Random Matrices and Their Applications Workshop

January 6 – 9, 2015

Room 115, 1/F, Knowles Building

The University of Hong Kong

Programme and Abstracts

CONTENTS

ORGANIZERS

Chafaï Djalil (Université Paris-Dauphine, France)

Li Wai Keung (The University of Hong Kong, China)

Najim Jamal (CNRS & Université Paris-Est Marne-la-Vallée, France)

Yao Jianfeng (The University of Hong Kong, China)

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GENERAL INFORMATION

Registration & Enquiry Desk

The Registration & Enquiry Desk will operate at the following times and venue:

Date	Time	Venue
Tuesday, 6 January	08:30 – 08:45 & Coffee Breaks	Rm115, 1/F, Knowles Building
Wednesday, 7 January	08:45 – 09:00 & Coffee Breaks	Rm115, 1/F, Knowles Building
Thursday, 8 January	Coffee Breaks	Rm115, 1/F, Knowles Building
Friday, 9 January	Coffee Breaks	Rm115, 1/F, Knowles Building

If participants require urgent assistance outside the operating times of the Registration & Enquiry Desk, they may visit the Department of Statistics and Actuarial Science, Room 303, 3/F, Run Run Shaw Building.

Opening Ceremony

Date: Tuesday, 6 January
Time: 08:45 – 09:00
Venue: Room 115, 1/F, Knowles Building, HKU

Lunches & Dinner

Lunches and dinner are by invitation only. Tickets will be provided for invitees individually.

Lunches will be held in Eliot Room, 14/F, KK Leung Building from 12:30 to 14:00 on 6 – 9 January.

Dinner will be held on

Wednesday, 7 January
Venue: Jumbo Kingdom (Shum Wan Pier Drive, Wong Chuk Hang, Aberdeen)
Time: Right after the last talk that day
Assemble for transportation by 18:00 outside Library Extension

A coach will be arranged to take guests back to hotels after the dinner at 21:45.
The return route would be as follows:
Jumbo Kingdom → Hotel Jen Hong Kong → Robert Black College, HKU → Bishop Lei International Hotel

Coffee Breaks

Light refreshments will be served in the common area between Rooms 114 and 115, Knowles Building, HKU at the following hours:

Tuesday, 6 Jan	**Wednesday, 7 Jan**	**Thursday, 8 Jan**	**Friday, 9 Jan**
10:30 – 11:00	10:30 – 11:10	10:30 – 11:00	10:30 – 11:00
15:30 – 16:00	15:30 – 16:00		15:30 – 16:00

Name Badges

Each participant will be issued a name badge upon registration. The badge will be the official pass to talks and coffee breaks. As access to events will be strictly controlled, it would be appreciated if you could wear your badge at all times. If any participants have lost their badges, they can contact the Registration & Enquiry Desk for a replacement.

Announcements and Notices

A message board will be placed near the Registration & Enquiry Desk for announcements and important notices.

Bad Weather

In the event of *Gale/Storm Signal No. 8 or above* or *Black Rainstorm Warning Signal*, the talk will be cancelled unless the signals are lowered two hours before the start time of the talk.

Should any talks/events unfortunately be cancelled due to the aforesaid signals or any other causes, relevant notice will be put up for participants' information on the homepage of the workshop: http://djalil.chafai.net/wiki/hk2015.

Internet Facilities

HKU provides free WiFi service for visitors of the University to surf the Internet for research or administrative purposes on campus. Connection to Wi-Fi.HK via HKU is easy and no registration is required. However, Wi-Fi.HK via HKU has limited capacity and provides web browsing service only. The service uses unencrypted channel and hence, may not be secure. To connect PC/mobile device to Wi-Fi.HK via HKU service, please find the procedure here: http://www.its.hku.hk/documentation/guide/network/wifi/openwifi.

Car Parking

Complimentary parking is available on campus. Please take the parking ticket to the Registration & Enquiry Desk for arranging complimentary parking.

No Smoking Policy

Smoking is prohibited in all areas of the campus, including corridors and restrooms.

Safety and Security

Please do not leave your belongings unattended at any times inside or outside the venue.

