



**7th International Summer School
of the SFB/TRR21
"Control of Quantum Correlations in Tailored Matter"
Heinrich-Fabri-Haus, Blaubeuren
July 21 - 23, 2014**

Chair: R. Löw, R. Kleiner, F. Jelezko ...

Scientific Topic:

Quantum Information and Quantum Simulation

Speakers:

Dr. Hermann Kampermann, University Düsseldorf
Prof. Dr. Peter van Loock, University Mainz
Ass. Prof. Dr. Peter Rabl, University Wien
Dr. Hendrik Weimer, University Hannover

Topics:

Quantum Information
Quantifying Entanglement
Quantum Discord
Gates, Protocols, Errors and Fidelities
Quantum Simulation
etc...

Poster Session:

Presentations by the students of the SFB/TRR21

Co.Co.Mat Award:

Award by the SFB/TRR21 for last year's best PhD Thesis

Overview:

Mo 21.07.	Speaker	Tue, 22.07.	Speaker	Wed, 23.07.	Speaker
	<i>Arrival</i>	9:00-10:00	Peter Rabl <i>Quantum Computing with Trapped Ions (Tutorial)</i> <i>Discussion</i>	9:00-10:30	Peter Rabl <i>From trapped ions to macroscopic quantum systems (Talk)</i>
		10:00-10:30	<i>Coffee Break</i>	10:30-11:00	<i>Coffee Break</i>
		10:30-12:00	Hermann Kampermann <i>Quantum discord as a resource (Talk)</i> <i>Discussion</i>	11:00-12:00	Hendrik Weimer <i>Quantum Simulation with Rydberg Atoms (Talk)</i> <i>Discussion</i>
		12:00-13:00	<i>Lunch</i>	12:00-13:00	<i>Lunch</i>
13:00-14:30	Hermann Kampermann <i>Introduction to quantum information (Tutorial)</i> <i>Discussion</i>	13:00-17:30	<i>Excursion</i>	13:00-14:00	Reinhold Kleiner <i>Superconductors for QIV (Talk)</i> <i>Discussion</i>
14:30-15:00	<i>Coffee Break</i>			14:15-15:00	<i>Final discussion with SFB PhD's</i>
15:00-16:30	Peter van Loock <i>Realistic states and encodings, ideal gates (Tutorial)</i>				<i>Departure</i>
16:30-17:00	<i>Coffee Break</i>				
17:00-18:00	Peter van Loock <i>Measurement-based quantum information processing (Talk)</i>				
18:00-18:30	Co.Co.Mat Award				
18:30-19:30	<i>Dinner</i>	18:30-19:30	<i>Dinner</i>		
19:30-open end	Start Poster session	20:00-21:00	Evening talk: Fedor Jelezko QIV with NV		

Peter van Loock

Tutorial

"Realistic states and encodings, ideal gates"

- mixed quantum states
- mixed-state entanglement, entanglement criteria
- qudits and qumodes (continuous variables)
- unitary quantum gates, universal quantum gates
- optical encodings and gates

Fachvortrag/Tutorial

"Measurement-based quantum information processing":

- multipartite entanglement, cluster states, graph states
- one-way quantum computation
- optical implementations

Hermann Kampermann

Tutorial

"Introduction to quantum information"

- Quantum mechanics and information processing
- The qubit
- Entanglement of bipartite pure states
- Quantum teleportation
- Superdense coding

Talk/Tutorial2

"Quantum discord as a resource"

- Discord of bipartite states
- Discord versus entanglement
- The role of discord in entanglement distribution
- Discord and noise

Peter Rabl

Tutorial:

"Quantum Computing with Trapped Ions"

-) trapping of ions
-) ion-light interactions, sideband transitions, laser cooling
-) quantum state preparation and tomography
-) ion qubits
-) Cirac-Zoller gate
-) geometric gates
-) Outlook: spin models and quantum simulation with trapped ions

Talk:

"From trapped ions to macroscopic quantum systems"

-) Introduction to nanomechanical systems in the quantum regime
-) Coupling of nanomechanical systems to spin qubits (NV centers)
-) Preparation of macroscopic superposition states
-) mechanical quantum transducers

Hendrik Weimer

Tutorial:

"Digital Quantum Simulation"

- Quantum simulation on a quantum computer
- Many-body interactions
- Dissipative quantum state engineering

Talk:

"Quantum Simulation with Rydberg Atoms"

- Introduction to Rydberg atoms
- Rydberg EIT
- Mesoscopic Rydberg gates
- Digital quantum simulation architecture

Poster Presentations (incomplete):