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Optical integration with femto-second laser written waveguides

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Current ion trap quantum computing systems usually make use of free-space optics to deliver the light to the ions. This practice makes the setups susceptible to drifts and vibrations and limits the number of ions which can be manipulated. For a scalable system it is thus necessary to increasingly integrate optical elements from external components directly into the ion trap. We use femto-second laser pulses to write single-mode and polarization-maintaining waveguides directly into borofloat glass. Unlike other materials used in CMOS technology, borofloat glass is transparent for ultraviolet light required for the manipulation of 40Ca+ ions. Henceforth, a microstructured surface trap was realized featuring two of these waveguides, one for 397nm light and one for 729nm light. In parallel, we build up an integrated cryogenic quantum computing system to enable fast trap testing and to investigate the quality of the light delivery to the ions. The cryogenic experimental setup is designed to contain two separated vacua, one rough vacuum environment enclosing the cold head and a ultra-high vacuum experimental chamber with the ion trap. The design enables to separate the experimental chamber from the cryostat under vacuum and bake it for even better vacuum. For the future we plan to further increase the running time of the cryostat by building an additional experimental chamber to be able to swap the chambers if baking or work on one of them is necessary.

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