D 3.1 Designs of optimal electrode geometries for vertical ion transport and for a flat multipole ion trap

The final design for the vertical shuttling ion trap chip is shown in fig. **Fig. 1**. The chip has been designed to be 12x12mm to meet mounting requirements in the cryogenic system described in section 3.4. The chip contains 40 dc control electrodes to provide axial containment and shuttling capabilities. All bonding sites from electrodes to chip carrier bond pads are located on two opposite sites. This allows for uninterrupted laser access along one axis without bonding wires being present. This also another requirement due to the mounting system describes in section 3.4.

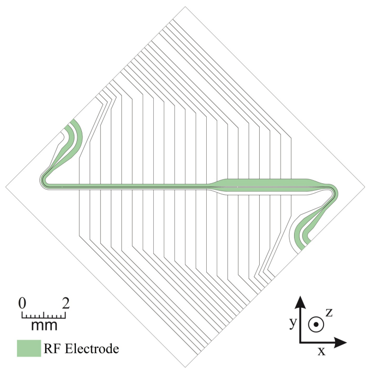

Fig. 1 Design for the vertical shuttling trap with 40 DC control electrodes and integrated microwave cavity.

The final design for the flat multipole ion trap chip described is given in **Fig. 2.** Similarly to the vertical shuttling trap, the flat multipole chip has been designed to be 12x12mm to meet cryogenic mounting requirements described in section 3.5. The chip also contains 40 dc control electrodes to provide axial containment and shuttling capabilities.

Principal axis rotation could not be provided via asymmetric RF electrodes due to the need to use several uniform RF electrodes to produce homogenous trapping parameters. Therefore, in between the each RF electrode the ground electrodes are replaced with 4 dc control electrodes which can be used to apply a principal axis rotation about each trap site [2]. This structure can be seen more clearly in **Fig. 3.**

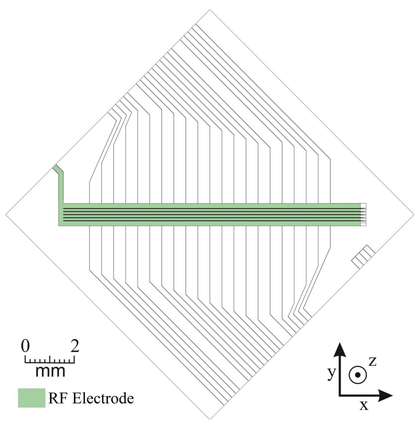

***Fig. 2** Design for the flat multipole trap with 40 DC control electrodes and 5 linear trapping regions*

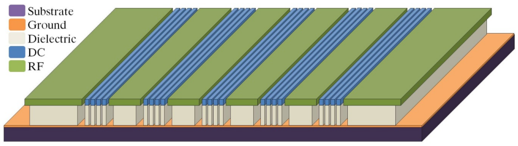

***Fig. 3** Three dimensional view for the design of a microfabricated flat multipole ion trap.*