Séminaire des doctorants du LPTHE

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Distribution of the ratio of level spacings in random matrix ensembles.

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Initially introduced as a description of energy levels of heavy atomic nuclei by Wigner, Random Matrix Theory (RMT) is nowadays an active field of theoretical physics with ramification in various disciplines such as number theory, quantum chaos and finance to cite just a few. In RMT, the distribution of level spacings plays a very important role: it has been widely used since the inception of the theory and is considered as the "reference" measure of spectral statistics. Since different models may and do have different level densities, one has to perform a procedure on the spectrum called unfolding. This procedure automatically set a constant mean level density by stretching apart eigenvalues in the spectrum which are too close to each other and by squeezing eigenvalues which are too far apart. This procedure is not unique and the choice of the unfolding procedure is quite arbitrary. It seems then natural to search for an other mea-

sure which is independent of the level density. This has been done quite recently by Oganesyan and Huse [1]: instead of looking at the spacing they prefer to look at the ratio of two consecutive level spacings. This quantity has the advantage that it does not require any unfolding.

In this talk, I will make few remarks on random matrix theory and the unfolding procedure. I will then derive simple expressions for the probability distribution of the ratio of two consecutive spacings for the classical ensembles of random matrices [2]. These expressions, which were lacking in the literature, will be compared to numerical data from a quantum many-body lattice model and from zeros of Riemann zeta function.

[1] V. Oganesyan and D. A. Huse, Phys. Rev. B 75, 155111 (2007).

[2] Y. Y. Atas, E. Bogomolny, O. Giraud, and G. Roux, Phys. Rev. Lett. 110, 084101 (2013)