Program

February 15 (Monday), 2016

Opening (08:55 – 09:00)

09:00 – 10:30

Mary Beth Ruskai: Contraction coefficient for noisy quantum channels

Fumio Hiai: Quantum divergences and reversibility

11:00 – 12:30

Frank Hansen: Inequalities for quantum channels

Raymond Sze: Operator theoretical approach to quantum error correction

14:00 – 15:30

Marius Junge: An operator algebraic approach to quantum capacity

Soojoon Lee: Stability theorem of the depolarizing channel for the output quantum Rényi entropies

16:00 – 17:30

Jaewan Kim: Exponential function, coherent states, and quDits

Magdalena Musat: Quantum error correction and the Connes embedding problem

February 16 (Tuesday), 2016

09:00 – 10:30

Erling Størmer: Separable states and the structural physical approximation of a positive map

Marcin Marciniak: New examples of exposed positive maps

11:00 – 12:30

Marek Miller: Positive maps on low dimensional matrix algebras

Wai-Shing Tang / Yu Yang: A decomposition theorem for k-positive linear maps on matrix algebras

14:00 – 15:30

Frederic Shultz: Variations on the Choi matrix in determining complete positivity

Arvind: Enhancing the entanglement detection power of positive map

16:00 – 17:30

Jeong San Kim: Strong monogamy of multi-party quantum entanglement

Lin Chen: Recent progress on the distillability problem

February 17 (Wednesday), 2016

09:00 – 10:30

James Mingo: Freeness and the partial transpose

Ion Nechita: Block-modified random matrices, operator-valued free probability, and applications to entanglement theory

11:00 – 12:30

Karol Życzkowski: Distinguishing generic quantum states

Benoit Collins: Positive maps from free probability theory

February 18 (Thursday), 2016

09:00 – 10:30

Tsuyoshi Ando: Conditions for separability of matrices in $\mathbb{M}_2 \otimes \mathbb{M}_n$

Kyung Hoon Han: X-parts of multi-qubit states and witnesses

11:00 – 12:30

Adam Majewski: On quantum correlations

Yoshiko Ogata: A class of asymmetric gapped Hamiltonians on quantum spin chains and its classification

14:00 – 15:30

Marek Bożejko: Generalized Fock spaces and second quantization as examples of completely positive maps and hypercontractive semigroups

Salman Beigi: Hypercontractivity and log Sobolev inequalities for completely bounded norms

16:00 – 17:30

Dariusz Chruściński: Dynamical maps and memory kernels

Joonwoo Bae: Operational characterization of divisibility of dynamical maps

February 19 (Friday), 2016

09:00 – 10:30

Jun Tomiyama: Under the $C^\star$-envelope

Tobias Fritz: A mathematical toolbox for resource theories

10:45 – 11:30

Man-Duen Choi: The principle of locality made simpler but harder

Abstracts

Tsuyoshi Ando (Hokkaido University, Sapporo, Japan)

Conditions for separability of matrices in $\mathbb{M}_2 \otimes \mathbb{M}_n$

A necessary condition for a positive element in $\mathbb{M}_2 \otimes \mathbb{M}_n$ to be separable is (PPT), that is, to have a positive partial transpose. We will discuss what additional requirements guarantee separability.

Arvind (IISER, Mohali, India)

Enhancing the entanglement detection power of positive map

In the talk I will present two different methods of enhancing the entanglement detection power of positive maps which are not completely positive. These two methods are automorphisms on these maps and local filters. I will also discussion the connection between these two methods and physical interpretation of the operations involved. I will also discuss the new entangled states that can be unearthed in this way and their use in quantum cryptography.

Joonwoo Bae (Hanyang University, Ansan, Korea)

Operational Characterization of Divisibility of Dynamical Maps

Divisibility of dynamical maps turns out to be a fundamental notion in characterising Markovianity of quantum evolution, while the decision problem for divisibility itself turns out to be computationally intractable. In this work, we propose the operational characterisation of divisibility of dynamical maps by exploiting distinguishability of quantum channels. We prove that distinguishability for any pair of quantum channels does not increase under divisible maps. Using the fact that quantum entanglement enables one to increase distinguishability of channels we provide the operational characterization for the full hierarchy of so called k-divisiblity ($k = 1, 2, \dots$). Finally, from the fact that min-entropy corresponds to the information-theoretic measure of distinguishability, the entropic characterisation to divisible maps is also provided.

