

NONLINEAR OPTICS (PHYC/ECE 568)

Spring 2022 - Instructor: M. Sheik-Bahae

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Homework #5, Due Monday, March 29

1. $\chi^{(3)}(\omega; \omega, \omega, -\omega)$ in Na vapor

With reference to the spectrum of $|\chi^{(3)}(3\omega; \omega, \omega, \omega)|$ in atomic sodium given in Boyd, page 150 (3rd ed.), sketch (neatly and clearly) what you think might be the spectrum of $|n_2| \propto |\chi^{(3)}(\omega; \omega, \omega, -\omega)|$. Explain the primary differences between the two. (*You may be only qualitative regarding the magnitude of the nonlinearity*)

3. NLO susceptibilities: resonances and selection rules

A fictional molecule has the following energy levels. Draw the spectrum (for $0 < \hbar\omega < 8$ eV) for the (a) linear absorption coefficient α , (b) two-photon absorption (TPA) coefficient β , (c) SHG: $|\chi^{(2)}(2\omega; \omega, \omega)|$ and (d) THG: $|\chi^{(3)}(3\omega; \omega, \omega, \omega)|$.

Be quantitative in your x-axis. Assume a finite broadening in your drawings. Point out the resonances (diagrammatically) on your graph for each case and show the relative strengths if obvious. Note: no calculations needed for this problem either.

