CURRICULUM VITAE

Guionnet Alice

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French, married, three children.

Cursus :

22	:	Elected to the National Academy of Sciences.
22	:	Elected to the American Academy of Arts and Sciences.
20	:	IMS Fellow.
18	:	Blaise Pascal Medal, fellow of the European Academy of Sciences.
18	:	Elected to Académie of Sciences (France).
17	:	Elected to Academia Europaea.
15	:	CNRS research director first class at ENS Lyon.
12	:	Simons investigator.
12	:	Professor position at MIT.
12	:	Chevalière de la légion d'honneur.
10	:	Médaille d'argent du CNRS.
09	:	Loève prize.
06	:	Miller Institute Fellowship, Berkeley, USA.
06	:	Doisteau-Blutet Prize from the French Academy of Science.
05	:	Promoted CNRS research director.
03	:	Rollo Davidson prize.
03	:	Habilitation à diriger des recherches.
00	:	Move to Ecole Normale supérieure (Lyon).
99	:	Oberwolfach's prize.
99	:	Move to Ecole Normale supérieure (Paris).
95-96	:	Post Doc position at Courant Institute, NYU, USA
95	:	Defense of my PhD thesis, directed by G. Ben Arous.
1993	:	Permanent position as a chargée de recherche, CNRS.
1989	:	Admission to Ecole Normale Supérieure (Paris)

Research :

I started my Ph-D thesis in 1991-92 under the direction of Gerard Ben Arous. I studied Langevin dynamics for Sherrington-Kirkpatrick model of spin glasses. Glasses are alloys with impurities, assumed to be randomly distributed according to the sample. I studied the dynamics for such systems. It is expected to age at low temperature in the sense that its evolution depends on all the past and show different characteristics on different time scales. This subject, related with the aging phenomenon, was the central topic of [10], [11], [12], [50], [83], [84], [8], [3]. The main results were the convergence of the Langevin dynamics for Sherrington-Kirkpatrick model, as well as a study of the long time behaviour at large temperature [45] and aging for the spherical model [8].

After my PhD thesis, I was interested by completely different problems with P. Del Moral related with non linear filtering problems and more specifically by particle approximation to non linear filtering equations [42, 43, 44].

I did also a short post Doc with B. Zegarlinski. It was a great opportunity to learn about coercive inequalities and in particular log-Sobolev inequality [15]. We studied the latter for short range interaction models of particles in random environment [83, 84] and proved stretched exponential decay.

At the end of my PhD thesis, I started to be interested in large random matrices with Gaussian entries because of their occurence in Sherrington-Kirkpatrick model. I obtained with G. Ben Arous large deviations estimates for the empirical measure of the eigenvalues of these matrices [13]. On a technical point of view related, due to a logarithmically singular potential, I studied with Thierry Bodineau the static of vortex systems introduced by Onsager and proved large deviations principles for the law of their empirical measure [22].

However, [13] was the beginning of many of the projects I worked on since then as they concern large random matrices, with an emphasis in applications to free probability and large deviations questions. Indeed, the study of large deviations in the more general multi-matrix framework proposed by Voiculescu could be attacked [33, 34, 52, 20] via hydrodynamics ideas that I learned at Courant institute where I had the chance to do a one year Post Doc in 1995-1996. The central result was a comparison between the two entropies introduced by Voiculescu [20]. Unfortunately, this result is still sort of optimal. However, with C. Bordenave and C. Male, we could understand the heavy-tailed analogue to Voiculescu entropy and derive in this more localized setting a full large deviation principle [25].

Coming back to the more classical study of the spectrum of one large random matrix, I obtained with O. Zeitouni concentration of the spectral measure in [85] for diverse models of large random matrices. We also proved a full large deviation principle for the spectral measure of generalized Gaussian sample matrices by studying the asymptotics of Itzykson-Zuber integrals (see [86, 87]). In the same direction, we studied with A. Dembo and O. Zeitouni the moderate deviations for the spectral measure of a non centered Gaussian Wigner matrix [46].

