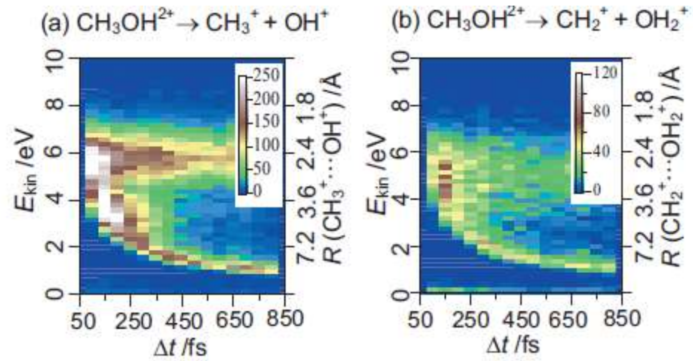


Fig.5. The contour plots of the kinetic energy E_{kin} versus the delay time t for the two fragmentation pathways of CH_3OH^{2+}, induced by intense laser fields in the pump-probe coincidence momentum imaging experiment: (i) non-migration pathway and (ii) migration pathway.

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.

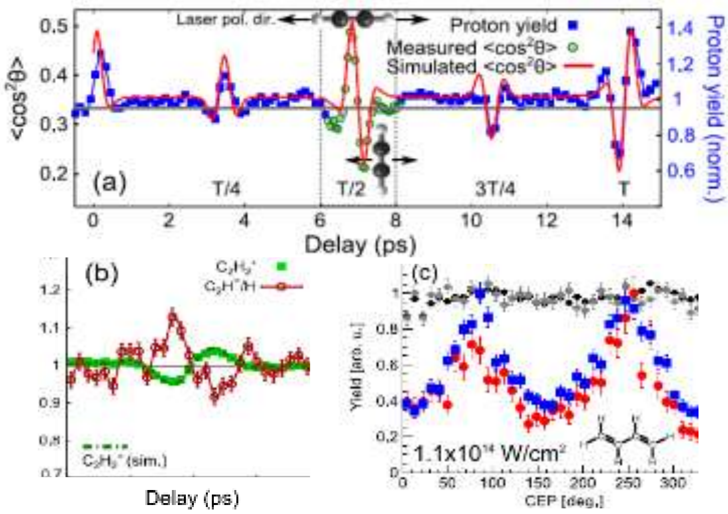


Fig.6. Efficient control of chemical reactions of hydrocarbons in intense laser fields by tailoring the laser pulse. (a) measured and simulated <$\cos^2\theta$> and (b) fragments yields over the pump-probe delay; (c) the fragment yield versus the CEP of the laser pulse.

Key references (up to 3 key publications*)

1. **<u>H.L. Xu</u>**, 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)
2. **<u>H.L. Xu</u>**, A. Azarm, S.L. Chin, "*Controlling fluorescence from* N_2 *inside femtosecond laser filaments in air by two-color laser pulses*," Applied Physics Letters 98, 141111 (2011)
3. **<u>H.L. Xu</u>**, 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.

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

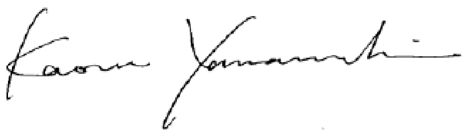
Name: Professor Kaoru Yamanouchi

Affiliation: Department of Chemistry, School of Science, The University of Tokyo

Email: kaoru@chem.s.u-tokyo.ac.jp

Telephone: + 81-3-5841-4334

Relation: Collaborator

Signature  Date March 29, 2016

Nomination form for the 2016 Nishina Asia Award

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

Nominee

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

Academic Employment

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

Education and Qualifications Received

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

Prizes and Awards

2016 Junior Fellowship, Fondation Science Mathematique de Paris, France.
2012 Ernest Rutherford Fellowship, Science and Technology Facilities Council, UK.
2012 Enrico Fermi Fellowship, University of Chicago.
2009 Research Excellence Award, Korea Institute for Advanced Study.

Recent Invited Talks (Selected)

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

"Ramond-Ramond Charges and the Gamma Class," Strings Conference 2014, Princeton (US), June 25 (2014)

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

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

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

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

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

Publication Statistics (InspireHEP database, as of Mar. 10th, 2016)

Papers Published in SCI Journals:	**29**
Papers Cited More than 250 times:	**1**
Papers Cited More than 100 times:	**5**
Papers Cited More than 50 times:	**3**
Total Accumulated Citations:	**1672**

Citation for the Award (within 30 words)

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

Description of the work

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

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

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

Since then, Dr. Lee made several other crucial contributions for d=2 and d=3 supersymmetric gauge theories by computing their sphere partition functions and also unraveling their physical meaning. Until very recently, there has been little progress in our understanding of strongly interacting conformal field theories in d=3. This is related to the fact that there is no efficient and systematic tool to control the long-distance behavior of the 3d theories such as 't Hooft anomaly matching condition in even-dimensional theories. S^3 SUSY partition functions, computed by Sungjay in collaboration with Hama and Hosomichi in 2010-2011, provided for the first time an efficient and systematic tool to study the strong infrared (IR) physics of the 3d (SUSY) gauge theories analytically: confirm detailed predictions of the AdS4/CFT3 correspondence and answer to a long-standing question of defining a measure counting the number of degrees of freedom in 3d, analogous to Zamolodchikov's theorems in 2d CFTs.

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

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

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

Key references (up to 3 key publications*)

N=5,6 Superconformal Chern-Simons Theories and M2-branes on Orbifolds

Kazuo Hosomichi, Ki-Myeong Lee, Sangmin Lee, Sungjay Lee,Jaemo Park,
JHEP 0809 (2008) 002

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

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

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

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

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

Signature Piljin Yi [signature] Date 2016.03.10

Nomination form for the 2015 Nishina Asia Award

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

Candidate name: Dr. Liangjian Wen

Affiliation: Institute of High Energy Physics, Chinese Academy of Sciences, Beijing

--------------------**Curriculum Vitae**-----------------------------

Nationality: Chinese

Address:

Experimental Physics Division,

Yuquan Road 19B, Shijingshan District,

Beijing, China, 100049

Email: wenlj@ihep.ac.cn

Telephone: 86-10-88236768

Career:

Jul 2012 – present, Associate Researcher at Institute of High Energy Physics

Jan 2014 – Jul 2014, Visiting Scholar at Stanford University

Oct 2012 – Dec 2013, Post-doc at Stanford University

Jul 2010 – Apr 2012, Post-doc at Institute of High Energy Physics

Education:

Jul 2010, Ph.D. in Particle Physics and Nuclear Physics, Institute of High Energy Physics

Jun 2005, Bachelor Degree in Applied Physics, University of Science and Technology of China (Hefei, China)

Citation for the Award (within 30 words)

For his key and innovative contributions to the Daya Bay experiment which leads to the discovery of a new type of neutrino oscillation, denoted by a parameter called theta-13.

Description of the work
The Daya bay collaboration announced in 2012 the discovery of a new type of neutrino oscillation, and the neutrino mixing angle θ_{13} measurement. This result was selected by the "Science" magazine as one of the 10 most important breakthroughs in 2012. Liangjian played the most important role in this work. Liangjian and another student proposed an energy calibration scheme which led to an unprecedented energy scale uncertainty. He led the data analysis effort to select neutrinos, study backgrounds and systematic errors. He invented a simple cut to remove completely bad flasher PMTs, much better than other experiments. His event selection scheme soon becomes the standard of the collaboration. He invented a time-since-last-muon method that can deal with high muon rate, to determine 8He/9Li background when he was an undergraduate. Since we have only two months of data, this method is limited by statistics and he then invented a new method by reducing non-interacting-muons to improve the precision. His initiatives and innovations actually appear everywhere, from efficiency calculation for the time-correlated muon veto cut, the random coincidence background calculation, to the determination of fast neutron backgrounds, etc. He seems to know everything and almost everyone relies on him for unknowns. His analysis becomes the official one of the collaboration reported at journals without any dispute. Liangjian developed a maximum likelihood method to reconstruction the energy and the event vertex in the liquid scintillator without bias and with the best possible energy and vertex resolution. This innovative work is published at Nucl. Instrum. and Meth. A 629 (2011) 296-302. Liangjian also worked at the EXO and JUNO and has a number of publications.
Key references (up to 3 key publications*)
F. P. An et al (Daya Bay Collaboration), Observation of electron-antineutrino disappearance at Daya Bay, Phys. Rev. Lett. 108 (2012) 171803 Petr Vogel, Liangjian Wen, Chao Zhang, Neutrino Oscillation Studies with Reactors, arXiv:1503.01059, submitted to Nature Communication L.J. Wen, et al., Nucl. Instrum. and Meth. A 564 (2006) 471-474. *) Copy of one most significant publication should be attached.
Nominator (name, affiliation, email, telephone and relation to the candidate)
Yifang Wang Institute of High Energy Physics, Chinese academy of Sciences, Beijing yfwang@ihep.ac.cn +86-10-88597198 Supervisor
Signature [signature] Date Mar. 23. 2015

Nomination form for the 2016 Nishina Asia Award

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

Name : Bedangadas Mohanty

Affiliation : National Institute of Science Education and Research Bhubaneswar (NISER)

Address : School of Physical Sciences, National Institute of Science Education and Research (NISER), PO- Jatni, Dist-Khurda, Pin: 752050; Odisha, India

Email id : bedanga@niser.ac.in

Telephone : +918895584872; +91674-2494007,

Nationality : Indian

Date of Degree of PhD : July 2002

Discipline : Physical Science

Field of Specialization : Experimental High Energy Physics (Heavy-Ion Collisions)

Employment History:

S.N	Period	Employer	Designation
1	June 2012 till date	National Institute of Science Education and Research Bhubaneswar	Associate Professor
2	July 2012 till date	Homi Bhabha National Institute, Mumbai	Associate Professor
3.	August 2009 – July 2012	Homi Bhabha National Institute, Mumbai	Assistant Professor
4.	August 2008 to June 2012	Variable Energy Cyclotron Centre, Kolkata	Scientific Officer-E
5.	January 2004 to July 2008	Variable Energy Cyclotron Centre, Kolkata	Scientific Officer-D

Educational Qualification:

S.N	Degree	Institute/University	Year	Specialization	Division
1	B.Sc	Utkal University	1994	Physics	1st (Best Graduate)
2	M.Sc	Utkal University	1996	Physics	1st (Gold Medalist)
3	PhD	Institute of Physics	2002	Experimental High Energy Physics	Awarded best thesis by Indian Physics Association

4	Post-Doc	Variable Energy Cyclotron Centre, Kolkata Lawrence Berkeley National Laboratory	2002-03 2006-07	Experimental High Energy Physics	Department of Atomic Energy K. S. Krishnan Fellow Offered Staff position - Declined

Awards and Recognitions:

- Year 2015: **Shanti Swarup Bhatnagar Prize (Highest scientific prize in India)**.
- Year 2014 Onwards: Elected member of Editorial Board ALICE experiment at the Large Hadron Collider Facility, CERN, Geneva.
- Year 2011-2014 : Deputy Spokesperson STAR Experiment at Relativistic Heavy Ion Collider Facility at Brookhaven National Laboratory, New York, USA
- Year 2010-2011 : **Swarna Jayanti Fellowship** Department of Science and Technology, Govt. of India.
- Year 2008-2011: Physics Coordinator STAR Experiment, Brookhaven National Laboratory, New Year, USA
- Year 2006: Young Scientist award – Department of Atomic Energy, Govt of India
- Year 2003: **Associate of Indian Science Academy**, Bangalore
- Year 2003: **INSA Young Scientist Medal** – Indian National Science Academy, New Delhi
- Year 2002: Best thesis award in nuclear physics, Indian Physics Association.
- Year 1997: L.K. Panda Award, Institute of Physics, Bhubaneswar
- Year 1996: **University Gold Medal**, Utkal University, Bhubaneswar

Mentoring of students and postdocs:

Mentored 5 PhD students:

1. Md. Nasim, postdoctoral fellow at UCLA, USA.
2. Chitrasen Jena, postdoctoral fellow at University of Padova, Italy.
3. Ranbir Singh, visiting scientist at University of Catania, Italy and then Scientist at NISER.
4. Subhash Singh, postdoctoral fellowship at KSU, USA stationed at BNL, USA.
5. Md. Rihan Haque, postdoctoral fellow at University of Utrecht, Netherlands.

