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## NEW SIGN UNVEILED AT THE NANDA CAMPUS

**O**n the first of November 2016, National Hsinchu University of Education (NHCUE) formally merged with NTHU and renamed as the Nanda Campus of NTHU. On January 11 of this year a new name plaques at the entrance of the Nanda Campus were jointly unveiled by six past and present presidents of the two schools: Frank Shu, Wen-tsuen Chen, Lih-juann Chen, and Hong Hocheng of NTHU; and Hsian-cheng Tseng and Hwei-pang Chen of the former NHCUE. Underneath the main gateway that is topped with the Chinese characters of NTHU, the six presidents jointly removed a red curtain to reveal the new plaques, a historical

moment in the development of NTHU.

"Thanks to your concerted efforts and enthusiastic cooperation, we finally kick the ball into the goal," announced Hocheng, the incumbent president of NTHU. With the participation of both past and present university presidents, the ceremony highlighted that school mergers require an integration of education policy and institutional restructuring, the success of which relies on the joint efforts of administrators, faculty, and students.

President Hocheng recalled that during the past two years he often met with President Hwei-pang Chen to discuss the merger. Chen entered NHCUE at the age of 16 as a student, and eventually became its president. Recalling such discussions, Chen said that, "As an alumnus, I once vowed to oppose the merger; but as a president, it was my duty to support it to the best of my ability."

Chen also said that he was especially grateful to Hocheng for assuming the major responsibility for the merger, adding in German *Ende gut, alles gut*, (All's well that ends well), since Hocheng was once a student in Germany. Comparing the ten-year merger process to a two-person-three-legged relay race, Chen thanked all the presidents who were present at the ceremony, saying, "It is your wisdom and courage that has made it possible to bring this race to a successful completion," adding that it is equally important that we shall continue at



All six past and present presidents of NTHU and NHCUE have their thumbs up to celebrate the successful merge.



All six past and present presidents of NTHU and NHCUE have their thumbs up to celebrate the successful merge, jointly unveiling the new name plaques at the entrance of the Nanda Campus of NTHU. From left to right: Wen-tsuen Chen, Hsiancheng Tseng, Hong Hocheng, Hwei-pang Chen, Frank Shu, and Lih-juann Chen.

the same level of effort and cooperation so that we can make this merger a greater success.

The plan to merge these two universities was first formulated when Frank Shu was the president of NTHU and Hsiancheng Tseng was the president of NHCUE. Looking back at the long and arduous process, both are highly satisfied to see that the plan has finally been brought to fruition.

"It's a great pleasure to see that the merger is finally complete," exclaimed Shu. He explained that in Taiwan the merger of two universities is not an easy task, due to limitations of personal vision and the entrenched viewpoints of different disciplines, whether science, engineering, or humanities. Thus for Shu the merger is a good opportunity to restructure the education system in Taiwan and to facilitate interdisciplinary cooperation. In Shu's estimation, "Our success will have a great impact on the entire university system in Taiwan."

Tseng compared the merger to the film *The Guns of Navarone*, in that it was a cooperative effort which brought mutual benefit to all concerned parties, rather than one school rescuing another, adding that, "One thing that really motivated me was that NTHU would have the best colleges of education and art among all universities in Taiwan."

In expressing his enthusiasm for the merger, Wen-tsuen Chen stated, "Once you've got your sights set on the right goal, all that remains is to keep moving in that direction!" He said that children's education is very important, and that the merger will ensure that NHCUE's tradition of excellence in the training of primary and secondary school teachers is sure to be continued at NTHU.

Wen-tsuen Chen also mentioned that NTHU initially emphasized science and engineering, and later established its Colleges of Technology Management, Humanities and Social Sciences, and with the addition of the Colleges of Education

and Arts, NTHU finally has the scope of a world-class comprehensive research university.

Lih-Juann Chen graduated from the Experimental Elementary School of NHCUE. He mentioned that he has lots of memories of those happy, carefree days, especially the many foreign visitors at the school, some of whom he interviewed in his capacity as a student reporter. He also said that he expects that the addition of NHCUE's colleges of education and arts will go a long way in making NTHU one of the top universities in the world.

The presidents also thanked the project's administrative team for their hard work over the past ten years, especially the two vice presidents, Hwai-pwu Chou of NTHU and Chi-hui Lin of NHCUE, who should be regarded as the "chief engineers" of the merger. President Hocheng said that there was a stretch of time when the seven-member team from the two schools met and worked overtime almost every week, despite regular protestations from their families.

Prior to the name change, on weekends and holidays quite a few NHCUE alumni were seen at the main gate taking souvenir photos before the old sign "Hsinchu University of Education" was taken down. After being removed, the old sign was properly packed and sent to the university archives for permanent preservation.



## FOUR NTHU PROFESSORS RECEIVE THE MINISTRY OF EDUCATION'S ACADEMIC AWARD

The Ministry of Education recently announced the recipients of the 60<sup>th</sup> Academic Award, amongst whom are four NTHU faculty members: Prof. Kingman Cheung of the Department of Physics, Prof. Jang-ping Sheu of the Department of Computer Science, Prof. Kuang Mei of the Department of Linguistics, and Prof. Sheng- tsiang Tseng of the Institute of Statistics.

