**Paolo Antonelli:** *On a class of non-linear Schrödinger equations with non-linear damping*

In this talk I will report about some results obtained together with R. Carles (Montpellier) and C. Sparber (Chicago) on nonlinear Schrödinger equations with a nonlinear damping term. Such equations are used in nonlinear optics, where the damping term models multiphoton absorption, and in Bose-Einstein condensation, when the gas has a negative scattering length and the damping is interpreted as a three-body recombination term. In general (a small) nonlinear damping term is used to describe the solution of a NLS equation after the blow-up time and can be seen as a method to continue the solution after that time. I will introduce the main tools used in the analysis and describe the properties of the solutions for this class of equations.

**Olga Bernardi:** *Weak KAM Theory: from PDE to dynamics*

The aim of Weak KAM Theory is to recognize a sort of integrable structure for Tonelli Hamiltonians (i.e. smooth, convex and superlinear in each fiber) and to understand dynamical informations encoded in the related effective Hamiltonian. Starting from the min-max formula for the effective Hamiltonian, we introduce and illustrate the dynamical content of a recent Evans’ approximate variational principle for Weak KAM Theory. Moreover, we discuss the ”boundary rigidity phenomenon” for convex hypersurfaces and some link with Lyapunov functions for the corresponding dynamics.

**Federico Cacciafesta:** *Dispersive estimates for the Dirac equation with potentials*

The Dirac equation is one of the most important equations in quantum mechanics. Its rich algebraic structure often provides several difficulties: despite the free dynamics can be fairly easily related to the wave one, potential and nonlinear perturbations require indeed some efforts. In this talk I will review some dispersive estimates for suitable potential perturbations, focusing in particular on the case of the Coulomb potential. These are joint works with P. D’Ancona e E. Seré.

**Claudio Cacciapuoti:** *Stationary States for the NLS on a Tadpole-Graph*

Metric graphs have recently become popular models for almost one-dimensional ramified structures. The non-linear Schrödinger equation (NLS) on graphs is intended to describe
the dynamics of systems such as Bose-Einstein condensates in ramified (magnetic and/or optical) traps. In my talk I will consider a NLS supported on a tadpole-graph, a metric graph obtained by attaching a half-line to a cycle. I will focus attention on the NLS with power-type focusing non-linearity, defined on functions which are continuous at the junction point between the half-line and the cycle. I will exhibit the stationary solutions of the equation and explain how they bifurcate from (embedded) eigenvalues and threshold resonances of the linear system. This is a joint work in collaboration with D. Finco and D. Noja.

Livia Corsi: *Degenerate resonant tori*

Roberto Feola: *Quasi-periodic solutions for quasilinear forced NLS*

We focus on the existence of quasi-periodic, small amplitude, solutions for quasi-linear and fully nonlinear NLS equation on the torus in presence of a quasi-periodic forcing. We obtain the existence for a Cantor sets of frequencies which has asymptotically full measure as the perturbation parameter goes to zero. We give a sketch of the proof which is based on a Nash-Moser iterative scheme on a scale of Banach spaces. In order to invert the linearized operator which has non constant coefficients up to the highest order derivatives, we perform a regularization procedure that conjugates it to a constant coefficients differential operator plus a bounded remainder. Hence we apply a KAM-like scheme to completely diagonalize it on a suitable Cantor set.

Emanuele Haus: *Growth of Sobolev norms for the non-linear Schrödinger equation on the two-dimensional torus*

We study the non-linear Schrödinger equation (with polynomial non-linearity of any odd integer degree) on the two-dimensional torus and exhibit orbits whose Sobolev norms grow with time. The main point is to make use of accurate and highly non-trivial combinatorial analysis in order to reduce to a sufficiently simple toy model, which generalizes the one discussed in the paper by J. Colliander, M. Keel, G. Staffilani, H. Takaoka and T. Tao for the case of the cubic NLS. We also aim (work in progress) at giving estimates of the time needed to obtain such growth, by refining and adapting to this more general case the techniques used for the cubic case in the work by M. Guardia and V. Kaloshin. This is a joint work with M. Guardia and M. Procesi.

Alberto Maiocchi: *An averaging theorem for nonlinear PDEs*

We present an averaging theorem which applies to a wide class of weakly nonlinear PDEs. We show that, in the limit of vanishing nonlinearity, dynamics is controlled by an effective equation, which contains only the resonant terms of the nonlinearity.
Alberto Maspero: *One smoothing properties of the KdV flow on \( \mathbb{R} \)*

I prove a 1-smoothing result of the KdV flow on \( \mathbb{R} \). To this end I will show that the scattering map is a perturbation of the Fourier transform by a regularizing operator.

Riccardo Montalto: *KAM for quasi-linear PDEs*

I will present some recent results concerning the existence of quasi-periodic solutions for quasi-linear PDEs.

Gabriella Pinzari: *Global Kolmogorov tori in the planetary problem*

We prove the existence of an almost full measure set of \((3n-2)\)-dimensional quasi periodic motions in the planetary problem with \((1+n)\) masses, with eccentricities arbitrarily close to the Levi-Civita’s limit value and relatively high inclinations. This extends previous results in [Arnold 1963], [Robutel, 1995], [J. Féjoz, 2004], [P. PhD 2009], [Chierchia-P. 2011] where smallness of eccentricities and inclinations was assumed. The proof exploits nice parity properties of a new set of coordinates for the planetary problem, which reduces completely the number of degrees of freedom for the system (in particular, its degeneracy due to rotations) and, moreover, is well fitted to its reflection invariance. This allows the explicit construction of an associated close to be integrable system, replacing Birkhoff normal form, common tool of previous literature.

Andrea Raimondo: *Universality for Scalar Nonlinear Waves*

In the long-wave regime, nonlinear waves may undergo a phase transition from a smooth to a fast oscillatory behaviour, a phenomenon commonly known as dispersive shock. For the class of local Hamiltonian PDEs, such as KdV, Dubrovin conjectured that the transition is universal, decribed by a special solution of a certain fourth order ODE (of Painlevé type). In this talk I will show how to extend the Dubrovin’s universality conjecture to a wider class of equations, I will provide a classification of universality classes and the explicit description of the transition by means of special functions. In particular, I will show that the Benjamin-Ono equation belongs to a novel universality class with respect to the ones known in the literature.