Classical and Quantum Solitons (E16)

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Solitons are solutions of classical field equations with particle-like properties. They are localised in space, have finite energy and are stable against decay into radiation. The stability usually has a topological explanation. After quantisation, solitons give rise to new particle states in the underlying quantum field theory that are not seen in perturbation theory. We will focus mainly on kink solitons in one space dimension, vortices of the abelian Higgs model in two dimensions, and Skyrmions in three dimensions. Quantised Skyrmions give us a model for protons and neutrons and larger nuclei like the alpha particle, where the topological charge is the conserved baryon number.

Pre-requisites

This course assumes you have taken Quantum Field Theory and Symmetries, Fields and Particles. The small amount of topology that is needed will be developed during the course.

Literature

1. N. Manton and P. Sutcliffe, *Topological Solitons.* C.U.P., 2004 (Chapters 1,3,4,5,7,9).
2. E.J. Weinberg, *Classical Solutions in Quantum Field Theory.* C.U.P., 2012 (Chapters 1,2,3,4,8).
3. R. Rajaraman, *Solitons and Instantons.* North-Holland, 1987.

Additional support

Three examples sheets will be provided and three associated examples classes will be given.