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The Spring 2017 Beihang University Vision Forum Sets the Stage for Human Resource System Reform

On May 23-24, the 2nd Beihang University Vision Forum for International Young Scholars, sponsored by Beihang University and co-sponsored by the International Research Institute for Multidisciplinary Science, the Institute for Economics and Business, and Office for Talent Management, was held in the University’s Vision International Cultural Exchange Center.

More than 80 young scholars from world renowned universities and research institutions including Harvard University, MIT, University of Cambridge, Stanford University, Imperial College London, University of Toronto, Northwestern University, and U. S. Lawrence Berkeley National Laboratory, LBNL participated in the Forum.

Academician Zhang Jun, Secretary of the CPC Beihang University Committee, Deputy Secretary, Professor Cheng Jiwei, and Vice President, Professor Wang Yunpeng attended the Forum. The Forum also had keynote speaker, Academician Wang Huaming from the School of Material Science and Engineering, together with deans and secretaries of the Schools, and scholars and experts with titles of honor. The opening ceremony was co-hosted by Deputy Secretary Cheng Jiwei and Director of the Human Resource Department Xiao Zhisong.

Party Secretary Zhang Jun, in his speech, congratulated on the opening of the 2nd Vision Forum, and expressed his gratitude and extended greetings to the young scholars for traveling long distances to gather at Beihang. He highly appreciated the success of the 1st Vision Forum in 2016, and believed that the 1st Vision Forum effectively promoted academic exchanges and sparked wisdom.

Secretary Zhang pointed out that currently the world is undergoing profound changes, and scientific and technological revolution, economic restructuring, industrial upgrading, as well as integration of information technology and industrialization are working together to form major opportunities for innovation and development. China’s comprehensive power and economic strength are increasing, and, at the historic moment of boosting the construction of a world’s science and technology power, the craving for higher education, science and knowledge, and talents of excellence is stronger than ever before. Talented young people are the key to a nation’s future development, and never has been a time more suitable for overseas-educated talents to start a career for the development of the country.
Secretary Zhang said that as the first higher education institution featuring aeronautics and astronautics since the founding of the People’s Republic of China, Beihang’s aspiration, inheritance and future are closely related to the rejuvenation and development of this nation. Ever since the dawn of its history in 1952, aviation experts nationwide have gathered at Beihang, the outstanding ones of whom had studied at some of the world renowned universities including the Massachusetts Institute of Technology, California Institute of Technology, and Imperial College London, and created many firsts in China’s aviation history, making prominent historic contributions to the country. With innovation and advancement, inclusiveness and cooperation, Beihang has led the way of innovation by serving strategic needs of the nation and orienting for global scientific frontier, with the magnificent accomplishment of 11 First Prizes of national level science and technology awards in the past 12 years and 8 faculty members elected academicians of the Chinese Academy of Sciences and the Chinese Academy of Engineering within 6 years.

He said that Beihang has the determination and aspiration to retain people of talent and wisdom, will continue to promote the University’s talent management programs, will comprehensively deepen the personnel system reforms, and will take effective measures to foster innovation and development. A place where dreams come true, Beihang shall be the start for outstanding young scholars’ pursuit of innovation and dreams. Secretary Zhang sincerely welcomed young talents to join Beihang, where personal dreams would integrate into Beihang dreams, and further merge into the Chinese dream of the great rejuvenation of the Chinese nation.

“Love and inclusiveness hold talented people together, and future is made by cultivating them to thrive further”. Over the past year, Beihang University appointed 67 faculty members for positions including Global Youth Talent 1000 Program, National Science Fund for Outstanding Young Scholars, and Zhuoyue 100 Program. Party Secretary Zhang Jun issued letters of appointment to their representatives and presented them with a book On the College Avenue – Beihang in Oral Account, wishing them to better integrate into Beihang, develop Beihang, and fulfill the dreams.

Vice President Wang Yunpeng, professor and Yangtze River Scholar, awarded the ‘Certificate of Honor for Specially Invited Speakers’ to Academician Wang Huaming and representatives of young scholars participating in the Forum in expression of his appreciation for their excellence.

While giving a comprehensive introduction to the glorious history and achievements of Beihang, Vice President Wang Yunpeng pointed out that the University would never leave its original aspiration behind, would keep forging ahead with keen determination, would bring out Beihang’s leadership and courage to best advantage, and would continue with the glory of 11 First Prizes of national level science and technology awards in 12 years.

From the perspective of policies, mechanisms for innovation and compensation and benefits, Vice President Wang elaborated on the strategy to promote and transform top research teams. The University will provide support through coordination of resources across departments and divisions, and will vigorously implement talent management programs, improving the environment for the development and innovation of talented people. He sincerely welcomed the young scholars to join Beihang, to share our vision of inclusiveness, love, and success. “And we will work together to realize the goals set forth in the blueprint of the 16th CPC Beihang University Congress meeting”.

The Forum’s invited speaker, member of the Chinese Academy of Engineering, Academician Wang Huaming introduced his research on laser additive manufacturing for high-performance large metallic components, and the innovations in serving strategic needs of the nation, followed by representatives of Beihang University’s faculty members: Professor Zhao Lidong, Professor Sebastian Wandelt and Professor Guan Yingchun of Global Youth Talent 1000 Program, cordially sharing experiences and accomplishments in their area of expertise.

5 sub-forums in Mathematics and physics, Engineering sciences, Chemistry and material science, Information science, and Economics, management and business were held in the afternoon for in-depth discussions around cutting-edge science and technology, further promoting academic exchanges and cooperation among young scholars through presentations and discussion of academic issues, broadening horizons, inspiring creativity and connecting a bridge of friendship.

During the two-day forum, the Schools actively prepared, took initiatives in connecting with outstanding young scholars, and enhanced in-depth communication and exchanges between faculty members of research teams and the participating young scholars to present the
personnel system reform conducted talent reviews for the professoriate recruitment. All this was to systematically and effectively implement the University’s strategies for talent team construction.

The University’s biannual Forum aims at advancing the frontier of sciences and continuously promoting scientific research across disciplines and success of young scholars. The Forum creates a suitable platform and a network of academic exchanges for outstanding young scholars worldwide through a series of activities.

With the information sessions held overseas, this combination of inviting-in and reaching-out aggregates global talents of outstanding achievements in deepening human resource reforms and to implement the University’s strategies for recruiting excellent faculty members, better realizing the goal of building a world-class university rooted in the homeland of China.

