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# The Large-Time Asymptotics of Some Wiener Integrals and the Interband Light Absorption Coefficient in the Deep Fluctuation Spectrum

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**Abstract.** In this paper we prove the existence of the interband-light-absorption coefficient and investigate its asymptotics for a number of models.

## 1. Introduction

The interband light absorption coefficient (ILAC) is an important characteristic of doped semiconductors. By using approximations widely accepted in semiconductor physics this quantity can be written as [1, 2]:

$$\alpha(\lambda)=\frac{\alpha_0}{V\omega}\sum_{n,m}\delta(\lambda-\lambda_n^+-\lambda_m^-)\left|\int_\Lambda \psi_n^+(x)\overline{\psi_m^-(x)}\,dx\right|^2, \tag{1.1}$$

provided the temperature is sufficiently low and the Fermi energy lies in the gap between the valence and the conductance bands. In (1.1) the constant $\alpha_0$ is determined by fundamental physical constants and the band structure of the ideal (non-doped) semiconductor. $V$ denotes the volume of the semiconductor sample $\Lambda$. $\omega$ is the light frequency and $\lambda=-E_g+\omega$, where $E_g$ is the distance (gap) between the valence and the conduction band. $\lambda_n^\pm$ and $\psi_n^\pm$ are the eigenvalues and orthonormalized eigenfunctions respectively of the operators $H_\Lambda^\pm$, given on $\Lambda$ by

$$H_\Lambda^\pm=-\Delta\pm q \tag{1.2}$$

with appropriate (e.g. Dirichlet) boundary conditions on $\partial\Lambda$. These Hamiltonians describe the motions of electrons and holes in the conduction and valence bands under the influence of the random (impurity) potential $q(x)$. The energy levels $\lambda_n^\pm$ are counted from the bottom of the respective band.[1]

It is known (see [1, 2]) that the ILAC has several asymptotic regimes depending on the form of the random potential, the frequency interval, etc. In particular, suppose $q(x)$ is a homogeneous Gaussian random field with mean zero and cor-

[1] For simplicity we consider only the case of equal effective masses of electrons and holes. This allows us to normalize the constants in front of the kinetic energy to 1