### **Kingman Cheung: Outstanding Contributions in Collider Physics and Electroweak Symmetry Breaking**

Prof. Kingman Cheung completed his Ph.D. in physics in 1992 at the University of Wisconsin-Madison and in August 2003 joined NTHU's Physics Department. His research focuses on theoretical particle physics and particle physics phenomenology, especially their application in colliders.

Prof. Cheung's research centers on the most fundamental questions in physics: the origin of mass, a unified theory of energy, the structure of space-time, and the properties of dark matter. To date, over 160 of his research papers have been published in leading academic journals, including eight

published by *Physical Review Letters*.

In recognition of his many accomplishments in collider physics and electroweak symmetry breaking, he was awarded the Thomson-Reuter Research Front in 2011 and elected as a fellow of the American Physical Society in 2013. In 2016 he received the Ministry of Science and Technology's Outstanding Research Award.

Upon receiving this award, Prof. Cheung thanked his colleagues at the Department of Physics for sharing his teaching and administrative duties so that he could give full attention to his research. In addition, he thanked his colleagues for their invaluable collaborations, especially Professors Tzu-Chiang Yuan of Academia Sinica, Wai-Yee Keung of University of Illinois at Chicago, Jae-Sik Lee of Korea, and Po-Yan Tseng, Chih-Ting Lu and Jung Chang. Without the hard works and contributions of these people, he would not have the present achievements.

He also thanked his wife and daughter for their encouragement, support, and understanding. Finally, he acknowledged the special grace of God in all his achievements, adding that he plans to dedicate his future research to the glory of God.



Professor Kingman Cheung of the Department of Physics.



## Jang-ping Sheu: Internationally Acclaimed Researcher on Wireless Networks

Prof. Sheu earned his doctorate in computer science at NTHU in 1987. He specializes in the Internet of things and wireless networks, and has garnered international acclaim for his work in the areas of wireless communications and mobile computing. As a result of his many accomplishments in the field of computer science, he has won three Outstanding Research Awards from the Ministry of Science and Technology, the Distinguished Engineering Professor Award of the Chinese Institute of Engineers, the K.T. Li Breakthrough Award of the Institute of Information & Computing Machinery (IICM), the Y.Z. Hsu Scientific Chair Professorship, and the Pan Wenyuan Outstanding Research Award; in 2009 he was elected fellow of the Institute of Electrical and Electronics Engineers (IEEE). In addition to presenting his research at numerous conferences and in many well-known international journals, Sheu has made

many outstanding contributions in the areas of technology transfer and software and hardware system implementation. Octopus, a wireless sensor hardware series designed by Sheu and transferred to a number of manufacturers, won the 2012 NTHU Outstanding Contribution Award for Industry-Academia Cooperation. In 2011 and 2013 his teaching materials on wireless sensor networks won the Excellent Award from the Ministry of Education's Pilot Program to Promote Network Communication Talent. Sheu said that receiving this most recent award is a major encouragement and affirmation of the research he and his research team have been conducting for the past three decades. He also expressed gratitude to NTHU for providing a supportive research environment, and to his family for their companionship and steadfast support.



**a** Professor Jang-ping Sheu of the Department of Computer Science.

**b** Professor Emeritus Kuang Mei of the Department of Linguistics.

## Kuang Mei: Eminent Scholar of Sinology and Chinese Grammar

After earning his Ph.D. in Linguistics from Harvard University in 1972, Kuang Mei returned to teach in Taiwan. Since then, apart from taking a leave to teach at the Chinese University of Hong Kong for 2 years and various short-term teaching appointments at foreign universities, he has devoted all his effort to the promotion of sinology and linguistic studies in Taiwan.



When NTHU set up the Department of Chinese Language and Literature in 1980, Mei was appointed as its first chair. Afterwards, he was actively involved in the establishment of a number of other liberal arts departments at NTHU, including the Department of Foreign Languages, the Institute of History, and the Institute of Linguistics.

Mei's academic research can be divided into linguistics and sinology. In the field of linguistics, together with Prof. Ting-chi Tang, Mei pioneered the application of syntactic theory to the field of Chinese grammar. During the 1980s Mei conducted a number of surveys which shed new light on the syntax of the aboriginal languages of Taiwan. In the 1990's, he conducted extensive fieldwork on the Tibeto-Burman

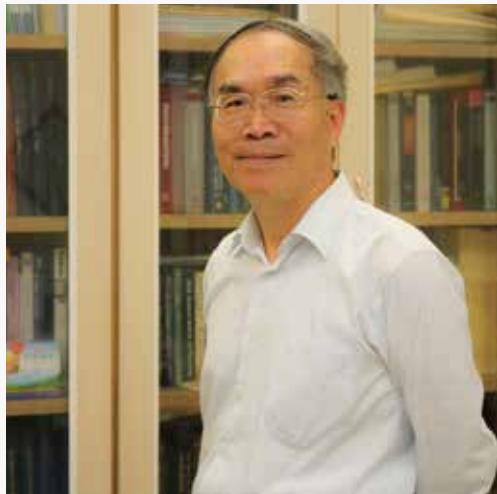
languages in northwestern Yunnan.

With a background in Chinese literature, Mei has extensive knowledge of ancient books, especially the philological literatures of the pre-Qin period. Following his retirement, he spent three years writing his latest book, *A Survey of Ancient Chinese Grammar*, which summarizes the results of his decades of research on the syntactic structure of Chinese, Austronesian, and Tibeto-Burman.