Disclaimer of Liability

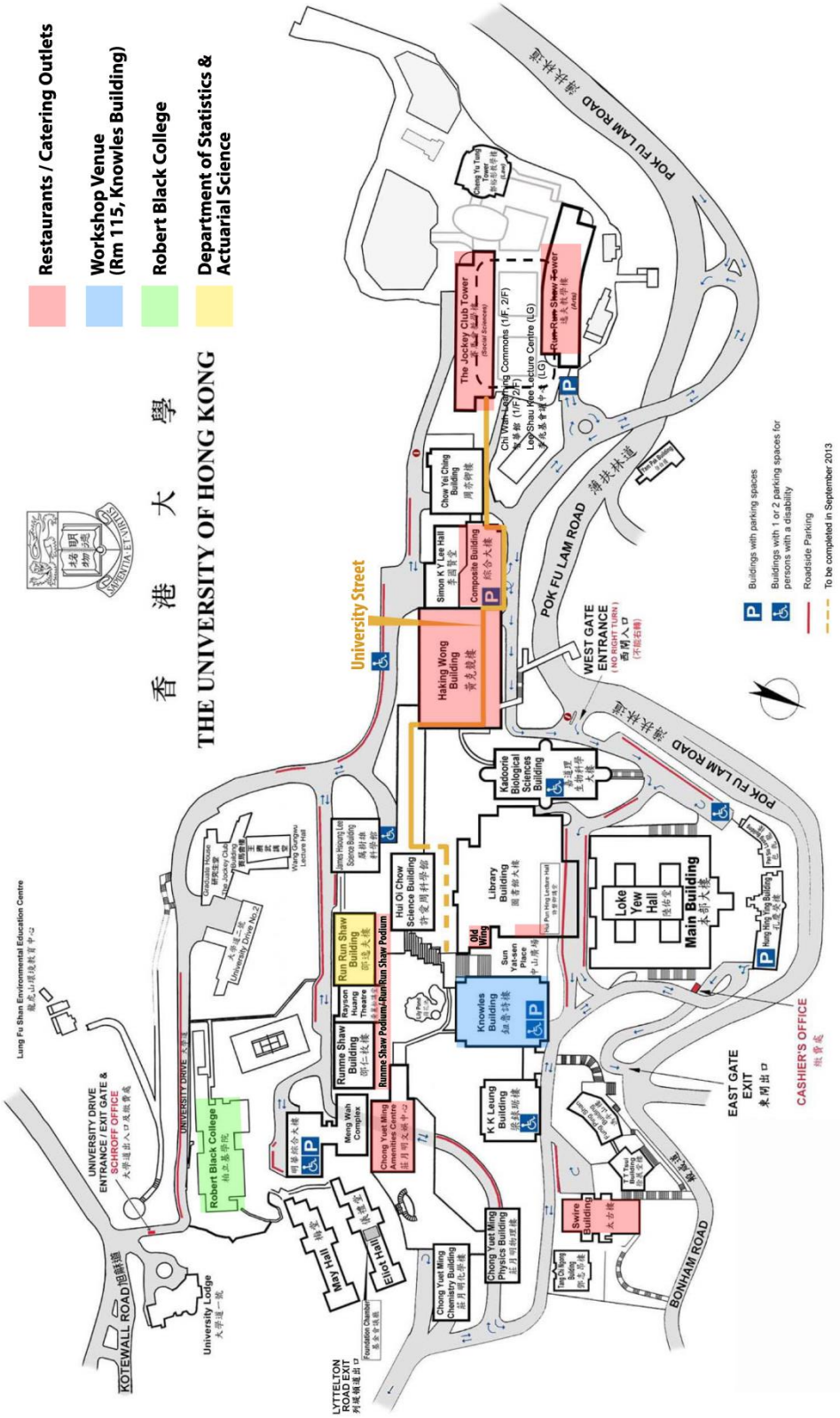
The Organizer of the Random Matrices and Their Applications Workshop will not accept any liability for damages of any nature sustained by participants or their accompanying persons, or loss of or damages to their personal property during the workshop or any related events.

The Secretariat

For enquiries, please contact the Secretariat of the Random Matrices and Their Applications Workshop:

The Secretariat, Random Matrices and Their Applications Workshop
Department of Statistics and Actuarial Science
Room 303, 3/F, Run Run Shaw Building
The University of Hong Kong
Pokfulam Road, Hong Kong
Telephone: (852) 3917-8312
Facsimile: (852) 2858-9041
E-mail: saas@hku.hk

MAPS OF HKU CAMPUS

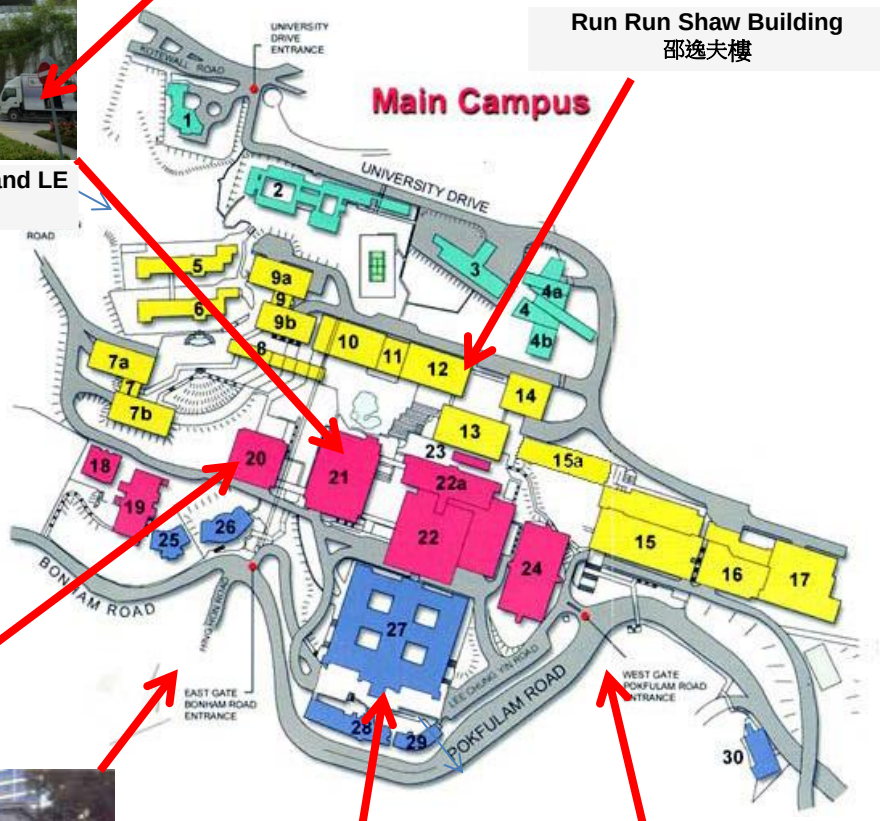


MAPS OF HKU CAMPUS

Knowles Building and LE
鈕魯詩樓

Assemble for transportation by 18:00, 7 Dec, 2015 outside Library Extension (LE)

Run Run Shaw Building
邵逸夫樓



K.K. Leung Building
梁銶琚樓

East Gate Bonham Road Entrance
東閘般咸道入口

Main Building & Loke Yew Hall
本部大樓及陸佑堂

West Gate Pokfulam Road Entrance
西閘薄扶林道入口

TRANSPORTATION

MTR (underground railway)

Please go to HKU Station on the Island Line. Exit A2 will lead you to the main campus of the University of Hong Kong.

