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Effect of Isoelectronic Doping at the As Site in Iron-based Superconducting Systems

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FeAs-based superconductivity can be induced with various doping strategies—either electron doping, hole doping or isoelectronic doping. In this talk, we will focus on the unique isoelectronic doping at the As site. By using different dopants such as P [1,2] or Sb [3], positive or negative chemical pressure can be generated onto the FeAs layers. The positive chemical pressure suppresses/destroys the spin-density-wave (SDW) ordering, and then superconductivity emerges around a quantum critical point. In contrast, the negative pressure tends to recover the suppressed/hidden SDW ordering. The isoelectronic doping also influences the electronic and magnetic state of 4f electrons in the rare-earth atomic layers and 3d electrons of the Fe planes, especially in the case of proximity between 4f and 3d energy levels. This was manifested by the observation of local-moment ferromagnetism of 4f electrons in $\text{EuFe}_2(\text{As}_{1-x}\text{P}_x)_2$, $\text{CeFeAs}_{1-x}\text{P}_x\text{O}$ and $\text{CeFeAs}_{1-x}\text{P}_x\text{O}_{0.95}\text{F}_{0.05}$ [4] systems. Our results demonstrate the intriguing interplay/competition of intersite RKKY coupling among 4f-moments, intrasite Kondo interaction between 4f- and 3d- electrons, and \mathbf{k} -space Cooper pairing of 3d electrons. This work was done in collaboration with Zhu-An Xu and Jian-Hui Dai, and was supported by National Basic Research Program of China (Grant Nos. 2007CB925001 and 2010CB923003).

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