Materials Science & Engineering Program

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Flat-Band Materials

Unlike a localized state induced by defect in a crystalline solid, the so-called flat band is truly a Bloch state but yet without band dispersion. It arises from destructive interference of Bloch wave functions, independent of the single-particle crystalline Hamiltonian (i.e., the strength of lattice hopping). Flat band can host a range of exotic quantum phases, such as ferromagnetism, Wigner crystallization, superconductivity and high-temperature fractional quantum Hall effect. In this talk, I will first briefly review lattice models which give rise to 2D/3D flat bands including a new Coloring-Triangle lattice we found recently. I will then discuss real flat-band materials including our recent work on pyrochlore Sn2Nb2O7 which hosts 3D flat bands. A novel mechanism for the formation of Weyl points enabled by doping of doubly degenerated 3D flat bands, instead of symmetry breaking of a Dirac point, will also be discussed.

Biosketch

Feng Liu, Professor and Chair, Department of Materials Science and Engineering, Adjunct professor, Department of Physics, University of Utah. He received his PhD in Chemical Physics from Virginia Commonwealth University in 1990. Prof. Liu is a fellow of American Physical Society and recipient of Senior Humboldt Award. His research interest lies in theoretical and computational studies of low-dimensional nano and quantum materials, with a most recent focus on topological materials. He is also a co-founder of two high-tech start-up companies.

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