(Text by Wang Rui; photos by Sun Yecheng. Original text in Chinese by Kong Juan)

From a Meeting: Creating Our Own Legend of Talent Management Requires Careful Planning and Solid Work

On April 17, 2017, the University’s working meeting on talent and personnel system was held in the 1st Lecture Hall. The meeting aimed to take initiative in grasping the opportunities of the national policy of building world-class universities with top-ranking subjects (namely the “dual approach to world-class higher education”), promote talent teams, give a comprehensive summary of the University’s work on talent and personnel system, put forward goals and procedures under the new situation, cement cohesion, and implement responsibilities following the guidelines put forward by the 16th CPC Beihang University Congress.

The University leaders Zhang Jun, Xu Huibin, Wei Zhimin, He Xinzhou, Cheng Jiwei, Tao Zhi, Liu Shuchun, Fang Jiancheng, Huang Haijun and Wang Yunpeng, Assistant to the President Zhang Guang, deans and secretaries of the Schools, faculty representatives, scholars and experts with titles of honor, and administrative staff from relevant Offices attended the meeting, which was presided over by Cheng Jiwei.

President Xu stressed that the competition between higher education institutions nationwide has become increasingly fierce, and, at a point of no return, the racing for becoming world-class universities
with high-quality courses is ready to start like an arrow on the straining cord. “Only through deepening comprehensive reform and speeding up the construction of world-class talent teams can we bring about actual improvement in the University’s educational quality, innovation ability and cultivation capacity.”

In recent years, Beihang University has continuously been pushing for human resource system reform, and, in accordance with the plan, preliminary classification of professoriate titles and research faculty titles has been completed at the Schools first chosen. Innovating measures for talent recruitment and management, establishing “talent zones”, hosting the Vision Forum, optimizing supporting policies and improving mechanisms have brought about positive influences.

“We must give in-depth analysis of and sum up experience from our work in the past, based on which we must comprehend precisely what are ‘world-class standards’, ‘Chinese characteristics’, and ‘Beihang style’, and, with a broad international perspective and a high sense of responsibility, we must learn from and introduce the experience of world-class universities while strengthening and promoting Beihang’s advantageous positions, distinguishing features, and overall strength,” said President Xu. “With mind emancipated, reform and innovation, and responsibilities fulfilled, Beihang will speed up the construction of world-class talent teams and will have inexhaustible motive force in realizing the goal of becoming a world-class university rooted in the homeland of China.”

Secretary Zhang presented the award certificates to the representatives from the School of Material Science and Engineering, the School of Transportation Science and Engineering, the School of Apparatus Science and Optoelectronic Engineering, and the School of Chemistry for their work of excellence in 2016.

President Xu issued letters of appointment to the tenure track professors from the School of Material Science and Engineering, the School of Computer Science, and the School of Transportation Science and Engineering, which were among the first to initiate the reform.

In the keynote speech, Vice President Wang Yunpeng gave a complete review of the new breakthroughs, new platforms, and new initiatives in 2016, and provided an in-depth analysis of the difficulties facing the University in talent team construction, which, he believed, could only be solved through reform and innovation.

He made it clear that the reform must go closely around the “dual approach to world-class higher education”, being goal-oriented, problem-oriented and demand-oriented.

“Through deepening reform, enhancing quality, coordinating efforts, enlarging scope, recruiting and cultivating talented faculty members, and providing support through coordination of resources across departments, we are to build and put into effect a three-level responsibility system involving the University, the Schools and the research teams,” said Vice President Wang. “And we shall continue to improve methods of...”
assessment based on the classification of professional titles, and make solid progress in the construction of world-class talent teams, thus giving full support to the University’s talent cultivation, subject development and science and technology innovation.”

For the purpose of experience sharing, Dean of the School of Material Science and Engineering, Professor Jiang Chengbao gave a detailed report on the measures taken by the School to promote the reform from the aspects of development goals, talent teams and scientific orientation.

Dean of the School of Apparatus Science and Optoelectronic Engineering, Professor Xu Lijun shared their mode of innovation and working mechanism regarding recruitment and development of talents.

Dean of the School of Aeronautical Science and Engineering, Professor Wen Dongsheng shared his thoughts on the talent team construction in aeronautics & astronautics: taking on responsibilities, facing up to the challenges of developing top-ranking subject, being goal-oriented and problem-oriented, he put forward pragmatic measures for the next stage’s work.

“Beihang provided me with a desk of tranquility”, Yangtze River Young Scholar and Professor Wu Xiaoqiao from the School of Foreign Languages told pleasingly and impressively about the academic platform and atmosphere at Beihang, from deep love to the creation of fruitful results, from realization of humanity to the discovery of development rules.

“The year 2017 is the initial year after the 16th CPC Beihang University Congress meeting, is the groundbreaking year for the 13th five-year plan, and is the year of welcoming the 19th CPC National Congress, responsibility coming with mission, opportunities and challenges co-existing,” said Party Secretary Zhang Jun in his concluding speech. “Under the guidance of General Secretary Xi Jinping’s remarks on the work regarding talents, we should develop a profound understanding of the urgency, responsibility, and implementation: the three important issues of our work regarding talents. Currently, overall plans at national level for the ‘dual approach to world-class higher education’ are being carried out, with great importance attached to talents and continuously deepening the reform of the system for talent development.”

Secretary Zhang asked that the entire University seek unity in thinking, enhancing awareness, and taking initiative, with the growth rate of talents outrunning the pace of development. “With the insights, the sincerity, the daring in judgement, the magnanimity, and the sound strategy, we will open the way to welcoming talents, and, in the process, bring out the world-class standards, Chinese characteristics and Beihang style to best advantage.”

Secretary Zhang stressed that to promote our work regarding talent and personnel system, the University, the Schools, and the Offices should have less of a posture of waiting, depending, or wanting, but more of dashing, venturing, and trying.

The University should set up platforms, gather resources, improve mechanisms, and provide security. The Schools should face up to difficulties, try to do things autonomously, take initiatives, and put their hearts, minds, and strengths on the things and the people they are focusing on. The Schools and the Offices should spot talents through big data and large-scale exchanges, should cultivate talents based on precision, differentiation and goals, should develop talents through providing suitable environments and career opportunities, and should bring success to talents by giving them heavy responsibilities, opportunities for great accomplishments and leadership in research teams.

