

Quantum Information Summer School 2016

July 25th to 28th, 2016

Habib University

9:00 am - 4:30 pm

www.habib.edu.pk/qiss2016



Habib University
shaping futures

Quantum Information Summer School 2016 at Habib University

The field of quantum information and computation is a unique merger of ideas from physics, computer science, information theory, engineering and philosophy. Applications of the field range from algorithms that break secure communication protocols we use online everyday to resolving paradoxes at the cosmological scale related to black holes.

The summer school on quantum information and computation at Habib University envisions a vibrant quantum information research community within Pakistan. The aim is to bring together some of the leading experts in their area to engage, train and collaborate with Pakistani researchers and students.

Who should attend?

Advanced undergraduates, graduate students, faculty, researchers interested in quantum information research

What do you get?

Training in an area at the frontiers of scientific research

Application Procedure

Due to limited seat availability, applications are mandatory and can only be submitted through the website (30th June 2016, 11:59 PM PST deadline). QISS 2016 is heavily subsidized; there is no registration fees.

Student applicants requiring financial support need to submit the following with their application:

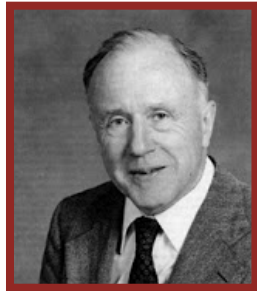
- A brief cv including current status and level of education
- A statement of interest (max one page)
- A statement from a faculty mentor confirming the student's eligibility and recommending the student (This can be sent directly to qjss2016@habib.edu.pk)

Application Decisions: 5th July 2016

Important Notes for Applicants

Financial support is available for those who qualify.

Habib University will provide financial support of up to PKR 10,000 to successful financial aid applicants. The decisions of the application committee are final. Approved support will be withdrawn if you do not actually attend the school. Support will be provided in the form of reimbursement of travel / accommodation receipts during the conference. *For any queries, please contact the organizers at qjss2016@habib.edu.pk.*



John A. Wheeler, 1990

“ The idea that every item of the physical world has at bottom — a very deep bottom, in most instances — an immaterial source and explanation; that which we call reality arises in the last analysis from the posing of yes-or-no questions and the registering of equipment-evoked responses; in short, that all things physical are information-theoretic in origin and that this is a participatory universe. ”





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SPEAKERS



DR. BARRY SANDERS

Dr. Barry Sanders is AITF iCORE Strategic Chair in Quantum Information Science and Director of the Institute for Quantum Science and Technology at the University of Calgary. Dr Sanders also holds a QianRen B Chair in the Division of Quantum Physics and Quantum Information of the National Laboratory for Physical Sciences at the Microscale at the University of Science and Technology China.

Dr Sanders is especially well known for seminal contributions to theories of quantum-limited measurement, highly nonclassical light, practical quantum cryptography and optical implementations of quantum information tasks. His current research interests include quantum resources & algorithms, optical & atomic implementations of quantum information tasks and protocols, quantum processes in biological systems, and machine learning for quantum control.

TUTORIAL TOPIC

Implementations of Quantum Information

ABSTRACT

These lectures focus on how to prepare, protect, process and read quantum information with photons, ions, superconductors and semiconductors. We also discuss applications and assessing progress for such systems.



DR. MUHAMMAD SABIEH ANWAR

Dr. Muhammad Sabieh Anwar is an Associate Professor of physics at the LUMS Syed Babar Ali School of Science and Engineering. He helped establish the physics department and was among the principal founders of the School's experimental facilities and curriculum. He remained Chair of the Physics Department for a period of five years. Ideas from his physics instructional laboratories have been replicated in five Pakistani universities.

His research interests encompass spintronics, magnetism and optics. Sabieh has published around fifty research articles in international journals including Science and Physical Review Letters. He is the General Secretary of the Khwarizmi Science Society which is aimed at popularization of science at the grass roots levels. Prior to joining LUMS SSE in 2007, Sabieh was a post-doc in chemistry and materials science at University of California, Berkeley and a PhD student, as Rhodes Scholar, at the Oxford University. He is recipient of the TWAS medal in physics in 2008 and the National innovation Prize in 2015.

