Fluctuating electromagnetic fields close to interfaces: Theory and applications
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Abstract
We give an overview over the effects due to the evanescent near field of a dielectric body caused by thermal and quantum fluctuations inside the material, describing the fluctuating near field within the macroscopic framework of Bynt's fluctuating electrodynamics. Furthermore we discuss two possible applications of the near field effects in thermophotovoltaics and enabling thermal microscopy.

Fluctuating Electrodynamics

- Fluctuating electrodynamics
- Macroscopic stochastic Maxwell equations
- Fluctuation-dissipation theorem
- Dyadic Green's functions

Evanescent Near Field

![Evanescent Near Field](image)

**Near Field Energy Density**

![Near Field Energy Density](image)

**Summary: Fluctuating Near Field**
- Characteristic distance dependence
- Surface mode gives "macroscopic" fluctuating spectrum
- Spatial minimum due to surface mode
- Coating/solid configuration strongly influences distance dependence

Radiative Heat Transfer

![Radiative Heat Transfer](image)

**Summary: Radiative heat transfer**
- Binding of evanescent modes
- Power law is geometry dependent
- TE modes are dominant for Df Bac materials

Forces

- Fluctuating fields and forces
  - Van der Waals and Casimir forces
  - Vacuum friction

Application of Near Field Effects

- Scanning Thermal Microscopy

Thermophotovoltaics

![Thermophotovoltaics](image)

**Semi-Infinite Bodies**

![Semi-Infinite Bodies](image)

**Related problems**

- Radiation of thermal near field
- Proper inclusion of nonlinearity
- Efficient coupling between theory and experiment
- Thermal exciton force and Onsager theorem

References