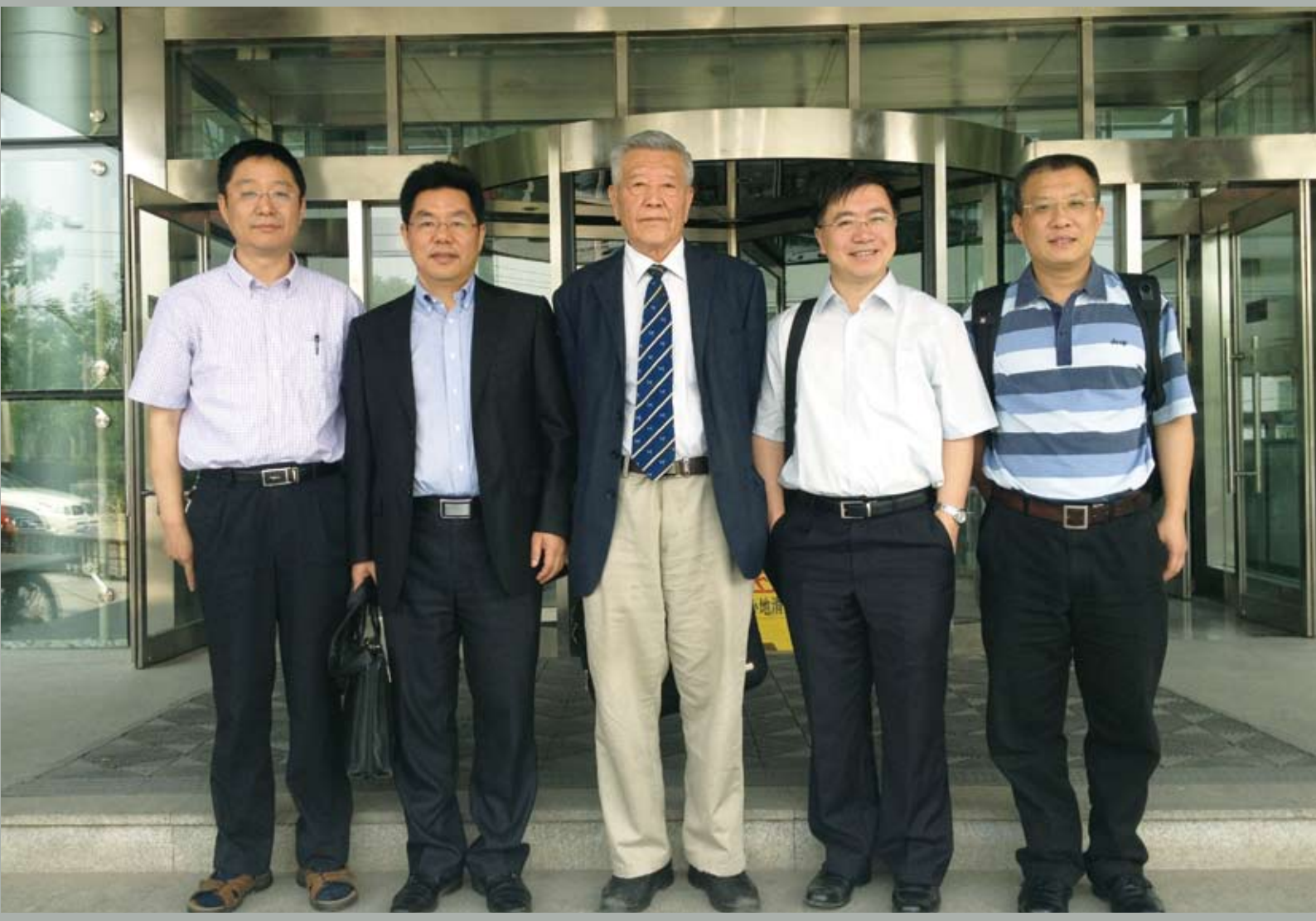
Editor's note:
Lately the CAS selected 25 from the many achievements scored by its scientists during the period of the 12th National Five-Year Plan (from 2011 to 2015) and highlighted them as major S&T achievements and hallmark advances. *BCAS* is presenting some of them in installments, with the first appearing here in two short reports.