In his acceptance speech Prof. Mei said that he is honored to receive this award. He also indicated that since linguistics has established a solid foundation in Taiwan, he hopes that more distinguished scholars could be recognized for their research efforts, so that the general public will have a greater understanding of the field of linguistics.

### **Sheng-tsaing Tseng: Statistical Methodologies and Applications in High-tech Industry**

After obtaining his doctoral degree in Management Sciences from Tamkang University in 1982, Tseng taught at the National



Professor Sheng-tsaing Tseng of the Institute of Statistics.



Taiwan Institute of Technology (now the National Taiwan University of Science and Technology). In 1995, he joined NTHU Institute of Statistics. Tseng won three Outstanding Research Awards by the National Science Council. In addition to his teaching and research, he currently serves as an Associate Editor of *Technometrics*, an important journal in the field of industrial statistics.

Tseng's main research areas include reliability analysis and run-to-run process control. As for the former, in his work on assessing the lifetime information of highly-reliable products, he has constructed the Exponential Dispersion (ED) degradation model to investigate the optimal design of an accelerated degradation test (ADT) for highly-reliable products (including the determinations of stress levels, sample sizes, and termination times). This ED model provides a systematic approach to testing the lifetime of highly-reliable products. In addition, for the IC manufacturing processes involving a multi-input and multi-output dynamic model, Tseng has constructed the MEWMA feedback controller and the major contribution of this controller is that the global stability conditions can be easily satisfied even when the process dynamic and disturbance dynamic occurred simultaneously. Prof. Tseng said that he is honored to receive this recognition for his research, and thanked the Ministry of Science and Technology and the Ministry of Education for their financial support. He also thanked his family for their ongoing support and care. Finally, Tseng said that he is most grateful to all the students he has directed, adding that "To work with this group of talented students to achieve excellent research results is the driving force of my research projects."



## THREE NTHU FACULTY MEMBERS WON MOE'S NATIONAL CHAIR PROFESSORSHIP

The Ministry of Education announced the nine recipients of the 20<sup>th</sup> National Chair Professorship, amongst them are three faculty members of NTHU: Professors Wang Sue-Lein of the Department of Chemistry, Kwo J. Ray-nien of the Department of Physics, and Chang Cheng-shang of the Department of Electrical Engineering.

### **Wang Sue-Lein: Breakthroughs in the Fluorescence Properties and the Synthesis of Crystalline Nanoporous Inorganic Framework Materials**



Professor Wang Sue-Lein.

After receiving her doctorate in chemistry at Iowa State University in 1985, Wang completed her postdoctoral research at the Exxon Company and returned to teach at NTHU's Department of Chemistry in 1986. Wang's research expertise is nanoporous inorganic framework solids; she has made numerous breakthroughs and demonstrated great impact in leading research in the field of crystalline porous materials. This is the second time that Prof. Wang won the National Chair Professorship.

Wang's laboratory is using mild hydrothermal methods with varied solvent systems, including deep eutectic solvents, to explore novel intra-crystalline nanoporous solids to elucidate structure-property relationships. Her work is widely respected across the synthetic porous solids community as being of the highest quality. Her major contributions are: (1) discovery of activator-free porous solids to emit intense photoluminescence to launch unprecedented lanthanide-free phosphor materials for LED devices; and (2) unearthed the very first crystalline mesoporous structure and achieving rational design synthesis of crystalline channels using surfactant-type templates, which is a long-standing challenging problem in the field of porous materials science, but it has long been hampered by misconceptions.

Wang has published nearly three hundred SCI journal papers and holds six patents on phosphor materials; her many breakthroughs in the field have greatly enhanced enhance the academic reputation of NTHU and Taiwan. In her acceptance speech, Prof. Wang said that she is very grateful to her



students for their creativity and prudent attitude in research, she looks forward to more innovations in practically useful novel porous materials.

### **Kwo J. Raynien: Passion for Knowledge, Striving for Excellence, and Lifelong Learning**

Prof. Kwo's research work centers on novel thin film materials via the inventions of advanced thin growth techniques, and explorations of their unique physical properties for potential applications in nanoelectronics, superconductivity and spintronics. From 1981 to 2003 she has engaged in fundamental forefront physics research at the world renowned Bell Labs, New Jersey, United States, during which time she received worldwide recognitions for a series of groundbreaking discoveries and innovations. In 2003, Kwo returned to Taiwan with her husband, Professor Minghwei Hong, and was appointed as a Distinguished Chair Professor at NTHU in 2008. Currently she serves as the Vice President of Research and Development at NTHU.

Kwo specializes in experimental condensed-state physics over forty years. She has invented molecular epitaxy techniques for metals and oxide thin films. Her research interests are broad, spanning from magnetronics, superconductivity, nanoelectronics, to spintronics. After returning to Taiwan, she has established a world class nanoelectronics research team and successfully developed the next-generation, high-mobility channel transistors, thereby making Taiwan one of the leading players in global nanotechnology realm. About four years ago she turned her attention to the emerging field of low dimensional quantum matter physics, a brand new field that is expected to revolutionize the future of science and technology through research and development of new areas such as spintronics and quantum computing.

