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Topological transitions as cascade evolution in complex systems of physical (magnetic) knots/links

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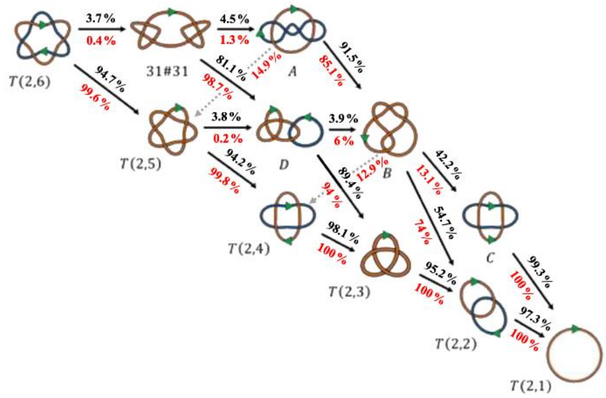
Xin LIU, a professor of the Faculty of Science, Beijing U Technology. He obtained his PhD in theoretical physics from Lanzhou U, and the PhD in Mathematics from U Queensland, Australia. He was a BOTAP fellow of the Beijing municipal government, Sydney U Postdoctoral Research Fellow, Visiting Fellow of the Isaac Newton Institute of Mathematical Sciences at Cambridge U, referee of the Israel Science Foundation, and reviewer of Mathematical Review of the American Mathematical Society. His area of research is theoretical physics and applied mathematics, in the direction of knot topological invariants in classical field theory (fluid mechanics in particular), various topological excitations in physics, and knot invariants in topological quantum field theory.

Abstract



Recent laboratory and numerical experiments in classical and quantum fluids as well as other systems (such as recombinant DNA plasmids) show that physical knots/links are highly unstable, decaying from a high-topological complexity state to a low-complexity state through a series of reconnection events. A possible theoretical picture for this phenomenon is that hierarchy of topological complexity is closely related to energy or other dynamical spectrums. This talk serves as a review of the following progress: (i) relationship between ropelengths/crossing numbers of tight prime knots and links versus their groundstate energy spectrum; (ii) adapted HOMFLYPT polynomial values used to quantify complexity of torus knots and links; (iii) in an algebraic space spanned by an orthogonal polynomial basis (such as Legendre, Hermitian, etc.), the complexity degree of a knot is defined in terms of its associated knot polynomial such as Jones, Alexander-Conway, etc. Moreover, some undergoing work on relevant numerical simulation of quantum fluids is introduced. Our emphasis will be placed on the role that topologically non-conservative transitions play in the evolution of a knot complex system, in the hope of finding a scenario where a scalar topological invariant is employed to manage the spectrums of energy or other dynamical properties.

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