TUTORIAL TOPIC

Introduction to Quantum Information

ABSTRACT

The tutorial will introduce the essentials of quantum information: states, dynamics and measurements. Based on these preliminary ideas, we will exemplify some basic quantum circuits and algorithms for computing as well as quantum communication. Finally, we will review adiabatic quantum computation and the emergent areas in topological quantum information processing.

SPEAKERS



DR. ABUZER YAKARYILMAZ

Dr. Abuzer Yakaryilmaz is a theoretical computer scientist working on computational complexity for quantum models having limited and restricted memories, also known as small space--bounded quantum Turing machines and quantum automata. He completed his PhD in Bogazici University (Istanbul, Turkey) in 2011. His thesis title is "Classical and Quantum Computation with Small Space Bounds". Then he did 3-year postdoc in Andris Ambainis' group in Latvia. After this, he worked as a researcher in LNCC (Petropolis, RJ, Brazil) between 2014 and 2016.

TUTORIAL TOPIC

Introduction to Constant-Memory Quantum Machines

ABSTRACT

We start with the basics of automata theory and review deterministic and probabilistic automata shortly. Then, we introduce quantum finite automata (QFAs) and provide some simple examples representing how we can gain advantages of quantum computation. We also present some algorithms that can read the inputs many times, known as two-way models (2QFAs). As a nice and interesting topic from computational complexity, we also show some examples of interactive proof system protocols where the verifier is a 2QFA. Depending on the remaining time, we represent how QFAs can implement more general quantum operators (superoperators).



DR. BENNO SALWEY

Dr. Benno Salwey was born, raised and has studied in the area of Freiburg, southern Germany, which lies beautifully at the feet of the black forest. After his masters in physics at the Quantum Optics and Statistics group at Andreas Buchleitner, he pursued his PhD under the inspiring reign of Gilles Brassard, one of the founders of the field of quantum cryptography, and Stefan Wolf, an expert not only in cryptography but also in the philosophical aspects of quantum theory. His main interests are the ultimate limits of quantum cryptography as well as the foundations on which quantum theory is built.

TUTORIAL TOPIC

(Quantum) Cryptography Based on Minimal Principles

ABSTRACT

Quantum theory in turn makes the problem of large scale secret key distribution feasible. Only a small shared secret is needed to authenticate a classical channel between the parties with a message authentication scheme. Most of the secure communication channel can be replaced with a completely insecure quantum communication channel, and thus untrusted physical carriers of (quantum) information such as light-particles can be used to establish a long secret key.

Each speaker will deliver three 90 minute tutorial lectures in addition to a problem solving techniques section. The expectation is that starting from an introductory level students get an intensive exposure to the area. The school will run from 25th July to 28th July 2016. Dr. Barry Sanders will also deliver a public talk titled *Symmetries: From Abdus Salam's Universe to Quantum Information Technologies* at Habib University.

The meeting will also be utilized to develop an initial framework for a national level quantum network in Pakistan.



Program Schedule

	Mon	Tue	Wed	Thu
8:30 - 9:00	Registration			
9:00 - 10:30	Dr. Sabieh Introduction to Quantum Information I	Dr. Abuzer Intro to Constant-Memory Quantum Machines I	Dr. Sabieh Problem Solving Session	Dr. Abuzer Problem Solving Session
BREAK				
10:45 - 12:15	Dr. Benno (Quantum) Cryptography Based on Minimal Principles I	Dr. Barry Implementations of Quantum Information I	Dr. Benno Problem Solving Session	Dr. Barry Problem Solving Session
LUNCH				
1:30 - 2:45	Dr. Sabieh Introduction to Quantum Information II	Dr. Abuzer Intro to Constant-Memory Quantum Machines II	Dr. Sabieh Introduction to Quantum Information III	Dr. Abuzer Intro to Constant-Memory Quantum Machines III
BREAK				
3:00 - 4:30	Dr. Benno (Quantum) Cryptography Based on Minimal Principles II	Dr. Barry Implementations of Quantum Information II	Dr. Benno (Quantum) Cryptography Based on Minimal Principles III	Dr. Barry Implementations of Quantum Information III
	Business Meeting		Public Talk by Dr. Barry Sanders	School Banquet





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