Later, I started to study matrices which are very different from the Gaussian matrices, namely heavy tailed random matrices. Typically in Gaussian random matrices all the entries are small, whereas if the entries are heavy tailed, it will typically have a few big entries per row, the others vanishing (or being very small). An example is the case of the adjacency matrix of Erdòs Renyi graphs where entries take only the values 0 and 1, and the latter with such a small probability that even in a matrix with size going to infinity you will have typically only finitely many entries equal to one per row. I studied with G. Ben Arous [15] and S. Belinschi and A. Dembo [6] the convergence of the spectral measure of random matrices with heavy tailed entries, hence putting on a firm mathematical ground an article by Cizeau and Bouchaud. I established with F. Benaych Georges and C. Male the central limit theorem for their linear statistics [25]. More recently, I studied the localization/delocalization properties of the eigenvectors of such matrices (in the case of α stable entries) with C. Bordenave [23, 24]. In particular, we have shown that there is a transition for very heavy tail entries.

Non-normal matrices are also interesting. They are matrices which do not commute with their adjoint. Their spectrum can be highly unstable and one could wonder if the spectrum of random non-normal matrices is typically stable and converges. With O. Zeitouni and M. Khrishnapur, we considered the spectral measure of non-normal matrices with law invariant by unitary conjugation and proved that it converges to a deterministic measure whose support is a single ring [65]. In [88] we study the convergence of the support of such matrices. With P. Wood [89], we analyzed the convergence of the empirical measure of non-normal matrices towards the associated Brown measure and in particular the effect of adding a polynomially small GUE matrix.

An important line of my research concerns matrix models. They are random matrices in interaction. [86, 87] can be used to study matrix models whose interaction is quadratic. In [53], I characterized the limiting spectral measures of two matrices distributed according to the Gibbs measure of Ising model on random graphs, hence putting on a firm mathematical ground some work of Matytsin. I improved this study of matrix models with M. Maida in two papers [66] and [67]; the first article [66] considers the problem of generalizing these results to more complicated interaction by using characters expansions. The second article [67] tackles easier asymptotics but answer harder questions such as second order corrections, analyticity etc This work could also be used by M. Maida to obtain large deviations for the largest eigenvalue of perturbed Gaussian matrices. We recently generalized this result by completely different techniques with F. Benaych-Georges [16, 17]. With E. Maurel-Segala, we gave general criteria to prove a perturbative expansion of general Gaussian matrix integrals [70, 69] and show that this expansion can be seen as generating functions for the enumeration of interesting graphs sorted by their genera; this allowed to put on a firm mathematical ground that the topological expansion obtained formally by Brézin-Itzykson-Paris and Zuber are also asymptotic in the context of several matrices. The main ideas are to derive equations, known as loop equations or Dyson-Schwinger equations, and to analyze them asymptotically thanks to concentration inequalities. In [71], we show how to weaken the hypothesis to derive these loop equations in greater generality [71]. We generalized these results and arguments to matrices over the unitary and the orthogonal groups with B. Collins [41] and then with J. Novak [78]. With G. Borot, I combined these ideas with complex analysis to obtain topological expansions for non-perturbative (one-cut [28] and then several cuts [29]) regime of one-matrix β-models [28], hence generalizing results by Ercolani and Mc Laughlin who used Riemann Hilbert techniques. With K. Kozlowski, we extended this type of results to more general potentials [2] and more general interactions [31]. With Alex Little and K. Kozlowski, we could also extend this analysis in the case where the potential is complex, hence the integral a priori oscillatory [76]. Another approach to β ensembles was proposed in [1] and [2]; the idea is that β-Dyson Brownian motions can be obtained for $\beta \leq 2$ as the limit of discrete processes where one flips a coin every unit of time to decide whether a matrix will evolve according to the Hermitian Brownian motion or by keeping its eigenvectors fixed but its eigenvalues following independent Brownian motions.

Another line of my research is the study of the asymptotics of several matrix models and their asymptotic non-commutative law. I extended the first order asymptotics of several matrix models to non perturbative but convex situations with D. Shlyakhtenko [81]. The idea was to build non-commutative laws related with a strictly convex interaction as functions of free Brownian motions, hence embedding its von Neumann algebra into the von Neumann algebra generated by an infinite number of free semi-circle laws. In the case of a small interaction, we succeeded recently to show that indeed we can build a map so that indeed it is a function of finitely many free semi-circle law; that is we build a non-commutative free monotone transport [82]. This in particular allows to show that the Von Neumann algebra of q-deformed semicircular elements is isomorphic to the Von Neumann algebra of semicircular elements provided q is small enough. We extended this result to non-pertubative but convex interaction with Dabrowski [38].

