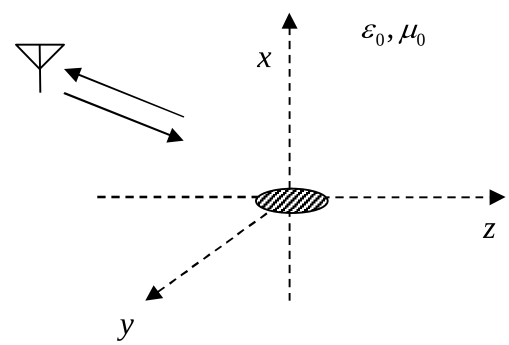
EM Scattering

Homework assignment 4

Problem 1:

By illuminating a dielectric particle with an electromagnetic wave and measuring the scattered field we would like to find quantitative data about that particle. The incident field is generated by an antenna far away from the particle and the measurement is performed by the same antenna. Both the strength and polarization of the scattered field are measurable. The position of the antenna may be chosen voluntarily as long as the particle and the antenna remain far apart. We make the following assumptions: (i) the dielectric particle is small compared to the vacuum wavelength, (ii) it is an ellipsoid, and (iii) its distance with respect to the antenna is known. For simplicity we also assume that the axes of the ellipsoid coincide with the x-y-z axes of a known coordinate system.



(i) Is it possible to estimate the elements of the depolarization tensor of the particle by such measurements? Give an answer with details.

(ii) Is it possible to estimate the dielectric constant of the particle?

(iii) How about its scattering cross section for any direction of the incident wave?

Problem 2:

A plane wave which is propagating in vacuum along the x-axis (wave number k_0) is normally incident on an infinitely long, perfectly conducting cylinder of radius a whose axis is along z. The electric field of the incident wave is linearly polarized along the y-axis and has an amplitude of E_0. We would like to use the approximation of physical optics to analyze this problem.

(i) Find the electric surface current induced on the cylinder using this approximation.

(ii) Find the amplitude of the far-zone electric field scattered in the x direction (the forward scattered wave).

Hint: use the expression for the far-zone field of 2D objects discussed in lecture 7 (integral equations).