

Journées ANR HEAD

Rapport sur les contributions

ID de Contribution: **1**

Type: **Non spécifié**

Arrival - welcome

ID de Contribution: 2

Type: **Non spécifié**

Large-time stability of partially dissipative hyperbolic systems

lundi 13 avril 2026 16:00 (1 heure)

In this talk, we consider hyperbolic systems with dissipative effects arising from viscosity or friction. We start by reviewing recent results on the stability of perturbations around constant equilibria. Then, we discuss how the stability analysis changes when passing from constant states to space-periodic traveling waves. In this setting, we introduce a space-averaged Shizuta–Kawashima-type condition and show that it characterizes high-frequency spectral stability for one-dimensional partially diffusive hyperbolic–parabolic systems with space-periodic coefficients. This criterion further enables us to establish nonlinear stability results for sufficiently small initial perturbations.

Orateur: CRIN-BARAT, Timothée

ID de Contribution: 3

Type: **Non spécifié**

Talk 2

lundi 13 avril 2026 17:00 (1 heure)

Orateur: KAZAKOVA, Maria (LAMA, USMB)

ID de Contribution: 4

Type: **Non spécifié**

Mini-course 1: on discrete integration by parts methods

mardi 14 avril 2026 09:00 (1h 30m)

The course will review several aspects of **discrete integration by parts methods**. The ultimate goal is to construct finite difference approximations of the first order derivative that satisfy a similar integration by parts formula as in the continuous setting on a half-line. Basic questions (and partial answers) include existence, uniqueness and non-existence results. We shall connect the theory with various problems in matrix theory or discrete mathematics (Hankel determinants, Vandermonde matrices, Bernoulli polynomials etc.). Several open questions will be listed.

Orateur: COULOMBEL, Jean-François (Institut de Mathématiques de Toulouse)

ID de Contribution: 5

Type: **Non spécifié**

Mini-course 1: on discrete integration by parts methods

mardi 14 avril 2026 10:45 (1h 30m)

The course will review several aspects of **discrete integration by parts methods**. The ultimate goal is to construct finite difference approximations of the first order derivative that satisfy a similar integration by parts formula as in the continuous setting on a half-line. Basic questions (and partial answers) include existence, uniqueness and non-existence results. We shall connect the theory with various problems in matrix theory or discrete mathematics (Hankel determinants, Vandermonde matrices, Bernoulli polynomials etc.). Several open questions will be listed.

Orateur: COULOMBEL, Jean-François (Institut de Mathématiques de Toulouse)

ID de Contribution: 6

Type: **Non spécifié**

Talk 3

mardi 14 avril 2026 14:00 (1 heure)

Orateur: VIGNAL, Marie-helene (Institut de Mathématiques de Toulouse, Université Toulouse 3 - Paul Sabatier)

ID de Contribution: 7

Type: **Non spécifique**

Are L^∞ solutions to hyperbolic systems of conservation laws unique?

mardi 14 avril 2026 15:00 (1 heure)

For hyperbolic systems of conservation laws in 1-D, fundamental questions about uniqueness and blow up of weak solutions still remain even for the apparently “simple” systems of two conserved quantities such as isentropic Euler and the p-system. Similarly, in the multi-dimensional case, a longstanding open question has been the uniqueness of weak solutions with initial data corresponding to the compressible vortex sheet. We address all of these questions by using the lens of convex integration, a general method of constructing highly irregular and non-unique solutions to PDEs. Our proofs involve computer-assistance. This talk is based on joint work with László Székelyhidi, Jr.

Orateur: KRUPA, Sam (Ecole Normale Supérieure)

ID de Contribution: 8

Type: **Non spécifié**

Dispersionless limit in the Euler-Korteweg system

mardi 14 avril 2026 16:30 (1 heure)

The Euler-Korteweg equations are a modification of the Euler equations which include in the momentum equation a term modelling capillary forces. Mathematically, this supplementary term is of dispersive nature, and after a reformulation the system looks like a degenerate Schrödinger equation. We consider here the behaviour of smooth solutions when the capillary coefficient is very small. When the problem is posed on the full space, we prove that the solutions converge to a solution of the Euler equation. On the half space, we obtain a formal WKB expansion which indicates the presence of a boundary layer. We shall also discuss the question of the limiting problem if the initial data exhibit a phase transition across a layer whose thinness depends on the capillary coefficient.

