

## Supplementary Information:

# Multi-site Integrated Optical Addressing of Trapped Ions

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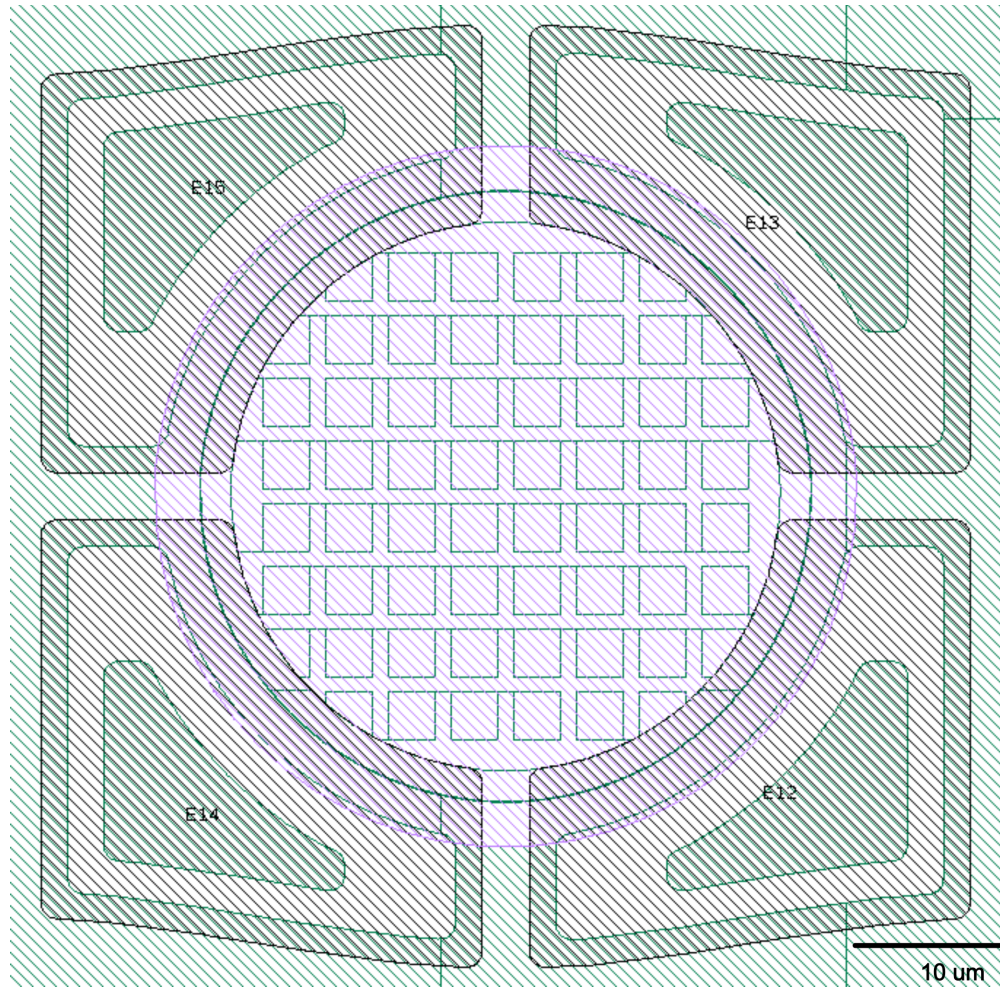
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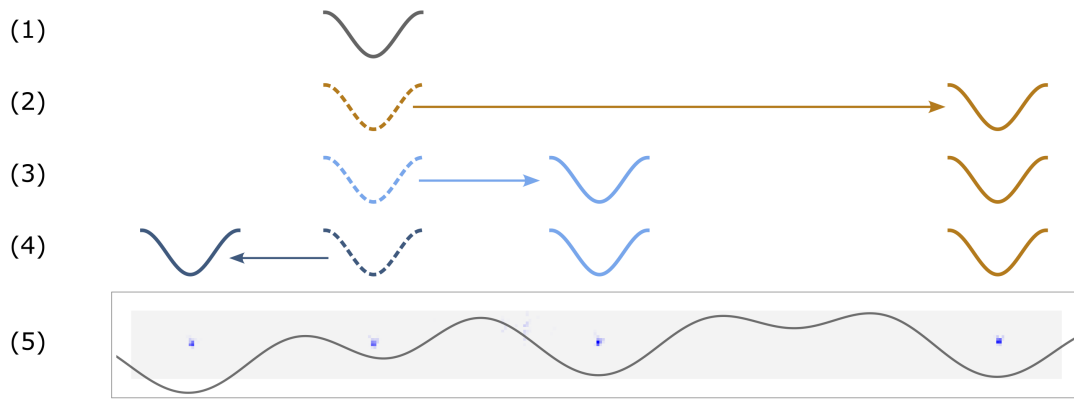
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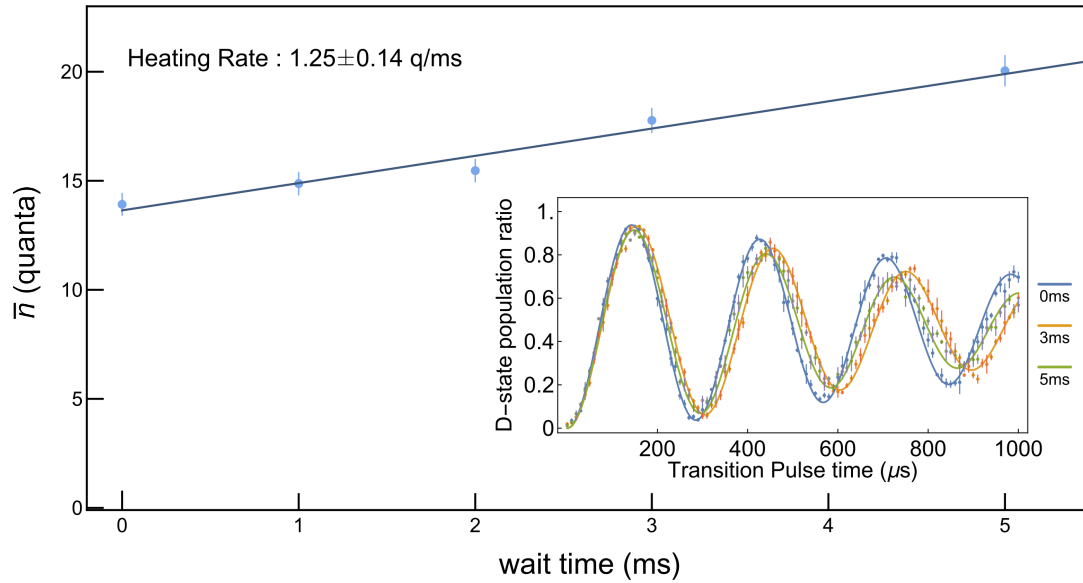
## **Supplementary Figures**



**Supplementary Fig. 1. Lithography mask in the SPAD region** A metal mesh is located on top of the SPAD (purple circle), consisting of  $3\ \mu\text{m} \times 3\ \mu\text{m}$  holes with  $1\ \mu\text{m}$  wide metal traces. The mesh and SPAD are surrounded by nearby electrodes, also shown in Fig. 1a.



**Supplementary Fig. 2. Multi-ion loading sequence** Three waveguide-illuminated independent ions are loading sequentially, starting from one loading location that used free-space beams. 3+1 ions are trapped simultaneously by generating potential wells and loading/shuttling ions via steps (1) to (5). The potential plot at (5) represents a real four-ion solution that is used in this work, providing secular frequencies of  $2\pi \times 1.02\text{MHz}$ .



**Supplementary Fig. 3. Heating rate measurement** A heating rate of  $1.25 \pm 0.14$  q/ms is measured using fully integrated beams for state preparation, cooling, and Rabi flopping, while a free-space beam is used for detection. **inset:** Measured Rabi flopping for different wait times.