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Effects of competing Neel-type magnetic fluctuations and nematic order on the superconductivity of the iron arsenides[1] RAFAEL M. FERNANDES, University of Minnesota, ANDREW J. MILLIS, Columbia University —
In many iron-based superconductors, the presence of two matching electron pockets displaced by (π, π) gives rise to Neel-type magnetic fluctuations, in addition to the usual stripe-type magnetic fluctuations peaked at $(\pi, 0)$ and $(0, \pi)$. Indeed, recent neutron scattering experiments observed both types of fluctuations in certain hole-doped iron pnictides, which intriguingly do not display superconductivity. In this talk, we employ an Eliashberg approach to address the impact of competing (π, π) and $(\pi, 0)$ fluctuations on the superconducting state of the iron arsenides. We show that, surprisingly, even weak short-ranged Neel fluctuations strongly suppress the $s^{\pm}$ state. The main contribution to this suppression comes from a repulsive $s^{\pm}$ interaction induced by the Neel fluctuations, and not from the inelastic scattering pair-breaking that they promote. Upon enhancing the strength of the Neel fluctuations, a d-wave state appears, preceded by either an intermediate $s + id$ state or a non-superconducting region, forming a two-dome structure. We compare our results to experimental findings, and discuss their implications to the optimal T_c of the iron arsenides, arguing that it can be enhanced via a tetragonal-symmetry breaking induced by nematic order.

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