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Spin anisotropy due to spin-orbit coupling in optimally hole-doped $\mathbf{Ba_{0.67}K_{0.33}Fe_2As_2}$ YU SONG, HAORAN MAN, RUI ZHANG, XINGYE LU, CHENGLIN ZHANG, Rice University, MENG WANG, University of California, Berkeley, GUOTAI TAN, Beijing Normal University, L.-P. REGNAULT, Universite Grenoble Alpes, YIXI SU, Julich Centre for Neutron Science, JIAN KANG, R. M. FERNANDES, University of Minnesota, PENGCHENG DAI, Rice University —
We use polarized inelastic neutron scattering to study the temperature and energy dependence of spin space anisotropies in the optimally hole-doped iron pnictide $Ba_{0.67}K_{0.33}Fe_2As_2$ ($T_c = 38$ K). In the superconducting state, while the high-energy part of the magnetic spectrum is nearly isotropic, the low-energy part displays a pronouced anisotropy, manifested by a c-axis polarized resonance. We also observe that the spin anisotropy in superconducting $Ba_{0.67}K_{0.33}Fe_2As_2$ extends to higher energies compared to electron-doped $BaFe_{2-x}TM_xAs_2$ (TM =Co, Ni) and isovalent-doped $BaFe_2As_{1.4}P_{0.6}$, suggesting a connection between T_c and the energy scale of the spin anisotropy. In the normal state, the low-energy spin anisotropy for optimally hole- and electron-doped iron pnictides onset at a temperature similar to the temperature in which the elastoresistance deviates from Curie-Weiss behavior, pointing to a possible connection between the two phenomena. Our results highlight the relevance of the spin-orbit coupling to the superconductivity of the iron pnictides.

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