Salman Beigi (IMP, Teheran, Iran)

Hypercontractivity and log Sobolev inequalities for completely bounded norms

In this talk I present the notions of hypercontractivity (HC) and the log-Sobolev (LS) inequality for completely bounded norms of one-parameter semigroups of super- operators acting on matrix algebras. The equivalence of the completely bounded versions of HC and LS under suitable hypotheses will be shown. Also a version of the Gross lemma which allows LS at general q to be deduced from LS at $q = 2$ will be discussed.

Marek Bożejko (Uniwersytet Wrocławski, Wrocław, Poland)

Generalized Fock spaces and second quantization as examples of completely positive maps and hypercontractive semigroups

In my talk we will consider the following topics:

- Generalized Fock spaces $F(T,H)$ for real Yang-Baxter contraction T on a real Hilbert space H.
- Anyonic Fock spaces and type B-Fock spaces.
- q-Discrete Brownian Motion related to q-discrete Hermite polynomials.
- Second quantization $\Gamma(T,S)$ from the von Neumann algebra $G(T,H)$ generalized by T-Gaussian operators $G(f) = a(f) + a + (f)$,where f is in a real Hilbert space H.
- If $S = \exp(-t)\mathrm{Id}$, we get so called generalized Ornstein-Uhlenbeck semigroup $U_t = \Gamma(T,S)$ and in many cases of T we have hypercontactivity, i.e. U_t maps L^2 into L^∞, where L^2 is the Fock space $F(T,H)$ and $L^\infty = G(T,H)$.

The subject of the talk is taken from the papers together with W. Ejsmont, T. Hasebe, E. Lytvynov, I. Rodionova, R. Speicher, Q. Xu , H. Yoshida and J. Wysoczanski.

Lin Chen (Beihang University, Beijing, China)

Recent progress on the distillability problem

The distillability problem is a well-known open problem in entanglement theory. It asks whether quantum states can be asymptotically converted into pure entanglement, which is the necessary resource for quantum-information tasks. We report the recent progress on the distillability problem, by showing that the following two families of $M \times N$ bipartite entangled states ρ are 1-distillable. (i) ρ has rank $\max\{M,N\}$, and (ii) $M = N = 3$, ρ has negative partial transpose (NPT), and the partial transpose of ρ has at least two non-positive eigenvalues. The result (i) solves an open problem proposed by P. Horodecki and J. Smolin et al in 1999. As a corollary of (i) and (ii) all NPT states of rank at most four are 1-distillable. We further construct a family of 1-undistillable two-qutrit NPT states $\rho(\varepsilon)$ of rank five containing a positive parameter ε. For any given integer n and sufficiently small ε, it turns out that $\rho(\varepsilon)^{\otimes n}$ is 1-undistillable. We also conjecture that $\rho(\varepsilon)^{\otimes n}$ is an undistillable NPT bound entangled state when n approaches the infinity.

Man-Duen Choi (University of Toronto, Toronto, Canada)

The principle of locality made simpler but harder

This is an expository talk of my own adventure in the quantum wonderland (concerning the mathematical problems on direct sums and tensor products – the basic structure in the theory of matrix theory and operator algebras). No working knowledge of quantum information is required in this talk.

Dariusz Chruściński (Nicolaus Copernicus University, Torun, Poland)

Dynamical maps and memory kernels

We analyze dynamical maps for quantum evolution generated by master equation with memory kernel. We provide partial characterization of admissible memory kernels. For qubit system we present sufficient conditions which guarantee that the corresponding memory kernel generates physically legitimate quantum evolution. Interestingly, we are able to recover several well known examples and generate new classes of nontrivial qubit evolution.

Benoit Collins (Kyoto University, Kyoto, Japan)

Positive maps from free probability theory

We interpret the super convergence properties of the free additive convolution semigroup in terms of Choi matrices, and provide new examples of maps that are positive but not completely positive. In particular, we show that some of our constructions yield new examples of indecomposable positive maps and describe some applications to the geometry of the set of separable states. This is joint work with Patrick Hayden and Ion Nechita.

