Nikolay Prokofiev

Bi-polaron superconductivity in the low density limit

It has been assumed for decades that high values of Tc from the electron-phonon coupling are impossible. At weak-to-intermediate coupling strength this result follows from the Migdal-Eliashberg theory, while at strong coupling, when bipolarons form, the transition temperatures are low because of the large effective mass enhancement. However, the latter conclusion was based on numerical solutions of the Holstein model. I will discuss a different model with electron-coupling based on the displacement modulated hopping of electrons and argue that much larger values of the bipolaron Tc can be achieved in this setup. Non-locality of the problem gives rise to small-size, yet relatively light bipolarons, which can be studied by an exact sign-problem-free quantum Monte Carlo approach even in the presence of strong Hubbard and Coulomb potentials. We find that Tc in this model generically and significantly exceeds typical upper bounds based on Migdal-Eliashberg theory or superfluidity of Holstein bipolarons, and, thus, offers a route towards the design of high-Tc superconductors via functional material engineering.