

Curriculum vitae

Kilian Talo Theodor Singer

(Dr. rer. nat.)



- 21.8.1973 born in Überlingen (Lake Constance)
- January 2008: Promoted by the „Eliteprogramm Postdoktorandinnen und Postdoktoranden“ of the Landesstiftung Baden-Württemberg
- since March 05: **Project leader** and assistant in the “Quantum Information Processing” group of Prof. Dr. Ferdinand Schmidt-Kaler at the **University of Ulm**
Project titles:
“Deterministic implantation of single atomic ions into solids with nm spatial resolution”
“Strong optical dipol forces on ions”
- Dec. 04 – Feb. 05: **Postdoctoral position** in Freiburg
- November 2004: PhD **graduation with distinction** (“summa cum laude”)
- July – August 2004: PROBRAL DAAD research scholarship at the **University of São Paulo** in Brazil in Professor Luis Gustavo Marcassa’s group
- December 2003 Relocation of our group to the **University of Freiburg**
- February-Mai 2003: DAAD research scholarship at the **University of Connecticut** in Storrs in Professor Phillip Gould’s group
- October 2000: **started PhD** thesis in Prof. Dr. Matthias Weidemüller’s group at the **Max-Planck-Institut für Kernphysik in Heidelberg**.
Title of my PhD thesis: “Interactions in an ultracold gas of Rydberg atoms”
- August 2000: **diploma** (grade: very good)
- August 1999: diploma thesis in Professor Dr. Annemarie Pucci’s group (Heidelberg)
Title of diploma thesis: “Infrared-optical and dc-measurements of the conductivity of ultrathin Cu-films on Si(111)-7x7 “
- 1996 – 1997: studies at the **University of California in Berkeley**
- 1996: prediploma (grade: very good)
- 1995: received scholarship from the “**Studienstiftung des deutschen Volkes**“
- 1994: started to study physics at the “**University of Heidelberg**”
- 1994: participant in the **final round of the German computer science contest**
- 1993 – 1994: community service for fifteen months in the field of caring for severely handicapped people
- 1993: acquired general qualification for university entrance
(awarded the prize for the **best A-level results at my school**)
- 1992-1993: head of students’ government
- 1984-1993: secondary school: Käthe-Kollwitz-Gymnasiums in Neustadt an der Weinstrasse
- 1980-1984: primary school Gimmeldingen

Details about my research career

Project leader (since 2005, Ulm):

Deterministic implantation of single atomic ions into solids with nm-spatial resolution:

- Novel method for deterministic implantation of single atoms into solids
- Deterministic control of the number of implanted atoms achieved (publication in preparation)
- Relies on a linear ion trap with laser cooled ions as an ion source
- Expected spacial resolution 1 nm
- Works for almost all chemical elements
- Applications: Fabrication of scalable solid state quantum computers, Improvement of solid state devices by means of deterministic doping, Fabrication of nano and sub-nano electronic devices

Strong optical dipol forces on ions:

- Quantum phase transitions with effective spin-spin interactions
- Bose-Einstein-Condensate of phonons in an ion trap and superfluid-Mott insulator transition

Optimal control methods:

- Optimization of the transport and splitting of ion crystals
- Optimization of light pulses for quantum information processing

Information processing with ion crystals / scalable quantum computer

- Modeling and simulation of novel ion trap configurations with fast multipole method
- Experimental control system

PhD thesis (2000-2004, Heidelberg/Freiburg)

Lithium und Cesium atoms in an optical dipole trap

- Magneto optical trap for Lithium und Cesium
- Development and stabilization of diode laser systems
- Optical dipole trap with a CO₂ laser

Interactions between ultra cold Rydberg atoms:

- Design and construction of a new experimental setup
- Design of vacuum chamber (CAD-Design), laser system and electronics
- Observation of interaction induced line broadening and excitation inhibition in a gas of ultracold Rydberg atoms

Patent:

- Novel method for the coherent addition of laser beams

Research scholarship at the University of Connecticut:

- Construction of an optical imaging system for atoms inside a magneto optical trap
- Calculation of long range interaction potentials between Rydberg atomen

University education (1994-2000, Heidelberg)

Diploma thesis:

- Spectroscopy of ultra thin metal films
- Development of a computer program for the simulation of thin film properties

Year abroad at University of California in Berkeley:

- First year graduate courses in quantum mechanics and electrodynamics
- Practical work at the Lawrence Berkeley National Laboratory

Early research activities (1994, Neustadt an der Weinstrasse)

German computer science contest:

- Development of a so far unknown method for hand writing recognition

List of publications

1. *W. Schnitzler, N. M. Linke, R. Fickler, J. Meijer, F. Schmidt-Kaler, and K. Singer,*
Deterministic Ultracold Ion Source targeting the Heisenberg Limit
Phys. Rev. Lett. 102, 070501 (2009) 253001.
2. *U. G. Poschinger, G. Huber, F. Ziesel, M. Deiss, M. Hettrich, S. A. Schulz, G. Poulsen, M. Drewsen, R. J. Hendricks, K. Singer and F. Schmidt-Kaler,*
Coherent Manipulation of a $^{40}\text{Ca}^+$ Spin Qubit in a Micro Ion Trap,
submitted for publication (2009), (arXiv 0902.2826).
3. *J. Meijer, S. Pezzagna, T. Vogel, B. Burchard, H.H. Bukow, I. W. Rangelow, Y. Sarov, H. Wiggers, I. Plümel, F. Jelezko, J. Wrachtrup, F. Schmidt-Kaler, W. Schnitzler and K. Singer,*
Towards the implanting of ions and nanoparticles with nm spatial resolution,
Appl. Phys. A 91, 567–571 (2008) (invited paper).
4. *G. Huber, T. Deuschle, W. Schnitzler, R. Reichle, K. Singer and F. Schmidt-Kaler*
Transport of ions in a segmented linear Paul trap in printed-circuit-board technology,
New J. Phys. 10 013004 (2008).
5. *J. Meijer, T. Vogel, B. Burchard, I. Rangelow, L. Bischoff, J. Wrachtrup, M. Domhan, F. Jelezko, W. Schnitzler, S. A. Schulz, K. Singer, F. Schmidt-Kaler,*
Concept of deterministic single ion doping with sub-nm spatial resolution,
Appl. Phys. A 83, 321-327 (2006).
6. *S. Schulz, U. Poschinger, K. Singer, F. Schmidt-Kaler,*
Optimization of segmented linear Paul traps and transport of stored particles,
Progress of Physics, Wiley 54, No. 8 - 10, 648 (2006).
7. *M. Reetz-Lamour, T. Amthor, J. Deiglmayr, S. Westermann, K. Singer, A. Luiz de Oliveira, L. G. Marcassa and M. Weidemüller,*
Prospects of ultracold Rydberg gases for quantum information processing,
Fortschr. Phys. 54, 776 (2006).
8. *M. Weidemüller, M. Reetz-Lamour, T. Amthor, J. Deiglmayr, K. Singer, L.G. Marcassa,*
Interactions in an Ultracold Gas of Rydberg Atoms,
in: Laser Spectroscopy XVII, pp. 264-274 (2005).
9. *M. Weidemüller, K. Singer, M. Reetz-Lamour, T. Amthor and L. G. Marcassa,*
Ultralong-Range Interactions and Blockade of Excitation in a Cold Rydberg Gas,
Atomic Physics XIX (Proceedings of ICAP 2004) and in Braz. J. Phys. (2004).
10. *K. Singer, J. Stanojevic, M. Weidemüller, and R. Côté,*
Long range interaction potentials for the ns-ns, np-np and nd-nd asymptotes for Rubidium Rydberg atom pairs,
J. Phys. B: At. Mol. Opt. Phys. 38, 295 (2004).

11. *K. Singer, M. Reetz-Lamour, T. Amthor, S. Fölling, M. Tschernack, and M. Weidemüller,*
Spectroscopy of an ultracold Rydberg gas and signatures of Rydberg-Rydberg interactions,
J. Phys. B: At. Mol. Opt. Phys. 38, 321 (2004).
12. *K. Singer, M. Reetz-Lamour, T. Amthor, L. G. Marcassa, and M. Weidemüller,*
Spectral Broadening and Suppression of Excitation Induced by Ultralong-Range Interactions in a Cold Gas of Rydberg Atoms,
Phys. Rev. Lett. 93, 163001 (2004).
13. *K. Singer, M. Reetz-Lamour, M. Tschernack, S. Fölling, and M. Weidemüller,*
Towards an ultracold dense gas of Rydberg atoms,
in: Interaction in Ultracold Gases: From Atoms to Molecules (Wiley, New York 2003).
14. *K. Singer, M. Tschernack, M. Eichhorn, M. Reetz-Lamour, and M. Weidemüller,*
Method and apparatus for the coherent addition of laser beams from distinct laser sources,
German Patent DE 102 43 367 (2004).
15. *K. Singer, M. Tschernack, M. Eichhorn, M. Reetz-Lamour, S. Fölling, and M. Weidemüller,*
Phase-coherent addition of laser beams with identical spectral properties,
Optics Communications 218, 371 (2003).
16. *M. Mudrich, S. Kraft, K. Singer, A. Mosk, and M. Weidemüller,*
Thermodynamics in an ultracold mixture of optically trapped atomic gases,
in: Interaction in Ultracold Gases: From Atoms to Molecules (Wiley, New York 2003).
17. *K. Singer, S. Jochim, M. Mudrich, A. Mosk, and M. Weidemüller,*
Low-cost mechanical shutter for light beams,
Rev. Sci. Instrum. 73, 4402 (2002).
18. *M. Mudrich, S. Kraft, K. Singer, R. Grimm, A. Mosk, and M. Weidemüller,*
Sympathetic Cooling with Two Atomic Species in an Optical Trap,
Phys. Rev. Lett. 88, 253001-1 (2002).
19. *S. Kraft, M. Mudrich, K. Singer, R. Grimm, A. Mosk, and M. Weidemüller,*
Sympathetic cooling of lithium by laser-cooled cesium,
in: Laser Spectroscopy XV, Proceedings of the International Conference on Laser Spectroscopy (ICOLS01), 341-344 (2002).
20. *A. Mosk, M. Mudrich, S. Kraft, K. Singer, W. Wohlleben, R. Grimm, and M. Weidemüller,*
Mixture of ultracold lithium and cesium atoms in an optical dipole trap,
Appl. Phys. B 79, 791 (2001).
21. *G. Fahsold, K. Singer, and A. Pucci,*
In-situ IR-transmission study of vibrational and electronic properties during the formation of thin-film β -FeSi₂,
Journal of Applied Physics 91, 145 (2002).