Bus No.	Direction (To)	Boarding Point	Alighting Point	Operator
From Admiralty				
23	Pokfield Road	Pacific Place, Queensway	HKU East Gate, Bonham Road	Citybus
37A	Chi Fu Fa Yuen	Pacific Place, Queensway	HKU West Gate, Pok Fu Lam Road	Citybus
40	Wah Fu (North)	Pacific Place, Queensway	HKU East Gate, Bonham Road	Citybus
From Central				
3B	Pokfield Road	Jardine House, Connaught Road	HKU East Gate, Bonham Road	Citybus
40M	Wah Fu (North)	Lan Kwai Fong, D'Aguilar Street	HKU East Gate, Bonham Road	Citybus
From Wan Chai				
23	Pokfield Road	Southorn Playground, Hennessy Road	HKU East Gate, Bonham Road	Citybus
103	Pokfield Road	Stewart Road, Gloucester Road	HKU East Gate, Bonham Road	Citybus

Given that each bus route has numerous boarding points, the boarding points above are suggestions only. For the exact route list, operating hours and estimated travelling time of each bus route, please visit the homepage of the operator: http://www.nwstbus.com.hk/

Taxi

You may also wish to get a taxi to go directly to HKU. Information for taxi driver in Chinese: 香港大學 (薄扶林)
University of Hong Kong (Pokfulam)

Map of HKU

For the exact location of HKU and information on driver's route, please visit: http://www.maps.hku.hk/

HKU Catering Outlets

Main Campus

Chong Yuet Ming Amenities Centre Restaurant (Maxim's FOOD^*2*)
Location: 4/F, **Chong Yuet Ming Amenities Centre**
Tel: 2857-5511
Operation Hours: 7:30 a.m. - 9:30 p.m. (Daily)

Chong Yuet Ming Amenities Centre Cafeteria (New Life Support Enterprises Ltd.)
Location: 2/F, **Chong Yuet Ming Amenities Centre**
Tel: 2794-3778
Operation Hours: 7:30 a.m. - 9:00 p.m. (Daily)

Fong Shu Chuen Amenities Centre Restaurant (Asia Pacific Catering Corporation Ltd.)
Location: 2/F, Fong Shu Chuen Amenities Centre, **Swire Building**
Tel: 2548-1109
Operation Hours: 7:30 a.m. - 8:00 p.m. (Mon - Fri)
11:00 a.m. - 2:00 p.m.
Closed (Sun & Public holidays)

Global Lounge Coffee Corner (Pacific Coffee)
Location: G/F, Fong Shu Chuen Amenities Centre, **Swire Building**
Tel: 2291-0071
Operation Hours: 8:30 a.m. - 9:30 p.m. (Mon - Fri)
9:00a.m. - 5:00 p.m. (Sat)
Closed (Sun & Public holidays)

HKU Halal Food Corner (Ebeneezer's Kebabs & Pizzeria)
Location: 1/F, Fong Shu Chuen Amenities Centre, **Swire Building**
Tel: 2915-5168
Operation Hours: 10:00 a.m. - 8:00 p.m. (Mon - Sat)
Closed (Sun & Public holidays)

HKUSU Cafeteria A (Starbucks Coffee)
Location: G/F, **Composite Building**
Tel: 2559-9061
For further information, please contact the outlet.

HKUSU Cafeteria B (U-Deli)
Location: G/F, **Composite Building**
Tel: 2517-3633
For further information, please contact the outlet.

Main Library Coffee Shop (Starbucks Coffee)
Location: G/F, **Library Building (Old Wing)**
Tel: 2546-5251
Operation Hours: 7:30 a.m. - 10:00 p.m. (Mon - Fri)
7:30 a.m. - 7:00 p.m. (Sat)
10:00 a.m. - 7:00 p.m. (Sun & Public holidays)

Robert Black Dining Room
Location: **Robert Black College**, University Drive, Main Campus
Tel: 2296-1771
For further information, please visit their website, http://www.rblack.hku.hk/dining/

Union Restaurant (Asia Pacific Catering Corporation Ltd.)
Location: 4/F, **Haking Wong Building**
Tel: 2546-0347
Operation Hours: 7:30 a.m. - 9:30 p.m. (Daily)

Outpost II (SUBWAY)
Location: **Runme Shaw Podium**
Tel: 2561-9002
Operation Hours: 8:00 a.m. - 8:30 p.m. (Mon - Sat)
8:00 a.m. - 5:30 p.m. (Sun)
Closed (Public holidays)

Outpost III (Tung Wah Group Hospital (TWGHs) iBakery)
Location: **Run Run Shaw Podium**
Tel: 5402-4546
Operation Hours: 8:30 a.m. - 7:00 p.m. or until stock last (Mon - Fri)
Closed (Sat, Sun & Public holidays)

Outpost IV (Mangrove Tuck Shop)
Location: **Main Library Covered Podium** (near Sun Yat-sen Place)
Tel: 3526-0933
Operation Hours: 10:00 a.m. - 4:00 p.m. (Mon - Fri)
Closed (Sat, Sun & Public holidays)

Centennial Campus

Centennial Campus Catering Outlet A (GROVE Café)
Location: LG/F, **The Jockey Club Tower**
Tel: 2530-0043
Operation Hours: 8:00 a.m. - 10:00 p.m. (Mon - Fri)
11:00 a.m. - 10:00 p.m. (Sat, Sun & Public holidays)
11:00 a.m. - 10:00 p.m. (Mon - Sun during non-term time)

Centennial Campus Catering Outlet B (Delifrance)
Location: G/F, **The Jockey Club Tower**
Tel: 2546-2121
Operation Hours: 7:30 a.m. - 9:30 p.m. (Mon - Fri)
8:00 a.m. - 8:00 p.m. (Sat, Sun & Public holidays)

Centennial Campus Catering Outlet C (Super Super Congee & Noodle)
Location: G/F, **Run Run Shaw Tower**
Tel: 2857-2807
Operation Hours: 7:30 a.m. - 9:30 p.m. (Mon - Sat)
Closed (Sun & Public holidays)

Centennial Campus Catering Outlet D (BIJAS Vegetarian)
Location: G/F, **Run Run Shaw Tower**
Tel: 2964-9011
Operation Hours: 11:00 a.m. - 9:00 p.m. (Mon - Sat)
Closed (Sun & Public holidays)

