A BCS-BEC crossover in the extended Falicov-Kimball model: Variational cluster approach

K. Seki[a], S. Yamaki[a], T. Kaneko[a], R. Eder[b], and Y. Ohta[a]

[a]Department of Physics, Chiba University, Chiba 263-8522, Japan
[b]Karlsruhe Institute of Technology, Institute for Solid State Physics, 76021 Karlsruhe, Germany

Motivated by recent experimental and theoretical studies of the excitonic insulators, we use the variational cluster approximation (VCA) to calculate the single-particle Green's function $A(k,\omega)$ and anomalous Green's function $F(k,\omega)$ of the Falicov-Kimball model extended by a finite f-hole valence bandwidth. We thus determine the single-particle excitation gap due to the bound state formation of an electron and a hole. We also evaluate the order parameter Δ indicating the coherence between c and f states in the excitonic insulating phase. We thereby discuss the excitonic insulator that typifies either a BCS condensate of electron-hole pairs (weak-coupling regime) or a Bose-Einstein condensate of preformed excitons (strong coupling regime). A BCS-BEC crossover of the model thus manifests itself as a function of the Coulombic coupling strength. Details will be reported in Ref. [1].

Reference:
[1] K. Seki *et al.*, in preparation.