Supervised Masters Thesis for three students:

1. Ms. Roli Esha, currently graduate student at UCLA, USA.
2. Mr. Evan John Phillip, currently graduate student at University of Stony Brook, USA.
3. Mr. Arabinda Behera, currently graduate student at University of Stony Brook, USA.

Supervised 7 Postdoctoral Fellows:

1. Dr. Victor Roy, Postdoctoral Fellow 2012, currently Alexander von Humboldt fellow FIAS, Frankfurt, Germany.
2. Dr. Anirban Lahari, Postdoctoral Fellow 2013, Currently Postdoctoral Fellow at TIFR, Mumbai.
3. Dr. Sandeep Chatterjee, Postdoctoral Fellow 2014, Currently Postdoctoral Fellow at VECC, Kolkata.
4. Dr. Sabyasachi Ghosh, Postdoctoral Fellow 2015, Currently Postdoctoral Fellow at IFT, UNESP, Sao Paulo, Brazil.
5. Dr. Ajay Dash, Postdoctoral Fellow since 2015
6. Dr. Purba Bhattacharya Postdoctoral Fellow since 2015
7. Dr. Ashwini Kumar Postdoctoral Fellow since 2015

Teaching:

Undergraduate teaching at NISER Bhubaneswar, core courses of Quantum Mechanics, Nuclear and Particle physics, and Relativity, has been lecturer at various **international schools** aboard (Tokyo Institute of Technology, Japan and Institute of Particle Physics, Wuhan, China) and **SERC schools** (SERC School in theoretical high energy physics, SERC schools in experimental high energy physics) in India.

Academic/Scientific/Administrative Positions

Current:

1. Chairperson, School of Physical Sciences, NISER.
2. Dean of Faculty Affairs, NISER.
3. Member STAR Experiment Council, BNL, USA.
4. Member Collaboration Board, ALICE, LHC, CERN.
5. Member ALICE experiment Editorial Board, LHC, CERN.
6. Coordinator ALICE-India light flavour spectra group.
7. Member Subject Research Committee of P.G. Department of Physics, Utkal University.
8. Member Academic Council, NISER.
9. Life member of Indian Physics Association and Member of American Physical Society.

Previous:

1. Deputy Spokesperson, STAR Experiment, BNL USA.
2. Physics Analysis Coordinator, STAR Experiment, BNL, USA.
3. Co-convener of Spectra Physics Working Group, STAR Experiment, BNL, USA.
4. Chairman Post Graduate Council of Schools, NISER.
5. Member Disciplinary Action Committee, NISER.

6. Member of STAR Experiment Decadal Plan Committees for future physics prospects and programs of STAR at RHIC, BNL, USA.
7. Member of 2009/2010 RHIC & AGS Users Executive Committee, BNL, USA.
8. Member STAR Beam User Request Preparation committee in the years 2008, 2009 and 2010.
9. STAR Trigger Board in the year 2008, 2009 and 2010.

Advisory Committee Member of Conferences:

1. International Advisory Committee Member Strangeness in Quark Matter, "Strangeness in Quark Matter", UC Berkeley Clark Kerr Campus, Berkeley, USA from June 27 – July 1, 2016; Dubna, July 6-11, 2015; Birmingham - July 22-27 2013.
2. International Advisory Committee Member Asian Triangular Heavy-Ion Conference, New Delhi 15-19 February 2016; Pusan, Korea, 7 - 10th November 2012
3. Member of International Program Committee for the international conference on "Heavy ion collisions in the LHC era", Qui Nhon, in central Vietnam, 27th - 31st July, 2015; 2012
4. International Advisory Committee Member for The 40th (XL) edition of the International Symposium on Multiparticle Dynamics will be held in Antwerp, Belgium, 21-25, September 2010.

Selection Committee, Referee and Examiner:

1. Referee for the Physical Review Letters, Physical Review, Physics Letters B, Modern Physics Letters, Journal of Physics G, Current Science and Pramana journals.
2. **Project Reviewer**: Veni grant in the Innovational Research Incentives Scheme, **Netherlands Organisation for Scientific Research**, Hague, Netherlands.
3. **Project reviewer**: Lise Meitner-Postdoctoral -position received by the **Austrian Science Fund**, Vienna, Austria.
4. **Project Reviewer: Office of Nuclear Physics (NP) within the Department of Energy Office of Science, USA (evaluated research projects for grants received from from MSU, LANL, Purdue University etc).**
5. Reviewer of Tsinghua University, China 221 Program Evaluation.
6. Member of Selection Committee for Rahul Basu memorial best thesis award in the area of high-energy physics.

Invited Talks (*talks at the important conferences):

Sl. No	Invited Talk/Session Chair	Conference/Workshop/Symposium/Institute	Place	Date
1.	Physics of Relativistic Heavy-Ion Collisions	6th Asian Triangular Heavy Ion Conference	New Delhi	February 15-19, 2016
2.	Freeze-out Dynamics at RHIC Beam Energy Scan Program	Strongly Interacting Hot and Dense Matter: Theory and Experiment	GSI, Darmstadt, Germany	November 2-6, 2015
3.	Search for Critical Point in QCD phase Diagram	13th international eXtreme QCD (XQCD)	Central China Normal University (CCNU), Wuhan, China	September 21-23, 2015
4.	Freeze-out dynamics in high energy heavy-ion collisions	Discussion Meeting on High Moment of Net-charge, Net-Kaon and Net-protons in High-Energy Nuclear Collisions	Lawrence Berkeley National Laboratory, Berkeley USA	June 22-24, 2015
5.	Search for QCD Critical Point and Beam Energy Scan	7th International Conference on Physics and Astrophysics of Quark Gluon Plasma (ICPAQGP-2015)	VECC/SINP Kolkata, India	February2-6, 2015
6.	Exploring the QCD phase diagram through high energy nuclear collisions at RHIC	QCD at High Density	TIFR, Mumbai, India	January 27-30, 2015
7.	Experimental Overview of the QCD Phase Diagram	5th Asian Triangle Heavy Ion Conference (ATHIC) 2014	Osaka University, Japan	August 5 - 8, 2014
8.	Baselines for high moment analysis to study QCD Phase Diagram	Topical Meeting on High Moment Analysis in High Energy Nuclear Collisions	Central China Normal University, Wuhan, China	July 10 - 16, 2014.
9.	Study of QCD phase structure through high energy heavy-ion collisions	New Frontiers in QCD 2013, Yukawa Institute of Theoretical Physics	Kyoto, Japan	November 18 - December 20, 2013
10.	Exploring the QCD phase structure through relativistic heavy-ion collisions	International Symposium on Nuclear Physics	Mumbai, India	December 2-6, 2013.
11.	A new state of matter in relativistic heavy-ion collisions	Workshop on High Energy Physics and Phenomenology, WHEPP13	Puri, India	December 12-21, 2013
12.	Exploring the QCD phase structure through relativistic heavy-ion collisions	International Nuclear Physics Conference	Frienze, Italy	June 2-7 , 2013
13.	High Energy Nuclear Collisions and Phase Diagram of strong interactions	National Conference on Nuclear Physics, NCNP 2013	Sambalpur, India	March 01-03, 2013

14.	QCD Phase Diagram,An Overview	8th International Workshop on Critical Point and Onset of Deconfinement, CPOD 2013	Nappa Valley, CA, USA	March 11-15, 2013
15.	Results from the Beam Energy Scan Program at RHIC	EMMI Workshop	GSI, Darmstadt, Germany	February 15, 2013
16.	Phi-meson production a probe for de-confinement transition in high energy heavy-ion collisions	Lawrence Berkeley National Laboratory	Berkeley, USA	December 4, 2012
17.	Summary of RHIC results and future directions	University of California, Los Angeles	Los Angeles, USA	December 3, 2012
18.	Beam Energy Scan Program at RHIC	Asian Triangle Heavy Ion Conference 2012	Haeundae, Pusan, South Korea	November 14, 2012
19.	Relativistic Heavy Ion Collider Experiments: What have we learned?	QGP-Meet 2012	Variable Energy Cyclotron Center, Kolkata, India	July 3, 2012
20.	Results from the Relativistic Heavy Ion Collider	DAE-BRNS Symposium on Nuclear Physics	Andhra University, Vishakhapatnam, India	December 26-30, 2011
21.	Studying the QCD phase diagram using conserved number distributions in high energy collisions	7th International Workshop on Critical Point and Onset of Deconfinement	Institute of Particle Physics (CCNU), China	7-11 November 2011
22. *	STAR experiment results from the beam energy scan program at RHIC	XXII International Conference on Ultrarelativistic Nucleus-Nucleus Collisions (QM2011)	Annecy, France	23-28 May 2011
23.	Possible evidence for thermalization at RHIC	The Phase Diagram of QCD - Bring your own	Tata Institute Of Fundamental Research, Mumbai, India	December 13 - 14, 2010
24.	Exploring the QCD landscape with high-energy nuclear collisions	2010 Annual Fall Meeting of the APS Division of Nuclear Physics	Convention Center in downtown Santa Fe, NM, USA	November 2-6, 2010
25.	QCD Critical Point	Third Asian Triangle Heavy-Ion Conference (ATHIC 2010)	Institute of Particle Physics, Central China (Hua-Zhong) Normal University, Wuhan, China	October 18-20, 2010
26.	Search for the QCD Critical Point	QCD IN THE MEDIUM	Department of Physics, University of Calcutta, India	4 - 6 October 2010.

27.	Experimental study of the QCD phase diagram using high energy nuclear collisions	Strong Interactions in the 21st Century	Tata Institute Of Fundamental Research, Mumbai, India	February 10 - 12, 2010
28.	Current status of Thermalization from available STAR results	Workshop on critical point, fluctuations and thermalization	Jammu University, Jammu (Patnitop), India	17th Sept to 19th Sept, 2009
29.	Experimental study of the QCD phase diagram and search for the critical point at RHIC	Free Meson Seminar	Tata Institute of Fundamental Research, Mumbai, India	June 23, 2009
30.	Search for the QCD Critical Point Through Study Of Higher Moments Of E-by-ENet-Proton Distributions	Heavy Ion Tea Seminar	Lawrence Berkeley National Laboratory, Berkeley, USA	April 14, 2009
31. *	Phase transitions, Fluctuations and Correlations	21st International conference on nucleus-nucleus collisions at ultra relativistic energies, QM2009	Knoxville, USA	March 30 - April 4, 2009
32.	New Results from Relativistic Heavy Ion Collider	Homi Bhabha Centenary DAE-BRNS Symposium on High Energy Physics 2008	Varanasi, India	14-18 December 2008
33.	Probe the QCD phase diagram with phi-mesons in high energy nuclear collisions	Strange Quark Matter 2008	Beijing, China	6-10 October 2008
34. *	STAR results on medium properties and response of medium to highly energetic partons	20th International conference on ultra relativistic nucleus-nucleus collisions, QM2008	Jaipur, India	February 4-10, 2008
35.	Search for the color factor effect at RHIC	International Symposium on Multiparticle Dynamics	LBNL, Berkeley, USA	August 4-9, 2007
36.	Search for Effects of the QCD Color Factor in High-Energy Collisions at RHIC	Nuclear Science Division Special Seminar	Lawrence Berkeley National Laboratory, Berkeley, USA	May 29, 2007
37.	Effect of color charge dependence on energy loss at RHIC	23rd Winter workshop on nuclear dynamics (WWND07)	Big Sky, Montana, USA	February 12-18, 2007
38. *	Properties of particle production at large transverse momentum in Au+Au andCu+Cu collisions at RHIC	Quark Matter 2006, 19th International Conference on Ultra-relativistic Nucleus-Nucleus Collisions	Shanghai, China	November, 2006
39.	A view on present and vision for future	VECC Foundation Day Celebration, R and D Activities at VECC -Present and Future	Kolkata, India	June 16, 2006
40.	Experimental results from forward rapidity at RHIC	QGP MEET 2006	Kolkata, India	February 6, 2006