Kwo also spent much of her efforts to exhort young students and encouraged them:

"Have passion for what you are studying, stick with it for a good period of time, then for sure you will be able to achieve good results." She also attaches great importance to the development of characters, and often encourages her students to reflect deeply on the purpose of seeking advanced educations, why they are studying physics, what are their goals, and the true meanings of life.

In accepting this award Prof. Kwo said, "I am very grateful to my husband who gives me strong supports unselfishly." She also thanked her colleagues at NTHU for their encouragement and helps. Finally, she expressed thanks to all the members of her research team, especially her bright and



Professor Kwo J. Raynien.



cheerful students, stating that "It has been a great joy for me to accompany them in their journey to mature into good scientists."

### **Chang Cheng-Shang: At the Vanguard of High-speed Internet Research**

After completing his Ph.D. in electrical engineering at Columbia University in 1989, Prof. Chang worked at the IBM Watson Research Center for 4 years, conducting research in the stochastic majorization theory, for which he received

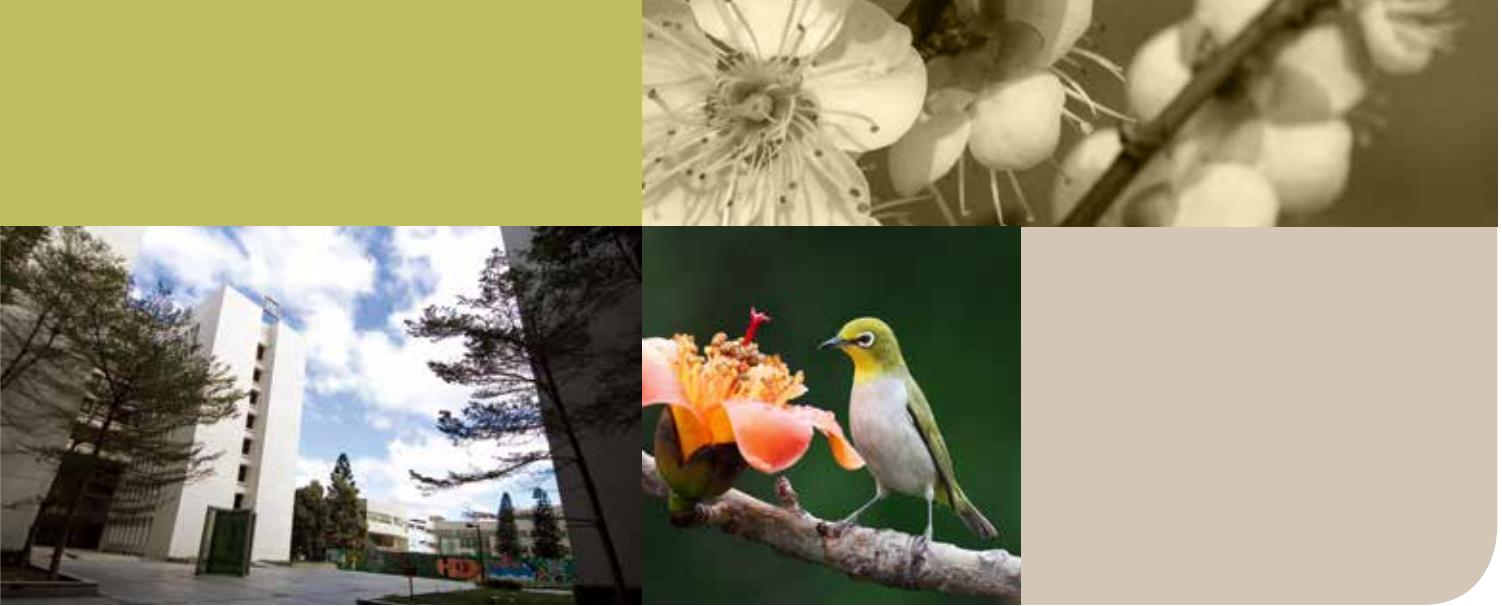
development of the Internet—stochastic quality of service. In August 1993 Chang joined NTHU, and in 1997 he put forth his system theory on networks, which later became the cornerstone of communication network analysis. In 1999 he commenced research on high-speed switches, resulting in the development of the series of Birkhoff-von Neumann switches, which have opened up new research directions for high-speed switches.

In 2008, the work of Chang's research team was included in the National Science Council's list of the 50 most significant scientific achievements of modern times, in recognition of his outstanding contributions to the field of high-speed switching technology. In 2011 he received the Ministry of Education's Academic Award. When presented with the National Chair Professorship, Dr. Chang stated, "I would like to thank NTHU and the Ministry of Science and Technology for their support and encouragement. I'm also grateful for all the invaluable help and inspiration I've received from my research team."



Professor Chang Cheng-shang.

IBM's Outstanding Innovation Award in 1992. During that time he also conducted research in the effective bandwidth theory, and succeeded in solving one of the most difficult problems hampering the early



## NTHU'S DEPARTMENT OF POWER MECHANICAL ENGINEERING RANKED HIGHEST IN TAIWAN

**O**n March 8 the international higher education information organization Quacquarelli Symonds (QS) announced its latest World University Rankings by Subject. NTHU's Department of Power Mechanical Engineering was ranked 38<sup>th</sup> in the field of mechanical engineering—the highest in Taiwan! Moreover, NTHU's Department of Physics and Institute of Astronomy have moved up in the rankings for the past three, and in the latest rankings both entered the top 100.

