College of Optical Sciences
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Many-Particle Theory of Luminescence and Absorption from Excited Semiconductors

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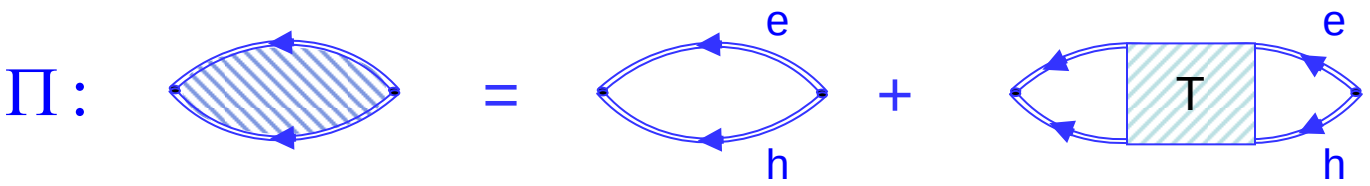
Supported by **AFOSR, JSOP**

Microscopic theory of absorption/luminescence

Maxwell's equations (↔ photon Green's function, valid for incoherent light, photon distribution, photon Wigner function, luminescence reabsorption, exciton polariton dispersion, e-h continuum polariton effects)

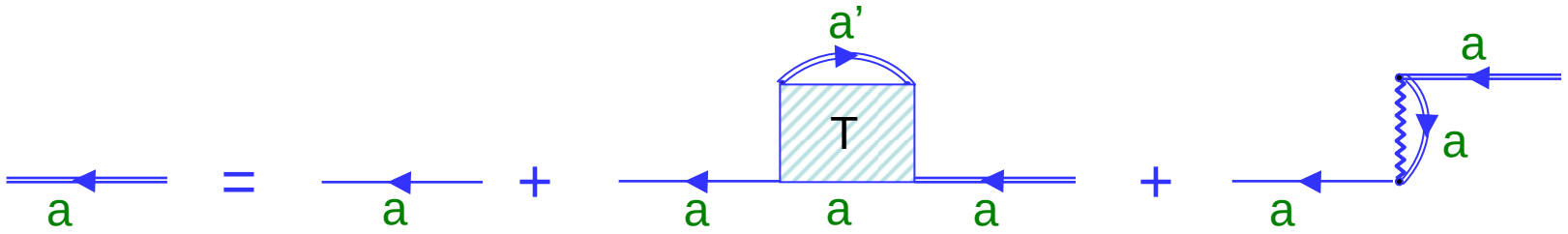
Optical polarization (↔ recombination rate, optical susceptibility)



Microscopic theory of absorption/luminescence

T-matrix (⇔ non-perturbative e-h, e-e, h-h correlation)

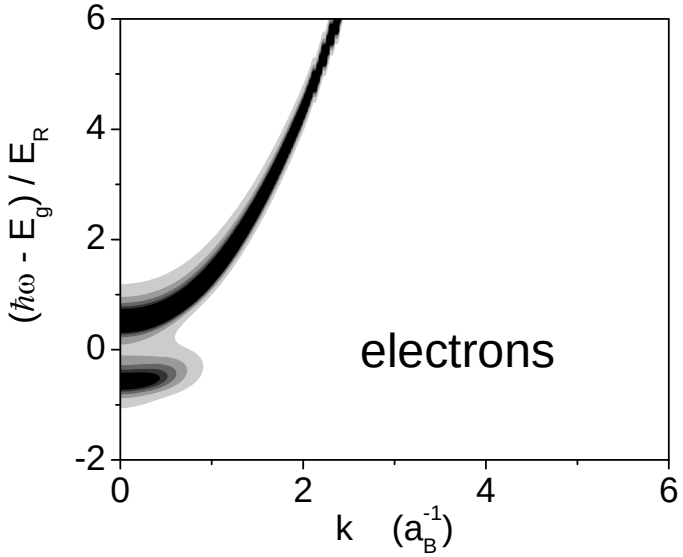
Dyson equation (⇔ quasi-particles, energy renormalization, damping and dephasing, chemical potential, density, ionization degree)