41.	Results from STAR experiment at RHIC	9th Workshop on High Energy Physics Phenomenology-WHEPP-9	Bhubaneswar, India	January 3-14, 2006
42.	Results from the Relativistic Heavy Ion Collider	50th DAE-BRNS International Symposium on Nuclear Physics	Mumbai, India	December 12-16, 2005
43.	Results on transverse momentum spectra in p+p and d+Au collisions from STAR experiment at RHIC	47th Workshop on Physics of Hadronic Interaction at LHC with Nucleons and Nuclei and Phase Transition Physics and "The 1st physics ALICE week	Erice, Italy	December 2-10, 2005
44.	Identified hadron spectra at large transverse momentum in p+p and d+Au at 200 GeV	Brookhaven National Laboratory Nuclear Physics Seminar	Brookhaven National Laboratory, USA	November 22, 2005
45.	Particle production in p+p, d+Au and Au+Au collisions at RHIC	Lawrence Berkeley National Laboratory Nuclear Physics Seminar	Lawrence Berkeley National Laboratory, USA	November 17, 2005
46.	First results from Photon Multiplicity Detector at RHIC	5th International conference on physics and astrophysics of quark-gluon plasma	Kolkata, India	February 8-12, 2005
47. *	Particle Production at forward rapidity in d+Au and Au+Au collisions	Quark Matter 2005, 18th International Conference on Ultra-relativistic Nucleus-Nucleus Collisions	Budapest, Hungary	August 4, 2005
48.	Photon and charged particle multiplicity fluctuation and correlation in 158 AGeV/c Pb on Pb collisions	Wayne State University	Detroit, USA	February 2003
49.	Disoriented Chiral Condensates: Experimental Review	QGP Meet 2004	Institute of Physics, Bhubaneswar, India	October 2004
50.	Fluctuations and QCD Phase transitions	QGP Meet 2003	Variable Energy Cyclotron Centre, Kolkata, India	May 2003
51. *	Particle Density Fluctuations	XVI International Conference on Ultra-Relativistic Nucleus-Nucleus Collisions (Quark Matter 2002)	Nantes, France	July 17-24, 2002
52.	Some interesting results from high energy heavy-ion collision experiments	Alumni and Foundation day of the Institute of Physics.	Institute of Physics, Bhubaneswar, India	September 3-4, 2002
53.	Fluctuation in photon and charged particle	DAE-BRNS symposium on nuclear physics	SINP/VECC Kolkata, India	December 26-30, 2001

Nomination form for the 2016 Nishina Asia Award

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)
Hung, Ling-Yan Physics Department, Fudan University, 220 Handan Lu, Shanhai, China E-mail: Personal Data D.O.B.: 4th September, 1982 Place of birth: Hong Kong, China Nationality: Australian Marital status: Single Positions held • 2014- Professor, Physics Department, Fudan University • 2012- 2014 Post-Doctoral Researcher, Harvard University Theoretical research on the dynamical evolution of phases of matter and classification thereof Advisor: Prof. S. Sachdev • 2009- 2012 Post-Doctoral Researcher, Perimeter Institute Theoretical research on the applications of string theoretic methods to analysing phases of matter Advisor: Prof. R. Myers Academic Qualifications • 2005- 2009 Ph.D in Theoretical Physics (viva: July 2009, Graduation ceremony 2010) DAMTP, University of Cambridge, UK Thesis Title: Applications of brane configurations Thesis Advisor: Prof. M.B. Green • 2004-2005 Certificate of Advanced Study in Mathematics, (Course renamed: Master of Advanced Study) University of Cambridge, UK, (Overall grade: Distinction) • 2001-2004 B.A. in Physics University of Oxford, UK (Top first of class 2004, first Class Honour) Honors and Awards • 2015 Qiu-Shi Outstanding Young Scholar Award • 2012 Croucher Fellowship (to be held at Harvard) The Croucher Foundation, Hong Kong • 2009 Croucher Fellowship (to be held at the University of Oxford), The Croucher Foundation, Hong Kong (declined) • 2006-2008 Overseas Research Studentship, Higher Education Funding Council for England • 2005 Class 1, Smith-Knight/Rayleigh-Knight Essay, University of Cambridge, UK • 2005-2009 Gates Scholarship, Gates Cambridge Trust 2004 Scott Prize for performance in the BA (three-year) examination (Top first), Physics, University of Oxford, UK

- 2001-2004 Lee Shau Kee Scholarship for studies at Wadham College, Oxford

Citation for the Award (within 30 words)

Significant contributions to the fundamental problems at the junction of field theory, (quantum) gravity and condensed matter physics, these vastly different areas tied together by the ubiquitous role of many-body entanglement.

Description of the work

The nominee's work is focused on understanding the implications of many body entanglement in (quantum) gravity via the AdS/CFT correspondence. She has a series of work that elucidates the dictionary of computing entanglement entropy in higher derivative gravity theories, and also the holographic duals of Renyi entropies, and the connection of these black hole solutions to extended operators, namely the twist operators in a field theory dual. Her work culminated in the discovery that the positivity of the relative entropy, a constraint following from unitarity of the field theory, is satisfied naturally by Einstein equations. This result was quickly made use of by other groups to demonstrate that conversely the positivity of the relative entropy implies Einstein equations. This line of research opens up a new avenue in recovering structures of (quantum) gravity from the properties of many body entanglement.

She has also since branched off to the study of topological phases of matter, which involves more intricate pattern of quantum entanglement. She has worked on classification of topological orders particularly in 2+1 dimensions with symmetries, which led to a discovery of a connection of the classification with the concept of anyon condensation. This line of research culminated in a description of boundary conditions for non-Abelian topological orders and a counting of their ground state degeneracies in a generic orientable 2d manifold with boundaries, which is a long-standing problem.

Key references (up to 3 key publications*)

1. Relative Entropy and Holography

David D. Blanco, Horacio Casini (Centro Atomico Bariloche), Ling-Yan Hung (Harvard U., Phys. Dept.), Robert C. Myers (Perimeter Inst. Theor. Phys.)

JHEP 1308 (2013) 060

2. On Holographic Entanglement Entropy and Higher Curvature Gravity

Ling-Yan Hung, Robert C. Myers, Michael Smolkin (Perimeter Inst. Theor. Phys.)

JHEP 1104 (2011) 025

3. Ground State Degeneracy of Topological Phases on Open Surfaces

Ling-Yan Hung (Harvard U., Phys. Dept. & Fudan U.), Yidun Wan (Perimeter Inst. Theor. Phys.).

Phys.Rev.Lett. 114 (2015) no.7, 076401

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

Nominator (name, affiliation, email, telephone and relation to the candidate)
Nominator: Ruibao Tao, Affiliation: Fudan University, Shanghai, China, Email:rbtao@fuda.edu.cn Tel: +86-21-65642968, Relation to the candidate: The candidate is one of professor working in same physics department with the nominator.
Signature: Ruibao Tao Date: 22 March, 2016

	multiplicities at SPS and it's prospect at RHIC and LHC			
54.	Photon multiplicity detector : From SPS to RHIC and LHC	International conference on physics and astrophysics of quark-gluon plasma	Jaipur, India	November 26-30, 2001
55.	Localized charged-neutral fluctuations in 158 A GeVPb + Pb collisions	CERN Heavy Ion Forum "on Event-by-event physics	CERN, Geneva, Switzerland	June 21-22 2001
56.	Search for disoriented chiral condensates in 158.A GeVPb+Pb collisions in WA98 experiment	Relativistic heavy-ion physics (RHIP'99). Hot and dense matter	Prague, Czech republic	August 30 - 3 September, 1999

Top 10 Publications

Authors	Year	Title	Journal	Volume	Page	Citations And Impact Factor (IF)	Remark
S. Gupta, X. Luo, B. Mohanty H. Ritter N. Xu	2011	Scale for the Phase Diagram Of Quantum Chromodynamics	Science	332	1525	111 and 31 (IF)	Corresponding author
STAR Collaboration	2011	Observation of Anti-matter Helium-4 nucleus	Nature	473	353	62 and 38.6 (IF)	Part of PhD Thesis of my student and head of the Paper Committee
	2010	Observation of An antimatter hypernucleus	Science	328	58	91 and 31 (IF)	Physics Analysis Leader
STAR Collaboration	2014	Energy Dependence Of Moments of net Proton Distributions At RHIC	Physical Review Letters	112	032302	126 and 7.9 (IF)	Corresponding author, primary author
		Beam Energy Dependence of moments of the net charge multiplicity distributions in Au+Au collisions at RHIC		113	092301	87 and 7.9(IF)	

	2010	Higher Moments Of net-proton Multiplicity Distributions at RHIC		105	0223 02	168 and 7.9 (IF)	
STAR Collaboration	2016	Centrality and Transverse momentum dependence of elliptic flow of multi-strange hadrons and phi-meson in Au+Au collisions at 200 GeV	Physical Review Letters	116	0623 01	5 and 7.9(IF)	Primary Author And Part of my PhD Student Thesis work
	2013	Observation of an Energy-depend ent Difference in Elliptic flow Between particles And anti-particles In relativistic Heavy ion collisions		110	1423 01	41 and 7.9 (IF)	
STAR Collaboration	2009	Energy and System Size Dependence of Phi meson Production in Cu+Cu and Au+ Au collisions	Physics Letters B	673	183	75 and 4.5 (IF)	Primary Author and Corresponding author
STAR Collaboration	2007	Energy Dependence of pi+/-, p and pbar transverse momentum spectra in Au+Au collisions at 62.4 and 200 GeV	Physics Letters B	655	104	165 and 4.5 (IF)	Primary Author And Corresponding author

STAR Collaboration	2006	Identified hadron Spectra at large Transverse Momentum in p+p and d+Au collisions at 200 GeV	Physics Letters B	637	161	236 and 4.5 (IF)	Primary Author And Corresponding author
B. Mohanty J. Serreau	2005	Disoriented Chiral Condensates: Theory and Experiment	Physics Reports	414	263	36 and 22.9 (IF)	First author
STAR Collaboration	2005	Multiplicity and Pseudorapidity Distributions of Photons in Au+Au collisions at 62.4 GeV	Physical Review Letters	95	0623 01	40 and 7.9 (IF)	Primary Author And Corresponding author ONLY PRL From India Detector in Heavy-ion experiments
STAR Collaboration	2005	Experimental and Theoretical Challenges in the Search for the Quark gluon Plasma: The STAR Collabora tion's critical assessment of the evidence from the RHIC collisions	Nuclear Physics A	757	102	2220 and 1.5 (IF)	Several Of my Analysis Results Part of this White paper

* Complete list of publication separately attached.

Institutions visited for research collaboration – long duration (selected list):

Institution	Year
CERN, Geneva, Switzerland	1998 – 2016 (several times)
Brookhaven National Laboratory, Upton New York, USA	2000-2016 (several times)
Lawrence Berkeley National Laboratory, Berkeley, USA	2006-2016 (several times)

Yukawa Institute of Theoretical Physics, Kyoto and University of Tokyo, Osaka University, Japan	2014, 2010, 2014
GSI, Darmstadt, Germany	2013, 2014, 2015
Institute of Particle Physics, Wuhan China	2011, 2012, 2014, 2015
Pusan University, South Korea	2012

Outreach and Science Popularization:

1. "STAR experiment reports the discovery of anti-strange matter" – CURRENT SCIENCE, VOL. 99, NO. 7, 10 OCTOBER 2010, Page 873 .
2. "STAR experiment launches the QCD Critical Point Search Program at the Relativistic Heavy Ion Collider facility" – CURRENT SCIENCE, VOL. 100, NO. 5, 10 MARCH 2011, Page 618.
3. "STAR Experiment reports observation of the antimatter helium-4 nucleus" – CURRENT SCIENCE, VOL. 100, NO. 11, 10 June 2011, Page 1613 .
4. "Formation of a perfect fluid in high-energy heavy-ion collisions" – CURRENT SCIENCE, VOL. 103, NO. 11, December 2011, Page 1267 .
5. "Properties of a system of fundamental constituents of visible matter" – CURRENT SCIENCE, VOL. 106, NO. 6, March 2014, Page 798 .
6. Scientific secretary and Organizing Committee member of Understanding the Universe through LHC on 28 February, 2009 an outreach program, held at VECC/SINP, Kolkata, India.
7. Several Popular physics talks in INSPIRE INTERSHIP PROGRAM FOR YOUNG TALENTS (2012, 2013, 2014, 2015, 2016) Sponsored by: Department of Science and Technology (DST), Govt. Of India
8. Mentor to several summer students selected by Indian Academy of Sciences.

