Symposium SAMOP Dissertation-Prize 2014 (SYAD)

jointly organized by all divisions of the section AMOP

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The divisions of the section AMOP award a PhD prize 2014. The prize acknowledges excellent research from PhD work and its excellent oral and written dissemination. Eligible for nomination were scientifically excellent PhD theses from the research fields of AMOP completed in 2012 or 2013.

Based on the nominations, a jury formed by the heads of the AMOP research units and a representative of jDPG, has selected four finalists for the award. They have been invited to present their research in this symposium. The awardee will be selected from the finalists after the symposium by the prize committee.

The committee members in 2014 are Thomas Möller (Berlin) from the Atomic Physics Division (A), Andreas Görtler (Berg) for the Short Time-scale Physics Division (K), Gereon Niedner-Schatteburg (Kaiserslautern) for the Molecular Physics Division (MO), Clemens Walther (Hannover) for the Mass Spectrometry Division (MS), Bernhard Unterberg (Jülich) for the Plasma Physics Division (P), Andreas Buchleitner (Freiburg) for the Quantum Optics and Photonics Division (Q), Sebastian Heupts (Heidelberg) as a representative of the Young DPG, and Matthias Weidemüller (Heidelberg) as Chairman of the section AMOP.

The winner will be honoured during the Ceremonial Session on Wednesday, March 19th.

Overview of Invited Talks and Sessions

(Lecture room: Audimax)

Invited Talks

SYAD 1.1	Tue	10:30–11:00	Audimax	**Rotationally resolved fluorescence spectroscopy - from neurotransmitter to conical intersection** — •Christian Brand
SYAD 1.2	Tue	11:00–11:30	Audimax	**Quantum simulations with ultracold atoms: Beyond standard optical lattices** — •Philipp Hauke
SYAD 1.3	Tue	11:30–12:00	Audimax	**Degenerate quantum gases of alkaline-earth atoms** — •Simon Stellmer
SYAD 1.4	Tue	12:00–12:30	Audimax	**One step beyond entanglement: general quantum correlations and their role in quantum information theory** — •Alexander Streltsov

Sessions

SYAD 1.1–1.4	Tue	10:30–12:30	Audimax	**Symposium SAMOP Dissertation-Prize 2014**

SYAD 1: Symposium SAMOP Dissertation-Prize 2014

Time: Tuesday 10:30–12:30 Location: Audimax

Invited Talk SYAD 1.1 Tue 10:30 Audimax

Rotationally resolved fluorescence spectroscopy - from neurotransmitter to conical intersection — •Christian Brand — Institute for Quantum Optics, Quantum Nanophysics and Quantum Information, University of Vienna, Austria

The combination of rotationally resolved electronic spectroscopy and high level *ab initio* calculations allows a very detailed analysis of molecular structure both in the electronic ground and excited state. Beyond that it contains a wealth of information regarding the excited state photophysics and internal motions, and enables us to look for interactions between electronic states.

In a comprehensive study on the model system indole we observe that the energies of the two lowest excited singlet states vary systematically depending on the nature and the position of a given substituent. This is of major importance as indole is the chromophore of the aromatic amino acid tryptophan and hence is responsible for its emission properties. Depending on whether electron density is donated or withdrawn by the substituent, the energetic gap between the S_1 and S_2 is altered and sometimes even the energetic ordering on the states can be reversed. The photophysical consequences are numerous and will be illustrated for a number of characteristic examples.

Invited Talk SYAD 1.2 Tue 11:00 Audimax

Quantum simulations with ultracold atoms: Beyond standard optical lattices — •Philipp Hauke — Institute of Quantum Optics and Quantum Information, Innsbruck, Austria

Many prominent problems of quantum many-body physics (such as high-Tc superconductivity or quark confinement) remain unsolved, because the exponential growth of Hilbert space prevents numerical treatment of more than a few particles. To solve such models, Feynman proposed thirty years ago to design quantum devices that are governed by the same equations as the abstract model. Ultracold atoms in optical lattices are – thanks to their unprecedented cleanness and control – ideal candidates for such "quantum simulators," and experiments that exceed the capabilities of classical computers are already being performed. In this talk, I present various new avenues that become open by going beyond standard setups, e.g., via exotic geometries, higher orbitals, or spin-dependent lattices. In particular, I discuss the exciting possibilities given by a periodical lattice driving, which allows us to explore frustrated quantum magnetism and which provides an alternative to light-induced synthetic gauge fields. Indeed, experiments along these lines are already being carried out. The proposed systems may realize topological phases, anomalous quantum-Hall states, or spin liquids, thus promising insight into some of the most important problems of condensed-matter and high-energy physics.

Invited Talk SYAD 1.3 Tue 11:30 Audimax

Degenerate quantum gases of alkaline-earth atoms — •Simon Stellmer — Institut für Quantenoptik und Quanteninformation, Innsbruck — Universität Innsbruck — Atominstitut der TU Wien

Alkaline-earth atoms are a well-established and very successful platform for optical clocks, but their introduction into the field of quantum gases occurred only very recently. Atoms of alkaline-earth elements are strikingly different from the widely used alkali atoms with respect to their nuclear, electronic, and scattering properties. Their unique features, such as narrow transitions and metastable states, are at the heart of many novel quantum simulation protocols and related proposals. These fascinating ideas, however, require deeply degenerate samples.

In my talk, I will sketch a robust and efficient scheme that allowed us to reach quantum degeneracy in strontium for the first time. I will then elaborate on an experiment that beautifully combines various favorable properties of strontium: the attainment of Bose-Einstein condensation purely by laser cooling, i.e. without the stage of evaporative cooling. This work holds prospects for the generation of a continuous atom laser.

Invited Talk SYAD 1.4 Tue 12:00 Audimax

One step beyond entanglement: general quantum correlations and their role in quantum information theory — •Alexander Streltsov — ICFO - The Institute of Photonic Sciences, Castelldefels, Spain

Quantum entanglement is by far the most famous kind of quantum correlations and its fundamental role in several tasks in quantum information theory is undeniable. However, recent discoveries suggest that entanglement is not always necessary: a quantum computer can outperform its classical counterpart even without any entanglement. This and related examples demonstrate the limits of the concept of entanglement and suggest the formulation of more general quantum correlations which are more suitable for the tasks under study. Quantum discord is the most famous measure of such general quantum correlations beyond entanglement. In this talk we discuss the role of quantum discord in the quantum measurement process and in the task of entanglement distribution. In particular, we show that quantum discord is the essential resource for this task: the distribution of any finite amount of entanglement requires the transmission of at least the same amount of discord. Our results also reveal optimal distribution protocols even if the exchanged particle exhibits no entanglement with the rest of the system.