Alternative trap geometries
Paul-Straubel trap:
Multipole traps

Potential of an n-pole trap:

\[ \Phi \propto \left( \frac{r}{r_0} \right)^{n-2} \]

Ion trajectories in a 32-pole trap
Cylindrical trap

Optimizing trap potential:
Width of axial resonance vs. Tuning Ratio
Tuning Ratio: $U(\text{korr})/U(\text{ring})$

\[ V = \frac{1}{2} V_0 \sum_{k=0}^{\infty} C_k \left( \frac{r}{d} \right)^k P_k(\cos \theta) \]

\[ d^2 = \frac{1}{2} \left( z_0^2 + \frac{1}{2} \rho_0^2 \right) \]
TITAN Cooler Trap
Linear Traps

Stability diagram for radial motion
Blade trap with segmented electrodes

Univ. Ulm, Innsbruck
Ulm linear multizone trap

Stefan Schulz, Ulrich Poschinger, Frank Ziesel and Ferdinand Schmidt-Kaler
Segmentierte Mikrafalle
3D Microchip Traps

- Ti/Au on Al₂O₃-Wafer
  10nm/400nm
- fs-Laser cut Au/Ti and Al₂O₃
  accurate to 1µm
- mounting on Chip Carrier
- optically cooled in He flow cryostat, 300K ... 77K ... 4.2K


Planar Traps

- Thick resist technique, liftoff, evaporation
- Au, few µm, on Sapphire
- Integration of high magnetic field gradient current lead

M. Hellwig, et al., NJP 12, 065019 (2010)
MEMS Gallium-Arsenide ion trap in a microchip

Univ. Michigan
NIST Planar Trap Chip

Magnified trap electrodes

CCD pictures of strings of Mg$^+$ ions (trapped 40 mm above surface)


John Chiaverini, Signe Seidelin, Didi Leibfried, David Wineland
Planar traps:
Ring structures on a surface
Mainz 2006
Trap potentials for a 3 ring configuration and different voltage settings

Potential depth and minimum position varies with voltage settings
Realisation of a prototype multi-ring planar trap by thick film technology (silver of ceramic substrate)
Total diameter 1 cm
„Stylos Trap“
Maiwald et al., Nature Physics online (2009)
Pixel trap
Moving center of Pixel Trap
Pixel trap
Onion trap