**Segmented Ion Traps for Quantum Computing**

**EU Microtrap Project**

A collaboration between National Physical Laboratory (UK) and the Universities of Aarhus, Innsbruck, Oxford, Siegen and Ulm. Aimed at developing an EU technology capability in trapped ion microstructures for application to quantum information science.

Photos and parameters below from working prototype of the project’s first trap at Ulm University. See Schulz et al. New Journal of Physics 10 (2008) 045007 for details.

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**Intermediate Scale Trap**

Designed to investigate separation of ions in a regime where ion-electrode distances are large enough to give low motional heating, with a geometry optimised for a high optical coefficient for a given breakdown voltage.

Fabricated by Uni. Liverpool (S. Taylor & B. Britic)

**Fabrication Process**

- TiAu (10µm) on Al,O₃, water (405µm) cut with femtosecond laser
- Three wafers stacked, glued and wire-bonded to package
- 500µm wide storage zone (Ulm’s results below)
- 250µm wide processing zone (awaiting results)

**Planar Trap**

Planar traps based on a simple metal patterned substrate have recently been demonstrated at NIST [1] and MIT [2] with promisingly low heating rates measured. This type of trap is inherently easily scalable. Furthermore these particular traps are designed to be manufactured in-house on short time scales to allow rapid testing and development of new electrode geometries. The first trap we’ve fabricated has a geometry similar to that of the proposed Sandia Mk2 to test some of the design aspects.

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**Sanda Mk2 Planar Trap**

Fabrication underway at Sandia National Laboratories (Matt Blain & D. Stick) funded by iARPA. Design and testing input from Oxford and Innsbruck (W. Hänsel).

**Fabrication Process**

- Trap can be evaporatively coated with different metals to investigate effects of different materials. Ion ‘sees’ no dielectric or exposed semiconductor.
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**The Oxford Planar Trap**

Planar traps based on a simple metal patterned substrate have recently been demonstrated at NIST [1] and MIT [2] with promisingly low heating rates measured. This type of trap is inherently easily scalable. Furthermore these particular traps are designed to be manufactured in-house on short time scales to allow rapid testing and development of new electrode geometries. The first trap we’ve fabricated has a geometry similar to that of the proposed Sandia Mk2 to test some of the design aspects.

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**Sandia Mk1 Planar Trap**

**Fabrication Process**

- Trap is of a ‘6-wire’ design. The split central control electrode allows a static quadrupole gradient to be applied to ions located between the central control electrodes. All other gaps are 10µm.

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**EU Microtrap Project**

Photos and parameters below from working prototype of the project’s first trap at Ulm University. See Schulz et al. New Journal of Physics 10 (2008) 045007 for details.

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**Trap on vacuum system (below) currently under construction**

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**Trap under vacuum (below). Imaging is through the front window which is conductive (ITO coating) to prevent charging. The laser beams pass through the side windows and pass parallel to the trap’s surface. Neutral fluorescence has been observed and trapping attempts are underway.**

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**Features**

- Ion ‘sees’ no dielectric or exposed semiconductor.
- Trap can be evaporatively coated with different metals to investigate effects of different materials. Ion ‘sees’ no dielectric or exposed semiconductor.
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**Future Developments**

- Slot designed to accommodate pre-aligned package of diffractive optics and fibres for laser delivery and fluorescence collection.
- Geometry is compatible with currently envisioned ‘near-ideal junctions’.
- Integration of filters into the trap structure is possible with this fabrication technology.