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Magnetic fluctuations in single layer FeSe

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Single layer FeSe films grown on $SrTiO_3$(001) (STO) have been an extensive focus because of their reported high superconducting critical temperature of 40-100K. Despite a lot of work done already, the nature of the paramagnetic state and the origin of superconductivity remains puzzling. Here we use density functional theory (DFT) spin-spiral calculations to address the paramagnetic and superconducting nature of the monolayer FeSe/STO. The spin-spiral energy dispersion E(q) is found to be extremely flat around the q=0 checkerboard (CB)-antiferromagnetic (AFM) configuration. Those q states in the plateau share similar electronic band structure. Mapping E(q) onto (extended) Heisenberg models places this S=1 spin system in a region of parameter space where CB-AFM quantum fluctuations lead to a magnetically disordered paramagnetic state. Modeling the paramagnetic state as an incoherent superposition of spin-spiral states arising from thermal/quantum fluctuations, the electronic spectrum around the Fermi level closely resembles that observed by angle-resolved photoemission spectroscopy. A superconducting theory is developed within a symmetry-based $k{\cdot}p$ like method with the electrons coupled to CB-AFM type spin fluctuations; this model provides a robust prediction of nodeless d-wave superconductivity and naturally explains the experimental finding of fully-gapped yet anisotropic order parameter.

Biography

Tatsuya Shishidou, a native of Japan, received his Master degree in Physics (1996) from Osaka University and his PhD in Physics (1999) from Hiroshima University. He was a Research Associate at Northwestern University, Illinois with Prof AJ Freeman from 2000 to 2003. He was an Assistant Professor at Hiroshima University from 2003 to 2016. In 2016, he joined the University of Wisconsin-Milwaukee. He is currently an Associate Scientist working with Prof M Weinert. He is author and co-author of over 50 scientific publications.

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