According to Hwan-you Chang, Associate Director of the Office of Research and Development, in the latest QS rankings NTHU again received outstanding marks. In comparison with the previous year, NTHU's rankings improved in four broad subject areas: the humanities, natural sciences, engineering, and the social sciences. In three specific subjects NTHU entered the top 50: electrical engineering (no. 30), mechanical

engineering (no. 38), and materials science (no. 48). In another six subjects NTHU was ranked between 51 and 100 i.e.: linguistics, computer science, chemical engineering, chemistry, physics and astronomy, and statistics.

In the subject of electrical engineering, NTHU was ranked at the 40<sup>th</sup> in 2016, but drastically jumped to the 30<sup>th</sup> in 2017.

In the 2015 and 2016 rankings for mechanical engineering, NTHU was ranked among the top 51-100, but this year rose to the 38<sup>th</sup>—the highest ranking ever for NTHU. According to Tsai Hung-yin, Chair of the Department of Power Mechanical Engineering, in recent years both the

faculty members and students in his department have been very active in international academia. At present 14 of the department's teachers are members of the American Society of Mechanical



President Hong Hocheng presenting a banner to the NTHU Racing team prior to their departure to the Student Formula Japan competition in September 2016.



Comprised mainly of students from the Department of Power Mechanical Engineering, for several years in a row the DIT Robotics group has participated in robotics competitions held in Europe.



Engineers (ASME), and four are members of the Institute of Electrical and Electronics Engineers (IEEE). Furthermore, in recent years a number of student groups have gone abroad to represent NTHU at international competitions in such areas as robotics and race cars.

Dr. Tsai also pointed out that the Department of Power Mechanical Engineering added programs in nano-engineering and micro-systems in 2015, and since then a number of outstanding teachers in the fields of micro-electromechanical systems and nano-engineering have joined the department. In addition, the Department boasts a number of eminent alumni, including Vigor Yang, the William R. T. Oakes Professor and Chair of the School of Aerospace Engineering at the Georgia Institute of Technology and an Academician of Academia Sinica and the American Institute of Aeronautics and Astronautics (AIAA). Amongst the Department's many alumni now holding top positions in the high-tech industry, one who stands out is Huang Youzhi, the technical director at Largan Precision. The Department's strong reputation has also been enhanced by its many graduates who have gone on to establish successful companies.

This year NTHU has entered the top 100 in the subjects of physics and astronomy. According to Professor Mou Chung-yu, Chair of the Department of Physics, the QS

ranking criteria includes such items as academic reputation, alumni performance, and citations per paper—in all of which his Department has excelled in recent years. In addition to outstanding performance in the area of faculty publications (especially in highly influential journals), the Department has also made major progress in the area of internationalization, as indicated by participation in large-scale international research teams working in such areas as high-energy physics and the Hadron Collider Project; in the area of astrophysics, NTHU faculty have joined the ALMA program located in the Atacama Desert in northern Chile.

Dr. Mou says that in recent years the Department of Physics and the Institute of Astronomy have gone all out in recruiting outstanding faculty, including top-notch professors from Spain, Germany, Japan, and the United Kingdom. This is one of the reasons why his Department has done so well in this year's rankings.

Ever since QS added the subject of materials science, NTHU's Department of Materials Science and Engineering has been ranked in the top 100, and the entire Department was very excited to have moved-up to the top fifty in the latest rankings.

QS ranking	Subject
Top 50	electrical engineering (30)
	mechanical engineering (38)
	materials science (48)
	linguistics
51-100	computer science
	chemical engineering
	chemistry
	physics and astronomy
	statistics

Subjects that were ranked in the top 100 in QS Rankings, 2017.



## MAX PLANCK INSTITUTES TO ESTABLISH A BRANCH IN TAIWAN

The Max Planck Institutes (MPI), widely lauded as the cradle of German science, announced last January its plan to establish the Center for Complex Phase Materials in Hsinchu. MPI plans to strengthen its cooperation with NTHU, National Chiao Tung University (NCTU), and the National Synchrotron Radiation Research Center (NSRRC). With an annual budget of around 400,000 euros (14 million Taiwan dollars) jointly provided by Germany and Taiwan, MPI plans to support young scientists, doctoral students, and post-doctoral researchers in the development of superconducting materials, nanomaterials, and magnetic materials.

During the press conference,

NTHU President Hocheng Hong said that this cooperative project demonstrates that Taiwan's scientific research is amongst the best in the world. Comparing scientific research with the Olympic Games, he said that if you are competing in the tennis doubles, you certainly would like to choose a partner whose ability is on par with your own.

Founded in 1948, MPI is named after the German physicist Max Planck, famous for his work on quantum

theory as well as for being amongst the first to recognize the significance of Einstein's theory of relativity. MPI employs thousands of researchers, who publish more than 15,000 papers each year in the world's leading academic journals; 18 of its researchers have been awarded the Nobel Prize in the fields of physics, chemistry, and medicine.

