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**Spin dynamics and a novel orbital-antiphase pairing symmetry in iron-based superconductors** ZHIPING YIN, KRISTJAN HAULE, GABRIEL KOTLIAR, Rutgers University — We use first-principles many-body method, including ab initio determined two-particle vertex function, to study the spin dynamics and superconducting pairing symmetry in a large number of Fe-based superconductors. In Fe compounds with high transition temperature, we find both the dispersive high-energy spin excitations, and very strong low energy commensurate or nearly commensurate spin response, suggesting that these low energy spin excitations play the dominate role in cooper pairing. We find three closely competing types of pairing symmetries, which take a very simple form in the space of active Fe  $3d$  orbitals, and differ only in the relative quantum mechanical phase of the  $xz$ ,  $yz$  and  $xy$  orbital contributions. The extensively discussed  $s^{+-}$  symmetry appears when contributions from all orbitals have equal sign, while the opposite sign in  $xz$  and  $yz$  orbitals leads to the  $d$  wave symmetry. A novel orbital antiphase  $s^{+-}$  symmetry emerges when  $xy$  orbital has opposite sign to  $xz$  and  $yz$  orbitals. We propose that this orbital-antiphase pairing symmetry explains the puzzling variation of the experimentally observed superconducting gaps on all the Fermi surfaces of LiFeAs. This novel symmetry of the order parameter may be realized in other Fe superconductors.

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