With V. Jones and D. Shlyakhtenko, applying the connections between random matrices and combinatorics, we built matrix models for general loop models, in fact traces on planar algebras, and constructed a tower of free group factors in [73]. We more recently studied the associated von Neumann algebras [74] and the extension to Gibbs measures [75](with an application to the counting of configurations of Potts model on a random graph); this puts on a firm mathematical ground the uses of random matrices to compute the partition function of loop models on random graphs.

I also studied universality for local fluctuations of the spectrum with A. Figalli. With F. Bekerman and A.Figalli, we could develop approximate transport maps from a β-model to another β-model: this was successfully used to on prove universality, hence providing a new proof of a result by Bourgade, Erdos and Yau. We could extend these ideas with A. Figalli to perturbative several matrix models and polynomial in several independent matrices close to identity in [54], hence providing the first universality results for such models in such a generality. In both cases, the idea to construct approximate transport maps is based on solving approximately Monge-Ampère equation.

In the last few years, I got interested by random tilings. One considers tiling by lozenges of a given domain given at random and wants to understand how it looks like when the mesh of the domain goes to zero. These tilings are in many respect similar to random matrices as they are very rigid, and in fact in good cases the distribution of the positions of tiles is similar to that of the eigenvalues of random matrices, except that they live on a discrete lattice. Thanks to equations inspired from the work of N. Nekrasov, we could extend ideas coming from the analysis of random matrices to this discrete setting with A. Borodin and V. Gorin [26]. We recently completed a book with G. Borot and V. Gorin to analyze as well tilings of non-simply connected domains [27]. We could also obtain local estimates to derive fluctuations of the boundary of the liquid region with Huang [55].

Recently, I worked on large deviations for Wigner matrices with sub-Gaussian entries [58, 3]. We introduced a new idea based on tilting the measure via spherical integrals. I found this new line of research to be fruitful, and followed it in a few works [59, 21, 56, 7]. We finally obtained a very precise description of the large deviations for the largest eigenvalues of subGaussian matrices with Raphael Ducatez and Nick Cook [36]. It turned out that these techniques can also be applied to derive large deviations for the largest eigenvalue of a matrix with variance profile [47] and Kronecker matrices [60]. I started inverstigating the uses of random matrices, large deviations and spin glass techniques in statistical learning with Justin Ko, Lenka Zdeborova, Florent Krazkala [64, 63, 62].

I wrote two lecture notes on random matrices [9, 10] and a book with G. Anderson and O. Zeitouni [1] published by Cambridge University Press.

Most of my research is motivated by the understanding of the global behaviour of systems in high dimensions, often coming from physics, using techniques from large deviations or coercive inequalities. From this theme, deviations to combinatorics, free probability or PDE's occured and were (and hopefully will still be in the future) rather enjoyable.

Chosen talks and courses :

- Two invited talks at Hypathie seminar, november 1999.
- Invited speaker at the European Statistician conference in Prague, august 2002.
- Invited talk at the ICIAM 2003 conference in Sydney, Australia, july 2003.
- 6 hours course at XXIX Conference on Stochastic Processes and their Applications in Rio, Brazil, august 2003.
- Invited talk at Karslruhe Stochastic-Tage, march 2004.
- Invited talk at SPA meeting, Vancouver may 2004.
- Invited talk at the European mathematical society conference at Stockholm, june 2004.
- Short course on random matrices, Eurandom, march 2006.
- Invited talk at ICM 2006, Madrid.
- Course on random matrices at St Flour summer school, july 2006.
- Course on random matrices at IAS/PCMI, Utah, july 2007.
- Plenary talk at the second Canada-France congress, june 2008.
- Levy Lecture at the 7th world congress in probability, Singapour, july 2008.
- Plenary lecture at ICMP, august 2009.
- IMS medallion lecture at SPA, Oaxaca (Mexico), july 2011.
- Course in St Petersbourg probability summer school, july 2012.
- Course in IMA summer school, Minneapolis, july 2012.
- Gergen lectures at Duke, october 2012.
- Colloquium lectures at AMS meeting, San Diego, January 2013.
- Invited address, AMS meeting, Boston 2013.
- Bellow lectures, Northwestern University, Chicago march 2013.
- Takagi Lectures, Tokyo university, november 2014.
- CRM lectures, Montreal, july 2015.
- Les Houches lectures, Les Houches, july 2015.
- Panorama of mathematics, Bonn, oct. 2015.