President Hocheng pointed out that MPI is like Taiwan's Academia Sinica, in that it administers numerous research institutes in many different



The MPI has recently announced plans to establish the Center for Complex Phase Materials in Hsinchu. Present at the press conference were (first row, left to right, beginning with second from left) Prof. Ray-nien Kwo of NTHU's Department of Physics, NSRRC Director Shang-jir Gwo, Director Liu-hao Tjeng of the MPI branch in Dresden, Science and Technology minister Hung-duen Yang, NSRRC Chairman Lih-Juann Chen, NTHU President Hong Hocheng, and UST Vice Chancellor Cheng-chen Chen.



fields. However, MPI also cooperates very closely with academia, providing it with a steady stream of talented researchers. This is a good model for the operation of national research institutes, since it encourages interdisciplinary cooperation and the training of research personnel.

Liu-hao Tjeng, Director of the MPI branch in Dresden, Germany, recently visited Taiwan to announce the establishment of the new center. During the press conference, NSRRC Director Shangjr Gwo said that 20 years ago Tjeng's research team visited NSRRC to conduct experiments using its synchrotron light source, and since then both sides have jointly published more than 90 papers in top international journals. Director Tjeng said that during his many years of cooperation with Taiwanese scientists, he has been deeply impressed by their dedication and enthusiasm, and that the establishment of this new center will certainly provide greater

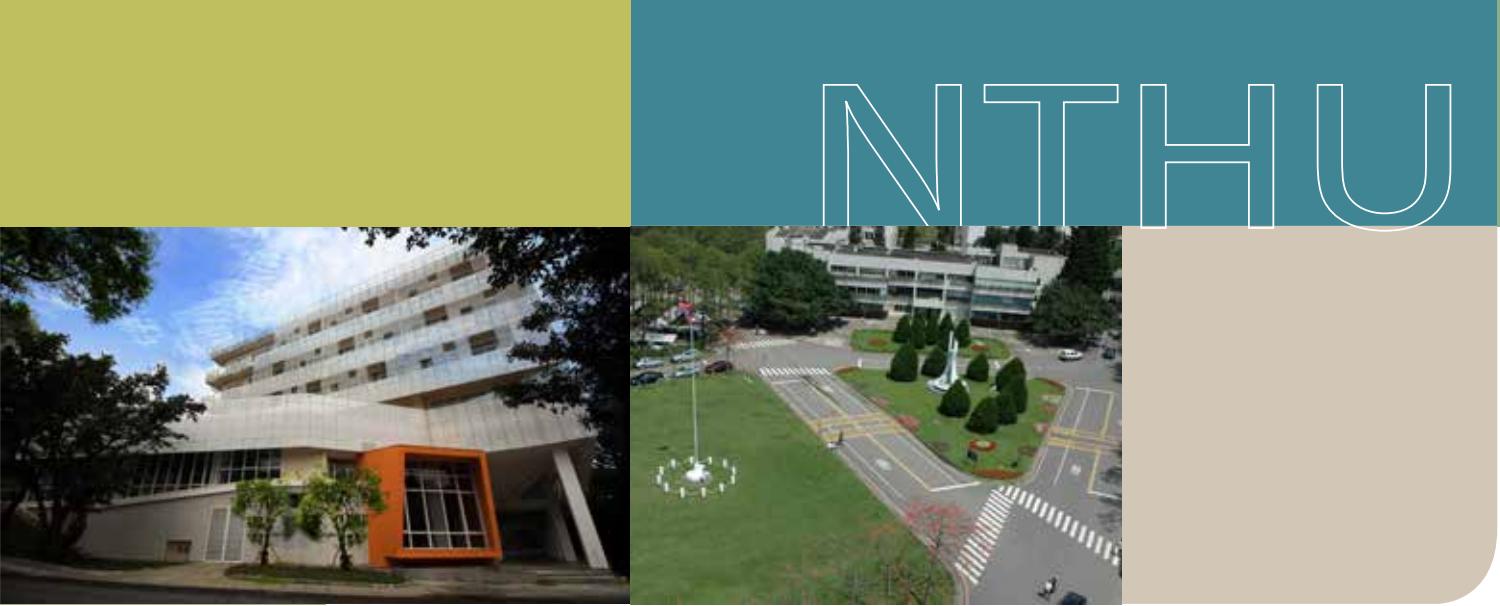
cooperation among scientists in Germany and Taiwan.

Also at the press conference, NSRRC Chairman Lih-Juann Chen said that the Taiwan Photon Source (TPS) opened last year in Hsinchu, and is already engaging in cooperative projects with research institutions around the world. He also stated that MPI has invested 1.5 million euros (52 million Taiwan dollars) to build a beam line experimental station at the TPS.

In 2013 and 2016 MPI signed a memorandum arranging for academic exchanges with NTHU and NCTU. Professor Ray-nien Kwo of NTHU's Department of Physics will work with MPI to study quantum materials and advanced films.

Also at the conference, Science and Technology Minister Hung-duen Yang noted that while some 25,000 to 30,000 academic papers are published by Taiwanese researchers every year, only 3% of these are the result of international cooperation. By contrast, over half of the papers published by researchers at Harvard are the result of international cooperation. Thus he is looking forward to increased cooperation between Taiwanese researchers and their counterparts overseas, especially those in Germany, as a way of increasing both the quality and quantity of domestic research.





