Special Lectures

Speaker:
M. Brachet
ENS Paris, France

Title:
A journey from classical to quantum turbulence

Abstract:
In a first part, I will recall some results obtained in the early 80's on classical (Navier-Stokes/Euler equation) turbulence and the inviscid flow singularity problem. I will then illustrate the increase of available computing power during the last 35 years by showing up to date numerical results. I will end the classical part of my talk by showing how spectral truncation of the Euler equation allows the study of irreversible behaviors and bifurcations over a turbulent background.

The second part of my talk will start by a brief introduction to physical systems displaying regimes of quantum turbulence and standard models of superfluidity. The rest of the talk will concentrate on models based on the Gross-Pitaevskii equation (GPE, also called the non-linear Schrödinger equation). After introducing the Madelung transformation and vortex reconnection, I will show how spectral truncation of the GPE allows to consider some finite temperature effects. I will end the talk by showing some recent numerical results on quantum turbulence.

Speaker:
Alan Newell
University of Arizona, USA

Title:
Wave turbulence: Open challenges

Abstract:
A brief overview of the premises on which the derivation of the wave turbulence closure is based and a discussion of several open challenges.

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Keynote Lectures

Speaker:
V.S. Bagnato
IFSC – University of São Paulo – São Carlos –SP - Brazil

Title:
EXPERIMENTAL OBSEVATIONS IN A TURBULENT BEC: DEMONSTRATION OF NONTHERMAL STATES AND UNIVERSAL SCALING PROPERTIES

One of the out-of-equilibrium states of great interest in superfluids is the state of turbulence. In this state, the proliferation of vortices or waves, creates one of several known states of turbulence. From equilibrium, with energy injection, there is evolution establishing a cascade of energy that causes migration of energy to high moments, resulting in a dependence of power law type in the energy spectrum. The reason the system evolves this way has to do with its quest for equilibrium, reaching possibly a stationary state. If the energy injection is ceased, the system evolves in time.
Observing the high moment component in the distribution allows us to verify its dependence by determining whether it is a non-thermal state. We detected in our experiment regions of excitation, where exponential (rather than Gaussian) dependence reveals the presence of non-thermalizing states. Such out-of-equilibrium states exhibit universal behavior when scaled. This universal behavior is of great interest, specially if associated with turbulent states. (Financial support from FAPESP, CNPq and CAPES. This work had athe participation of A. Garcia, A. Cedrim, G. Roati, G. Telles)

Speaker:
O. Cadot
University of Liverpool, UK

Title :
Multistability in turbulent wake : symmetry breaking state and high Reynolds number bifurcation

Abstract :
The communication will present recent experimental progress in the comprehension of the large-scale dynamics of turbulent wakes produced by three-dimensional bluff bodies. A focus will be done on the identification of the static symmetry breaking mode leading to bifurcations and multi-stable dynamics with turbulent background.

Speaker:
G. Eyink
Johns Hopkins University, USA

Title:
Stochastic Lagrangian Dynamics of Vorticity in Wall-Bounded Navier-Stokes Turbulence

Abstract:
The fundamental geometric and Lagrangian properties of vorticity for a smooth Euler solution have been generalized to viscous Navier-Stokes solutions by Constantin & Iyer (2008, 2011) using a stochastic Lagrangian framework. As we show, this theory is best understood within the Kuz'min-Oseledets formulation of Navier-Stokes, in terms of the "vortex momentum" associated to a continuous distribution of infinitesimal vortex rings. This theory provides an infinite set of exact Lagrangian conservation laws for Navier-Stokes vorticity, the "stochastic Cauchy invariants". These are preserved only backward in time, due to the irreversibility of Navier-Stokes dynamics. For wall-bounded flows, these invariants allow a complete representation of interior vorticity in terms of the vorticity generated at a solid wall, as it is advected, stretched and rotated by the flow. Just as in superfluids, this cross-stream transport of tangential vorticity generated at the wall is exactly related to drag and energy dissipation via the Taylor-Josephson-Anderson relation. We exploit the stochastic Cauchy invariants in a numerical implementation using a space-time database of turbulent channel-flow at $Re_\tau=1000$. In contrast to conventional pictures, we show that the process of vortex-lifting in the wall buffer layer, crucial to turbulent drag-generation, is not an abrupt lifting of discrete vortex lines but is instead a distributed event over past space-time and involves intense competition between linear viscous destruction of vorticity and nonlinear Lagrangian chaos that exponentially magnifies & rotates vorticity.

