



# Computational Methods for Electromagnetic Phenomena: Electrostatics in Solvation, Scattering, and Electron Transport

*Wei Cai*

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## **Computational Methods for Electromagnetic Phenomena: Electrostatics in Solvation, Scattering, and Electron Transport** Wei Cai

A unique and comprehensive graduate text and reference on numerical methods for electromagnetic phenomena, from atomistic to continuum scales, in biology, optical-to-micro waves, photonics, nanoelectronics and plasmas. The state-of-the-art numerical methods described include:

- Statistical fluctuation formulae for the dielectric constant
- Particle-Mesh-Ewald, Fast-Multipole-Method and image-based reaction field method for long-range interactions
- High-order singular/hypersingular (Nyström collocation/Galerkin) boundary and volume integral methods in layered media for Poisson-Boltzmann electrostatics, electromagnetic wave scattering and electron density waves in quantum dots
- Absorbing and UPML boundary conditions
- High-order hierarchical Nédélec edge elements
- High-order discontinuous Galerkin (DG) and Yee finite difference time-domain methods
- Finite element and plane wave frequency-domain methods for periodic structures
- Generalized DG beam propagation method for optical waveguides
- NEGF(Non-equilibrium Green's function) and Wigner kinetic methods for quantum transport
- High-order WENO and Godunov and central schemes for hydrodynamic transport
- Vlasov-Fokker-Planck and PIC and constrained MHD transport in plasmas



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