## NTHU RESEARCHERS DISCOVER A GROUND-BREAKING MOLECULAR SWITCH

A micro-machine injected into the human body to repair damaged organs may sound like something straight out of a science fiction, but before long it may well come true. A research team led by Prof. Masaki Horie of the Department of Chemical Engineering and doctoral student Kai-Jen Chen have succeeded in creating a light-controlled molecular switch as slender as a single hair, yet conveying energy equal to more than 1,650 times its own weight. With Chen serving as the first author, their research report has recently been published in the prestigious journal *Nature Communications*.

This year's Nobel Prize in Chemistry was awarded to three distinguished scientists working in the field of molecular machines, highlighting the importance of this research area. In the report Chen says that a molecular machine is a tiny device controlled by such external stimuli as light, heat, and electrical

signals to produce movements at the molecular scale similar to those of motors, gears, and muscles.

Under Horie's guidance, Chen conducted a series of experiments with solid-body single crystals, which have wider applications than those conducted in a liquid, but are also more challenging. He found that ferrocene supramolecular crystals expand when illuminated by blue laser irradiation, and that they quickly return to their original state once the irradiation is removed. Imbedded into an electrical circuit, these expansions and contractions become a photo-induced supramolecular switch.

It was also found that this photo-induced



The groundbreaking discovery of a molecular switch by Associate Prof. Masaki Horie (right) and doctoral student Kai-Jen Chen (left) has recently been published in *Nature Communications*.



supramolecular switch can be switched on and off ten times per second, which amounts to 600 times per minute, while still maintaining a fairly stable current. According to Chen, "In the future, it may well be possible to accelerate the speed of such a switch to 85 times per second!"

Using this tiny super-fast molecular switch to remotely control material objects, the research team uses a micro-sensing system to discover that, by converting optical energy into mechanical kinetic energy, a supramolecular crystal can flip globules 1,650 times heavier than its own weight. Since the experiments entailed positioning supramolecular crystals only a few dozen micrometers in size—smaller than the average mote of dust—on the tip of a needle, the slightest draft could have a confounding effect. Thus Chen conducted the experiments in the dead of night, with the laboratory air-conditioning turned off, peering into the microscope while holding

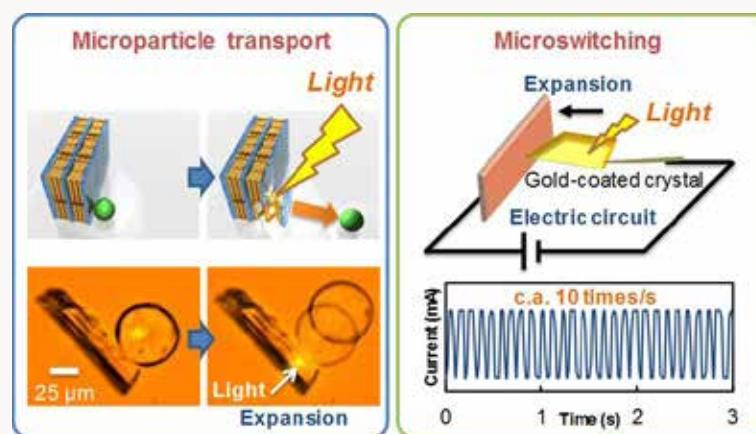
his breath. Looking back on the meticulous conditions, he joked, "Now I'm able to easily hold my breath for up to a minute without any discomfort."

Wary of biting off more than they can chew, many graduate students select a "safe" research topic they are sure can be completed in a short time. By contrast, encouraged by Prof. Horie, Chen chose the highly challenging research topic of photoresponsive supramolecules, which he worked on for four years. Yet, with the continual expert guidance and support of his mentor, Chen obtained outstanding results and his research report—his very first—has been published in an internationally renowned journal.

Horie says that their discovery of the photo-induced supramolecular switch was something of an accident. Thus he always encourages students to try things out and play around a bit, since "You never know what you might discover." Horie has been teaching at NTHU since 2010, and has been highly impressed with the university's facilities and research environment.

The photo-induced supramolecular switch is an area of basic research with the potential to rewrite the history of science and technology. Horie expects that it will soon be possible to develop molecular machines which are smaller, more complex,

and more functional. Once they are advanced enough to function like a tiny computer, they can be injected into the body to repair damaged organs.



Left: Irradiated by laser light, the molecular crystal instantaneously expands, causing the globule to bounce. Right: Controlling the laser light to adjust the crystal's rate of expansion and shrinkage, the electrical circuit can switch on and off up to 10 times per second.



## NTHU RESEARCHERS SPEARHEAD A MAJOR LEAP FORWARD IN MEDICAL TECHNOLOGY

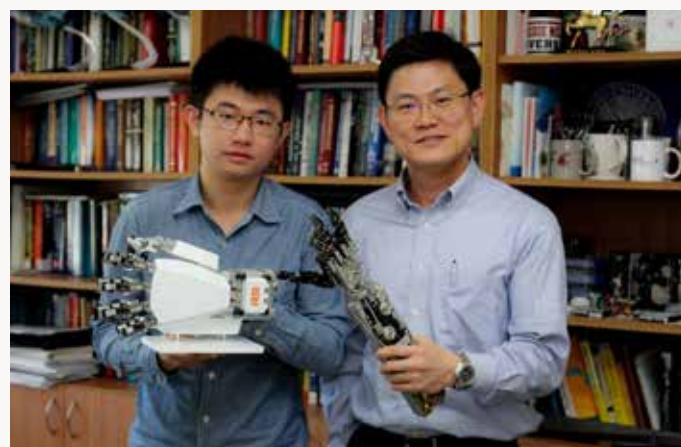
**A**n interdisciplinary research team led by NTHU's Professor James Chang has developed a wearable robotic hand nimble enough to make a fist and complex gestures, and detailed information on all its movements can be simultaneously transmitted to a cloud database. Specially designed to assist the recovery of patients with stroke, this device is currently undergoing clinical trials.

