# Laudatio of Semyon Dyatlov.

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23 of July 2018

It is a great pleasure to present to you Semyon Dyatlov who receives today the 2018 IAMP Early Career Award.

It was attributed to him for *" the introduction and the proof of the fractal uncertainty principle (FUP), which has important applications to quantum chaos and to observability and control of quantum systems."*

Semyon Dyatlov is born in Novosibirsk (1987). He has prepared his PHD (defended in 2013) with M. Zworski as advisor. He was awarded a Clay Research Fellowship in 2013. In January 2015 he became a tenure track Assistant Professor at MIT and was dividing his time between teaching at MIT and being a Clay Fellow. He received a Sloan Fellowship in February 2017. In January 2018 he starts as Assistant Professor at Berkeley.

Semyon Dyatlov has been the leader in many collaborations for the development of this FUP concept and on its applications. Roughly speaking, FUP states that wave functions cannot simultaneously concentrate near fractal sets in position and momentum. At the origin, outside the standard Heisenberg Uncertainty principle, one can also refer to questions in Harmonic Analysis (and this is indeed a tool) considered by Beurling-Malliavin in a famous paper at Acta Mathematica (1962) whose title was : *"On Fourier transforms of measures with compact support."*
FUP was introduced in a paper by Dyatlov and Zahl (2016) who developed a general microlocal framework for relating FUP to the existence of spectral gaps for open chaotic systems. Using methods from additive combinatorics they then proved FUP in some cases obtaining new spectral gap results. The strongest version of FUP till recently was proved by Bourgain and Dyatlov

(Annals of Math. 2018) but a recent preprint at ArXiv in May of Rui Han and Wilhelm Schlag is announcing new developments.

There are other deep and impressive works done by Dyatlov in the last years that we mention briefly:

- The first proof (with Colin Guillarmou) of a 1967 conjecture of Smale on the meromorphic continuation of dynamical zeta functions for Axiom A flows. Since the initial work by Selberg, Artin-Mazur and Smale, dynamical zeta functions have been studies by many mathematicians including Ruelle, Parry, Fried, Rugh, Kitaev, Pollicott, Baladi, Tsujii, Liverani. Because of the noncompact setting, powerful new methods had to be developed by Dyatlov–Guillarmou.

- A detailed description of quasi-normal modes and of exponential decay of waves for Kerr-de Sitter and Kerr black holes. This work has played a crucial role in the recent proof of global non-linear stability of Kerr–de Sitter black holes by Hintz–Vasy.

- General results on the distribution of scattering resonances for r-normally hyperbolic trapping.

- In continuation of the founding work by Johannes Sjöstrand, new results about fractal Weyl laws: these Weyl laws apply in chaotic scattering to describe the density of resonant states in terms of the dimension of the trapped set.

In conclusion, all the work of Semyon Dyatlov is characterized by a very clever use of

- mathematical analysis (microlocal analysis–semi-classical analysis, harmonic analysis, ..)

- fractal and differential geometry

- dynamical systems

which is combined with the choice of nice mathematical problems strongly motivated by physics.

Congratulations Semyon.