PKU ACCELERATES A VISION OF TOMORROW

Renowned as a research leader, Peking University (PKU) keeps pushing the boundaries to produce novel technologies that will advance research and benefit humanity. Its scientists are exploiting cutting-edge methods to develop the latest research equipment and platforms and provide a strong foundation for breakthrough opportunities.

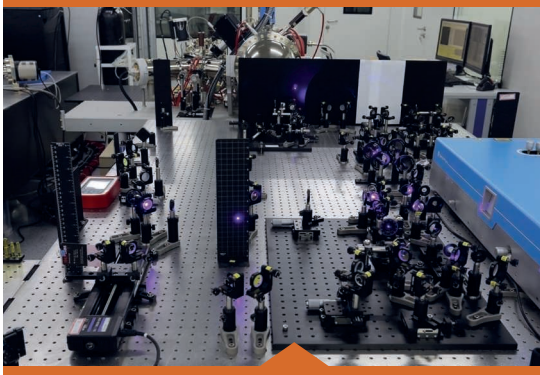
One example is the ultra-compact laser plasma accelerator built by PKU physics professor Yan Xueqing and his team, almost 40 years after Tajima and Dawson first proposed the concept in 1979. Based on interactions between high-intensity laser pulses and plasmas, this novel system can generate electric fields more than 1,000 times greater than those produced by conventional accelerators, and speed up protons to 15 MeV, producing high-energy particle beams with an energy spread of 1% and a low charge of 10pC. As reliable as a conventional accelerator, Yan's version greatly reduces complexity and cost. It has proven to be a success in terms of quality assurance, stability, intensity, control and repeatability of proton beams. "The laser accelerator will spur a new wave of technological revolution," says Yan, who is optimistic about its application in proton therapy for cancer. "It will also enable significant advances in particle and medical physics, structural biology, fundamental chemistry and materials science."

Another physics professor, Gong Qihuang, is dedicated to advancing photoelectron imaging technology, which enables micro-scale probing of electronic structures and dynamics by using ultra high spatial-temporal resolutions. Based on the photoelectric effect, his team have developed an experimental platform that integrates femtosecond laser pulses with high temporal resolution, and nanoscale ultra high spatial resolution with electrons. It uses ultrafast lasers to excite a sample for the generation of emitted photoelectrons and a set of electronic lenses to control photoelectrons for direct imaging. Harnessing key technologies like optical probing for the measurement of weak signals, the platform marks an important improvement in ultra high spatial-temporal resolution technology and provides a novel tool for optoelectronics, photonics, plasmonics, ultrafast spectroscopy and micronano device research, broadening our understanding of the microscopic world.

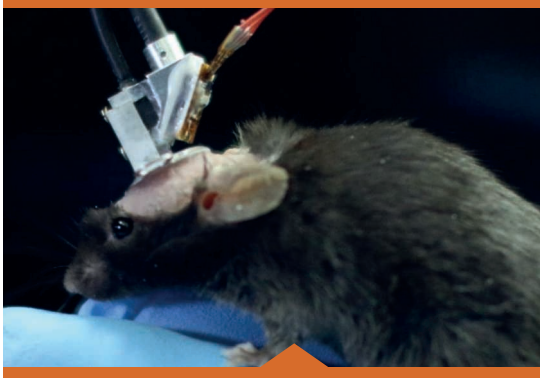
Imaging technology can also be applied to unveil the neural mechanisms underlying brain activities. Using a hollow photonic crystal fibre that delivers 920nm femtosecond laser pulses, a MEMS scanning mirror and a super-flexible fibre bundle, an interdepartmental team led by Cheng Heping, a professor from PKU's Institute of Molecular Medicine, designed a head-mounted high-resolution, very fast, miniaturized, two-photon microscope called FHIRM-TPM. With high spatiotemporal resolution, it allows imaging of synaptic transmission in freely-behaving animals and reveals local spine activities, contributing to the understanding of information integration processes *in vivo*. Cheng's team also succeeded in attaching the microscope to a gradient index (GRIN) lens deeply embedded in the mouse's hippocampus, allowing monitoring of neuronal structure and activities deep within its brain. The microscope will also enable the probing of longer-term interactions between different brain regions during specific behaviours.

Medical application of imaging technologies is also well-represented in work by the molecular imaging laboratory of PKU's biomedical engineering department. Led by professor Ren Qiushi, the team is devoted to the research and development of multimodal, multi-scale, molecular imaging equipment, capable of movement control, data collection, image reconstruction and integration, as well as image analysis and processing. Their advanced multimodal pre-clinical imaging system integrates CT, PET, SPECT and FMT, a world-first, and has been successfully commercialized. The team's Ray-Scan 64-Slice PET/CT clinical imaging system received a medical device registration certificate from the China FDA in early 2014. These systems are invaluable in the early diagnosis of severe diseases, major drug discovery, and research efforts by universities and technology companies. "Our next step is to collaborate with international experts to achieve ultra high resolutions for our imaging equipment," says Ren. ■

The ultra-compact laser plasma accelerator developed by Yan Xueqing's team can be applied in cancer therapy.



The photoelectron imaging experimental platform designed by Gong Qihuang's team achieves ultra high spatial-temporal resolution.



Cheng Heping's high-resolution, fast, miniaturized two-photon microscope enables imaging of neuronal structures in moving animals.

Ren Qiushi's team has developed a multimodal molecular imaging system, an important aid for the early diagnosis of cancer.