Speaker:
G. Gallavotti
Universita' di Roma La Sapienza, Roma, Italy

Title:
Statistical ensembles out of equilibrium: the turbulence case

Abstract:
How to formulate a theory of ensembles analogous to that for the equilibrium ensembles (eg. canonical or microcanoniocal ensembles) to describe the stationary states out of equilibrium? A proposal is suggested by the example of the Navier-Stokes equation. The NS equation will be considered for an incompressible fluid in a periodic box and subject to a stirring force constant in time and acting at large scale (i.e. at the scale of the container). Stationary states depend on a single parameter R=Reynolds number=inverse of viscosity and form a family E of probability distributions on the velocity fields. The possibility will be discussed of existence of other equations whose stationary states have -exactly- the same distributions through a mechanism analogous to that for the the

equivalence of equilibrium states of different ensembles (which will be proposed to be similar to the equivalence in the thermodynamic limit which in the NS case will correspond to the ultraviolet regularization N -> infinity).

Speaker:
A. Pouquet
UCAR, USA

Title:
Dissipation, Intermittency and Anisotropy in Decaying Rotating Stratified Turbulence: A Case of Marginal Instability?

Abstract:
Analyzing a large data base of high-resolution direct numerical simulations of decaying rotating stratified flows, one can show that anomalous mixing and dissipation, marked anisotropy, and strong intermittency are all observed simultaneously in an intermediate regime in which both waves and eddies interact efficiently nonlinearly. A critical behavior governed by the stratification occurs at Richardson numbers of order unity, close to the shear instability threshold, and with an accumulation of data points in its vicinity. This confirms the central dynamical role of strong large-scale intermittency in the vertical velocity, the temperature and their gradients in such turbulent flows.

Speaker:
S. Turitsyn
Aston University, UK

Title:
Optical wave turbulence in fibre lasers

Abstract:
Traditional wave kinetics describes the slow evolution of systems with many degrees of freedom to equilibrium via numerous weak non-linear interactions and cannot be directly applied to important class of dissipative (active) optical systems with cyclic gain and losses, such as lasers with non-linear intracavity dynamics. Radiation of certain clases of fibre lasers is characterised by a highly irregular nonlinear interactions of a large number of logitudinal modes. These lasers present an interesting class of cyclic wave systems, characterized by non-uniform double-scale dynamics with strong periodic changes of the energy spectrum and slow evolution from cycle to cycle to a statistically steady state. I will overview our previous research on optical wave turbulence in fibre lasers and will discuss more recent results related to detection of cohernet structures in the fibre laser radiation.

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Talks

Speaker: Alexakis, Alexandros; ENS Paris, France.
Title: Energy fluxes in quasi-equilibrium flows

Speaker: Bagnato, Vanderlei; University of São Paulo, Brasil.
Title: EXPERIMENTAL OBSERVATIONS IN A TURBULENT BEC: DEMONSTRATION OF NONTHERMAL STATES AND UNIVERSAL SCALING PROPERTIES

Speaker: Bardos, Claude; Université de Paris 7- Denis Diderot, France.
Title: A baby version of the Landau damping and a road map to the Quasilinear approximation

Speaker: Bec, Jérémie; Mines-ParisTech, Sophia-Antipolis, France.
Title: Are PDEs providing relevant tools to describe turbulent flows?

Speaker: Biferale, Luca; Dept. Physics and INFN University of Rome Tor Vergata, Italy.
Title: Recent results on rotating turbulence

Speaker: Bouchet, Freddy; ENS de Lyon and CNRS, France.
Title: Rare transitions in barotropic and baroclinic turbulence

Speaker: Bourgoin, Mickael; ENS de Lyon and CNRS, France.
Title: Lagrangian particle tracking in normal and superfluid turbulent flow

Speaker: Brachet, Marc; ENS Paris, France.
Title: A journey from classical to quantum turbulence.

