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Prominent role of spin-orbit coupling in FeSe revealed by inelastic neutron scattering YUAN LI, MINGWEI MA, Peking University, PHILIPPE BOURGES, YVAN SIDIS, Laboratoire Leon Brillouin, CEA Saclay, France, YANG XU, SHIYAN LI, Fudan University, BIAOYAN HU, JIARUI LI, FA WANG, Peking University — In most existing theories for iron-based superconductors, spin-orbit coupling (SOC) has been assumed insignificant. Here we use spin-polarized inelastic neutron scattering to show that collective low-energy spin fluctuations in the orthorhombic (or "nematic") phase of FeSe possess nearly no in-plane component. Such spin-space anisotropy can only be caused by SOC. It is present over an energy range greater than the superconducting gap $2\Delta_{sc}$ and gets fully inherited in the superconducting state, resulting in a distinct c-axis polarized "spin resonance". Our result demonstrates the importance of SOC in defining the low-energy spin excitations in FeSe, which helps to elucidate the nearby magnetic instabilities and the debated interplay between spin and orbital degrees of freedom. The prominent role of SOC also implies a possible unusual nature of the superconducting state.

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