28/2/6346 Solitons and instantons in elementary particle physics.
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This thesis is concerned with the use of extended solutions to classical field theories in elementary particle physics. We consider the interpretation of these solutions as collective bound states (solitons) and as tunnelling configurations (instantons). We also present a detailed account of the Inverse Scattering Technique applied to the Sine-Gordon system and the topological classification scheme for solitons and instantons. Topological currents are constructed for theories whose fields take values on spheres and on Lie group manifolds.

We construct soliton solutions to constrained theories of the σ-model type. The theories considered are nonlinear Heisenberg $SU(2)/U(1)$, chiral $SU(2) \times SU(2)$ and chiral $SU(3) \times SU(3)$. Three dimensional solitons are found using an exotic modification to the Lagrangian obtained by raising the natural Lagrangian to the three-halves power. This results in a theory whose solitons have neutral stability under dilatations. The three dimensional solution to the $SU(2)/U(1)$ theory is particularly interesting as it takes the form of a twisted vortex ring.

A final chapter is devoted to the problem of setting the instantons of nonabelian gauge theories in Coulomb gauge. This problem was raised by Gribov in 1977 and costs doubt on the massless particle content of these theories.