Topological Solitons

by

Paul Sutcliffe
Durham University

Lectures at the LMS Undergraduate Summer School
Kent, July 2016

Mathematically, topological solitons are finite energy particle-like solutions of nonlinear differential equations, in which the number of particles is a topological quantity. Physically, topological solitons are a way of storing a localized lump of energy in a nonlinear system. They have applications in a range of areas in particle physics, condensed matter physics, nuclear physics and cosmology. There are technological applications in magnetic systems, where topological solitons are being used in the design of the next generation of data storage devices.

The lectures will provide a brief introduction to the topic of topological solitons, using some simple examples to illustrate the main ideas. Applications to magnetic systems will be used to motivate some of the examples and the technological use of domain walls and magnetic Skyrmions will be mentioned. Material to be covered includes kinks, the calculus of variations, energy bounds, Bogomolny equations, Derrick's theorem, topological charges, holomorphic maps from the plane to the Riemann sphere and magnetic Skyrmions.

Recommended literature

Topological Solitons, N.S. Manton and P.M. Sutcliffe, Cambridge University Press, 2004.

The lectures will cover some of the more elementary material from Chapters 5 and 6.