Pairing induced by third electron

I will present a simple mechanism and an exact theory of electron pairing from repulsive interaction. When the kinetic energy is small, the dynamics of nearby electrons on a lattice becomes strongly correlated. By developing a controlled kinetic energy expansion, I will show that two doped electrons in an insulator can attract and form a bound state. This attraction in a repulsive Fermi system can be understood in terms of correlated electron hopping assisted by a third nearby electron in real space, or in a complementary picture, as a consequence of virtual interband transition of a third electron in a completely filled band. Different from the Kohn-Luttinger theory, this three-particle pairing mechanism does not rely on the existence of Fermi surface and is operative at infinitesimal carrier density. It enables spin-triplet superconductivity, pair density wave, BCS-BEC crossover and Feshbach resonance involving electron trimers. Possible realization in twisted bilayer graphene, ZrNCl and WTe2 will be discussed.

[1] V. Crepel and L. Fu, Science Advances 7, eabh2233 (2021) [2] V. Crepel and L. Fu, arXiv:2103.12060 [3] K. Slagle and L. Fu, Phys. Rev. B 102, 235423 (2020) [4] V. Crepel, T. Cea, L. Fu and F. Guinea, to appear