According to Secretary Zhang, the University will stand its ground on excellence in faculty and staff, and stick to the philosophy of recognition, love, tolerance, and trust for the congregation of talents, uniting them with platforms and mechanisms, increasing group cohesion with common career pursuits and responsibilities, and uniting their efforts with reform and development. “Forging ahead with keen determination, pioneering spirit and innovation, we have the talent to retain talents, to tolerate their faults and to forgive their offences. With the global vision, and the true character to undertake solid work, we shall get right to the job of enhancing our talent management programs, creating our own legend of promoting and transforming talent teams with power, endurance and merit, accelerating the construction of world-class talent teams and contributing to the magnificent goal of becoming a world-class university rooted in the homeland of China.”

(Text by Wang Rui; photos by Kong Xiangming. Original text in Chinese by Li Yan)
Beihang University Held a Panel Discussion on Studying the Important Speech of General Secretary Xi Jinping’s on Intellectuals

Chinese President Xi Jinping joined a panel discussion with political advisors from 3 non-CPC parties at the fifth session of the 12th National Committee of the Chinese People’s Political Consultative Conference (CPPCC) in Beijing on March 4, 2017. He called on intellectuals to make greater contribution to the nation’s development.

On March 14, Beihang University held a panel discussion to better study the important speech of General Secretary Xi Jinping’s on intellectuals. Party Secretary Zhang Jun, Deputy Secretary Cheng Jiwei, and Vice President Wang Yunpeng joined the discussion. Around 40 representatives from different Schools and Offices attended the meeting, including staff in charge from the Office of the Party and University Administration, Organization Department, Publicity Department, United Front Work Department, and the Human Resource Department, as well as secretaries and faculty representatives from the Schools.

Secretary Zhang summarized the prominent ideas of the important speech in four aspects: General Secretary Xi said that the CPC has always valued the importance of intellectuals, who are elites of the society, pillars of the nation, pride of the people and treasure of the country; “Intellectuals across the country should take on a sense of urgency and responsibility, and work hard to build China into a moderately prosperous society in all respects and a major sci-tech power,” Xi said; he hoped the intellectuals consciously take the lead in practicing socialist core values, stick to the principle of putting the interest of the nation and the people first, and make greater contributions through innovations; the whole society should care for and respect intellectuals, and create a favorable environment that honors knowledge and intellectuals, General Secretary Xi said, pointing out that authorities must fully trust intellectuals and seek their advice on policy making.

Secretary Zhang pointed out that to better our work regarding intellectuals is one of our most urgent tasks at the moment of accelerating the pace of building Beihang into a world-class university, and that we must be good at working with talented people, uniting them with common career pursuit, gathering them with suitable platforms...
Professor Zhuang Weihua from the University of Waterloo Visited Beihang University

Professor Zhuang Weihua from the University of Waterloo, Canada, visited the School of Electronics and Information Engineering of Beihang University on March 17th, 2017. On behalf of Beihang University, party secretary of the University, Academician Zhang Jun welcomed Prof. Zhuang and had a short conversation with her. Thereafter, Prof. Zhuang gave a presentation entitled ‘Recent Research on Vehicular Ad Hoc Networks’ in Room F708 of New Main Building, and had an in-depth discussion with the attendees.

Prof. Zhuang has been with the Department of Electrical and Computer Engineering, University of Waterloo, Canada, since 1993. Her current research focuses on the technologies of wireless communication networks and vehicular networks. Prof. Zhuang is Fellow of the IEEE, Fellow of the Engineering Institute of Canada, Fellow of the Canadian Academy of Engineering, Tier I Canada Research Chair in wireless communication networks and elected member in the Board of Governors of the IEEE Vehicular Technology Society. Besides, she is selected as a member of the seventh batch of China’s ‘Global Talent 1000’ program. She was the Editor-in-Chief of IEEE Transactions on Vehicular Technology. Prof. Zhuang was honored the Outstanding Performance Award by the University of Waterloo, and the Premier’s Research Excellence Award by the Ontario Government for her demonstrated contributions to mobile communications.

(Text by Bai Lin; photo by Tang Qiuyuan. Original text in Chinese by Sun Yecheng)
High-fidelity fusion method for optical satellite remote sensing images

Optical satellite imaging has a wide range, is free from national boundaries, and is of great importance to national security, economic construction and social development. Since the year of 2000, most optical satellites simultaneously capture panchromatic (Pan) and multispectral (MS) images. Pan images mainly offer high-resolution texture information, while MS images mainly provide low-resolution spectral information. Different from Pan and MS images, fused images can provide high-resolution texture and spectral information, and can reveal the objects which cannot be seen in gray images, so that it plays an important role in military intelligence interpretation.

Image fusion aims to sharpen MS images by using the high-resolution texture information of Pan images, and to generate high-resolution MS images that can accurately reflect the textural and spectral information of ground objects. Image fusion is the key technology of satellite remote sensing image processing, and we are subject to the long-term blockade of advanced remote sensing image processing technology from the United States, Canada and the European Union. For example, in 2012, the Canadian government blocked the proposed sale of Canadian firm PCI Geomatics to the Chinese firm NAVInfo for national security reasons. In the case that the strongly reflected objects are oversaturated, and the synthesized low-resolution Pan images have grayscale distortion, the existing additive transformation based methods will cause texture distortion and spectral distortion problem \[^{[1]}\]. To address this problem, a novel remote sensing image fusion model based on multiplicative transformation has been proposed in our research. This model has two steps, as follows:

(1) Low-resolution Pan image synthesis based on ground object classification and bilateral error regression

The synthesis of low-resolution Pan image is the generation of a low-resolution Pan image that corresponds to the original pan image by the weighted summation of MS image bands. The existing methods do not distinguish the spectral responses of different ground objects to the different bands of Pan and MS images. These methods take unilateral error regression to calculate the weights of different bands for synthesizing low-resolution Pan images, thus causing the gray-level distortion of the synthesized low-resolution Pan images. To tackle this problem, we accurately analyze the spectral response difference of ground objects from two viewpoints, i.e., ground objects and image bands \[^{[3]}\], and propose a ground object classification and bilateral error regression based low-resolution Pan image synthesizing method.

Firstly, the precondition of an accurate synthesis of low-resolution Pan images is accurate analysis of the ground objects that have similar relative spectral response in Pan and MS bands. However, the existing classification methods only consider relative relationship of MS bands. It leads to great reflectance difference of Pan band in the same ground object class. To solve this problem, the values of each Pan and MS pixel are combined as a vector, and then the ground objects are classified according to the direction of these vectors. Secondly, since the Pan image (dependent variable, \(P\)) and the MS image (independent variable, \(M\)) have measurement errors (\(\Theta\), \(\varepsilon\)), the bilateral error regression model, i.e., \(P + \varepsilon = (M + \varepsilon) \in\) is employed to calculate the weights of different bands for different ground objects \(\Theta\), so that the low-resolution Pan image \((P)\) has been accurately synthesized in our method.