- Beatrice Yomark Distinguished lecture series, february 2016.
- Abel symposium, August 2016.
- Minerva lectures, Columbia university, august 2017.
- Heilbronn lectures, sept. 2017.
- Aisenstadt chair, CRM, Canada, march 2019.
- Plenary lecture at IEEE ISIT 2019, Paris, july 2019.
- Plenary lecture at ECM 2020.
- Plenary Lecture at ICM 2022.
- Plenary lecture at StatPhys 2025.

Research management :

I was an associate editor at Stochastic processes and applications from 1999 to 2006. I was editor of the Annales de l'Institut Henri Poincaré from june 2006 to june 2011. I was editor for the Annals of probability from 2021 to 2024 together with C. Garban.

I was a member of CNRS national committee from 2008-2012. I was member of the Conseil National des Universités from 1998 to 2001 and of the ANR project scientific committee in 2005 and 2006. I was a member of the scientific committee of the French Mathematical Society from 2003 to 2007, a member of the scientific committee of IHP in 2010, and a member of the scientific committee of the CRM (Montreal) from 2007 to 2010. I was a member of the scientific committee of IMA (Minneapolis) as well as of the scientific committee of Bernoulli society. I was a member of the hiring committee at MIT from 2012-2015. I have been director of UMPA, ENS Lyon, from september 2016 till january 2021.

I was in charge of the ANR project GranMa with F. Benaych-Georges and B. Eynard on Random Matrices from 2009 to 2012 http://www.umpa.ens-lyon.fr/ aguionne/ANRGranMa.html. I am the PI of an ERC grant LDRAM, ERC-2019-ADG Project: 884584, on large deviations for Random Matrices, which started in september 2020.

I have organised a few conferences in ENS Lyon (séminaire Hypathie, Rencontres mathématiques, Rencontre de l'ANR GranMa, Probably on), and coorganized a few conferences in the USA (with D. Shlyakhtenko and D. Voiculescu in Berkeley (2007) and UCLA (2010), with L. Saloff Coste in Cornell (2007)) I coorganized a semester at MSRI during fall 2010 and in 2021, as well as a school in les Houches on integrable systems in march 2012, a summer school PCMI in Park city (2017), a summer school in Changchun, China, during july 2012. I coorganized few conferences in Oberwolfach. Within my project LDRAM I organized so far two conferences (one on the six-vertex model and another on the applications of random matrices to statistical learning).

I had eleven PhD students who defended their PhD: M. Maida (Professor in Lille), E. Maurel-Segala (maitre de conférences at Université Paris Sud) and Camille Male (CNRS in Bordeaux). My students from MIT, F. Bekerman and A. Lodhia, have defended their PhD in 2017. More recently, J. Husson (2019), F. Parraud(2021) , R. Memin (2023) , C. Dworaczek (2024, with K.

Kozlowski), V. Piccolo (2025, with G. Ben Arous), T. Buc d'Alché (2025,with Gregory Miermont) have defended their PhD thesis. I briefly mentored Nicola Kistler and Boris Hanin, and as LDRAM postdocs Justin Ko, Raphael Ducatez, Alessandra Occelli, Jeanne Boursier, Slim Kammoun,Alex Little, Jana Reker and Ella Hiesmayr.

Being a CNRS researcher, I have no teaching duties but tried to teach topics courses regularly (in 2008-2009, I taught Random partitions and random matrices, in 2009-2010 Large deviations and concentration of measures and a course on concentration inequalities in 2010-2011. In 2022 I taught Large Random matrices and applications). I gave a topics course on random matrices in 2007 at Berkeley University. At MIT I taught 3 graduate courses (Random matrices, Markov Chains, Stochastic analysis) and one undergrads classes (18-440).

Research Articles

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