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# Industrially microfabricated 3D ion traps for quantum information processing and metrology

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Building a useful fault tolerant quantum computer requires precise and coherent control over several thousands of qubits. While the trapped ion platform has demonstrated such control over a limited number of ions, scaling to larger qubit numbers requires microfabricated trap chips characterized by a high degree of integration and process stability which can usually only be achieved within industrial facilities. This includes overcoming challenges regarding multi-metal layer stacks for complex electrode designs and incorporating photonic layers for ion addressing. Also, ion traps for quantum metrology applications such as chip-scale optical atomic clocks will benefit from precise and controlled fabrication processes.

In the BMBF project "ATIQ", we are developing ion traps with integrated waveguides based on patterned dielectric thin films. Fabrication of the photonic layer and electrode metallization will be done by "Black Semiconductor"and Infineon Technologies, respectively. Testing of the trap chip will be carried out at PTB. We are also working towards 3D trap architectures based on dielectric substrates for compact and reliable ion clocks. To fabricate these 3D traps, we use state-of-the-art MEMS wafer bonding technology while also investigating new processes for microstructuring Through-Glass-Vias (TGVs) together with our project partner "LPKF Laser & Electronics".

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