Differential energy fluxes in a layer of solid structure

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In the layer of a solid structure with a plane-parallel structure, the propagation of energy fluxes in equilibrium and at its violation is realized by differential fluxes of charge carriers, photons, phonons and quasiparticles of other species. The joint propagation of these fluxes corresponds to specific regularities due to the mechanisms of their scattering. In the equations of flux propagation and their boundary conditions, it is necessary to take into account the consequences of scattering and the role of the generated fluxes. Taking into account the scattering of fluxes not only in the thickness of the layer, but also on its boundaries, especially in thin layers, significantly increases the understanding of how the fluxes of quasiparticles, differential and integral energy fluxes propagate. In the approximation of the relaxation time, the boundary value problems on the propagation of differential fluxes of quasiparticles with allowance for the scattering of fluxes at the boundaries of the layer have the same form. Hence, the general conclusions obtained earlier for the charge carrier fluxes are also valid for the fluxes of photons and phonons. In particular, the fluxes superlinearly depend on the probabilities of their scattering at the boundaries of a thin layer, and also on the ratio of the thickness of the layer to the free path characteristic length. Fluxes emerging from the layer have the same dependence on the indicated characteristics of the boundaries and the dimensionless parameter of the thickness of the layer. The smaller the layer thickness parameter, the stronger is the superlinear dependence of all differential and integral fluxes. In this case, due to the exchange of differential fluxes, the effect of neighboring layers on the considered layer is more significant.

Keywords: *charge carriers, photons, phonons, differential fluxes, integral fluxes, energy transfer*

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