Orateur: AUDIARD, Corentin (Sorbonne Université)

ID de Contribution: 9

Type: **Non spécifié**

Mini-course 2: orbital stability of periodic waves in Hamiltonian systems under localized perturbations

mercredi 15 avril 2026 09:00 (1h 30m)

In Hamiltonian systems, periodic waves often correspond to coherent structures: recurrent, robust patterns that persist over time. Notable examples include water waves, periodic sequences of light pulses in nonlinear optical fibers, and soliton trains in Bose-Einstein condensates. To date, nonlinear stability results for periodic standing or traveling waves in Hamiltonian systems have primarily addressed co-periodic perturbations. A longstanding open problem concerns their stability with respect to localized perturbations: a natural setting in many physical applications. We begin this minicourse by reviewing classical stability methods for Hamiltonian systems with symmetry. These approaches characterize stable solutions as constrained minimizers of an appropriate Lagrangian functional, which is built from conserved quantities of the system and is positive definite on a finite-codimensional constraint space. We then explain why this framework breaks down for periodic waves under localized perturbations and introduce a novel approach that combines variational methods, Floquet-Bloch theory, and Duhamel-based estimates with a modulational ansatz. This alternative approach yields orbital stability results for periodic waves in key Hamiltonian models, such as the Korteweg-de Vries, Klein-Gordon, and nonlinear Schrödinger equations, with respect to L^2 -localized perturbations.

Orateur: DE RIJK, Björn (Karlsruher Institut für Technologie)

ID de Contribution: 10

Type: Non spécifié

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Orateur: DE RIJK, Björn (Karlsruher Institut für Technologie)

ID de Contribution: **11**

Type: **Non spécifié**

Talk 6

mercredi 15 avril 2026 14:00 (1 heure)

Orateur: BELLON, Gilles (Centre National de Recherches Météorologiques)

ID de Contribution: 12

Type: Non spécifié

Global well-posedness and asymptotic behavior of an inviscid non-equilibrium radiation hydrodynamics system

mercredi 15 avril 2026 15:00 (1 heure)

We consider the one-dimensional diffusion approximation, non-equilibrium model of radiation hydrodynamics derived by Buet and Després (J. Quant. Spectrosc. Radiat. Transf. 85 (2004), no. 3-4, 385–418). This system describes a non-relativistic inviscid fluid subject to a radiative field under the non-equilibrium hypothesis, that is, when the temperature of the fluid is different from the radiation temperature, and it is a non-conservative parabolic balance law system. We are interested in the global existence and asymptotic behavior of small perturbation of constant equilibrium states. The approach we take can be divided into three steps: first, we study the local well-posedness of the system; second, the decay properties of the linear system around a constant state are studied under the framework of Sizhuta and Kawashima (Hokkaido Math. J. 14 (1985), no. 2, 249–275); and third, we perform the nonlinear energy estimate based on the linear results, which will give us the a priori energy estimate as well as the decay rate of solutions needed to conclude the global existence and asymptotic behavior. For this last step we introduce a notion of entropy for the system that allows us to recast it in a form such that the nonlinear estimate can be closed. This talk is based on a joint work with C. Lattanzio and R. G. Plaza.

Orateur: VALDOVINOS, José Manuel (Institut de Mathématiques de Toulouse)

ID de Contribution: 13

Type: **Non spécifié**

Variations on the Gatenby-Gawlinski model for acid-mediated tumour growth

mercredi 15 avril 2026 16:30 (1 heure)

For evident reasons, Cancer Biology is one of the most challenging topics of current medical research and understanding the mechanism behind its uncontrolled growth is a crucial issue. Among other explanations of the process, the Warburg effect posits that a pivotal role is played by the so-called aerobic glycolysis, i.e. the fact that, even in presence of oxygen, lactic acid fermentation can be favoured by tumour cells, enhancing their metabolism and, as a consequence, the invasive features.