Discovery of Iron-based High-temperature Superconductors with Critical Temperature beyond 40 K and Studies on Some Fundamental Physical Properties

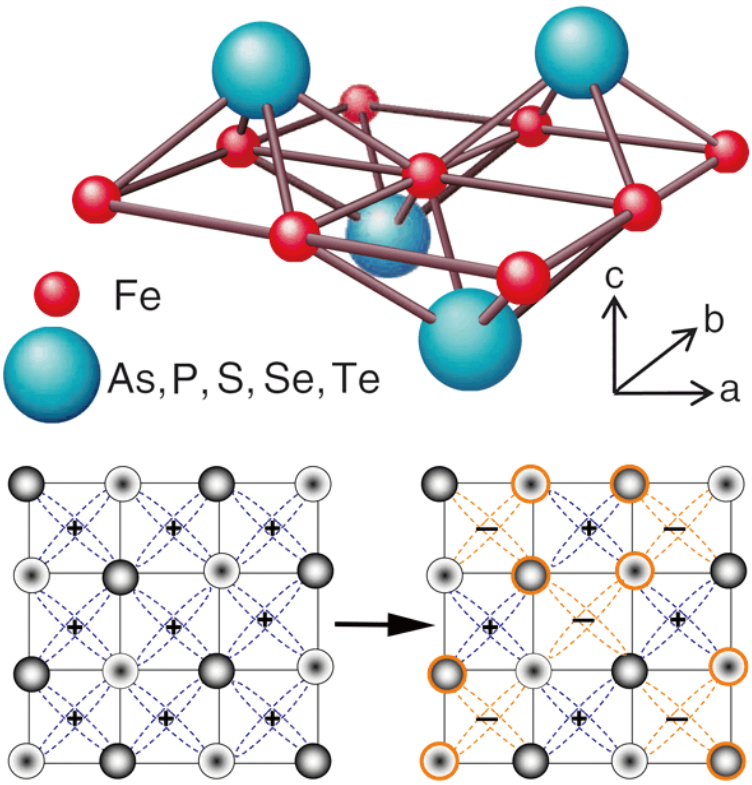


The joint team won the First Prize from the National S&T Awards for Natural Sciences in 2013, after a three-year vacancy of this prize. From left to right: Profs. WANG Nanlin, CHEN Xianhui, ZHAO Zhongxian, WEN Haihu and FANG Zhong.

Superconductivity, the mysterious absence of electrical resistance and appearance of complete diamagnetism manifesting in some materials below a critical temperature, has drawn a lot of attention from physicists since its first identification by Prof. Heike Kamerlingh Onnes and his colleagues of Leiden University, the Netherlands in 1911. Due to its great potential in the technology of electrical engineering, information, track transportation, bio-medicine, etc., the research of superconductivity has always been an attractive field in science. In particular, high-temperature (HT) superconductivity, which appears above the temperature of McMillan Limit (commonly assumed as 39 kelvin) under ambient pressure, has been assiduously explored by scientists all over the world.

To some extent, the fact that as many as 10 scientists have been awarded with the Nobel Prize for physics in recognition of their contributions to superconductivity and underlying physical mechanisms has footnoted the significance of this mysterious phenomenon for human beings. Still, for physicists around the world, unconventional superconducting mechanisms and explorations of novel superconductors remain the most attractive subjects to pursue, as the frontiers of physical studies.

