

Wilhelm und Else Heraeus Seminar # 702:

***“Otto Stern's Molecular Beam Research
and its Impact on Science”***

1-5 September 2019

**Arthur von Weinberg-Haus (Alte Physik)
Robert-Meyer-Str. 2, Frankfurt**

Honorary Chairs: Dudley Herschbach and Peter Toennies

Organizers: Horst Schmidt-Böcking and Bretislav Friedrich

Website: <https://indico.fhi-berlin.mpg.de/event/35/>

Aims of the Conference

The year 2019 presents a two-fold opportunity to remember the pioneer of quantum physics and Nobel Laureate Otto Stern (1888-1969). In 1919, at Max von Laue's and Max Born's Institute for Theoretical Physics of the University of Frankfurt, Stern launched the revolutionary molecular beam (or molecular ray) technique. This technique made it possible to send atoms and molecules with well-defined momentum through vacuum and to measure with high accuracy the deflections they underwent when acted upon by transversal forces. Thereby, heretofore unforeseen quantum properties of nuclei, atoms, and molecules could be revealed that became the basis for our current understanding of quantum matter. In the iconic Stern-Gerlach experiment, completed in February 1922, the reality of space quantization of angular momentum had been demonstrated. The momentum resolution achieved corresponded to an energy resolution of a micro electron volt.

This year marks also the fiftieth anniversary of Otto Stern's death. After a heyday period at the University of Hamburg (1923-1933), Stern was forced by the Nazi regime to emigrate. He settled in the U.S., first at Pittsburg (1933-1945) and then in Berkeley (1946-1969). After the Second World War, Stern was generously helping many of his friends and colleagues with CARE packages. And he would not miss an opportunity to visit Europe – to see his friends at conferences and meetings, in particular in Copenhagen, London, and, foremost, in Zurich.

The main aim of this conference is to show that many key areas of modern science, in particular of Physics and Chemistry, originated in the seminal molecular beam work of Otto Stern and his school. The participants will benefit from talks and discussions that will highlight the current state of the art in these areas.

Program

Sunday, 1 September 2019

16:00 – 22:00 Welcome reception

Monday, 2 September 2019

9:00-10:00 Festive Opening in *Alte Aula*

9:00-9:30 **Dudley Herschbach**: *Welcome: An homage to Otto Stern*

9:30-10:00 **Alan Templeton**: *My uncle Otto Stern*

10:00-10:30 Coffee Break

10:30-13:00 **History: Karin Reich, Chair**

10:30-11:20 **Keynote: Tilman Sauer**: *Otto Stern's trajectory*

11:20-12:10 **Arne Schirrmacher**: *From theory to experiment (and back to theory)?
On Otto Stern, Max Born and other physicists in the 1920s*

12:10-13:00 **Massimiliano Badino**: *Otto Sackur, Otto Stern, and the Beginning of the
Quantum Theory of Gases*

13:00-14:00 Lunch

14:00-15:45 **Magnetic and Electric Resonance Spectroscopy: Horst Kessler, Chair**

14:00-14:45 **Keynote: Christian Griesinger**: *From Stern's beam experiments to
modern biomolecular NMR spectroscopy*

14:45-15:15 **Hermann Requardt**: *Economic aspects of NMR: Analytic devices and
medical imagers*

15:15-15:45 **Harald Schwalbe**: *Protons, Electrons - how they spin and interact to
discover major aspects of Chemistry and Biomedicine*

15:45-16:15 Coffee break

16:15-19:00 **Foundations of Quantum Mechanics: Wolfgang Demtröder, Chair**

16:15-17:00 **Keynote: John Briggs**: *Quantum or classical perception: The Imaging
Theorem and the Ensemble Picture*

17:00-17:30 **Michael Devereux**: *Reduction of the atomic wave function in the
Stern-Gerlach magnetic field*

17:30-18:00 **Wolfgang Schleich**: *At the interface of gravity and quantum mechanics*

18:00-18:30 **Ron Folman**: *Stern-Gerlach Interferometry on the Atom Chip*

18:30-19:00 **Hendrik Ulbricht**: *Prospects for testing quantum mechanics with levitated
optomechanics*

19:00-20:00 Dinner

20:00-20:30 **Foundations of Quantum Mechanics Cont'd: Marlan Scully, Chair**

20:00-20:30 **Bob Griffith**: *What Do Quantum Measurements Measure?*

20:30-22:00 Poster Session with Wine+Beer+Bretzel

Tuesday, 3 September 2019

9:00-10:30 **High Precision Measurements: Peter Toschek, Chair**

9:00-9:45 **Keynote: Joachim Ullrich:** *Precision experiments for the revised SI - and the future of time*

9:45-10:30 **Klaus Blaum:** *Precision Physics in Penning Traps Using the Continuous Stern-Gerlach-Effect*

10:30-11:00 Coffee Break

11:00-13:00 **Femto- and Atto-science: Reinhard Dörner, Chair**

11:00-11:45 **Keynote: Paul Corkum:** *Using light to control electrons that, in turn, create new light sources*

11:45-12:10 **Olga Smirnova:** *Synthetic Chiral Light for Efficient Chiral Light-Matter Interaction*

