COHERENT EXCITATION OF BIO- MOLECULES IN THREE LEVEL RESONANCE WITH TWO STANDING WAVES AND ITS CONNECTIONS WITH RAMAN COHERENT SCATTERING MICROSCOPY

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The coherent Raman Scattering **(CRS)** opens a new level of microscopy in biological systems. The CRS techniques work with the same molecular vibrations that are probed in spontaneous Raman spectroscopy. The biggest advantage, compared with spontaneous Raman spectroscopy, is the improvement in the imaging speed, which is a very attractive attribute in the biological imaging. The CRS use the nonlinear vibrational technique, which improve the readout of chemical physical information.

Using the standing waves of two laser frequencies in Raman resonance with the ground an excited states of bio-molecules, we propose a new model of description of coherent Raman microscopy in which it is used the conception of bimodal coherent states. The vibration of bio-molecules can be studied during the shift in the time of the spectral distances between lines of Mollow triplet. We show that in the three level systems the Resonance Fluorescence may be an additional information to CRS which takes in to consideration not only local vibration of molecule, but the low frequency migration aspects of molecules between the two nodes of standing wave.

The imaging systems based on the Raman spectroscopy, used in medicine and biology, are called Raman microscopes [1, 2]. The disadvantage of Raman spontaneous microscopy consists in a typical small imaging speed, which is not sufficient for real-time imaging of biological systems. In the last time the disadvantage of Raman spontaneous microscopy was covered by recent coherent Raman scattering CRS microscopy and coherent anti-Stokes Raman spectroscopy (CARS). CARS is a parametric process between the **two** waves in which input and output photons exchange energy but the quantum state of the molecules is left unchanged after the nonlinear process. A resonance occurs when $\omega_p - \omega_S$ is tuned to match the frequency of a Raman-active molecular vibration, Ω, which shows a peak in the CARS spectrum. The CARS signal is usually accompanied by a non-resonant background, resulting from nonlinear optical responses mediated through molecular virtual or electronic states, or both [3]. CARS spectroscopy has been developed into a powerful tool for monitoring the dynamics of chemical reactions, especially in combustion analysis. The authors Zumbusch et al. [4] have studied the CARS imaging of living cells with femtosecond (fs) pulses and a collinear beam geometry, which triggered the development of modern CARS microscopy.

We propose the similar model of excitation of molecules in two standing waves which are in Raman resonance relative the ground and excited state of molecules. As the amplitude of standing wave is modulated, the resonance fluorescent spectrum of such molecule depends on its position relative the nodes and anti-nodes of standing waves. In this case all possible low frequency oscillations of the molecule between the two nodes of standing wave may be detected, studding the time dependence of the spectral distances between the Mollow triplets of resonance fluorescent field. In such scheme we can measure the vibration states of molecule and its shift from the equilibrium position, because the array of two standing waves creates the effective potential for the molecule. This system creates the possibility to detect space-time holograms connected CRS and Mollow triplet of resonance fluorescent scattering. For this, we study the interaction of the three levels molecule in interaction with two standing waves. For a relative big detuning from resonance, between atomic transitions and standing waves, we have eliminated the superior level of Lambda-type atom.

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