

**MPIPKS-ITAMP Tandem Workshop**  
**Cold Rydberg Gases and Ultracold Plasmas**  
**(CRYP10)**

Sept. 6, 2010 – Sept. 17, 2010

Scientific coordinators:

Charles S. Adams, Thomas Pohl, Hossein R. Sadeghpour

Organization:

Claudia Pönisch

The CRYP10-Workshop was part of a joint Tandem-Workshop program between the MPIPKS and the Institute for Theoretical Atomic, Molecular and Optical Physics (ITAMP, Cambridge, USA), intended to complement and expand the scope of a preceding Rydberg Physics workshop held at ITAMP in 2009. This timing and back-to-back format proved to be very successful and remarkably demonstrated the rapid progress in the field.

The workshop brought together 89 scientist from 15 different countries, among them a large number of world-leading experts on cold Rydberg atom physics. The first week featured 38 invited talks given by a balanced mix of senior researchers as well as younger scientists. The program has covered the full spectrum of topical research in the field. Two sessions on “Quantum Information” presented theoretical schemes for applications of cold Rydberg atoms in quantum information science and reported on recent experimental breakthroughs in realizing first quantum phase gates with Rydberg atoms. This was complemented with a session on “Rydberg Atom Traps”, constituting one major prerequisite for future work on such applications. New developments towards Rydberg-interaction based approaches to nonlinear quantum optics were presented in the “Rydberg Optics” session. Three sessions devoted to the physics of “Ultracold Plasmas” provided an experimental and theoretical discussion of collective phenomena arising from the electron as well as ion dynamics, the formation of a novel type of ultracold plasmas from cold molecular beams and the recombination of Rydberg atoms in magnetized plasmas, being of outmost importance for the production of antihydrogen atoms. Two sessions on “Single Atom Control” and “Rydberg Spectroscopy” gave an account of the impressive degree of control over internal and motional states, currently achievable. A wide range of questions concerning the dynamics of cold Rydberg gases, from few-body effects to many-body problems, has been addressed in three sessions on “Rydberg Molecules” and “Many-body Dynamics”.

Over the past few years research on cold Rydberg systems has become increasingly diverse. The described workshop program fully reflected this interdisciplinarity, and aimed at merging these different aspects to possibly work out new ideas and directions for future research. Judging from the entirely positive feedback, this objective has been met successfully.

Subsequently, a one-week Focus Workshop was devoted to tutorial talks as well as discussions among a smaller group of researchers, intended to explore common interests and follow up on outstanding topics that arose during the first week. The first four days featured two 90min introductory talks by senior researchers followed by presentations from postdocs and PhD students. The number of participants was deliberately held to a limited number, in order to provide a more informal environment. Indicated by the lively discussions during all talks, this concept was very well received by the younger scientists, as it gave the sometimes rare opportunity to clarify questions in greater detail. In addition to the last day, which was kept free, the relaxed schedule provided plenty of time for additional round table discussions and specific project work. Indeed, several collaborations between the participating groups were initiated during the second week, attesting to the general success of the Focus Workshop as well.