Acronimo:

Titolo del progetto:

The charm of integrability: from nonlinear waves to random matrices

Programma di Finanziamento

PRIN 2022

Codice Progetto

2022TEB52W

Settore ERC

PE1

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Ruolo Uniba (Principal Investigator/R.U.L)

Responsabile Unità Locale

Responsabile scientifico

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Dipartimento

Dipartimento di Matematica

Finalità

This project aims to study nonlinear systems originating from classical and quantum physics that have the property of being exactly solvable or integrable in some asymptotic regime.

Abstract

For 50 years, integrability has continuously staked claims in an ever-growing range of applications in mathematics and in physics. Indeed, integrable and near-to-integrable models keep emerging in important areas of Classical and Quantum Physics such as Condensed Matter and Plasma Physics, Optics, Gravity,

Statistical Physics and String Theories.

The modern theory of integrable systems grew up around the study of the Korteweg de Vries (KdV) equation, with origins in the seminal work of Kruskal and Zabusky about the recurrence behavior of solutions, the discovery of the Lax pair, multi-soliton solutions, bi-Hamiltonian structures and infinite number of conservation laws. In later surprising connections, integrable systems like the KdV equation and the Toda lattice were proven to appear in combinatorial models, in random matrices and the geometry of moduli spaces of algebraic curves.

In general, integrability provides the route to an explicit description of behaviour and phenomena that turns out to be ubiquitous in nonlinear systems. Actually, the idea that an integrable behaviour persists in non-integrable systems, together with the combination of front-line geometrical and analytical techniques in the theory of Hamiltonian equations, is the leitmotiv of this research project.

Risultati attesi

1) To study the theory of soliton gases, and substantiate the features of the “unlikely marriage” of integrability and randomness motivated by the complexity of many nonlinear wave phenomena;

2) To give new insights into the fundamental class of wave-induced dynamics in the theory of stratified fluids and in the theory of vorticity by linking their dimensionally reduced models to the theory of integrable PDEs;

3) To use spectral methods and Riemann-Hilbert methods to describe solution for physically relevant initial/boundary value problems of nonlinear PDEs;

4) To study nonlinear wave phenomena, such as the formation and the dynamics of singularities, blow ups, wave breaking, shocks, elliptic/hyperbolic regime transition, dispersive/dissipative regularization.

5) To study geometric and algebraic properties of integrable Hamiltonian and bi-Hamiltonian systems arising in mathematical and physical models, together with their hierarchies of symmetries/conserved quantities.

Partenariato

Evidenze pubbliche (inserire il link a procedure, avvisi, …)

Contributo MUR

187.423,00 €

Budget Uniba

5.000,00 €

Data avvio delle attività

28.09.2023

Data fine delle attività

28.02.2026

Pagina web progetto (inserire link)

https://people.sissa.it/~grava/PRIN.html