Speaker: Bulgac, Aurel; University of Washington, USA.
Title: Towards Quantum Turbulence in Cold Atomic Fermionic Superfluids

Speaker: Cadot, Olivier; University of Liverpool, UK.
Title: Multistability in turbulent wake : symmetry breaking state and high Reynolds number bifurcation

Speaker: Cencini, Massimo; Istituto dei Sistemi Complessi -CNR, Italy.
Title: Time irreversibility in reversible and irreversible shell models of turbulence

Speaker: Chevillard, Laurent; ENS de Lyon and CNRS, France.
Title: On the stochastic modeling of Lagrangian velocity and acceleration in turbulent flows

Speaker: Danaila, Luminita; Université de Rouen, France.
Title: Quantum turbulence exploration using the Gross-Pitaevskii equation

Speaker: Dauxois, Thierry; CNRS and ENS de Lyon, France.
Title: Energy cascade in internal wave attractors

Speaker: Dubrulle, Berengere; CEA Saclay, France.
Title: Irreversibility and singularities

Speaker: Eyink, Gregory; The Johns Hopkins University, USA.
Title: Stochastic Lagrangian Dynamics of Vorticity in Wall-Bounded Navier-Stokes Turbulence

Speaker: Falkovich, Gregory; Weizmann Institute of Science, Israel.
Title: No weak turbulence for old men.

Speaker: Frisch, Uriel; Univesité Côte d'Azur - Observatoire de la Côte d'Azur, France.
Title: Non-selfsimilar time decay of the total energy in fully developed turbulence

Speaker: Gallavotti, Giovanni; Universita` di Roma, La Sapienza, Italy.
Title: Statistical ensembles out of equilibrium: the turbulence case

Speaker: Gibbon, John D.; Imperial College London, UK.
Title: The Navier-Stokes Bermuda Triangle

Speaker: Herbert, Corentin; CNRS - ENS de Lyon, France.
Title: Abrupt transition in atmospheric jets through Reynolds stress resonance

Speaker: Krstulovic, Giorgio; Observatoire de la Côte d'Azur, UCA. France.
Title: How do trapped particles interact with and sample superfluid vortex excitations?

Speaker: Kumar, Krishna; Indian Institute of Technology Kharagpur, India.
Title: Features of turbulent magnetoconvection in nanofluids

Speaker: Kuznetsov, Evgenii; LITP, Russia.
Title: Expansion of the strongly interacting superfluid Fermi gas: symmetry and self-similar regimes

Speaker: Lvov, Victor; Weizmann Institute of Science, Israel.
Title: Superfluid turbulence: energy suppression by mutual friction in He-3, intermittency enhancement in coflowing He-4 and strong anisotropy of counterflowing He-4

Speaker: Mailybaev, Alexei; Instituto Nacional de Matemática Pura e Aplicada - IMPA, Brasil.
Title: Fluid Dynamics on Logarithmic Lattices: Theory and Applications

Speaker: Matsumoto, Takeshi; Department of physics, Kyoto university, Japan.
Title: Numerical simulation of dissipative solutions to the Euler equations

Speaker: Mininni, Pablo; Universidad de Buenos Aires, Argentina.
Title: Dual cascades in quantum turbulence

Speaker: Musacchio, Stefano; University of Torino, Italy.
Title: Condensate in quasi-two-dimensional turbulence

Speaker: Navon, Nir; Yale University USA.
Title: Matter-wave turbulence in a quantum gas

Speaker: Nazarenko, Sergey; Universite Cote d'Azur - INPHYNI, France.
Title: Inverse cascades in BEC

Speaker: Newell, Alan; University of Arizona, USA.
Title: Wave turbulence: Open challenges

Speaker: Nore, Caroline; Univ. Paris-Sud, Université Paris-Saclay, Frace.
Title: Von Kármán flows: when simulations meet experiments

