Abstracts of the Workshop

Dispersive equations of Math Physics

3-5 MARCH 2025, Pisa

Speaker. *Jacopo Bellazzini, University of Pisa*

Title. *Compact embeddings for fractional super and sub harmonic functions with radial symmetry*

Abstract. *We prove compactness of the embeddings in Sobolev spaces for fractional super and sub harmonic functions with radial symmetry. The main tool is a pointwise decay for radially symmetric functions belonging to a function space defined by finite homogeneous Sobolev norm together with finite L^2 norm of the Riesz potentials. As a byproduct we prove also existence of maximizers for the interpolation inequalities in Sobolev spaces for radially symmetric fractional super and sub harmonic functions. Joint work with Vladimir Georgiev.*

Speaker. *Francesco Fanelli, BCAM Bilbao*

Title. *Hyperbolic effects in incompressible fluid mechanics*

Abstract. *In this talk, we are interested in the well-posedness theory of a system of PDEs which describes the dynamics of a non-homogeneous fluid displaying* non-dissipative *viscosity effects. Examples of such fluids arise both in quantum and classical hydrodynamics. At the mathematical level, the non-dissipative nature of the viscosity is encoded by an odd term, dubbed precisely* odd viscosity *tensor. As the odd viscosity term involves higher order space derivatives of the velocity field and of the density, it is responsible for an apparent loss of regularity in the classical* a priori *estimates.*

In this talk, we show how to circumvent such a loss of derivatives and establish a well-posedness result in the framework of Sobolev (or, more generally, Besov) spaces of high enough regularity. The key is the identification of a suitable effective velocity *in the model, which allows to highlight a hyperbolic structure underlying the system of equations.*

The talk is based on joint works with Rafael Granero-Belinchón *(Universidad de Cantabria),* Stefano Scrobogna *(Università degli Studi di Trieste) and* Alexis Vasseur *(University of Texas at Austin).*

Speaker. *Nakao Hayashi, University of Waseda*

Title. *Nonlinear boundary problem for the nonlinear Schrödinger equation in a scale invariant space*

Abstract. *We consider the nonlinear Schrödinger equation with the power nonlinearity of order 2q-1 and the nonlinear Neumann boundary condition with the power nonlinearity of order q. Our purpose in this talk is to show that if the data are suitably small in a scale invariant space with 2<q<3, then there exists a unique global solution.*

Speaker. *Ryunosuke Kusaba, University of Waseda and University of Pisa*

Title. *Commutation relations between the complex Ginzburg-Landau semigroup and monomial weights and their application*

Abstract. *We give explicit formulae of commutation relations between the complex Ginzburg–Landau (CGL) semigroup and monomial weights in terms of the linear combination of the CGL semigroup and its derivatives. As an application, we present a new approach to obtain weighted estimates of global solutions to the CGL type equation in the super Fujita-critical case. This talk is based on a joint work with Prof. Tohru Ozawa and Prof. Yi Huang.*

Speaker. *Tohru Ozawa, University of Waseda*

Title. *Equations for the free particle from the Galileian point of view*

Abstract. *A charaterization is given to the time-dependent free Schro"dinger operator by means of the invariance under the Galilei group with U(1)-gauge, thereby supporting the foundation of Quantum Mechanics on the basis of the invariance naturally arising in Classical Mechanics. This talk is based on a recent joint-work with Hiromichi Nakazato, Department of Physics, Waseda University.*

Speaker. *Mario Rastrelli, University of Pisa and University of Waseda*

Title. *Fractional L^p Sobolev Spaces with point interaction*

Abstract. *In this talk, we present key definitions and classical results regarding the Laplace operator perturbed by point interactions in dimensions $d = 2, 3$. Recent advancements have led to the derivation of Strichartz estimates for fractional domains, enabling the study of the perturbed Nonlinear Schrödinger equation (pNLS). We will apply Komatsu's theory of fractional operators to extend these results to Lebesgue spaces L^p, for suitable values of p. A new proof of local well-posedness in the energy space for pNLS in d=2 is provided, utilizing the contraction method. This result is then generalized to fractional domains in $d = 3$.*

Speaker. *Nikolay Tzvetkov, UMPA, ENS Lyon*

Title. *A smoothing effect for the fractional Schrödinger equations on the circle and observability*

Abstract. *We show that, after a renormalisation, one can define the square of the modulus of the solution of the fractional Schrödinger equations on the circle with data in Sobolev spaces of arbitrary negative index. As an application, we obtain observability estimates with rough controls. This is a joint work with Paul Alphonse.*