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Signatures of time reversal symmetry breaking in multiband superconductors

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Multiband superconductors serve as natural host to several possible gound states that compete with each other. At the boundaries of such competing phases, the system usually compromises and settles for 'mixed' phases that can show intriguing properties like co-existence of magnetism and superconductiivty or even co-existence of different superconducting phases. The latter is particularly interesting as it can lead to non-magnetic ground states that spontaneously break Time-Reversal symmetry. While the experimental verification of such states has proved to been challenging, the theoretical investigations have provided exciting new insights into the nature of the ground state and its excitations all of which have experimental consequences of some sort. These include extrinsic properties like spontaneous currents around impurity sites, and intrinsic properties in the form of collective excitations. These collective modes bear a unique signature and should provide clear evidence for time reversal symmetry broken state. While the results are general, in light of recent Raman scattering experiments, its direct relevance to extremely hole doped $\mathrm{Ba}_(1-x)K_x(FeAs)_2 will be presented where a strong competition of s-wave and d-wave ground state is expected.$