(2) High-fidelity Pan and MS remote sensing image fusion model based on the multiplicative transformation

The existing additive transform based methods, i.e., \(F_{ij} = P_{ij} + M_{ij}\), generate fused images by adding the texture information of Pan image and the spectral information of MS image. In optical satellite imaging, due to the strong spectral reflection, aircraft, ships and other military targets are easy to engender over-saturation problem. In such situation, the edge of Pan image is difficult to be precisely matched with the spectral information of MS image while generating the fused image, so that the edge of fused image will be blurred. To address this problem, the representation approach of texture information and spectral information of fused image has been changed on mechanism, and has established Pan and MS image fusion model based on multiplicative transformation \[^{[7\text{2}]}\].

\[e_{ij} = \frac{P_{ij}}{F_{ij}}\]

Specifically, the texture information of fused image is represented by the ratio between Pan image and low-resolution Pan image, i.e., \(P_{ij}/F_{ij}\), the spectral information of fused image is represented by up-sampled MS image. And the new fusion model based on multiplicative transformation, i.e., \(F_{ij} = P_{ij} + M_{ij}\), has been constructed. Here, the damage to the texture information of the fused image caused by the over-saturation is suppressed by the ratio transformation of the MS band to the low-resolution Pan image (see Fig). Compared with the GS fusion method (implemented by ENVI software) and UNBPansharp

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<th>Fusion methods</th>
<th>Distortion (the smaller, the better)</th>
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<tr>
<td>GS</td>
<td>12.37% 10.21%</td>
</tr>
<tr>
<td>UNBPansharps</td>
<td>9.16% 9.25%</td>
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<tr>
<td>Our method</td>
<td>2.01% 2.07%</td>
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Magnetic skyrmion-based synaptic devices

Magnetic skyrmions are promising candidates for next-generation information carriers, owing to their small size, topological stability, and ultralow depinning current density. A wide variety of skyrmionic device concepts and prototypes have recently been proposed, highlighting their potential applications[1]. Furthermore, the intrinsic properties of skyrmions enable new functionalities that may be inaccessible to conventional electronic devices. Here, we report on a skyrmion-based artificial synapse device for neuromorphic systems[2]. The synthetic weight of the proposed device can be strengthened/weakened by positive/negative stimuli, mimicking the potentiation/depression process of a biological synapse. Both short-term plasticity (STP) and long-term potentiation (LTP) functionalities have been demonstrated with micromagnetic simulations. This proposal suggests new possibilities for synaptic devices in neuromorphic systems with adaptive learning function.

The primary components of the proposed skyrmionic synaptic device are a ferromagnetic (FM) layer (e.g., Co) on a heavy metal (HM, e.g., Pt) and an energy barrier. The FM layer has perpendicular magnetic anisotropy (PMA), and the Dzyaloshinskii-Moriya Interaction (DMI) is generated at the interface between the FM layer and the HM, shown in Fig 1.

The proposed skyrmionic synaptic device was numerically simulated by solving the Landau–Lifshitz–Gilbert (LLG) equation with spin transfer torques as follows:

\[
m \frac{dt}{m} = -\gamma |m| \times H_{eff} + am \frac{dt}{m} + u \frac{dt}{m} (m \times m)
\]

where \( m = M/M_s \) is the reduced magnetization, \( M_s = 580 kA/m \) is the saturation magnetization, \( \gamma = -2.21 \times 10^(-13) A T/cm \) is the gyromagnetic ratio, \( H_{eff} = H_{eff}/M_s \) is the reduced effective field, \( a = 0.3 \) is the Gilbert damping, \( t \) is the thickness of the ferromagnetic layer, \( u = \gamma (h_0 |P/2 | M_s) \cdot j \) is the density of the spin current, and \( P=0.4 \) is the spin polarization.

Three primary operation modes are developed for our proposed synaptic device: the initialization mode, the potentiation mode, and the depression mode. Before we illustrate the operation modes of the proposed synaptic device, we define two terms: (a) positive stimulus, which signifies an electric current with an amplitude of 5 MA/cm² flowing from terminal A to terminal B; and (b) negative stimulus, which signifies an electrical current with amplitude of 5 MA/cm² flowing from terminal B to terminal A. In the initialization mode (from 0 to 35 ns), skyrmions are generated in the presynapse region of the device. Owing to the repulsion between skyrmions and the nanotrack edges, a threshold value for the total number of skyrmions (11 skyrmions in our design, with a 120-nm-wide nanotrack) in the presynapse region of the device will be reached. This threshold value determines the programming resolution of the synaptic weight of the device. In the potentiation mode (from 35 to 65 ns; see Fig 2(b)), a positive stimulus drives skyrmions from the presynapse region into the postsynapse region, increasing the synaptic weight of the device. Similarly, in the depression mode (from 87 to 117 ns; see Fig 2(c)), a negative stimulus drives skyrmions from the postsynapse region into the presynapse region, decreasing the synaptic weight of the device. The red curve in Fig 2(d) shows the normalized mz (i.e., the average magnetization component in the z direction) of the postsynapse region of the device.

References

shifting of $m_z$ corresponds to the variation in the skyrmion number and size. It should be noted that two skyrmions fail to pass through the barrier in both the potentiation and depression modes. This can be explained as a consequence of the insufficiency of the total driving force, which consists of the driving force of the electric current and the repulsion force of the skyrmions. Taking the potentiation mode as an example, as skyrmions move into the postsynapse region, the repulsion force of the skyrmions in the presynapse region, which favors skyrmion motion from the presynapse region into the postsynapse region, will decrease, whereas the repulsion force of the skyrmions in the postsynapse region, which hinders skyrmion motion from the presynapse region into the postsynapse region, will increase. Meanwhile, the driving force of the electric current (herein we consider a direct current, DC) and the repulsion force of the barrier remain unchanged. Finally, all these forces enter an equilibrium state, leaving two skyrmions in the presynapse region. The synaptic weight of the postsynapse region of the device can be determined by measuring the magnetoresistance through the detection device at terminal C. This dynamic weight behavior, illustrated in Fig 2(d), demonstrates the stimulus-induced synaptic plasticity of the proposed skyrmionic device. It is worth noting that the size of the skyrmions also depends on the driving force and the repulsion force, as shown in the snapshots in Fig 2. As soon as the stimulus is turned off, the compressed skyrmions begin to expand into an equilibrium state, leading to an obvious change of $m_z$ in the postsynapse region. To illustrate the potentiation/depression dynamics without considering the size impact of skyrmions, the change of the skyrmion number ($N_{sk}$) in the postsynapse region is also depicted as the blue line in Fig 2(d).

