NLO Protocol Jose

28th August 2019

1. What is nonlinear in Nonlinear Optics?
The relationship between the polarization and the electric field.

2.When can we observe this relationship?(the question was not really like that, he made a joke saying that why kids in school do not study it in the Gymnasium)

3. Write down the linear polarization.
I started writing the general case, he stopped me and told me to consider the case of a time-invariant and local space. I wrote eq.1.9 while explaining each term. He asked me about when X is an scalar to which I answered that it occurs for isotropic media.

4.Write down the polarization in the nonlinear case until the second order.
I wrote eq.2.1.

5.Write down the nonlinear polarization as a vector.
I wrote eq.2.2 explaining a bit each part.

6.He showed me equation 2.32 and he asked me to explain the triple dots, the S(w) and the deltas.
Kronecker deltas (1 for w=0, 0 for the others w) necessary for taking into account the field when w=0, since E is real and doesnt have a complex conjugate. S(w), sum of frequencies that give us wp. Triple dot, short-form tensor notation for multiplication and summation term by term.

7.He asked me to write the polarization for the cases of SFG, OR and Electro-optic Kerr effect.
Eqs. 2.33, 2.34 and 2.35. While writing them down I was talking about the terms a bit and the fenomena.

8.He asked me to consider the case of an amorphous waveguide in which dispersion does not ocur and the pulse propagates whithout any perturbation.

Since he was asking me about solitons, I thought that the exam was being too fast, so I started analysing the question. I talked about amorphous materials saying that they dont present 2nd order nonlinearities, to which statement Koos was glad and in his excitement he asked me about why was that.

I related it to Neumann's principle and since amorphous materials do not have a preference in orientation,and effects come as an average, they do not show 2nd order nonlinearities.

Then we continued talking about solitons. I mentioned the definition and I drew the last lecture graphs about amplitude, phase and frequency respect to time for anomalous GVD and SPM in order to explain the case that he gave me.

9. What is the form of the pulse?
An hyperbolic secant.

Professor Koos creates a calm environment for the exam. While writing a formula or drawing try to explain what you are doing or mention the terms involved, for the drawings remember the axis. Lot of luck!!