Electromagnetic Scattering I (53919, 5 cr)
Exercise 1

1. Derive the following relation between the Stokes parameters $\mathbf{I} = (I, Q, U, V)^T$ and the ellipsometric parameters

$$\begin{aligned} I &= c^2 \\ Q &= c^2 \cos 2\eta \cos 2\gamma \\ U &= c^2 \cos 2\eta \sin 2\gamma \\ V &= c^2 \sin 2\eta, \end{aligned}$$

where $c^2 = a^2 + b^2$ (a and b being the semimajor and semiminor axis, respectively), γ the clockwise angle between $\mathbf{e}_\parallel$ (Bohren-Huffman, p. 50) and major axis, and $|\tan\eta| = b/a$ (ellipticity). (6 points)

2. Draw the vibration ellipses for the Stokes parameters $\mathbf{I} = (3, 1, 2, -2)^T$ and $\mathbf{I} = (25, 0, 24, 7)^T$. (6 points)

3. An electromagnetic plane wave propagating in a nonabsorbing medium is normally incident on an infinite slab between $z = 0$ and $z = h$ with a refractive index $m_1 = n_1 + ik_1$. Derive the expressions for the slab reflectance and transmittance. (12 points)

4. Derive expressions for the electric and magnetic fields $\mathbf{E}$ and $\mathbf{B}$ in the electric dipole approximation. Vector potential is

$$\mathbf{A}(\mathbf{r}) = \frac{-ikc\mu_0}{4\pi}\,\mathbf{p}\,\frac{e^{ikr}}{r},$$

where $\mathbf{p}$ is the electric dipole moment. (Jackson 9.2; 12 points)