The participating physicians are planning to use the resulting data to establish a related database, opening a new page in the history of medical technology.

Professor Chang said that stroke typically impairs the normal dexterity of the fingers, but such condition can be recovered by re-establishing the connection among damaged nerves. This reconnection can be achieved by extensive amount of precise rehabilitative exercise leading to production of biodata pertaining to the muscle tension of the patient's hands, and in the traditional approach to rehabilitation, such data has to be obtained qualitatively and quantitatively by medical staff working personally with the patient. Nowadays, however, Chang's robotic hand promises to automatically provide the same essential data in precise digital form, thereby revolutionizing the rehabilitation process.

With support from the Ministry of Science and Technology, the research team spent nearly three years working in conjunction

with Professor Mao-Jiun Wang of NTHU's Department of Industrial Engineering and Engineering Management and Dr. Yu-Cheng Pei of the Linkou Chang Gung Memorial Hospital. The robotic hand they developed includes a system for detecting muscle tension, and also monitors the elasticity and



Prof. James Chang (right) and Mr. Shu-Wei Pu are key members of an interdisciplinary research team that has developed a wearable robotic hand for providing robot-assisted rehabilitation for stroke patients.

movements of the finger joints. Mr. Shu-Wei Pu, a Ph.D. candidate of the Department of Power Mechanical



Engineering, was the main developer of the robotic hand. According to Pu, the system can accurately record the tension of each finger, analyze the data, respond to the patient's current situation, and upload all this data to a cloud database monitored by the patient's doctor, "Something traditional rehabilitation couldn't even dream of!" Doctor Pei says that winter is the peak season for strokes, and during cooler weather stroke patients find it increasingly difficult to control their limbs, making it hard to take care of themselves. He also indicates that the majority of stroke patients have upper limb paralysis, and that spasticity and muscle weakness impair joint movement, such as the hand's ability to grip and extend the fingers.

Doctor Pei further points out that the physician can program the robotic hand

to accurately replicate a wide variety of movements required in rehabilitation. Thus, whenever he finds it convenient, the patient can use the device to assist with gentle movements of the joints while carefully monitoring his hand tension. Such self-service devices help to reduce the cost of medical care. Through the guidance of the Ministry of Science and Technology and the Instrument Technology Research Center of the National Applied Research Laboratories, NTHU has been awarded a patent for this device, which is now being developed by a company specially set up at the Hsinchu Biomedical Science Park. The research team is currently working on the development of a robotic hand which works in conjunction with the stroke patient's voluntary control.



The wearable robotic hand gathers essential information on the patient's condition and transmits it to a cloud database.



## PROFESSOR CHIEN SHARES PRIZE MONEY WITH HIS ALMA MATER

- a** Premier Lin Chuan (left) presenting Chien with the Award.  
**b** Chien and his research team at the conferral ceremony for the 2016 Executive Yuan Award for Outstanding Contributions in Science and Technology.

Dr. Chen-Fu Chien, a Tsing Hua Chair Professor at the Department of Industrial Engineering and Engineering Management received the 2016 Executive Yuan Award for Outstanding Contributions in Science and Technology for his accumulated research achievements on "Data Mining and Big Data Analytics to Enhance Smart Production for Semiconductor Manufacturing." Premier Lin Chuan presented Chien with the Award, including NT\$1 million, on the 29<sup>th</sup> of December (which happened to be Chen-Fu's 50<sup>th</sup> birthday). On the next day Chen-Fu donated half the prize money to the NTHU Sustainability Fund, commenting that this is the best way to express his gratitude to his beloved *alma mater* as well as those who have supported him!

Professor Chien received B.S. with double majors in Industrial Engineering and Electrical Engineering at NTHU in 1990. He attributes his accomplishments to the excellent education he received at NTHU, as well as the nurturing of his academia career and collaborative research with industries in Taiwan. Together with his students and team members, he humbly presented the check to President Hocheng Hong.

At the event Chien pointed out that the NTHU Sustainability Fund was established in 2013 when he was the Vice President and Secretary General as an endowment to support NTHU long term developments with sustainable investment income. Since the endowment is relatively small, he hopes that his gesture will encourage others to follow suit,

especially NTHU graduates. Chien's research centers on decision analysis, big data, and resource optimization, directly addressing critical challenges of Taiwan industries for transformation and technology migration. In particular, Chien is promoting "Industry 3.5" as the optimal manufacturing strategy for Taiwan that is a hybrid strategy between the existing "Industry 3.0" and to-be "Industry 4.0," with disruptive innovations on the basis of core competence of Taiwan manufacturing expertise. He also proposed "blue lakes strategy" for niche segments that Taiwanese manufacturers should employ Industry 3.5 to enhance their competitive advantages.



Prof. Chien, together with his teammates, presenting a check to President Hocheng Hong.

# NTHU



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