4CS20-2020-000206

Abstract for an Invited Paper
for the 4CS20 Meeting of
the American Physical Society

Low-valence layered nickelates: a cuprate analog for high-temperature superconductivity?

ANTIA BOTANA, Arizona State University

The physics behind high-temperature superconductivity in cuprates remains a defining problem in Condensed Matter Physics. Among the myriad approaches to addressing this problem has been the study of alternative transition metal oxides with similar structures and electron count that are suggested as proxies for cuprate physics. After 30 years of trying, a non-cuprate compound with a cuprate-like structure that exhibits superconductivity at high temperature has been found: hole-doped NdNiO2. Because this material is a member of a series of reduced layered nickelates, this result suggests the possibility of a new family of unconventional superconductors. By means of first-principles calculations, we have analyzed the similarities and differences between this family of low-valence planar nickelates and cuprates. Even though the nickel oxide materials possess a combination of traits that are widely considered as crucial ingredients for superconductivity in cuprates (a square-planar nature, combined with the appropriate 3d-electron count, and a large orbital polarization) they also exhibit some important differences (a much larger d-p energy splitting, and lack of magnetism in the parent compound). Our results show that low-valence layered nickelates offer a new way of interrogating the cuprate phase diagram and are singularly promising candidates for unconventional superconductivity.