



**International Conference on Multi-Condensate Superconductivity and
Superfluidity in Solids and Ultra-Cold Gases
14 - 18 May 2018 (Trieste, Italy)**

**Characterization of the Superfluid Properties of Electron-hole Double
Layers using Diffusion Quantum Monte Carlo**

**Pablo LÓPEZ RÍOS, Andrea Perali, Richard J. Needs, and
David Neilson**

Fixed-node diffusion quantum Monte Carlo (DMC) is a powerful computational tool capable of accurately describing systems with strong interparticle correlations. The DMC method has been used in total-energy studies of electron-hole systems in the past. In our work we compute DMC excitation energies, which we then interpret from a BCS-like perspective to obtain the superfluid gap Δ , chemical potential μ , and effective mass m^* of quasiparticles in the symmetric electron-hole double layer system as a function of carrier density. From these data we find (i) a large-gap superfluid regime over a broad range of low densities, (ii) the near-absence of a BCS regime at high densities, and (iii) an overall evolution of the superfluid parameters qualitatively identical to that in BCS-BEC crossovers in non-Coulomb pairing systems, suggestive of an underlying universal behavior. In this talk I will present these results, along with details of the computational methodology.