

# Quantum Optics and Atomic Physics Seminar

**Title:** Deterministic ultracold ion source targeting the Heisenberg limit

**Speaker:** Robert Fickler  
Ulm University, Germany

**Time:** Tuesday, June 9 at 10:15

**Place:** 1520-216

## Abstract:

We have realized a universal deterministic single ion source on the basis of a linear segmented ion trap applicable to a wide range of elements and molecules [1,2]. Initially, cold  $^{40}\text{Ca}^+$  ion crystals are trapped within a segmented linear trap. Those ions are then deterministically extracted and detected with an efficiency of 90% at a distance of 29cm. For single ion extraction we measured a mean velocity of 19.47km/s with a  $1\sigma$ -spread of only 6.3m/s and a beam divergence of  $600\mu\text{rad}$ . We have also demonstrated the extraction of mixed ion crystals containing other dopant ions. Ion ray-tracing simulations predict that it is possible to focus down the ion beam to nm resolution with a custom built Einzel-lens [3]. This technique can e.g. be applied to generate color centers in diamond or to implant P into Si. Both systems provide a possible way for the realization of a solid state quantum computer [4,5]. In addition, the electrical properties of semiconductor devices can be greatly enhanced by the deterministic implantation of single ions [6].

[1] J. Meijer et al., Appl. Phys. A 91, 567 (2008)

[2] W. Schnitzler et al., Phys. Rev. Lett. 102, 070501 (2009)

[3] R. Fickler et al., arXiv:0903.3425 (accepted for publication in Journal of Modern Optics)

[4] F. Jelezko et al., Phys. Rev. Lett. 93, 130501 (2004)

[5] B. Kane, Nature 393, 133 (1998)

[6] T. Shinada et al., Nature 437, 1128 (2005)

Michael Drewsen

**Coffee, tea and bread rolls will be served at 10.00**