Random Matrices and Their Applications Workshop

PROGRAMME

Tuesday January 6, 2015

08:30 – 08:45	Registration
08:45 – 09:00	Opening Speech by Professor Kenneth M.Y. Leung, Associate Dean (Research and Graduate Studies), Faculty of Science, HKU
09:00 – 09:45	Pajor Alain *Interactions between high dimensional geometry and random matrix theory*
09:45 – 10:30	Lytova Anna Yu *On the CLT for linear eigenvalue statistics of the sum of independent matrices of rank one*
10:30 – 11:00	Coffee Break
11:00 – 11:45	Zheng Xinghua *Integrated covariance matrix estimation for high-dimensional diffusion processes in the presence of microstructure noise*
11:45 – 12:30	Adamczak Radoslaw *Norms of submatrices and entropic uncertainty relations for high dimensional random unitaries*
12:30 – 14:00	Lunch (by invitation)
14:00 – 14:45	Bordenave Charles *Non-backtracking spectrum of random graphs*
14:45 – 15:30	Nadakuditi Raj Rao *New applications of random theory*
15:30 – 16:00	Coffee Break
16:00 – 16:45	Caputo Pietro *Spectral properties of random Markov matrices*
16:45 – 17:30	Male Camille *The spectrum of random graphs in free probability theory*

Wednesday January 7, 2015

08:45 – 09:00	Registration
09:00 – 09:45	Guionnet Alice *About topological expansions*
09:45 – 10:30	Couillet Romain *Random Matrices and Robust Estimation*
10:30 – 11:00	Coffee Break
11:00 – 11:45	Cucker Felipe *Eigenvalue computations and random matrices*
11:45 – 12:30	Hardy Adrien *Large complex correlated Wishart matrices: Fluctuations and asymptotic independence at the edges*
12:30 – 14:00	Lunch (by invitation)
14:00 – 14:45	Shao Qiman and Zhou Wenxin *Cramér moderate deviations for studentized two-sample U-statistics with applications*
14:45 – 15:30	Kozhan Rostyslav *Eigenvalues of rank one perturbations of β -ensembles*
15:30 – 16:00	Coffee Break + Group Photo
16:00 – 16:45	Maïda Mylène *Yang Mills, unitary Brownian bridge and discrete orthogonal polynomials*
16:45 – 17:30	Chen Yang *Hankel determinant and Painlevé III*
18:00 –	Dinner (by invitation) at Jumbo Kingdom (Shum Wan Pier Drive, Wong Chuk Hang, Aberdeen) Assemble for transportation by 18:00 outside Library Extension A coach will be arranged to take guests back to hotels after the dinner at 21:45

Thursday January 8, 2015

09:00 – 09:45	Johnstone Iain *James' Five Fold Way and spiked models in multivariate statistics*
09:45 – 10:30	Onatski Alexei *Testing hypotheses about sub- and super-critical spikes in multivariate statistical models*
10:30 – 11:00	Coffee Break
11:00 – 11:45	Bose Arup *Large sample behaviour of high dimensional autocovariance matrices*
11:45 – 12:30	Merlevède Florence *On the empirical spectral distribution for matrices with long memory and independent rows*
12:30 – 14:00	Lunch (by invitation)

Friday January 9, 2015

09:00 – 09:45	Bai Zhidong *Order determination of high-dimensional dynamic factor models*
09:45 – 10:30	Pan Guangming *The Tracy-Widom law for the largest eigenvalue of F matrix*
10:30 – 11:00	Coffee Break
11:00 – 11:45	Collins Benoît *Random positive maps*
11:45 – 12:30	Salez Justin *Atoms in the limiting spectrum of diluted random graphs*
12:30 – 14:00	Lunch (by invitation)
14:00 – 14:45	Shcherbina Mariya *CLT for eigenvalue counting function of orthogonal and symplectic matrix models*
14:45 – 15:30	Soshnikov Alexander *Products of independent elliptic random matrices*
15:30 – 16:00	Coffee Break
16:00 – 16:45	Knowles Antti *Anisotropic local laws for random matrices*
16:45 – 17:30	Yin Jun *Eigenvector distribution of anisotropic random matrices*

Random Matrices and Their Applications Workshop

ABSTRACTS

Norms of submatrices and entropic uncertainty relations for high dimensional random unitaries

Adamczak Radoslaw
University of Warsaw, Poland

I will show that with high probability random unitary matrices satisfy an almost optimal version of entropic uncertainty principle. As a tool I will present certain uniform estimates for norms of submatrices of a random unitary matrix complemented by corresponding lower bounds. I will conclude with a discussion of possible extensions and open questions. Based on joint work with Rafal Latala, Zbigniew Puchala and Karol Zyczkowski.

Order determination of high-dimensional dynamic factor models

Bai Zhidong
Northeast Normal University, China

Consider the following dynamic factor model:

$$\mathbf{y}_t = \sum_{l=0}^{q} \mathbf{\Lambda}_l \mathbf{f}_{t-l} + \boldsymbol{\varepsilon}_t \,, t = 1, 2, \ldots, T$$

where $\mathbf{\Lambda}_l$ is an $N \times k$ loading matrix (of full rank), are $\{\mathbf{f}_t\}$ i.i.d. k -factors, and $\boldsymbol{\varepsilon}_t$ are independent white noises. This model is very important in financial statistics. Now, we assume that $N/T \to c > 0$ and we want to estimate the orders k and q separately. Define a random matrix

$$\mathbf{\Phi}(\tau) = \frac{1}{2T} \sum_{t=1}^{T} (\mathbf{y}_t \mathbf{y}_{t+\tau}^{*} + \mathbf{y}_{t+\tau} \mathbf{y}_t^{*})$$

where $\tau \geq 0$ is an integer. When there are no factors, the matrix $\mathbf{\Phi}(\tau)$ reduces to

$$\mathbf{M}_\tau = \frac{1}{2T} \sum_{t=1}^{T} (\boldsymbol{\varepsilon}_t \boldsymbol{\varepsilon}_{t+\tau}^{*} + \boldsymbol{\varepsilon}_{t+\tau} \boldsymbol{\varepsilon}_t^{*}).$$

When $\tau = 0$, $\mathbf{M}_\tau$ reduces to the usual sample covariance matrix whose ESD tends to the well-known M-P law and thus $\mathbf{\Phi}(0)$ reduces to the standard spike model and hence the number $k(q+1)$ can be estimated by the number of spiked eigenvalues of $\mathbf{\Phi}(0)$. To obtain separate estimates of k and q, we have to employ the spectral analysis of $\mathbf{M}_\tau$. In our work, we derive the LSD of $\mathbf{M}_\tau$ and then establish the strong limits of extreme eigenvalues of $\mathbf{M}_\tau$ for some $\tau > 0$. Finally, we will establish the spiked model analysis for $\mathbf{\Phi}(\tau)$.

