

Topological Structure of Knotted Vortex Lines in Liquid Crystals

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Abstract: In this paper, a novel decomposition expression for the U(1) gauge field in liquid crystals (LCs) is derived. Using this decomposition expression and the φ -mapping topological current theory, we investigate the topological structure of the vortex lines in LCs in detail. A topological invariant, i.e., the Chern-Simons (CS) action for the knotted vortex lines is presented, and the CS action is shown to be the total sum of all the self-linking and linking numbers of the knot family. Moreover, it is pointed out that the CS action is preserved in the branch processes of the knotted vortex lines.

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Key words: knotted vortex lines, liquid crystals, Chern-Simons action, branch processes

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