OPTICAL FIELDS GENERATED IN SPIN-POLARIZED VCSELS

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Our contribution is related to both wave and quantum aspects of spin-polarized vertical cavity surface emitting lasers (spin-VCSELs). In contrary to conventional VCSELs, spin-VCSELs are pumped using spin-polarized current in order to control polarization of the emitted light. Threshold current reduction which was already theoretically and experimentally demonstrated belongs to important promises of these devices. Despite that, they are still not commercially available. In order to design an optimal spin-VCSEL structure, one has to study the confinement of electromagnetic field. Thus, in the first part of this work we present exact calculations of the electromagnetic-field distribution inside a spin-VCSEL based on the matrix formalism developed by Fördös et al. The formalism is constructed in the framework of transfer and scattering matrices and treats VCSELs as a multilayer containing classical active dipole layers. We discuss not only technological importance of such calculation. Additionally, we investigate the possibility of extracting the laser dynamics-related quantities using the same formalism. In the second part, we adress statistical properties of the emitted light including those related to the quantum nature of the active-layer and electromagnetic field interaction. This calculation may form a basis for a needed extension of the already existing phenomenological description of light propagation in spin-VCSELs.