ESI Erwin Schrödinger International Institute for Mathematics and Physics

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ESI SENIOR RESEARCH FELLOW LECTURE COURSE

Summer Term 2020

The Erwin Schrödinger International Institute for Mathematics and Physics (ESI) of the University of Vienna offers the following Lecture Course held by a Senior Research Fellow in residence during the Summer Term 2020:

Dynamics in Spatially Confined Hamiltonian Systems
Piotr Bizón (Jagiellonian University, Kraków)

Lecture Course (442637 VO): April 20 - May 25, 2020
Time: Monday, 13:45 - 15:15
Start: Monday, April 20, 2020
End: Monday, May 25, 2020

Venue: ESI, Schrödinger Lecture Hall

Abstract: The subject of lectures is propagation of nonlinear waves in the presence of spatial confinement. The confinement may be due to the boundedness/compactness of the domain (as for water waves on the sea), a trapping potential (as for Bose-Einstein condensates), or a timelike boundary at spatial infinity (as for gravitational waves in the presence of a negative cosmological constant). The problem is challenging because the mechanism stabilizing the evolution of waves on unbounded domains - dissipation of energy by radiation - is absent in the confined setting. Since the waves cannot escape to infinity, they keep interacting for all times, inducing a complicated long-time behavior. The central physical question is how the energy injected to the system (for instance, by wind to the sea) gets distributed over the degrees of freedom during the evolution, in particular can energy migrate to arbitrarily small spatial scales leading to a turbulent behavior. This subject lies at the interface between mathematics and physics, connecting fundamental problems in the theory of partial differential equations with various areas of nonlinear physics.

Outline of lectures:

(1) Propagation of waves in spatially unbounded systems; dissipation by dispersion.

(2) Examples of spatially confined systems: wave equations on compact manifolds, nonlinear Schrödinger equation with a trapping potential, asymptotically anti-de Sitter spacetimes.

(3) Spatially coherent solutions and their stability: nonlinear bound states, time-periodic and quasi-periodic solutions.

(4) Resonant approximation: derivation and basic properties, finite-dimensional invariant manifolds.

(5) The cubic Szegő equation and its perturbations; weakly turbulent solutions.

(6) Physical applications: vortices in Bose-Einstein condensates, instability of anti-de Sitter spacetime.

For more information and references, see http://th.if.uj.edu.pl/ bizon/

Course website: https://www.esi.ac.at/events/e303/
Link to the course directory

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Director