Awards Symposium (SYAW)

jointly organized by all divisions of the section AMOP

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Overview of Invited Talks and Sessions

(Lecture hall Audimax)

Prize Talks

SYAW 1.1	Wed	13:30–14:15	Audimax	**Frequency comb spectroscopy and interferometry** — •Nathalie Picqué
SYAW 1.2	Wed	14:15–15:00	Audimax	**Capitalizing on Schrödinger** — •Wolfgang P. Schleich
SYAW 1.3	Wed	15:00–15:45	Audimax	**Quantum information processing with macroscopic objects** — •Eugene Polzik

Sessions

SYAW 1.1–1.3	Wed	13:30–15:45	Audimax	**Awards Symposium**

SYAW 1: Awards Symposium

Time: Wednesday 13:30–15:45 Location: Audimax

Prize Talk SYAW 1.1 Wed 13:30 Audimax

Frequency comb spectroscopy and interferometry — •Nathalie Picqué — Max-Planck Institute of Quantum Optics, Garching, Germany

A frequency comb is a broad spectrum of evenly spaced phase-coherent narrow laser lines. Initially invented for frequency metrology, such combs enable new approaches to interferometry. A scheme which has grown increasingly popular has been to exploit time-domain interference between frequency combs of different repetition frequency.

One of the most widespread applications has been dual-comb spectroscopy, which enables fast and accurate measurements over broad spectral bandwidths, of particular relevance to molecular sensing. Accurate determination of all spectral line parameters and broadband detection in light-starved conditions become possible and, combined to nonlinear excitation of the samples, they open up new opportunities for precision spectroscopy and stringent comparisons with theories in atomic and molecular physics. Concurrently, progress towards chip-scale dual-comb spectrometers promises integrated devices for real-time sensing in analytical chemistry and biomedicine.

With the recent dual-comb digital holography, another application of frequency-comb interferometry, novel optical diagnostics can be envisioned, such as precise dimensional metrology over large distances without interferometric phase ambiguity, or hyperspectral 3-dimensional imaging with high spectral resolving power.

With selected examples, I will illustrate the rapidly advancing field of dual-comb interferometry.

Prize Talk SYAW 1.2 Wed 14:15 Audimax

Capitalizing on Schrödinger — •Wolfgang P. Schleich — Institut für Quantenphysik and Center for Integrated Quantum Science and Technology (IQ^{ST}), Universität Ulm, Albert-Einstein-Allee 11, D-89081 Ulm, Germany — Institute of Quantum Technologies, German Aerospace Center (DLR), Söflinger Strasse 100, D-89077 Ulm, Germany — Hagler Institute for Advanced Study and Department of Physics and Astronomy, Institute for Quantum Science and Engineering (IQSE), Texas A&M AgriLife Research, Texas A&M University, College Station, Texas 77843-4242, USA — Laureate of the Herbert Walther Award 2021

The superposition principle is a cornerstone of quantum mechanics and results from the linearity of the Schrödinger equation. In this talk we motivate the non-linear wave equation of classical statistical mechanics as well as the linear Schrödinger equation of quantum mechanics from a mathematical identity. Moreover, the linearity is crucial for the use of matter wave interferometers as sensors for rotation and acceleration. We show that the phase in a Kasevich-Chu atom interferometer measures the commutator of two unitary time evolutions and thus the acceleration. In addition, we report the observation of the Kennard phase using water waves and the realization of a Kennard interferometer with a scaling superior to the Kasevich-Chu interferometer.

Prize Talk SYAW 1.3 Wed 15:00 Audimax

Quantum information processing with macroscopic objects — •Eugene Polzik — Niels Bohr Institute, University of Copenhagen, Denmark — Laureate of the Herbert Walther Award 2020

Single atoms and atom-like particles have always been in the mainstream of quantum information processing and quantum technologies. However, as it has been realized for the first time about twenty years ago, collective entangled quantum states of large many-body quantum systems can be generated and possess some unique properties and advantages. In the talk I will review the basic ideas and experiments with macroscopic quantum systems developed at my group over the past two decades. Examples of macroscopic entangled systems span from collective spins of large atomic ensembles to motional degrees of freedom of mechanical oscillators. Such entanglement enables quantum teleportation, quantum memory and quantum sensing with macroscopic atomic and solid state objects. A special case of measurements in a negative mass reference frame in which a simultaneous measurement of the position and the momentum becomes possible will be highlighted. Applications of this principle to sensing of magnetic fields, acceleration and gravitational waves will be briefly discussed.