TOPOLOGY SEMINAR

Topologically protected vortex knots and links

By

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Abstract: The physical properties of condensed-matter systems can often be approximated by a "mean field" which, outside a small singular locus of the system (defects), takes values in a topological space M called the order parameter space. A topological vortex is a codimension two defect, about which the order parameter field winds in a way that corresponds to a non-contractible loop in M. If the fundamental group of the order parameter space is non-Abelian, then these vortices exhibit a remarkable behavior: not all pairs of topological vortices are free to pass through each other.

It is then natural to wonder if such vortices could be employed in tying robust linked structures in physical fields. As a minimum, such a structure should not untie via strand crossings and local reconnections, which are the usual means of decay for knotted and linked vortex loops. In this talk, we will present several examples of such structures. Our approach is based on the fact that if the second homotopy group of M is trivial, then the order parameter field admits a combinatorial description, which, depending on the fundamental group of M, can be expressed graphically. Hence, finding topologically stable tangled structures reduces to constructing nontrivial invariants for "colored" links, which remain unchanged in strand crossings and local reconnections.

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