Citation for the Award (within 30 words)

Dr. Bedangadas Mohanty is being nominated "for his outstanding and significant contributions to the study of the Quantum Chromodynamics phase diagram in high-energy nuclear collisions and for the discovery of the heaviest anti-matter nucleus."

Description of the work:

His scientific contributions can be categorized into four broad areas:

- **The strong interactions, described by Quantum Chromo Dynamics (QCD), are** one of the four basic interactions that occur in nature. The phase diagram tells us how matter organizes itself when subject to variations in thermodynamic parameters, and it is a key to **understanding the emergent properties of the strong interactions.** While phase diagrams of systems of atoms and molecules interacting via the electromagnetic interaction have been very widely studied and precisely known (e.g water), that for the strong interactions had remained a conjecture for a long time. Dr. Mohanty has significantly contributed towards the establishment of the Phase Diagram of QCD.

(a) He led the physics program of a dedicated experiment at Brookhaven National Laboratory for the purpose of studying phase diagram of QCD called the "Beam Energy Scan Program". His work has led to the possible existence of a critical point in the phase diagram of QCD. He led the team that established the "observable" for the critical point search in the experiment that is published in **Phys.Rev.Lett. 105 (2010) 022302. This work** is considered as a landmark work in the field. Then, based on the first data of the beam energy scan program, they showed that the possible critical point region of the QCD phase diagram is near the beam energy of 20 GeV (temperature ~ 160 MeV and baryonic chemical potential ~ 400 MeV). This work is published in **Physical Review Letters 112 (2014) 032302.** He has very successfully led the beam energy scan physics program to publish so far **5 important scientific papers in Physical Review Letters**.

(b) He has ***significantly*** contributed to the establishment of the quark-hadron transition and its transition temperature that is published in **Science 332 (2011)1525,** and "Physics World" considered it among the 10 best in the year 2011.

- ***Contribution to establishing the formation of a new phase of matter the Quark Gluon Plasma (QGP), in the laboratory***: This state of matter existed in the first few microseconds old Universe. In QGP quarks and gluons are de-confined and move freely in volumes much larger than nucleonic scales. In order to achieve such matter in the laboratory, temperatures of the order of 10^{12} degrees Kelvin need to be created. The quark-gluon plasma state allows for studying transport properties like viscosity, thermal conductivity, opacity and diffusion co-efficient of QCD matter. Dr. Mohanty has several significant papers on signatures that experimentally confirm the existence of QGP, related to the observation of strangeness enhancement in heavy-ion collisions – **Phys.Lett.B 673 (2009) 183;** jet quenching effect - **PRL 97 (2006) 152301 and Physics Letters B 655 (2007)104, 637 (2006)161; and** partonic collectivity – **PRL 116 (2016) 062301 and PRL 99 (2007) 112301.** These are summarized in a review paper in **Nucl. Phys. A 757 (2005) 102.** They support the formation of a QGP that exhibits perfect fluidity (viscosity to entropy density ratio close to the quantum bound). These papers have a total citations of about **2300**.

- ***The discovery of two new anti-matter nuclei***:
  (a) Dr. Mohanty as the physics analysis leader led a team that discovered the heaviest known anti-matter nuclei the **anti-alpha** (consisting of two anti-protons and two anti-neutrons) in the laboratory. The discovery is published in **Nature 473 (2011) 353**. This measurement provided the probability of production of anti-helium through nuclear interactions, thereby providing the predominant baseline for measurements carried out in space.
  (b) Dr. Mohanty as the physics analysis leader led a team that discovered the heaviest strange anti-matter nuclei. Normal nuclei are formed only of protons and neutrons. Hyper-nuclei are made up of protons, neutrons and hyperons. The **anti-hypertrion**, nuclei consist of anti-proton, anti-neutron and anti-lambda (a strange hadron). This work is published in **Science 328 (2010) 58**. It has implications for neutron stars and also understanding of the nuclear force. To study nuclei, nuclides are arranged into a two-dimensional table of nuclides. On one axis is the number of neutrons N, and on the other is the number of protons Z. The discovery of antihyperon introduces a third axis (strangeness) and the table becomes three-dimensional.
- ***Disoriented Chiral Condensates (DCC) and Chiral Phase Transition:*** J. D. Bjorken, F. Wilczek and collaborators have advocated the existence of DCC due to the chiral phase transition in QCD matter. The possibility of producing quark-gluon plasma in high-energy collisions is an exciting one from the point of view of observing the chiral phase transition as the hot plasma expands and cools. As the system returns to its normal phase it is possible for local regions of misaligned vacuum to be produced. These domains, which are analogous to misaligned domains of a ferromagnet have been named Disoriented Chiral Condensates (DCCs). DCC's are regions where the chiral field is aligned in a isospin direction. These domains relax back to ground state configuration by emitting pions. Towards this goal, and since a neutral pion readily decays to photons, Dr. Mohanty has put in several years of effort to search for the signature of the chiral phase transition (through DCC) by ***establishing photon production in heavy-ion collisions using a detector built in India.*** He is the lead author of the Physical Review Letters paper on inclusive photon production in heavy-ion collisions (**PRL-95 (2005) 062301**) using the Indian detector. His contribution to photon production and to the physics of DCC in heavy-ion collisions led to the invitation from the editorial board of Physics Reports to write a review article, titled "Disoriented Chiral Condensate – Theory and Experiment", published in – **Phys. Rept. 414 (2005) 263**

- **Impact of the contributions:**
  (a) His work has contributed to the experimental confirmation of the formation of the Quark Gluon Plasma. This has enabled (for the first time) the study of properties of QCD matter

like viscosity, conductivity, diffusion co-efficient and opacity.

(b) His work has contributed to the phase diagram of QCD becoming a reality: transition temperature, order of transition and two different phases have been established at zero baryonic chemical potential. The possibility of the existence of a critical point is the seen in data.

(c) The discovery of anti-alpha and anti-hypertriton, have implications in the fields of cosmology, astro-particle physics and nuclear physics.

He has been invited to deliver plenary talks at important conferences in his field and he gave the conference summary talk on "Phase transitions, Critical point and Correlations" at Quark Matter 2009. Within India his scientific work has been recognized through the award of the CSIR Shanti Swarup Bhatnagar Prize (highest scientific honor in India for scientists below the age of 45 years) and the DST Swarna Jayanti Award ((highest scientific honor in India for scientists below the age of 40 years).

Key references (up to 3 key publications*)

1. *Scale for the Phase Diagram Of Quantum Chromodynamics, Science 332 (2011) 1525
2. #Observation of Anti-Matter Helium-4 nuclei, Nature 473 (2011) 353
3. Energy Dependence of Moments of net-proton Distributions at RHIC, Physical Review Letters 112 (2014) 032302

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

Two papers one from Nature and another from Science are attached together with a certificate from Dr Nu Xu, Spokesperson for STAR Collaboration, Lawrence Berkeley Laboratory.

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

Name: Spenta R Wadia

Affiliation: International Centre for Theoretical Sciences (ICTS-TIFR), Tata Institute of Fundamental Research, Bangalore, India

Email: spenta.wadia@icts.res.in; spenta.wadia@gmail.com

Telephone: +91 - 80 – 6730 6010

Relation to the Candidate: Senior Colleague

Signature Date 20 March 2016

Nomination form for the 2016 Nishina Asia Award

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)
Name: Hongming WENG **Date of Degree of Ph.D.**: September 23rd, 2005 **Affiliation**: Institute of Physics, Chinese Academy of Sciences **Nationality**: Chinese **Address**: Institute of Physics, Chinese Academy of Sciences, Zhong Guan Cun Nan San Jie, 8, P.O. Box 603, Beijing 100190, China **Phone**: +86-10-6284-9941 (office); +86-138-1157-0964(mobile) **Fax**: +86-10-6255-3698 **Email**: hmweng@iphy.ac.cn **Education**: • Sep. 1st, 1996 ~ Aug. 31st, 2000, Department of Physics, Nanjing University, China B.S. in Physics • Sep. 1st, 2000 ~ Aug. 31st, 2005, Department of Physics, Nanjing University, China Ph.D. in Physics **Research Experience**: • Sep. 28th, 2005 ~ Mar. 31st, 2007, Kawazoe Lab., Institute for Materials Research, Tohoku University, Japan Postdoctoral Researcher • Apr. 1st, 2007 ~ Aug. 31st, 2010, Research Center for Integrated Science, Advanced Institute of Science and Technology, Japan Assistant Professor • Sep. 1st, 2010 ~ Present, Associate Professor, The Institute of Physics, the Chinese Academy of Sciences, China **Honors and Awards**: • JSPS Postdoctoral Fellowship (2007) • 100-talent program of Institute of Physics (2010) • NSF China "Excellent Young Scientist Award" (2014)
Citation for the Award (within 30 words)
For his outstanding contributions to the discovery of Weyl semimetals, in particular, the theoretical prediction of TaAs family compounds as candidates for Weyl semimetals.

Description of the work

Weyl semimetal is a new topological state of matter that differs from topological insulators, and further it can host Weyl fermions as low-energy quasi-particles — a long sought massless chiral particle proposed as the building block of the Standard Model, but never being observed as fundamental particles. In recent years, we have witnessed the rapid development of this field, stimulated by the discovery of real Weyl semimetal materials, to which Weng has made crucial contributions. While most of the topological semimetals discovered up to now are known compounds, while their topological nature has remained unknown for many years. Weng's work in collaboration with his colleagues, using the first-principles calculations, predicted the unique topological electronic structure of TaAs family compounds, leading to the discovery of Weyl semimetals and Weyl fermions. This work has set up a good example in condensed matter physics showing that computational predictions can drive fundamental discovery and materials design.

In 1928, Paul Dirac proposed the 4-component Dirac equation to describe the motion of relativistic electrons. In the second year, 1929, Hermann Weyl found that Dirac equation can be further simplified if electrons are massless. This leads to the Weyl equation with 2-component chiral Weyl fermions as its low energy particles. Since then, the simplest Weyl representation has been widely accepted in quantum field theory and used as the building block of the Standard Model for particle physics. Unfortunately, all fundamental particles found up to now are massive (including neutrinos) due to symmetry breaking, therefore none of them are true Weyl fermions.

On the other hand, in condensed matter physics, the progress in studying topological states has opened up the possibility of finding Weyl fermions as low-energy quasi-particles of a new topological state, called Weyl semimetals. As early as 2003, a couple of studies, in the context of anomalous Hall effect, has proposed that Weyl nodes can exist in condensed matter materials and can be viewed as magnetic monopoles in the crystalline momentum space. Nevertheless, the field then kept quiet for some years, because it was generally difficult to put the Weyl nodes, if any, exactly at the Fermi level.

The situation, however, has been changed since 2011. A couple of candidates were theoretically proposed as Weyl semimetals, such as pyrochlore iridates and $HgCr_2Se_4$, although they are difficult to realize. In the following years, 2012-2014, further progress was made. Topological Dirac semimetals, where two Weyl nodes with opposite chirality coexist and overlap in the momentum space, were theoretically predicted and experimentally materialized in Na_3Bi and Cd_3As_2, which substantially promoted the field again. In those studies, Weng has made important contributions, being the coauthor of the paper for $HgCr_2Se_4$ [PRL, 107, 186806 (2011)], and one of the corresponding authors for the Na_3Bi paper [PRB, 85, 195320 (2012)] and the Cd_3As_2 paper [PRB, 88, 125427 (2013)].

The true challenge has been: how to find a realistic compound with separated Weyl nodes at the Fermi level? For that purpose one needs to break either time reversal or inversion symmetry, and the latter should be a better choice for experimental measurements. First-principles calculations should play an important role towards that end. After trying numerous compounds, the breakthrough was made by Weng et al. in 2014. They theoretically predicted [PRX, 5, 011029 (2015)] that TaAs family compounds are non-centrosymmetric Weyl semimetals. Soon after the theoretical prediction, Weng et al., collaborating closely with experimental groups, finally observed the Weyl nodes in the bulk [Nature Physics, 11, 724 (2015)] and related Fermi arcs [PRX, 5, 031013 (2015)] on the surface of TaAs in 2015. This series of work leads to the discovery of Weyl semimetals and Weyl fermions. The other members of TaAs family compounds, such as NbAs, TaP and NbP, have been all confirmed to be Weyl semimetals by recent experiments, too. I should mention that this field is highly competitive, and a similar discovery has been made almost simultaneously by a joint group from Princeton and Peking University. Nevertheless, the predictive role played by Weng et al. is crucial in this endeavor.

