



Physics Colloquium

Thursday, 30 April 2026 | 17:00 – 18:00, Seminar Room 3rd Floor

Recent Developments in Ultralong-Range Rydberg Molecules

Prof. Peter Schmelcher

ZOQ - Center for Optical Quantum Technologies, University of Hamburg

ABSTRACT

A review on the most recent activities in Rydberg molecular physics at the center for optical quantum technologies will be provided. I start out with addressing the exotic properties of ultralong-range Rydberg molecules (ULRM). Trilobite and butterfly states can easily be controlled by weak external electric or magnetic fields. I demonstrate that synthetic dimensions based on quantum numbers can be used to design conical intersections and consequently non-adiabatic interaction effects in the spectra of ULRMs. Ultrafast decay processes are a consequence of these intersections. Quenches of external fields then lead to a rich rovibrational quantum dynamics of ULRM and it is shown that the ULRM is a self-diffracting molecule. Very recently high precision spectroscopy of trilobite molecules has been performed and we present the theory experimental collaboration results. Last, but not least, we show the non-adiabatic stabilization of those molecules in a regime where an adiabatic approach would predict a fast decay into highly energetic products.

References:

- R. Srikumar, S.T. Rittenhouse and P. Schmelcher, *Physical Review A* 110, 062808 (2024).
- R. Srikumar, F. Hummel and P. Schmelcher, *Physical Review A* 108, 012809 (2023).
- M. Exner, R. Srikumar, R. Bla'ttner, M.T. Eiles, P. Schmelcher and H. Ott, *Physical Review Letters* 134, 223401 (2025).
- M. Exner, R. Srikumar, R. Bla'ttner, M.T. Eiles, P. Schmelcher and H. Ott, *acc.f.publ. Physical Review Research* (2025).
- F. Hummel, M.T. Eiles and P. Schmelcher, *Physical Review Letters* 127, 023003 (2021).