Superconductivity and electronic systems close to the phase separation instability

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Abstract: Short-range interactions in electronic systems lead to the various types of orderings that are sensitive to the variation of electronic concentration. This includes systems with the charge, spin, or orbital ordering, either purely electronic or cooperative with lattice deformation. Electronic phase separation instability lends itself as a way to optimize the concentration of electrons in segments of the material. In systems with mobile counter-ions this scenario has been observed as a real phase separation in several instances, but more interesting are the cases in which the counter-charges are immobile, since the long-range Coulomb forces strongly influence the state of the electronic system. Depending on the parameters such as carrier concentration, stiffness of the lattice modes, electronic order etc, two generic cases are possible. First is the case of the statically or dynamically textured electronic system, composed of the "electron-rich" and "electron-poor" regions. Second, and even more interesting, is the case in which the long-range Coulomb forces and electronic charge fluctuations completely forbid the separation, leading to a homogenous electronic phase with anomalous dielectric properties and electronic interactions favouring superconductivity. We review these scenarios in our model with strong electronic interactions and discuss some recent experimental developments, particularly in relation to some new phase diagrams discovered in 1T-phase of layered transition-metal dichalcogenides. The latter exhibit an interesting combination of Mott, charge-density-wave and superconducting phases.

Related references

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