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Coherent diffraction imaging using high harmonic generation sources

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Soft X-ray microscopy can become an important and widespread technique through the combination of Coherent Diffraction Imaging (CDI) techniques and High Harmonic Generation (HHG) X-ray sources. HHG, a nonlinear optical route to soft X-ray generation, has advanced far enough to generate X-ray fluxes in the water window which are sufficient to make imaging in short times (seconds) feasible, and CDI techniques can replace objective lenses for high-quality imaging, circumventing the two main obstacles to widespread use of X-ray microscopy. The combination of these technologies can be very effective, and will mean that soft X-ray microscopy can progress from a specialised technique to a general one, with the associated huge improvements in ease of sample handling and preparation (compared to electron microscopy), and resolution (compared to visible light microscopy).

The aim is to demonstrate a tabletop soft X-ray microscope that can achieve resolutions down to 10nm on samples with dimensions up to $\sim 10\mu\text{m}$. Additionally, the 2D information obtained will be used to produce 3D images using tomographic reconstruction. This goal, 10nm resolution within a sample with dimensions of the order of $10\mu\text{m}$, will have a significant impact on biological imaging.