

TOPOLOGICAL SOLITONS AND THEIR APPLICATIONS

Overview

This is a 12-hour course on topological solitons. Solitons are localized solutions to the equations of certain nonlinear classical field theories. Such theories appear in a wide variety of areas of physics (optics, condensed matter physics and particle physics, to name but a few), making a basic familiarity with solitons particularly useful. The subject is vast, with solitons divided into two broad categories: non-topological and topological. In the interest of time, the goal of the course is to give an overview of topological solitons.

The fact that solitons are localized allows an interpretation as particles, and indeed in many early applications it was suggested that certain "ordinary" particles (most notably baryons, the class of particles which includes the proton and neutron) are in fact solitons of an underlying field theory of other particles (mesons).

Non-topological solitons (not discussed in the course) owe their existence to a sort of "cancellation" between effects of dispersion and non-linearity. While in a sense the same could be said of topological solitons, it is more useful to argue that they owe their existence to topological considerations (pertaining to the manifold of vacuum configurations of the underlying field theory). Topological solitons are found in theories with a property known as spontaneous symmetry breaking, a characteristic of virtually all theories of particle physics (most notably, the Standard Model).

The objectives of the lectures are as follows:

1. To obtain a basic understanding of various aspects of classical field theory.
2. Familiarize the students with the theory behind topological solitons, using the kink (in φ^4 theory with symmetry breaking) and vortex (in the Abelian Higgs model) as principal examples.
3. Give examples of solitons from condensed matter physics and particle physics/cosmology.

Course participants will learn these topics through lectures. Also case studies and assignments will be shared to stimulate research motivation of participants.

Modules	Course Duration: December 10-15, 2018 Last Date for registration: November 12, 2018 Number of participants for the course will be limited to fifty. It will be compulsory for registered participants to attend the entire module.
You Should Attend If...	<ul style="list-style-type: none">• You are a graduate student or an engineer interested in gaining an understanding of the fundamental elements of topological solitons.• You are a researcher interested in understanding a fascinating aspect of field theory.
Fees	The participation fees for taking the course is as follows: Participants from abroad: US \$500 Industry/ Research Organizations: 15000 Academic Institutions: 5000 The above fee includes all instructional materials, computer use for tutorials and assignments, 24 hr free internet facility and food charges. The participants will be provided with accommodation on payment basis.

The Faculty



Prof. Richard MacKenzie is in the faculty of Physique des particules, Université de Montréal, Canada. His research interests include theoretical particle physics, quantum field theory and its applications in particle physics, cosmology and condensed matter physics. He also works on semi-classical methods, topology in field theory, solitons, instantons and quantum information.



Prof. Subhashish Banerjee is a faculty member of Indian Institute of Technology, Jodhpur. His research interests are quantum statistical mechanics, quantum field theory and quantum information.

INSTRUCTION FOR REGISTRATION:

- (1) Register at the GIAN portal on the link <http://www.gian.iitkgp.ac.in/> by clicking on 'Course Registration/Participant Login'.
- (2) It shall state – 'Registration to the portal is one-time affair and will be valid for lifetime of GIAN. Once registered in the portal, an applicant will be able to apply for any number of GIAN courses as and when necessary. One-time non-refundable fee of Rs. 500/- is to be charged for this service. Please also note that mere registration to the portal will not ensure participation in the courses'.
- (3) Once done with registration, please select the course 'Topological Solitons and Their Applications' from the list of courses.
- (4) Send the copy of registration details from GIAN website to the following email; gianiitj@gmail.com or subhashish@iitj.ac.in

Course Co-ordinator

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