The aim of the talk is to present a mathematical model for such a phenomenon, in the form proposed in 1996 by Robert A. Gatenby and Edward T. Gawlinski, based on a system of reaction-diffusion equations and discusses some of its most significant properties, including the computational evidence of the existence of propagation fronts. Time permitting, I will also discuss other complementary items such as the existence of fronts for simplified models, stability (dynamic and structural), heterogeneity, homogenisation...

Collaborations with Irene Anello, Thierry Gallay, Pierfrancesco Moschetta, Donato Pera, Elisa Scanu, Chiara Simeoni (variable subgroups...).

Orateur: MASCIA, Corrado (Sapienza Università di Roma)

ID de Contribution: 14

Type: **Non spécifié**

Mini-course 3: symmetrizers

jeudi 16 avril 2026 09:00 (1h 30m)

The aim of this lecture is to present new results concerning the well-posedness of hyperbolic systems defined in a domain with a corner. In the canonical half-space geometry, Kreiss's theory [1970] characterizes well-posed problems in terms of an algebraic condition, the so-called uniform Kreiss–Lopatinskii condition. The main contribution of Kreiss's work is the construction of a so-called Kreiss symmetrizer, which reduces the proof of the a priori energy estimate to a simple integration-by-parts argument.

Although it seems to be a natural extension, the well-posedness issue for hyperbolic corner problems is a rather open question since the seminal work of Osher [1973].

Here, we introduce a new notion of symmetrizer adapted to corner problems, which makes it possible to characterize well-posed problems in terms of a non-intersection condition. In this way, Kreiss's half-space theory is extended to corner domains.

The lecture will be divided into four sections of increasing technical difficulty, all relying on the same fundamental ideas. Section 1 is devoted to the Cauchy problem. Section 2 extends the ideas of Section 1 to the half-space problem. Section 3 considers the strip problem, which serves as a toy model for studying interactions arising from multiple boundaries. Finally, Section 4 is devoted to corner domains and relies heavily on the toy-model analysis developed in Section 3.

Orateur: BENOIT, Antoine (ULCO)

ID de Contribution: 15

Type: **Non spécifié**

Mini-course 3: symmetrizers

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Orateur: BENOIT, Antoine (ULCO)

ID de Contribution: **16**

Type: **Non spécifié**

Talk 9

jeudi 16 avril 2026 14:00 (1 heure)

Orateur: BESSEMOULIN-CHATARD, Marianne (Laboratoire de Mathématiques Jean Leray)

ID de Contribution: 17

Type: **Non spécifié**

Emergence of peaked singularities in the Euler-Poisson system

jeudi 16 avril 2026 15:00 (1 heure)

We consider the one-dimensional Euler-Poisson system equipped with the Boltzmann relation. We provide the exact asymptotic behavior of the peaked solitary wave solutions near the peak. This enables us to study the cold ion limit of the peaked solitary waves with the sharp range of Holder exponents. Furthermore, we provide numerical evidence for C^1 blow-up solutions to the pressureless Euler-Poisson system, whose blow-up profiles are asymptotically similar to its peaked solitary waves and exhibit a different form of blow-up compared to the Burgers-type (shock-like) blow-up. This is a joint work with Sang-Hyuck Moon (Pusan National University) and Kwan Woo (University of Basel).

Orateur: BAE, Junsik (Kyungpook National University)

ID de Contribution: 18

Type: Non spécifié

Hyperbolic regularization effects for degenerate elliptic equations

jeudi 16 avril 2026 16:30 (1 heure)

Among weak solutions of Burgers' equation, a single strictly convex entropy is sufficient to characterize the sign of all entropy productions. In particular, if that entropy production vanishes, then the solution must be continuous. It turns out that this fact can be interpreted as a regularity result for a degenerate elliptic equation in the plane, and generalized to prove partial regularity results for a large class of planar nonlinear equations $\operatorname{div} G(\nabla u) = 0$ which are only qualitatively elliptic. This is joint work with Riccardo Tione.

Orateur: LAMY, Xavier (Institut de Mathématiques de Toulouse)