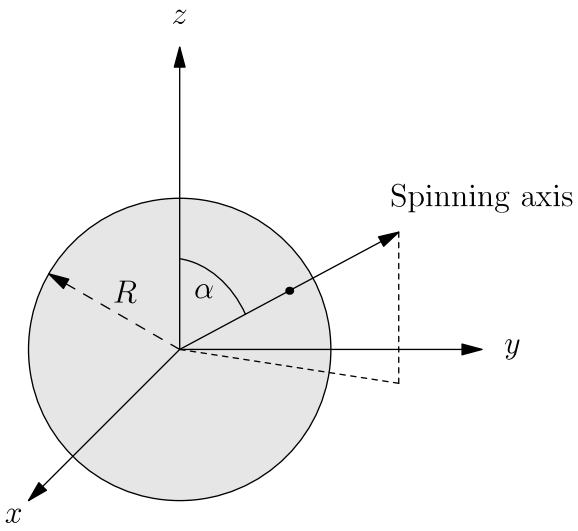
M99E.1—Radiation from a Rotating Sphere

Problem

Electromagnetic radiation of wave length λ is observed to originate from a system consisting of an electrically charged sphere of radius R placed in a uniform magnetic field B and spinning about its axis with a very large angular velocity ω. The spin axis of the sphere, which is free to move, makes an angle α with the field direction. Assume $R \ll \lambda$.



a) Explain briefly why the system radiates electromagnetic energy.

b) Find in terms of the given quantities, not all of which may be necessary, the ratio Q/M of the total charge Q to the mass M of the sphere assuming that both charge and mass are uniformly distributed over its volume.

c) What is the polarization of the radiation field?