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Generating electron-hole superfluidity in experimentally realizable graphene and GaAs heterostructures DAVID NEILSON, ANDREA PERALI, University of Camerino, ANDREW CROXALL, Cambridge University, ALEXANDER HAMILTON, University of New South Wales — Exciton bound states in solids between electrons and holes have been predicted to form a superfluid at high temperatures. We present results of determination of the experimental parameter ranges needed for generating electron-hole superfluidity in three different heterostructures: double bilayer graphene, GaAs double quantum wells, and hybrid hole-bilayer graphene – GaAs electron-quantum well structures. We find that in the double bilayer graphene [1] and GaAs quantum well systems, the sample parameters necessary to generate equilibrium superfluidity of the electron-hole pairs are close to values already achieved in experiments. Our results indicate that the superfluid transition temperatures should be at or above liquid helium in both cases. For the hybrid bilayer graphene – GaAs quantum well structure, we obtain chiral superfluid states with phase coherence across the graphene–GaAs interface. Our results are based on a mean field approach with self-consistent screening of the pair Coulomb interaction. This approach has been successfully tested in a quantitative way [2] against recent Diffusion Quantum Monte Carlo results in a related system.

[1] A. Perali, *et al.*, Phys. Rev. Lett. **110**, 146803 (2013)
[2] D. Neilson, *et al.,* arXiv:1308.0280

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