PHYC 40210 Problem Set 3, due 2pm 26th April 2024

Q1. If the velocity of sound in TeO_2 is $3.1x10^3$ ms^{-1}, what is the minimum acoustic wave frequency needed for successful operation of a TeO_2 AOM with a laser beam diameter of 0.5 mm and an operating wavelength of 633 nm? What is the corresponding Bragg angle?

Q2. For the above set up, what will be the fractional change in wavelength of the first order diffracted beam?

Q3. For the above set up, what variation in the acoustic wave frequency is required to produce 100 resolvable spots?

Q4. What voltage is required to produce 100 resolvable spots with a laser beam of diameter 1.0 mm in an electro-optic deflector consisting of a cube of KD*P of side 2 cm given that $r_{63} = 9.8\times10^{-12}$ mV^{-1} and $n_o = 1.510$ at λ=540 nm ?

Q5. A Faraday isolator is to be made from a glass slab 50 mm thick. What size of magnetic field needs to be applied assuming that the glass has a Verdet constant of 520 min $T^{-1}cm^{-1}$? If the modulator has a length of 5 cm and a coil of 200 turns is wrapped around it, what will the corresponding current be?

Q6. The electro-optic coefficient r_{63} for KD*P is 9.8×10^{-12} m/V for λ = 540 nm. What voltage must be applied to a KD*P crystal in order to produce half wave modulation? What is the polarisation state of the output if this voltage is halved? (The ordinary refractive index of KD*P at 540 nm is 1.510).