Speaker: Onorato, Miguel; Dipartimento di Fisica, Universita' di Torino, Italy.
Title: Anomalous correlators in classical nonlinear dispersive wave systems

Speaker: Pandit, Rahul; Indian Institute of Science, Bangalore, India.
Title: The formation of compact objects at finite temperatures in a self-gravitating bosonic system

Speaker: Perlekar, Prasad; TIFR Hyderabad.
Title: Pseudo-turbulence in three-dimensional buoyancy driven bubbly flows

Speaker: Petrelis, Francois; Ecole Normale Supérieure, France.
Title: Growth rate distribution and intermittency in kinematic turbulentdynamos: Which moment predicts the dynamo onset?

Speaker: Picozzi, Antonio; University of Bourgogne Franche Comté, France.
Title: Disorder-induced acceleration of wave condensation in multimode optical fibers

Speaker: Pouquet, Annick; UCAR, USA.
Title: Dissipation, Intermittency and Anisotropy in Decaying Rotating Stratified Turbulence: A Case of Marginal Instability?

Speaker: Pushkarev, Andrei; Skolkovo Institute of Science and Technology, Russia.
Title: Nonlinear Ocean Waves Generator and Fourier-Real Space Energy Pipelines

Speaker: Proment, Davide; University of East Anglia, UK.
Title: Irreversible dynamics of superfluid vortex reconnections

Speaker: Pumir, Alain; ENS de Lyon and CNRS, France.

Title: Extremely large velocity gradients in turbulent flows

Speaker: Ray, Samriddhi S.; ICTS-TIFR, India.
Title: Many-body chaos in a thermalised fluid

Speaker: Thalabard, Simon; IMPA, Brazil.
Title: Spontaneous randomness and Kelvin-Helmholtz interfaces

Speaker: Tuckerman, Laurette; ESPCI, Paris, France.
Title: Transition to turbulence in wall-bounded shear flows: model Waleffe flow and directed percolation

Speaker: Turitsyn, Sergei; Aston Institute of Photonic Technologies, UK.
Title: Optical wave turbulence in fibre lasers

Speaker: Venaille, Antoine; ENS de Lyon CNRS, France.
Title: Topological Waves in Fluids

Speaker: Verma, Mahendra K.; IIT Kanpur, India.
Title: Variable energy flux in turbulence

Speaker: Volk, Romain; ENS de Lyon, France.
Title: Lagrangian acceleration time scales in anisotropic turbulence

Posters

Presenter: Allende, Sofia; Univesité Côte d'Azur, France.
Title: Dynamics and fragmentation of small flexible fibers in turbulence

Presenter: Azam, Pierre; INPHYNI, UCA, France.
Title: TBA

Presenter: Campolina, Ciro; Instituto de Matemática Pura e Aplicada - IMPA, Brasil.
Title: Singularities in the 3D Incompressible Euler Equations on Logarithmic Lattices

Presenter: Faller, Hugues; CEA Saclay, France.
Title: High order numerical methods for Computational Fluid Dynamics

Presenter: Giuriato, Umberto; Univesité Côte d'Azur - Observatoire de la Côte d'Azur, France.
Title: Clustering and phase transitions in a 2D quantum fluid with impurities

Presenter: Griffin, Adam; University of warwick, UK.
Title: Vortex scattering by impurities in a Bose–Einstein condensate

Presenter: Lydon, Karl; Aston University, UK.
Title: Towards a Kinetic Theory of Dipoles

Presenter: Miloshevich, George
Title: Imbalanced collisionless Alfven wave turbulence and the inverse cascade of the generalized cross-helicity

Presenter: Tavares, Hugo; Instituto de Matemática Pura e Aplicada-IMPA, Brasil.
Title: Lattice-Boltzmann simulations for immiscible 2D Rayleigh-Taylor turbulence

Presenter: Verma, Akhilesh K.; Indian Institute of Science, Bangalore, India.
Title: PERSISTENCE-TIME PROBLEM IN THE THREE-DIMENSIONAL HVBK MODEL FOR SUPERFLUID TURBULENCE