Name(s)

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Project Number

S1505

Project Title

Dynamics of Penta-Hepta Defects in a Hexagonal Pattern

Abstract

Objectives/Goals
The objective is to determine how two penta-hepta defects in a hexagonal structure will interact, in particular, to test Tsimring's theoretical description in which conjugate defects should attract and annihilate, reforming a perfect hexagonal structure.

Methods/Materials
A hexagonal structure of about 100 bubbles was created by blowing nitrogen gas through a hypodermic needle into a solution of distilled water, glycerin, and Mr. Bubbles. Defects were created by selectively popping bubbles with a needle to produce two separate penta-hepta defects, whose interaction was videotaped for later analysis. The procedure was repeated, varying the positions along the rolls where the bubbles were popped as well as the distance between the defects. The defects' interactions were examined, Tsimring's parameter N was calculated for each pair, and it was determined whether or not they behaved as predicted.

Results
Interactions of the five conjugate pairs of defects were studied. In four of the cases, the defects annihilated as predicted, but in one case the two defects repelled each other.

Conclusions/Discussion
Tsimring's theoretical description of the interaction of penta-hepta defects in a hexagonal lattice is largely correct, but not capable of fully describing the interaction. The interaction may be the result of competing influences such as momentum and the starting conditions of the bubbles, as well as Tsimring's attractive/repulsive force.

Summary Statement

The motion and interaction of pairs of penta-hepta defects in a hexagonal lattice of soap bubbles was studied in the laboratory and compared to theory, with a significant discrepancy between theory and experiment observed.

Help Received

Professor M. Dennin of UCI suggested this experiment and allowed me to use his lab and equipment. Father went over research papers with me and edited my work. Mother helped prepare the display board.