ABSTRACTS

➢ HENRIK UEBERSCHAR (CEMPI postdoc 2014-2016)

An important object of study in the theory of disordered quantum systems are Schroedinger operators with a random potential. In 1958, Anderson discovered that for sufficiently strong disorder their eigenfunctions could be exponentially localized. I will discuss some new results about the geometry of eigenfunctions on tori with random Dirac masses, the limit of large tori and the breakdown of exponential localization in weakly disordered systems.

➢ MARC LEFRANC (PhLAM)

Un modèle mathématique pour comprendre comment le foie se met à l'heure des repas.

Pour s'adapter aux contraintes imposées par l'alternance des jours et des nuits, la plupart de nos organes disposent d'une horloge biologique qui est synchronisée sur ce cycle, et qui leur indique à quel moment de la journée ils se trouvent. En particulier, l'horloge du foie, organe qui régule notre métabolisme, est calée sur les rythmes des repas, et ses dysfonctionnements sont associés à des pathologies telles qu'obésité et diabète. Nous avons construit un modèle mathématique du couplage de cette horloge au rythme repas/jeûnes, en bon accord avec les données expérimentales. Nous avons pu reproduire les dérèglements de cette horloge sous l'effet d'un stress nutritionnel tel qu'un régime riche en graisse, et nous utilisons ce modèle pour concevoir un protocole thérapeutique basé sur l'administration à un moment précis de la journée d'une substance régulant l'un des gènes de l'horloge.

A mathematical model to understand how the liver tracks meal timing

To adapt to the alternation of days and nights, most of our organs have a biological clock synchronized to that cycle, and which thus keeps the time of the day. In particular, the liver clock, an organ that regulates metabolism, tracks the alternation of meals and fasting periods. Clock dysfunction has been associated with pathologies such as obesity and diabetes. We have constructed a mathematical model describing how this clock is coupled to the feeding/fasting cycles, which agrees well with experimental data. It reproduces the clock disruption observed under a nutrional stress such as a high-fat diet, and we use our model to design a therapeutic protocol based on the administration at a given time of the day of a drug regulating one of the clock genes.

➢ PIERRE SURET (PhLAM)

We report optical experiments and numerical simulations devoted to the investigation of integrable turbulence in the focusing regime of 1D-NLSE [1-7]. We present in particular direct single-shot recordings of optical RWs by using a specially-designed Time Microscope (TM) ultrafast acquisition system [3]. RWs with time scale of the order of 300 fs are found to emerge from the propagation of partially coherent waves having initial time scale of 5ps.

Using our TM and another optical sampling setup, we measure precisely the probability density function (PDF) of optical power of the nonlinear random waves rapidly fluctuating with time. The PDF of optical power is found to evolve from the exponential distribution to a strong heavy-tailed distribution. The exponential distribution of the power corresponds to a Gaussian statistics for the field. Our experiments thus reveal the occurrence of extreme events (RWs) in integrable turbulence with a probability much higher than predicted by the normal law.

In the talk, we will discuss the open question of the mechanisms underlying the formation of RWs in integrable turbulence [3-5]. Finally we will emphasize the crucial question of the dependence of the stationary statistics on the initial statistics [1,6,7]

References

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