Qubit synthesis far from equilibrium

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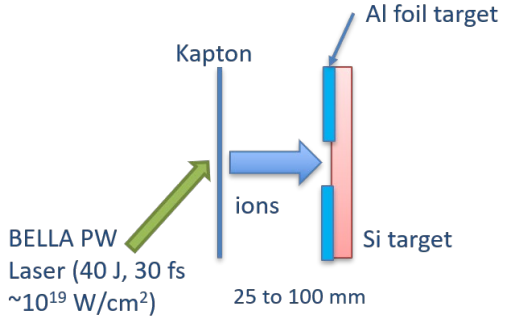
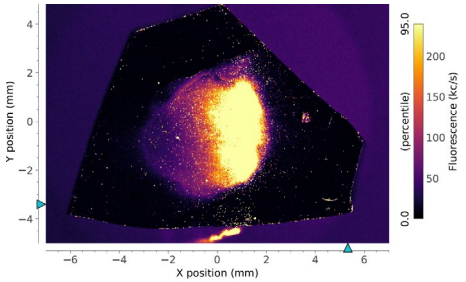
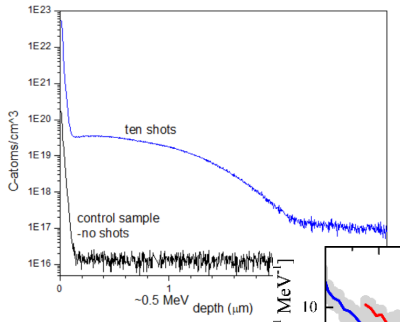
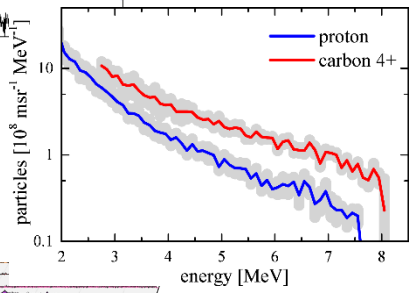
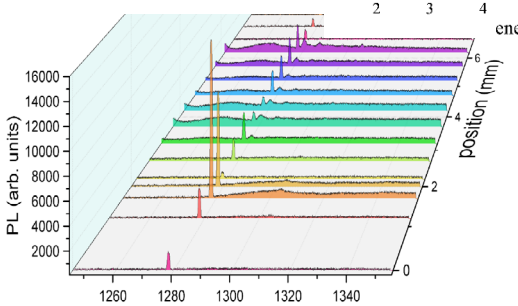
We report on ion acceleration experiments at the BELLA PW laser (~10^{19} W/cm^2, up to 1 Hz). Proton and carbon ion pulses with intensities in the 10^12 ion/shot range are characterized with a Thomson parabola for energies above 2 MeV. We quantify the flux of lower energy ions through implantation into silicon wafers and ex situ analysis and find that carbon ions with energies below 2 MeV are implanted with fluences of ~10^14 atoms/cm^2/shot. Intense ion pulses excite and heat targets, leading to the annealing of preformed defects as well as the formation of new color centers in silicon and diamond. We discuss opportunities for materials processing and qubit synthesis with intense ion pulses from laser-plasma acceleration.

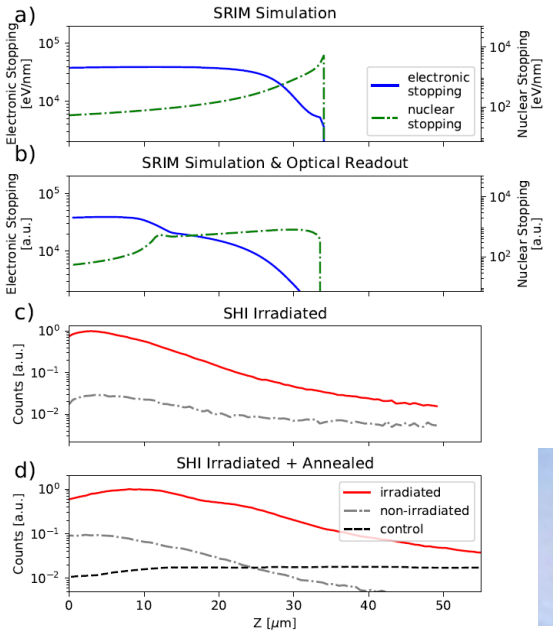


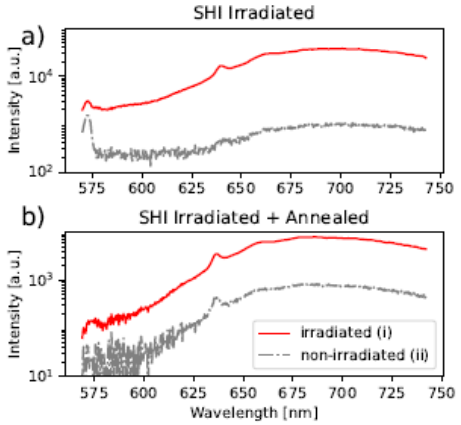


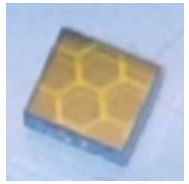


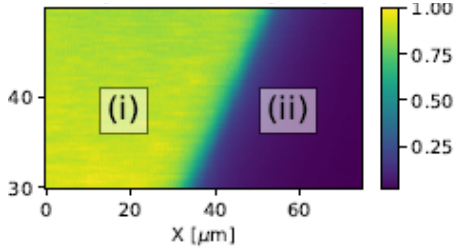












- Rep rate 0.2 Hz (can be up to 1 Hz), ions up to 8 MeV, >1 J/cm2 de-bunched to >10 ns
- We observe G-centers, a color center qubit in silicon, NIR co. R. Wunderlich, J. Meijer, U Leipzig
- S. Steinke, et al., Phys. Rev. Accel. Beams 23, 021302 (2020) and in preparation

- We observe direct formation of nitrogen-vacancy centers in nitrogen doped diamond along the trajectories of swift heavy ions, https://arxiv.org/pdf/2011.03656.pdf
- Evidence of 1D strings of >1000 NV-centers with nearest neighbor coupling
- Plans for experiments at the short focal length beamline at BELLA !

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