PRACTICAL
Quantum basis of the spin manipulation by electric fields

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1/ Starting from the non-relativistic Dirac Hamiltonian, written for the case of a 2D free-electron gas with a confinement direction perpendicular to the propagation direction, we deduce the Rashba Hamiltonian. This strategy allows the direct identification of the Rasba interaction term and interaction constant alpha, as a measure of the spin-orbit interaction. One can thus understand how alpha can be controlled via the external electric field (in Datta-Das spin transistor geometry).

2/ as in a standard QM problem within the Heisenberg-Dirac formalism, we solve the stationary Schrodinger equation by diagonalising the spin-orbit Hamiltonian and find the eigenvalues and the stationary eigenfunctions.

3/ Furthermore, we study the time evolution, solving the time dependent Schrodinger equation. Then, by calculating average values of the spin operators Sx, Sy, Sz we can demonstrate and discuss the spin precession

4/ We analyse the spin-orbit influence on the calculated parabolic e(k) band structure and discuss how the spin-orbit constant alpha can be extracted from ARPES experiments. We can illustrate with some examples of ARPES for materials with important potential in spin-orbitronics (when materials with significant SO are used for generation of spin currents by spin-Hall effects).