Non-backtracking spectrum of random graphs

Bordenave Charles
CNRS & Université de Toulouse, France

The non-backtracking matrix of a graph is a non-symmetric matrix on the oriented edge of a graph which has interesting algebraic properties and appears notably in connection with the Ihara zeta function and in some generalizations of Ramanujan graphs. It has also be proposed recently in the context of community detection. In this talk, we will study the largest eigenvalues of this matrix for the Erdos-Renyi graph G(n,c/n) and other simple inhomogeneous random graphs (stochastic block model). This is a joint work with Marc Lelarge and Laurent Massoulié.

Large sample behaviour of high dimensional autocovariance matrices

Bose Arup
Indian Statistical Institute, Kolkata, India

We study the large sample behaviour of the sequence of high dimensional sample autocovariance matrices $\{\hat{\Gamma}_i\}_{i\geq 0}$ from an infinite dimensional vector linear process. Under suitable conditions on the coefficient matrices and the driving process, we prove that the expected average trace of any polynomial in these matrices converge. In particular, the limiting spectral distribution of any symmetric polynomials of these matrices, including the matrices $\hat{\Gamma}_i + \hat{\Gamma}_i^*$ and $\hat{\Gamma}_i\hat{\Gamma}_i^*$ exist. Our approach is through the algebraic method of free probability in conjunction with the method of moments. Thus, we are able to provide a general description for the limits in terms of some freely independent variables.

Spectral properties of random Markov matrices

Caputo Pietro
Università Roma Tre, Roma, Italy

We discuss various models of Markov matrices obtained by normalizing the entries of an i.i.d. random matrix. The spectrum of such matrices conveys information on the convergence to equilibrium of the associated Markov chain. We show the existence of a limiting spectral distribution and investigate its properties for both reversible and non reversible Markov chains. In the sparse regime obtained by taking the original variables to be heavy-tailed we describe the limiting distribution in terms of the spectral measures of suitable randomly weighted trees. Based on joint works with Djalil Chafai, Charles Bordenave, and Daniele Piras.

Hankel determinant and Painlevé III

Chen Yang
University of Macau, China

We study a Hankel determinant generated by a singularly deformed Laguerre weight, through the multiplication of the standard Laguerre weight by $\exp(-t/x)$, $x \in R^+$, $t > 0$. It transpires that the finite n Hankel determinant which maybe expressed in an integral representation of a particular Painlevé III. In a double scaling scheme, where n tends to infinity and t tends to 0, in a combination, the infinite Hankel determinant has again an integral representation in terms of a C potential and its derivatives. Here the C potential satisfies a second order non-linear ode, which turned out to a Painleve III with lesser parameters. From which we obtain asymptotic expansions of the scaled and in some sense infinite Hankel determinant.

Random positive maps

Collins Benoît
University of Ottawa, Canada

In operator algebras (and quantum information theory), positive and completely positive maps play an important role. While completely positive are well understood and characterized, the situation for positive maps is very different. The purpose of this talk is to show that random matrix techniques supply a large class of new positive maps. We will explain how our random constructions can act as powerful entanglement witnesses.

Random matrices and robust estimation

Couillet Romain
École Supérieure d'Electricité, France

This talk will browse through the recent advances of random matrix theory applied to robust statistics, and more precisely to robust covariance matrix estimation. It shall be shown in particular that some widely used classes of robust covariance matrix estimates (such as Maronna's and Tyler's), which take the form of the matrix solution of an implicit equation, behave in the random matrix regime as classical random matrix models more amenable to analysis. Such results allow for the design of novel improved signal processing algorithms that account both for the commensurability of population and sample dimensions and for the impulsiveness in the observations (either due to non-Gaussian observations or to the existence of outliers among the samples). Applications to array processing (and the introduction of the Robust G-MUSIC algorithm) as well as to portfolio optimization based on financial data will be discussed.

Eigenvalue computations and random matrices

Cucker Felipe
City University of Hong Kong, China

A long standing open problem in numerical linear algebra is the computation of eigenpairs (eigenvalue–eigenvector). We either know efficient algorithm that fail to be numerically stable or algorithms exhibiting numerical stability but whose complexity analysis (and even convergence!) eludes us. In the talk, we give some advances emphasizing the role played by random matrices on these advances.

About topological expansions

Guionnet Alice
MIT, USA

We discuss large dimensions asymptotics of various models. This is based on joint work with E. Maurel Segala, G. Borot and K. Kozlowski.

Large complex correlated Wishart matrices: Fluctuations and asymptotic independence at the edges

Hardy Adrien
KTH, Sweden

We study the asymptotic behavior of eigenvalues of large complex correlated Wishart matrices at the edges of the limiting spectrum. In this setting, the support of the limiting eigenvalue distribution may have several connected components. Under mild conditions for the population matrices, we show that for every generic positive edge of that support, there exists an extremal eigenvalue which converges almost surely towards that edge and fluctuates according to the Tracy-Widom law. Moreover, given several generic positive edges, we establish that the associated extremal eigenvalue fluctuations are asymptotically independent. Finally, when the leftmost edge is the origin, we prove that the smallest eigenvalue fluctuates according to the hard-edge Tracy-Widom law. This is a joint work with W. Hachem and J. Najim.