Tobias Fritz (Max Planck Institute, Leipzig, Germany)

A mathematical toolbox for resource theories

Classical and quantum information theory are largely concerned with the following type of problem: can a given object be converted into a desired one? And if so, at what rate? I will explain how the theory of ordered commutative monoids provides a mathematical toolbox for this type of question. Applying this toolbox to zero-error communication yields some new results in graph theory. Once the open problem of ”epsilonification” will have been dealt with, our toolbox provides an overarching framework for resource theories in quantum information theory and beyond. This talk is based on http://arxiv.org/abs/1504.03661 and subsequent developments.

Kyung Hoon Han (University of Suwon, Suwon, Korea)

X-parts of multi-qubit states and witnesses

By the entries in the X-parts of multi-qubit matrices, we will discuss necessary conditions of full separability, bi-separability, (genuine) entanglement witnesses, decomposability. Several ones are sufficient when they are X-shaped. Among X-shaped multi-qubit genuine entanglement witnesses, we find all optimal ones. This talk is based on joint work with Seung-Hyeok Kye.

Frank Hansen (Tohoku University, Sendai, Japan)

Inequalities for quantum channels

We investigate new inequalities for a class of operations on states as they are observed trough a quantum channel. In mathematical terms, we study the filtering of the perspective of a regular operator map through a completely positive linear map and apply this to quantum channels. In particular, we obtain inequalities for partial traces of operator means of several variables. We extend Lieb-Ruskai’s convexity theorem from two to $n+1$ operator variables and apply the result to quantum channels.

Fumio Hiai (Tohoku University, Sendai, Japan)

Quantum divergences and reversibility

Among the most important in quantum information theory is the concept of quantum divergences. Up to now, quite a few types of quantum divergences have been introduced with a variety of applications. The (Umegaki) relative entropy and Rényi relative entropies are very familiar ones. An important class is the family of f-divergences, a special case of quasi-entropies due to D. Petz, that are provided corresponding to operator convex functions f on $(0,\infty)$. The so-called sandwiched Rényi divergences are another type of quantum divergences, actively discussed in these years. The most significant property of a quantum divergence $D(\rho,\gamma)$ for quantum states ρ,γ is the monotonicity inequality (i.e., Data-processing inequality) $D(\Phi(\rho),\Phi(\gamma)) \le D(\rho,\gamma)$ under certain stochastic maps Φ (typically, completely positive and trace-preserving maps). The monotonicity or contraction property is indeed a primary requirement for a quantum quantity to be called a divergence. The maximal contraction $\eta_D(\Phi) := \sup_{\rho\neq\gamma} D(\Phi(\rho),\Phi(\gamma))/D(\rho,\gamma)$ is an interesting topic in quantum information. Another significant problem in the opposite direction is to analyze when the equality case $D(\Phi(\rho),\Phi(\gamma)) = D(\rho,\gamma)$ is sufficient for Φ to be reversible for ρ,γ, i.e., $\rho = \Psi(\Phi(\rho))$ and $\gamma = \Psi(\Phi(\gamma))$ by some stochastic map Ψ. The problem has been discussed by many authors in different settings. In my talk I will discuss the reversibility problem for another (non-standard) type of f-divergences and the sandwiched Rényi divergences (more generally, the α-z-Rényi divergences). The talk is based on joint work with M. Mosonyi.

Marius Junge (Univ. Illinois, Urbana, USA)

An operator algebraic approach to quantum capacity

Quantum capacity is measure of how many qubits can be send effectively through a noisy quantum channel. This quantity goes back to the beginning of quantum information theory and is fundamentally important in sharing the amazing properties of quantum systems. However, form an entropic point of view the expression of corresponding to quantum capacity has to undergo regularization, a large n limit of an averages of one shot expression. Since the work of Hastings, it is clear that this regularization process is required for almost any expression relating to capacity.

In this talk we will start from the Choi representation of the channel and explore certain properties of the Stinespring for upper and lower estimates of the quantum capacity using a mathematical structure inspired by quantum groups. These structures are immune under taking tensor product and we automatically get estimate for the regularized capacity. We will study the depolarizing channel in high dimension as an example. Joint work with Gao and LaRacuente

Jaewan Kim (KIAS, Seoul, Korea)

Exponential function, coherent states, and quDits

A conjugate relationship between exponential functions and infinite polynomials are presented with physical implications. While the optical coherent states have some similarity with exponential functions, superpositions of photon number states with photon numbers in modulo are similar to the infinite polynomials. These are called pseudo-phase states and pseudo-number states, respectively and their conjugate relation is the discrete version of phase-number conjugacy. Pseudo-phase/number states can be used as two basis sets of quDit information processing. Maximal entanglement, teleportation, and cluster state of these quDits will be demonstrated.

