Influence of the internal anisotropy in uniaxial nematic liquid crystals on the angular features of the phase and group velocities

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The report presents the results of investigation of the dynamics of uniaxial nematic liquid crystals with molecules of the rod-like and disc-like form. The work is based on the Hamiltonian formalism. To adequately describe the dynamics of nematic liquid crystals, except for the densities of additive integrals of motion, as the reduced description parameters introduced additional dynamic variables caused by the internal spatial anisotropy. They are the unit vector of the anisotropy and conformational degree of freedom, which characterizes the geometry of the molecule. On the basis of the developed approach, we obtain closed algebras of Poisson brackets for the entire set of reduced description parameters and derive nonlinear dynamic equations taking into account the internal degrees of freedom. It was found that the inclusion of internal degrees of freedom leads to a possible propagation of two anisotropic acoustic waves - the first and second sounds. At the same time the first sound is similar to that found in ordinary liquid, and the second one is caused by molecules deformations. The analytical expressions of the phase and group velocities of acoustic spectra of collective excitations are obtained and their angular features are investigated. It is shown that the phase and group velocities are functions of the polar angle and the parameter λ representing the ratio of the densities of the molecules deformation energy and kinetic energy. Clarified the behavior of the velocities of the first and second sounds at $\lambda << 1$ and investigated their fronts spread. The analytical expressions for the angle between the phase and group velocity for the first and second sounds are derived and coefficient of acoustic anisotropy is calculated. It was found that, like in crystals, the absolute value of group velocity exceeds the absolute value of the phase one.