James' Five Fold Way and spiked models in multivariate statistics

Johnstone Iain
Stanford University, USA

This is a first half of a joint talk with Alexei Onatski. It is 50 years since James' 1964 paper on the distribution of matrix variates and latent roots, in which he gave a remarkable classification of many of the eigenvalue distribution problems of multivariate statistics. We

revisit the classification, now from the viewpoint of high dimensional models and low rank departures from the usual null hypotheses.

Anisotropic local laws for random matrices

Knowles Antti
ETH Zürich, Switzerland

Most of the literature on random matrices focuses on matrix models that are isotropic in the sense that their Green functions are with high probability close to a multiple of the identity matrix. Such models include Wigner matrices, Erdos-Renyi graphs, and random band matrices. I will talk about matrix models that are not isotropic. An important family of examples is provided by sample covariance matrices whose underlying population has nontrivial correlations. I present a new method that yields local laws for such anisotropic models. An application is the proof of the Tracy-Widom-Airy statistics near the soft edges. This result applies in the single-cut and the multi-cut cases. Further applications to the distribution of eigenvectors will be given in the talk of J. Yin.

Eigenvalues of rank one perturbations of β-ensembles

Kozhan Rostyslav
KTH, Sweden

We propose sparse matrix models for rank one sub-unitary perturbations of β-ensembles of unitary random matrices and rank one non-Hermitian perturbations of β-ensembles of Hermitian random matrices. The eigenvalues of these perturbations have interpretation as scattering resonances of open quantum systems in the physics literature. Using these matrix models and theory of orthogonal polynomials we are able to explicitly compute the joint eigenvalue density for any $\beta < \infty$. If time permits, we will discuss the microscopic limit of density of states and show it is universal for a class of sub-unitary CMV random matrices. This is a joint work with Rowan Killip.

On the CLT for linear eigenvalue statistics of the sum of independent matrices of rank one

Lytova Anna Yu
Institute for Low Temperature, Ukraine

We consider random matrices of the form $M_n = \sum_{\alpha=1}^{m} \tau_\alpha \mathbf{y}_\alpha \mathbf{y}_\alpha^T$, where $\mathbf{y}_\alpha \in \mathbb{R}^n$ are i.i.d. normalized isotropic random vectors with dependent components and τ_α are real numbers. We find a class of random vectors satisfying some moment conditions such that for any smooth enough test-function φ the linear eigenvalue statistics $Tr\varphi(M_n)$ converge in distribution to the Gaussian random variable. We also consider a tensor analog of such

matrices, $M_n = \sum_{\alpha=1}^{m} \tau_\alpha \mathbf{Y}_\alpha \mathbf{Y}_\alpha^T$, where now for every α vector $\mathbf{Y}_\alpha = \mathbf{y}_{\alpha 1} \otimes \cdots \otimes \mathbf{y}_{\alpha k}$ is a tensor product of k i.i.d. normalized isotropic random vectors, k is fixed, and $m/n^k \to c \in [0,\infty)$ while $n \to \infty$. We show, in particular, that the limit of the empirical spectral distribution of $\mathbf{M}_n$ coincides with that one for M_n.

Yang Mills, unitary Brownian bridge and discrete orthogonal polynomials

Maïda Mylène
Université de Lille, France

About twenty years ago, the physicists Douglas, Kazakov, Gross and Matytsin, working on Yang-Mills theory, made some predictions on the behavior of the partition function of the models they considered. These results played an important role in the developments of this kind of jauge theories. In this talk, I will explain how some modern tools, and in particular recent results on discrete orthogonal polynomials obtained by K. Liechty and D. Wang, allow us to give a rigourous proof and a better undertsanding of the prediction of physicists. This is joint work with T. Levy.

The spectrum of random graphs in free probability theory

Male Camille
CNRS & Université Paris 5, France

Free probability theory has been introduced by Voiculescu in the 80's for the study of the von Neumann algebras of the free groups. In that context, the notion of freeness plays the role of independence in classical probability.

In the 90's, Voiculescu realized that a family of independent random matrices whose eigenvectors are sufficiently uniformly distributed are asymptotically free. This phenomenon is called asymptotic freeness and had a deep impact in operator algebra and probability.

Nevertheless, the approach does not work when the eigenvectors are not enough uniformly distributed, for instance for adjacency matrices of random graphs. Yet, the framework of free probability can be enriched to describe these models, thanks to an extended notion of freeness.

The aim of this talk is to present the application of this recent method for two important models of random graphs, namely the Erdős-Rényi graphs and the uniform regular graphs.

On the empirical spectral distribution for matrices with long memory and independent rows

Merlevède Florence
Université Paris Est Marne-La Vallée, France

The talk will focus on the empirical eigenvalue distribution of sample covariance matrices. We will show in particular that if the sample covariance matrix is generated by independent copies of a stationary regular sequence then its empirical eigenvalue distribution always has a limiting distribution depending only on the spectral density of the sequence. We characterize this limit in terms of Stieltjes transform via a certain simple equation. No rate of convergence to zero of the covariances is imposed. If the entries of the stationary sequence are functions of independent random variables the result holds without any other additional assumptions. The talk is based on a joint work with M. Peligrad.

New applications of random theory

Nadakuditi Raj Rao
University of Michigan, USA

We describe some recent success stories where random matrix theory has enabled new applications: these include new theory and algorithms for transmitting light perfectly through highly scattering or opaque media, for separating foreground and background of videos and in medical MRI datasets. We conclude by highlighting some newly discovered random matrix universality phenomena emerging from scattering theory and semidefinite optimization that suggest intriguing inter-connections and directions for theoretical research.

Testing hypotheses about sub- and super-critical spikes in multivariate statistical models

Onatski Alexei
University of Cambridge, UK

This is a second half of a joint talk with Iain Johnstone.