Jeong San Kim (Kyung Hee University, Suwon, Korea)

Strong monogamy of multi-party quantum entanglement

In this talk, we first recall the concept of ”strong monogamy” of multi-party quantum entanglement proposed in [B. Regula et. al., Phys. Rev. Lett. 113, 110501 (2014)], and present some related results. We consider a large class of multi-qubit generalized W-class states, and analytically show that the strong monogamy inequality of multi-qubit entanglement is saturated by this class of states. We then move to higher-dimensional quantum systems and propose the square of convex-roof extended negativity(SCREN) as a powerful candidate to characterize strong monogamy of multi-party quantum entanglement beyond qubits. We also consider some case of mixed quantum states, which are in partially coherent superposition of multi-qudit W-class states and vacuum, and discuss its strongly monogamous property in terms of SECRN.

Soojoon Lee (Kyung Hee University, Seoul, Korea)

Stability theorem of the depolarizing channel for the output quantum Rényi entropies

The stability theorem of the depolarizing channel states that if a state is close to achieving the minimal/maximal output value of a certain quantity through the channel, then it must be close to an input state giving the minimal/maximal value. We show that the stability theorem of the depolarizing channel holds for the output quantum p-Rényi entropy for $p \geq 2$ or $p = 1$, which is an extension of the known case $p = 2$. As an application, we present a protocol in which Bob determines whether Alice prepares a pure quantum state close to a product state. In the protocol, Alice transmits to Bob multiple copies of a pure state through a depolarizing channel, and Bob estimates its output quantum p-Rényi entropy. By using our stability theorem, we show that Bob can determine whether her preparation is appropriate.

W. Adam Majewski (The Gdansk University, Gdansk, Poland)

On quantum correlations

Under the rules of Quantum Statistical Mechanics, we present the new rigorous approach for description of correlations of quantum observables. Centered on quantum probability we describe the most important deviation of quantum mechanical approach to correlations from its classical counterpart. In particular, guided by certain results from operator spaces the difference between the theory of entanglement for C^*-algebra and W^*-algebra case will be pointed out. Furthermore, an analysis of quantumness of correlations will be given.

Marcin Marciniak (University of Gdansk, Gdansk, Poland)

New examples of exposed positive maps

We present new examples of exposed positive maps. They are obtained by ’bonding’ two maps of the form $B(K_1) \ni X \mapsto A_1XA_1^* \in B(H_1)$ and $B(K_2) \ni X \mapsto A_2X^{\mathrm{T}}A_2^* \in B(H_2)$ into a one map $\phi : B(K_1 \oplus K_2 \oplus \mathbb{C}) \to B(H_1 \oplus H_2 \oplus \mathbb{C})$, where K_i, H_i are finite-dimensional Hilbert spaces, and $A_i : K_i \to H_i$ are linear maps, $i = 1,2$. Properties of the ’bonding’ procedure will be discussed and sketch of the proof of exposedness will be presented. Finally, a class of entangled states witnessed by the maps ϕ will be described.

Marek Miller (Uniwersytet Wrocławski, Wrocław, Poland)

Positive maps on low dimensional matrix algebras

In this talk, I present some of the results published recently (arXiv: 1412.7469, 1503.04283, 1510.04920), concerning extreme and exposed points of the set of all positive maps acting on a low-dimensional matrix algebra. I will give a summary of the methods that allow, on the one hand, to specify some new examples of extremal positive maps, and on the other, to sketch a strategy how to analyse the structure of the set of positive maps in terms of its topological and semigroup properties.

James A Mingo (Queen's University, Kingston, Canada)

Freeness and the partial transpose

The partial transpose has been a useful tool for detecting entanglement for some time and became even more useful since Aubrun showed that the partial transpose of a Wishart matrix may be entangled.

It has been known for some time that independent Wishart matrices are asymptotically free. I recently showed that the partial transpose of a Wishart matrix is asymptotically free from the original matrix, the other partial transpose, or the full transpose. I also have applied this to Haar unitary (or orthogonal) random matrices. I will explain this and some other results involving the partial transpose. This is joint work with Mihai Popa and Emily Redelmeier.

