Multicomponent electron-hole superfluidity in double bilayer graphene.

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Superfluidity in coupled electron-hole sheets of bilayer graphene[1] is multicomponent[2] because of the small tunable bandgap between the conduction and valence bands[3]. We investigate the superfluid BEC-BCS crossover properties as functions of the carrier densities and the energy bandgaps. We determine the momentum dependent multicomponent superfluid gaps, the multicomponent condensate fractions, and the chemical potential.

For small bandgaps, we find that the valence band enhances superfluidity, but that the interaction-driven excitations from the valence to the conduction band can inhibit the system from entering the BEC regime even at very low densities.

We establish an optimal range of densities and energy bandgaps to suppress excitations from the valence band and to make the superfluidity strong enough to push the system into the strongly coupled BEC regime. We show that this is the optimal condition for the realization of high-T_C superfluidity.

References

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