We consider spiked models representing each of the five classes of multivariate statistical problems identified by James (1964). For each of the models, we describe the phase transition of the largest eigenvalue, and derive the asymptotic behavior of the likelihood ratios that correspond to null and alternative hypotheses about sub-and super-critical spikes. We find that the statistical experiment of observing the eigenvalues in the super-critical regime, parameterized by local deviations of the spike from its value under the null, converges to simple Gaussian shift experiment, and therefore, the best test about a single super-critical spike is based on the largest eigenvalue only. Our findings for the sub-critical regime are totally different. In that regime, the experiment of observing the eigenvalues converges to a Gaussian sequence experiment, and no optimal test about a sub-critical spike is available. We derive the asymptotic power envelopes for such tests.

Interactions between high dimensional geometry and random matrix theory

Pajor Alain
Université Paris-Est Marne-la-Vallée, France

We shall discuss some results on quantitative estimates of the smallest and largest singular values of random matrices with independent columns. We shall also survey recent results on the approximation of the covariance matrix.

The Tracy-Widom law for the largest eigenvalue of F matrix

Pan Guangming
NTU, Singapore

Let X and Y be $p \times n$ and $p \times m$ independent and real random matrices consisting of i.i.d random variables with mean zero, variance one and sub Gaussian tail . The distribution of the largest eigenvalue of $(XX' + YY')^{-1}XX'$ is proved to follow the Tracy-Widom law, which generalizes Johnstone's earlier result.

Atoms in the limiting spectrum of diluted random graphs

Salez Justin
Université Paris Diderot (Paris 7), France

A decade ago, Khorunzhy, Shcherbina and Vengerovsky established convergence of the empirical spectral distribution of large Erdos-Renyi random graphs with fixed average degree. Yet, only very little is known about the limiting measure. In particular, Ben Arous asked for the precise location of its atoms (Open Problem 14 of the 2010 AIM Workshop on Random Matrices). In this talk, I will present a complete answer to this question.

Cramér moderate deviations for studentized two-sample U-statistics with applications

Shao Qiman[1] and Zhou Wenxin[2]
[1]*Chinese University of Hong Kong, China*
[2]*University of Melbourne, Australia*

Two-sample U-statistics are widely used in a broad range of applications, including those in the fields of biostatistics and econometrics. In this paper, we establish sharp Cramér type moderate deviation theorems for studentized two-sample U-statistics in a general framework, including the two-sample *t*-statistic and Studentized Mann-Whitney test statistic as prototypical examples. In particular, a refined moderate deviation theorem with second-order accuracy is established for the two-sample *t*-statistic. These results provide theoretical guarantees and therefore extend the applicability of the existing statistical methodologies from the one-sample *t*-statistic to more general nonlinear statistics. Applications to two-sample

large-scale multiple testing problems with false discovery rate control and the regularized bootstrap method are also discussed. This is a joint work with Qi-Man Shao and Jinyuan Chang.

CLT for eigenvalue counting function of orthogonal and symplectic matrix models

Shcherbina Mariya
Institute for Low Temperature Physics, Ukraine

While Central Limit Theorems (CLT) for linear eigenvalue statistics of smooth test functions are proven now for many ensembles of random matrices, similar results for the test functions with jumps (e.g. indicators of some intervals) as a rule require much more advanced techniques, and corresponding CLT are known only for a few classical models with gaussian distribution of entries. We present a proof of CLT for the jump test functions for orthogonal and symplectic matrix models with analytic potentials.

Products of independent elliptic random matrices

Soshnikov Alexander
University of California, USA

For fixed $m > 1$, we study the product of m independent $N \times N$ elliptic random matrices as N tends to infinity. Our main result shows that the empirical spectral distribution of the product converges, with probability 1, to the m-th power of the circular law, regardless of the joint distribution of the mirror entries in each matrix. This leads to a new kind of universality phenomenon: the limit law for the product of independent random matrices is independent of the limit laws for the individual matrices themselves.

This is a joint work with Sean O'Rourke, David Renfrew, and Van Vu.

Eigenvector distribution of anisotropic random matrices

Yin Jun
University of Wisconsin-Madison, USA

As an application of the anisotropic local law (introduced in A. Knowles's talk), we study the eigenvector distribution of anisotropic random matrices. Examples include sample covariance matrices whose underlying population has nontrivial correlations, and Wigner matrices whose entries have arbitrary mean. It turns out that eigenvectors are asymptotically independent and uniformly distributed on an ellipsoid. A key ingredient of the proof is a new type of self-consistent comparison method.

Integrated covariance matrix estimation for high-dimensional diffusion processes in the presence of microstructure noise

Zheng Xinghua
Hong Kong University of Science & Technology, China

We consider estimation of the integrated covariance (ICV) matrices of high-dimensional diffusion processes based on high-frequency data in the presence of microstructure noise. We adopt the pre-averaging approach to deal with microstructure noise, and establish the connection between the underlying ICV matrix and the pre-averaging estimator in terms of their limiting spectral distributions (LSDs). A key element of the argument is a result describing how the LSD of (true) sample covariance matrices depends on that of sample covariance matrices constructed from *noisy* observations. This result enables one to make inferences about the covariance structure of underlying signals based on noisy observations. We further propose an alternative estimator, the pre-averaging time-variation adjusted realized covariance matrix, which possesses two desirable properties: it eliminates the impact of noise, and its LSD depends only on that of the targeting ICV through the standard Marchenko-Pastur equation when the covolatility process satisfies certain structural conditions.