Magdalena Musat (University of Copenhagen, Copenhagen, Denmark)

Quantum error correction and the Connes embedding problem

Work on quantum error correction led J. Smolin, F. Verstraete and A. Winter to conjecture in 2005 that every unital quantum channel might always be well approximated by a convex combination of unitarily implemented ones. In earlier joint work with U. Haagerup we disproved this conjecture by showing that so-called non-factorizable quantum channels, which we constructed in all dimensions greater than or equal to 3, are counterexamples. In recent work, we exhibited an asymptotic property of factorizable quantum channels which leads to a reformulation of the Connes embedding problem. I will survey these results, and will further discuss more recent work with U. Haagerup and M.-B. Ruskai, where we study the convex structure of factorizable quantum channels.

Ion Nechita (Technische Universität München, Munich, Germany)

Block-modified random matrices, operator-valued free probability, and applications to entanglement theory

Motivated by the problem of entanglement detection in quantum information theory, we study the spectrum of random matrices which have been modified by a linear map acting on their blocks. More precisely, for a unitarily invariant random matrix acting on a tensor product space, we consider the matrix obtained by acting with a fixed, hermiticity preserving map, on one factor of the tensor product. We discuss the limiting spectral distribution of the modified matrix, in terms of the initial distribution of the random matrix, and of the linear map acting on the blocks. The key ingredient in the proof is a freeness result, with amalgamation over some commutative, finite dimensional algebra. This is joint work with Octavio Arizmendi and Carlos Vargas.

Yoshiko Ogata (University of Tokyo, Tokyo, Japan)

A class of asymmetric gapped Hamiltonians on quantum spin chains and its classification

We introduce a class of gapped Hamiltonians on quantum spin chains, which allows asymmetric edge ground states. This class is an asymmetric generalization of the class of Hamiltonians introduced by Fannes Nachtergaele and Werner. It can be characterized by five qualitative physical properties of ground state structures. The latter property has an application to the classification problem.

Mary Beth Ruskai (University of Vermont, Burlington, USA)

Contraction coefficient for noisy quantum channels

Generalized relative entropy, monotone Riemannian metrics, geodesic distance, are all known to decrease under the action of quantum channels. In the classical setting the maximal contraction rate of these is independent of the defining function and equal to the maximal contraction of the Fisher information under column stochastic matrices. Analysis of a simple CQ channel for qubits shows that the maximal contraction depends on the operator convex function used in the definition, and allows resolution of several conjectures. We also discuss bounds on, and relationships between, the maximal contraction for these quantities as well as the trace distance. Based on joint work with F. Hiai.

Frederic Shultz (Wellesley College, Wellesley, USA)

Variations on the Choi matrix in determining complete positivity

For a linear map $\Phi : M_m \to M_n$, the map Φ is completely positive iff the Choi matrix $\sum E_{ij} \otimes \Phi(E_{ij})$ is positive (semi-definite). It is often useful in quantum information theory to work with other bases $\{B_i\}$ of M_m rather than the standard basis $\{E_{ij}\}$, but then positivity of the corresponding matrix $\sum B_i \otimes \Phi(B_i)$ is not necessarily equivalent to complete positivity of Φ. The determination of those bases for which this property holds is closely related to the question of whether the linear map taking a basis of M_m to its dual basis is a complete order isomorphism. We give necessary and sufficient conditions for this property, and apply it to determine which of the common bases of M_m such as the Pauli basis or the Weyl basis have the same complete-positivity determining property as the standard basis. This is joint work with Vern Paulsen.

Erling Størmer (University of Oslo, Olso, Norway)

Separable states and the structural physical approximation of a positive map

We first introduce a necessary condition for a state to be separable. Then we discuss the structural physical approximation - the SPA - of a positive map of the $n \times n$ matrices into itself. Main attention is given to some equivalent conditions for the SPA to be separable.

Raymond Sze (The Hong Kong Polytechnic University, Hong Kong)

Operator theoretical approach to quantum error correction

The idea of quantum error correction is to protect quantum information from errors due to decoherence and other quantum noise during the transmission of information in quantum channels. In this talk, we will describe an operator theoretical approach to the study of quantum error correction. Classical results, like Knill-Laflamme result, as well as some recent development, e.g., operator quantum error correction, will be discussed. Examples of quantum circuits implementing these error correcting schemes will also be presented, if time permits.

