From Cuprates to Irridates: an optical study of the anomalous pseudo-gap

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Many body systems involving strongly interacting electrons exhibit various rich and interesting physical phenomena, among them the well known Mott insulator. Undoped cuprates and iridates belong to this class, and have in common that the Mott-insulating state is formed by half-occupying a single non-degenerate band. In the case of the cuprates doping holes or electrons in the Mott-insulating phase results in high Tc superconductivity, the exact mechanism of which is still not fully established. Based on strong similarities in crystal structure and the common feature of the Mott-insulating parent state, the effect of doping Sr_2IrO_4 is expected to result in a superconducting state. While superconductivity has not yet been established in this family of materials, a peculiar gap in the density of states is observed both in iridates and in cuprates. In the cuprates the pseudo-gap feature shows up in various different types of charge and spin spectra, in particular in the infrared optical spectra. An important unanswered question concerns the relation and/or interplay between the pseudo-gap state and the superconducting state: are they competing phases or is the former a precursor of the latter ? Here we present optical data on a wide range of cuprate [1] and iridate [2] compounds, and investigate the doping and temperature dependence of the pseudo-gap at low energies. We demonstrate the similarity of the optical signature for a pseudo-gap in disordered superconductors close to a metal-insulator transition of the Mott type [3]. Based on these similarities, and the absence of a correlation between superconductivity and pseudo-gap in a broad class of materials, we argue that the pseudo-gap is a signature of the presence of residual correlations unrelated to pair-formation, which are inherited from the correlated insulating state.

References

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