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Nodal and nodeless Superconductivity in Iron-Based Superconductors[1]

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The superconducting phase in Iron-based superconductors (pnictides) exhibits a variety of different properties depending on the doping regime and specific parameters such as band structure and interaction which describe the different compounds. The question of the symmetry of the superconducting order parameter combined with the role of interaction-induced anisotropies plays a decisive role to distinguish material- dependent effects from universal mechanisms in this family of compounds. In our talk we attempt to provide an overview of the superconducting phases currently discussed for different classes of pnictides. Specifically, we report on our work on functional renormalization group (FRG) calculations for the pnictides and how it can contribute to our understanding of the different compounds. We discuss from first principles why LaOFeAs shows nodeless while LaOFeP shows nodal anisotropic extended s-wave superconductivity, which we find to be dictated by the existence / non-existence of an additional hole pocket at $\mathrm{M} = (\pi, \pi)$ in the unfolded Brillouin zone. We also elaborate on the nodal phase in KFe_2As_2 as being of d-wave symmetry type and explain its microscopic origin related to the absence of electron pockets which are gapped out at large hole doping. In particular, we will draw a direct line from band structure and interaction parameter calculations to FRG which accomplishes to study Fermi surface instabilities from a truly ab initio starting point, and illustrate this approach for the LiFeAs compound.

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