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Orbital angular momentum from a spin rotation: the optical and electron-beam cases.

The angular momentum of photons and of most material particles can be split into spin and orbital components. In the optical case, processes involving a controlled conversion of angular momentum from one form to another in suitable media were conceived and experimentally demonstrated, both in the classical [1] and quantum regimes [2]. These processes allow for the generation of a nonzero orbital angular momentum from an imposed rotation of the spin. We will briefly review some of these processes, and survey their applications in classical and quantum optics [3,4]. A similar process can be theoretically proposed for the case of material particles, such as electrons, that are freely propagating in suitable electric and magnetic fields [5]. The latter effect might lead, among other possible applications, to designing a relatively high-efficiency electron-beam spin filter, a device for which there is no current existing technology.

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