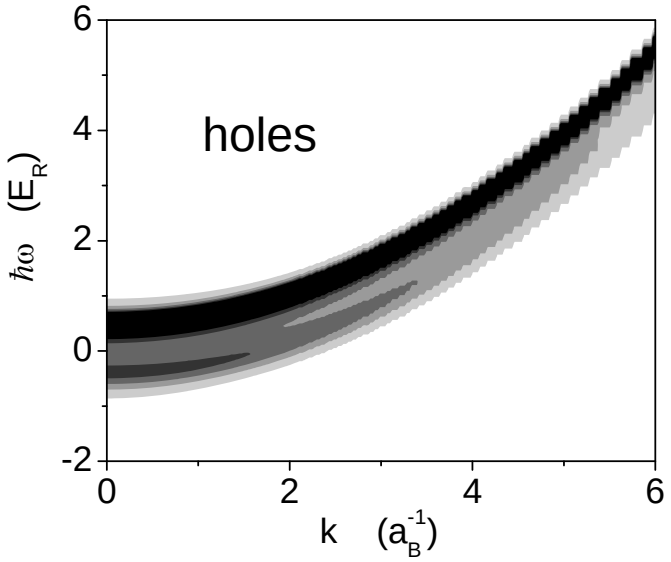


T-selfenergy includes electron bound to hole as exciton

quasi-statically screened Hartree-Fock selfenergy
+
Coulomb hole selfenergy

Spectral functions of electrons and holes

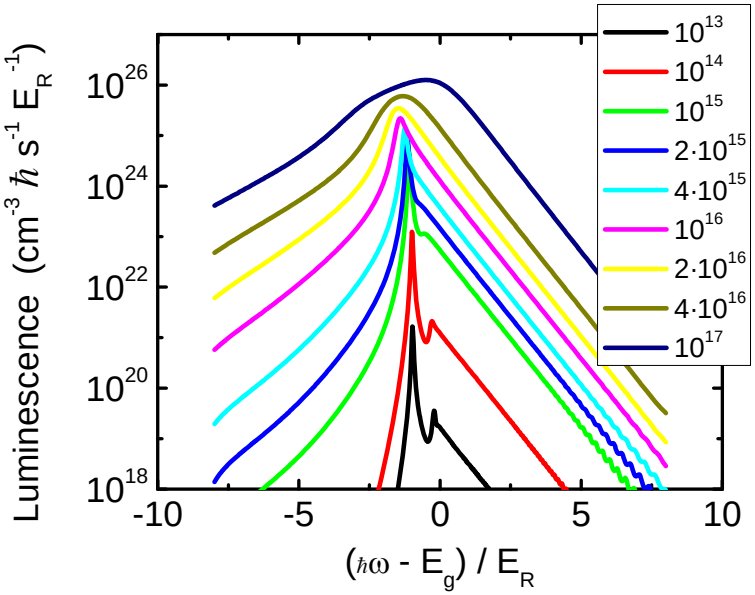


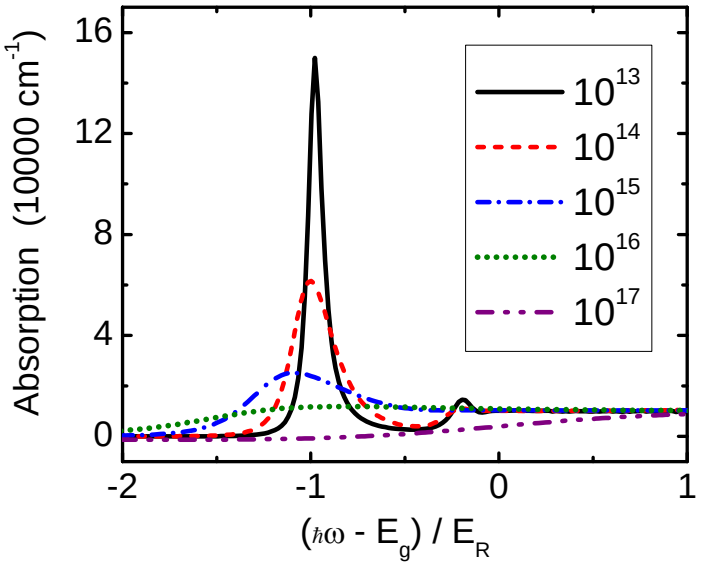


The contour plots of the spectral functions show a broadened single-particle parabola and side-bands due to exciton effects described by the T-selfenergy.

Rupper, Kwong, Binder, Phys. Rev. B 79, 155205 (2009)

Luminescence and absorption spectra





Luminescence and absorption of excited bulk GaAs under the assumption of quasi-thermal equilibrium. The density-dependent modification contain phase-space filling, Hartree-Fock mean-field effects, and excitonic effects from a partially ionized exciton gas within the T-matrix approximation.

Rupper, Kwong, Binder, Phys. Rev. B 79, 155205 (2009)