12:10-12:35 **Kiyoshi Ueda:** *Ultrafast molecular and electronic dynamics probed by free-electron lasers*

12:35-13:00 **Ursula Keller:** *Attoclock revisited*

13:00-14:00 Lunch

14:00-16:00 **EPS Historic Site Ceremony**

Remarks:

Peter Feldmann, Oberbürgermeister der Stadt Frankfurt

Prof. Dr. Birgitta Wolff, Präsidentin der Goethe Universität

Prof. Dr. Petra Rudolf, Präsidentin der European Physical Society

Prof. Dr. Dieter Meschede, Präsident der Deutschen Physikalischen Gesellschaft

Prof. Dr. Michael Lang, Dekan des Fachbereichs Physik der Goethe Universität

Prof. Dr. Kurt Scharnberg, Grußwort der Universität Hamburg

Prof. Dr. Wolfgang Grünbein, Präsident des Physikalischen Vereins Frankfurt

Prof. Dr. Andreas Mulch, Stellvertretender Generaldirektor der Senckenberg Gesellschaft für Naturforschung

Unveiling of the EPS Historic Site Plaque

Keynote: Michael Eckert: *Frankfurt Physicists*

16:00-16:30 Coffee Break

16:30-18:45 **Cold atoms and molecules: Reinhold Schuch, Chair**

16:30-17:15 **Keynote: Dan Kleppner:** *Our Patrimony from Otto Stern and My Memories of Otto Frisch*

17:15-17:45 **Kang-Kuen Ni:** *Ultracold Chemical reactions with molecules in slow motion*

17:45-18:15 **Monika Schleier-Smith:** *Choreographing Quantum Spin Dynamics with Light*

18:15-18:45 **Klaas Bergmann:** *STIRAP: Notes about its history and some news*

19:00-22:00 **Conference Dinner** with **Ludger Wöste's Physical Amusements**

Wednesday, 4 September 2019

- 9:00–10:30 **Reaction Dynamics: Dudley Herschbach, Chair**
9:00–9:40 **Keynote: Gerard Meijer:** *Manipulation and control of molecular beams*
9:40–10:05 **Eva Lindroth:** *Time delays in photoionization*
10:05–10:30 **Christiane Koch:** *Quantum effects in cold and controlled molecular dynamics*
- 10.30–11.00 Coffee Break
- 11.00–13:00 **Matter Waves: Burkhard Fricke, Chair**
11:00–11:40 **Keynote: Peter Toennies:** *Otto Stern and Wave-Particle Duality*
11:40–12:10 **Markus Arndt:** *Macromolecular Matter Wave Interferometry and Talbot-Lau Deflectometry*
12:10–12:35 **Maksim Kunitski:** *Rotating rotationless: nonadiabatic alignment of the helium dimer and trimer*
12:35–13:00 **Wieland Schöllkopf:** *Grating Diffraction of Molecular Beams: Present Day Implementations of Otto Stern's Concept*
- 13:00–14:00 Lunch
- 14:00–16:00 **MOTs and Optical Lattices: Hanns-Christoph Nägerl, Chair**
14:00–14:45 **Keynote: David Pritchard:** *Magneto-Optical Trap: Origins and Applications*
14:45–15:10 **Dörte Blume:** *Interaction effects in ultra cold atom systems*
15:10–15:35 **Ana Maria Rey:** *Engineering spin squeezing in a 3D optical lattice with interacting spin-orbit-coupled fermions*
15:35–16:00 **Mike Tarbutt:** *Laser cooling and magneto-optical trapping of molecules*
- 16:00–16:30 Coffee Break
- 16:30–18:50 **Exotic beams: Udo Strohbusch, Chair**
16:30–17:10 **Keynote: Dick Zare:** *Microdroplet Chemistry*
17:10–17:35 **Manfred Faubel:** *Liquid micro jet studies of the free vacuum surface of water and of chemical solutions by soft X-ray photoelectron spectroscopy*
17:35–18:00 **Gil Nathanson:** *From Liquid Rays to Gas Rays: The Non-Maxwellian Evaporation of Helium from Water Microjets*
18:00–18:25 **Henrik Stapeldeldt:** *Laser-induced rotation and alignment of molecules in helium nanodroplets*
18:25–18:50 **Mikhail Lemeshko:** *Far-from-equilibrium dynamics of molecules in helium nanodroplets*
- 19:00–20:00 Dinner
- 20:00–20:30 **Otto Stern's relationships with Pauli and Gerlach: Hartmut Hotop, Chair**
20:00–20:15 **Karl von Meyenn:** *Stern's friendship with Pauli*
20:15–20:30 **Horst Schmidt-Böcking:** *Stern's relation to Gerlach*
- 20:00–22:00 Poster Session with Wine+Beer+Bretzel

Thursday, 5 September 2019

Post-Conference Program 8:30-18:30

8:30 Bus from Frankfurt to Geisenheim am Rhein

10:00 [Boat ride on the Rhein from Geisenheim to Braubach and back](#)

Lunch on Boat

17:30 Bus from Geisenheim to Frankfurt

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