The discovery of Weyl semimetals and Weyl Fermions is highly appreciated by the international community. Soon after its discovery, this work together with that done by the Princeton group and else was selected as one of the Top 10 Breakthroughs of the year 2015 by <Physics World>, and also as one of the Highlights of Year 2015 by the American Physical Society. For this reason, I think Weng well deserves the Nishina Asia Award.

Key references (up to 3 key publications*)

1. *Weyl Semimetal Phase in Noncentrosymmetric Transition-Metal Monophosphides*, Hongming Weng*, Chen Fang, Zhong Fang, B. A. Bernevig, Xi. Dai, **Phys. Rev. X 5**, 011029 (2015);
2. *Experimental discovery of Weyl semimetal TaAs*, B.-Q. Lv*, Hongming Weng*, B. B. Fu, X. P. Wang, H. Miao, J. Ma, P. Richard, X. C. Huang, L. X. Zhao, G. F. Chen, Z. Fang, X. Dai, T. Qian, and H. Ding, **Phys. Rev. X 5**, 031013 (2015);
3. *Observation of Weyl nodes in TaAs*, B.-Q. Lv*, N. Xu*, Hongming Weng*, J. Z. Ma, P. Richard, X. C. Huang, L. X. Zhao, G. F. Chen, C. E. Matt, F. Bisti, V. N. Strocov, J. Mesot, Z. Fang, X. Dai, T. Qian, M. Shi, **Nature Physics 11**, 724-727 (2015).

*Copies of these significant publications are attached.
Nominator (name, affiliation, email, telephone and relation to the candidate)
Lu Yu, Institute of Physics, Chinese Academy of Sciences, lyu@iphy.ac.cn, Phone:86-10-8264-9325, Fax:86-10-8264-0073, not related
Signature Date 22 March, 2016

Nomination form for the 2015 Nishina Asia Award

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

Description of the work
Pengjie Zhang works on the statistics of the large scale structure (LSS) of the universe and using LSS to probe fundamental cosmological physics. He made significant contributions to testing General Relativity (GR) at cosmological scale and the Copernican principle, two fundamental principles of cosmological physics. (1) The E_G method to test GR at cosmological scale (Zhang et al. 2007, PRL). Although GR has been rigorously tested in solar system, it is difficult to test at cosmological scales. Therefore the observed cosmic acceleration can be either caused by a mysterious dark energy, or modifications of GR at cosmological scale. A key to break this degeneracy is to test GR at cosmological scales independently. By combining weak lensing and redshift distortion, Zhang et al. (2007) proposed the E_G method which directly measures the capability of mass to distort space-time. Furthermore, by construction, it significantly reduces uncertainties from the otherwise troublesome galaxy bias and initial density fluctuation. It is therefore a highly discriminating probe of various gravity models such as GR, DGP, f(R) and TeVeS. E_G has been widely accepted as a major method to test GR at cosmological scale (e.g. Clifton et al. 2012, review of modified gravity and cosmology on Physics Reports). It was applied in SDSS surveys and confirmed GR at z~0.3 and ~50 Mpc scales (Reyes et al. 2010). It has been adopted as an important scientific goal by stage IV dark energy surveys such as DESI and LSST. It is capable of testing GR at 1% accuracy at ~100 Mpc scale over the past 10 billion years. (2) The "linear" kinetic SZ method which confirmed the Copernican Principle (Zhang & Stebbins, 2011, PRL). The Copernican Principle, a corner stone of modern cosmology, assumes that we do not live in a special region of the universe. However, it is extremely hard to verify, especially over billion light year radial scale and above. This leaves a major loophole in modern cosmology. For example, violations of the Copernican Principle along the radial direction (the LTB models in general and the void model to be specific), which are consistent with CMB, can explain supernovae data without resorting to cosmic acceleration and dark energy. It therefore challenges a major discovery of modern cosmology and physics. Zhang and Stebbins (2011) found that, violations of the Copernican Principle will inevitably cause a diffuse kinetic Sunyaev Zel'dovich (kSZ) effect with unique "linear" dependence on density fluctuation. Interesting void models, which can explain supernovae data without dark energy, cause a linear kSZ effect orders of magnitude larger than observation. Therefore this linear kSZ test was the most stringent test of the Copernican principle. It robustly ruled out the void models and confirmed the Copernican Principle at >1Gpc radial scale. Ethan Vishniac, the chief editor of ApJ and a leading expert on the kSZ effect, appraised this work as "hard to see any loopholes", during an interview by physicsworld.
Key references (up to 3 key publications*)

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

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

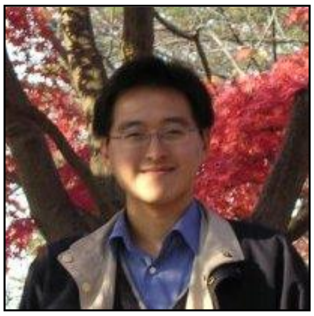
Nominator (name, affiliation, email, telephone and relation to the candidate)

Name: Yipeng Jing
Affiliation: Center for Astronomy and Astrophysics, Department of Physics and Astronomy, Shanghai Jiao Tong University
Email: ypjing@sjtu.edu.cn
Telephone: 0086-21-34203945 (o), 0086-13641754198 (mobile)

Relation to the candidate: the nominator is the vice dean for research of the department of physics and astronomy. He has been a colleague of the candidate for more than 10 years, and is working in the same research field.

Signature Yipeng Jing Date 2015/3/14

Nomination form for the 2016 Nishina Asia Award

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)
Name: Kai-Feng Chen *Affiliation:* Department of Physics, National Taiwan University *Education:* 2005 Ph.D. in Physics, National Taiwan University *Nationality:* Taiwan (R.O.C.) *Address:* R529, Department of Physics, National Taiwan University, No. 1, Sec. 4, Roosevelt Rd., Taipei 10617, Taiwan *E-mail:* kfjack@phys.ntu.edu.tw *Telephone:* +886-2-3366-5153 *Field of Research:* Experimental High Energy Physics CMS Experiment at CERN, Geneva, Switzerland (since 2006) E391a Experiment at KEK, Tsukuba, Japan (since 2005) Belle Experiment at KEK, Tsukuba, Japan (since 1998) *Honor:* IUPAP Young Scientist Prize (2008) Foundation for the Advancement of Outstanding Scholarship Award (2010) Ta-You Wu Memorial Award (2012) GoldenJade Young Scientist Prize (2014) 
Citation for the Award (within 30 words)
"his significant contributions to the measurement of the rarest Bs meson decays with the data from the Large Hadron Collider"
Description of the work

The Bs meson is an unstable composite particle consisting of a bottom antiquark and a strange quark, and decays into two charged muons with a tiny probability of 1/300,000,000. This decay, although rate is very small, but it is especially interesting. Any difference in the observed rate with respect to the prediction would provide a direction in which the Standard Model of particle physics should be modified or extended.

Given the importance, this decay has been searched for more than 30 years by many particle physics experiments. But until recently, only the large production rate of Bs mesons provided by the Large Hadron Collider (LHC) can have the chance to reach the required sensitivity. Prof. Kai-Feng Chen is a member of the CMS (Compact Muon Solenoid) experiment at the LHC. He took over the responsibility of CMS B-physics convenership and coordinated this research work within the collaboration. In summer 2013, CMS collaboration has finished the analysis work with its full data set collected in 2011 and 2012. The result, which shows a statistical significance higher than four standard deviations, had been published in the journal PRL.

Since both CMS, and the LHCb (Large Hadron Collider beauty) experiment, had reach four standard deviations and only a step away from the criterion of "Discovery", a joint analysis for combining the data sets from two experiments has been proceed, with Prof. Chen as one of the corresponding authors. The combined result has a statistical significance exceeding six standard deviations. It is the best measurement of the rarest Bs meson decay so far. It is a major milestone in the particle physics, has been published in the journal Nature.

Key references (up to 3 key publications*)

1. CMS and LHCb Collaborations, "Observation of the rare Bs to mu+mu- decay from the combined analysis of CMS and LHCb data", Nature 522 (2015) 68.
2. CMS Collaboration, "Measurement of the Bs to mu+mu- branching fraction and search for B0 to mu+mu- with the CMS experiment", Phys. Rev. Lett. 111 (2013) 101804.
3. CMS Collaboration, "Search for Bs to mu+mu- and B0 to mu+mu- decays", J. High Energy Phys. 04 (2012) 033.

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

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

Name: Professor Yuan-Huei Chang

Affiliation: Department of Physics, National Taiwan University

E-mail: yhchang@phys.ntu.edu.tw

Telephone: +886-2-3366-5126

Relationship: Chairman of the department

Signature Yuan Huei Chang Date 2016-03-27

Nomination form for the 2016 Nishina Asia Award

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)
Bowen Xiao, Central China Normal University Nationality: China Address: Institute of Particle Physics, Central China Normal University, Wuhan, 430079 China Date of Birth: June 12, 1981 B.S. Physics, Peking University, China, 2003. M. Phil. Physics, Columbia University, USA, 2003-2006, Ph.D. Physics, Columbia University, USA, 2003-2008 ((PhD adviser: Prof. Alfred H. Mueller) Postdoctoral Fellow, Lawrence Berkeley National Laboratory, USA, 2008 – 2010 Postdoctoral Fellow, Pennsylvania State University, USA, 2010-2012 Professor and Young 1000-plan Scientist, Central China Normal University, 2012 – Honors and Awards: Honorable Mention, Chinese Physics Olympiad, 1998 Freshman Scholarship, Peking University, 1999 Honorable Mention, the Chinese Mathematical Contest in Modeling, 2000 Chun-Tsung Scholar Fellowship, Peking University 2001 Young 1000-Plan Scholar, China, 2012
Citation for the Award (within 30 words)
For establishing an effective kt-factorization in dilute projectile-dense target collisions, for explaining why there are two distinct gluon distributions, for finding a new AdS5-gravity solution corresponding to uniformly accelerating particles.
Description of the work

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

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

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

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

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

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

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

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

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

Key references (up to 3 key publications*)

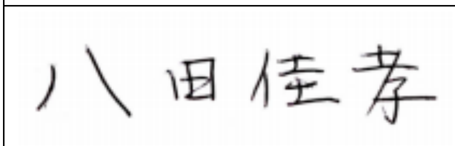
[1] F. Dominguez, C. Marquet, Bo-Wen Xiao and F. Yuan, Universality of Unintegrated Gluon Dis- tributions at small x, Phys. Rev. D83:105005, (2011).

