Elliptic Rydberg States as Direction Indicators

Netanel H. Lindner, Asher Peres, and Daniel R. Terno

Department of Physics, Technion—Israel Institute of Technology, 32 000 Haifa, Israel

abstract The orientation in space of a Cartesian coordinate system can be indicated by the two vectorial constants of motion of a classical Keplerian orbit: the angular momentum and the Laplace-Runge-Lenz vector. In quantum mechanics, the states of a hydrogen atom that mimic classical elliptic orbits are the coherent states of the SO(4) rotation group. It is known how to produce these states experimentally. They have minimal dispersions of the two conserved vectors and can be used as direction indicators. We compare the fidelity of this transmission method with that of the idealized optimal method.