Solar Physics 2010: Exercises to Lecture 5
Due Date: 18. May 2010 at 9:00

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1 Polarization Ellipse

Show that at a given point $\vec{x}$, the time evolution of the electric field vector of an electromagnetic wave in an isotropic medium is described by an ellipse. Hint: Use the plane-wave ansatz,

$$\vec{E}\,(t) = \vec{E}_0 e^{i\left(\vec{k}\cdot\vec{x}-\omega t\right)}\,, \tag{1}$$

with the polarization described as

$$\vec{E}_0 = E_1 e^{i\delta_1}\vec{e}_x + E_2 e^{i\delta_2}\vec{e}_y. \tag{2}$$

$\vec{e}_x$ and $\vec{e}_y$ are unit vectors in the x and y directions, respectively. The beam propagates along the z-axis. The coefficients E_1 and E_2 are the (real) amplitudes and $\delta_{1,2}$ are the phases.

2 Mueller Matrix

The most general Jones matrix describing the interaction of monochromatic light with matter has eight independent parameters. How many independent parameters does a Mueller matrix have that describes the same interaction of a polarized beam with matter?