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

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

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

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



Yoshitaka Hatta
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Relation to the candidate: collaborator

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Relation to the candidate: Ph.D. Advisor

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Relation to the candidate: collaborator

Signature Date March 27, 2016

Nomination form for the 2016 Nishina Asia Award

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)
<u>Name</u>: **Dr. Haozhao Liang** <u>Affiliation</u>: **Quantum Hadron Physics Lab., RIKEN Nishina Center, Wako 351-0198, Japan** <u>Nationality</u>: **People's Republic of China** <u>Address</u>: **B202, 546 Kishine-cho, Kohoku-ku, Yokohama-shi, Kanagawa 222-0034, Japan** <u>Email / Telephone</u>: **haozhao.liang@riken.jp / +81-48-462-1226** <u>Employment / Education</u>: (Date of the Ph.D degree: July 2010) 2015.4 – present **Research Scientist (tenured), RIKEN Nishina Center** 2014.1 – 2015.3 **Foreign postdoctoral researcher, RIKEN Nishina Center** 2012.8 – 2013.12 **JSPS postdoctoral fellow, RIKEN Nishina Center** 2010.7 – 2012.7 **Postdoctoral fellow, School of Physics, Peking University** 2007.11 – 2010.7 **Institut de Physique Nucléaire, Université Paris-Sud XI (Degree: Ph.D in Physics)** 2005.9 – 2010.7 **School of Physics, Peking University (Degree: Ph.D in Physics)** 2001.9 – 2005.7 **School of Physics, Peking University (Degree: B.S. in Physics)**
Citation for the Award (within 30 words)
For his outstanding contributions to the application of self-consistent covariant density functional theory for interdisciplinary studies on nuclear physics
Description of the work
Dr. Liang has developed a self-consistent treatment of the covariant density functional theory to shed new light upon many long-standing problems in nuclear physics. A relativistic description of nuclei has been known for many years, but a full functional treatment in finite quantum systems like nuclei is technically very difficult. Dr. Liang and his collaborators, for the first time in the world, have succeeded in establishing a new hybrid method with the relativistic Hartree-Fock approach and the random phase approximation (RHF+RPA), with which all crucial physical effects with spin-isospin degrees of freedom in nuclei can be taken into account. This new method of Dr. Liang has opened a new era of nuclear science: spin-isospin resonances are so important for quantitative estiates of the nuclear β decay that is relevant to the *r*-process nucleosynthesis (see the first one of "Key references" (KR)). Also, the fate of the so-called pion condensation in the neutron star strongly relies on it. Dr. Liang's new results suggest that conventionally believed pictures may have to be overridden. Besides, his most reliable computation with isospin corrections provides a firm reference for the Beyond-the-Standard-Model physics (quoted by PDG in Review of Particle Physics; see the second one of KR). Based on these expertizes, Dr. Liang is ambitious to frame a new understanding of pseudospin symmetry that has been an over-40-year puzzle since Prof. Arima pointed out (see the third one of KR). These are all epoch-making breakthroughs and further future developments are anticipated.

Key references (up to 3 key publications*)

- H. Liang, N.V. Giai, and J. Meng, "*Spin-isospin Resonances: A Self-Consistent Covariant Description*", Phys. Rev. Lett. 101, 122502 (2008).
- H. Liang, N.V. Giai, and J. Meng, "*Isospin corrections for superallowed Fermi β decay in self-consistent relativistic random-phase approximation approaches*", Phys. Rev. C79, 064316 (2009).
- H. Liang, S. Shen, P. Zhao, and J. Meng, "*Pseudospin symmetry in supersymmtric quantum mechanics: Schrödinger equations*", Phys. Rev. C87, 014334 (2013).

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

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

Name: **Prof. Kenji Fukushima**

Affiliation: **Department of Physics, The University of Tokyo**

Email / Telephone: **fuku@nt.phys.s.u-tokyo.ac.jp / +81-3-5841-4123**

Relation to the candidate:

Dr. Liang and I have known each other since we met at international conference some years ago. Then, we, the nuclear theory group at The University of Tokyo, have invited Dr. Liang to give a seminar talk on the spin-isospin excitations, which was quite impressing. Also, Dr. Liang recently gave a seminar talk to all the members of Department of Physics, The University of Tokyo, including researchers from various fields other than nuclear theory, which was very successful, I think, and I have decided to nominate him as a strong candidate for the Nishina Asia Award 2016.

Signature　　　　　　　　　　　Date　March 29, 2016

Nomination form for the 2016 Nishina Asia Award

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)
Prof. Li-Sheng Geng, School of Physics and Nuclear Energy Engineering, Beihang University, Beijing, China E-mail: lisheng.geng@buaa.edu.cn Tel: 86-10-82338376 Nationality: Chinese Employment : 2011.10-now, Beihang University, Professor of Physics 2009.10-2011.09, Technical University of Munich, Humboldt Research Fellow 2006.04-2009.09, Valencia University, Postdoc 2005.10-2006.03, ITP, CAS, Visiting Research Scientist. Education : 2001.09-2007.07, Peking University, Ph.D. candidate in Nuclear and Particle Physics 2002.10-2005.09, Osaka University, Ph.D. candidate in Nuclear and Particle Physics 1997.09-2001.07, Lanzhou University, Bachelor of Science
Citation for the Award (within 30 words)
For his contribution to the construction of the first complete nuclear mass table in the relativistic mean field theory and advancing the understanding of baryon magnetic moments and masses
Description of the work

Professor Li-Sheng Geng works on the development and application of covariant approaches in order to understand the structure of nuclei and nucleons. He constructed the first complete nuclear mass table based on the relativistic mean field theory, which provides key inputs to nuclear astrophysical simulations and to ongoing experimental efforts to study exotic nuclei. He discovered that a covariant formulation of the baryon chiral perturbation theory enables the solution of a long-standing puzzle in understanding the magnetic moments of the octet baryons. He showed that the latest state-of-the-art lattice QCD simulations of octet baryon masses can be nicely described in the covariant baryon chiral perturbation theory, and therefore allowing for a model independent prediction of the baryon sigma terms.

1) Professor Li-Sheng Geng performed the first comprehensive study of the ground state properties of atomic nuclei ranging from the proton drip line to the neutron drip line in the relativistic mean field theory, taking into account self-consistently deformation effects and pairing interactions. The resulting bulk properties are not only in good agreement with the then existing data, but also provide key inputs to nuclear astrophysical simulations and the ongoing experimental studies of exotic nuclei in facilities such as FRIB and RIBF. In addition, the systematic investigation sheds light on the relativistic mean field theory and leads to follow-up refinements essential to further improve the theoretical approach.

2) Chiral perturbation theory, as a low-energy effective field theory of QCD, has played an indispensable role in understanding low-energy strong interaction phenomena. On the other hand, a few troubling puzzles have arisen since 1990's that have casted doubts on its application in the one-baryon sector with u, d, and s three flavors. Professor Li-Sheng Geng discovered that the long-standing puzzle on the magnetic moments of the octet baryons can be solved in the covariant baryon chiral perturbation theory, thus paving the way for a deeper understanding of nucleons and their counterparts. In addition, he showed that the covariant baryon chiral perturbation theory can well describe the state-of-the-art lattice QCD simulations of the octet baryon masses with unphysical quark masses, and therefore allowing for a model independent prediction about baryon sigma terms, particularly the nucleon ones, which play an important role in our understanding of the quark flavor structure of the nucleons and in direct dark matter searches.

Key references (up to 3 key publications*)

1) Masses, deformations and charge radii: Nuclear ground-state properties in the relativistic mean field model, **Li-Sheng Geng**, Hiroshi Toki, Jie Meng, Prog.Theor.Phys. 113 (2005) 785-800
2) Leading SU(3)-breaking corrections to the baryon magnetic moments in Chiral Perturbation Theory, **L.S. Geng**, J. Martin Camalich, L. Alvarez-Ruso, M.J. Vicente Vacas, Phys.Rev.Lett. 101 (2008) 222002

3) Octet baryon masses in next-to-next-to-next-to-leading order covariant baryon chiral perturbation theory, X.-L. Ren, L.S. Geng, J. Martin Camalich, J. Meng, H. Toki, JHEP 1212 (2012) 073

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

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

Prof. Jie Meng, School of Physics, Peking University

E-mail: mengj@pku.edu.cn

Tel: 86-10-62757743

Relation to the candidate: Ph.D. advisor and long time collaborator

Signature ______ Date March 29, 2016

Nomination form for the 2016 Nishina Asia Award

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

Name: Yilong Han **Nationality:** Hong Kong, China

Email: yilong@ust.hk **Phone:** (852)-23587492

Affiliation: Physics Department, Hong Kong University of Science and Technology (HKUST)

Website: http://www.phys.ust.hk/yilong/

Associate Professor July 2013 – present

Assistant Professor August 2007 – June 2013

Department of Physics, Hong Kong University of Science and Technology, Hong Kong, China

Postdoctoral fellow January 2004 – August 2007 University of Pennsylvania, USA

Ph.D. in Physics September 1998 – December 2003 University of Chicago, USA

B.S. in Physics September 1994 – June 1998 Peking University (Beijing University), China

Research

Experimental Soft Condensed Matter Physics and Statistical Physics

Selected Publications (* denotes corresponding author) :

[13] B. Li, F. Wang, D. Zhou, Y. Peng, R. Ni and Y. Han*, Modes of surface premelting in attractive colloidal crystals, *Nature* **531**, 485 (2016). (highlighted in a *Phys.org* article)

[12] B. Li, D. Zhou and Y. Han*, Assembly and phase transitions within colloidal crystals, *Nature Reviews Materials* 1, 15011 (2016). (selected as the journal cover article)

[11] Z. Wang, F. Wang, Y. Peng, and Y. Han*, Direct observation of liquid nucleus growth in homogeneous melting of colloidal crystals, *Nature Communications* **6**, 6942 (2015).

[10] Y. Peng, F. Wang, Z. Wang, A. Alsayed, Z. Zhang, A. G. Yodh and Y. Han*, Two-step nucleation processes in solid-solid phase transitions, *Nature Materials* **14**, 101–108 (2015). (selected as the journal cover article)

[9] Z. Zheng*, R. Ni, F. Wang, M. Dijkstra, Y. Wang and Y. Han*, Structural signatures of dynamic heterogeneities in monolayers of colloidal ellipsoids, *Nature Communications* **5**, 3829 (2014).

[8] Z. Wang, F. Wang, Y. Peng, Z. Zheng, and Y. Han*, Imaging the homogenous nucleation during the melting of superheated colloidal crystals, *Science* **338**, 87 (2012). (editorially highlighted in a *Science* Perspective article, *Nature Materials* Research Highlights article and a *Physics Today* Search and Discovery article)

[7] Z. Zheng, F. Wang and Y. Han*, Glass transitions in quasi-two-dimensional suspensions of colloidal ellipsoids, *Phys. Rev. Lett.* **107**, 065702 (2011). (editorially highlighted as an *Editor's Suggestion* and in a Physical Review *Physics Viewpoint* article)

[6] Y. Peng, Z.-R. Wang, A. Alsayed, A. G. Yodh, and Y. Han*, Melting of colloidal crystal films, *Phys. Rev. Lett.* **104**, 205703 (2010). (editorially highlighted in a *Physical Review Focus* article)
[5] Y. Han*, Y. Shokef*, A. M. Alsayed, P. Yunker, T. C. Lubensky and A. G. Yodh, Geometric frustration in buckled colloidal monolayers, *Nature* **456**, 898-903 (2008). (editorially highlighted in a *Nature* News and Views article)
[4] Y. Han, A. M. Alsayed, M. Nobili, J. Zhang, T. C. Lubensky*, and A. G. Yodh, Brownian motion of an ellipsoid, *Science* **314**, 626-630 (2006).
[3] Y. Han and D. G. Grier*, Configurational temperature of charge-stabilized colloidal monolayer, *Phys. Rev. Lett.* **92**, 148301 (2004).
[2] Y. Han and D. G. Grier*, Confinement-induced colloidal attractions in equilibrium, *Phys. Rev. Lett.* **91**, 038302 (2003).
[1] Y. Han and D. G. Grier*, Vortex rings in a constant electric field, *Nature* **424**, 267 (2003); *erratum Nature* **424,** 510 (2003).

Awards HKUST School of Science Research Award 2012
Achievement in Asia Award (Robert T. Poe Prize) 2014
by the International Organization of Chinese Physicists and Astronomers (OCPA)

Citation for the Award (within 30 words)

For the outstanding contributions to our understanding of crystal melting, solid-solid transition and glass transition, especially their kinetics at the single-particle level through creative experimental investigations of colloids.

Description of the work

Prof. Han has made outstanding contributions to our understanding of phase transitions using novel colloidal systems. Micrometer sized colloidal particles in liquid suspensions exhibit stochastic Brownian motions that can be directly visualized using conventional optical microscopy and tracked conveniently by image processing methods. These “big atoms” can also assemble into various phases, similar to atoms in traditional hard condensed matter systems. Hence colloids are excellent model systems for studying phase transitions that occur ubiquitously in hard condensed matter but that are otherwise extremely difficult, if not impossible, to study by similar direct imaging methods because of the much shorter elementary length scale defined by atomic distances. Prof. Han’s work in this direction has opened the door to a much deeper understanding of phase transitions, especially poorly understood phenomena related to microscopic nucleation kinetics. In particular, his group recently achieved the first experimental observations of several phenomena at the single-particle level, including homogenous melting of a three-dimensional (3D) crystal [1], nucleation in a solid-solid transition [2], surface premelting, grain-boundary-mediated two-dimensional (2D) melting and isostructural solid-solid transition [3].

