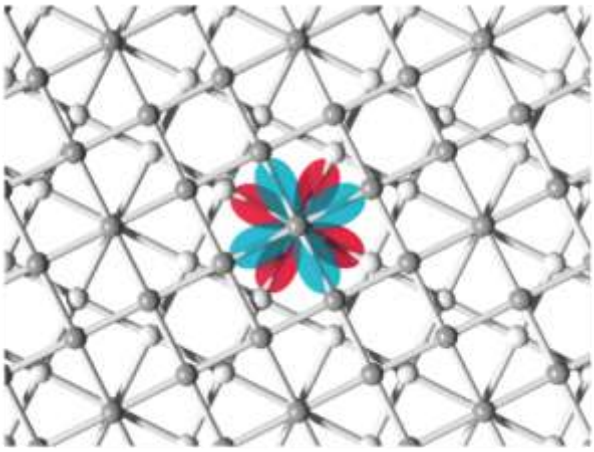
High-temperature topological superconductivity in twisted double layer copper oxides

Marcel Franz
Oguzhan Can, Tarun Tummuru, Ryan P. Day, Ilya Elfimov, Andrea Damascelli
Quantum Matter Institute, University of British Columbia, Vancouver BC, Canada V6T 1Z4
franz@phas.ubc.ca

Abstract:

A great variety of novel phenomena occur when two-dimensional materials, such as graphene or transition metal dichalcogenides, are assembled into bilayers with a twist between individual layers. As a new application of this paradigm, we consider structures composed of two monolayer-thin *d*-wave superconductors with a twist angle θ that can be realized by mechanically exfoliating van der Waals-bonded high-Tc copper oxide materials, such as $Bi_2Sr_2CaCu_2O_{8+\delta}$. On the basis of symmetry arguments and detailed microscopic modelling, we predict that for a range of twist angles in the vicinity of 45^o, such bilayers form a robust, fully gapped topological phase with spontaneously broken time-reversal symmetry and protected chiral Majorana edge modes. When $\theta \approx 45^o$, the topological phase sets in at temperatures close to the bulk $T_c \simeq 90$ K, thus furnishing a long sought realization of a true high-temperature topological superconductor.

REFERENCES



FIGURES

Figure 1: Schematic view of two copper-oxygen square lattices with twist angle close to 45^O.