We also investigated the dynamics of the synaptic plasticity of the proposed device with respect to the stimulus characteristics. In specific, we considered three stimulus configurations: case 1, 1.5 ns in duration at 5-ns intervals, as shown in Fig 3(b); case 2, 1 ns in duration at 2-ns intervals, as shown in Fig 3(c); and case 3, 1 ns in duration at 5-ns intervals, as shown in Fig 3(d).

Each configuration consists of eight stimulus pulses. We monitored the magnetococonductance change of the postsynapse region of the device, expressed by the ratio to the magnetococonductance without skyrmions ($G_0$). As these figures show, cases 1 and 2 demonstrate an LTP property, while case 3 demonstrates an STP property. Compared with cases 1 and 3, with the same interval, a proper stimulus duration is required to transfer STP to LTP. Cases 2 and 3 demonstrate that the interval of the stimulus also plays an essential role in the device’s plasticity. To eliminate the effect of conductance variation due to skyrmion size oscillation, the skyrmion number ($N_{sk}$) is also calculated, as shown in Fig 3(e), which corresponds to the above analyses.

The STP and LTP of the proposed synaptic device can be explained by the competition between the driving force provided by the electric current and the repulsion force provided by the barrier when the skyrmion passes through the barrier. When the skyrmion approaches the barrier, the repulsion force of the barrier increases, as shown in the energy profile of Fig 3(a). Upon receipt of an input stimulus, the driving force of the electric current proceeds the skyrmion uphill along the force energy profile (from point 1 to point 2). However, the skyrmion fails back to point 1, if the input stimulus is not of sufficient
behavior is consistent with the psychological model of a biological synapse.

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References


Stratification induced by evaporation

Paints and inks are examples of colloidal dispersions, consisting of tiny particles suspended in a liquid. When they are laid in a film on solid ground, such as a drywall or a piece of paper, the liquid evaporates, and the particles are condensed to form a solid layer. This is how we paint the wall in beautiful colors and write on paper.

There are many interesting physics under such a common phenomenon in our everyday life. As the liquid evaporates, particles below the surface are forced to move with the descending interface, resulting in an accumulation of particles near the interface. At the same time, particles are jostling randomly, undergoing the so-called Brownian motion. This Brownian motion is faster for smaller particles, so they can quickly move away from the interface where the particle concentration is high. Larger particles, on the contrary, move slowly and accumulate at the interface. The result is a layering structure with more large particles on the top, which is widely assumed for any evaporation rate. Therefore it came out as a surprise when a group of researchers in Surrey, UK found exactly the opposite phenomena: when the evaporation rate is high, small particles accumulate near the interface[1].

To explain this effect, Jiajia Zhou and Ying Jiang from the School of Chemistry, together with Masao Doi, director of the Center of Soft Matter Physics and Its Applications, considered an evaporating film containing a binary mixture of small and big particles. They described each particle type using a standard diffusion equation, but different to previous theories, they explicitly accounted for an interaction between particles. This interaction, however, isn’t symmetric: big particles find it difficult to squeeze into a packed region than small particles, much like an adult finds it harder to move on a crowded street than a child. This asymmetry pushes big particles away from the surface. Using numerical calculations, they identified a criterion for the small-on-top structure:

\[ \alpha^2 (1 + \frac{v_e h_0}{D_f}) \varphi_{01} > 1 \]

where \( \alpha \) is the size ratio, \( v_e \) is the evaporation rate, \( h_0 \) is the film thickness, \( D_f \) and \( \varphi_{01} \) are the diffusion constant and the initial volume fraction for the small colloids, respectively. Therefore, there are two scenarios for the stratification: when the evaporation rate is low, the big colloids appear on the top; when the evaporation rate is high, the unusual small-on-top structure forms.

This research has been published in Physical Review Letters [2].
Intermittent energy dissipation by turbulent reconnection

Magnetic reconnection—the process responsible for many explosive phenomena in both nature and laboratory—is efficient at dissipating magnetic energy into particle energy. It is believed that the magnetic reconnection, in the solar corona and the Earth’s magnetosphere, occurs in a small “diffusion region” with scale of ion skin depth. Such a region generally follows the two-fluid picture, but at its boundary the antiparallel-merging magnetic field lines may strongly fluctuate, and inside it, fine structuring such as X-lines and O-lines typically appears. During reconnection, the magnetic field lines “break” and “reconnect”, and a large amount of energy is released in terms of hard X-rays on the Sun and energetic electrons in the magnetotail. It is still a puzzle how so much magnetic energy is dissipated to particle energy in such a small region. The X-line is traditionally suggested as the main point where energy dissipation happens, as two opposite plasma jets are always produced there. However, recent 3-D simulations indicate that O-lines may also be important. So far, exactly where the energy dissipation happens has been unclear.

To reveal the energy dissipation during reconnection, identifying X-lines and O-lines should be the first step. This requires that (1) multiple spacecraft are located simultaneously inside the diffusion region and have sub-ion-scale separations and (2) a tool is available for reconstructing the fine structures around the spacecraft trajectories. The European Space Agency (ESA) four-spacecraft mission Cluster can readily satisfy the first criterion: in the autumn of 2003, Cluster detected a few magnetic reconnection events in the Earth’s magnetotail, where the ion diffusion region has a scale of 1000 km. In these events, Cluster had a separation of ~200 km, i.e. 1/5 ion scale; hence, all satellites were located simultaneously inside the diffusion region. To meet the second criterion, the research team recently developed and tested a new method, i.e. the first-order Taylor expansion (FOTE), which has been published in 2015 in Journal of Geophysical Research (JGR)—a renowned journal in space physics—as the cover paper, and attracted considerable attention from the international colleagues.

The research team used FOTE method and the Cluster in situ measurements in 2003 to reveal the energy dissipation during reconnection. They discovered numerous current filaments and magnetic nulls inside the diffusion region of magnetic reconnection, with the strongest currents appearing at spiral nulls (O-lines) and the separatrices. Inside each current filament, kinetic-scale turbulence is significantly increased and the energy dissipation, $E' \cdot J$, is 100 times larger than the typical value. At the jet reversal point, where radial nulls (X-lines) are detected, the current, turbulence, and energy dissipations are surprisingly small. All these features clearly demonstrate that energy dissipation in magnetic reconnection occurs at O-lines, not X-lines.
These results have been published in Geophysical Research Letters (GRL)—a renowned journal in space physics—and highlighted as a “Research Spotlight” by the American Geophysical Union (AGU). Respectively, the European Space Agency (ESA) and American Geophysical Union (AGU) had a press release regarding these results. In the press release of AGU, the results were believed to “upend conventional wisdom of magnetic reconnection”; while in the press release of ESA, the results were thought to “challenge the current view of magnetic reconnection”. Also, these results will “spark a great deal of discussion”—as stated by AGU—and “enable scientists to rethink of the standard view of magnetic reconnection”—as stated by ESA.