Previous studies of phase-transitions using colloidal systems were mainly carried out on repulsive colloids, which cannot form solid-vapor interfaces. One of Prof. Han's important contributions to the advancement of the field was the development of a novel type of colloid with attractive interactions that can be tuned by adjusting temperature. This new colloid can be used to model real atomic systems more faithfully than repulsive colloids because they can mimic realistic atomic attractions. Prof. Han's first breakthrough using attractive colloids was in the area of surface pre-melting, which occurs throughout nature, for example, during glacier movement and ice-skating. He and his research group found that monolayer and bilayer crystals exhibit qualitatively different pre-melting behaviors because of their different bulk melting and solid-solid transition behaviors via novel surface-bulk coupling [3]. They observed for the first time that a 2D crystal with free surfaces melts homogenously from both surfaces and within the bulk, contrary to the commonly held belief of a purely heterogeneous surface-mediated mechanism [3].

Prof. Han extended this work using repulsive colloid spheres to study other important phase transitions. He and his group achieved homogeneous melting in a colloidal crystal for the first time by superheating the interior of a defect-free crystal to avoid surface melting [1]. This lead to the key insight that the nucleation precursors are particle swapping loops rather than any previously assumed defects [1]. Under strong superheating conditions, they also discovered various fundamental deviations from classical nucleation theory. Prof. Han's work has also impacted on our understanding of solid-solid transitions. These transitions are of broad interest because they widely exist in the earth's mantel and throughout metallurgy, but the underlying kinetic processes are poorly understood. He and his group discovered rich kinetic pathways, some of which have not even been imagined before. For example, a superheated thin-film square lattice does not directly transform to the equilibrium triangular lattice, but firstly melts into a liquid nucleus, then recrystallize into a triangle-lattice nucleus [2]. They explained this phenomenon with a general mechanism that should similarly occur in some atomic crystals. Prof. Han also experimentally studied colloidal glasses composed of non-spherical particles for the first time and discovered that translational and rotational glass transitions can occur at different points.

Besides his outstanding achievements in experimental soft condensed matter physics, Prof. Han has carried out creative theoretical work. He mapped the exact state spaces of some frustrated spin systems and lattice gases to complex networks, and mathematically proved that the eigenvalue distributions of the connectivity matrices, i.e. the spectra of the networks, become Gaussian when systems are infinitely large. This is a remarkable insight because exact and general results about high-dimensional phase space are very limited.

Prof. Han also made many novel discoveries as a student and postdoc. He made analogy between certain confined colloidal spheres and spins for the first time, which opens the door to mimic spins with colloids. His experimental and theoretical work on Brownian motion of a single ellipsoid has been discussed in an undergraduate textbook 《Statistical Mechanics》, 3rd Edition by Pathria and Beale. He experimentally tested the configurational temperature for the first time and theoretically derived a serious of hyper-configurational temperatures. He also discovered a large zoo of colloidal convection patterns in electric fields.

Prof. Han's experiments greatly expand our understanding of the microscopic kinetics of melting and solid-solid transitions, which are of fundamental importance for materials science and metallurgy. His publications are frequently editorially highlighted for their significance. He is one of the leading scientists working in soft condensed matter of his generation whose work impacts knowledge far outside of his own field, and therefore Prof. Han has my strongest recommendation for the prestigious Nishina Asia Award.

Key references (up to 3 key publications*)

1. B. Li, F. Wang, D. Zhou, Y. Peng, R. Ni and Y. Han*, Modes of surface premelting in attractive colloidal crystals, *Nature* **531**, 485 (2016).
2. Y. Peng, F. Wang, Z. Wang, A. Alsayed, Z. Zhang, A. G. Yodh and Y. Han*, Two-step nucleation processes in solid-solid phase transitions, *Nature Materials* **14**, 101–108 (2015). (cover article)
3. Z. Wang, F. Wang, Y. Peng, Z. Zheng, and Y. Han*, Imaging the homogenous nucleation during the melting of superheated colloidal crystals, *Science* **338**, 87 (2012).

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

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

Prof. Michael Altman
Head, Department of Physics
Hong Kong University of Science and Technology
Email: phaltman@ust.hk
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Relation to the candidate: administrative supervisor

Signature [signature] Date 30 March 2016

Nomination form for the 2016 Nishina Asia Award

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)
Dr. Bijaya Kumar Sahoo, Associate Professor at Theoretical Physics Division, Physical Research Laboratory (PRL), Ahmedabad-380009, India e-mail: bijayakumar.sahoo@gmail.com telephone: 0091 79 2631 4455 Nationality: India Doctor of Philosophy (Atomic Physics): Indian Institute of Astrophysics, India, January 2000-September 2005 Master of Science (Particle physics as special subject, First class): Utkal University, India, September 1997 - August 1999 Bachelor of Science (Physics Honors, First class with "Distinction"): Nayagarh college, India, August 1994 - May 1997
Citation for the Award (within 30 words)
For his central contributions in the development of Relativistic Coupled Cluster (RCC) method in many body system and in its applications to parity violation effect and time violation effect in atoms.
Description of the work
Dr. Sahoo developed a novel many-body approach in a relativistic coupled-cluster (RCC) framework. The many-body wave function in RCC is expressed in terms of hole-particle excitations and at every level of excitation, correlation effects to all orders of perturbation (difference of exact two body potential and the mean field potential) are included. Therefore RCC is equivalent to Relativistic Many-Body Perturbation Theory to all orders of perturbation. Unlike some many-body methods, the RCC method is size extensive; i.e. the energy calculated by RCC scales correctly as the number of particles in a system increases. RCC deals with two very different fundamental interactions --the usual electromagnetic interactions in an atom and the neutral current weak interaction between the atomic electrons and the nucleus. A proper treatment of the interplay of those two interactions is very challenging, and the RCC has been applied to Ba^+ (Phys. Rev. Lett. 96, 163003 (2006)) and to Ra (Phys.Rev. A92, 022502 (2015)), It is possible to extract the nuclear weak charge and compare with the Standard Model (SM). Also he obtained the CP violating electric dipole moment (EDM) enhancement factor K for Thallium (Phys.Rev.Lett. 106, 20040 (2011)), K=EDM(Thallium)/EDM(electron). Many New Physics beyond the SM suggest large

electron EDM (10^8-10^10 times larger than the SM prediction) and it will be expected to be found in atoms or molecules in enhanced form. So precise calculation of K is crucially important.
In addition, Dr Sahoo has employed variants of RCC method, that are developed to study hyperfine interactions, oscillator strengths, isotope shifts, nuclear moments, lifetimes of atomic states etc. in a very creative way. These studies have important applications in nuclear physics and astrophysics.

Key references (up to 3 key publications*)

*) Phys. Rev. Lett. 96, 163003 (2006)
Phys.Rev. A92, 022502 (2015)),
Phys.Rev.Lett. 106, 20040 (2011))

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

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

Takeshi Fukuyama,
Former Professor at Ritsumeikan University,
Present position: Cooperative Researchers at Osaka Univ. Research Center of Nuclear Physics (RCNP).
I met Dr. Sahoo first when I was a member of Kakenhi, "Fundamental Physics Using Atom" (FPUA). He was invited to the Conference of FPUA in Japan and to the Sakemi-san's group for collaboration, several times. (Their result is Ref. arXiv:1512.02055 to appear in Phys Rev.A)
This indicates his position in the development of RCC method.
I have been maily concerned with FPUA on the electric dipole moment of leptons and hadrons (I reviewed EDM in Int.J.Mod.Phys. A27 (2012) 1230015).
At writing this review I knew that he studied the enhancement of d_e in $d(Thallium)$ using RCC method. At that time there was some discrepancies of this factor between their group and the other group of Dzuba and Frambaum, and I. myself, checked this point and discussed with Sahoo when he was in Japan. Indeed this discrepancy was found to come from the initial condition of valence electron and their method was proved to be reliable.
He organized the International Conferences, "CP Violation in Elementary Particles and Composite Systems " at Mahabaleshwar on 7-23 Feb. 2013 and "Exploring Fundamental Physics using Atomic System (EFPAS 2015)" at his Institute (PRL), Ahmedabad on May 6-May 8 2015. I attended at both conferences and am so impressed with his ability and warm personality.
Undoubtedly he is one of the most outstanding young scientists in particle and composite systems in the world.

Signature Takeshi Fukuyama Date March 22 2016

Nomination form for the 2016 Nishina Asia Award

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)
Name: BIJAYA KUMAR SAHOO AFFILIATION: Theoretical Physics Division Physical Research Laboratory Navrangpura, Ahmedabad 380009 Gujarat, India Date of PhD degree: 25-03-2006 Nationality: INDIAN Address: D-09, PRL Residences, Vikramnagar, Ahmedabad 380058, Gujarat, India Email: bijaya@prl.res.in/bijayakumar.sahoo@gmail.com Telephone: 0091 97 26046778 (Mobile) 0091 79 2631 4455 (O) 0091 79 2686 0104 (R) Please find enclosed CV in PDF.
Citation for the Award (within 30 words)
For his groundbreaking work on the theory of parity and time-reversal violations in atoms and its applications to searches of physics beyond the Standard Model of particle interactions.
Description of the work
Dr. Bijaya Sahoo has made seminal contributions to a wide range of problems in fundamental atomic physics. The topic of his PhD thesis, relativistic many-body theory of parity non conservation (PNC) in atomic ions is still of great contemporary importance. It can be combined with high accuracy PNC measurements of atomic ions to probe new physics beyond the Standard Model. He developed for the first time a theory of PNC in atomic systems based on the relativistic coupled cluster theory (RCC), which is currently the most powerful relativistic many-body theory for atoms, and used it to calculate the PNC amplitude in Ba^{+}. to an accuracy of less than 1% (PRL 96, 163003 (2006)). This result when combined with the results of ongoing experiments on Ba^+ PNC would yield a quantity known as the weak charge. A discrepancy in the values of the weak charge obtained by this approach and the Standard Model, would constitute an important test of the Standard Model. The theory developed by Dr Sahoo incorporates in a very ingenious way two very different fundamental interactions; the electromagnetic and the neutral current weak interactions simultaneously in an atomic system. He has also used this theory to evaluate the PNC amplitudes for systems for which experiments are either underway or planned, i.e.. Cs, Fr, Ra^+ and Yb^+ and the results have been published in leading international journals. Dr. Sahoo has reformulated his theory for PNC and creatively applied it to electric dipole moments (EDMs) of atoms arising from parity and time-reversal violations. Using this theory, he has obtained new limits on the electron EDM and the coupling constant for CP violating scalar-pseudoscalar interaction in Tl which have shed light on new physics beyond the Standard Model and our understanding of matter-antimatter asymmetry in the Universe. These results were published in PRL and PRA Rapid Communication. Earlier, his pioneering work on the

determination of EDM enhancement factors in Rb and Cs was published in PRL. He has very recently in collaboration with experimenters fron the University of Tokyo and Tohoku University proposed a new experiment to unambiguously observe the nuclear anapole moment, a new fundamental property of the nucleus which can provide valuable information about nuclear parity nonconserving forces. This experiment will be performed at CYRIC, Tohoku University. His latest relativistic many-body work on Hg EDM of closed-shell atoms provides rigorous limits on hadronic and semi-leptonic CP violating couplings, which constrain the parametric space of certain supersymmetric models. His insightful theoretical analysis of the EDMs of other closed shell atoms (Xe and Rn) could be combined with future experiments on these atoms to confirm the information obtained from Hg. The results he obtained for these atoms have also been published as Rapid Communications in Phys. Rev. A.

Dr. Sahoo's work has advanced several areas of atomic, molecular and optical (AMO) theory including atomic clocks. He has performed high precision calculations to estimate important systematic errors of many novel atomic clocks. He has also demonstrated the potential of several new candidates for atomic clocks that are capable of replacing the present Cs primary frequency standard on the basis of his innovative theoretical investigations. In fact, he has shown recently that the experimentally determined quadrupole shift of the octupole clock transition in Yb^+ is inconsistent with high precision many-body results and has suggested further experimental verification. The majority of his studies on atomic clocks have been reported either in PRL or Rapid Communications in PRA. He has also developed special theoretical methods to investigate possible temporal variation of the fine structure constant in combination with astrophysical observations and atomic clock frequencies.

