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Ultrafast Quantum Control in Semiconductor Nanostructures using Twisted Light GUILLERMO QUINTEIRO, PABLO TAMBORENEA, Univ de Buenos Aires, JAMAL BERAKDAR, Martin Luther Univ — We investigate possible uses of twisted light (TL) —or light carrying orbital angular momentum (OAM)— as a tool to control semiconductor-based nanostructures. Two systems are considered, namely quantum dots (QD) and quantum rings (QR). For both structures we employ a simplified two-band model in the effective-mass approximation, having a conduction and a heavy-hole valence bands. In the case of disk-shaped QDs, we predict that the TL would allow to induce optical transitions which are normally regarded to be forbidden. The OAM l and other parameters of the TL beam can be used to precisely control the final state of the electron. In the case of QRs, we study induced electric currents. We analyze the evolution of the system in terms of Heisenberg equations of motion. We find an analytical solution that resembles the standard Optical Bloch Equations. Using this solution, we find the evolution of the z-component of OAM and the electric current circulating the ring. Our results indicate that the electric current could be as large as μA, in the time-scale of pico-seconds. For an appropriate radius of the ring, the photo-induced magnetic field would be large enough to switch within picoseconds the magnetic moment of particles placed within the ring.

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