Wai-Shing Tang / Yu Yang (National University of Singapore, Singapore)

A decomposition theorem for k-positive linear maps on matrix algebras

Following an idea of Choi, we obtain a decomposition theorem for k-positive linear maps from M_m to M_n, where $2 \leq k < \min(m,n)$. As a consequence, we give an affirmation answer to Kye's conjecture (also solved independently by Choi) that every 2-positive linear map from M_3 to M_3 is decomposable. This research is joint work by Yu Yang, Denny H. Leung and Wai-Shing Tang.

Jun Tomiyama (Tokyo Metropolitan University, Tokyo, Japan)

Under the $C^\star$-envelope

We discuss the meaning of $C^\star$-envelope of a Banach *-algebra through the example of the algebra associated with a topological dynamical system, where there appear big difference between them such as the existence of a non-selfadjoint closed ideal and that of a topologically irreducible representations in a Hilbert space which is not irreducible.

- M. de Jeu and J. Tomiyama, *Maximal abelian subslgebras and projections in two Banach algebras associated with a topological dynamical system*, Studia Math. **208** (2012), 47–75.
- M. de Jeu and J. Tomiyama, *Algebracally irreducible representations and structure space of the Banach algebra associated with a topological dynamical system*, preprint.
- J. Tomiyama and M. Cho, *Note on the structure of non-commutative ℓ^1-algebras associated with topological dynamical sytems*, 2015.

Karol Życzkowski (Jagiellonian University/Center for Theoretical Physics, Cracow/Warsaw, Poland)

Distinguishing generic quantum states

Properties of random mixed states of dimension N distributed uniformly with respect to the Hilbert-Schmidt measure investigated. We show that for large N, due to the concentration of measure phenomenon, the trace distance between two random states tends to a fixed number $1/4+1/\pi$, which yields the Helstrom bound on their distinguishability. To arrive at this result we apply free random calculus and derive the symmetrized Marchenko–Pastur distribution. Asymptotic value for the root fidelity between two random states, $\sqrt{F}=3/4$, can serve as a universal reference value for further theoretical and experimental studies. Analogous results for quantum relative entropy and Chernoff quantity provide other bounds on the distinguishablity of both states in a multiple measurement setup due to the quantum Sanov theorem. Entanglement of a generic mixed state of a bi–partite system is estimated. $*$ a joint work with Łukasz Pawela and Zbigniew Puchała (Gliwice), see arxiv:1507.05123

List of Participants

- **Tsuyoshi Ando** (Hokkaido Univ., Sapporo, Japan)
- **Arvind** (IISER, Mohali, India)

- **Joonwoo Bae** (Hanyang Univ., Ansan, Korea)
- **Seongbok Baik** (KT Infra Laboratory, Daejeon, Korea)
- **Salman Beigi** (IMP, Teheran, Iran)
- **Marek Bożejko** (Univ. Wroclaw, Wroclaw, Poland)

- **Lin Chen** (Beihang Univ., Beijing, China)
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- **Tobias Fritz** (Max Planck Institute, Leipzig, Germany)
- **Katsushi Fujiwara** (Kyoto Univ., Kyoto, Japan)

- **Kil-Chan Ha** (Sejong Univ., Seoul, Korea)
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- **Frank Hansen** (Tohoku Univ., Sendai, Japan)
- **Jaeseong Heo** (Hanyang Univ., Seoul, Korea)
- **Fumio Hiai** (Tohoku Univ., Sendai, Japan)
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- **Marek Miller** (Univ. of Wroclaw, Wroclaw, Poland)
- **James Mingo** (Queen's Univ., Kingston, Canada)
- **Magdalena Musat** (Univ. Copenhagen, Copenhagen, Denmark)

- **Joohan Na** (KIAS, Seoul, Korea)
- **Ion Nechita** (Technische Universität München, Munich, Germany)

- **Yoshiko Ogata** (Univ. of Tokyo, Tokyo, Japan)

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- **Mikael Rørdam** (Univ. Copenhagen, Copenhagen, Denmark)
- **Mary Beth Ruskai** (Univ. of Vermont, Burlington, USA)

- **Gunjan Sapra** (Kyoto Univ., Kyoto, Japan)
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- **Yu Yang** (National Univ. of Singapore, Singapore, Singapore)
- **Hyun Jae Yoo** (Hankyong National Univ., Anseong, Korea)
- **Sang-Gyun Youn** (Seoul National Univ., Seoul, Korea)

- **Karol Życzkowski** (Jagiellonian Univ., Cracow, Poland)