Dr Sahoo's commitment to the highest standards of research is reflected in his more than 95 peer reviewed papers in the leading journals of physics that include several single author papers, four Phys. Rev. Lett., sixteen Rapid Communications in Phys. Rev. A, one Fast Track Communication in J. Phys. B etc. He was also invited to write a book chapter on atomic clocks for the Handbook on Relativistic Quantum Chemistry of Springer Publication. He has received several awards both in India and abroad in recognition of his superlative research achievements. He has also given numerous invited talks in leading international conferences and workshops on atomic physics. He has undoubtedly made the most important theoretical contributions in advancing the field of parity and time-reversal violations in atoms in recent years. As a matter of fact he is widely considered to be one of the leading atomic many-body theorists in the world. This is indeed remarkable considering that he is only 38 years of age. In view of his outstanding research contributions to theoretical fundamental atomic physics and his high international standing, he undoubtedly deserves to be be awarded the Nishina Asian Award 2016.

Key references (up to 3 key publications*)

1. *B. K. Sahoo, R. K. Chaudhuri, B. P. Das and D. Mukherjee, Relativistic Coupled-Cluster Theory of Atomic Parity Nonconservation: Application to $137Ba^+$, Phys. Rev. Lett. 96, 163003 (2006).

2. H. S. Nataraj, B. K. Sahoo, B. P. Das, and D. Mukherjee, Intrinsic Electric Dipole Moments of Paramagnetic Atoms: Rubidium and Cesium, Phys. Rev. Lett. 101, 033002 (2008).

3. Y. Singh and B. K. Sahoo, Rigorous Limits on the Hadronic and Semileptonic CP-Violating Coupling Constants from the Electric Dipole Moment of ^{199}Hg, Phys. Rev. A 91, 030501(R) (2015).

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

Nominator (name, affiliation, email, telephone and relation to the candidate)
Name: Koichiro Asahi Affiliation, e-mail, telephone: (until 31 March 2016) Department of Physics, Graduate School of Science and Engineering, Tokyo Institute of Technology, E-mail asahi@phys.titech.ac.jp, Phone 03-5734-2455 (from 1 April 2016) RIKEN Nishina Center for Accelerator-Based Science, RIKEN, E-mail asahi@riken.jp, Phone 048-462-1111 ext. 4752, 080-2112-4743 Relation to the candidate: Researcher in the research field common to the candidate.
Signature *Koichiro Asahi* Date *30 March 2016*

Nomination form for the 2016 Nishina Asia Award

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)
Name: Bijaya Kumar Sahoo Affiliation: Associate Professor, Theoretical Physics Division, Physical Research Laboratory (PRL), Ahmedabad 380009, India Curriculum vitae: - Ph.D.: Indian Institute of Astrophysics, India, September 2005 (Thesis title: "Coupled-cluster theory of parity non-conservation in atoms") - Nationality: India - Address: Navrangpura, Ahmedabad-380009, India - Email: bijaya@prl.res.in - Telephone: 0091 79 26314455
Citation for the Award (within 30 words)
The candidate have developed a novel many-body atomic theory in a relativistic coupled-cluster framework and performed most accurate calculation of the electron electric dipole moment of an atomic system.
Description of the work
Dr B. K. Sahoo's Ph.D. thesis work probes the standard model (SM) of elementary particle physics via sophisticated high precision atomic calculations. He has developed a novel many-body approach in a relativistic coupled-cluster (RCC) framework that deals with two very different fundamental interactions, namely the usual electromagnetic interactions in an atom and the neutral current weak interaction between the atomic electrons and the nucleus, which has been published in Phys. Rev. Lett. 96, 163003 (2006) and it has already been cited 35 times. He has also performed high accuracy calculations for the parity non-conservation (PNC) observable in singly ionized, which is being considered for the observation of PNC at the University of Washington, Seattle, USA. The method he has developed has been later employed to determine the PNC results accurately in many atomic systems including in Ra+ that has been cited 48 times. Recently, he has also demonstrated a procedure for inferring signature of possible existence of nuclear anapole moment (NAM) of Fr atom in collaboration with our group at Cyclotron and Radioisotope Center, Tohoku University, Japan. As a part of his thesis work, Dr. Sahoo has also obtained a new limit to the coupling constant for a parity and time reversal violating scalar pseudoscalar interaction in Tl electric dipole moment (EDM) calculations which can deepen our understanding of semi-leptonic CP violation with

important implications for new physics beyond the SM; this work was published as a Rapid Communication in Phys. Rev. A. It also paved the way for the determination of the enhancement factors of the EDMs of Rb and Cs arising from the EDM of the electron. This work was published in Phys. Rev. Lett. and has been cited by 27 times. Recently, he has also performed very sophisticated calculations to extract best limits on the Theta_QCD parameter, chromo EDMs of up and down quarks and coupling coefficient related to tensor-pseduotensor interaction between electron and quarks. These results are published as Rapid Communication in Phys. Rev. A.

Dr Sahoo's commitment to the highest standards of research are reflected in his more than 95 peer reviewed papers in the leading journals of physics that include many single author papers, 4 Phys. Rev. Letts., 16 Rapid Communications in Physical Review A, 1 Fast Track Communication in J. Phys. B etc. He was also invited to write a book chapter on atomic clocks which will appear soon in the Handbook on Relativistic Quantum Chemistry of Springer Publication. He has received several awards both in India and abroad in recognition of his achievements. He has guided successfully two PhD students who are now working outside India on postdoctoral fellowships and assisted several PhD and Masters students to carry out projects in collaboration with him. He has been teaching to the PhD students at Physical Research Laboratories since he joined that institute. He is widely considered to be one of the leading atomic many-body theorists in the world.

Key references (up to 3 key publications*)

(1) B. K. Sahoo, R. K. Chaudhuri, B. P. Das and D. Mukherjee, "Relativistic Coupled-Cluster Theory of Atomic Parity Nonconservation: Application to 137Ba+", Phys. Rev. Lett. 96, 163003 (2006).

(2) B. K. Sahoo and B. P. Das, "Parity nonconservation in ytterbium ion", Phys. Rev. A 84, 010502(R) (2011).

(3) B. K. Sahoo, D. K. Nandy, B. P. Das and Y. Sakemi, "Correlation trends in the hyperfine structure of 210,212Fr", Phys. Rev. A 91, 042507 (2015)

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

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

Name: Yasuhiro Sakemi

Affiliation: Professor, Cyclotron and Radioisotope Center, Tohoku University

E-mail: sakemi@cyric.tohoku.ac.jp

Telephone: +81-22-795-7795

Relation to the candidate:

Dr. B.K. Sahoo is the important collaborator from theoretical side on our experimental project about the search for the permanent electric dipole moment (EDM) using laser cooled radioactive atoms at CYRIC. To calculate the enhancement factor of the electron EDM to heavy atoms such as Francium is most important to extract the EDM with highest accuracy, and Dr. Sahoo's theoretical method 'Relativistic Coupled Cluster theory' is needed for this type of studies. We started the collaboration from the international workshop on Violation of discrete symmetries in atoms and nuclei in 2010 at Trento, Italy. We also applied JSPS - INSA Bilateral Cooperation Program of JSPS from 2013 to 2015. We have already 2 publications with the collaboration.

Signature *Yasuhiro Sakemi* Date 31-March, 2016

Nomination form for the 2016 Nishina Asia Award

Candidate (name, affiliation, curriculum vitae including the date of the degree of Ph.D., nationality, address, email and telephone)
B. K. Sahoo, Present appointment: Associate Professor Address: Theoretical Physics Division, Physical Research Laboratory (PRL)Navrangpura,Ahmedabad-380009, Tel. No.: 0091 79 26314455(O) email:bijaya@prl.res.in Nationality: Indian Curriculum vitae Education Bachelor of Science: Nayagarh college, India August 1994-May1997 Master of Science: Utkal University India September 1997-August 1999 Doctor of philosophy: Indian Institute of Astrophysics, January 2000-September 2005 Ph.D. Indian Institute of Astrophysics, 2005 Past appointments Guest scientist GSI, Darmstadt, Germany –March 2006 Postdoctoral fellow: Max-Planck Institure, Dresden, Germany April 2006- March 2008 Postdoctoral fellow: KVIm RuG University, Groningen, the Netherlands March 2008-June 2010 Reader: Theoretical Division, PRL, June 2010 – June 2013 Awards Young international scientists fellowship award from the Chinese Academy of Sciences 2010 INSA medal for young scientists award from the Indian National Science Academy 2012
Citation for the Award (within 30 words)

groundbreaking works on theoretical aspects of atomic physics to guide exploration beyond the standard theory of particle physics such as atomic parity violation and search for EDM(electric dipole moment) of atoms

Description of the work

Atomic system has played crucial roles in establishing the standard electroweak theory and is expected to give hints on the search for physics beyond the standard theory. Dr. Sahoo's works are directed to this direction. He is one of very few physicists in the world who are capable of advancing this frontier.
Dr Sahoo's work in Phys. Rev. Lett. 96, 163003 (2006) based on his Ph.D. dissertation is of great contemporary importance. It probes the standard model (SM) of elementary particle physics via sophisticated high precision atomic physics. During the course of this work, he has developed a novel many-body approach in a relativistic coupled-cluster (RCC) framework that deals with two very different fundamental interactions, the usual electromagnetic interactions in an atom and the neutral current weak interaction between the atomic electrons and the nucleus.
He has also performed high accuracy calculations for the parity non-conserving (PNC) observable in singly ionized atom Ba^+, which is being considered for the observation of PNC at the University of Washington. The achieved accuracy of calculation is typically of order 1 % or less. The method he developed has further been employed to determine the PNC results in many atomic systems including in Ra+ . Recently, he has also demonstrated a procedure for inferring signature of possible existence of nuclear anapole moment (NAM) of Fr atom in collaboration with scientists from Tohoku University, Sendai.
Dr. Sahoo has obtained a new limit to the coupling constant for parity and time reversal violating scalar pseudo-scalar interaction in Tl electric dipole moment (EDM) calculations which can deepen our understanding of semi-leptonic CP violation with important implications for new physics beyond the SM; this work was published in Rapid Communication in Phys. Rev. A. It also paved the way for the determination of the enhancement factors of the EDMs of Rb and Cs arising from the EDM of the electron. Recently, he has also performed very sophisticated calculations to extract best limits on the $¥theta_{QCD}$, chromo EDMs of up and down quarks and coupling coefficient related to tensor-pseduo-tensor interaction between electron and quarks.
Dr. Sahoo's work has advanced several areas of Atomic, Molecular and Optical (AMO) theory including atomic clocks by performing high precision calculations to estimate important systematic errors of many novel atomic clocks. He has also demonstrated the potential of several new candidates for atomic clocks that are capable of replacing the present Cs primary frequency standard on the basis of his innovative theoretical analysis. In fact, he has shown recently that the experimentally determined quadrupole shift of the octupole clock transition in Yb+ is inconsistent with theoretical result and argued for its further verification. Most of his clock studies are reported

either in PRL or PRA as Rapid Communication. Following this work, he has demonstrated an ideal geometric configuration of an ion trap to minimize in the measurements of quadrupole moments of states that are involved in the Yb+ ion clocks. He has also used his methods to investigate possible temporal variation of the fine structure constant in combination with the astrophysical observations and atomic clock frequencies.

These papers are of outstanding quality and helped much to experimental projects using atoms.

Key references (up to 3 key publications*)

1. Phys. Rev. Lett. 96, 163003 (2006)
2. Phys. Rev. A 79, 052512 (2009).
3. Phys. Rev. Lett.106, 200403 (2011).

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

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

Motohiko Yoshimura, Research Center of Quantum Universe, Faculty of Science, Okayama University

Email address: yoshim@okayama-u.ac.jp

Telephone: 086-251-8499

I had many chances to become familiar with theoretical atomic physicists in the world, since I have been involved in atomic physics experiments at Okayama to explore unknown properties of neutrinos. In particular, we invited young world-top atomic physicists in the world to International conferences we organized in Japan. Sahoo was one of the best among them. We also invited him to give a talk in our seminar at Okayama and discussed many issues related to our project. Dr. Sahoo showed in these occasions his great talent to communicate his professional skills to non-experts.

Signature 吉村太彦 Date March 30, 2016