Based on their long time accumulation in this field, a joint team established by collective and cooperative forces from the Institute of Physics (IOP) of CAS, and the University of Science and Technology of China (USTC) made a lot of discoveries of original innovations. Standing out from others are the following: the breaking through of the McMillan Limit of superconducting transition temperatures and the identification of iron-based superconductors as a new family of HT superconductors; the successful synthesis of a series of novel iron-based superconducting materials as well as the identification of them as the second family of HT superconductors; and the verification of iron-based superconductors as unconventional superconductors out of their basic physical characteristics. Particularly, the team remains the record holder of the highest critical temperature achieved so far — they succeeded in achieving superconductivity at a critical temperature as high as 55 K. Due to their excellent performance and significant contributions, major contributors of the team, namely CAS academician Prof. ZHAO Zhongxian (IOP), Profs. CHEN Xianhui (USTC),

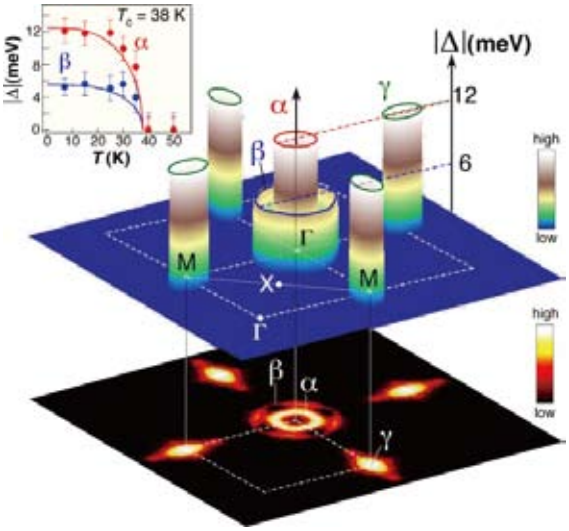


Schematic structure of the Fe-As or Fe-Se layer in an iron-based superconductor, as revealed by IOP scientists

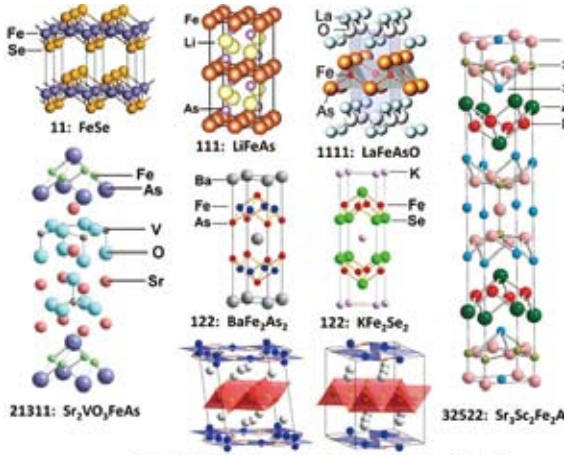
WANG Nanlin (IOP), WEN Hai-Hu (IOP) and FANG Zhong (IOP) won the First Prize from the 2013 National S&T Awards for Natural Sciences, after a three-year-long vacancy during which no recipient was deemed to be worthy of this prestigious prize.

Up to the date of January 4, 2013, the eight representative papers published by the team on iron-based superconductors had been cited by international community for 3801 times, and other 20 major papers for 5145 times. Their work drew intensive attention in the international community, and as a result has stayed in spotlight, being reported and highlighted with commentaries by internationally recognized well-known journals, such as *Science*, *Nature*, *Physics Today*, and *Physics World*, among others. "Several groups in China are building on the recent discovery of a new superconductor that carries electricity without resistance at a relatively balmy temperature of 26 kelvin," the top journal *Science* concluded in a commentary published on April 25, 2008 entitled *New Superconductors Propel Chinese Physicists to Forefront*. "What surprises me — probably it shouldn't — is the number of good papers coming out of Beijing," commented Prof. Peter Hirschfeld, a theorist from the University of Florida, Gainesville. "They've really jumped on this," he was quoted in the same commentary. Another physicist, Prof. Steven Kivelson from Stanford University was also quoted expressing his surprise: "What's striking is not only that it's coming out of China but that it's not coming out of the United States."

According to statistics released by the National Science Library, CAS, as of February 2013, among the 20 most frequently cited papers on iron-based superconductivity or superconductors, nine were contributed by Chinese authors; and among them seven were authored/co-authored by scientists from IOP.



IOP scientists conduct research in the newly identified superconductors using highly accurate Angle Resolved Photoemission Spectroscopy (ARPES).



Atomic structures of selected major types of iron-based superconducting systems, many of which were discovered by the IOP/USTC team.