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References

ESA Press Release: http://sci.esa.int/cluster/58994-a-marks-the-spot-for-magnetic-reconnection/

Control of nano-manipulating systems:
key technology supporting ultrahigh precision motions

Nano-manipulating systems are playing a more and more important role in ultrahigh precision servo tasks, with successful applications in various emerging areas, such as atomic force microscope (AFM), nano-assembly and manufacturing, and semiconductor instruments.

Note that piezoelectric actuators and flexure-based mechanisms have been recognized as the important components of a nano-manipulating system due to their advantages of high displacement resolution, high bandwidth, compact size, and friction-free motion. However, the control of such nano-manipulating systems is challenging due to the ultrahigh precision requirements and model complications such as the hysteresis nonlinearities of piezoelectric actuators, high-order dynamics of the flexure-based mechanisms, and the existence of model uncertainties.

To address the above problems, existing methods follow the methodology of hysteresis compensation combined with closed-loop control strategies based on the modeling of both hysteresis nonlinearities and dynamic characteristics of the nano-manipulating system. Note that most of the reported works were concerned with the stability and robustness problems of the closed-loop system. However, the results on quantitative analysis of the motion errors caused by the model uncertainties, high-order unmodeled dynamics, and the compensation error are very rare, which limits their applications to tracking/scanning based servo tasks.

Fig 1. Experimental setup of a nano-manipulating system
To improve both the motion accuracy and the transient performance, Professor Peng Yan’s team from the School of Automation Science and Electrical Engineering proposed a sliding mode disturbance observer-based adaptive integral backstepping control method with hysteresis compensation for the nano-manipulating system (as shown in Fig 1), where an improved rate-dependent Prandtl-Ishlinskii (PI) model was constructed. The proposed method can improve the robustness of the nano-manipulating system, and better deal with the model uncertainties, various disturbances, and compensation errors.

By establishing an accurate mathematical model, including the hysteresis of the piezoelectric actuators and the dynamics of the electromechanical characteristics of the system, we derive the feedback controller combined with the forward compensator to achieve robust tracking capability and optimized transient behavior so that the overall system can deliver nano-precision motions when tracking reference trajectories.

The proposed control framework is applied to a nano-manipulating test platform (see Fig 1), where real time embedded algorithms are developed based on the control methodology. The comparisons of the hysteresis loops between the experimental result and the rate-dependent PI model simulation result in both X-axis and Y-axis are depicted in Fig 2, where good modeling accuracy is demonstrated. Meanwhile, the circular contour tracking is also performed when X-axis and Y-axis sinusoidal tracking experiments are simultaneously actuated. The circular contour tracking results are given in Fig 3, where excellent tracking performance with two-dimensional contouring error less than 30nm is validated in the experiments.

It is worth pointing out that the developed high precision control technique has better tracking capability and transient responses, compared to existing results on nano-positioning methods. Therefore, the proposed technique can be considered as a better option supporting high precision scanning of AFM or SPM (scanning probe microscope) where trajectory tracking/scanning performance is critical for such systems, which can be illustrated in Fig 4.

Fig 2. Comparisons of the hysteresis loops between experimental results and the model outputs

Fig 3. Circular contour tracking and tracking error

Fig 4. Nano-manipulator based high precision SPM scanning

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Phosphorus quantum dot saturable absorbers for mode-locked fiber lasers

Ultrafast fiber laser sources have become an essential tool facilitating a wide range of scientific and industrial applications. In fiber lasers, ultrashort pulses can be generated by passive mode-locking. This requires the aid of a nonlinear component called saturable absorber (SA) which acts as a passive optical switch in a laser cavity. The current dominant saturable absorber is semiconducting saturable absorber mirror (SESAM), which has its own drawbacks, such as narrow operating bandwidth, complex fabrication and packaging issues. These limitations are driving research into the exploration of alternative materials for SA applications; of particular interest are two-dimensional (2D) layered nanomaterials with high optical nonlinear susceptibility, ultrafast carrier dynamics and broadband working wavelength. Among these 2D materials, black phosphorus (BP) has received particular interest with a direct bandgap varying from 0.3 eV in bulk to 2 eV in monolayer and thus offers potential in bridging the gap between zero-bandgap graphene and large-bandgap semiconducting transition metal dichalcogenides (s-TMDs).

Apart from the 2D layered structure, ultrasmall quantum dot (QD), another form of nanomaterials, exhibiting unique properties owing to the quantum confinement and edge effects, has been reported to possess prospective homogenous size and sizeable bandgap; and thus it offers new opportunities for photonic applications. Here, we fabricate the ultrasmall BP quantum dot (BPQD) based SA as an ultrafast mode-locker for short pulse generation. We demonstrate the self-starting mode-locked pulses generated from an erbium-doped (Er-doped) fiber laser to underscore its applicability as a broadband SA material.

In our experiment, the BPQDs are firstly prepared by ultrasound-assisted liquid phase exfoliation. The BPQD dispersion is then deposited on the microfiber by using optical deposition method. The BPQD-based SA is realized by the nonlinear interaction of processed nanomaterial with the evanescent field of light in a microfiber. The microscope images of the microfiber BPQD SA device are shown in Fig 1 (a). The upward image shows the microfiber coated with BPQDs at a magnification of 500 times; the downward image and the inset, at a magnification of 500 and 1000 fold respectively, present the evanescent field of light in the microfiber device after injecting a 650 nm He-Ne laser source. The nonlinear optical absorption of the integrated BPQD-SA is shown in Fig 1 (b). The saturable average power and normalized modulation depth of the device are 1.69 mW and 8.1 %. Thus, the BPQD-SA shows strong saturable absorption property illustrating potential to be used for short pulse generation.