LIST OF PARTICIPANTS

Participants	Affiliation	E-Mail
Adamczak, Radoslaw	University of Warsaw	R.Adamczak@mimuw.edu.pl
Ao, Mengmeng	Hong Kong University of Science and Technology	maoaa@ust.hk
Auguin, Nicolas	Hong Kong University of Science and Technology	nicolas.auguin@gmail.com
Bai, Yanru	The University of Hong Kong	tsdwx56@hku.hk
Bai, Zhidong	Northeast Normal University	baizd@nenu.edu.cn
Bordenave, Charles	Centre National de Recherche Scientifique (CNRS) and Université de Toulouse	charles.bordenave@math.univ-toulouse.fr
Bose, Arup	Indian Statistical Institute	bosearu@gmail.com
Cai, Weixin	The University of Hong Kong	wiltsai@hku.hk
Caputo, Pietro	Roma Tre University	pietrocap@gmail.com
Chafaï, Djalil	Université Paris-Dauphine	djalil@chafai.net
Chen, Yang	University of Macau	yangbrookchen@yahoo.co.uk
Collins, Benoît	University of Ottawa and Kyoto University	bcollins@uottawa.ca
Couillet, Romain	École Supérieure d'Electricité	romain.couillet@supelec.fr
Cucker, Felipe	City University of Hong Kong	macucker@cityu.edu.hk
Guionnet, Alice	Massachusetts Institute of Technology (MIT) and Centre National de Recherche Scientifique (CNRS)	guionnet@math.mit.edu
Han, Guangyue	The University of Hong Kong	ghan@hku.hk
Hardy, Adrien	Royal Institute of Technology (KTH)	ahardy@kth.se
Hu, Jiang	Northeast Normal University	huj156@nenu.edu.cn
Hui, David	Hong Kong University of Science and Technology	davidhui@connect.ust.hk
Johnstone, Iain	Stanford University	imj@stanford.edu
Knowles, Antti	ETH Zürich	knowles@math.ethz.ch
Kozhan, Rostyslav	Royal Institute of Technology (KTH)	kozhan@kth.se
Lam, Yeh	The University of Hong Kong	ylam@saas.hku.hk
Li, Wai Keung	The University of Hong Kong	hrntlwk@hku.hk
Li, Weiming	Beijing University of Posts and Telecommunications	liwm601@gmail.com
Li, Zeng	The University of Hong Kong	u3001205@hku.hk

Li, Zhaoyuan	The University of Hong Kong	zyli12@hku.hk
Liu, Dang-Zheng	University of Science and Technology of China	dzliu@ustc.edu.cn
Luo, Shan	Shanghai Jiao Tong University	sluomath@sjtu.edu.cn
Lytova, Anna Yu	Institute for Low Temperature, Kharkov, Ukraine	anna.lytova@gmail.com
Maïda, Mylène	Université Lille 1	mylene.maida@math.univ-lille1.fr
Mak, Don	World Scientific	dkmak@wspc.com
Male, Camille	Centre National de Recherche Scientifique (CNRS) and Université Paris Descartes	camille.male@gmail.com
Merlevède, Florence	Université Paris-Est Marne-La-Vallée	florence.merlevede@u-pem.fr
Morales, David	Hong Kong University of Science and Technology	eedmorales@ust.hk
Moreno-Pozas, Laureano	Universidad de Málaga	lmp@ic.uma.es
Nadakuditi, Raj Rao	University of Michigan	rajnrao@umich.edu
Nagao, Taro	Nagoya University	nagao@math.nagoya-u.ac.jp
Najim, Jamal	Centre National de Recherche Scientifique (CNRS) & Université Paris Est - MLV	najim@univ-mlv.fr
Oestman, Johan	Hong Kong University of Science and Technology	eejohan@ust.hk
Onatskiy, Alexey	University of Cambridge	ao319@cam.ac.uk
Pajor, Alain	Université Paris-Est Marne-La-Vallée	alain.pajor@univ-mlv.fr
Pan, Guangming	Nanyang Technological University	gmpan@ntu.edu.sg
Salez, Justin	Université Paris 7	justin.salez@univ-paris-diderot.fr
Shao, Qi-Man	Chinese University of Hong Kong	qmshao@sta.cuhk.edu.hk
Shcherbina, Mariya	Institute for Low Temperature Physics, Kharkov, Ukraine	shcherbi@ilt.kharkov.ua
Shen, Keren	The University of Hong Kong	rayshenkr@hku.hk
Song, Jian	The University of Hong Kong	txjsong@hku.hk
Soshnikov, Alexander	University of California, Davis	soshniko@math.ucdavis.edu
Su, Zhonggen	Zhejiang University	suzhonggen@zju.edu.cn
Wang , Chen	National University of Singapore	stawc@nus.edu.sg
Wang, Cheng	Shanghai Jiao Tong University	cescwang@gmail.com
Wang, Hanchao	Chinese University of Hong Kong	hcwang06@gmail.com
Wang, Qinwen	Zhejiang University	wqw8813@gmail.com
Wong, Mo Dick	University of Cambridge	mdw46@cam.ac.uk

Wong, Raymond	The University of Hong Kong	rwong@hku.hk
Xie, Junshan	Henan University	xjsnwpu@163.com
Yang, Guangyu	Zhengzhou University	guangyu@zzu.edu.cn
Yang, Hailiang	The University of Hong Kong	hlyang@hku.hk
Yang, Liusha	Hong Kong University of Science and Technology	yangliusha@gmail.com
Yang, Xinxin	Hong Kong University of Science and Technology	xyangai@ust.com
Yang, Yingrui	The University of Hong Kong	yryang2014@gmail.com
Yang, Yuping	Southwest University	yangyuping@gmail.com
Yao, Jianfeng	The University of Hong Kong	jeffyao@hku.hk
Yaskov, Pavel	Steklov Mathematical Institute, Russian Academy of Science	yaskov@mi.ras.ru
Yin, Jun	University of Wisconsin-Madison	jyin@math.harvard.edu
Yip, Iris	Hang Seng Management College	irisyip@hsmc.edu.hk
Yiu, Rachel	The University of Hong Kong	rachelyiu@hotmail.com
Yu, Philip	The University of Hong Kong	plhyu@hku.hk
Yuen, Kam Chuen	The University of Hong Kong	kcyuen@hku.hk
Zhang, Deng	Shanghai Jiao Tong University	zhangdeng@amss.ac.cn
Zheng, Xinghua	Hong Kong University of Science and Technology	xhzheng@ust.hk
Zhou, Wenxin	University of Melbourne	wenxin.zhou@unimelb.edu.au
Zhu, Qianqian	The University of Hong Kong	qianqzhu@hku.hk
Zhu, Qiling	Zhejiang University	zhuqiling@zju.edu.cn

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