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Magnetic correlations in FeSe-based superconductors[1]

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Elucidating the nature of the magnetism of a high-temperature superconductor is crucial for determining the mechanism behind superconductivity. It is well established that the parent compounds of the cuprate and iron-pnictide superconductors exhibit Neel and stripe magnetic order, respectively. In contrast, FeSe exhibits nematic order but not magnetic order in the parent phase, and its magnetic ground state is undetermined. In this work, we used inelastic neutron scattering to study the spin fluctuations in FeSe ($T_c = 8.7$ K) and heavily electron-doped FeSe-based superconductor $Li_{0.8}Fe_{0.2}$ODFeSe ($T_c = 41$ K). The results revealed the coexistence of spin fluctuations near (π, 0) and (π, π) in FeSe, both of which are coupled to nematicity. The quantitative measurements of energy and momentum dependence of the spin fluctuations above and below the nematic phase transition show that FeSe is an S = 1 nematic quantum-disordered paramagnet. In addition, in $Li_{0.8}Fe_{0.2}$ODFeSe, ring-shaped magnetic resonant excitations were observed at 21 meV at (π, 0.62π) and equivalent wavevectors surrounding (π, π). As the energy increased, the spin fluctuations display a twisted dispersion, which is different from that of iron pnictide superconductors, but rather analogous to that of hole-doped cuprates. The effect of electron doping on the spin fluctuations, nematicity, and superconductivity in this system will be discussed. References: 1) Q. Wang et al., Nature Communications 7, 12182 (2016) 2) Q. Wang et al., Nature Materials 15, 159, (2016) 3) B. Pan et al., arXiv:1608.01204 (2016)

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