We developed an erbium (Er)-doped fiber laser consisting of single-mode all-fiber integrated components for an alignment-free and compact system, as shown in Fig 2. The fiber amplifier consists of a length of 0.7 m single-mode Er-doped fiber (EDF) pumped by a 980 nm pump laser diode. In addition to the fiber amplifier, the cavity includes a polarization-independent optical isolator (PHISO) to ensure unidirectional propagation, 10% fiber output coupler to deliver the signal for both spectral and temporal diagnostics, and polarization controllers (PC) to enable a thorough and continuous adjustment of the net cavity birefringence. The cavity total length is ~37.8 m and the laser operated in the average-soliton regime.

Self-starting mode-locking is observed at the fundamental repetition frequency of the cavity of 5.47 MHz [Fig 3 (a)], with 24.7 pJ single pulse energy. The spectrum is centered at 1561.7 nm, with a full width at half maximum (FWHM) of 3 nm [Fig 3 (b)]. The corresponding pulse duration is 882 fs, shown in Fig 3 (c). The time-bandwidth product is calculated to be 0.325, close to the Fourier transform limit of a sech² pulse. The fundamental frequency shows a high signal to background extinction ratio of ~67 dB, indicating low-amplitude fluctuations, and stable mode-locking operation performance. The inset of Fig 3 (d) shows high cavity harmonics, recorded on a span of 150 MHz, without any noticeable sign of Q-switching instabilities, implying good pulse-train stability. To further evaluate the operating stability of the microfiber-based BPQD SA device and mode-locking performance of the fiber laser, we recorded the optical

Fig 1. (a)Photograph of the microfiber deposited with PQDs; (b)saturable absorption property of the PQD-SA device
Fig 2. The schematic of ultrafast Er-doped fiber laser
Fig 3. Mode-locking performance: (a) pulse train; (b) optical spectrum; (c) autocorrelation; (d) radio frequency spectra
Theoretical simulation and optimum design of lithium-sulfur battery electrode system

The research on the new lithium battery with high energy density, stable cycling performance and low cost has become the hotspot today, and the exploration of battery electrode material with excellent performance is of great significance to the research of lithium battery. Sulfur materials have a high theoretical energy density (2600Wh/kg), and the advantages of environment-friendly and low price, making the lithium-sulfur batteries more attractive among many different types of lithium batteries. Lithium-sulfur battery technology began to be studied in the 1960s, and, after several decades of development, the lithium-sulfur battery technology still has some problems (low discharge capacity and the rapid decayed capacity). Related research focuses on the optimization of the performance of the electrode material system. It is necessary to optimize the design of positive and negative electrode system of lithium-sulfur battery in theory.

The negative electrode system protection & modification

Lithium metal has the highest theoretical relatively capacity (3860mAh\cdot g^{-1}), the lowest density, the smallest electrochemical equivalent (0.26g\cdot Ah^{-1}) and the lowest standard potential (-3.04V) of all metal elements, which is assembled as a negative electrode metal lithium battery that has a higher capacity density and operating voltage. However, the practical application of lithium metal anode still faces many challenges, for example, charge and discharge process of lithium metal electrode changes a lot in volume; complex reaction happens on metal surface, and induces remarkable interface resistance; lithium dendrites and “dead lithium” can be caused during both charge cycle and discharge cycle, which may even induce the battery internal short circuit and cause explosion. In view of the above problems, there have been proposed various methods for modifying the surface of a lithium metal electrode and the two-dimensional layered material has been used as a protective film for a lithium metal electrode and has achieved very good results. In addition, there is a very broad space in the two-dimensional material research. One of the most promising directions is to build Vander Waals heterogeneous structure, that is, these different properties of the two-dimensional material layers stacked to form a new artificial structure. The initial results of this type of structure have shown that rich device functionality can be achieved. In the future trend of small-scale integration of small devices, the two-dimensional material heterogeneous knot must be the next generation of electronics and optoelectronics most critical elements.

In this work, the first-principles method is used to study the feasibility the two-dimensional layered materials with different elemental composition and structural features as protective films for lithium metal or sodium metal electrode, and investigate the main factors that determine the protection effects. It is found that the defect type, the crystal structure, the bond length of the key, the size of the ring and the metal neighbor effect can have a significant effect on the protective effect. On one hand, the introduction of defects, the increase of bond length and the appearance of metal proximity can promote the diffusion of lithium ions (sodium ions) through the protective film, thereby reducing the ion transport impedance and improving the electrode ion conductivity; on the other hand, all of these factors will induce the negative impacts on the mechanical properties of the protective film, so that its Young's modulus and critical strain and stress are greatly reduced, which is not conducive to inhibition of metal lithium dendrite growth.

Based on the calculated results, the theoretical analysis shows that the influence of the electrons in the two-dimensional layered material and the distribution of the charge affect the protective effect of the protective film. For example: electron capture is a major factor in determining the diffusion barrier of Li+ ion; the lower the charge density around the defect, the smaller resistance the ion diffusion passes through; the electrons in the metal transfer to the protective film, filling in the anti-binding orbit and weakening the covalent bond in the protective film, which is the origination of the metal proximity effect\textsuperscript{11}. Our study not only provides new insights into the interaction mechanism between lithium (sodium) ions and...
protective film materials at the atomic level, but also provides a basis for the study of the application of new layered materials in metal electrode systems.

The catalytic properties of the cathode system

Lithium-sulfur battery cathode material system also faces great challenges, for example: large volume expansion happens on sulfur material during lithiation process; conductivity of Li$_2$S/Li$_2$S$_x$ is poor; polysulfides easily solve in the electrolyte, resulting in the shutting effect between cathode and anode, speeding up the battery capacity attenuation and reducing the battery Coulomb efficiency. In order to solve these problems, various nanostructured electrodes are used as a loading material to suppress the dissolution and loss of polysulfides, such as nanostructured C/S composite electrodes, heteroatom-doped carbon materials, metal oxides, metal sulfides (MOF), etc., the results showing that the role of polysulfides bonding and limiting field for the electrode material design is very important, which also further improves the performance of lithium-sulfur battery and provide an important theoretical guidance. However, the understanding of the interaction between anchoring materials and polysulfides and their mechanisms for improving battery performance is not clear enough. Using the theoretical simulation and experimental analysis, the adsorption of Li-S species, the catalytic oxidation and the functional transport mechanism of Li$_2$S by metal sulfide can be investigated, and the important parameters that determine the performance of battery can be explored at the atomic scale \cite{3}.

We have focused on the interaction between the lithium-sulfur clusters and the loading materials \cite{2}. This time, we further investigate the key parameters that make great influence on catalytic properties and cycling performance. We explored the lithium-sulfur battery discharge products Li$_2$S in the metal sulfide surface catalytic oxidation mechanism, made a series of metal sulfide depth study, simulated decomposing energy barrier and transport energy barrier. The results show that the size of the catalytic oxidation-reduction ability of metal sulfide, as the main material, is very important for the transportation of lithium ions and the adsorption of polysulfide.

