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EXPERIMENTALLY PROVED POSSIBILITY OF GENERATING STABLE NONLINEAR DIRECTORY WAVES IN LIQUID CRYSTALS

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Abstract. *In this work we present an experimental attempt aiming at investigating the possibility of mechanical excitation of solitary directory waves. Thus, we have built an experimental set-up by means of which we excited with a compression wave a smectic liquid crystal (elaidic acid) placed inside a capillary tube at 46 ℃. After the first three excitations within the capillary tube we observed by help of a microscope, the occurrence of some dark transversal minims alternating with bright maxims zones, which have shown a tendency of motion. Afterwards, a soliton-like stable structure appeared and propagated during the next excitations along the tube. These results are repeatable and can be described by means of the effect of the shearing waves in liquid crystals. Using the Ericksen-like equations, which led to a damped driven sine-Gordon equation, we have shown that in the case of a strongly damped motion, we can get dark soliton-like solutions, in good agreement with the experimental results.*

Keywords: solitons, directory waves, liquid crystals

1. Introduction

Studies concerning directory waves in liquid crystals began since 1968 [1, 2]. More recently, several authors presented preliminary experimental studies on director waves [3]. In these experiments, the liquid crystal cell consists of two polished glass plates of dimensions 0.5×5×30 cm^3, the cell thickness being of about 50μm, fixed by four spacers. As an exciter, they used a Mylar film 20 μm thick. As a substance with homeotropic texture, an MBBA-like liquid crystal was used, having the mesophase interval between 22 °C and 47 °C. Within the framework of these experiments, one has noticed the generation of several transverse dark lines and their propagation along the liquid crystal cell. These experiments have put into evidence the possibility to generate directory waves into nematics. These waves are incompressible since their velocities are much less than the ones usually encountered in the case of incompressible waves in fluids. These dark lines were interpreted as having a soliton-like behavior [4]

2. Experimental results.

In our study concerning the possibility of exciting soliton-like directory waves in liquid crystals, we used a flexible capillary tube with a 500 μm diameter.

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