The strong interaction between metallic conductivity and Li$_2$S/Li$_2$S$_x$ can reduce the energy barrier, promote the transport of lithium ions, control the surface precipitation of Li$_2$S, accelerate the surface-mediated redox process, and improve the Li-S battery overall performance. Experimental results show that the decomposing energy barrier and transport energy barrier have important effect on the initial over-potential and lithiation reaction rate.

Through a systematic study on various metal sulfides, especially compared with carbon materials like Ni$_2$S$_2$, SnS$_2$, FeS, and other electrode load materials, VS$_2$, TiS$_2$, CoS$_2$, and other materials as a positive electrode have a higher specific capacity, lower over-potential and good cycle stability. It is demonstrated that the inherent metallic conductivity, strong interaction with LiPSs, facilitated Li ion transport, controlled Li$_2$S precipitation, accelerated surface mediated redox reaction, and catalyzing reduction/oxidation capability of MxSy are critical in reducing the energy barrier and contributing to the remarkably improved battery performance. More importantly, our density functional theory simulation results are in good agreement with our experiments measuring the activation barrier, polysulfide adsorption, lithium diffusion rate, and electrochemical behavior, which allows us to identify the mechanism for how binding energy and LiPSs trapping dominate the Li$_2$S decomposition process and overall battery performance. The catalytic mechanism of Li$_2$S catalytic oxidation of metal sulfide is expounded by the first-principles calculation and experiment. It provides a practical and feasible way for designing new electrode materials and improving the performance of lithium-sulfur battery \cite{3}.

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References


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Education, Research Background and Honors

Toshitaka Kajino was born in Niigata, Japan in 1956 as the third son of his father who was a high school math teacher, and his mother who was from an old family with over 400 years of history. In his childhood, he had wanted to become a novelist, a calligrapher in China, a medical doctor, or a scientist. He was the first in his family and among his relatives to receive the PhD degree. He earned his B.S. in physics in 1979 and his PhD in physics in 1984 from the University of Tokyo under the supervision of Professor Akito Arima, who is currently Honorary Distinguished Professor of Beihang University. From 1984 to 1993, he was on faculty of Tokyo Metropolitan University. In 1993, he moved to National Astronomical Observatory of Japan and joined the faculty of Department of Astronomy, Graduate School of Science at the University of Tokyo. He has been keeping the professorship in these two institutions till now.

Active Research Areas

Research on Big-Bang Cosmology and Element Genesis: After completing his PhD degree, Kajino went directly to join the Department of Physics at Tokyo Metropolitan University, where he studied Big-Bang cosmology and primordial nucleosynthesis. In 1989, he proposed an inhomogeneous
keeps a very good collaborative relationship with Chinese scientists in the field of nuclear astrophysics and cosmology. In March, 2017, the International Research Center for Big-Bang Cosmology and Element Genesis was established at Beihang University, of which he is the director. The Research Center will mainly focus on the fundamental study and the interdisciplinary research on cosmological origin and evolution of elements. He shall activate even stronger collaboration among all faculty members in the Research Center for Nuclear Science and Technology (RCNST) and the School of Physics and Nuclear Engineering, as well as the International Research Institute for Multidisciplinary Science at Beihang University.

Kajino is internationally renowned nuclear astrophysicist and cosmologist. The 13th International Conference on Origin of Matter and Evolution of Galaxies (OMEG), which Kajino and his colleagues started in 1991, was held in Beijing in 2015. He also chaired the 14th International Symposium on Nuclei in the Cosmos (NIC) in his home town, Niigata, Japan in 2016.

Kajino visited China many times and keeps a very good collaborative relationship with Chinese scientists in the field of nuclear astrophysics and cosmology. In March, 2017, the International Research Center for Big-Bang Cosmology and Element Genesis was established at Beihang University, of which he is the director. The Research Center will mainly focus on the fundamental study and the interdisciplinary research on cosmological origin and evolution of elements. He shall activate even stronger collaboration among all faculty members in the Research Center for Nuclear Science and Technology (RCNST) and the School of Physics and Nuclear Engineering, as well as the International Research Institute for Multidisciplinary Science at Beihang University.

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WELCOME new starters
Beihang University Calls for Global Talents

Founded in 1952, Beihang University is one of the top research universities in China, focusing on basic and cutting-edge research and high-level education. One of the first universities funded by China’s “211” and “985” programs, it has seven state key laboratories and twenty-five provincial and ministerial key laboratories. Today, Beihang University is known for outstanding research and education in aviation and aerospace sciences, power and energy engineering, material science, mechanics, information science, transportation science, apparatus science, management and law.

Beihang University is committed to its goal of becoming a world-class university with top ranking science and engineering disciplines. As part of Beihang’s further pursuit for excellence in research and education, we have expanded our global search for the best research talents to join our International Research Institute for Multidisciplinary Science (IRIMS). Eleven independent international research centers were established under the name of IRIMS. As the core of IRIMS, these research centers are devoted to establishing a world-class, advanced and multidisciplinary research platform.

Beihang University welcomes applications for full-time professors, associate professors and excellent scientists. Preference will be given to candidates whose research emphasis demonstrates the potential to complement and advance the IRIMS existing research strengths. Successful candidates will be provided competitive salaries and start-up funds, in line with “Global Talent 1000” Program, “Global Youth Talent 1000” Program and Beihang “Zhuoyue” Program.

Requirements & Qualifications

Global Youth Talent 1000 Program: candidates should be under the age of 40; have obtained a PhD degree from a world-renowned university with at least 3 years of research experience abroad; or have obtained a PhD degree in Chinese mainland with at least 5 years of research and teaching experience abroad; special offers will be granted to those who have excellent research achievements during their doctoral study.

“Zhuoyue” Program Professor & Associate Professor: candidates should have a PhD degree from a world-renowned university; or have obtained a PhD degree in Chinese mainland with at least 2 years (Professor) or 1 year (Associate Professor) of research experience abroad; have a proven record of faculty or research fellow position abroad before coming to China.

We also welcome eminent scholars, both domestic and international, to join the IRIMS and create its international excellence.

Interested individuals should contact relevant Schools to send application materials. For policy-related matters, please contact the Human Resource Department at rsc@buaa.edu.cn or visit http://rsc.buaa.edu.cn. For more information about Beihang University, please visit www.buaa.edu.cn.
International Research Institute for Multidisciplinary Science